Proceedings of the 2009 Annual Research Conference of

The Architectural Research Centers Consortium

LEADERSHIP IN ARCHITECTURAL RESEARCH

Between Academica and the Profession

Edited by:
Hazem Rashed-Ali, Ph.D
Shelley Roff, Ph.D.

College of Architecture
The University of Texas at San Antonio
San Antonio, TX, 15-18 April

Proceedings of the 2009 Annual Research Conference of the Architectural Research Centers Consortium: Leadership in Architectural Research, Between Academia and the Profession.

Hazem Rashed-Ali and Shelley Roff, Editors.

Cover design by: Marc Blizard

Design and production by: Hazem Rashed-Ali

ISBN: 978-1-935129-15-8

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Forward

Recent decades have witnessed a notable expansion of architectural research activities, with respect to both subject and methodology. This expansion can be mostly credited to an increase in government and private funding of primarily academic research initiatives. More recently, however, a noticeable increase in research activities within the architectural profession makes it possible to argue that it is the profession itself that is now taking leadership in the development of contemporary research agendas. This growing significance of architectural research, in both academia and the profession, is ultimately a response to the diverse challenges facing the profession; most notably, the issue of environmental sustainability, but also including the rapid pace of technological change, the increased diversity of users, and the growing complexity of architectural projects. Engaging research is an essential factor in facing these challenges as well as taking full advantage of the opportunities they offer. For this research to be most effective, however, a greater perspective and a clearer definition of its role and the goals it can aspire to, in both academia and the profession, are needed; and most importantly, the question becomes, how do we foster a more integrated research culture between academia and the profession?

The theme for the 2009 ARCC conference invited an exploration of existing and future trends in leadership in architectural research, the impact of these trends on research subjects and methodologies, and how this leadership can foster an integrated research culture. In this context, the conference explored a variety of topics in which architectural research is used to enhance design quality, expand the knowledge base, and systematically analyze and address common challenges, while at the same time responding to regional and local influences. The conference also explored the role that collaborative and interdisciplinary research can play in this regard, both between academia and the profession, as well as between different disciplines of the built environment and other professions.

The papers included in these proceedings were selected through a rigorous two-stage blind peer review process in which each submission was evaluated by 3 reviewers from the ARCC board and conference technical review committee. In the first stage, we received 147 abstract submissions representing 71 institutions from 13 countries. Of these, 90 abstracts were accepted and their authors invited to submit full papers. In the full paper review stage, we received 59 submissions representing 46 institutions from 10 countries. Of these, 51 papers were accepted and the authors invited to make aural presentations in the conference, 50 of whom attended the conference while one author declined. The conference also included a panel discussion addressing the conference's main theme of leadership in architectural Research, two keynote presentations, and a presentation from the ARCC's New Researcher Award Recipient. The panel discussion and presentations are not included in these proceedings.

On behalf of the Architectural Research Centers Consortium, we would like to express our gratitude to all the abstract and paper reviewers, who contributed their time to the review process. We would also like to express our great appreciation for the conference sponsors, The American Institute of Architecture, and the College of Architecture; the University of Texas at San Antonio., Without their generous support the conference would not have been possible.

Conference Chairs:

Hazem Rashed-Ali, Ph.D
Shelley Roff, Ph.D.

College of Architecture,
The University of Texas at San Antonio

Architectural Research: Challenges & Opportunities

Thoughts Toward a Clinical Database of Architecture: Evidence, Complexity, and Impact
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Thoughts toward a clinical database of architecture: evidence, complexity, and impact

Leonard R. Bachman

University of Houston, Houston, Texas

ABSTRACT: This paper examines how architecture is building a clinical database similar to that of law and medicine and is developing this database for the purposes of acquiring complex design insight. This emerging clinical branch of architectural knowledge exceeds the scope of everyday experience of physical form and can thus be shown to enable a more satisfying scale of design thinking. It is argued that significant transformational kinds of professional transparency and accountability are thus intensifying. The tactics and methods of this paper are to connect previously disparate historical and contemporary events that mark the evolution of this database and then to fold those events into an explanatory narrative concerning clinical design practice. Beginning with architecture's use of precedent (Collins 1971), the formulation of design as complex problems (Rittel and Webber 1973), high performance buildings to meet the crisis of climate change, social mandates of postindustrial society (Bell 1973), and other roots of *evidence*, the paper then elaborates the *themes* in which this database is evolving. Such themes include post-occupancy evaluation (Bordass and Leaman 2005), continuous commissioning, performance simulation, digital instrumentation, automation, and other modes of data collection in buildings. Finally, the paper concludes with some anticipated *impacts* that such a clinical database might have on design practice and how their benefits can be achieved through new *interdisciplinary relations* between academia and practice.

Conference theme: Collaborative and Interdisciplinary Research
Keywords: evidence, complexity, accountability, non-local scale

INTRODUCTION

This paper examines the advent and evolution of architectural knowledge bases as they equate to the clinical databases found in professions such as law and medicine. The term *clinical* is initially defined here as the application of a body of knowledge to the diagnosis and therapeutic treatment of a specific problem case. A practitioner in this sense is a clinician.

Organizationally, the discussion first elaborates some evidence establishing how and why these sets of architectural knowledge are already accumulating. Second is an exploration of existing architectural databases and their clinical application in design. Next, discussion speculates on the impacts of clinical perspectives on architectural practice. Finally, a disciplinary model of architecture is offered to bridge between the profession and academia.

Law and Medicine are relevant examples of professions with essential clinical databases. Medicine has the most prolific set, with epidemiology, pharmacology, toxicology, and so forth; all of which refer back to the health treatment of individual cases through principles of anatomy, biology, and chemistry; just as architecture refers back to the vitality of individual building cases through thermodynamics, statics, acoustics, and so forth. Each health case is as unique as each building case… and then again; both medicine and architecture operate on generalizable principles. In medicine this generalizing is termed casuistry, referring to matters based collectively on the study of actual cases or case histories. An emphasis on use of medical research in clinical practice has spawned the field of Evidence Based Medicine (EBM). A later section of this paper examines the opportunities and dilemmas of EBM as perceived in the medical field and as applicable to architecture.

The clinical database of law is nicely translated into architecture through Peter Collins book, *Architectural Judgement* (1971). Collins compares the use of precedent in law to that of precedent buildings in architecture. William Hubbard endorses Collins' take on the model of law as analogous to that of architecture: "what we want in both fields… is work that reflects and responds to change yet gives the impression of continuity" (Hubbard 1981:91). As in medicine, each application of the law to a particular situation is simultaneously unique and generalizable… again, just as in architecture. So where medicine has its various specialized databases, law will have similar divisions of case precedents such as civil, criminal, tax, and so forth. Both legal and medical data sets provide a compendium of wisdom and history upon which new decisions can be intelligently based and without which judgement is only negligently decided.

To begin tracing the emergence of this clinical perspective in architecture, consider the words of Charles Garnier, speaking on the acoustics of his design for the 1889 Paris Opera. In the full spirit of trial and error, Garnier proclaimed a separation between the formal and performal tenets of architecture (Athanasopulos 1983: 26):

> I must explain that I have adopted no principle, that my plan has been based on no theory, and that I leave success or failure to chance alone.

Today, some 120 years later, architects are gradually but decisively reversing this separation of the visibly tangible forms of their works from the invisible dynamics that buildings always manifest. There is a connecting of formal and performal thinking underway and a developing reliance on new kinds of unified insight that can inform and inspire design.

What is being connected? On one hand is the immediate and tactile experience of architecture as material, form, and space; that which is normally thought of as the perceptible and sensual aspects of architecture and which forms the conventional ambition of designers. On the other hand is the equally real but far less visual dimension of dynamic relations that a building embodies and then sets in play, such as the interrelated flows of energy, heat, light, air, sound, people, information, etc. In architecture this second invisible realm is usually linked to aspects of phenomenology as advocated by Christian Norberg-Schultz's *Genius Loci* (1980) along with the writings of Zumthor, Holl, Leatherbarrow, Harries, Perez-Gomez and others.

Early evidence of this invisible and ephemeral second dimension was discussed in Norberg-Schulz's, *Intentions in Architecture* (1966) as the "filters, barriers, and switches" that make up building envelopes. Stephen Groák then invoked a complex systems view of these dynamics as "flow" in *The Idea of Building* (1992) as a formless and immaterial system of conduits, reservoirs, capacitors, and barriers. Still later, John Tillman Lyle asserted the *Regenerative Design* (1994) mandate of designing form to manifest process and flow. Most recently, Ralph Knowles furthers the discussion by describing the interplay of seasonal variation and human habitation in *Ritual House* (2006).

An more metaphysical context for these reconnected formal and performal dimensions of design can be interpreted from David Bohm's *Wholeness and the Implicate Order* (1980) wherein physical form is an "explicate order" that has been unfolded into the world of direct perception, versus dynamic or "implicate order" consisting of immaterial dynamic relations. For ease of discussion, Bohm's implicate order can be thought of as parallel to the probabilistic cosmology arising from the study of particle physics and quantum theory (e.g. Heisenberg's uncertainty principle of 1926). In this perspective, physical form is a lower "explicate" order experienced at the local scale of immediate perception. The dynamic and performal, or "implicate" order of systemic flows then is evidenced at a higher macro scale of reality in terms of flow and relation. In plain architectural lingo, this macro scale is a "non-local" perspective of change, relation, interaction, and adaptation… all beyond the ordinary direct sensual perception.

Returning to the reconnection of these two dimensions and to the emerging clinical database in architecture, note that it is only in their complementary wholeness that the full reality of architecture is confronted. Limiting design to one or the other as a single focus is reductive and mechanistically simplistic. Garnier's technical and scientific innocence of acoustics at the opera house can be easily excused; it would be another decade before Wallace Sabin would instigate the study of indoor acoustics. For the modern practitioner however, the paired mandates of formal and performal realities are here to stay. It only remains to accept them as complementary aspects of the same thing and to treat their duality as generative and synergistic.

1. THE ROOTS OF EVIDENCE

Clinical knowledge of architecture and the growth of a database to capture that knowledge are both rooted in progressive historical and evolutionary forces. This section briefly enumerates some fundamental influences of these trends.

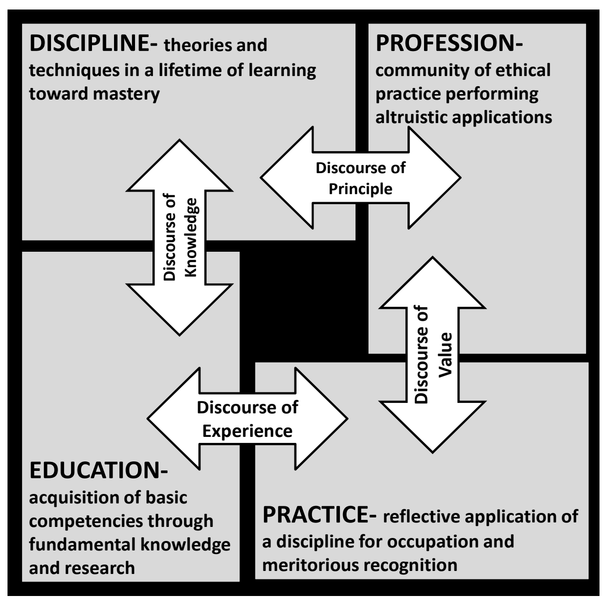

Figure 1: A framework for disciplinary knowledge.

1.1. History

In its roots, architecture as a profession is given society's license and monopoly in the design of the built environment (Fig. 1). Like any profession, this license is granted on the basis of its practitioners having acquired a large and difficult body of knowledge and committed to a lifetime of learning, refining, and growing this knowledge base. This contract is actualized in the architect's livelihood and occupation in service to society through application of that knowledge. This framework is familiar to readers of such works as Piotrowski and Robinson's edited volume, *The Discipline of Architecture* (2001) or Rapoport's essay on *The Cultural Responsiveness of Architecture* (1987).

Objections as to the disciplinary nature of architecture have certainly been made on the grounds that architecture is dominated not so much by the lower two realms of knowledge, declarative or procedural, as by implicit understanding, sensitivity, and sensibility. But these objections simplistically overlook the fact that any profession is anchored in the third and higher realm of structural knowledge; knowing "what and how" are normative, but knowing "why" is critical. So in the end architecture is comprised of a body of built and un-built work upon which its contributions can be judged. That body of work and the critical assertions of its value are, therefore, the disciplinary root of the profession, just as the epistemological basis of any profession is so rooted in its progress, accomplishments, and seminal works.

Obviously, architecture builds its body of knowledge, or what Walter Gropius called "the accumulated wisdom of architecture," by different methods than do law or medicine. Similar questions are asked concerning how architecture is like the model of art or the model of science. What matters in this discussion is only that such knowledge does exist and is identifiable.

Historically then, the knowledge base of architecture has accumulated with time and with lessons learned. Initially this knowledge was knit into a contract with the cultural elite rather than with society in general. That is to say, architects worked more toward the shared experiences and values of the privileged classes than toward the infrastructure and well being of society and for the built environment at large. Architectural service directly to the general population and to civic institutions is a more recent phenomenon.

As an accumulation of knowledge and wisdom, service to culture and privilege is rooted in the epicurean pleasure principle of celebration. In that context the essential value of knowledge, function, economy, and suitability is subsumed by desire for status, glory, and monumentality, all at any cost. In these modern and more democratic times however architects are engaged increasingly more by the transformation of essential requirements into built forms that are meaningful, serviceable, and yet still as masterful as the monumental works dedicated to culture. It is these later works that have instigated and formalized the clinical knowledge of architecture. Along the way, several new and important societal forces also asserted themselves, such as building codes, legal liability, technical society, and licensure. Most historically important perhaps was the eventual promotion of architecture to full ranking as a profession by its taking membership in the academy (Fisher 2008).

1.2. Performance

A second root of evidence for the emergence of architecture's clinical database is found in the measured performance of buildings. It is a relatively easy point: architects design buildings to work, to do something instrumental.

So long as the historical role of architecture was one of service to cultural appetites and privileged resources, the mandate of functional performance was an assumed *fait-accompli* and weak force. With the ascent of social and civic service however, the practical operation and performance of a building becomes increasingly important. With the simultaneous advent of technology and the means of measuring performance, it becomes easier to ask questions about performance, measure results, and to track performance over time. Finally, with the development of qualitative research methods and statistical tools, architects can empirically inquire and critique the value of more than just quantitative factors such as energy use. Qualitative issues such as human perception and environmental behavior are now also on the table. And when the answers are easier to attain, the questions become much more compelling.

1.3. Society

Having invoked social transformation as a shift toward data driven design in a both an historic and a performative context, some specific influences in current events should be referenced. The characteristics of our emerging postindustrial society fulfill this need quite nicely (Bell 1973).

Table 1: The overlay of industrial and post-industrial society in the context of architecture. Source: (Bachman 2006)

Industrial Establishment	**Post-Industrial Emergence**
Planning	
Sustenance from nature	Sustainability with nature
Anthropocentric	Biocentric
Linear production	Cyclical flows
Tactical objectives	Strategic goals
Short-term plan	Long-term plan
Incremental shifts	Continuous change
Practice	
Product and tradition	Process and discipline
Local effects of action	Global interaction
Mechanistic relationships	Systemic relationships
Machine as the icon	Nature as the icon
Heuristic procedures	Cybernetic integration
Physical prototyping	Simulation modeling
Mass standardization	Mass customization
Design	
Hierarchical and linear	Holistic and non-linear
Deterministic simplicity	Teleological complexity
Intuitive heuristics of form	Self-emergent form
Inevitable future	Future scenarios
Innovative individuals	Transdisciplinary teams
Pioneer-as-hero model	Designer-as-collaborator
Design for elite status	Design for social justice
Automatic control	Intelligent automation
Transient static solutions	Robust dynamic solutions

Foremost among these characteristics is the transformation to a new system of value production, away from one primarily based on the value of industrial products and toward the value created by use of information. This refers not to the innate usefulness of information per se, but rather to what is attained in the intelligent collection, organization, and inference from data. This intelligence is what distinguishes mere data from useful information in the first place.

It is generally accepted that leading nations had already become pre-imminently information and service economies by the 1950's. More recent notions of knowledge professions, service workers, information technology, learning organizations, and globalization attest to further and deepening change. Architecture as a service profession is well aligned to capitalize on the now recognizable postindustrial notion of value creation (Table 1). The architect's actual ability do so however, may hinge on their willingness to point to a discreet body of captured and codified knowledge, ergo, a clinical database of architecture. Heretofore, the profession at large has been content, perhaps even secretly delighted, to maintain a kind of mystical, artistic, and cult driven air as to architectural knowledge. While the magic of making architecture will likely remain cloaked in professional acculturation, it is increasingly likely that the value of what architects produce and the knowledge base on which it is founded will have to become more explicit.

1.4. Planning

Another word for the operation of postindustrial intelligence is strategy, the plan of how knowledge will be collected, organized, and applied. Expectations of postindustrial society are that a strategic meta-plan for projects can be articulated at the proposal stage. This requires the architect to communicate in advance how delivery will occur, and by what processes and sequence. All of which presupposes the existence of a specialized knowledge base i.e., clinical database on which to operate.

At the level where this information targets the actual design, planning is increasingly expected to go beyond normative programming in the sense of creating an agenda for the client's wants and needs. The trend is for buildings to be more than static objects that house the user function. Rather, they are expected to facilitate the institution and operations of use in flexible ways, and respond to change and reorganization. Buildings will increasingly be seen less as status objects and more as integral parts of long range plans.

Consequently, there are new demands for information driven design. Design must facilitate long range scenario planning goals and objectives, what Buckminster Fuller called "inventing the future." Further, the information folded into such scenarios requires a participatory process involving not just the client owner's dictates, but rather a full spectrum of users, suppliers, consultants, and other related stakeholders.

Themes elaborating how architects employ this planning based data are described in Section 2, below. The present point is that a foundational need for such data is driven first by a postindustrial notion of the value vested in pre-ordering such data, and secondly in the inclusive scope of sources from which that data is collected.

1.5. Nature

As Lyle (1994) recounted, architectural response to the knowledge structure of ecological fit traces to the work of biologist turned urban ecologist, Patrick Geddes. With Frederick Law Olmstead, Geddes presaged the advent of postindustrial times in the construct of history across "paleotechnic, technic, and neotechnic" epochs (Geddes 1915). Their description of linear industrial throughput in the technic era and cyclical looping of systems in the neotechnic are accurate mappings of what Bell later distinguished as industrial and post-industrial society.

To support the emergence of a clinical database in architecture, consider the stages of ecologically based design which architects have developed since Geddes: solar, passive, green, sustainable, and regenerative to name a broad but probably not complete list. While all of these relate in some way to the evidence of performance as discussed above, they also involve the knowledge base of an entire ethic. More than just energy efficiency, the broader scope of Design *with Nature* (McHarg 1969) has grown to include project specific data on indoor air quality, chemical sensitivity, eco-aesthetics, and so forth. It also involves measures at the global scale, such as carbon neutral, ecological footprint, and global warming.

Keeping abreast of this rapidly escalating issue and the continuously evolving information needed for appropriate design is not possible through traditional design thinking. It requires access to a database of vetted knowledge that allows for clinical application to specific cases, again, just as in medicine and in law.

2. THEMES OF COMPLEXITY

Tuning now to the sources of clinical knowledge in architecture, the four roots of evidence from the previous section can be illustrated in practice. While some of these current practices are not yet recognized as clinical databases, it is increasingly clear that they will eventually be thought of in that way.

The characteristics of clinical practice are adapted here from a description of how the clinical model is relevant in educational research (Elstein 1977). These traits will be useful in linking architectural design to clinical knowledge. To wit, a clinical practice is:

1. Problem initiated and problem directed
2. Concerned with action directed toward a particular problem and specific *case*
3. Performed *collaboratively*
4. Involved with collecting *information* and drawing conclusions
5. Performed diagnostically and therapeutically to identify and *resolve* disorders or discordance
6. Dependent on the clinician's *interpretive* reading of the problem and selection of an appropriate

remedy
7. Based on a comprehensive body of *collected cases* that comprise a clinical database for practitioners

A medical description of clinical practice helps to summarize: "systematic and critical assessment, continuous experimentation, and subsequent revision of knowledge" (Maletrud 2001). Bearing these definitional characteristics in mind, the following paragraphs of this section detail how clinical databases are realized in architecture.

2.1. Precedent

Case method has long been a recognized clinical tool of medicine and law, and although the word "case" is seldom used in architecture in the same clinical way, the use of precursor design examples is well ennobled as "precedent." The difference in architectural case work with law and medicine is mostly semantic. Precedent in architecture allows access to theories about what is good design. Moreover, as Collins (1971) and Howard (1980) both show, precedent cases allow designers the opportunity to re-read and re-interpret previous works in innovative ways that lead to authentically new designs and new design thinking.

It happens then that history is, to a limited extent, a ready-made and naturally evolving clinical database of architecture. The caveat is that each precursor building case is not automatically recorded and written down in a clinical way. The designer's intention, the client's brief, the development plan, and even the success-in-use are often not made public. Frequently we are left with little more than post-hoc statements and knowledgeable but externally authored critique.

Several works of architectural literature do, nonetheless, focus on the development of particular typologies or particular architectural approaches, even sometimes on particular buildings. Each of these works uses some form of case study methodology to derive generalizable knowledge, and each case thus becomes a catalogued item in a clinical database, from where present and future architects can apply the codified knowledge to appropriate new cases.

2.2. Postoccupancy evaluation

Post-Occupancy Evaluation (POE) is defined as the assessment of a building directly through the perceptions of the actual user-occupants. POE is a detailed and systematic measurement performed after the occupants have had sufficient time to accommodate their activities to their new environment. POE provides an opportunity to identify lessons learned in the project outcomes as compared to the intended results. As such, POE is also a means of both verifying that the design intent was achieved and validating that the intent was appropriate in the first place. Studies of this sort have been undertaken since the late 1960s (Preiser 1999) and are increasingly seen as an integral part of the project process.

POE data is often proprietary in nature and such studies may contain confidential information as well as potentially litigious records of warranty concerning the outcomes. Nonetheless, many POE reports are made public through professional and academic channels. Two models for such accessible POE data would be academic research investigations and publically driven institutional inquiry. For the first model refer to the work originating with the Vital Signs Project and the case study database created at schools across the U.S. (University of California, Berkeley 2008) or the Integrated Building Technology library in Hong Kong (University of Hong Kong 2008).

For the second model on publically generated institutional POE studies, refer to the example of UK Usable Building Trust publications (The Building Trust 2008). Most notable here are the Postoccupancy Review of Building Engineering (PROBE) Studies which tie back to the 1963 Royal Institute of British Architects (RIBA) document, Plan of Work for Design Team Operation, which included a section on collecting feedback from recently occupied building projects (Bordass and Leaman 2005). By 2002, some 500 cases later, more than twenty PROBE studies had been published in the Building Services Journal. Other publications from the PROBE team are now appearing in the journal Building Research and Information. These Useable Building Trust PROBE efforts (principally by Bill Bordass and Adrian Leaman) typically entail full disclosure releases from all parties of the building team and the opportunity for the designers to respond to the findings. As such, the collected PROBE studies form an objective and foundational literature for a clinical POE database.

Taken as a whole then, POE first establishes a reliable body of evidence from which the practitioner-designer can interpretively read new problems then perform diagnostic and therapeutic resolution. Second, POE methodology has created new meta-knowledge on how to conduct such design studies, how to parse relevant information, and how to use such information to refine design knowledge. In either the academic case of Vital Signs or the public institutional case of PROBE, both examples point to a growing and potentially ubiquitous means of clinical architectural knowledge that could arguably be seen as requisite to best practice qualification.

2.3. Continuous commissioning

Commissioning studies and continuous commissioning investigations (Cx) are performed to confirm that the current operation and control of a building is aligned with the current uses of the building. These are usually engineering level studies as they involve detailed knowledge of building systems and building physics. It has been demonstrated that commissioning is cost effective, particularly where there is continual change in how a building is used due to churn, operational changes, alterations in the institutional model, or technical modifications (Portland Energy Conservation 2002). It is not unusual for Cx to be considered essential to the delivery of an optimal building or to be incorporated into Total Quality Management practices.

Aside from the usual move-in adjustments and verification of building systems operation such as air balancing and light fixture aiming; commissioning is now practiced to insure whole building alignment. In this broader sense, commissioning work begins in the first conceptual design phase and runs through all phases of design, construction, move in, early operation, and is potentially repeated periodically throughout the life of the building. As a required and optionally advanced component of Leadership in Energy Efficient Design, (LEED) certification, a commissioning authority is appointed early on as an agent of the owner to anticipate, identify, and collaborate in the resolution of operational problems.

In the continuous commissioning mode, the host building and the occupant cohort are treated as two living entities. Each of the two involves complex and interactive dynamics, and they both play off one another in sometimes direct and sometimes subtle ways. Moreover, both the host and the occupant change with age, use, and modification. Optimizing the host-occupant relationship then requires annual or other periodic revisits.

The diagnostic and therapeutic role of commissioning is thus a clinical practice. As the leader of the design team then, the architect must be expected to incorporate the protocols and lessons-learned knowledge issuing from commissioning practices. With time, a database inevitably evolves case-by-case. Commissioning and the meta-knowledge attained concerning how to align host building with occupant cohort form an evidentiary and therefore clinical database.

2.4. Instrumentation and automation

Precedent, POE, and CX demonstrate separate and distinct examples of clinical databases in architecture. Each has an underlying dimension of data acquisition, organization, and interpretation in design practice. To show how such databases evolve though, it is necessary to examine methods by which such data are acquired in the first place. This process begins with the advent of accurate and inexpensive digital instrumentation.

Digital instrumentation facilitates cybernetic feedback by enabling continual measurement and verification of how a building is being used, how controls are sensing conditions, and what the operation of the building does in response. Instrumentation furthers the feedback loop by storing these measurements digitally and making them readily available for analysis in formats as simple as a spreadsheet.

At the smallest level of instrumentation are devices that collect and log readings, and the related software that allows us to convert the raw collected data into visualizations, patterns, and statistical inferences. Miniature devices capable of collecting thousands of readings across months of time divided into designated intervals between measurements are now readily available, reliable, and affordable. They are also easy to use with interface software and USB connection to a computer. With a few such devices and a good plan for how to interpret the data, it is now easy to take temperature, light level, humidity, sound and other quantitative measurements and convert them into an accurate picture of building and occupant behavior.

At a second level of instrumentation, the everyday digital control and operation of buildings is itself a growing source of diagnostic feedback. Direct Digital Control (DDC) for example has been in use for more than twenty years. Systems such as these are used to automate the control logic of buildings, signal failure alarms, and to integrate the operation of several building systems such as lighting and security or energy use. Since these systems both sense building conditions and control equipment in response, they provide two way communications between the building and the building operators. And since DDC is recordable, it creates a continuous record of interactions.

The third level of instrumentation takes the building to the level of artificially intelligent robot. These systems can actually learn the building's use and response patterns and decide independently how to anticipate and optimize building operation. Where features of the building are dynamic, such as operable shading devices or dimmable glazing for example, the building-as-robot can calculate the optimum balance of daylight versus solar heat gain and adjust the building components to suit.

Finally, it is increasingly likely and practical to allow for the building and the occupants to interact through a second generation of robotic interface. Feedback is provided at the Oberlin Center for Environmental Studies for example by a dashboard type monitoring system located near the entry. Here even passersby can observe real time data such as how much energy the building is producing with photovoltaics versus how much it is consuming.

Beyond this, the robot may soon become an animated genii-like avatar that appears on the building computer intranet. This building-to-occupant feedback and interaction could easily and beneficially be used to initiate occupant control of their own environment (Brager 2008). And of course the whole conversation would be a matter of record and potential diagnostics, a clinical database for better commissioning and for better design of the next building.

3. IMPACT

Having examined the root sources of clinical knowledge in architecture, compared design case knowledge with other disciplines, and then explored just a few examples of clinical design knowledge, this discussion now turns to a more speculative view on the impacts of clinical databases in architecture.

3.1. Dilemmas

In medicine, the term casuistry has been used to invoke a rich double meaning. The pejorative meaning is that of over-subtle, even dishonest or sophistic reasoning. This leads to a caveat on the proposition of clinical databases in any discipline. Medicine, for one, is having vigorous discourse on the difference between the rational scientific approach to clinical practice as

contrasted to a more holistic and personalized approach (Malterud 2001). The question distinguishes expertise from wisdom very nicely.
In architecture as in law and medicine, the practitioner is engaged in a complex and indeterminate web of interrelated factors. These have been classified as wicked problems (Rittel and Webber 1973). In systems theory such indeterminate problems are seen as normal and accurate descriptions of the world. Our everyday mechanistic and simplistic view experienced as a heuristic experience of the world has been exposed as insufficient and shallow. The truth is better regarded as probabilistic, contingent, and situational. As discussed in the introduction of this paper, the complex world of interrelated networks is inherently more satisfying to the designer than the everyday one of first order perception; the implicate is valued over the explicate order; and critical insight is valued over normative rules.
Neither lawyers, doctors, architects, nor most other disciplines deal with simple mechanistic cause-and-effect, relationally organized challenges. Formulamatic or rule based procedures for delimiting the problem-space of complex problems, devising operations within that space, and even for defining a successful outcome are all to be denied. A contingent and flexible means of dealing with ambiguity is really what is needed. At the same time, the complex problem-space model also speaks strongly for the use of clinical evidence: Without case histories and clinical evidence it is after all, impossible to recognize the immutable determinates, from the irrelevant noise, from the fertile ambiguity.

3.2. Accountability

For some, the scary dark side of clinical evidence is the accountability it demands. When a bona fide database of such evidence is at hand, practitioners are professionally bound to it as the source of best practice. With such knowledge as currency, the designer can use the legal model of warrants to explain how they sanction or justify their design decisions. Without such knowledge, the designer is less accountable, but also more encumbered. That encumbrance results from being continually forced to construe warrants from the ground up.
As previously discussed, design warrants are now expected to be supported by evidence and best practice models. The mandates of precedent, POE, and Cx, along with the availability of digital measuring tools, simulation modeling, survey methods, qualitative validity and so forth are looming close overhead. If tomorrow's designs do not embrace these clinical mandates then Postindustrial society will probably force them on architecture anyway.

3.3. Collaborative opportunity

Many other impacts of clinical knowledge could be discussed here: redistribution of services, collaborative design practices, specialization, and so on. In the limited scope of this paper however, only one will be offered. It is chosen in the spirit of the named conference theme: collaborative research between academia and the profession.
Figure 1 suggests that architecture, like any discipline, can be thought of as four domains connected by four first-order discourses. This model is derived primarily from the many seminal essays found in *The Discipline of Architecture* (Piotrowski and Robinson, ed. 2001). Applying this Figure 1 model to the current discussion illustrates how academia could be positioned as the cultivator and storehouse of disciplinary knowledge. In many ways this is already the case: schools generate most architectural literature, schools store that literature in libraries, schools provide a forum for fair critique. There is however far greater opportunity.
Continuing education can form a vital link between academia and practice, where occupational experience is traded for applied research, critical ideals, and updated knowledge. In the context of the profession, a new notion of internship has been proposed as a learning organization approach to a practice academy (Malecha 2005). This professional internship model would easily align with and complement the suggested continuing education link with practice.
Finally, as universities and schools of architecture continually reinvent themselves (Fisher 2008), colleges of architecture are investing in facilities such as laboratories and digital fabrication shops. It is unlikely in the near term that practice firms will own such facilities or would be willing to develop expertise and protocols for the use of such resources. Instead, these new academic laboratories and shops might well be the very meeting places where continuing education and internship program activities occur.

CONCLUSION

A disciplinary model of architecture implies a clinical database. This paper elaborates how forces have led to the evolution of such databases and the design practices that such evidence supports. Some large and growing components of such clinical knowledge have been illustrated by the examples of precedent building cases, POE, and Cx. Digital technology and qualitative assessment tools were discussed as the font of clinical data and best practice knowledge. Further speculation points to impacts including issues of accountability, complexity, and of expertise versus wisdom. Finally, a disciplinary model is offered for collaboration across the four domains of architecture, and it is suggested that this collaboration be hosted by specialized facilities in schools of architecture.

ACKNOWLEDGEMENT

Professors Ralph Knowles, Marc Schiler, and Mark Childs stimulated and contributed many ideas that show up here. I take the blame where their thoughts are not well represented and am indebted for what does shine through. Special thanks to Mark for his recent insight on William Hubbard's work. Christine Bachman, my spouse and colleague, shared lots of critical conversation and many draft readings. I also wish to give a special thanks to the ARCC conference organizing committee at UTSA, namely Hazem Rashed-Ali and Shelley Roff.

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Rethinking models of architectural research: we don’t do objects

Jim Stevens[1,2], Philip Plowright [1,2], and Anirban Adhya[1,2]

[1]SYNCH Research Group (synchRG)
[2]Lawrence Technological University, Southfield, Michigan

ABSTRACT: Historically, an argument can be made that architectural research was produced internal to firms and manufacturers as proprietary objects or sets of data. The concept of disciplines and professions reinforced the separation of open-sourced knowledge and the application of that knowledge in a commercial context. However, design has rapidly changed from an object-solution profession and is now faced with finding solutions to complex problems within complex systems. The past practice model of client, architect, and final product seems an ill-fit in this new context. The question is how to integrate a critical research process into a professional capacity in which that architectural research needs an inherent and immediate value to be performed or pursued. The SYNCH Research Group [synchRG] was formed in response to this question. Although research consortiums, design initiatives and research centers exist within many schools of architecture, most operate as a department or extensions of a school of architecture. SynchRG operates in neither private practice nor as a division of the university. Organized as a diverse and fluid association of faculty, students, professionals, and consultants, the synchRG group is focused on a design methodology and philosophical structure rather than a client, site, building, typology, or object. The focus on idiosyncratic or aesthetic solutions to singular problems is set aside in order to provide a collaborative intellectual space for professional based explorations. The paper will examine synchRG’s response to current architectural research challenges and illustrate its unique structure as a possible model to be replicated. A dialogue will be initiated on a model for practice aligned with both academia and industry.

Conference theme: New methodologies in architectural research
Keywords: systems, open source, applied research,

INTRODUCTION

The use of the term “research” in architecture is ill-defined at best and empty semantics at worst, and, at the very least, its application to design and/or practice is misleading terminology. The discussion surrounding research in architecture is not novel to the last few years. The Journal of Architectural Education (JAE) devoted an entire issue in May of 1979 to the question of research in architecture, surveying educators and practitioners. Throughout the 1980s and 1990s, various articles were published, often with the same language referencing research in architecture as “emerging” (Joroff 1984) or how it was changing the profession (Shibley 1986; Trombley et al 1984). Many papers concern the relationship between academic knowledge and the improvement of practice. The word “research” is presently in vogue both in academia and practice, but one could argue that this terminology has simply replaced what has been known as *critical practice* without a change to content, methodology or intention.

1. DOMINANT ISSUES

1.1 Architectural research

Architectural research has traditionally been produced in two distinct domains. First, there is proprietary research, internal to firms and manufacturers. These are either legally protected technology, products, or sets of data and knowledge particular to a market segment that the firms operate in. As this knowledge is important to the maintenance of market share, there is a vested interest to maintain control over this data through secrecy and intellectual property rights. Second, there is academic research, pursued within the confines of architecture schools as ideas discussed in conferences and published in journals. While worthy and important, there is a gap that occurs between traditional pursue of academic knowledge and professional application, with one of the major hurdles being dissemination and access to that knowledge. There are very few sites of professional, free, and open dissemination. InformeDesign, at the University of Minnesota, attempts to address this issue for interior design, architecture, landscape architecture, and urban planning by making abstract knowledge available to those professions based on the categories of space, issues, and occupants. However, InformeDesign acknowledges part of their mission is to maintain or reinforce the jurisdictions or boundaries of these professions through the application of abstract, or academic knowledge (InformeDesign 2008).

The concept of disciplines and professions reinforces the separation of knowledge internal to a firm or company engaged in commercial development and the dissemination of that knowledge for other application both within and without the conceptual confines of a profession. It creates a silo mentality. As noted by Meredith Davis, director of North Carolina State University's PhD program in design,

> A 2005 Metropolis survey of 1,051 designers, design faculty, and students in all design disciplines found that as much as 90 percent of design research findings are inaccessible to students and faculty, even in their own institutions. There are no design-sensitive research databases or search engines (enter “branding” in the typical library search and you get books on cattle) and most of the research generated by private practice is proprietary. (Heller 2007).

There also seems to be a lack of agreement on what exactly research in architecture encompasses. Valid positions can be taken for a range from designing a garage for your neighbor to sociological studies of color perception to the thermal resistance of wall components, among many others. In the design studio and practice, precedent studies of existing projects are within the tradition of “design research.” Sustainability is probably one of the most common terms used connected to research today, but now we have two words without clear definitions. And then when “design” is introduced, the issue is confused even more. This openness is seen as a positive element in the creative process, definitions and firm boundaries are resisted in order to allow ideas of progress and development to thrive.

Some arguments place the idea of research as overvalued (Kieran 2007). In academia, the idea of research is resisted in relation to the tenure process. As academics have fought to maintain flexibility over their creative output, scholarly research, as a traditional path to tenure for most academics in hard sciences, is blended with “creative activities” in the design fields. We are not supporting the tightening of these definitions, as there is health in diversity and exploration. We are addressing an aspect of research, applied research, and in particular a model in which to pursue that research that reacts to changes in the organization of knowledge.

A critical shift is occurring, one that should be considered in context of applied research in architecture. This shift is the reframing of design thought in architecture from the discreet object solution to the systems approach. Not only architecture, with its traditional boundaries of aesthetics and distribution of form in space, is affected but all of the design fields. Design has rapidly changed from an object-solution profession, that of the isolated single focus, and is now faced with finding solutions to complex problems within complex systems. These problems and the associated approaches to solutions are very difficult to comprehend in traditional methodological models such as historic architect as the master mason or contemporary architect as the sole designer. The past practice model of client, architect, and final product no longer has the same relevance in this new context. The role of the architects moves beyond the aesthetic jewelry box to instead assemble multidisciplinary teams to pursue less tangible solutions. The question is how to integrate a critical applied research process of professional capacity that uses academic flexibility and is not end-goal focused, yet can also produce solutions both of abstract and concrete natures. The issue is not whether research can be defined, nor whether applied research is being performed but how to approach an old model of practice and academia which is not structured to support a systems-based approach. The entire process, including the dissemination of research, needs to be disconnected from the tenure or proprietary processes, following Creative Commons or Open Source models of design (and architecture) beyond the notion of single architect and object.

1.2 How objects blind us

We (the authors) argue that architecture needs to relinquish its fetish on the artifact or the object, and then examine what the effect is on a series of associations. As the focus shifts from the discreet object to a complex assemblage of relationships as the site of inquiry, there are several ramifications. (1) The dominant mode of analysis from Rene Descartes in the 17th century to Jacques Derrida in the late 20th century is predicated on the idea of a closed relationship of binary opposition between two “things”. The Western world has been defined as opposing pairs of meaning: mind-body, black-white, life-death, sky-earth, sun-moon, nature-technology, man-animal. Even the most aggressive post-structuralist philosophy didn't eliminate this structure, it simply pointed out the inherent power differential between the members of the pairs, positioning one as a degenerate of the other. These pairs have been instrumental in developing meaning in Western culture and flavor of how our culture perceives reality. (2) As the modern period came into full development, the primacy of meaning was located within the object itself, or, extending this idea to a body of knowledge, within the boundaries of this discipline's discourse. The object and their associated discipline became focused on interiority. These boundaries and territories of a discipline have been guarded and protected as proprietary knowledge. (3)An extension of the focus on the object is a bias it has lent to Architecture. Thus architecture frames itself not as an association of complex elements in space, which includes the social, material, and experiential, but instead as the erection of an object or building.

When the idea of applied research is introduced into the design process, the idea of *system*, rather than object, could be said to be the site of possibilities. In the complex layering of engineering, codes, by-laws, budgets, users, public interest, material applications, life safety, human comfort, social values, and aesthetics (to name a few) that are involved in a contemporary architectural design project, simplifying a project down to program or typology seems less relevant and less successful. Furthermore, when these related but diverse layers are engaged as part of the design investigation as a system, solutions occur which would not normally present themselves primarily due to the diverse field of inquiry and small yet significant effects.

System theory recognizes the field as the major *site* of operation yet it is only by contrasting the field with the object does architecture traditionally manifest. The object supports defined boundaries, as in those traditionally defended by professions. The field suppresses those boundaries. As Neal Leach recognizes, for a thing to lose its boundaries is for that thing to become invisible (Leach, 1999). Or to say it in another way, and to quote *The Incredibles*: "if everyone is special, then no one is special" (Bird 2004). As the boundaries of the field are removed, the recognition of the object as having membership in that particular discipline is brought into question. The question, when shifting from the object to the system, is how do we open the field of influence to other disciplines without losing the integrity of the design language of the profession in which we are operating? Of course, another question could be, is it important to maintain that particular language? The development of system theory not only eliminates the binary pairing as defined positions, it makes traditional boundaries irrelevant to the process. The focus of design and research in architecture is changed. Instead of struggling with arbitrary and culturally fleeting issues of meaning, a systems approach asks how something functions regardless to its traditional category.

There is a further critical shift that occurs when introducing the system instead of the object as the focus of an architectural exploration. The strength of the system is its lack of interest in the firm, fixed and stable boundaries of an object. The strength of the design solution is then found in relevance, rather than the object-focused terms of signification, meaning, truth, or identity. Instead of asking what something *means*, the question of the signifier in Western metaphysics, the priority of a system approach is, *how does it function*? Function, in this case, should not be conceived in simplistic operational terms nor is it a fixed category. Function in the system changes, shifts and flexes depending on the association of objects (bodies and machines) in the act of becoming. For example, a bicycle is a machine without a function until it forms an assemblage with a cyclist and a road or path. Only at that point does the bicycle become a vehicle. If the machine "bicycle" forms an association with the "window" in adjacency with the "bicycle store," it becomes an object of commerce. Placed in a gallery and connected to particular viewers, the bicycle becomes a work of art. In each case, depending on the assemblage formed, the function of the bicycle is different (Colebrook 2006). This is difficult to conceive in architectural terms, as function has been traditionally related with typology, program, or economics in fixed categories. Instead, the question can be rephrased: *what does it [the system] do*? or *what is its [the system's] effect*?

Ultimately, the alignment brought into design by a systems approach is a way to address contemporary complex problems that are unapproachable through the idea of the discreet object. Applied system thought in architecture is about methodological complexity, not visual complexity. It is a network structure rather than aesthetically driven object. This does not remove the aesthetic nor the object from architecture; it simply displaces its importance. The object, along with parallel issues of aesthetics, cost, function, surface, production, assembly, material, perception, experience, associations, is reintroduced as a form of influence per the field dynamic.

If we extend the idea of system into an operational structure for SYNCH Research Group (synchRG) (as a case study), then alignment and associations which allow for the pursuit of applied research emerge, with applied research at the core of the operations. There is a shift in both authority and hierarchy—stop thinking like a principle, stop trying to own or control something, start acting like a designer.

2. OPPORTUNITIES AND APPLICATIONS

2.1 Applied research centers based in universities

The academic architectural culture has been developing positions towards applied research. Across the globe, schools of architecture are learning to become more innovative in their partnerships, collaborations, and research. Applied research and development of research centers are important phenomena currently seen in universities. There are currently 95 centers of applied research housed in the 57 architecture member-schools of the Architectural Research Centers Consortium (ARCC 2008). This growing body of architecture research centers can be categorized into four categorical research models: (1) faculty led centers focusing on certain concentrations within the department (e.g., MIT SENSEable City), (2) college outreach programs and community design centers (e.g., Lawrence Technological University, Detroit Studio), (3) studio based initiatives (e.g., University of Kansas Studio 804), and (4) independent non-profit practice-based centers (e.g., University of Detroit Mercy, Design Center).

2.2 Cross disciplinary models

Many allied disciplines like urban design, urban planning, environmental design, and landscape architecture have invested in developing frameworks and models for applied research in a university context not based on the bias of the object. These discourses have engaged in multi-disciplinary and interdisciplinary research models, which can be studied as a possible asset for importing into architectural design. Compared to traditional architecture research, these disciplines have demonstrated more openness, stronger partnerships, and collaborative relationships among various groups. A few of the more prominent examples in urban design, environmental design and planning will be discussed below as case studies.

The *Urban Design Project* (UDP) is a center devoted to service, teaching, and research in the pursuit of critical practice of urban design at the University of Buffalo School of Architecture and Planning (UDP 2007). The center serves the communities of the Buffalo-Niagara city-region by bringing faculty, professionals, and students together with local governments, community based organizations, and citizens in general, to engage the work of making better places and stronger communities. The work of the Urban Design Project has encompassed independent projects, faculty consultations, student studio projects, and supervised thesis investigations dealing with sites of diverse scale and engaging local, regional, national, and international institutional partners. University alignment is limited to space, heat, software environment, and some computers in return of the overhead costs paid to the university.

The goal of the *Center for Environmental Design Research* (CEDR) at the University of California Berkeley is to inculcate research in environmental planning and design. Such research, according to CEDR manifesto, is aimed at "increasing the factual content of planning and design decisions and at promoting systematic approaches to design decision making" (CEDR 2008). The center reinforces the broad scope of environmental planning and design through interdisciplinary organization of discourses, resources, and personnel. The research opportunities range from local environments of people within buildings to region-wide ecosystems, from small detail of building construction to large scale urban planning, from the history of the built environment to the design process itself. Center's research and technology transfer projects in the planning and design of urban spaces involve many CEDR faculty from multiple departments. CEDR also manages and edits *Places*, a prominent journal in the U.S. principally focused on urban design, which acts as a publication outlet for students and faculty in the university as well as institutions and organizations nationally and internationally.

The UM/ULI Real Estate Forum, a joint venture of the University of Michigan (UM) and Urban Land Institute(ULI), is a non-profit volunteer organization dedicated to enhancing real estate education at the professional and academic level. The forum acts as an umbrella organization for other professional organizations interested in promoting scholarship and professionalism in the real estate community. The forum is an integral component of the College of Architecture and Urban Planning Graduate Certificate in Real Estate at the University of Michigan. Through series of lectures, conferences, academic and professional participation in events, and competitions, the forum provides an opportunity for discussion, debate, and dialog regarding real estate design, development, and planning.

The review of these three cross-disciplinary research centers provides some critical insights into the organization structure and modus operandi related to applied research. These could be useful for rethinking the model of applied research in architecture. There is a broad focus and range to the centers. There is generally an interdisciplinary attitude that necessitates collaborative partnerships. Multiple relationships are developed with the community, business, politics, profession, and the academia. The centers are led by a Director and advised by an advisory board. There is involvement of students, often in paid positions, and participation of faculty and professionals as PI and consultants. Information is disseminated to the academia, profession and the community

2.3 New opportunities

Although the applied research centers and cross disciplinary models are making valuable contributions there are still new opportunities that can be explored to address larger issues within the profession. All of the research centers are organizationally aligned to respond to an industrialized set of problems; one that responds to the needs of an individual or group of individuals (client). Design problems are solved and then reintroduced in the following project. As Klaus Krippendorff (2006: xv) describes in *The Semantic Turn,* functional, aesthetic, and market considerations that justified products of design in the past have been replaced or overshadowed by more social, political cultural and ecological concerns. All of the referenced research centers are organized in a traditional practice model, responding to market considerations of the industrial era. The centers do create relationships with interdisciplinary teams and conduct outreach to the community; taking on projects that the market otherwise would ignore but there is no larger organizational alignment to insure that the solutions can be replicated. They do disseminate findings through the academic community and receive post-project peer review but there is limited co-creation with other research centers, they are not focused or provided with a road map that insures continuity between themselves and their counterparts. In reaction to the need to move away from designing for the market and progressing toward solving the immense problems that face the profession; synchRG turned outside the design profession to reorganize itself affectively.

2.4 Open source model

As opposed to community or social based professions referenced above, our (constructed) architectural history has led us to believe that the challenges we face can be solved with a stroke of genius by a solitary designer. Our own lack of progress as a profession and our fixation on fashion and aesthetics have shown that the challenges we now face require a new organizational alignment for our research endeavors.

One possible resource which could act as a model for organization and cross-disciplinary involvement is open source software development. Open source software is predicated under the assumption that when a program is developed, the source code will be openly distributed and redistributed. Open exchange of ideas and knowledge and an open development process is required. For the open source organizational alignment to work, participants must commit to a common set of rules.

- All software is created with the foundation called source code. This code is made available for free distribution.
- When using the source code developers are then expected to make the new software available to the originator and future developers. This is a critical step to maintain the circular process of development.
- If programmers modify the source code then the new software will be renamed or given a version number. A small modification or a "patch" is often an exception.
- New software that embeds the source code cannot place further licensing restrictions that would prohibit future development.
- Distribution of the source code cannot be restricted to exclude specific professions, person or groups.
- Software innovations are not proprietary but mutually beneficial.

The open source software community identified early that not one individual could solve all of the problems facing the profession and that it was inefficient for programmers to replicate efforts. This understanding has streamlined the development process and has allowed the community of programmers to respond to a rapidly changing market. Unlike the proprietary development market, the open source organizational alignment depends on an organizational entity that serves to provide direction or a "road map" of goals along with a "community" of developers that continually improve the software. This organizational alignment is best described by James Dixon (2007) as the "beekeeper" analogy. The beekeeper (organizational entity) provides an environment that is attractive for bees (other software developers), an environment that will allow bees to do what they do best—make honey. The beekeeper then sells the honey that funds the further development of the bee farm. The beekeeper and the bees have a symbiotic relationship, one providing the environment and the other providing the work (development). Developers rely on the source code to get their own projects working and the organizational entity (Professional Open Source Software Company POSS) relies on the need for the source code by potential clients. As with any new organizational alignment a new structure for funding and intellectual property was required.

Many open source companies protect intellectual property with copyleft licensing. This is to say, that the originator of the source code reserves the right to dictate how transparent and accessible the source code is to others. Unlike copyright laws that restrict distribution and replication of materials, copyleft allows for distribution and replication as long as the originator of the source code is given credit (GNU 2007). It also requires that the newly created software be licensed under the same copyleft license. Regulation of copyleft software license is typically done with a General Public License (GPL). In the simplest terms it is not "all rights reserved" but "some rights reserved." Each source code developer can customize the GPL but to be considered open source the fundamental ideals of the community must be maintained (It is important to note that some open source community members believe that any act of claiming rights is counter to the community values).

In terms of funding, the source code is not developed for free. It can be assumed that the creator incurred expenses to arrive at a product that is in demand by other development partners. Traditionally proprietary software developers operate on a "go to market" funding model, one that creates in-house research, development, testing and release to the market, or the source code will be licensed from the creator for royalties or another monetary arrangement. The sales of the software are the final judge of the products success. This model presents the software as being an object or artifact, much in the way that a traditional architectural approach positions the building. Open source developers have developed alternative approaches not based on the object. One such approach is to package services to clients as a subscription rather than sell boxes of software. This works well because the software is always being developed and improved by the community as opposed to proprietary improvements delivered through version releases. Open source argues this is a better model because the customers decide when the software needs improvement and the community works to solve the issue. This fluid response to fast-moving problems serves as a lesson to the architecture profession.

Architectural research is not software development (or beekeeping) but there are many benefits to adopting synchronized research relationships. One such option is a direct relationship to "source code." Architecture's source code equivalent is a creatable knowledge base, a collection of research that will benefit the profession through open distribution. Open knowledge will prevent replication of tasks and allow for the continuation of unresolved projects by a diverse group of participants. Within this system lies a potential framework for a new model for architectural research. This new model will respond to the challenges faced by our profession while also recognizing the intuitive process of a new generation of researchers.

Extracting lessons from the open source community in relation to the architectural profession, there are several possible points to be noted. Principally, while open source allows for a fluid and diverse team, lowering barriers for both access and participation, it is still a *curated* process that is project focused. Oversight is based on production and knowledge, not titles and

positions, however. For an architectural community, this idea could be extended past the small scale, individual projects to a larger community organizational structure. This structure would connect diverse entities in a curated environment based on tracking projects, knowledge-bases, community issues, technological improvement. The curating entity is the system, not the objects in the system, and provides interface and access to freely distributed knowledge and research.
There are other points that can be extracted from the open source process to apply directly to the architectural community. All participants are encouraged to provide a free exchange of ideas and knowledge. The community must commit to recruiting cross disciplinary members and to identify projects that will incorporate the allied disciplines to remain engaged. Participants commit to opening the research up to the community through an accessible and curated database. Results should be published early and often, they can then be continually updated as new information and research is developed. Think of it as version 0.8, release 1.0 and update 1.23. Research participants commit to returning findings to the knowledge base. Peer review will occur in-process to allow for a more fluid research. Finally, *check your architectural ego at the door*. The community will need to commit to the idea that furthering the profession and the research findings is paramount, not the pristine artifact which is the flavor of the month for the glossy magazines.

2.5 synchRG/Institute for Advanced Processes

Based on the idea of systems rather than objects, alternative models of research, organization and ownership, the SYNCH Research Group (synchRG) was formed. The group is a non-rigid organization of faculty, students, professionals, and industry.

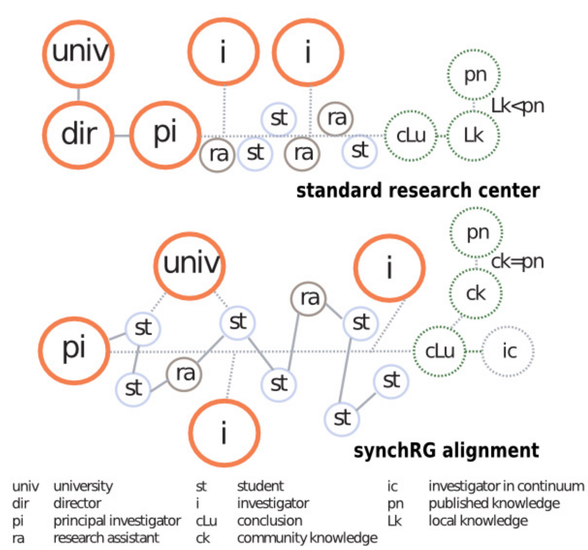

Figure 1: A comparison of referenced research centers' alignment (above) with synchRG's alignment

The group works with the idea of alignment rather than possession. An organizing thread is an approach which dismantles each proposed project into elements and then examines various individual solutions based on the question "what does it do?" in conjunction of its reassembly back into the larger context.

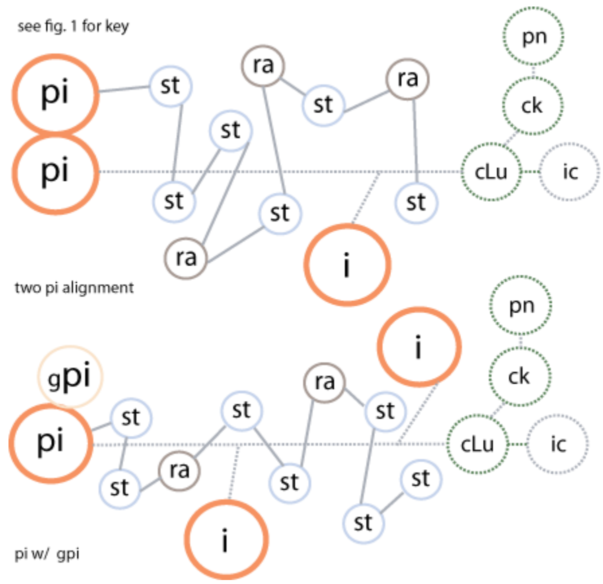

Figure 2: Two of many possible organizational alignments

SynchRG has attempted to set up an organizational alignment with open source community principles. Although operating on a local institutional level, the alignment provides for an effective open research environment. Project alignment defines participants with the following titles:

- Principle investigator: Normally conceives or brings project to the research group and is responsible for the project's completion and findings.
- Investigator: Participates in the project in a supporting role and assists the principle investigator when needed.
- Guest Principle Investigator (GPI): Has all of the duties of a principle investigator but normally is involved only in one specific project.
- Investigator in continuum (IC): Proceeds where a predecessor left off. Predicated on the idea that past investigations will be open and transparent to future research participants.

Various issues occur with a fluid entity like synchRG, specifically around the discussion of resources and funding. While pursuing funding sources for several concurrent projects, it became apparent that the virtual nature of the research group would work against grant applications. While being able to be fluid and assemble teams based on particular strengths, there was a lack of a defined organization or available resources. We needed alignment with another body that would provide some of the density expected in traditional grants. To solve some of these issues, synchRG proposed a partnership with Lawrence Technological University. Between the research group and the university a third body would be developed, an Institute. This Institute, vaguely named the Institute for Advanced Processes would be owned by neither the members of the research group nor the university. Instead, it would be an independent non-profit which was *aligned* with both synchRG and Lawrence Tech. Members of synchRG sit on the Board of Trustees along with Officers of the University to oversee this an independent non-profit, but the resources of the Institute are available to anybody who wishes to make a proposal for their use. There is both financial and legal separation from the research group and the university.

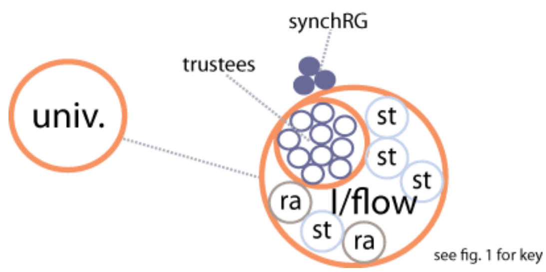

Figure 3: I/flow's organizational alignment

Alternative funding and financial models are being explored within the Institute to develop a core model of applied research. The fundamental question is how to integrate an applied research process into a professional capacity so that research needs an inherent immediate value to be performed or pursued.

SynchRG's unique organizational alignment allows for academic freedom, professional efficiency, organizational structure, and transparent findings with duration. The organizational alignment falls short in ability to reach beyond the university. SynchRG envisions that it will be only one of many groups (bees) that openly share knowledge in a larger community. It is this limitation that necessitates the need for a profession wide organizational alignment of research, one that facilities a transparent and open community.

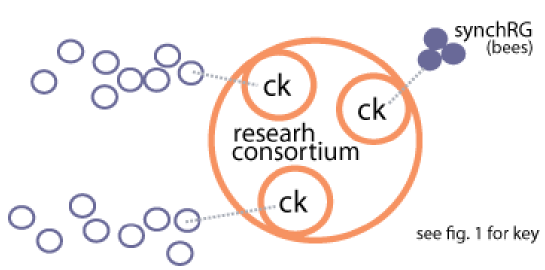

Figure 4: possible "open source" alignment for architecture.

CONCLUSION

Applied research is a popular discussion within architecture and design at the moment. In academics, however, this focus causes a paradigm shift in how work is done. Any group serious about applied research in architecture has only a few vectors of inquiry on which to focus. These are material studies, physical application research and studies, digital fabrication and computational processes, environment research (psychology/lighting/human comfort), and social research (urban/community). Many of these areas are resource heavy.

Within the late twentieth century debate of modernist morphological understanding (objects) of architecture and the postmodern notions of complexity (systems), there exists a contemporary paradox regarding the relative emphasis of form and function in defining, directing, and practicing architecture. The paradox is thus manifest in the polarization of contemporary theory, practice, and pedagogy of architecture: some commit to social change, but ignore questions of form, material, and spatial order; another is devoted to technology, computation, and morphology, but disregards social and cultural concerns (Hatuka 2007). Present in the design disciplines, the condition of separation and isolation is standard mode of operation in all of general sciences and research fields, Bruno Latour refers to this division between "epistemology, the social sciences and the science of texts" (Latour 1993: 5) as a modern condition, isolating politics, natural phenomena, social effects and studies of power from each other on an intellectual level. Within the design disciplines, Bernard Tschumi (1998) has asserted, this division has created a contradiction, as architects and designers have been unable to reconcile their need to address everyday life with a wish to engage abstract concepts.

To address Tschumi's concern for the gap between the spatial (abstract imagined space) and the social (lived experience) and Latour's desire to reconnect the various elements of our intellectual life, synchRG's proposed model provides a different framework for better understanding and functioning of architectural research. The critical question is why is it a problem that we don't have a good understanding of architectural research? Who cares and why should it matter?

First of all, this research model demonstrates a specific, but critical role of applied research in face of contemporary complex global social, economic, and environmental challenges that architecture as a discipline faces. Stephen Kieran (2007) outlines the development of an ethical architecture that unifies the art of design with the science of performance. He also underlines a research ethic as a necessary prerequisite to develop such an architecture, as does B.D.Wortham (2007) for reinvigorating the idea of research that has become naturalized and ubiquitous cutting across most disciplines. In his "The Way We Think about the Way We Think: Architecture is a Paradigm for Reconsidering Research," Wortham argues that the discipline should seek to become a leader in changing and broadening how research is understood and performed in academe. Twentieth century discussions and debates around architectural research are well documented in 1979 and 1990 issues of Journal of Architectural Education (JAE), works of Joroff and Morse (1984), and that of Julia Robinson (1990). The synchRG model, within the context of the twenty-first century, highlights the role of open source model and its experience and appropriation within architecture. This model reinforces the condition where research is "glue"—an interstitial adhesive place that binds theory and practice, that connects the profession and the academia. In the current context, discussed earlier, it is unlikely that much of the architectural research will be conducted solely in the proprietary realm of the profession or within academic confinement. Most of that will happen in "intermediate institutions" like synchRG and will then be enacted in practice and studied in the academic circles. The synchRG model highlights this function of research as a stage of assemblage and enactment. The research model illustrates the powerful role of open construction, use, and reconstruction of knowledge systems irrespective of ownership and typology. This understanding of research center as an interstitial place can be catalytic in promoting shared dialogic space, where things can function in relation to others, in simple sight or knowledge.

Second, the discussion of research in the present capitalist society needs to be in reference to the production and consumption of knowledge. The market seems to be doing a satisfactory job in providing objects and products. But with the continual shift into interconnected complex systems, it often ignores the everyday problems and disregards the importance of functions and processes within these complex systems. There is a two-fold gap between the research, production, and consumption of knowledge. One, research in architecture is engaged predominantly in the proprietary realm or the academic confines. Another, the knowledge produced for consumption and use by people is not designed or poorly designed. Within the constraints of economic interest and political control, human experience, use, and relations are sometimes neglected. Emphasizing systems, performance, and relationships within research, while still involving aesthetics, materials, structure and occupation, as demonstrated by the synchRG research model, is critical to restoring the roles of design and designers in architectural research.

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The role of architectural research centers in addressing climate change

John Carmody

University of Minnesota, Minneapolis, Minnesota

ABSTRACT: It is clear that an urgent, major transformation needs to happen in the design of the built environment to respond to impending climate change and other environmental degradation. This paper will explain the potential role of architectural research centers in this transformation and provide examples from the Center for Sustainable Building Research (CSBR) at the University of Minnesota. A research center can become a regional hub to coordinate and disseminate critical information. CSBR is leading the establishment of *Architecture 2030* standards in Minnesota, assisting local governments in writing green building policy, providing design assistance to local government, developing tools to assist design decision making, providing technical assistance to the affordable housing community in Minnesota, and establishing a regional case study database that includes actual performance information. CSBR is creating a publicly accessible, credible knowledge base on new approaches, technologies and actual performance outcomes. Research centers such as CSBR can be a critical component of the necessary feedback loop often lacking in the building industry. A research center can also fill major gaps in providing in depth professional education as well as be a catalyst for demonstration projects and public education.

Conference theme: Green and sustainable architecture
Keywords: sustainable architecture, architectural research center

INTRODUCTION

Sustainable design today draws from many roots that date back to the energy and environmental concerns of the 1970s but is based on a more holistic and comprehensive vision. There is now recognition that sustainability is not just about the environment and natural resources, it represents a balance between environment, economics and equity. During the 1990s, the impact of the built environment on people and the natural environment became more evident and widely discussed in the design professions. The movement toward more ecological design principles is based on the growing understanding that conventional development practices are not sustainable. According to the Millennium Ecosystem Assessment, “Over the last 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth” (MEA, 2005). The worldwide impacts of climate change in particular have recently been documented in reports by the United Nations Intergovernmental Panel on Climate Change (IPCC). According to the IPCC Synthesis report, “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level” (IPCC, 2007).

According to the *Architecture 2030* initiative, the built environment is responsible for 48% of carbon (CO_2) emissions in the United States. The transportation sector is responsible for another 27% of carbon emissions. Recently, the American Institute of Architects endorsed the goals of *Architecture 2030*, which sets a target of zero carbon emissions from buildings by 2030 and requires emissions to be reduced by 60% by 2010 (*Architecture 2030*, 2007). It is well documented that the building sector uses large shares of the world’s wood, minerals, water, and energy and generates a large portion of the waste going to landfills (Worldwatch, 1995).

Planning and design of the built environment not only results in environmental impacts from buildings themselves, but also impacts from the transportation patterns that are established by development. For example, according to a recent Caltrans study, transit-oriented development can reduce rates of greenhouse gas emissions by 2.5 to 3.7 tons per year for each household (CALTRANS, 2002).

It is clear that an urgent, major transformation needs to happen in the design of the built environment to respond to impending climate change and other environmental degradation. While there are many programs, emerging technologies, and motivated individuals in the design and construction community, there is a danger that systemic change will not occur quickly enough. There is a lack of feedback on what actually works in the field that could inform designers as well as establish the future research agenda. Perhaps most importantly, there are gaps in knowledge and missed opportunities in the fragmented building delivery process. Educational institutions are not able to respond quickly to driving forces for change in society and the profession, while research is not always effectively communicated to practice or education.

While rating systems like LEED have been successful vehicles in raising awareness in the marketplace, they are still not in widespread use. Unless sustainable design is required by a client, there is no urgency to change practice in many firms. Policy changes and code requirements that would drive change occur too slowly. There are many good intentions but the overall picture is one of disconnected parts that do not add up to a whole.

The biggest challenge for research, practice and education is that the magnitude of the problems and need for rapid response is unprecedented. Some scientists indicate that significant reductions in greenhouse gas emissions must occur in the next ten years to avoid catastrophic consequences. Knowledge is expanding quickly but it is not synthesized into forms that enable effective decision making. Current practices may not lead to the desired outcomes and it will be too late. It is well known that feedback loops in the design and construction industry are not well developed. Everyone needs better information now— designers, educators, clients, contractors, manufacturers, state and local governments.

1. CURRENT STATUS OF SUSTAINABLE GUIDELINES AND RATING SYSTEMS

Environmental assessment systems, ratings systems, and guidelines have played an important role in raising public awareness and transforming the market for more sustainable building practices in the United States. These systems define criteria for sustainable building and may be used as the basis for establishing requirements or incentives. Voluntary, market-based guidelines may be viewed as a precursor to more formal changes to standards and codes.

The introduction of new assessment and rating systems and the continuous updating of existing ones represent an evolution driven by several factors. These include the expansion of guidelines into new scales of development, additional phases of the process, and customized versions for specific building types. The evolution of guidelines is also driven by the desire for regional variation as well as accommodating new knowledge developed about best methods and practices. A key question in the development and use of these systems is whether they lead to the desired environmental outcomes when applied to real projects. Meeting certain requirements during design does not always translate into predicted performance. Most guidelines consist of a mixture of recommended processes, best practices, and some performance outcomes. Processes and practices are not always measurable and cannot be translated into quantifiable environmental outcomes.

One of the most common ways of assessing sustainable design is the use of point-based ratings systems. Relatively easy to understand and use, the points serve as surrogate indicators of real performance. This does not lead to a rigorous assessment or results that can be compared across projects (Cole, 2006). The drawback is that point-based systems can simply become like a set of specified requirements without fundamentally influencing the approach to achieving a high performance design. In addition, point-based systems reflect a weighting of the various environmental practices and impacts introducing subjectivity into the process. There is often no tracking of actual performance after a project is built. For sustainable design to evolve toward better practices and outcomes, this feedback loop must be more strongly established.

1.1. Commercial Building Guidelines

In commercial buildings, the most widely known and used national rating system is LEED from the US Green Building Council (USGBC). LEED is a point-based system with credits in the following categories:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Interior Environmental Quality
- Innovation and Design Process

Depending on the number of points, projects are Certified, Silver, Gold or Platinum. The LEED family of rating systems includes New Construction, Commercial Interiors, Core and Shell, Existing Buildings and some special versions for specific building types. The USGBC is participating in the development of *ASHRAE 189P, Standard for High Performance Buildings*.

Another national rating system, Green Globes, originated in Canada based on the BREEAM™ system from England and was introduced to the U.S. market by the Green Building Initiative. It is a point-based system with four levels of achievement from one to four globes. An existing building rating system called BOMA GoGreen in Canada is being introduced in the United States as the Green Globes Continuous Improvement Existing Building guidelines. The Green Globes rating system is going through the ANSI standards process.

In addition to the national rating systems, a number of innovative sustainable guidelines reflecting regional and local issues have been developed (e.g. New York City High Performance Building Guidelines, Minnesota Sustainable Building Guidelines, and the Florida Commercial Building Guidelines).

1.2. Residential Guidelines

A separate set of voluntary environmental assessment and rating systems have been developed for the housing sector. At a national level, LEED for Homes has been developed by the USGBC as one of its family of rating systems. The National Association of Home Builders (NAHB) has developed the NAHB Green Building Guidelines. Both LEED for Homes and the NAHB Guidelines are point-based systems with multiple levels of achievement. The NAHB Guidelines are currently going through the ANSI standards process. There are numerous well-established local and regional green building programs such as the Austin Green Building Program, BuiltGreen Colorado, BuiltGreen Washington, and EarthCraft Homes in Atlanta.

In the affordable housing sector, the Green Communities Initiative was developed by Enterprise. Launched in the fall of 2004, the initiative is a five-year, $550 million commitment to build more than 8,500 environmentally friendly affordable homes across the United States.

At the neighborhood scale, green development guidelines are emerging nationally (e.g. LEED ND) as well as regionally (e.g. Florida Green Development Guidelines).

1.3. Summary of Current Trends

- A diverse set guidelines and rating systems are continually evolving in response to the scale of development, building type and regional issues
- Guidelines are being adopted by states and cities as basis for codes, standards and incentives
- There is a movement away from simple point-based checklists toward more requirements and a focus on performance outcomes such as carbon emissions and energy consumption
- Life cycle assessment of materials is beginning to be included in guidelines and ratings
- There is increasing interest in life cycle cost analysis
- There is increased focus on actual performance during operation and the need for a feedback loop and continuous improvement

2. ROLE OF RESEARCH CENTERS

There is a role for architectural research centers in accelerating the necessary transformation within the profession and building industry. In an academic setting, research centers have a number of potential benefits. They are responsive to real world problems and emerging opportunities, and have the ability to develop relationships and connect to funding sources. They also have the ability to assemble and manage interdisciplinary research teams within the University, and they can partner with the professional community and the building industry, which helps to frame research questions.

A center does not need to duplicate any existing organizations or components already playing an effective role in the building sector. Its mission can be strengthening connections between these groups, filling gaps, and creating synergies so the network functions more effectively.

One model for this type of organization is the Center for Sustainable Building Research (CSBR) at the University of Minnesota. The Center is in the process of creating an integrated sustainable building knowledge base for the Minnesota region. A key reason for this is the need to simplify information and use common metrics and methods across a wide range of projects and programs. The components of the CSBR Knowledge Base are:

1. Performance Indicators
2. Performance-Based Guidelines
3. Performance-Based Policy Framework
4. Tools and Information
5. Tracking Actual Performance
6. Regional Case Study Database
7. Design Assistance
8. Education and Training

CSBR is leading the establishment of *Architecture 2030* standards in Minnesota, assisting local governments in writing green building policy, providing design assistance to local government, developing tools to assist design decision making, providing technical assistance to the affordable housing community in Minnesota, and establishing a regional case study database that includes actual performance information.

2.1. Performance Indicators

To address the problem of achieving clear outcomes, twelve measurable performance metrics have been identified. Wherever possible, benchmarks are set to provide a meaningful comparison of performance. As shown in Figure 1, these include:

BUILDING METRICS

- Energy
- Water
- Waste water
- Solid waste
- Materials
- Indoor environmental quality

SITE METRICS

- Transportation
- Physical Activity
- Education
- Stormwater
- Soil
- Heat Island
- Night sky
- Food

Some of these metrics are easily predicted during design (e.g. energy, water) and then can be measured during occupancy. Others are less predictable in design and can only measured during occupancy (e.g. IEQ, transportation use). In some cases, measurement methods are evolving (e.g. life cycle impacts of materials).

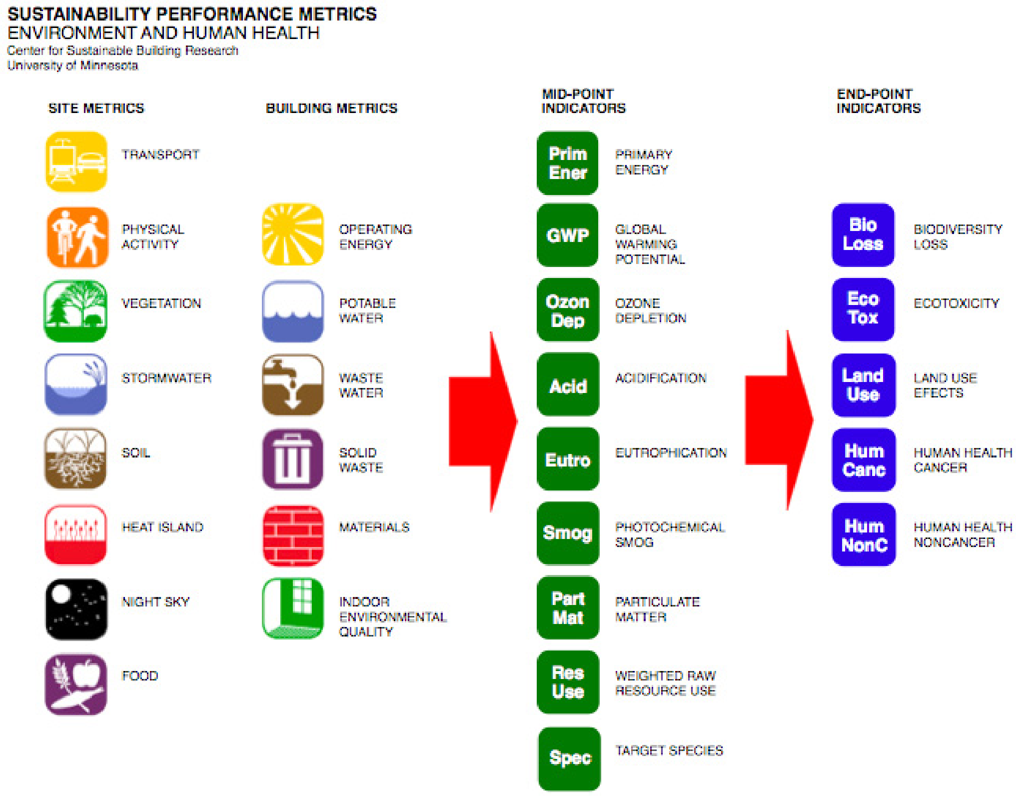

Figure 1: CSBR Sustainability Performance Metrics: Environment and Human Health Source: Center for Sustainable Building Research, University of Minnesota

The impacts of these metrics combined result in eight mid-point indicators shown in Figure 1 (ISO 2006). One of the most prominent of these is Global Warming Potential measured and CO2 equivalent. Ultimately, the mid-point indicators lead to end-point indicators concerning human health and environment.

2.2. Performance-Based Guidelines

CSBR is involved in two examples of performance-based guidelines and standards—the Minnesota Sustainable Building Guidelines (MSBG) and the Sustainable Buildings 2030 Project (SB 2030).

The Minnesota Sustainable Building Guidelines (MSBG) are an example of a regional system. The guidelines were mandated by state legislation for all projects with state funding. Consequently, they apply mostly to public buildings for state and local agencies. The need for regional systems is driven by the desire to integrate state programs and standards into the guidelines, the need to establish which guidelines are mandatory, and the need to set performance levels and add guidelines not covered by national guideline models. The Minnesota Sustainable Building Guidelines are not a point-based system and simply consist of the required or recommended guidelines in the following areas:

- Performance Management
- Site and Water
- Energy and Atmosphere
- Indoor Environmental Quality
- Materials and Waste

The benefit of having a mostly required set of guidelines is that all agencies and design teams know they must comply and application of a specific set of guidelines is ensured. Since there are no higher levels of achievement designated, this type of system does not result in the same level of recognition associated with LEED or Green Globes. The Minnesota Sustainable Building Guidelines are designed to emphasize actual performance outcomes as the basis for comparing buildings. As the user completes documentation, a scorecard or environmental balance sheet of key outcomes such as energy use and carbon emissions are determined. This lends itself to integration with performance-based initiatives such as *Architecture 2030*. The Minnesota guidelines also incorporate a regional version of the Athena EcoCalculator to determine actual environmental impacts of building assembly and material choices.

CSBR now provides design assistance to project teams, tracks outcomes and generally serves as the feedback loop on the project.

The Sustainable Buildings 2030 program concept emerged from the recommendations of the Minnesota Climate Change Advisory Group and was passed by the Minnesota legislature in spring 2008. According to the legislation, the purpose is "to establish cost-effective energy-efficiency performance standards for new and substantially reconstructed commercial, industrial and institutional buildings that can significantly reduce carbon dioxide emissions by lowering energy use." The performance standards are being designed to achieve the following reductions measured against energy consumption by an average building in each applicable building type in 2003: (1) 60 percent in 2010; (2) 70 percent in 2015; (3) 80 percent in 2020; and (4) 90 percent in 2025.

The legislation requires that the Center for Sustainable Building Research shall, in consultation with utilities, builders, developers, building operators, and experts in building design and technology, develop a Sustainable Building 2030 implementation plan that must address, at a minimum, the following issues:

1. training architects to incorporate the performance standards in building design;
2. incorporating the performance standards in utility conservation improvement programs; and
3. developing procedures for ongoing monitoring of energy use in buildings that have adopted the performance standards.

These standards will become the energy use requirements for state-bonded projects through the Minnesota Sustainable Building Guidelines. Utilities will be required to develop and implement conservation improvement programs that are expressly designed to achieve energy efficiency goals consistent with the Sustainable Building 2030 performance standards.

Program elements include:

- Set 2030 benchmarks for Minnesota buildings
- Assist in development of utility incentive programs
- Develop a case study database
- Track building performance in a database
- Develop knowledge base
- Assess needs and deliver training program for design professionals
- Assess needs and deliver training program for building operators

2.3. Performance-Based Policy Framework

To address the problem of multiple guidelines required by various funders and the concern over achieving certain outcomes, CSBR is assisting local governments in writing performance-based green building policies. Such a policy has been developed for the City of St. Paul for buildings that receive city resources.

The St. Paul policy has two requirements. First, the participant must choose one of the following rating systems and levels with which to comply:

COMMERCIAL PROJECTS:

- LEED New Construction (NC), Silver
- Green Globes, 2 globes
- B3 Compliant
- Saint Paul Port Authority Green Design Review

RESIDENTIAL PROJECTS

- LEED for Homes (H) or LEED NC (for large multifamily projects), Silver
- Minnesota Green Star, Silver
- Green Communities with Minnesota Overlay

The second requirement is that all projects must meet mandatory requirements within the chosen rating system. These requirements, known as the St. Paul Overlay, are:

- Predicted energy use must be at least 30% below current Minnesota Energy Code
- Predicted use of potable water in the building must be at least 30% below EPA Policy Act of 1990.
- Predicted water use for landscaping must be at least 50% less than a traditionally irrigated site using typical water consumption for underground irrigation systems standards
- Actual solid waste of construction materials must be at least 75% recycled or otherwise diverted from landfills.
- Indoor Environmental Quality must include the following strategies: increased ventilation, construction IAQ management plan, low-emitting materials, and thermal comfort
- Predicted on site stormwater management of volume and quality must be achieved for 1" rain events or less.
- Predicted greenhouse gas emissions must equal or be less than MN 2030 benchmark calculated on energy use
- Actual annual energy consumption data for the project must be entered into the State's B3 Benchmarking Database by the building owner or utility.

Each project's compliance with the Green Building Policy must be verified, in accordance with the verification method specified by the selected rating system.

2.4. Tools and Information

CSBR is involved in the development of tools and information to aid in decision making and compliance with performance requirements during design. Four examples are discussed below.

Determining greenhouse gas emissions is required more frequently on building projects. There are many calculators available that produce different results based on different assumptions. CSBR has developed a transparent Greenhouse Gas (GHG) Calculator for Minnesota building projects to provide a comprehensive and consistent approach. The calculator includes greenhouse gas impacts from several sources such as operating energy, water treatment and pumping, waste water treatment, solid waste, embodied effects of materials, transportation, vegetation, and soil disruption (see Figure 1).

Life cycle assessment represents an important advance from prescriptive practices to performance-based outcomes. CSBR has worked with the Athena Institute to develop a life cycle assessment tool called the Athena EcoCalculator that determines environmental impacts of building assemblies and materials (Athena 2007). The Athena EcoCalculator is now being integrated into both the LEED and Green Globes rating systems. It is also part of the Minnesota Sustainable Building Guidelines and the CSBR Greenhouse Gas Calculator. Life cycle assessment analysis can also be used to determine the avoided environmental impacts resulting from reusing existing buildings.

Another example is the *Efficient Windows Collaborative* program sponsored by the US Department of Energy. With increasing concerns over rising energy prices and the effects of greenhouse gas emissions on climate change, high performance windows and facades will play a key role in the transformation to more energy-efficient, sustainably-designed buildings. For over twenty years, the U.S. Department of Energy has supported a vertically integrated program to develop and advance the adoption of high performance windows and facades in both residential and commercial buildings. This work has been centered at Lawrence Berkeley National Laboratory in collaboration with CSBR and the Alliance to Save Energy, as well as window industry partners. The unique aspect of the program is the connection between basic and applied research, development of an extensive suite of tools to assess performance and assist decision making, and market transformation strategies that reduce barriers to the adoption of high performance windows and façades.

A final example is the *Knowledge Base and Technical Assistance Program for Affordable Housing* funded by McKnight Foundation in which the Center for Sustainable Building Research plays multiple roles in transforming the affordable housing sector in Minnesota toward sustainable design. The broad goal of the project is to assist in the transformation of affordable housing to be more energy efficient, healthy, and durable with reduced environmental impacts. To accomplish this, a knowledge base and technical assistance program are being developed for affordable housing in the region. The primary focus of this work is to develop the necessary tools and methods to evaluate real performance outcomes addressing the cost, energy efficiency, health, durability, and environmental impacts of the housing. These methods are being applied to selected case studies. The results will be included in a comprehensive knowledge base that serves key decision makers involved in the delivery of both single- and multi-family affordable housing.

2.5. Tracking Actual Performance

Tracking actual performance during building operation is critical to provide a feedback loop resulting in continuous improvement. The MSBG project is part of a larger project that includes tracking energy use in several thousand public buildings in Minnesota. Developed by The Weidt Group, this project is called the B3 Benchmarking Tool. This database forms the bases for future tracking of buildings that are part of the SB 2030 program. More in depth performance tracking occurs through post occupancy evaluations of exemplary sustainable building projects in the region.

2.6. Regional Case Study Database

One problem that occurs with the broad range of research activities and programs in the green building world is that information is scattered and often not collected in a consistent format. It becomes difficult to find relevant examples in a given region that clearly show performance and cost. For this reason, CSBR is developing a regional case study database across multiple research projects. This also addresses the problem that examples from other regions are not considered applicable in a local situation.

2.7. Design Assistance

CSBR continues to provide design assistance as part of many research programs such as the Minnesota Sustainable Building Guidelines. Recently, the Center has worked with graduate students to provide conceptual design services to communities through the Regional Sustainable Development Partnership. Design assistance is also provided to local governments and non-profit organizations.

2.8. Education and Training

A research center can also fill major gaps in providing in depth professional education as well as be a catalyst for demonstration projects and public education. CSBR provides faculty for the sustainable design track in the MS degree in the School of Architecture as well numerous continuing education classes. Projects such as Sustainable Buildings 2030 will lead to specific training programs for design professionals and building operators.

CONCLUSION

Architectural research centers at Universities have an important role to play in the major transformation of building design, construction and operation in response to climate change and other environmental degradation. Using examples from the Center for Sustainable Building Research at the University of Minnesota, there are several key concepts in developing and delivering effective knowledge to the profession.

1. Work at a regional scale. Research and case studies from other regions are often not viewed as applicable because of climatic and regulatory differences. Within a region, it is possible to develop the social networks and information flows needed to gather information, discover problems and find solutions.

2. Emphasize performance outcomes. Green building rating systems are useful in increasing awareness and providing an accessible process for delivering a building, but they are a surrogate for real performance. Moving to actual metrics and performance indicators is essential during design and later assessment of results.
3. Create feedback loops. It is critical that the actual performance of buildings is tracked and compared to relevant benchmarks. This information must then be communicated in an easily accessible way to building designers, owners, and operators so that continuous feedback and improvement can take place. Effective design of the knowledge base is important to meet this goal.
4. Seek simple tools and solutions. It is important not to overwhelm busy design professionals with detailed research studies and complex software programs. Research centers should design tools and package information so that decisions can be made quickly if necessary but more depth can be explored if desired. As much as possible tools should aid designers in making decisions based on performance outcomes.

ACKNOWLEDGEMENTS

All of the projects mentioned in the paper and their underlying concepts were developed as collaborative efforts with CSBR staff and others. CSBR staff include Richard Strong, Jonee Brigham, William Weber, Kerry Haglund, Virajita Singh and Dan Handeen. Outside collaborators on key projects such as the Minnesota Sustainable Building Guidelines and SB 2030 include The Weidt Group, LHB Inc., Center for Energy and the Environment, and Herzog Wheeler and Associates. I am particularly grateful to Wayne Trusty of the Athena Institute for his input on many of the projects and concepts described here. Finally, I would like to thank the many sponsors of projects mentioned in the paper. These include the Minnesota Departments of Administration and Commerce, the Minnesota Pollution Control Agency, the McKnight Foundation, the US Department of Energy, and the Athena Institute.

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Between Academia & the Profession

A collaborative research project on evidence-based and eco-effective design

Mardelle M. Shepley[1], Mara Baum[2], and Bill Rostenberg[2]

[1]Texas A&M University, College Station, Texas
[2]Anshen+Allen, San Francisco, California

ABSTRACT: The primary purpose of this study was to provide information regarding the design of healthcare facilities in the context of two important considerations, evidence-based design (EBD) and eco-effective design (EED). The secondary purpose was to test the effectiveness of research involving collaboration between practitioners and academic researchers, and the collaboration between EBD and EED professionals. The research team included designers and staff from a firm specializing in EBD and EED and a university researcher. Methods employed included focus groups, snowball surveys, and questionnaires. Practitioner focus groups specializing in EBD and EED identified critical questions that were translated into a 22-question, Likert and narrative-response survey. EBD and EED experts, via a snowball survey, selected the best practice institutions that would be the most appropriate recipients of a questionnaire that would address the role of EBD and EED. Administrators, representing these institutions, participated in the survey. This study is significant in that it demonstrates that in spite of prior perceptions that EBD and EED are in conflict with one another, administrators perceived the two as being fundamentally compatible. This conclusion is useful to designers and facility administrators by freeing them to incorporate both of these critical approaches in the design of new facilities. Observations are made regarding the collaborative process between practitioners and researchers.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: evidence-based design, sustainable design, eco-effective design, healthcare, interdisciplinary research

INTRODUCTION

The official birth of design research can be traced to the publication of work by individuals such as E.T. Hall in the 1950s, and the founding of the Environmental Design Research Association in 1968. Since then, topics for architectural research have typically been generated from within academe. More recently, however, healthcare designers, who are now aware of the meaning and implications of incorporating the results of studies in design, are sharing their informational needs with researchers and engaging in cooperative investigatory efforts. The potential impact and effectiveness of this interaction is one of the "lessons learned" from this study.

In keeping with this collaborative approach, the authors of this paper represent an alliance between a large design firm and a university researcher. While 10 years ago, few firms participated in research, the integration of research and practice is becoming more common. Several firms have hired research directors and staff, and a group has been established (Researchers in Professional Practice (RIPP)) to share the experiences of firm-based researchers and discuss the nature of research projects that are being conducted in design offices.

The topic of the research project described here stemmed from an issue that confronted the practitioners that initiated this study in their healthcare design practice – the perceived conflict between two important considerations, evidence-based design and eco-effective design. While evidence-based design has been a key factor in the design of healthcare facilities for the last 20 years, eco-effective design and related sustainability issues have only recently become a driving force in healthcare design.

For many years, it was believed that the constraints of hospital design would prohibit eco-effective and sustainable design. This has now been clearly disproven; two recent healthcare facilities have been accorded LEED Platinum status (Dell Children's Medical Center in Austin, Texas and the Center for Health and Healing at Oregon Health and Science University in Portland, Oregon), and many facility owners are committed to sustainable facility design and operation. Additionally, LEED for Healthcare credits will be incorporated into the upcoming release of LEED in 2009.

Designers and facility administrators and managers have disparate opinions regarding the relationship of these two approaches. Some argue that the two are mutually supportive or closely aligned, while others suggest that they are incompatible or unrelated. The primary purpose of this study was to provide data that would help clarify the relationship between these two approaches as perceived by healthcare facility administrators.

1. LITERATURE REVIEW

1.1. Definitions

Evidence-based design. Although the term was not in common use until the late 1990s, the first conference that raised the issue of the importance of design research in healthcare was held in 1988 (National Symposium on Healthcare Interior Design). Evidence-based design encompasses the design and operation of buildings to support positive health outcomes in the built environment through an expanding collection of solutions informed by research and practical knowledge (Hamilton 2003). The range of topics associated with evidence-based design is vast and thought by some to include research associated with sustainability and health. More mainstream topics include research associated with increased patient and staff safety, family satisfaction, staff efficiency, and access to positive distraction.

Eco-effective design. William McDonough and Michael Braungart (2002) describe eco-effective design as a design approach that strives to create ecological, social and economic value instead of generating waste or other negative by-products. Eco-effective design is a form of sustainable design in which the emphasis is on creating environments that accomplish more than ecological efficiency; proponents of EED focus on building projects, which have a positive impact on the natural environment.

Of the two approaches, EBD has a longer history as an approach to healthcare design and has been the primary innovative force in this specialization since the 1980s. However, both approaches continue to evolve; hence, their definitions are shifting, and potentially melding, over time.

1.2. Relationship between EED and EBD

Overall, authors who publish on the relationship between EED and EBD are divided in their perspectives; many claim that the two are connected and support one another (e.g., Guenther, et al. 2006); while others suggest that they are in conflict (e.g. Harvie 2006). While a number of studies have been recently completed or are currently underway that assess either sustainability in the built environment or investigate the relationship between building design and health outcomes, the relationship between the two approaches is rarely (if ever) incorporated (Shepley, Baum, Ginsberg & Rostenberg, in press). Often journals will pair articles on these topics in the same issue (e,g, Eagle 2005; Zimmerman 2008). This approach indicates that the editors realize that both subjects are important to healthcare design, however, the direct and indirect relationships between the two are not explored. Few studies have addressed both evidence-based design and eco-effective design in relation to each other.

2. METHODOLOGY

2.1. Collaboration between designers & researchers

The principal investigators in this study came from practice and academe, although all participants currently have or previously have had extensive experience in the others domain. As such, the researchers perceived their perspectives as completely compatible and took advantage of one another's strengths by building on their combined skill sets.

The research team members concur with Radu, in that there is "no axiological difference between architectural design and scientific research" (Radu 2006:350). Radu notes that the processes are similar, both relying on the incorporation of knowledge, heuristic process, and consensus. In both cases, outcomes cannot be guaranteed,

> Scientific research and architectural design are activities possessing their own risks. They create results covering an entire range from bad to outstanding. They have similar limits relating to their communication and the vulgarization of their generative process. The discipline of architecture reveals 'a human capacity (architectural design) performing at its most routine and as well as at its highest level of complexity. It is closer to human sciences than to natural sciences (Radu 2006:348).

The practitioners and researcher interacted both in tandem and sequentially. The activities described in Fig. 1 demonstrate the frequent "handing off of the baton" during the research sequence of idea generation, data collection/analysis, and dissemination. Occasionally, simultaneous collaboration was essential when skill sets overlapped (e.g. generating a list of subject sites, developing the survey, and disseminating the results). Firm representatives and the researcher collaborated in the idea generation phase, while data collection and analysis was conducted by the academic researcher as part of an effort to provide consistency in data retrieval protocols and to maintain objectivity in reviewing the data. The practitioners provided oversight and the benefit of their experience to the development of the research project. Likewise, the university researcher provided input on the contributions of the practitioners. The investigators shared in process of disseminating the results, with the objective of reaching as broad an audience as possible.

2.2. Collaboration between EED and EBD practitioners and researchers

The principal investigators also represented different specializations – eco-effective design and evidence-based design. The opportunity for interaction between these members of the research team was felt to be one of the more important outcomes of the study. While working together to identify the project objectives they became more aware of ways in which they could support one another's design intentions. One investigator, who specialized in EBD, was motivated to pursue the LEED certification process during the course of the study.

Table 1: Collaborator Roles.

Idea Generation	Data Collection / Analysis	Dissemination
1. Firm generates concept based on needs identified in field. 2. Academic researcher (AR) develops proposed protocol for study. 3. Firm members generate list of concepts for survey and list of study sites.		
4. AR and firm generate list of experts to evaluate sites.	5. AR distributes list of potential study sites to experts and analyzes data.	
6. Firm and AR develop survey.	7. AR distributes survey and analyzes data.	8. AR and firm write article/present results.

2.3. Hypotheses
The primary hypothesis of this study was that evidence-based design and eco-effective design are compatible approaches when designing healthcare facilities. At the same time, the researchers conceded that there were some minor conflicts (e.g., infection resistant materials, which support the infection control objectives of EBD, are not easily recyclable and therefore are in conflict with the tenets of EED), and a few objectives that were neither synergistic nor contradictory. For example, storm water management would probably not have any direct effect on the health and behavioural outcomes of inpatients.

2.4. Instruments
The research for this project involved four tools each of which was meant to inform the subsequent research phase. These tools included: 1) practitioner focus groups, 2) snowball sampling for the identification of experts, 3) a best practice facility survey, and 4) the EBD/EED questionnaire. The final phase of the study was dissemination, a priority to meet the applied research objectives of the investigators. These steps, along with information regarding the participation of the practitioners and the academic in each phase, are described in Fig. 2.
The process for each of the four research steps, leading to dissemination (Section 2.9), is summarized in Sections 2.5, 2.6, 2.7 and 2.8. While it might have been possible to generate the healthcare facility administrators' questionnaire without the input of focus and expert groups, the insertion of these steps increased the clarity and objectivity of the survey tool. The details regarding this methodology are provided in Shepley, Baum, Ginsberg & Rostenberg (in press).

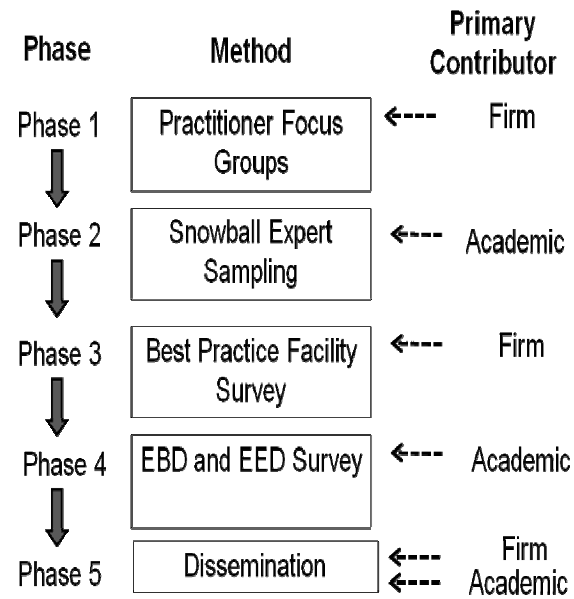

Figure 2: Phases.

2.5. Practitioner focus groups
Phase 1, practitioner focus groups, involved meetings with experts in the design firm. These participants helped to frame the concept behind the study (e.g. perceived synergy and conflict between evidence-based design and eco-effective design) and generated questions that to be included in the Phase 4, administrator survey. Some of the contributors specialized in EBD and others specialized in EED. Although several focus group members were familiar with and supportive of both approaches, none were expert in both. Once the questions were developed, the next challenge was to identify the healthcare facilities that would serve as the sites from which respondents would be solicited. The practitioner focus group and practitioner researchers generated a list of potential best practice EBD and EED healthcare facilities that would be presented to EBD and EED experts for ranking in the best practice facility survey.

2.6. Snowball expert sampling
To determine which facilities on the preliminary list were the most exceptional, the research team needed input from experts in EBD and EED. In Phase 2, therefore, the research team members collaborated to generate a group of experts who would ultimately review the nominees for best practice. Using a "snowball" method, recommendations for members of the panel of experts were gathered, first from the research team and then from the experts themselves. Once the recommendations for experts began to be repeated and new names we no longer provided, it was evident that the majority of expert candidates had been identified.

2.7. Best practice facility survey

The lists of best practice facilities were distributed by email to the experts identified in Phase 3, based on their specializations. A follow up by phone was necessary in a few cases, when no response was received, and in two cases the experts were approached in person. Each expert was asked to identify the top 10 facilities from the list that was provided, which best exemplified either EBD or EED principles, depending on the individual's specialization. They were also invited to add building projects to the list, if they felt an appropriate candidate for best practice was not included.

Twenty-six leading researchers and practitioners in each field were contacted to identify the healthcare facilities that most successfully embodied evidence-based or eco-effective design best practice principles.

2.8. EBD and EED survey

Phase 4, the EBD and EED survey, combined the information gathered in phases 1 (focus groups), 2 (snowball expert survey) and 3 (best practice survey). In Phase 1, practitioner focus groups specializing in each of these fields within the design firm identified critical questions that were translated into a 22-question, Likert and narrative-response survey. Phase 2 allowed the researchers to identify the experts who could identify the subject sites. Phase 3 finalized the sites from which administrator/respondents were selected.

In Phase 4, an administrator (typically a CEO or director of facilities) involved in the design of each the 18 best practice institutions (9 EED and 9 EBD) was asked to respond to the survey. The following were among the 22 questions:

1. To what extent did EBD/EED play a role in the design process?
2. To what extent is EBD/EED considered when making decisions regarding facilities, and clinical or administrative issues?
3. Are you collecting or have you collected data related to EBD/EED?
4. If you incorporated EBD/EED practices in your facility, are you collecting or have you collected…data related to EED/EBD?
5. Were there EBD/EED strategies that you considered but did not include in the project as a result of conflicts with the goals of EED/EBD best practices?
6. If you were to rebuild your facility, what changes might you make with regard to evidence-based goals?

2.9. Dissemination.

Dissemination was considered to be a critical phase of the research. Additionally, it was important to the research team that the study be useful to both academics and practitioners. As such it was decided that the findings should be published and presented in multiple forums, and communicated in formats that were compatible with each group.

3. RESULTS

3.1. Introduction

The data gathered at each phase of the project were used to inform the subsequent phase. The details of the results of this portion of this study are provided in Shepley, Baum, Ginsberg, and Rostenberg (in press).

3.2. Practitioner focus groups

Participants in the focus groups identified 10 primary issues for the survey ranging from the degree to which EBD or EED was incorporated in the completed facilities to perceived conflicts between the two approaches. Thirty-one EBD and fifty-two EED projects were selected for the pool of potential best practice facilities.

3.3. Snowball expert sampling

Fifty-two experts were contacted to select best practice projects. Twenty-six were EBD experts and 26 specialized in EED. The experts were from universities, professional practice, and organizations whose missions focused on evidence-based design or sustainability.

3.4. Best practice facility surveys

Of the 26 EBD and 26 EED experts who were approached, 16 EBD experts and 16 EED experts responded, representing 62% of the total subject population. Those projects that had a sufficient number of recommendations to be among the top-third were included in the study. As a result, 9 EBD and 9 EED projects were selected to participate in the survey process. With respect to EBD facilities, there was significant agreement regarding which facilities were most exemplary, and all those in the top-third had 6 or more votes. However, in the case of EED, some of the top-third projects only had 3 votes. Only one additional project was suggested as a result of allowing respondents to add to the pool, and the majority of experts selected fewer than 10 of the potential best practice facilities.

3.5. EBD and EED survey

The primary issues addressed by the survey fell into the categories of supportiveness and conflicts, frequency of data collection, decision-making and design process, and impacts of EBD and EED on the facilities.

<u>Supportiveness and conflicts</u>. Approximately 50% of the respondents saw the two approaches as supportive, while about 15% felt there was no relationship at all. Only 10% perceived the incorporation of both approaches as generating conflicts. (The remainder perceived the relationship to be not applicable to their facility.)

In general, EBD was perceived to have a positive relationship to sustainability, particularly with regard to access to nature, provision of positive distractions such as art, entertainment and music, choice, infection control, and proper acoustics and lighting. Interestingly, acoustics and lighting were also one of only two EBD factors that were considered to be problematic for EED. Staff support was the second EBD factor considered by some to conflict with EED.

However, Fig. 3 demonstrates that at an average of 50% of the respondents saw EBD strategies as having a positive impact on sustainability, regardless of the EBD characteristic. Beyond this, approximately 45% saw it as having no impact at all.

Consensus was not as strong regarding the impact of EED issues on health in EED facilities. Four items, sustainable landscape, water efficiency, reuse of rain water and mechanical systems developed to improve air quality were perceived to be potentially problematic regarding their impact on EBD by a small percentage of the respondents. These same items also received a high number of votes suggesting that EED had no impact on EEB health goals. On the other hand, nature and daylight received unanimous support in terms of their positive impact on health.

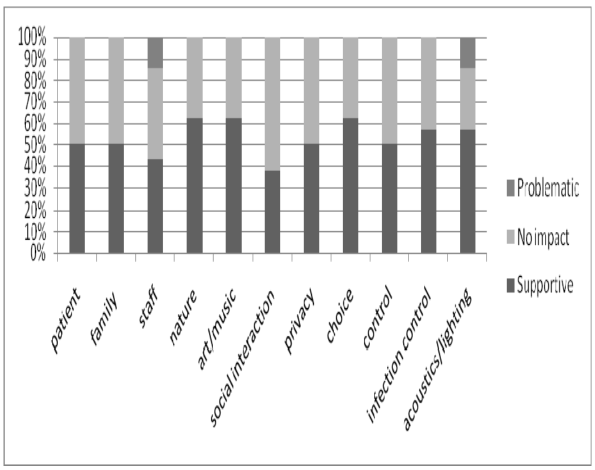

Figure 3: Impact of EBD Issues on EED in EBD Facilities. (Shepley, Baum, Ginsberg & Rostenberg, in press)

Frequency of data collection. Regarding frequency of data collection on evidence-based design and eco-effective design, the researchers found that more than 85% of EBD facilities were gathering data on EBD, although only about 12% were collecting data on EED. Data collection in the EED facilities on EED characteristics was less common. Slightly fewer than 50% of EED facilities were gathering data on EED. Surprisingly, the EED facilities were more interested in outcomes on EBD amenities, hence, more than 60% were gathering data on EBD.

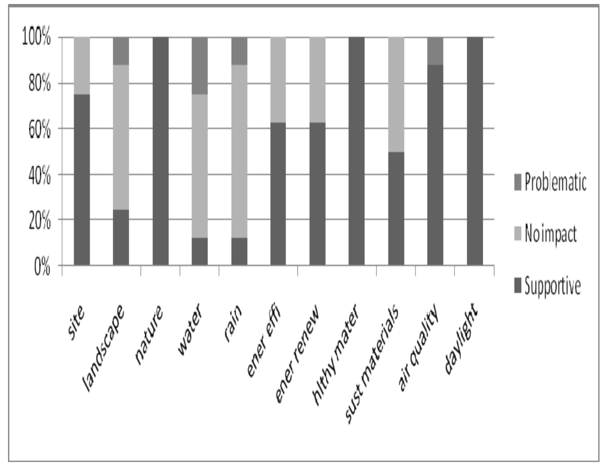

Figure 4: Impact of EED Issues on Health in EED Facilities. (Shepley, Baum, Ginsberg & Rostenberg, in press)

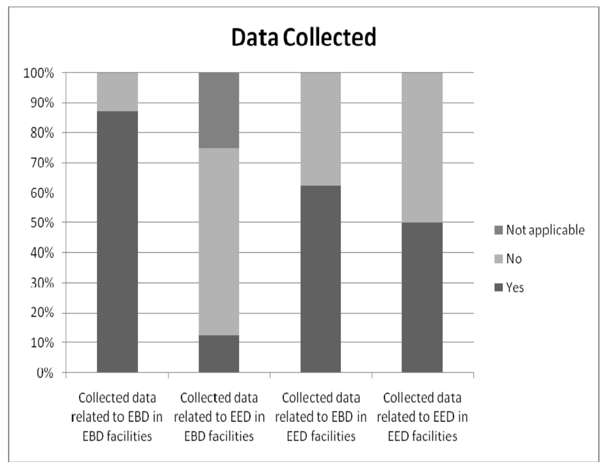

Figure 5: EED/EEB Frequency of Data Collection.

Decision making and design. The impact of these two approaches on decision-making and design was a focus of this research project. In EBD almost 80% of the facilities took EBD into consideration at a moderate or significant level, and a substantial number (approximately 65%) considered sustainability. In EED facilities, EBD is considered to play a moderate to significant role in decision-making 100% of the time, while EED plays a moderate to significant role in decision-making about 90% of the time.

3.6. Dissemination.

The investigators alternated the writing lead and first authorship on the development of two articles, one appearing in a peer-reviewed journal (Shepley, Baum, Ginsberg & Rostenberg, in press) and others appearing as publications through the two grant-awarding agencies, the Boston Society of Architects (Baum, Shepley, & Rostenberg, in review a) and the American Institute of Architects Upjohn Initiative. The work was submitted to three conferences one focused on academic research, one focused on health facility design, and the other focused on sustainable design.

4. DISCUSSION AND CONCLUSION

4.1. Relationship of EBD and EED

This study is significant in that it demonstrates that in spite of prior perceptions that EBD and EED are in conflict with one another, administrators perceived the two as being fundamentally compatible. This conclusion is useful to designers and facility administrators by freeing them to incorporate both of these critical approaches in the design of new facilities.

Supportiveness and conflicts. Overall, administrators suggested that while there are some conflicts between the two approaches, evidence-based design and eco-effective design are fundamentally compatible. This is not surprising in light of the fact that both these approaches address the health of people as impacted by the physical environment. The outcome of this study is reinforced by subsequent discussions with EED experts, who suggested that evidence-based design is a subset of sustainable design, and EBD experts, who describe sustainable design as a subset of evidence-based design. A more likely position is that their objectives are inextricably linked in a parallel effort to create socially responsible architecture.

Frequency of data collection. The study indicated that follow up research on EBD is being conducted at most best practice institutions. An interesting finding, however, was the lack of follow-up research being done on EED in EED healthcare environments. The authors of this article strongly recommend that building evaluations be conducted on all projects that have incorporated eco-effective design principles. With regard to the relationship between EED and EBD, research focusing on their impact on one another would help to clarify a collaborative agenda.

Decision-making and design. Surprisingly, evidence-based design played a bigger role in ongoing decision-making than eco-effective design in both types of best practice facilities. An increase in the impact of sustainable design will likely result from the institution of the new LEED guidelines for healthcare facilities.

4.2. Firm and researcher collaboration

The research collaboration represented by this project strived to overcome the multiple factors that have historically inhibited the integration of research into the practice of architecture, including: 1) difficulties in communication between academics and practitioners (few journals or conferences shared by both groups, lack of clarity about application of research results, etc.), 2) the time required to gather research relative to the immediate needs of a project in progress, 3) a lack of understanding of the nature of research and its potential contribution to building design, and 4) a lack of individuals who are trained both as researchers and designers to serve as translators. Partnership between researchers with design backgrounds and designers with research backgrounds gives this type of investigation roots in both realms. It also represents a rare partnership between individuals focused on evidence-based design to join those engaged in eco-effective design.

The collaborative process merged strengths of academia and professional practice. The impartiality and rigorous methodology of science wedded to the “in the trenches” knowledge of issues that drive built projects provided the ideal blending required for good healthcare design.

ACKNOWLEDGEMENTS

Funds for this project were provided by AIA Upjohn Initiative and the Boston Society of Architects Research Grants in Architecture program. The authors would like to acknowledge the contributions of Rachel Ginsberg of Anshen+Allen and Samira Pasha of Texas A&M University.

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Linking theory with practice and student projects with applied research: case study in Detroit

Joongsub Kim

Lawrence Technological University, Southfield, Michigan

ABSTRACT: The Detroit Studio is a community outreach program of Lawrence Technological University's College of Architecture and Design. It offers students and faculty the opportunity to link theory with practice, academia with the profession, and student projects with applied research. Architecture students work with stakeholders, participating in environmental and behavioral research for design projects. The project discussed here involved seventh grade students in Detroit's underserved communities who worked with junior architecture students to develop master plans for the community. The paper argues that although children are certainly considered in underserved communities, they rarely actively influence revitalization. While literature suggests that urban design benefits architectural education, urban design is underutilized. Although there is research investigating children's involvement in small projects, it rarely addresses the role of children in placemaking in the large built environment. Therefore, children play an important role in this project. In this project, a multi-phase approach to incorporating children in placemaking was applied with architecture students leading teams of about four children. Phase 1 consists of inquiry by impression through kids' video cameras, as they made observations through videos. Phase 2 examines formal pre-understandings, where children explore environmental variables and theoretical constructs. Phase 3 consists of therapeutic art exercises that help children transition to subsequent phases. Phase 4 includes exercises where children construct models of their ideal community. Phase 5 involves producing videos to educate the community about the emerging lessons. Phase 6 develops the children's ideas into master plan concepts. Research is conducted on several themes central to the children's ideas. Phase 7 incorporates the children's input and research outcomes into specific community master plan strategies. Social construction, as a primary theoretical base for our project, has guided our efforts through all phases in the project.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: service learning, urban design, youth participation, applied research, community revitalization

INTRODUCTION

This paper describes an approach taken by a community-based design studio project, and the outcome that was influenced by the project site's unique conditions. In particular, the paper demonstrates a child-focused feedback approach to a school-based community outreach program that focuses on revitalization and the primary outcome of such an approach.

This collaborative community revitalization project involves the Detroit Studio community outreach program of Lawrence Technological University architecture school, as well as various other participants. The project was directed by the author, who also oversees this community outreach program. The locations of the project include Brightmoor, Cerveny, Durfee, and East Warren, which are typical residential areas that comprise some of the most impoverished areas in Detroit. This project included multiple phases starting in summer 2004, and which continued through Fall 2006. The project was undertaken by a junior architecture studio. Key project collaborators included four middle schools; four community development corporations; a museum of African American history; an art college; various city departments; local business owners; community residents; and professional firms in architecture, urban design, and planning.

This paper demonstrates an approach that could lead the way to future studies of potentially important areas in school-community collaboration that focuses on revitalization and master planning.

Although the much shorter and general description of the project was published previously in another venue, this paper focuses on the project's emphasis of linking theory with practice, academia with the profession, and student projects with applied research; as well as the theory base for the project, in addition to providing more details about the project and its process.

Figure 1: Existing conditions (East Warren)

1. LITERATURE OVERVIEW

Our study sites, typical underserved residential areas in Detroit, have a far greater number of children per household than do suburban communities, according to the city planning department's reports and newspaper accounts. Various studies (Bell, 2004; Race & Torma, 1998) suggest that child-related issues are among the most worrisome to residents in poor communities. Moreover, despite extensive empirical research (Gifford, 2002) on children's behaviors toward the built environment and perceptions of it, the input from children aimed at community revitalization is rarely studied or implemented in architecture projects. While there are many examples of children participating in small-scale architectural projects such as playground designs, children rarely participate in community master planning or urban design and research (Kids Consortium, 2001).

Moreover, urban and social scientific perspectives are rarely applied in current undergraduate architectural education, despite empirical findings supporting the benefits that such perspectives provide to architectural design (for example, Telford, 2001). Mullahey et al. (1999) suggest that contemporary community outreach programs often neglect urban design projects. Research in the service-learning field conducted by Crews (1995) indicates that college students learn much through coaching young children. An area of common interest is that young people and children are all greatly attracted to visual media, and often prove to be skillful at using it to express themselves (Orton et al., 2001; Cooke, 2005).

2. METHOD

Based on these findings, we proposed a community outreach design studio program in which junior architectural students would engage children in active participation as key players in community master planning and architectural design, utilizing video, art, urban design, and social science perspectives. The lack of adequate theory, research, and practice concerning children's participation in community master planning led to the conclusion that a multi-faceted approach to the development of the studio project could yield useful results and could lead future studies in this important area in fruitful directions. Therefore, both a theoretical and an inductive approach to the design of the project seemed warranted, and methodological attention was given to multiple sources of data within a seven-phase methodology.

The rationale for designing and implementing the project is based on the following principles inspired by theories or concepts found in disciplines such as urban planning, sociology, anthropology, psychology, and other social sciences.

2.1. Storytelling

Studies have shown the power of storytelling as a creative means to help the listener make sense of a phenomena in some structured and meaningful way. Storytelling is often used in sociology, psychology, and other social sciences and the narrative is useful in social inquiry (Berger & Quinney, 2005). Besides adults, children also appear to benefit from storytelling as they communicate through their own eyes and language what they see, perceive, and experience in various environmental contexts (Burns, 2005). The use of video combined with art and model-making was especially compelling for children and architectural students, and these methods energized the children about telling their sides of stories. Phases 1 and 2 (see next page) of the proposed project benefited from storytelling.

2.2. Environmental Observation

As an important area of the field of environment and behavior (Gifford, 2002), environmental observation is utilized in our project. While there are many approaches to environmental observation, we advocated a "walk through"' supplemented with art and video, which appealed to the young participants. With children being led through the study sites by architectural students, these project participants actually see, feel, touch, smell, and connect with the physical environment at close range. Participants then analyze the characteristics of the physical environment and observe patterns or themes running through the environmental attributes and the behavioral characteristics of the people. While environmental observation was useful throughout the project, it has contributed particularly to Phase 1 and 2.

2.3. Action Research

We were inspired by “action research (AR)” or “participatory action research (PAR).” Action research allows research tasks such as data collection to take place simultaneously with design and implementation activities such as completing a design. The approaches of action research or participatory action research have been promoted in anthropology, planning, sociology, and other related fields (Kindon et al., 2007). Greenwood and Levin (1998) explain that AR promotes broad participation in the research process and that it supports action that leads to a more just or satisfying outcome for stakeholders. Through this approach, we were able to do the following: conduct design-design hypothesis testing frequently, while on the study sites; receive a prompt feedback on design hypothesis from children, teachers, parents, and other stakeholders; and, conduct a more sharply focused data collection, analysis, and synthesis based on such feedback. Action research was beneficial to Phases 4 through 7.

2.4. Therapeutic Designing

Based on some of the approaches or interventions that promote environmental sensibility in environmental psychology (Kopec, 2006; Bechtel & Churchman, 2002), we used art as a means to conduct a therapeutic exercise that aimed to spark the innate creativity of children and architectural students; to strengthen sensibility toward environmental characteristics in the built environment; and to provide a sense of comfort and to reduce anxiety in designing by children, architectural students, and other project participants. This type of therapeutic art is promoted in a wide range of settings (e.g., hospital), programs (e.g., business training), and projects including community revitalization (Wiener & Oxford, 2003; Blatner, 1997; McNiff, 1992). This approach was utilized primarily in Phase 3 of the proposed project.

2.5. Social Construction

Social construction aims to facilitate rather than dictate the design and development process, in order to allow a participant (e.g., a child, a student, a resident) to create or construct her own reality, her own image, and her own future (Kim, 2006). Informed by advancements made in sociology, planning, and other social sciences, the social construction model then advocates a bottom-up approach, self-help by the participants, and participatory democracy emphasizing decentralization, local control, and consumer power (Forester, 1999; Sanoff, 2000). The Detroit Studio project team believed that no one knows more about the study sites than the residents themselves (e.g., children, parents, teachers, and other local stakeholders) and also that residents should have a sense of ownership about their environment; its challenges, opportunities, and assets; the development process; and finally, the community vision. We tried to ensure that social construction would help us help residents themselves, including children, and assist them in having a sense of ownership. Social construction, as a primary theoretical base for our project, has guided our efforts through all phases in the project.

While social construction was used as a primary guiding insight or theoretical underpinning for the project, the successful development of the overall framework of the project needed concerted application of the abovementioned principles or strategies including storytelling, environmental observation, action research, and therapeutic designing, in order to implement the project with realistic sensibility.

2.6. Phase 1 (Summer 2004): Inquiry by Impression Through Kids’ Cam

[Observational evidence is collected by the children through videos.]

Junior architecture students led teams of two to four seventh-grade children from local communities on walks through their neighborhoods. There were four teams, each of which observed each of the four selected communities. While videotaping, children in the teams casually chatted about their neighborhoods. Each architectural student was instructed that careful attention must be given to the children’s experiences and the sense and meaning made of those experiences.

2.7. Phase 2 (Summer 2004): Formal Preunderstandings

[Environmental variables and theoretical constructs are explored.]

After finishing Phase 1, each team returned to its respective local middle school and began “deconstructing” the recorded videos. While analyzing the images and dialogues, the architectural students helped the children group frequently mentioned physical features into several categories. Likewise, the students were instructed to find themes running through the children’s dialogues and images by asking questions about concepts like sustainability, responsibility, and so forth. The students then helped the children correlate the physical characteristics to the emerging themes and discuss how they are related to one another.

2.8. Phase 3 (Summer 2004): Therapeutic Art Exercise

[The students helped the children make a smooth transition to the next phase.]

Each child drew a map of his or her community as directed by the students (The children conducted this exercise again at the end of Phase 7 for pre-test and pro-test comparison). The architectural students also created art work to express their feelings about the study neighborhoods, to analyze neighborhood characteristics, and to share their hopes about the project. The art work then was critiqued by students from a local art school. The goal of this exercise was to give children and the architectural students a "therapeutic" opportunity to reduce anxiety, clarify issues, brainstorm ideas, and organize their thoughts for the next phase.

2.9. Phase 4 (Summer 2004): Model-making Exercise

[The children's model of an ideal community is constructed.]

First, each team brainstormed concepts of the ideal community. Children were asked to write down ideas and play with pieces of foamcore (a polystyrene art material). Children then began making scale models of an ideal community. The students guided the children toward making the best use of the ideas that came out of the video and art exercises. Furthermore, the students helped the children think about how to connect individual elements in meaningful ways.

2.10. Phase 5 (Summer 2004): Editing and Viewing of Videos

Each team, led by its architectural student member, spent a couple of weeks editing the videos for public viewing. The team members, the children's parents and teachers, school principals, local community development corporations, residents, and the university faculty gathered to view the videos produced by the four teams. The goal of this phase was to educate the community about (1) the process by which understanding and analysis of their community characteristics, challenges, and opportunities were undertaken; (2) the roles that the children and students played; (3) the lessons emerging from the process and the project up to Phase 5; and (4) what lies ahead.

2.11. Phase 6 (Fall 2004 and Summer 2006): Developing the Children's Ideas into Workable Community Master Plan Concepts

(Research is conducted on the "urban agriculture-based community" theme.)

After our studio examined the input that the children gave through the videos and the model-making exercises, and local residents and other project participants reviewed the feedback received from the children, it became clear to our studio-community team that the theme of an urban agriculture-based community occurred repeatedly. It appeared that, for our study sites, it would be the most effective and original approach to addressing the extensive blight caused by vacant lots and buildings across our study community. To further explore the idea of urban agriculture, architectural students conducted thorough research on urban agriculture-based developments. For example, they developed principles of successful urban agriculture-based communities with supporting empirical data.

2.12. Phase 7 (Fall 2004 and Fall 2006):

[The input from the children and the research outcomes are incorporated into specific community master plan strategies.]

The outcomes of Phase 6 of the research project gave empirical support to the concerns of the children in our project: the impact of the physical environment on their own health, including obesity-related health problems that result from an unhealthy built environment. The Institute of Medicine (Koplan et al. 2006) has reported that the United States faces a national health epidemic of adult obesity. What is more troubling, however, is that children are increasingly facing obesity problems of their own (Koplan et al. 2006). Such a crisis is much worse in underprivileged areas like our study sites, because it is complicated by factors such as chronic poverty, crime, and other socio-economic issues.

The children expressed a number of very specific concerns, including the seeming overabundance of fast food restaurants; the lack of safe locations to play; the many unsafe and unhealthy vacant lots in their neighborhood; the fact that residents would like to grow food and flowers, but they don't know if the soil is safe; the desire for a safe, convenient, and inviting community center (that would include a computer lab, a recreation center, gardens, and nice shops) so they can interact with other kids and their parents in one place.

The idea of an urban agriculture-based community became stronger and more convincing as the project team members systematically studied the children's statements and the outcomes of research on urban farming and the impact of the physical environment on people's heath. In particular, there seemed to be a strong connection between the benefits of urban farming for poor communities and the goal of helping to create a built environment that promotes a healthy lifestyle in an earth-friendly setting. The project team also realized that obesity and fitness issues are complex: they are intertwined with many social, cultural, political, economic, and physical factors.

Building on the outcomes of the architecture, urban design, and social scientific research, as well as on the feedback of children and other stakeholders, teams of architectural students, guided by studio faculty, developed master plan proposals for East Warren (selected as a test site) based on the theme of sustainable urban agriculture. Throughout Phase 7, architectural students collaborated with children who had participated in the earlier phases, local community development corporations, local design firms and professionals, local city planning departments, city council, residents, and other stakeholders. Taking the steps mentioned above, the architectural students fine-tuned their community master plan proposals and architectural designs for the proposed urban agriculture education center and community market.

2.13. Master Plan Concept

The greater part of East Warren is proposed as an urban agriculture-based community and is divided into several sub-areas or districts according to a ¼ mile walking distance. Each district features a district or neighborhood center that includes neighborhood services and urban agriculture developments (e.g., roof gardens, micro-farms, greenhouses, hydroponic units, community gardens, etc.). These centers are also connected via a pedestrian network that crisscrosses the entire area. In addition to these features, the proposed urban farming community will include a model house that supports a healthy lifestyle, a running track and sports field, open spaces, and office and retail facilities that will accommodate urban agriculture and the mission of improving fitness. Moreover, the master plan called for incorporating existing institutional resources and amenities such as churches, schools, recreation centers, YMCAs, and other local assets into the collaborative approach to urban farming development.

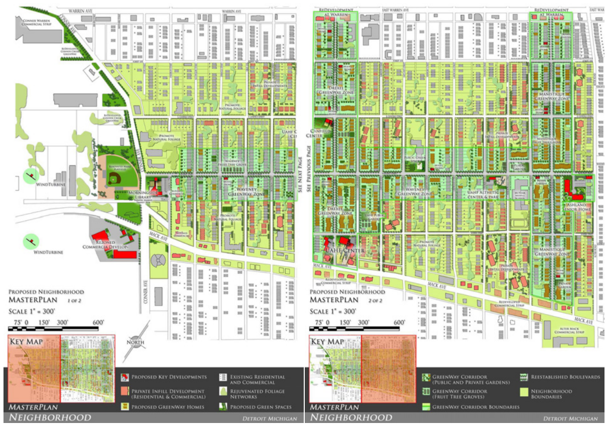

Figure 2: Example of a master plan drawing (for East Warren)

2.14. Architectural Design Concept for an Urban Agriculture Education Center and Community Market

This center is planned to be situated at the heart of the urban agriculture community in East Warren, as the major facility of the proposed farming community. This central facility will fulfill a number of significant goals as it serves the needs of the community. These goals include the following: educating youth and community residents about the value of a healthy lifestyle and the impact of the built environment on people; advocating urban agriculture development as a catalyst for community revitalization; conducting research on matters related to obesity, food, and fitness; promoting urban agriculture products; and modeling a healthy lifestyle. This center also provides services for residents interested in developing small businesses related to agriculture. In this center, local residents and minority farm owners from the outskirts of Detroit will be able to sell their produce.

3. MULTIFACETED CONNECTIONS

As the description of the project and its process illustrates above, we made conscious efforts in many ways to link theory with practice, academia with the profession, and student projects with applied research throughout the project. The following section summarizes the several types of connections we have explored in our project, and provides some of the key details.

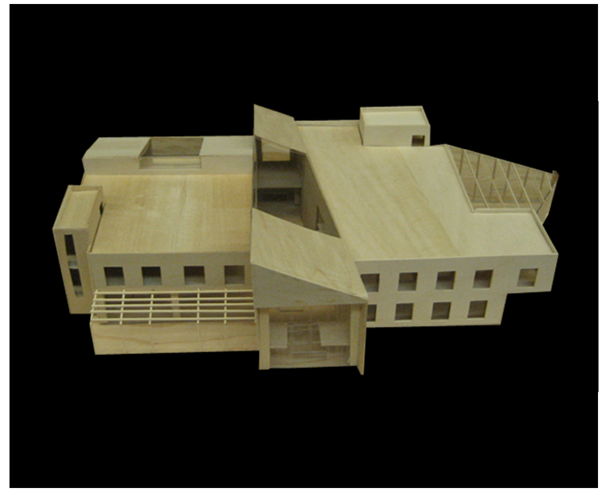

Figure 3: Example of architectural proposal for an urban agriculture education center and community market

3.1. Linking Theory with Practice

In the beginning of the project, the studio team explored several hypotheses about how to solicit feedback from children as they contemplated community revitalization and community master planning. Since literature on such theories was scant, we made a number of educated guesses based on other relevant theories from fields such as child psychology, educational psychology, environmental psychology, sociology, developmental psychology, anthropology, social psychology, and the like (see Method section). Once we felt comfortable with several theories, we then looked for specific cases where such theories were applied or could be applicable in real-life practices or situations. This was done in part to draw practical lessons from the past examples. It was particularly important for us to find or develop theoretical concepts that are marked by practical sensibility so we can actually apply them to our real-life cases and study sites in Detroit. We also tried to test our theoretical concepts, while working with children, their parents and teachers, and other residents in the study community, and we tried to improve the proposed theories based on the results of our field testing. This approach was most useful to Phases 1 and 2, but the other phases also benefitted from the same approach in various ways.

3.2. Linking Academia with the Profession

At critical junctures throughout the project, our studio interacted with a wide range of practitioners including architects, landscape architects, urban planners, transportation engineers, brownfield experts, housing specialists, urban agriculture experts, economists, child psychologists, and artists, as well as representatives from the professional associations such as the

American Institute of Architects and the American Planning Association. These people were invited to either our studio reviews or to other events such as community presentations, focus groups, community workshops, and the public reception and exhibition that revealed the project outcomes. What is particularly important to mention is that our studio conveyed the professional feedback to the children's parents and teachers, residents, and other key stakeholders in the community, using language familiar to those not formally trained in architecture and urban development. Likewise, we relayed the concerns, needs, and wants of children, their parents and teachers, and other residents to the professional experts. As such, it was important for our studio to play a role of facilitator between experts and non-experts throughout the project. This approach was particularly beneficial to Phases 6 and 7 above, although it was in general useful to other phases as well.

3.3. Linking Student Projects with Applied Research

It was critical for our studio faculty to develop and guide the project in such a way to ensure that the project is student-focused, by helping architectural students initiate their own ideas, develop their own concepts, apply them on their own, and learn from the mistakes committed during the process. As facilitators, the instructors advocated a bottom-up approach to our project, promoting democratic discourse, teamwork, negotiation, and various types of collaboration. Once students had a sense of ownership of the project, they freely experimented with bold ideas. At the same time, they found that some of their initial approaches needed to be modified. To make adjustments and improvements, and to test new or better alternatives, students frequently had to conduct independent research. Eventually, a broader scope of learning began to take place, not just within individual students, but also among students in the studio, on the field, or at the study site or community. We emphasized applied research more than theoretical research. As a result, students understood that whatever they proposed would have a real impact on the lives of residents and especially the children with whom they were working. The students learned that their proposals would have to be grounded firmly in the reality of the community with which they were working. This approach had a positive impact on all seven phases, according to the students' comments provided after the project's completion.

CONCLUSION

We do not claim that a child-based feedback system is better than an adult-based process, nor did we include children as the only major stakeholders in our project. However, given the demographic, social, and physical characteristics of our sites, we felt that incorporating the children's input is a very significant strategy in the revitalization of distressed communities.

As a result of this program, one of the participating middle schools has launched a similar kids' video program. The school intends to expand it across the entire neighborhood in the future. Another participating community is now collaborating with our community outreach program to develop a detailed plan and an implementation strategy for the proposed urban agriculture education and market center in Detroit. The City of Detroit Planning Department and a major community development agency are interested in collaborating with our program and one of the participating communities in this project to further develop and integrate the concept of urban community agriculture into the city's urban agriculture industrial park development proposal.

Children were asked to draw a map of their respective communities at the end of Phase 7 (the final phase). The outcomes of this exercise were compared with those of the exercise conducted in Phase 3. The goal of the comparison of the pre-testing and post-testing was to see whether there was any change in children's perspectives on or attitudes toward their physical surroundings and revitalization. The post-test showed that the maps produced in Phase 7 were more detailed and more fine-tuned. Moreover, the pre-project and post-project surveys indicated that children became more cognizant of the physical environment of their neighborhoods in terms of sensitivity to issues of safety, interaction, sustainability, and social responsibility.

The most important lesson our students and the participating communities learned was that children do care a lot about what is going on in their neighborhoods and they know clearly the problems that the neighborhoods face, the negative outcomes of such problems, what they want to change in their communities, and what their responsibilities are. Most of all, the children have many fresh ideas. If the children are encouraged in the right direction through positive reinforcement and proper guidance, many of their novel ideas can inspire adults and transform the behaviors and attitudes of others. Moreover, students, faculty, and communities learned that it is very feasible to incorporate a child-based feedback system as a key strategy in school-community collaboration for revitalization projects in impoverished urban areas. Through systematic mentoring, guidance, and follow-up, children can play a major role in master planning for poor neighborhoods. What we proposed here is just one kind of child-based feedback system. We hope our approach inspires other schools to develop additional successful systems in their community outreach programs in the future.

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Unconventional research in a conventional practice, a case study

Miranda Mote

BHDP Architecture, Cincinnati, Ohio

ABSTRACT: The primary subject of this paper is a historically conventional architectural practice that has enjoyed success with clients and projects in the Midwest. Currently, the firm's demographics and practice are typical to the industry nationwide. New leadership have emphasized the necessity of research and invested in employee centered, professional, and academic programs. The board of directors has diligently developed and supported programs that foster productive partnerships with academia.

The research and professional development programs described below are not unique to this firm. I will explore the potential and realized value they bring to this mid-sized corporate architectural firm, their project work and their respective academic partners. The following programs will be subjected to analysis and critique: 1. Continuing Education: Programming supports traditional classroom learning as well as an in-house research fellowship offered to enable employees to engage in research as a project.; 2. University Endowment: The endowed position will offer studios and lectures that encourage collaborative learning between practicing and future designers interested in sustainable design in Cincinnati.; 3. Executive Education: the firm has hired Xavier University as a professional consultant. Xavier University offers professional services to private clients utilizing its academic resources in their School of Business.

Objective: This case study will measure the success of research and professional development programs in terms of firm recruitment, financial return, and improved professional culture. The case study will conclude with recommendations for improved and continued partnership between practice and the academy and how research can be comfortably situated within the confines of conventional practice.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: continuing education, research fellowship, endowment

INTRODUCTION

BHDP Architecture is a respected, financially successful, architecture firm, which would like very much to attract the best and brightest architects and interior designers and compete for challenging clients and projects, and improve profitability. The firm's demographics and practice are typical to the industry nationwide. Currently, BHDP's demographics are 29% architect and interior design interns, 41% Project Architects and Managers, 18% leadership, business development and management, 11% support, and 1% dedicated research. The 1% dedicated research finds himself more and more on project work and is dedicated to workplace market research. Only 50% firm's architectural staff are licensed and only 10% of the firm are LEED AP. Both low percentages of licensure and LEED credentials could prove problematic long term. Zweig White's 2009 AEC Industry Outlook reported in that nationwide firms identified finding qualified staff and training staff as the most important business priority from 2005-2008. In 2009, the analysis reported that these priorities dropped to 3rd and 4th, falling behind the state of the economy. BHDP senior leadership acknowledge the necessity for research and employee training that benefits all markets and professional culture and have invested in employee centered, professional, and academic programs. Historically, BHDP Architecture has benefited from its proximity to the nationally recognized University of Cincinnati, School of Architecture and Interior Design but would like to also recruit nationally. In recent years, the Board of Directors have developed and supported programs that foster productive partnerships with academia; University of Cincinnati, Xavier University and Miami University. The research and professional development programs described in this paper are not unique to this firm, nationally, but are significant and unique compared to other firms in the region

1. FIRM HISTORY

1.1. Typical beginnings

BHDP Architecture was founded in 1937 as Woodward and Baxter. Future generations of owners renamed the firm as Baxter Hodell Donnelly Preston. Current firm markets grew out of early and long standing relationships with corporate and science and technology clients. BHDP Architecture has radically changed in the past ten years. In the late 90s, the long-standing practicing founders retired and an ownership transition occurred.

1.2 Planning for growth

Since 1996, the time of the recent ownership transition, BHDP experienced sustained growth in both revenue (from $8M in 1996 to $23M in 2007) and employees, expanding from 66 to 120 in three locations in 2007. In August of 2002, continued growth prompted a move to the Cincinnati downtown business district. The new office environment was intentionally designed to support collaborative work and includes support spaces for group learning activities and exhibit space. Since 2004, the new leadership's business planning and policies have focused on cultivating expertise to support project work in their markets as well as emphasize personal and professional development of employees.

1.3 Investing in Education and Research

In 2004, the board of directors formalized their commitment to professional development by establishing Baxter University; endorsing in-house continuing education with funding, resources, and dedicated time. Long term commitments include continued investments in an annual operating budget, human resources, continued direction and support for expanded programming, significant investments in technology that has improved communication, knowledge sharing and delivery of educational programs.

Secondly, the firm established the Carl Monzel Endowment in a partnership between University of Cincinnati, School of Architecture and Interior Design. The endowment has the potential to support research that benefits the Cincinnati architectural community at large and the firm. In a sense, the endowed professor could be a professional consultant to the profession. This endowment fund was established and developed in appreciation of, a deceased owner. BHDP established the endowment with a $100,000 contribution and is working with the University to raise additional funds.

Thirdly, BHDP board of directors planned for and funded nine employees to participate in a leadership development program at Xavier University's School of Business. The $110,000 investment included curriculum planning and classes throughout 2006 and 2007 for nine employees. The curriculum was designed to expose participants to a variety of business concepts that expand participant's business perspectives and leadership. The program is very interactive with a variety of work assignments that challenge participants to apply concepts with their current work environment.

2. MODELS OF PRACTICE EDUCATION AND RESEARCH

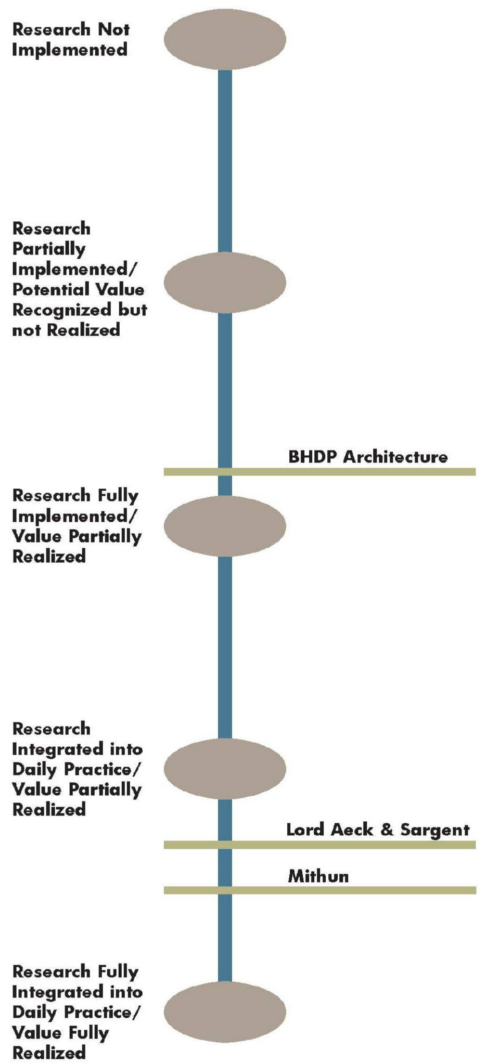


Figure 1: Research in architectural practice benchmarks

2.1. Value of Research

The value of research and educational investments can be measured by recruitment and retainment, financial return, and a dynamic and productive professional culture. BHDP, Mithun and Lord Aeck and Sargent all are working to distinguish themselves when competing for employees and projects and improve the long term health of their business.

2.1. Mithun

"Mithun's mission is to inspire a sustainable world through leadership, innovation, and integrated design." (Mithun firm website) Mithun is a medium sized (<100 employees) practice with multiple offices, founded in 1949 by Omer Mithun. Mr. Mithun was actively engaged in practice and the academy throughout his career. They are a two time winner of the AIA/CES Award of Excellence, a national AIA award that recognizes their accomplishments as a teaching practice. Mithun uses their in-house continuing education programming to advance their understanding of building technology, energy and waste systems, and work processes.

Firm leadership, full time researchers, and project architects plan and direct all aspects of Mithuniversity. Mithun plans for $400/per employee annually to support in-house educational programming. They also budget for employee time to support class development and in-house research. Programming includes lectures, project site visits, workshops, a visiting professor series, a distinguished speaker series, computer training, office design critiques, and webcasts.

Mithun also sponsors programs that go beyond the classroom and fund research and learning large and small. Their JDon Scholarships are small scholarships that nurture employee talents, not always specific to office markets. The Mithun Travel Research Trip is an annual tradition and is designed as architectural design research trips (international and domestic travel). The employees collectively deliver an in depth presentation or exhibit upon their return. Mithun also collaborates with public and private institutions outside the firm. Most recently, they collaborated with the Lady Bird Johnson Wildflower Center to develop and launch their Online Construction Carbon Calculator in 2007. The calculator is designed to assist designers, developers, owners and contractors to reduce the carbon footprint of their site engineering and development. Lastly, The Omer Mithun Foundation endowed a Professor in Sustainability at University of Washington for a three year term. Steve Kieren, James Timberlake, and KieranTimberlake employees have lead multi-disciplinary studios and seminars that have actively linked the College of Architecture and Urban Planning with the work of other University of Washington Colleges. There was also a public lecture.

Research and education are fundamental to Mithun's practice. Research, education, and project work all contribute to the firm's profitability and credibility.

2.2 Lord Aeck and Sargent

> Our mission is to provide innovative, responsive design - coupled with cutting-edge technological expertise and exceptional service to our clients. (Lord Aeck and Sargent, firm website)

Lord Aeck & Sargent is a mid-sized firm with three offices. All the design studios in the firm and leadership are fully engaged with their in-house continuing education program. Participation is mandatory and considered in employee evaluations, promotions, and compensation. In 2007, the firm won the AIA/CES Award of Excellence.

The firm's continuing education goal is to offer a solid continuing education program that benefits all employees and strengthens profitability by supporting design, technological expertise, and exceptional service. The firm established LASU in 1993 and have over time have built a program that now offers over 150 classes a year. This amounts to 12.5 classes a month across three offices. LASU is managed and directed by a six member board of advisors that includes the Manager of Professional Development, the Human Resources Manager, and four Principals, two of whom have been adjunct faculty at the college and university level.

The courses are presented to all three offices in a wide variety of formats including lectures, interactive roundtable discussions, user groups, project/construction site tours, and online as well as instructor-led interactive computer-based courses. Most classes are taught by internal staff experts, and all firm principals are required to develop and deliver classes annually. Classes are also taught by external experts, consultants, as well as Deans and Professors from major universities, fire marshals, engineers, code experts, and professionals from public agencies. The LASU curriculum consists of several topic categories, including: Core programs (mandatory for all employees); Design courses; Process oriented programs; Building Technology courses; Leadership classes; and Tools.

As a direct result of education investments, Lord Aeck and Sargent has reduced project errors and omissions to less than 1%, reported no project insurance claims in 2006 and 2007, and positioned themselves as an employee of choice at all three of their offices.

3. BHDP ARCHITECTURE PRACTICE EDUCATION AND RESEARCH

In 2002, BHDP took advantage of a necessary move to design their workplace as a means to redefine their workplace culture. The layout situates project work rooms at the center of the space with work stations grouped along the perimeter. The finished space displays many components of a work environment that in turn supports the demands of group presentations and exhibits. The office space is used to educate clients about bhdp project work, design, and work processes.

The workspace accommodates individual work, small and large group interaction and a customized intranet workspace that supports the exchange, archiving, and delivery of information across three separate offices. This virtual workspace has connected three offices, supported communication about educational programs, organized project and sales data and archived class/research materials.

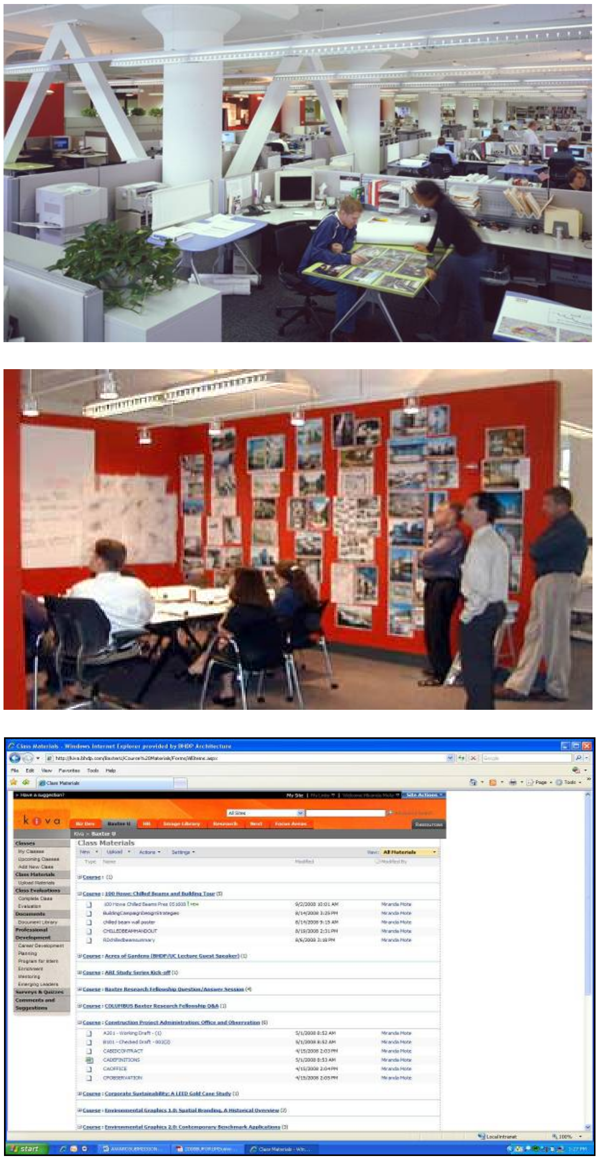


Figure 2: Flexible office environment, open project and lecture rooms, web based intranet archive and communication tool

3.1. Workplace Team Collaborative Research

> BHDP's research initiatives help us to respond to the challenges faced by our clients, through understanding workplace trends and "the workplace of the future". We are a knowledge and innovation-driven company because of our desire to better understand and serve our clients, and we will continue to investigate best practices through ongoing research efforts and strategic research relationships. (BHDP, 2009)

The above quotation summarizes how BHDP markets its past and desired research efforts and exposes their underlying motivations; service to clients, sophisticated and meaningful solutions for clients, and improved profitability. In 2003, BHDP Architecture funded a research grant with MIT's Department of Architecture and Planning to study the relationship between workplace culture, personal competencies and the design of the workplace. The study focused on one BHDP client and was based on observation, interviews and experimentation. The goal was to develop processes or tools that can be used in the design of the workplace based on the cultural assessment process.

These tools are used to improve and expand pre-design services to workplace clients. Since 2003 and this project, the workplace team has increased their net revenue by 50%.

3.2. Summary of Resource and Educational Investments

The BHDP intra-office intranet platform has been fully implemented at a cost of $975/per employee. Most Baxter University classes and in-house lectures are delivered to all three offices via video conferencing. The Baxter University annual operating budget spends $220/per employee. 2007 analysis revealed that participation totalled 1147 class time hours, with an average of 8.9 hours per employee; 86% of employees participated across three offices. 40% of BHDP employees were instructors or facilitated a guest speaker, some teaching multiple times. 50% of BHDP Senior Leadership taught or facilitated a Baxter University class.

Given the range of offerings, participation is weak. All BHDP leadership are not fully engaged as teachers or participants. At times some of the leadership questions the value of education and dialogue. The firm also does not promote or communicate information about in-house or public lectures in recruitment material, on the firm website, or in general marketing material.

Figure 3: Baxteru marketing of public lectures (BHDP, 2006)

3.3. Public Lectures

Baxter University plans for at least three public lectures a year. In the past, the lectures were primarily sponsored in Cincinnati, Ohio and catered to the Cincinnati professional community and University of

Cincinnati students and faculty. University of Cincinnati/BHDP Lectures have supported nationally recognized guest speakers, architects, and designers. In October 2007 the guest speaker, BHDP, and UC, SAID graduate students curated a public exhibit that complemented the Fall 2007 lecture. Beginning in 2009, the firm expanded its sponsorship to Miami University and AIA Cincinnati. Speakers and topics for all lectures are selected based on their practical and theoretical application and appeal to academia and practice. Most public lectures are offered at BHDP over lunch and again delivered to the public, students, and faculty the same afternoon. Most public lecture materials, presentations, handouts, and supplemental reading are archived for future reference on BHDP's office intranet, Kiva. After the first lecture bhdp saw a dramatic increase in employment inquiries from students and young professionals. Bhdp has been participating in University of Cincinnati's co-op program for 30 years. On average the firm would attract six students a year. In the Spring of 2007, bhdp interviewed and hired twelve highly qualified graduate students.

Past Lectures have been about built projects, speculative work, project delivery methods, innovative contractual relationships, building technology, advanced material technology, and design. Speakers are usually engaged in practice and the academy. The first of this series hosted the Director of Sustainability at Buro Happold in New York, New York. The lecture and seminar was intended to educate the office about key design and business strategies that support innovative and energy efficient design solutions. BHDP clients, consultants, employees, and University of Cincinnati graduate students attended. This lecture established a relationship with University of Cincinnati. After this lecture, BHDP and UC's Director of the Graduate Program worked together to select speakers and topics.

The February 2009 lecture hosted Marlon Blackwell and also successfully engaged University of Cincinnati, Miami University, and AIA Cincinnati. All three organizations participated in the lecture planning and enjoyed the benefits of direct contact with the guest speaker. Bhdp and University of Cincinnati are now planning their eighth lecture for October 2009.

3.4. Internal Educational Programs

The Baxter University curriculum is designed and led by key bhdp employees. These individuals are considered experts in the office. The core purpose of baxteru is to deliver resources that define quality and consistency and support a critical dialogue across project teams and offices. The basic curriculum addresses leadership development, research, professional outreach, sustainability, project delivery, the built environment, communications, BIM, strategic services, professional registration. All class materials, presentations, handouts, and supplemental reading are archived for future reference on BHDP's office intranet, Kiva.

In 2008, baxteru leadership analyzed professional registration at bhdp architecture. This analysis revealed that 50% of bhdp's architectural staff was not licensed. Less than 10% of this group was actively preparing for the ARE and reporting to IDP. Long term this could be detrimental to the employees and the firm. Lack of licensure directly effects project billing and profitability and the employees' long term earning potential. The 2009 baxteru budget planned for an ARE 4.0 study series, purchased ARE study materials, and established a schedule for all eligible employees to sit for all seven of the ARE 4.0 sections in fifteen months. Baxteru will track participation and success. Participating employees will be held accountable for their participation in 2009 when bonuses and compensation are considered by the bhdp board of directors.

Also in 2008, baxteru leadership analyzed employee LEED registration at bhdp. Analysis revealed that only 10% of the firm was LEED APs. Of this group only two owners were LEED APs and knowledgeable about the process and its impact on project processes and profitability. Baxteru leadership worked directly with the CEO and the office sustainability expert to develop a program that would support and encourage employees to prepare for and take the LEED NC and CI exams by May 2009. The 2009 baxteru budget planned for study material and four in-house educational programs that would support employees preparing for the exam. Forty-four employees agreed to participate and take the exam. Like with the ARE, Baxteru will track participation and success and articipating employees will be held accountable for their participation in 2009 when bonuses and compensation are considered by the BHDP board of directors. If all forty-four are successful, 59% of the firm will be LEED APs. This dramatic jump and continued education could improve project and office profitability, credibility, and improve project quality.

The baxteru leadership team is focused on delivering education and resources that will improve project quality and define effective work processes across all teams and offices. It is clear that bhdp's rapid growth has contributed to a decline in project quality and consistency that in turn threatens firm profitability. Long term, baxteru wants to be the umbrella for all bhdp research, standards, and education that supports project work, employee development and unifies the office.

3.5. In-house Research Fellowship

Within the confines of conventional practice one way to facilitate architectural research is to treat it as a project, BHDP being the client that pays for the research and demands a deliverable within a timeframe. The research fellowship is funded through and managed by Baxter University, hence the name, the Baxter Research fellowship. Baxter University advertised a request for research proposals in August of 2008.

> Baxter University requests creative proposals that investigate design, technology, and practice as they relate to architecture and interior design. (BHDP, 2008)

The program's primary objective is to support meaningful research by BHDP employees; enabling individuals to engage in a concentrated research effort and investigate its application to the profession, BHDP and the greater community. The award includes $3500 and three weeks (120 hours) paid time to conduct research and prepare a deliverable. Any employee is eligible to submit a proposal. A total of 8 proposals were submitted for consideration in September 2008.

The firm thought it necessary to include an outside expert, the firm's CEO, and a member of the baxteru leadership on the selection committee. Baxter University also funds expenses and speaking fee for the guest member to lecture at the office following the selection of the winning proposal.

BHDP Architecture recently awarded the 2008 Baxter Research Fellowship to Amy Hood. Ms. Hood's proposal, "Lessons From the Sustainable Pacific Northwest" leverages existing infrastructure already in place at BHDP, couples a critical examination of the professional culture of a region with the development of a mechanism for information sharing within BHDP. The project will build a sustainable building toolkit; an online, user friendly, catalogue of information useful to BHDP architects, interior designers, and clients. Ms. Hood will travel to Seattle, Portland, and Chicago to investigate the Green Building Program, visit several cutting edge buildings, and interview users, engineers, and architects.

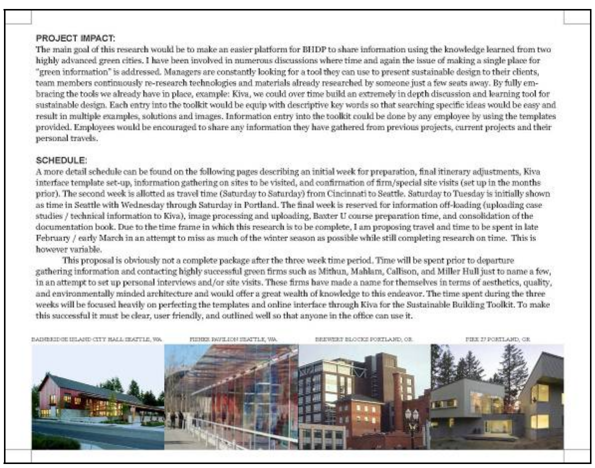
> Staying abreast of current and relevant green technologies is a challenge. Each entry into the building toolkit will be assigned descriptive key words so that project managers and architects can search ideas and see multiple examples of solutions and images for project planning and design. (Hood, 2008)

The fellowship will be awarded on an annual basis to a BHDP associate who will use the fellowship to "thoughtfully and creatively investigate knowledge and solutions that would directly benefit BHDP and our clients, " said Mike Habel, CEO of BHDP Architecture.

3.6. University Endowment

In 2004, BHDP established the Carl Monzel Endowment. The endowment will provide support for one quarter of teaching, lectures and workshops including a studio taught at DAAP, potentially multi-disciplinary. The studio may include participation from members of the Cincinnati architecture community who will be involved in workshops led by the endowed professor. The endowment recipient will also be the keynote speaker at an annual sustainable design symposium.

Figure 4: in-house lectures, in-house and public exhibits, student enrichment as a result of BHDP sponsorship, public lectures marketed to professionals and students (BHDP, 2004-2009)


PROJECT IMPACT:
The main goal of this research would be to make an easier platform for BHDP to share information using the knowledge learned from two highly advanced green cities. I have been involved in numerous discussions where time and again the issue of making a single place for "green information" is addressed. Managers are constantly looking for a tool they can use to present sustainable design to their clients, team members continuously re-research technologies and materials already researched by someone just a few seats away. By fully embracing the tools we already have in place, example: Kiva, we could over time build an extremely in depth discussion and learning tool for sustainable design. Each entry into the toolkit would be equip with descriptive key words so that searching specific ideas would be easy and result in multiple examples, solutions and images. Information entry into the toolkit could be done by any employee by using the templates provided. Employees would be encouraged to share any information they have gathered from previous projects, current projects and their personal travels.

SCHEDULE:
A more detail schedule can be found on the following pages describing an initial week for preparation, final itinerary adjustments, Kiva interface template set-up, information gathering on sites to be visited, and confirmation of firm/special site visits (set up in the months prior). The second week is allotted as travel time (Saturday to Saturday) from Cincinnati to Seattle. Saturday to Tuesday is initially shown as time in Seattle with Wednesday through Saturday in Portland. The final week is reserved for information off-loading (uploading case studies / technical information to Kiva), image processing and uploading, Baxter U course preparation time, and consolidation of the documentation book. Due to the time frame in which this research is to be complete, I am proposing travel and time to be spent in late February / early March in an attempt to miss as much of the winter season as possible while still completing research on time. This is however variable.

This proposal is obviously not a complete package after the three week time period. Time will be spent prior to departure gathering information and contacting highly successful green firms such as Mithun, Mahlam, Callison, and Miller Hull just to name a few, in an attempt to set up personal interviews and/or site visits. These firms have made a name for themselves in terms of aesthetics, quality, and environmentally minded architecture and would offer a great wealth of knowledge to this endeavor. The time spent during the three weeks will be focused heavily on perfecting the templates and online interface through Kiva for the Sustainable Building Toolkit. To make this successful it must be clear, user friendly, and outlined well so that anyone in the office can use it.

BAINBRIDGE ISLAND CITY HALL SEATTLE, WA — FISHER PAVILION SEATTLE, WA — BREWERY BLOCKS PORTLAND, OR

Figure 4: Baxter Research Fellowship program advertisement + guest speaker and selection committee member + employee generated research = measurable results to be determined (BHDP, 2008; Hood, 2008)

The "Monzel Scholar" will be a rotating, one-quarter teaching position that will include: Lectures and workshops for practitioners in Cincinnati, as well as students and faculty from the University of Cincinnati; collaborative learning between practicing and future designers interested in sustainable design; and an annual symposium on sustainable design issues.

Carl Monzel Endowment is an example of how firms can direct and support practical research in the academy and attract sophisticated professionals to the Cincinnati region. The program has been partially funded by BHDP. University of Cincinnati and BHDP are raising additional funds to fund the position indefinitely. Given the endowment is not fully funded, value has not been realized. This is unfortunate for both bhdp and the financially strained School of Architecture and Interior Design. This endowment represents a source of revenue and resources that could directly benefit students and bhdp employees. It could also be used to attract and retain employees and students in Cincinnati.

3.7. Executive Leadership Education

In 2006, BDHP hired Xavier University's Leadership Center to design and deliver an educational curriculum for a select group of employees. Nine bhdp employees spent over 500 hours in a classroom with Xavier University, School of Business faculty. The basic curriculum addressed leadership, team building, emotional intelligence, communication, business strategies, process improvement, and business strategy implementation. Instruction included reading assignments, case studies, instructional presentations, assignments, discussion, and in class exercises. One such class, Designing and Delivering Powerful Presentations required the individuals to use information learned from their experience and the class material to deliver a sales presentation.

The Xavier University Leadership Center markets themselves regionally and has helped many companies with customized programs like emerging leader as well as programs that address business communications, process and product management. The executive director, Len Brzozowski, is a former business consultant, argues that Xavier's program strength is that they aren't selling a solution, but helping their clients find their own solutions.

4. CRITIQUE AND RECOMMENDATIONS

4.1. Critique

All the basic parts of a research based practice are in place: educational programs, a research fellowship, market based research initiatives, and sponsorship of academic teaching and research. Most of these programs and initiatives are young and not fully integrated across all offices and teams. In addition, 100% of the senior leadership are not actively engaged with Baxter University programming as instructors and attendees. Only 50% of leadership taught or facilitated an educational program.

Baxter University could in fact bind all research efforts together by offering an active venue to share knowledge and engage in debate. In the past, most programming tended to react to current project work and to those employees willing to take the time to prepare a presentation. Recently, baxteru has reorganized its leadership and curriculum. Baxteru is striving to inform a proactive debate about design, project delivery, and building technology. Baxteru will continue to support and encourage research that informs projects, client and consultant relationships. At this time bhdp is just beginning to leverage sponsored lectures, the Baxter Research Fellowship, workplace research to benefit the firm as a whole. Once the Baxter Research fellowship is established, the goal is to use the research to generate original material and knowledge that informs project quality and client relationships. This original research could be shared through public and internal presentations, exhibits, and through the office intranet.

4.2. A shift to proactive research and learning

The BHDP leadership and employees need to proactively engage internal and external opportunities with critical and decisive motivations. Only then will research define and improve project quality and content. Not far behind is a long term financial benefit. Lord Aeck and Sargent have been building their programs for over ten years, and Mithun for over fifty years. This shift will take time and requires the unified commitment of bhdp ownership and management.

Baxteru leadership and employees need to ensure that the research fellowship delivers research through a variety of means; exhibits, presentations. Management needs to advocate its continued application in daily practice. This process should continue year after year, building on the momentum and success of previous fellowships. Constructing the fellowship as a project allows young staff to engage with and interact with professionals outside the firm. This external engagement should be actively maintained and used to build relationships for potential future projects and consultants.

BHDP should be more aggressive and engage students in their studio at student reviews and exhibits. It is possible that the Carl Monzel Endowment, once fully implemented will activate this relationship.

The firm should also benchmark other models of research based practice. Other models like NCARB Prize winners, the AIA Latrobe Fellowship, product industry research programs, as well as client based research programs.

As an alternative to passive lectures, BHDP should also consider utilizing invited experts as project critics, and ask them to offer detailed seminars to a select group of employees. So the firm can extract more detailed knowledge from guests and most importantly, open themselves up to critique. Firm leadership should explore the possibility of collaborating with expert speakers for an exhibit that displays complementary ideas and projects. They should also consider designing lecture series to inform potential and past research fellowship proposals. Bhdp should continue to invite clients and consultants to attend public and internal lectures to build a long-standing relationship and continue to advertize the public programs to the Cincinnati community at large.

Value from these investments in education, research, and employee development can only be realized if all firm leadership support and engage in all aspects programming and planning, demanding a return on their investment. Without this collective authority and advocacy, returns will continue to be modest. Zero error and omissions on projects, low employee turnover, and choice projects are dollars in the firm's pockets.

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Towards a More Sustainable Built Environment

Towards a Civic Environmental Design
Vincent Canizaro

Preservation & Sustainability: The Case for 'Realistic' Evidence-Based Design Policy
Christopher Koziol

Retro_Fit: Greening Educational Facilities for Carbon Neutrality and Students' Performance
Ihab Elzeyadi

Glass In Daylighting Design, an Experimental Investigation of the Impact of Glass Types
Khaled Mansy

Towards a civic environmental design

Vincent B. Canizaro

University of Texas at San Antonio, San Antonio, Texas

ABSTRACT: A symposium entitled *Designing for Civic Environmentalism*, held important lessons for architects and planners alike concerned with cultural and ecological sustainability. Itself an emerging discourse and practice, civic environmentalism (CE) is, according to William Shutkin, *"the idea that members (stakeholders) of a particular geographic and political community -- residents, businesses, government agencies, and non-profits -- should engage in planning and organizing activities to ensure a future that is environmentally healthy and economically and socially vibrant at the local and regional levels"* (Shutkin 2000). Andrew Light situates the area of concern within the urban environment (Light and Wellman 2003). His aim, while agreeing with Shutkin, is the inclusion of environmental virtues as the governing factor in relationships between persons in a community (civic) and between human and non-humans (ecology) in that same community. In sum, then CE is about the revival and engagement of civic life based on the protection of the environment for all. In this research paper, I describe three tenets for design practice based on civic environmentalism and present a key finding that emerged from my qualitative research (interview, participation, textual review) into the motivations and successful strategies emergent within the workshop. My research revealed that a key characteristic for a design practice based on CE is that the process is best when it works with an *a posteriori* or emergent logic. An *a posteriori* process privileges what is found at the site as the catalyst for development – reframing practice from application to discovery, preservation, and enhancement. By virtue of the local sensitivity it engenders, tempered with knowledge and skills from the outside (a priori), we increase the potential for design to yield the "goods" promised by civic environmentalism - places of ecological and cultural integrity, community, justice, and beauty.

Conference theme: Green and sustainable architecture
Keywords: sustainability, architecture, environmentalism, design, place

INTRODUCTION

> "Some deliberately take on work with a strong community orientation: low-income housing, work for minority communities, active participation in local planning issues, design of community centers... These architects recognize that for the built environment to be in good health, a diverse population must have decent places to live, and issues of land use and downtown planning must be appropriately solved for everyone." (Davis 1999:311)

Add to this a concern for ecological integrity and it serves as a reasonable picture of what might be called a "civic environmental design." What this description and most discussions on the subject have lacked is a discussion of method or process – a consideration about how a project is carried out affects the success of the final built environment. The *Designing for Civic Environmentalism Workshop*, held at the University of Texas School of Architecture in the fall of 2003, changed that in two ways. First, it included designers within the community of invited scholars adding disciplinary diversity to the discussion. Second, it included students in an exploratory studio-workshop. Guided by Steven Moore at the University of Texas at Austin, the students were asked to respond to the same set of questions put to the scholars, but to answer with design proposals. The intentionally open but structured process they followed revealed two distinct conceptual approaches that are key in the development of a civically engaged environmental design. I identify them as *a priori* or *conventional* and *a posteriori* or *emergent*. In philosophical thinking, *a priori* justifications are those that are fashioned through reason alone, relying on an inherent correspondence between one's knowledge and facts in the world. In contrast, *a posteriori* justifications are based on or require experiences of the world such that knowledge is contingent on that experience. An *a priori* design process might be one in which the inquiry, range of solutions, and sites for possible projects correspond to the structures and logic found within conventional practice. It is to operate within the normative limits of accepted procedure. *A priori* work finds its basis in the known and circumscribed – the expected. An *a posteriori* design process is one in which the kinds of sites, projects, and order of process are developed in direct response to the context of a *possible* project. Possible solutions are open-ended in scale, type, duration, and purpose and can lie outside of the specific disciplinary domain of architectural practice. *A posteriori* work is exploratory and emerges from the problem itself, resulting at times with the unexpected. The methodology used was qualitative, consisting of a singular case study informed by participant observation, interview, and textual review. My specific role, relative to the workshop, was as a critic and outside observer who was asked to summarize and contextualize the results of this relatively unique collaboration.

In this paper, I present and contextualize those findings. Beyond this, I have sought since then to extend and further detail these two approaches and their potential as a critique of normative design practice, particularly those attempting to practice with and aim towards sustainability. Further, I make available by these extensions, work, ideas, and specific methods already *in* practice, greatly enhancing the possibility of a robust civic environmental design (or CED).

1. CONTEXT: CIVIC ENVIRONMENTALISM AND ARCHITECTURAL DESIGN

What constitutes civic environmentalism is well-represented by the companion texts in this volume as well as the earlier issue of the *Journal of Social Philosophy* dedicated to the same theme (Light & Wellman 2003). For William Shutkin, from environmental policy and activism, it is "the idea that members (stakeholders) of a particular geographic and political community -- residents, businesses, government agencies, and non-profits -- should engage in planning and organizing activities to ensure a future that is environmentally healthy and economically and socially vibrant at the local and regional levels" (Shutkin 2000). Andrew Light, from environmental ethics, situates the area of concern within the urban environment (Light & Wellman 2003). His aim, while agreeing with Shutkin, is the inclusion of environmental virtues as the governing factor in relationships between persons in a community (civic) and between human and non-humans (ecology) in that same community. In sum, they suggest a revived and engaged civic life that prioritizes the protection of the environment for all.

In architecture, the ideas of civic environmentalism challenge architectural practice to move beyond the predominantly technical discourse of ecology, energy-efficiency, and sustainability. For a civically environmental design, architectural production must be reframed as a specific variety of environmental action. As such it poses a serious ethical and practical challenge to architectural professionals: to be more socially and ecologically engaged as citizen-architects who care for the environmental quality of the communities in which they build, and to be less concerned with the self-reflexive design of aestheticized objects.

The proposals for the design professions put forth by scholars considering civic environmentalism can be reduced to a few categories. Most focused on the civic dimension over the environmental suggesting that perhaps ecological science has yielded a more clear cut sense of what and how to do it. They emphasized that it is the responsibility of architects, planners, and landscape architects to address n their work the issues of: 1) **social justice** for both human and non-human populations including the equal dispensation of rights, representation, and physical space; 2) the creation of **better places,** defined mostly in terms of the maintenance of diversity and enhancement of community through such notions as enhancing street life and battling gentrification; 3) the conservation and maintenance of **local ecologies**; and, 4) the importance of **local knowledge** and the power of **participatory activity** in every project and place. Collectively they also suggested that both a *fidelity to* and respect for the *particularity* of places was central. And, they rested many of their arguments on the importance of direct sensory experience for the care and renewal of concern for places.

The proposals for social justice remained predominantly philosophical providing a sketch of an environmental ethics for designers. Professionals were asked to work towards the benefit of all. A request that extended beyond concern for the poor and disenfranchised to include non-humans who participate in the total ecology of those places. Also, general concern was voiced for a renewed commitment to the notion of the commons (land held to be public) as a kind of "good" that should be given consideration while professionals are engaged with specific proposals, sites, and buildings.

Considered together the proposals recall the statement, made by William Wurster that "architecture is a social art" (Wurster 1960). Much as Andrew Light has sought to move environmental ethics beyond abstract notions about the value of the environment, CED as an art of the social seeks to move beyond adherence to architectural abstractions and into a redefined practice of social *and* environmental concern (Light and Wellman 2003). CED is a practice of care. Based on these ideas, I propose three summary tenets for CED practice: 1) that the built environment, in acting as an agent for the benefit of both humans and non-humans is to preserve and enhance the environment aesthetically, ecologically, functionally, and with respect to history and the specificity of local culture; 2) that because "sites" for projects must be seen as already social, political, and ecological entities, all projects should be understood actually and conceptually as local renovations; and 3) that "programs" can no longer be conceived as free-floating abstract descriptions of economic needs in search of a "site" to appropriate but must be developed in consultation with regard to the specific conditions of the place. Or by extension, that places (sites) may serve as the catalyst for the development of programs most suitable to that place. In what follows we will look at how the two groups of student designers sought to operationalize these tenets.

2. FINDINGS: CIVIC ENVIRONMENTALISM STUDIO WORKSHOP

The studio portion of the workshop began with the critical consideration of texts – an immersion in the theory of civic environmentalism. And with an exploration of the watershed that would serve as the general locale for the as-yet undetermined projects – an immersion into the ecological and cultural conditions of a specific landscape. The students worked as individual designers and in groups. The site was the Boggy Creek watershed and neighborhood in east Austin, Texas. Historically this area has been the site of racial segregation, is marked by and suffers physical neglect, and still has the highest concentration of those living below the poverty line, many of whom are elderly, in the city. It has suffered from work completed by the Army Corp of Engineers to control drainage through the watershed. This work turned the waterway into little more than a drainage ditch and destroyed a potential urban amenity. More recently, it has begun to be the subject of gentrification as the economy of the city has skyrocketed. It is also a place of great natural beauty, deeply held religious belief, old houses, and well-tended gardens.

Initial efforts by the class to get to know the landscape in depth included the production of maps using Geographic Information Systems (GIS), visits to the area, interviews with locals, presentations from community representatives on the culture and ecology of the area, and climate analysis. Their exposure also included lectures on environmental design issues such as micro power, food security among the poor, and urban ecology. Lastly each student was required to adopt an animal that inhabits the city, such as bats, to be given consideration during design.

Eventually they settled into two groups. Each group developed a philosophical position based on the readings that guided the selection of sites, the determination of individual projects, and the style of "renovation" that would be appropriate. The Rosewood group selected the existing Rosewood neighborhood because they felt, after a thorough analysis, it needed to greatest amount of amelioration due to poverty and neglect. They were also captivated by the richness of "cultural and natural resources" that would provide a solid foundation for future work were they able to identify "trouble spots." The Featherlite group chose a mostly abandoned area (a brownfield site) because they felt it best situated for expressions of "appropriate" future development. One such development is the planned location of a light-rail system that would have a stop within their site establishing it as a planned node. Further, Featherlite chose to operationalize their contribution through a consideration of Maslow's "hierarchy of needs" and a sense of what makes a "good city" and a healthy community (Maslow 1968). They based their thinking on abstract universal principles, chose an essentially empty site, and developed individual schemes that would be appropriate and beneficial in many places but which would require being fitted to their site. By contrast, the Rosewood group operationalized their work through an analysis of the life within the neighborhood. They sought the narrative structure that gave local residents a sense of place and in doing so, developed individual projects from *within* that neighborhood and which may not been considered outside of it. Rosewood based their thinking on the specific conditions, which allowed, at least initially, the work to be generated responsively to local conditions.

It can be said that Featherlite sought to *apply* ideals and ideas developed outside of Boggy Creek while Rosewood *drew* their ideas from within it. Where Featherlite engaged in the *production of community* by designing effectively for what may come (more residents and higher land values), Rosewood focused on the *preservation of community* and more directly upon improving upon the existing conditions. Further, and this is a more elusive point to make, for Featherlite, care for residents and the local ecology was treated as a requirement, while with Rosewood, care was implicit within the structure of their narrative approach. The differences between their decisions are significant, not so much for the potential success of the resulting schemes but because they reveal two conceptually distinct possibilities for carrying out civic environmental design.

The Featherlite projects included a grocery store, a transit hub, economic incubator, housing, and a cafe. They were to be located in close proximity to correspond to smart growth principles of densification and a reduction in automobile travel. In this, they are all types of programs that might benefit *any* place as they are based more on satisfying needs considered universal. All were to be new construction on presently undeveloped land. The Rosewood projects consisted of a proposal for animal and non-human habitats in the neighborhood, a neighborhood recycling center, two proposals for waterway restoration, one including an interpretive center, the other a renovation of a neglected housing complex, a neighborhood power generation station and park refurbishment. Most involved improvement of some existing condition. And, overall the emphasis was infrastructural in that the projects were located within and around existing places and addressed more specific needs or "trouble spots," as the group referred to them.

2.1. *A Priori* and *A Posteriori: Method and Agency*

Extrapolated out of the immediacy of the studio, these differences correspond to what I earlier identified as conventional or *a priori* and emergent or *a posteriori*. I think it is significant that they emerged within the context of designers struggling to operationalize the precepts of CED and because these two approaches seem to mesh well with the tenets outlined above. All agreed to and pursued the goals captured in CED #1 and #2 while they differ in terms of #3. Featherlite pursued the more *conventional* or *a priori* approach by developing programs *for* Boggy Creek. While, Rosewood pursued an *emergent* or *a posteriori* one by developing programs *from* the idiosyncratic and specific existing conditions they found at Boggy Creek. Both were responsive to the place, but utilized different sources and rationale. With the former, the primary source for programs was the designer's ideas informed by architectural discourse, later conditioned to local circumstances. With the latter, the source was the place itself, for which ideas from architectural discourse acted as interpreter.

Thus, *a priori* and *a posteriori*, as methods and rationale for design differ on the source of one's authority and the priority of consideration. With *a priori,* decisions are based on universal structures of meaning and needs, such as how Featherlite used Maslow's formulation to determine, which "needs" were to be met. In contrast, *a posteriori* decisions are based on local structures of meaning and needs, such as how some of the Rosewood designers used interviews with local inhabitants to determine needs. Appropriately, each brings the benefits and limitations associated with the particular knowledge about which I will say more in the conclusion.

More importantly these distinctions also extend to the agency provided by the built environment itself. If we accept the premise that buildings, by safely housing our goods and protecting us during inclement weather, act on our behalf then it follows that the built environment acts as our agent. *A priori* agency, with regard to the built environment, is when a place means to benefit its inhabitants in terms of universal needs and through the application of universally derived codes. Such codes can be that of the "comfortable index," for the United States, between sixty-nine and eighty degrees with fifty percent relative humidity (Olgyay 1963). Or in terms of safety the code might mandate the inclusion of automatic door closers for the control of fire. Those door closers stand in for our human fallibility to not do so in event of emergency. In another sense, universal codes can also be those of taste, style, and/or tradition. Agency of this sort is not site specific and is used most effectively in speculative home "shops" to decide exactly what the "median" income prospective home buyer will be looking for in their new "home." And by home "fashion" magazines such as Dwell, which sell a universal conception of modernist style as an appropriate option everywhere.

Within this framework *a posteriori* agency is the organization of the built environment according to local needs, opportunities, and codes. Here we may also include a door closer, but it is deployed to deal with local conditions such as too many mosquitoes, or perhaps at the request of the owner. This door closer, like the first, stands in for the inhabitants normal role as the closer of doors but does so as a localized and specific response. Official building codes can also be derived in an *a posteriori* fashion. New York City in the wake of the 9/11 attacks has for the first time in its history begun to consider the rewriting of its safety codes for the construction and operation of buildings. There is much hand-wringing as "New York is abandoning many of the intricate restrictions, [that have been] carefully tailored to its quirks and jealously defended over the decades" (Lipton 2004:A21). Lastly, *a posteriori* agency can also be a means by which the built environment is specifically configured to take advantage of local circumstance: A house designed to admit cooling breezes in a hot climate, a well placed window to make visible a framed view, or the choice of limestone as a cladding material because it is contextual or locally available.

What remains to be accomplished is to situate the suggestions of the scholars, the results of the studio project, and my extensions within existing practice. That is where we will turn next.

3. EXTENSION: CASES WITHIN NORMATIVE PRACTICE

Within normative architectural practice, civic environmental design does not, as yet, exist. But aspects of it can be found in many practices and theoretical positions. Most clearly open to the environmental dimension of CED is the ever-enlarging set of practitioners engaged in green, sustainable, or ecological design. For the civic side, particularly when the civic dimension is construed beyond the city to refer to one's duties and obligations in belonging to a community, there are many socially conscious architects who normally engage in issues of low-income housing, diversity, and planning for communities. CED, by first establishing a dialectical relationship between environmental quality and social health, suggests that architecture must go beyond the production of material objects to engage social processes. Second, by expanding the definition of quality to include local ecologies and their non-human inhabitants, CED must be understood as a material, social *and* ecological practice. The designers discussed below each represent facets of that possible practice.

3.1. Michael Pyatok

> "I came to understand that the opinions and experiences of people from the most humble of backgrounds had equal value to those of professionals when shaping cities, neighborhoods, buildings, parks, and in general, the uses of our natural resources" (Pyatok, Personal Choices).

For at least twenty-two years, Michael Pyatok with his firm Pyatok Architects, have been engaged in the design of award-winning urban-based low-income housing for people traditionally excluded from conventional markets, thus fulfilling the model of a socially-conscious (or civically-oriented) design practice. He works to develop intimate connections with future residents and neighbors by working exclusively with non-profit developers (to keep the scale of owner/manager – client ratio intimate) and through his own very effective methods for community participation. "We structure it so that it is an engaging process. We solicit from residents their opinions on how they want to live, what they think about their community. And from neighbors, how they want these new introductions into the community to fit" (Stromberg 2002). Further, Pyatok maintains that the building community is actually the greatest product of their efforts, a vision of design that encompasses production, financing, and community organization. Nonetheless, he points out that, the "designs of these places send messages... about how much we cared about the people being housed there and how much we care about the neighborhoods... Good design is a sign of respect" (Stromberg 2002).

Pyatok gives us an example of both *a priori* and *a posteriori* methods and agency that enable his own brand of civic design while remaining within the realm of conventional (albeit expanded) practice. The firm is *a priori* in their use of conventional models of housing and in maintaining the standard roles within practice. And they are, *a posteriori*, in their engagement of community participation (to help them think in terms of local needs) and in the resulting built configurations tailored to those needs. The best example to date is a low-income townhome project, named Klahanie, designed for Southeast Asian residents in Issaquah, Washington. Arrangements include "swing rooms" that allow the borrowing of rooms to accommodate extended families, community gardens, details to allow the hanging of foodstuffs on the porch, culturally-meaningful colors, and the right to hang laundry out to dry (Pyatok 2000). All of these required a culturally and civically responsive design and development team. However, for now it remains to be seen whether environmental considerations, understood ecologically will redefine the environment in their environmental justice (Pyatok 1996).

3.2. Rob Wellington Quigley

> "Achieving a fit in the social process of design is even more critical. We must find a way to access the collective ego of those who are impacted by the buildings we design" (Quigley 1996:204).

Originating with his solar residential homes in the 1970s, Quigley and his firm have since established a strong track record of socially conscious conventional design and planning. They have recently begun to more fully embrace sustainable design principles. Quigley has, in a lecture in San Antonio, summed up his interest in the social process of design by referring to it as a "populist-enabled" method of maintaining "artistic authority." It is about "achieving the fit" between the built environment and those who will experience it. "We enjoy working with the community to solicit their input. We are comfortable coordinating the desires of a multiple client group that can include City staff, elected officials, civic groups and agencies, and community members" (Quigley). His most notable early achievement along these lines was the design of the first new single-room only (SRO) hotel in San Diego in seventy years as a response to a local social need (the rising number of homeless) he identified in conjunction with developers Chris Mortenson & Bud Fischer. His firm went beyond design, engaging the city in the production of new ordinances to make it possible. As a traditional project, it is a good building built cheap fitting between social need, financial means, and political reality. More importantly it represents an emergent model for practice in that a geographically specific need served as the origin of the project. This practice has continued more recently in the development of a parking garage for a college campus which Quigley planned for new programmatic elements as a way to develop life in the area. Uncharacteristic for an architect, Quigley has acted as the developer seeking tenants for which he will also serve eventually as architect.

Quigley supplies us with an example of both *a priori* and *a posteriori* methods and agency enabling his civic (and emerging environmental) design. Much of their effort lies in reinterpreting many (*a prior)* programs in specific relation to the community and site (*a posterirori*). These "design paradoxes," as Quigley refers to them, provide the source for the richness of the work leading to projects not only fitted to their clientele (as with Pyatok), but projects that are more effective and unexpected. The SRO's became dignified housing, the parking garage – a social place, and his Solana Beach Transit Station – a mixed-use project that includes low-cost housing, artists lofts, a restaurant, and retail shops. Quigley fills in the gaps between people and place by including them within the decision-making process and by expanding the architect's role to include politics, activism, and development. The built environment and the methods used to achieve it, enable residents to belong to their place. As for his environmental stance, we will also need to wait and see to what extent it becomes a full dimension of their work. Ideally, Quigley's sense of environmental responsibility will be something he brings to every circumstance just as he brings a sense of civic pride.

3.3. Samuel Mockbee and the Rural Studio

> "Architecture won't begin to alleviate all of these social woes. But what is necessary is a willingness to seek solutions to poverty in its own context, not outside it... with knowledge based on human contact and personal realization applied to the work and place" (Lindsey 2003: 63)

The Rural Studio, the late Samuel Mockbee's educational project, continues to benefit the residents of Hale County, Alabama, one of the poorest in the United States. Begun in 1992 with twelve University of Auburn architecture students the program has since evolved to include over four hundred students. To date they have completed approximately forty projects ranging from renovations, to ball fields to single-family housing.

Throughout its history the students have engaged in both *a priori* and *a posteriori* design and providing both kinds of agency – giving people "warm, dry, and noble" places to live but and also projects that have allowed residents to live according to local understanding, conditions, and meanings. All work is aimed at the mitigation of the kinds of social injustice closest to the concerns of architecture – the *a priori*: poverty, substandard housing; and the *a posteriori*: the relationship to a specific land, and the relationship to a place which serves as a source of values. Through the production of mostly dignified and dignifying private housing, the Rural Studio, like Pyatok, has stuck to the satisfaction of *a priori* needs but transformed those abstract ideas, as stated on their website, "into workable solutions forged by real human contact, personal realization, and a gained appreciation for the culture." Thus, their ultimate goal was an *a posteriori* process and agency summed up above and in their mission statement, again from the website: “The Rural Studio seeks solutions to the needs of the community within the community's own context, not from outside it.” Over time they have achieved this and the Rural Studio's primary mission, "the education of *citizen architects*" in which the students learn civic responsibility and participation as the virtue of practice (Lindsey 2003). By becoming integral with the community they have enabled their *a posteriori* approach. "Instead of encountering sites, clients, and building as abstractions, students in Newbern grapple with all directly" leading to projects that stem from within the community and which aim at enabling local ways of life, such as the construction of Shepard Bryant's Smokehouse for curing his daily catch and the oversized porches for daily life (Forney 2003).

Environmentalism at the Rural Studio is a low-key issue caught up mostly in the direct consideration of climate, energy efficiency, daylighting, and rainwater catchment. Their particular focus is on the use of recycled materials including the testing of a variety of cast-off materials for unconventional uses such as discarded carpet samples and baled corrugated boxes as exterior cladding and insulation. Further, while it explores these "building methods that foster responsible resource use," organizers admit that the program and the work are "not as sustainable as many wish"(Forney 2003). As time goes by, more and more students are likely to embrace ecological principles as they have shown ample skill with environmental justice.

3.4. Walter Hood

> "I am interested in how the everyday mundane practices of life get played out in cities, the unheralded patterns that take place without celebration" (Brown 2004).

Landscape architecture has of late had an increasingly intimate relationship with ecological values. Its longer relationship is with providing settings for activity and contemplation. Accordingly there has been a variety of established garden or park types through American history from the pleasure grounds that served as refuges for city dwellers to the recreational facilities for weekend ball games and cook-outs (Cranz 1982). Walter Hood's eleven-year-old practice contributes the best of this history to outdoor landscapes of neglect within the heart and at the edges of low-income neighborhoods. His site is Oakland, California. In bringing these *a priori* models from landscape history he relies on an *a posteriori* process to bring them to fruition, a process he refers to as "improvisation." Hood's goal is to develop settings that thrive in the city by best fitting both the present and future needs of a specific neighborhood and which re-establish forgotten or neglected city spaces. Serving as an advocate for the community he engages in historical – almost archaeological – research in order to interpret forgotten local history and community context. He has extensive conversations with neighborhood residents. And he engages in participant observation of the everyday uses and flows within and through the place. "Most people would simply see things Walter observes and ignore them... He sees the guy who comes and hangs out at the park as someone who enriches the experience of being there," says Randy Hester, a colleague (Brown 2004). Often he is seeking idiosyncracies that mark the place as special seeking to provide venues for constant daily activity. His Lafayette Park project, for instance, includes a shaded plaza for Tai Chi, a raised knoll which recalls an observatory that once occupied the site, barbeque pits, an underground fountain, play equipment, and a resurrected horseshoe pit. It is a park that appears to offer something for everyone.

His work, while predominantly civic is also ecologically driven. All of his ten Oakland park projects are restorations of one sort or another. Whether it is a stream restoration in Fruitvale, brownfield reclamation, or simply the cleaning up of a trashed lot, his projects better the ecological and cultural life of the city and the particular neighborhood. His work combines, in a unique and locally inflected way, economy and environmental justice through revitalization, and aesthetics and ecology through design.

3.5. Peter & Anneliese Latz

> "We understand avant-garde landscape architecture... as a translation of abstract ideas, ideas of nature, ecology, and society... The site itself and ecological programs are forming the spaces of the future" (Latz and Partner).

Peter & Anneliese Latz have produced provocative and well-known works by adapting the concepts of the *Volkspark* (people's park) and the ecological park to post-industrial landscapes. Developed in Germany in the early 20th century, the *Volkspark* was intended to provide city residents places for active recreation. Ecological parks by contrast serve to improve a city's ecological health by providing oxygen, cleaner air & water, and diverse habitats and are often didactic educating the public about healthy ecosystems. They focus these transformative efforts on "the renewal of destroyed and often contaminated sites" (Latz and Partner). These are essentially found places that require ecological, aesthetic, functional, and historical restoration. The resulting works are designed to benefit local populations by providing a place of either respite or active recreation, and by respecting the site's cultural heritage. To achieve these works it required a shift from their earlier more conventional *a priori* approach to an emergent *a posteriori* one.

Illustrating this shift with regard to the design of the Hafeninsel Park in Saarbrucken, Latz states, "We made plans for an English garden and for a formal garden.

We worked through all the clichés and then put them in the trash" (Lubow 2004). Instead, for the bombed-out and derelict port they excavated remnants of the old coal dock, existing foundations, and other found materials and produced a historically rich new park. Saarbrucken proved to be a pilot project for their more well-known and larger Landschaftpark Duisburg-Nord which has framed their practice to date. Occupying several miles along the Emscher River, Duisburg-Nord sits amid blast furnaces, slag heaps, and defunct railroad tracks all of which remain providing the spatial structure for the park. Maintaining the industrial carcass of the plant lends its visitors and neighbors an *a posteriori* agency by allowing them to participate in present activities and the past simultaneously. The plant which was so much of the life of the area remains and has been made eerily attractive by planting and excavation. Minor interventions and careful planning mark the Latz' brand of *a posteriori* design. Cooling tanks have become lily ponds, ore bunkers edge garden plots, railroad grades serve as paths, and piles of carcinogenic compounds are sculpted to discourage trespassing but left open to naturally bio-remediate. Their work presents a comprehensive civic environmental model for the future by combining, in an attractive fashion, ecological restoration and social benefit. Latz & Partners work here easily fulfills all three of the CED tenets proposed above providing a complete example of environmental design as a local "renovation".

3.6. Stefan Behnisch

> "… to attempt to create a architecture in response to the various aspects of context, where culture, urbanism, and concerns related to sustainability are incorporated in a seamless manner" (Behnisch, Behnisch, and Partner).

The work of Stefan Behnisch within the firm of Behnisch, Behnisch & Partner (BB&P) produces work that is well known for its dedication to sustainable principles, urbanism, and humane environments. They are a predominantly conventional firm in structure and method, but manage to produce works specifically tailored to key features of their locale and flows of energy through the site. Put differently, BB&P uses an *a priori* approach and techniques to achieve *a posteriori* agency. Beginning with the Institute for Forestry and Nature Research in the Netherlands, their civic and environmental commitments have been expressed most fully in the Nordeutsche Landesbank (Nord/LB) in Hanover, Germany, and in the recently completed Genzyme headquarters in Cambridge, Massachusetts.

Each of these projects employs an almost uniform and comprehensive set of technical strategies to satisfy their sense of environmental responsibility. These include: daylighting and the redirection of natural light to reduce the need for artificial lighting, double-shell cladding systems and atria for the control of the interior microclimate (summer cooling and winter heating), sun shading, geo-thermal cooling, thermal mass, active solar for the generation of power, the use of recycled and local building materials, and landscaped roofs. However, this *a priori* approach is clearly aimed at achieving a specific fit within the energy flows at that particular site and relative to the specific activities to be housed there.

The civic contributions, on the other hand come in a wide variety of forms with each variation aimed, again at achieving a fit appropriate to the locale. Within the examples cited above these include: some democratic participation (by future inhabitants) in design, buildings that contribute aesthetically to the cityscape in form and color, buildings that provide high-quality public space at the ground floor (a sort of modern arcade), and buildings which minimize consumed and embodied energy to the benefit of local society as a whole, and buildings which provide its staff varying degrees of control. Moreover, there lies the potential for a fuller CED as Stefan Behnisch continues to develop the firm. As he stated in preparation for a symposium entitled *Ecological Architecture as part of The Concert of Architectural Tasks*: "Ecology is not a separate topic... The ecological value of a building depends to a large extent on the approach of the users to their built environment... The rhythms of nature have almost fallen into disuse. Instead of considering them a nuisance and a source of reduced comfort in our civilized world, people could again be made aware of these rhythms."

4. PROVISIONAL CONCLUSIONS

To begin it must be made clear that a design practice based on civic environmentalism, in the fullness captured in this volume, remains elusive at present. So, I must amend an earlier statement. While nothing called civic environmental design exists as of yet, it is clear that there is ample precedent for its establishment within existing normative architectural practices. Full implementation will require consideration of ideas I have summarized and more research into the possibilities latent within this emerging discourse. The foundation of a civic environmental design is the merger of civic and ecological concern. The examples above suggest that this merger remains the primary impediment. Each would benefit from a fuller synthesis of both their civic or environmental commitments. Those practices whose focus is the civic/social dimension would benefit from a more thorough embrace of the ecological dimension. And, those focused on ecology, sustainability, and "green" concerns would find balance through greater concern for social justice and cultural meaning. A civic environmental design is inherently democratic, socially engaged, ecologically informed (including care for non-human populations), and aesthetically skilled. The objects of its production are likewise socially beneficial, ecologically sound, and capable of being understood as beautiful all within a local community. Moreover, it relies on processes that are in sync with these goals.

For this, I have concluded that the concepts, *a priori* and *a posteriori* that should be thought as dialectically interrelated. Each serves to balance the weakness of the other. A process characterized by *a priori* consideration is weak in that it tends to result in applied or conventional solutions but strong in that it embodies collective cultural knowledge. A process characterized by *a posteriori* consideration is weak in the reliance on local circumstances for solutions (i.e. Quigley's "fit" may never be ecological, unless asked for by the community), but is strong by its responsiveness to those local conditions (Light 2002). Further, *a priori* can guard against naive localism (prejudice, narrow-mindedness, provincialism) by maintaining codes and norms that emerge from outside of the particulars. And, *a posteriori,* by focusing on specific sites as the source of "programs" favors a "closer" or more well matched renovation.

Certainly any good practice derives its robustness from an appropriate blend of considerations. But I will maintain that at present *a priori* justification, process, and agency remains dominant in contemporary practice limiting the full potential of a civically environmental practice. And, further, that for CED abstract principles must always be tempered and conditioned by local opportunities. The benefits of *a posteriori* justification, process, and agency are clear. By focusing concern on the local it aids in establishing connections between local citizens and their local environment, thereby encouraging ecological citizenship in them and in the professionals who guide them. Further, by virtue of the local sensitivity it engenders, tempered with knowledge and skills from the outside, we increase the potential for design to yield the "goods" promised by civic environmentalism - places of ecological integrity, community, justice, and beauty.

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Preservation & sustainability: The case for ‘realistic’ evidence-based design policy

Christopher Koziol

University of Colorado, Denver, Colorado

ABSTRACT: In recent years, partisans of historic preservation have begun arguing “the greenest building is the one already built. Often voiced in response to a narrowly conceived idea of building envelope energy performance, the statement nevertheless assumes away a proper research agenda. The underlying values appear incommensurate, and the differences between practitioners has appeared in a variety of public policy controversies ranging from conflicts over local preservation and sustainability ordinances, to government building energy performance contracting, to sufficiency of USGBC LEED standards for addressing issues of historic buildings. The potential question for the architectural researcher addressed here, is how to best frame the underlying research question. What metrics and data are relevant to policy and building level analysis?

As a means of answering this question, this paper attempts to step-back from the tit-for-tat of the usual arguments by elaborating on how an evidence-based research program might address the problem. Specifically, the paper briefly discusses the genesis of evidence-based decision making in healthcare, and its ensuing extension into both building design and public policy making. The case is made that a discussion occurring among another group of scholars - those in public policy - is directly relevant to how designers might begin to more explicitly address what constitutes *evidence* in policy setting, as opposed to a more open-ended notion of *data*. The relevance of this as applied to sustainability and preservation lies in an urgency expressed by preservation advocates such as the National Trust for Historic Preservation and its recent call for “data to make our case.” This reference to data assumes that this will bring about agreement and supportive policy. However, the literature on evidence-based policy is more circumspect of simplistic relationships. It is interested in program logic (why we think an intervention will have the effect we think it will) and causation (how and through whom the effect will be carried out).

While this paper addresses methodological issues in research, its abstractions are grounded in particular examples and ongoing dilemmas in the relationship of preservation to sustainability. These examples will be used to illustrate the more abstract points.

Conference theme: new methodologies in architectural research

Keywords: historic preservation; evidence-based design; public policy

INTRODUCTION

It would be quite presumptuous to declare what *evidence-based design* ‘is’, and what it ‘is not.’ However, a brief review of the term’s use in the recent literature suggests that its most common association is as an extension of evidence-based medicine. Hence, its most frequent application in architecture is in health-care design. While this is not astonishing it is potentially limiting in the ways that empirical knowledge does and can affect various specialties of architectural practice. Specifically, recent controversies in the relationship of historic preservation to sustainability allow the researcher to explore another potential extension of the logic employed in evidence-based architecture. Public policy scholars hold a relationship to their practitioners (i.e., politicians) similar to that of medical researchers to theirs (i.e., doctors); and we might add, also akin to that of architectural researchers to architects.

Historic preservation is a term referring to a relatively complex practice and is used to mean different things among different groups. Preservation is public policy, it is local regulation, it is design, and it is conservation treatment among other activities. One recent way of understanding these multiple perspectives is treating preservation as a changing and evolving discourse (Smith 2006, Koziol 2008). In this, the perceptions and actions of individual actors are recognizable and subject to analysis within the larger context. Hence, like physical facts (e.g., material decay, structural failure), the actions of preservation actors can be observed, and their underlying assumptions of cause and effect inferred through analysis. In the language of evaluation research, the actions of preservationists are *theory-*

based (Rossi *et al* 2004).

Historic preservation, like many specializations in architecture and design, has been affected in recent years by the public discourse on sustainability (Lesak 2005). In recent years, partisans of historic preservation have begun arguing "the greenest building is the one already built" (Elefante 2007). This epithet, often voiced in response to a narrowly conceived idea of building envelope energy performance, is sometimes employed in a manner that assumes a *proposition* to be proven *fact*. Preservation advocates cite concepts like "embodied energy", "climate-responsive vernacular building types" and "sustainable craft traditions" in response to counter claims often reduced to a single metric of thermal resistance ('R' value) of a wall, roof, or most centrally to the preservationists' chagrin, windows. The underlying values appear incommensurate, and as a result neither side fully convinces the other of its argument.

The connection to the concept of evidence is based on the proposition that both physical facts and individual understandings manifested as behaviors can be understood and applied as evidence in the practice of historic preservation. Hence, the challenge is to develop a framework for such an analysis.

As this is a preliminary inquiry, this paper is not intended to be conclusive; rather the goal is to be constructively provocative. First, the connection to evidence-based design, as it is currently used in the literature, is established. Second, complications regarding the complexity of evidence as discussed in the policy and management evaluation literature are introduced. Third, these concepts are integrated and applied to a discussion of a case involving preservation and sustainability. Finally, an argument is made for the increased use of an expanded concept of *evidence* in historic preservation and architectural practice.

1. EVIDENCE-BASED DESIGN

1.1. Connection to evidence-based medicine

The discussion of evidence-based decision making in the design disciplines have largely grown as an extension of calls for better "integrating individual clinical expertise with the best available external clinical evidence from systematic research" (Sackett *et al* 1996: 71). The authors continue to define their concepts.

> By individual clinical expertise we mean the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice. …By best available external clinical evidence we mean clinically relevant research, often from the basic sciences of medicine, but especially from patient centred clinical research… Good doctors use both individual clinical expertise and the best available external evidence, and neither alone is enough. Without clinical expertise, practice risks becoming tyrannised by evidence, for even excellent external evidence may be inapplicable to or inappropriate for an individual patient. Without current best evidence, practice risks becoming rapidly out of date, to the detriment of patients. (Sackett *et al* 1996: 71-72).

Intriguing here, is the concept that effective practice is neither solely dependent upon the accumulated, and often tacit, expertise of practitioners, nor only on better 'basic science' research. What stands out in this argument is the importance of "patient-centered" knowledge. This idea of integration has led to a rapid adoption of this concept by other health and 'helping' professions. Nursing, social work and others have all seen increased reference to this concept in their respective literatures (Reynolds and Thinder 2000). As more professional disciplines have begun using this concept "evidence-based practice" (EBP) has begun to supplant the term "evidence-based medicine."

1.2. Connection to healthcare design

It is also no wonder that healthcare design would be among the first of the design specializations to adopt the language of evidence-based practice. Sharing a connection to patient-centered research, the extension of the concept was relatively unproblematic. Architectural researchers specializing in the behavioural and natural sciences have long had a ambivalent relationship with design practitioners (Rowe 1991). While the literature of post-occupancy evaluations (POEs) and building performance studies has long been readily shared among researchers it has frequently been ignored by practicing architects. However, the language of the evolving discourse of evidence-based practice has connected design researchers to users of healthcare architecture (i.e., patients), in a way that has provided access to a powerful constituency of clients, (i.e., health care managers and institutional providers) (Ulrich *et al* 2004). As a result, practicing architects are increasingly attentive to this trend (Hamilton 2006).

1.3. Extending the argument in architecture

Whether this close initial association to healthcare issues is a necessary limit or just an initial circumstance is still unresolved. However, Sherry Ahrentzen's (2006) thoughtful attempt to extend the concept of evidence-based design beyond its application to healthcare is particularly instructive. She acknowledges that such an expansion may be limited by some of the differences between healthcare and other design sectors. Specifically, in reviewing institutional differences between her area of interest, affordable-housing, and the more centralized healthcare sector, she notes:

> This is a different animal from the housing industry. The latter [housing] is rarely institutional (prisons being one exception). Desired outcomes are less agreed upon, more diffuse, and sometimes minimally measurable. The historical base of the industry is geared toward profit making and efficient, expedient construction rather than the care mission that underlies the healthcare industry. Evidence-based design appeals to the scientific minds of physicians and other clinicians who are trying to practice on the basis of medical evidence. This may be a harder sell among housing developers and others in the housing industry (Ahrentzen 2006: 29).

However, these institutional differences do not deter her from making a case for an extension. She largely rests her hope on the insight that managers and owners in other building sectors are as concerned about reduced costs and improved organizational performance as are those in the healthcare industry. Ahrentzen, much like Ulrich, uses another concept from the healthcare sector to propose a new agenda for architectural researchers. *Translational research* "is the bridge between research studies and day-to-day applications." While this connection is useful as a rationale for increased support for applied research it makes some assumptions about an unproblematic and linear process that have proven to be subject to more scrutiny in another related literature. Social policy evaluators have been engaging in a discussion of evidence-based practice of their own, and in general they are less sanguine about the linearity of *translation*.

2. EVIDENCE-BASED POLICY

2.1. Policy and program theory

Public policy, like the healthcare and design sectors, has its researchers and its practitioners. There is an extensive literature on both the difficulty in making the connection between them and in the efforts to improve the situation (Lindblom and Cohen 1979). However, unlike in cases related to patient care, public policy objectives are often more nuanced and even convoluted. Hence the discussion in that literature has more explicitly attempted to understand how policy actors believe their intervention will affect outcomes. This assumed causal mechanism constitutes the 'logic' or 'theory' of the program: "If we do X, the outcome will be Y." Hence, an important part of evaluation research has become the explicit elucidation of this relationship. This has become known as theory-based evaluation (Rossi *et al* 2004, Shaw *et al* 2006).

2.2. Types of evidence-based policy

A recent review of evidence-based policy in the evaluation field identified two poles in existing practice (Pawson 2002a). *Meta-analysis* combines and reduces data from multiple studies at the price of nuance and possibly comparability. *Narrative review* compiles detail but offers little analytical guidance as to patterns and actor motivations across studies. As a corrective to these extremes Pawson (2002b) suggests a 'third way,' under the banner of *realistic evaluation*. He proposes that by reviewing prior studies with the purpose of determining the operative program theories, one could better determine patterns of success and failure based not merely on those variables the researcher chose to count, but more significantly on the causal mechanisms assumed by the social actors. Following Popper (1959), he argues that such an approach allows for a process of inductive falsification which in turn might lead to being able to "rule out" infeasible policy approaches without a large 'n' sample. While Pawson's approach, and its claimed connection to program theory, is not without its critics (Blamey and Mackenzie 2007), it does afford a model for developing an approach which might be applicable to a field which is more heterogeneous in its objectives than, say, medical treatments; and does not have a sufficiently high number of documented cases to assure generalizable conclusions.

2.3. Connection of program theory to design

Hamilton (2006) and Ahrentzen (2006) have individually argued for the extension of evidence-based practice to the evaluation of design. Their suggested approach to this is one in which the practitioner – in this case, the architect – becomes a better *consumer* of research, who eventually may 'grow' into being a *producer* of research. While such a scenario, if implemented, might increase the amount of data available for future studies, this transformation of the practitioner remains, at best, a distant hope. This is where Pawson's experience with the rapidity of the policy cycle, as opposed to the pace of the typical research cycle, might better serve those of us interested in architectural practice. While we need not reject the desirability of more and better studies to aggregate and analyze, we also need not wait until they are available.

One other aspect of Ahrentzen's research scenario seems closer to fruition. She proposes that practitioners often learn through 'cases' and supposed 'best practices,' but acknowledges that there is little consistency in what is documented and presented in these studies. However, noting that there are already some good models in existence in the design field – such as the Rudy Bruner awards and Business Week / Architectural Record awards – she suggests a promising typology of best practice documentation adopted again from the medical field and adapted to affordable housing design.

- *Evidence-based best practice*: exemplary affordable housing policy, program, or design whose outcomes are supported by comprehensive, valid and compelling research evidence (e.g., post–occupancy evaluation; use of evidence-based guidelines or programming) that substantiates how design reflects/fosters positive social, sustainable, and economic outcomes;
- *Emerging best practices*: affordable housing policy, program, or design that shows potential but whose outcomes are only modestly documented by research;
- *Promising practices*: affordable housing policy, program or design that has not yet been documented but is identified as promising by experts in demonstrating potential positive outcomes (Ahrentzen 2006: 32).

While not explicitly referencing the realist framework, this hierarchy creates a particular opportunity at the level of 'promising practices.' Here practitioners and researchers can begin to discuss how a practice is intended to work to achieve its objectives. In this, the idea of program theory would be employed.

3. EVIDENCE-BASED DESIGN POLICY

3.1. From problems to cases

As an architect and scholar more familiar with historic preservation than either healthcare design or affordable housing, my examples for infusing the already developing discourse on *evidence-based design* with the insights afforded by *realistic evaluation* are from this field. A case in which I was a participant-observer is presented in outline.

3.2. Conflicting design ordinances

Boulder, Colorado is recognized as a municipal leader in sustainability, and its elected officials and managers have attempted to infuse this ethic into a variety of public policies. In addition to adopting stringent codes for new construction, the city has applied similar standards to renovation projects as well. Specifically, in the early 2000s the city adopted a point-based approach to best practices, named Greenpoints (*Greenpoints Program* 2009). As in many efforts focusing on making utilization easy, the guidelines for this program simplified ways of achieving the minimum number of points required to secure a building permit and eventual certificate of occupancy (COE). Installation of *new* windows resulted in a substantial number of 'points.' This provision proceeded in parallel to another municipal ordinance requiring a landmark alteration certificate (LAC) for modification to either individually designated local landmark buildings, or those located in one of Boulder's several historic districts (*Historic Preservation Program* 2009). Approval for such permits often required the retention of 'historic building fabric,' which can translate into a requirement to *not* replace existing windows, regardless of their energy efficiency. The differences between the two ordinances escaped close scrutiny until one high profile case caused an extensive controversy.

3.3. Incident and policy response

In 2004, one residential building owner in an historic district replaced their original single-pane windows with new double-pane windows, despite a decision from the landmarks board ordering them to keep the originals. The landmarks board ordered that the old windows be reinstalled. Before this occurred a "crusading" local journalist destroyed all the stored historic windows so that they could not be reinstalled. He claimed that this was to protect the homeowners and Boulder from this misguided "tyranny" (Roberts 2004).

The melodramatic aspects of the case aside, there were clearly vastly different interpretations of what was at stake in this case. To the city's credit, managers assembled a panel of five preservation and building performance experts to sort through the issues of energy conservation and historic preservation and make recommendations to the appropriate boards, to eventually be taken to the city council. As a member of this panel, what was particularly interesting in the ensuing process was the ease with which the panel agreed on the technical feasibility of combining sealing air leaks and storm sashes to adequately improve the performance of historic windows. We shared evidence, both in the form of case studies and aggregate data. We concluded that the retention of repaired historic windows did not *necessarily* detract from the goals of the Greenpoints program. In presenting our *technical* conclusions to city personnel, the reactions of the environmental staff, preservation staff, and political/policy staff were telling.

3.4. Three perspectives

The environmental staff needed to operate a program that was intelligible to homeowners and builders. Achieving a certain threshold of points was seen to be the simplest way to do this. This is an approach that has been used in other green building standards, including the United States Green Building Council's (USGBC) LEED program. Alternate means of satisfying requirements were seen as potentially confusing users. We can hypothesize that the environmental staff's program theory was that building owners (and their contractors) are willing to follow clear environmental guidance that is rewarded when it reaches the minimum threshold. These owners might rebel if the process becomes too ambiguous or complicated. The rebellion of citizen permit seekers might politically jeopardize the program, thus compromising the city's strides toward energy efficiency and environmental stewardship.

The preservation staff also had concerns about how the resolution of this controversy might affect the workings of their program. Historic preservation can be very nuanced, but when implemented as regulatory policy by local governments it also needs clear reference standards. The Boulder preservation staff and board relied on the *Secretary of the Interior's Standards for the Treatment of Historic Properties* as its reference, and indeed this is often considered the preservationist's canon. Retention of character-defining historic fabric is here considered essential. As a result, allowing other matters, like thermal performance, to be considered would require trade-offs between 'more' and 'less' important policy objectives. For preservationists, we might hypothesize that the program works because the principles are clear and defined at a level administratively 'above' local implementation. Preservationists warned that tampering with the standards might result in revocation of the city's status as a certified local government (CLG) under the National Historic Preservation Act (NHPA).

The managerial staff involved in this case were concerned that the public controversy be tempered and that public relations damaged incurred through media coverage of the window destruction case be mitigated. For them, we might hypothesize public policy worked in Boulder when it was perceived as progressive and forward-looking, while not seeming onerous or farcical. Reasonable debate and resolution were paramount.

3.5. Outcome

Since 2004, Boulder has revised its Greenpoints program to recognize window rehabilitation as a 'point equal' to replacing windows and modified its application for receiving a landmark alteration certificate to include a specific sub-application for window replacement. By developing a form that makes the point tallies for window replacement and rehabilitation equivalent, but stated separately and clearly, the process ideals of the environmentalists were upheld. Preservationists retained a clear reference standard, but added nuance and flexibility by creating a hierarchy of importance for different faces of the building. Street facing facades are 'primary,' side facing are 'secondary,' and backs are 'tertiary.' Alteration certificates for, say, backside patio doors are now more likely, without compromising *the standards*. The ordinance revisions have coursed their way through the legislative and rules processes without too much additional public acrimony, satisfying the policy managers.

4. CASE OR EVIDENCE?

4.1. Learning from cases

As in the several award programs approvingly cited by Ahrentzen, the preceding case is salutary, but in itself it does not provide generalizable evidence for future design policy actions in other contexts. However, what it does possibly do is contribute to building a middle-range theory of how environmentalists and preservationists separately and collectively understand the existing building stock. It may form the beginning of a more systematic review.

> The basic idea of systematic review is to draw transferable lessons from existing programmes and initiatives. Realist synthesis assumes that the transmission of lessons occurs through a process of theory building rather than assembling empirical generalizations. …Each of these begins with the notion that programmes are conjectures taking the form, 'if we apply programme X this unleashes process Y, which will result in Z'. The task of evaluation by these lights is to gather evidence to see if the process occurs as planned and, if it should not, then to amend the theory to account for the divergent outcomes. Realist synthesis accelerates this process around many, many cycles with a systematic review of an ensemble of different programmes purporting to use the same underlying mechanism. Knowledge resolutions occur as follows. The process starts with programme A, which we discover works in certain expected ways for certain subjects. We accept these findings not only because we are able to show the appropriate correlation but also because we are able to produce a theory of how it works. We then take this explanation to a second programme B, which works ostensibly using the same programme theory (Pawsonb 2002b: 347).

4.2. Transferring explanations

Some months after the above case I had the opportunity to sit in on meeting held at the National Trust for Historic Preservation in Washington, D.C.. The purpose of the daylong conclave was for Trust staff to query preservation professional about positioning preservation's agenda within the environmental movement. Of particular concern to several staff members was the USGBC's relative silence on the particular issues of historic preservation in meeting LEED certifications. Having made the claim that "the greenest building is the one that is already built," Trust policy advocates realized that evidence was needed if more that those who already believed in preservation were to be enlisted in its cause. What was remarkable about the conversation that ensued was the similarity of it to the characterization of the two poles of evidence-based policy described by Pawson (2002a). Some argued for what could be considered a meta-analysis of previous studies; although most admitted that there was not much valuable data available. Others pointed to the growing body of best practice cases; although they too realized that many lacked comparability and rigor. What was not discussed that day was a 'third way' akin to realistic evaluation.

4.3. Does Washington look like Boulder?

What if the concerns of the National Trust staff were comparable to those of Boulder's preservation community? and those of the USGBC staff paralleled those of the Colorado environmentalists? Then say, that the concerns of managers and directorates at both national organizations might look like the concerns of Boulder's political leadership. Is this plausible? Is it falsifiable? At this juncture the answer to both questions is contingently 'yes'. So, why not pursue the evolving program theory through this case. Hence, rather than blindly attempt to resolve all doubt about the ability of preservation to provide sustainable outcomes through the amassing and aggregation of meta-data, or simply accumulating anecdotal accounts of 'successes,' ask whether or not there is a patterning of assumed causal relationships along the lines of what occurred in Boulder.

CONCLUSION

Evidence-based practice affords architectural researchers a compelling touchstone for our own endeavours. However, rather than assuming that complex architectural problems are 'just like' medical treatments we may benefit from broadening our review of the evaluation literature to better understand how evidence is being used and developed at the policy level. Public policy research may afford design researchers one such complement to what constitutes evidence in the field of medical treatment. Hence, without abandoning the potential power of evidence we may find ways of making it more realistic in our particular practices.

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Retro_Fit: greening educational facilities for carbon neutrality and students' performance

Ihab M.K. Elzeyadi, Ph.D., FEIA

University of Oregon, Eugene, Oregon

ABSTRACT: Existing classrooms and educational spaces are problematic. They approximately consume 30% of the nation's electricity, generate 35% of our waste, use 8% of water resources and are responsible for 20% of green house gas (GHC) and carbon dioxide emissions. While the new construction sector of the building industry has benefited from green products and building strategies to produce high-performance sustainable schools, existing classrooms have been largely ignored. This is a problem of huge proportions because the amount of occupied classroom space in the US exceeds 20 billion square feet. These existing educational spaces, generally a product of the past 30-50 years, are not energy conscious, and many of the new building products and sustainable strategies are not applicable to existing classroom retrofits. This research project targets this problem by developing evidence-based design guidelines for retrofitting existing educational spaces through the Green Classroom Toolbox (GCRT) project. This paper gives a synopsis of this project and provides a roadmap for its future application and replication.

The objective of the GCRT project was to develop green design guidelines for retrofitting existing educational spaces based on carbon neutrality metrics and student achievement outcomes. These guidelines were generated from a list of best retrofit practices that were identified by practitioners in a baseline survey and a series of focus groups, in a collaborative effort with academics. The identified best practices were then analyzed for their impact on building energy use and carbon emission using computer simulations. This data was further analyzed together with an extensive meta-analysis of prior studies related to the impacts of the best practices on occupancy health and students' performance. One of the significant goals of this project is to link green retrofit best practices with their energy and carbon emission reductions as well as with their impact on human health and student achievements. The hope is to provide a comprehensive decisions support tool for practitioners and school principals that will help them prioritize and evaluate green classroom retrofit strategies in a holistic way.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings

Keywords: educational Environments, green retrofits, sustainable building performance, environmental impacts, occupant health & productivity

INTRODUCTION: OVERVIEW OF EXISTING EDUCATIONAL ENVIRONMENTS

Every day, 55 million students attend schools in the US. Unfortunately, the EPA estimates that 40 percent of our nation's 115,000 schools and universities suffer from poor environmental conditions that may compromise the health, safety, and learning of more than 14 million of these students (USGBC 2008). In fact, according to the American Society of Civil Engineers, our aging educational buildings are in worse condition than any other infrastructure, including prisons. In addition, educational facilities have four times the number of occupants per square foot than most work environments.

A recent and rapidly growing trend is to design green schools with the intent of providing healthy, comfortable, and productive learning environments (Fig. 1). While the new school construction sector of the building industry has incorporated green products and building strategies to produce high-performance sustainable schools, existing classrooms have been largely ignored. Given that the occupied classroom space in the US exceeds 20 billion square feet (this includes labs, lecture halls, and meeting spaces), this is a problem of huge proportions. These existing educational spaces, generally a product of the past 30-50 years, are not energy and environmentally conscious. In addition, many of the new building products and sustainable technologies are not applicable to existing classroom retrofits. This research project targets this problem by developing and implementing the Green Classroom Retrofit Toolbox (GCRT), which (1) quantifies the impact of green school retrofits on the triple bottom line of people, planet, and profit; and (2) ranks these retrofits to

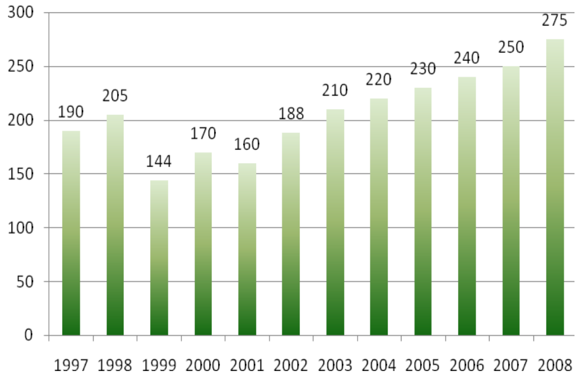

Figure 1: Education construction (million SF) (source: McGraw-Hill Construction & Analytics, 2007)

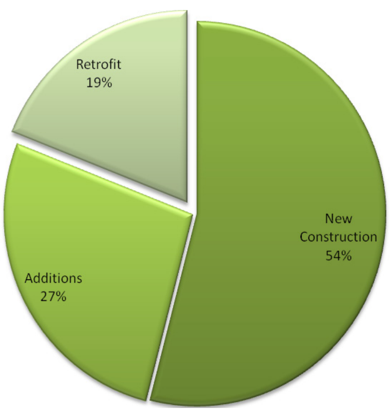

Figure 2: School project types by value (source: McGraw-Hill Construction, 2006)

provide design guidelines for making existing schools more sustainable and better learning environments. This project has huge potential benefits for school districts and tax payers due to the fact that more than 46% of all future schools' construction is either planned additions (27%) or retrofits (19%) (Fig. 2).

Currently, there is a great opportunity to impact the construction boom in schools and educational buildings. Building high-performance schools is reported to be the fastest growing sector of the building industry (McGraw-Hill, 2007), with a projected increase of 65% in the next five years (Fig. 3). It is expected to capture 27.4% of the commercial market construction (Fig. 4), topping the other market sectors in both value and number of projects. Although green schools provide a range of benefits, there is a current gap in information regarding their energy and CO2 performance, as well as their impact on sick days, operations and maintenance, life cost, insured and uninsured risks, power quality and reliability, state competitiveness, social inequity, and educational enrichment (National Research Council, 2007). The lack of evidence-based design guidelines for this building sector could lead to a devastating missed opportunity in directing that building momentum in the most effective way.

Based on a national review of 30 green schools, a study by Capital E (Kats, 2006) reported that green schools cost less than 2% more than conventional schools - or about $3 per square foot ($3/ft2) - but provide financial benefits that are 20 times as large. Kats also pointed out the lack of documented studies that evaluate and compare different scenarios for green retrofitting existing schools in terms of how well and how cost effectively they enhance student learning, reduce health and operational costs, and, ultimately, increase school quality and competitiveness. This gap in the existing literature was the main driver for the Green Classroom Retrofit Toolbox (GCRT) research project, which focuses on the impact of green retrofit scenarios for classrooms on the triple bottom line of, people, planet, and profit (3P).

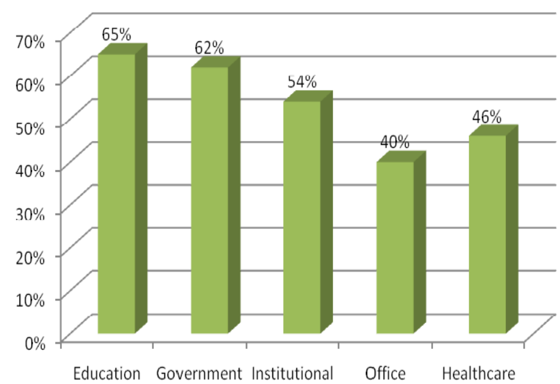

Figure 3: Top five sectors expected to have growth in green construction (source: Green Buildings Smart Market Report, Mc-Graw-Hill Construction, 2007)

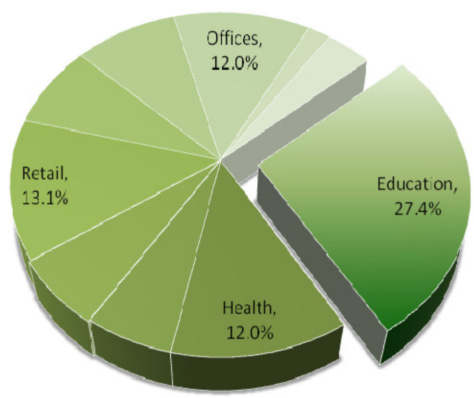

Figure 4: Commercial construction activity by value (source: McGraw-Hill Construction & Analytics, 2007)

1. AN ACTION RESEARCH APPROACH TO GREEN CLASSROOM RETROFITS

This interdisciplinary project targets the research problem by developing actionable green classroom retrofit guidelines. As reported by Ahrentzen (2006), the design and building professions have not established an agenda for organizing, disseminating, and advancing the state of knowledge on how good design is best employed to create long-term economic and social value. Typically, examples of "best practices" provide little evidence or criteria for what make them "best." For this reason, we developed our tools and tested them based on a deductive approach. First, in a collaborative effort between academia and local building professional organizations, we conducted a base-line survey to identify the best school green retrofit scenarios. This effort resulted in a check list of best practices of classroom retrofits collected from interviews and focus groups with designers, facility managers, and school principals. Second, this list of best practices was systematically evaluated using the triple bottom line scenario. The practices were tested for their energy and carbon effects as well as their impact on occupants' health and well-being.

1.1. Conceptualizing the Green Classroom Retrofit Toolbox (GCRT)

This project conceptualized the school environment from a place-based experience perspective, which assumes that any environment is composed of "people" and "buildings" on the macro-scale as well as "buildings" and the overall "environment" on the mega-scale (Elzeyadi 2003). While "people" in a school setting includes students, faculty, and staff, we are focusing our investigation primarily on the students (Fig. 5).

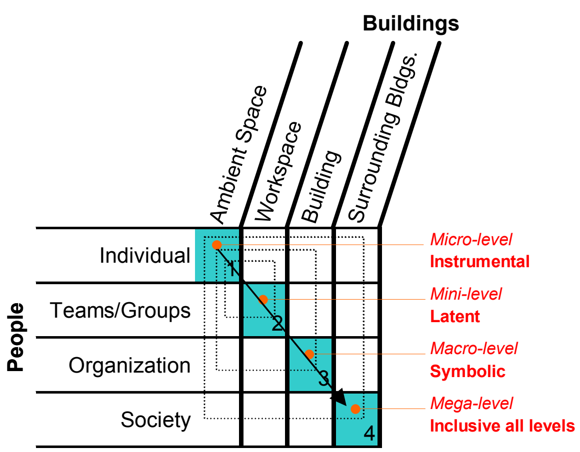

Figure 5: GCRT Conceptual framework

The project's conceptual framework treats students and their school environment as interdependent elements of a system. This systems epistemology rests on the idea that the environment is an organic structure; its parts are connected to each other by complex interactions in such a way that smaller parts of the system can be identified. The components can be dissected into sub-systems of independent variables (sub-systems), mediational variables (mechanisms), and outcomes (products).

1.2. GCRT objectives and the triple bottom line

The following goals and objectives guided the tasks of the GCRT project:

- Develop tools that will analyze the impact of separate green retrofit strategies while also acknowledging the larger effect of the interrelationship among these strategies on the building and its occupants' performance.
- Identify not only design retrofit strategies and best practices but also operations and maintenance ones, which have typically been neglected by previous design guidelines (National Research Council 2007).
- Provide evidence-based tools that have clearly specified attributes and practices.
- Classify the researched best practices and strategies based on categories that are relevant to building professionals. These are: (1) Energy & Atmosphere (Envelope, Lighting, HVAC, and Ventilation); (2) Materials and Resources (Site construction, Structural and non-structural); (3) Environmental Quality (IAQ, Comfort, and Acoustics); (4) Sustainable Sites (Density, Light Pollution, and Transportation), and (5) Water and Waste (Building fixtures, Landscaping, Recycling).

2. GCRT PROCESS AND PHASES

To generate comprehensive evidence-based design guidelines for green classroom retrofits, we have conducted the following tasks:

1. Surveyed and classified existing classroom types and typologies.
2. Held focus groups with school building designers, operators, principals, and contractors to generate a check list of best practices of green retrofit scenarios and products for classrooms.
3. Performed energy and carbon performance simulation analyses of the best practices (identified in the focus groups) for a prototypical K-12 school. This analysis simulated the energy and carbon performance of each suggested best practice of green retrofit as compared to a base case of a proto-typical school building in the Pacific Northwest.
4. Reviewed and analyzed previous studies linking the identified green design strategies to students' health and performance outcomes.

2.1. Methods and approach

This project was planned in three phases. The first phase researched and identified green classroom retrofit best practices (BP) based on a survey of opinions from school principals, building designers, and facility managers. The second phase used an experimental design approach to test the energy and carbon emissions performance of each retrofit BP strategy identified in the first phase using computer simulation and energy modeling software. The third phase analyzed the BPs based on their impact on occupants' performance relying on meta-analysis of previous studies.

2.2. Project phases and tools

The following sub-sections detail the research procedure for each phase of the project.

2.2.1. Phase 1: survey of best practices

A cross-sectional survey was designed to elicit responses from K-12 school owners and principals (O&P), architects and engineers (A/E), and facility managers (FM) on their views of best practices for green retrofitting of classes. The survey participants were chosen to represent a sample of each of the groups involved in decisions regarding school and classroom energy and environmental upgrades. Data was collected using focus groups and interviews across building professions and geographical locations. This enhanced our analysis of the various opinions by subgroups and helped achieve stronger research triangulation. A total of 24 professionals participated in focus groups as well as phone and personal interviews. Each interview lasted approximately 20 minutes and included both open-ended and structured questions. Focus groups were 60 minutes on average. The stratified sample of respondents was theoretically weighted to include a larger number of building designers since they represent the most diverse group. They included architects, energy/mechanical engineers, and lighting designers. Thus more emphasis was placed on the sample design to include a higher representation from this group. Building owners/principals comprised the second most important category, and it included an equal number of respondents from those two groups (Table 1). From the results of this phase of the research we compiled a checklist of best practices for classroom retrofits and green remodel strategies, which are available in a previous report (see Elzeyadi, in press).

Table 1: Survey participants and locations of focus groups

Location	A/E	F. M.	O & P	Total
Portland, OR	3	2	3	8
Salem, OR	2	1	2	5
Eugene, OR	6	2	3	11
Total	11	5	8	24

2.2.2. Phase 2: Experimental simulations

Energy analysis computer simulations were conducted for each best practice strategy identified in phase 1. These simulations were run using Integrated Environmental Solutions Virtual Environments™ (IESVE, see www.iesve.com) ApacheSim module. ApacheSim is a rigorous building thermal simulation approach that conforms to ANSI/ASHRAE Standard 140. The simulations were conducted on a two-story prototypical elementary school building in Eugene, OR. The building is a U-shaped double corridor classroom facility with a gross area of 54,802.11 sq. ft. and a 25% glazing-to-outside-wall ratio (Fig. 6). For experimental purposes, all best practices were compared to a base case model using one geographic climate location, Eugene, OR (44.12◦ North Latitude, 123.22◦ West Longitude and elevation of 357 ft). Every design retrofit strategy related to the building envelope or building performance that could be modeled using our analysis software was conducted. The energy simulations were based on a Sketch-up™ model in conjunction with *IESVE sustainability tool kit* plug-in modules (Fig. 7).

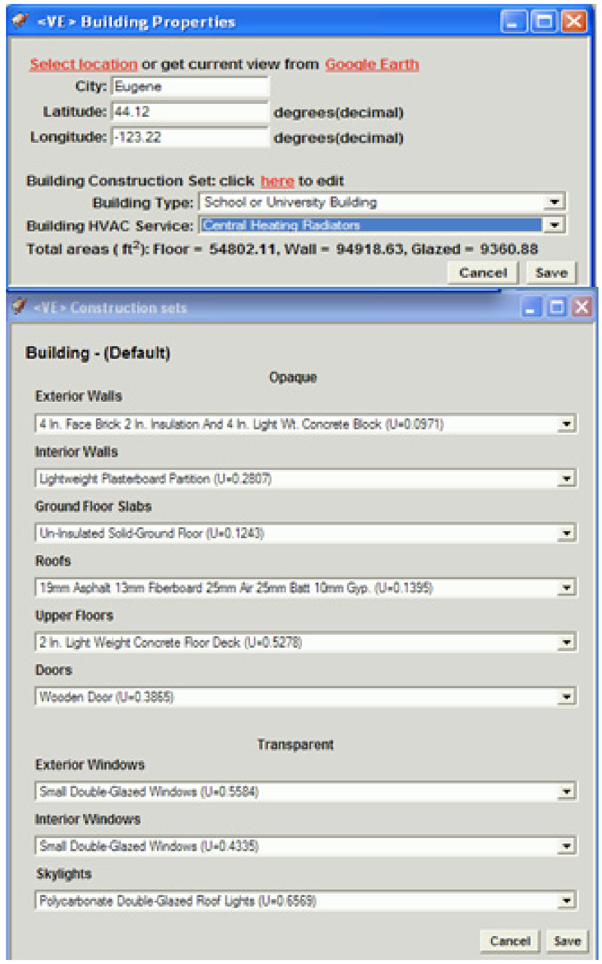

Figure 6: Building parameters and specifications for Energy & CO2 simulations using IESVE™ software

Each of the identified best practices was run separately to determine its specific impact on the building energy use and carbon generation, as proposed in the Architecture 2030 challenge (Mazria, 2006). In addition, a combined and optimized best practices model with most strategies combined was also modeled to provide an indicator of the mega impacts of the identified best practices on the total energy and CO2 emissions performance of the building. The detailed energy and emissions analysis included: Energy consumption (MMBtu), Carbon emissions (lbCO2), 2030 Challenge Targets (kBTU/ ft2), Thermal Comfort (%PPD limits), Peak HVAC loads (btu/h.ft2), Ventilation rates (cfm), and daylighting analysis (avg. fc/h operation).

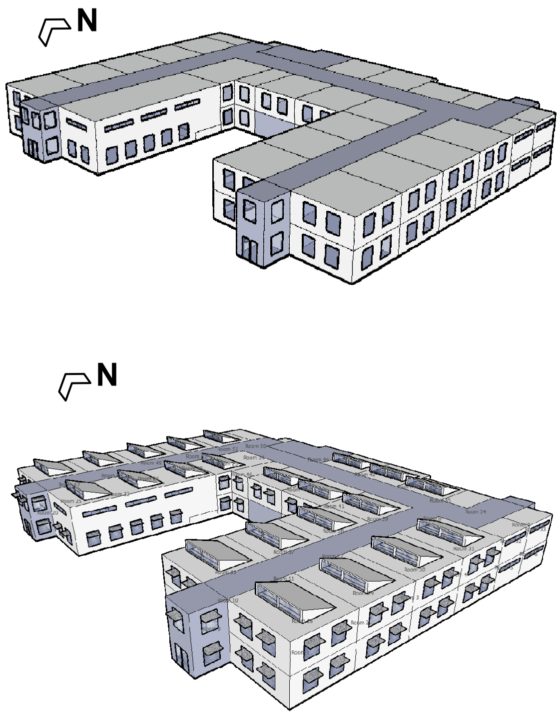

Figure 7: School building Sketch-up™ models prepared for IESVE™ simulations

2.2.3. Phase 3: Meta-analysis of health and performance impact

According to the US General Accounting Office, almost two-thirds of schools in the US have building systems that are in need of extensive repair or replacement (Kats 2006). Likewise, a published document by the American Federation of Teachers notes low IAQ in nearly 15 thousand schools (Schneider 2002). Despite the large body of research linking health and productivity issues with specific building design attributes, empirical studies looking at these issues in schools have been limited and have failed to acknowledge linkages between specific design strategies and occupant outcomes. This limits the relevant data available to understand and quantify the benefits of high-performance, healthy design in schools in general and retrofits in particular. To overcome this limitation, we conducted a meta-analysis of studies linking green design strategies to tasks done by "employees" in offices and other work environments. These workers are generally involved in tasks such as reading comprehension, synthesis of information, writing, calculations, and communications, which are very similar to the work students do. We reviewed 150 empirical studies that assessed indoor comfort and performance in office environments. This summary was combined with previous reviews done by Capital E (Kats 2006) and Fisk (2000) to outline the potential impacts of green schools on occupants' health and productivity related to improvements in indoor air quality, temperature control, and lighting quality.

3. ANATOMY OF AN EVIDENCE-BASED GREEN CLASSROOM RETROFIT TOOLBOX

The project goal was to develop a set of tools and evidence-based guidelines to help architects and school designers as well as school principals make informed decisions about green retrofitting their classrooms. To that end, we have developed three main decision support tools. The first is a checklist of best practices compiled from the focus groups and interviews of 24 school building designers, facility managers, and principals. The second tool is a prioritization guide that provides some comparative analysis and ranks the best practices based on their impact on building energy consumption and carbon emissions. The third tool is a meta-analysis guide that links these best practices to their impact on occupant health and performance in schools. These tools provide supporting documentation for the triple bottom line impacts of the green retrofits best practices on the planet (emissions), people (health and performance), and profit (energy savings). It should be noted that the tools were developed based on opinions, contexts, and climates of the Pacific Northwest and a specific middle school typology. We hope to replicate this study in the future in other contexts and climates of the US and to develop a series of case studies of school retrofits that demonstrate the application of these guidelines.

3.1. Best practices survey

The focus groups and interviews of the 24 school building architects and engineers (A&E), facility managers (FM), and school owners and principals (O&P) in the three largest cities in the state of Oregon yielded a comprehensive checklist of best practices. In addition, these professionals were asked to identify and rank the primary reasons for adopting such practices (as well as limitations to adopting them). The reasons they identified were organized into categories meaningful for designers and practical for future adoption. On average, 75 percent of the surveyed group identified "energy conservation" as the primary reason to adopt best practices, with FM citing it as the most important reason (94%), followed by A&E (74%), and O&P (60%). Secondary reasons for implementing these practices were to provide "indoor environmental quality – IEQ" (68%) and to provide "connections to nature - Biophilia" (63%). The other three reasons reported were "Global warming – Environment" (45%), "Right thing to do" (28%), and "Recycling" (7%). A breakdown of the reasons by each group is displayed in Fig. 8.

Professionals in the focus groups also identified a total of 27 best practices related to "Energy and Atmosphere (EA)." The second largest identified best practices are grouped under the "Indoor Environmental Quality (IEQ)" category with a total of 12. The rest of the identified best practices consisted of seven practices under "Materials & Resources (MR)," three practices in "Outdoor Environmental Quality (OEQ)," two others in "Water & Waste (WW)," and two in the "Sustainable Sites (SS)" category. Given that these best practices were chosen for their applicability for retrofits projects, it is not surprising to see fewer items identified in categories that pertain to site choices, orientation, outdoor conditions, and building form, which are categories more applicable to new construction rather than retrofits (Fig. 9).

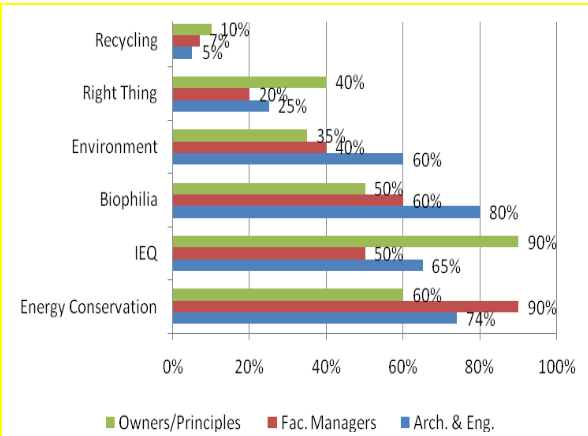

Figure 8: Reasons to adopt green classroom retrofits identified by different focus groups

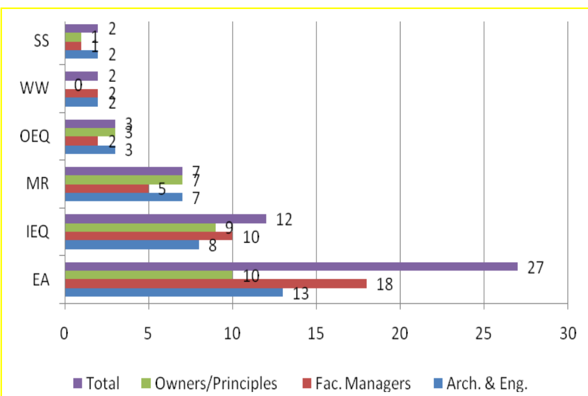

Figure 9: Number of best practices identified by different focus groups sorted by categories

3.2. Energy and CO2 analysis of best practices

One of this project's objectives is to evaluate and analyze the best practices identified earlier for their impact on school buildings' and classrooms' energy conservation as well as carbon (CO2) emissions, as one of the main causes for climate change. For this task we conducted energy simulation analysis for each best practice strategy identified earlier. These simulations were conducted using IESVE™ ApacheSim module (www.iesve.com). The simulations were conducted on a prototypical two-story elementary school building base case. The base case building is a U-shaped double corridor classroom facility with a gross area of 54,802.11 sq. ft. and a 25% glazing-to-outside-wall ratio (Fig. 10a). Similar to national trends of school buildings' energy use (McGraw-Hill 2007), the current simulation model predicted that the existing school base case would consume 46% of its total energy for space heating, 20% for water heating, 19% for Lighting, and 15% for cooling, and other equipment (Fig. 10b).

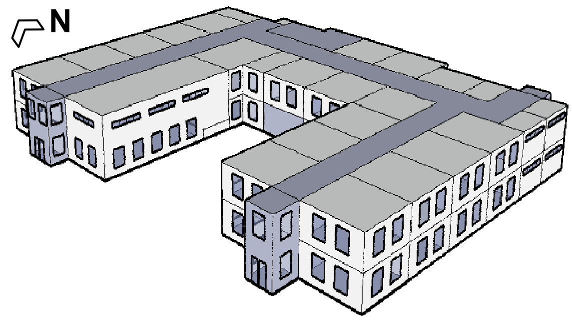

Figure 10a: Simulation base model used for energy analysis

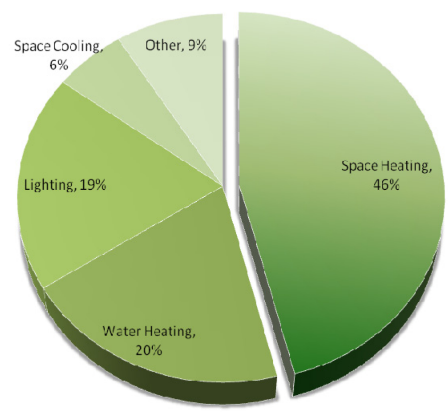

Figure 10b: Breakdown of energy use by building system category (base case usage)

The total yearly energy consumption calculated for the simulations was converted to kwh/ft2/year from kbtu/ft2 /year to normalize for the different sources of power supplied to the building. Figures 11 and 12 compare the impact of different envelope best practices on the yearly total building energy consumption (kwh/ft2), heating energy (kwh/ft2), CO2 emissions (lb/ft2), and average daylight levels in foot candles (fc) for the classrooms schedule. Fig. 11 shows ceiling insulation (R40), as well as cool roofs with radiant barriers, to be one of the most effective strategies for reducing energy loads and carbon emissions with respect to the envelope insulation categories of the best practices check list.

Fig. 12 shows the strong impact of top lighting strategies such as roof montiors and modular skylights on energy and emissions reductions. The same figure also shows that effective side lighting ranges between 35%-45% wall-to-glazing ratio for this climate and specific building typology. Fig. 11 and 12 together provide a comparison of thirteen of the envelope and daylighting best practices upgrades with the base case school as well as with an optimized best practices model with most of the green upgrades. The optimized best practices model is shown to reduce energy consumption for the school by an average of 50% in lighting and heating energy and an associated 59% reduction in carbon emissions.

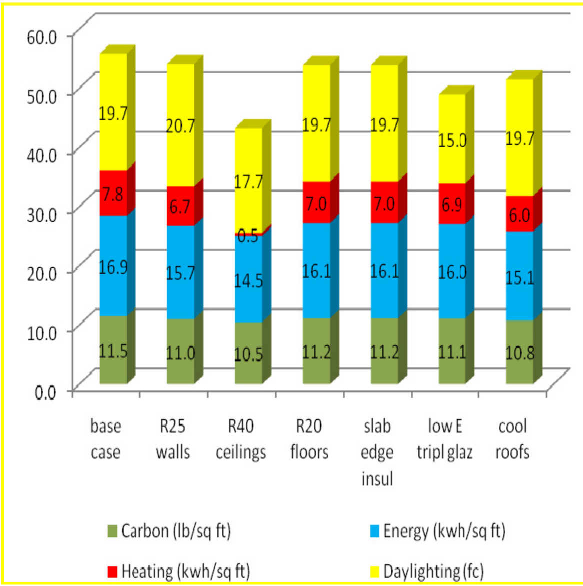

Figure 11: Energy and CO2 yearly emissions simulated by applying envelope insulation retrofits to base case

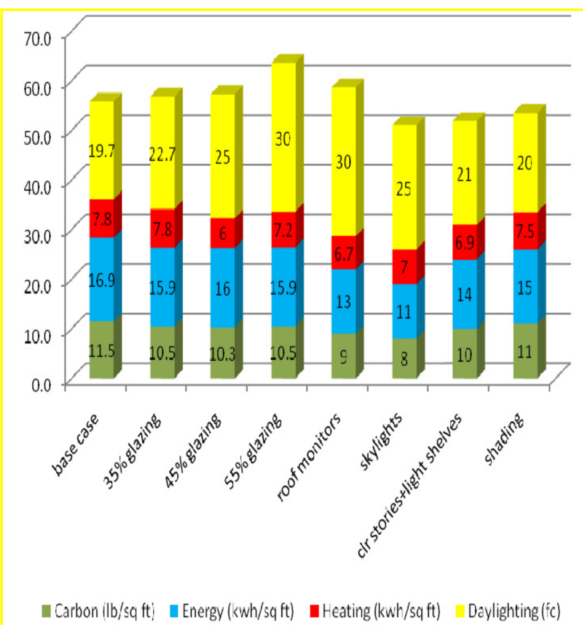

Figure 12: Energy and CO2 yearly emissions simulated by applying daylighting retrofits to base case school

3.3. Occupants' performance related to best practices

Data used in the following meta-analysis is partially based on a literature review published by Capital E (Kats 2003 and 2006). The review is supported by research conducted at the Center for Building Performance at Carnegie Mellon University, Building Investment Decision Support (BIDS) program. The BIDS program reviewed over 1,500 studies that investigated the relationship between building systems, such as lighting, ventilation, and thermal control, and occupants' outcomes, such as productivity and health (Loftness, et al. 2002). In addition, our analysis included data from a study conducted by William Fisk (2000) linking health and productivity gains of building occupants to better indoor environments and energy efficiency. We have also conducted a separate meta-analysis of more than 150 studies that link indoor environmental quality and comfort issues to occupants' performance in green buildings (see Elzeyadi, 2002; 2008). For simplicity and because of space limitations, we grouped results related to health, productivity, task performance, and test scores under the general heading of "human performance." Summaries of the conclusions from these reviews are given below under Green Retrofits related to three categories: Indoor Air Quality, Temperature Control, and Day/Lighting Quality.

Green Retrofits Related to Indoor Air Quality Positively Impact Occupants' Performance by 5-20%: The BIDS program identified 17 substantial studies that document the relationship between improved air quality and health. The health impacts include asthma, flu, sick leaves, sick building syndrome, respiratory problems, and other building-related illnesses. These 17 separate studies all found positive health impacts correlated with improved indoor air quality ranging from 13.5% up to 87% improvement, with average improvement of 41%. In a study of Chicago and Washington, DC schools, better indoor air quality in school facilities was correlated to a four percentage points increase in students' standardized test scores (Schneider 2002b). Although many of these studies did not isolate the specific impacts of practices (from the best practice check list we developed) on performance, the health impacts that were documented are related to many of these practices, such as increased ventilation rates, natural ventilation, increased insulation, and HVAC pollutants control. Based on the above results, we can very conservatively estimate that the better indoor quality afforded by the different best practices results in a 5-20% improvement in occupants' performance.

Green Retrofits Related to Temperature Control Positively Impact Occupants' Performance by 3-10%: The effects of indoor temperature control and thermal comfort on teachers' and students' satisfaction in classrooms are clear. In a large office phone survey conducted with key personnel from a range of best practices companies and schools in the USA, Ducker Worldwide (Ducker 1999) found a high correlation between the indoor air temperature acceptability and occupant satisfaction. Teachers perceive a high correlation between thermal comfort and student comprehension of lessons (Elzeyadi 2008). Research indicates that the best teachers emphasized that their ability to control the temperature in classrooms is very important to student performance (Heschong, Elzeyadi and Knecht 2001). A review of 14 studies by Carnegie Mellon on the impact of improved temperature control on productivity found a positive correlation between both perceived and experienced control and productivity improvements of up to 15% and with an average (mean) of 3.6% (Loftness, et al. 2005).

Green Retrofits Related to Day/Lighting Quality Positively Impact Occupants' Performance by 5-20%: Green school design typically emphasizes providing views and ambient daylight for classrooms and educational facilties. These strategies have been associated with improvements in performance on students' standarized test scores of 10-20% on average (Heschong Mahone Group 2003; Heschong, Elzeyadi and Knecht 2001). In a study of 200 utility workers, those with the best views performed 10-25% better on tests (Loftness 2002). The consensus findings in a review of 17 studies from the mid 1930s to 1997 found that good lighting "improves test scores, reduces off-task behavior, and plays a significant role in the achievement of students" (Loftness, et.al. 2005). Another synthesis of 53 generally more recent studies also found that better daylighting quality fosters higher student achievement (Elzeyadi 2002).

CONCLUSION: CHALLENGES OF AN EVIDENCE-BASED DESIGN TOOLBOX

The challenges of creating evidence-based design guidelines and best practices are threefold. First, identifying best practices based on expert feedback can lead to mixed and contradictory lists. This is due to the fact that experts usually rely on their own anecdotal experience, which lacks verification and external validity. Second, computer simulations of energy use and carbon emissions have limitations in modeling certain scenarios and practices, especially passive energy conserving strategies. Third, given the complex relationship between people and buildings, it is hard to isolate the impact of a specific design strategy on human performance in a cause-effect relationship. The other limitation of this study that should be noted is that the tools were developed based on opinions, contexts, and climates in the Pacific Northwest, specifically Eugene, OR, and also based on a specific K-12 school typology. We hope to replicate this study in the future in other contexts climate zones, with other school districts and classroom typologies. In addition, we intend to develop a series of case studies of school retrofits that demonstrate the application of these guidelines. In terms of achieving our objective of documenting the triple bottom line benefits of these green classroom retrofitting best practices for the planet (CO_2 reductions), profit (energy savings), and people (health and performance), the data presented a clear and compelling case that retrofitting existing schools today is extremely cost-effective, and is the right thing to do for the health and learning of our children. It is the goal of this study to reduce the gap in existing knowledge related to the availability of design analyses that target green school retrofits. Most important is the development of the check list as an evidence-based tool readily available for architects, designers, and school principals. The best practices list and guidelines identified earlier are available upon request (see Elzeyadi, in press). We hope this information will aid school designers, facility managers, and principals in making informed decisions for retrofitting existing classrooms to meet the Architecture 2030 challenge.

ACKNOWLEDGEMENTS

I would like to acknowledge the financial support from the American Institute of Architects and the Department of Architecture, University of Oregon that made this study possible. Special thanks go to the focus group participants, who provided valuable input for generating the best practices check list. Earlier input on the best practices list was also provided by the campus sustainability task force at the University of Oregon. Thanks are also due to Mr. Greg Kats of Capital-E for granting permission to use part of his previous analysis regarding human impacts of green buildings.

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Glass in daylighting design, an experimental investigation of the impact of glass types

Khaled Mansy

Oklahoma State University, Stillwater, Oklahoma

This paper reports on an experimental study that investigated the impact of clear and diffusing glass types on the design and performance of daylighting systems. Scale models of toplighting and sidelighting systems were tested in the lab under the standard CIE overcast sky. Quantitative analysis of the test results documented, with a good level of accuracy, the impact of different glass types on the overall efficiency of daylighting systems, and showed their impact on the distribution of light intensities inside the spaces tested. The findings and recommendations of this study should be helpful to architects and engineers who do design (or engineer) daylighting systems.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings.
Keywords: daylighting, glass, angle of incidence, visible transmittance, daylight factor.

INTRODUCTION

Because architectural design, by nature, is a trial and error process, experimental research in architecture is of a paramount importance. Experimental research complements the design process and helps to make it more effective (Mansy 2006). The subject of this paper was initiated by an observation that took place during the design process. The observation initiated a question; and later triggered an experimental pursuit in order to answer that question. In order to reach a scientific answer, an experiment was set up in the daylighting laboratory to test the impact of different glass types on the performance of daylighting systems. This paper reports on this experiment; its description, setup, findings, and conclusion.

1. THE OBSERVATION

The design and performance of daylighting systems is influenced by many factors, including the visible transmittance of the glass type to be used for windows and skylights. This is why, during the building construction process, the design firm should verify the visible transmittance of the glass before its approval for construction.
When the author was asked to verify the visible transmittance (VT) of glass by laboratory testing, the test was performed twice; first, using a beam of light, and second, under a three-dimensional artificial sky dome. The measured VT value was different in each test. In other words, the actual VT of glass depends not only on the glass type, but also on the nature of the light source. The question posed was: which value should be used in the design of the daylighting system and the prediction of its performance?

2. THE HYPOTHESIS

In order to explain why the measured VT depends on the geometry of the light source, a hypothesis was established, which was: the reason was the higher tendency of light energy to be reflected off glass with greater angles of incidence (Fig. 1). A secondary reason was thought to be the ability of glass to diffuse light.

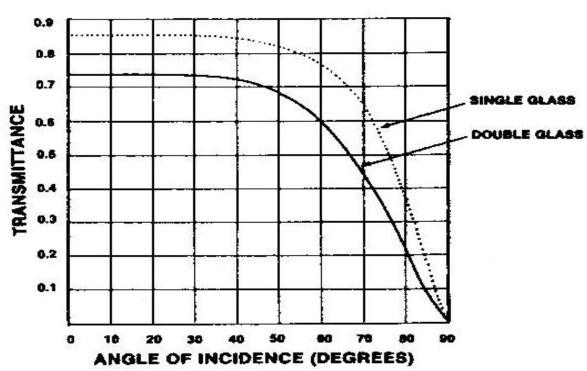

Figure 1: Transmittance vs. angle of incidence (Mazria 1979)

3. IMPORTANCE TO THE DESIGN PROCESS

In a typical case when scale models are used to test and predict the performance of daylighting systems, these models are built to represent the geometry of the space, the design of aperture (windows and skylights), and the finishing materials. Then, the model is tested under the appropriate sky condition (usually overcast sky) with bare openings, i.e., unglazed openings. In order to take the effect of glass type into consideration, the manufacturer-supplied VT is used as a modifier for the measured daylight factors.

Laboratory results showed that this method of using the same VT value as a modifier for the measured Daylight Factor (DF) at all points yields inaccurate results. Another source of inaccuracy is the fact that the glass VT depends on the nature of the light source.

For accurate prediction of the performance of daylighting systems, the appropriate VT value should be used in the analysis, or (at least) the designer should be aware of the potential inaccuracy of results obtained from testing daylighting models with bare openings; i.e., unglazed windows and skylights.

4. THE EXPERIMENTS

In the light of the proposed hypothesis and in order to investigate the impact of different glass types on the performance (especially the distribution) of daylighting systems, two experiments were performed. The first experiment investigated the impact of different glass types (clear and diffuse glass) on the performance of toplighting, i.e., skylights, and the second experiment investigated the impact of clear glass on the performance of sidelighting, i.e., windows.

4.1. Toplighting

The scale model built to test toplighting represented a square space that is 9.14m x 9.14m (30ft x 30ft), with a 3m (10ft) floor-to-ceiling height. The skylight was assumed to be 3m x 3m (10ft x 10ft) and located at the center of the space.

The model was tested under the standard CIE overcast sky as simulated by the artificial sky dome in the daylighting laboratory (Fig. 2). The model was tested four times to take readings for the base case (unglazed opening) and for three different glass types. For that, four sets of Daylight Factor (DF) readings were obtained from the light sensors inserted inside the model (Fig. 3). Each set of DF readings consisted of 40 readings, taken by the eight sensors along five lines inside the model (A, B, C, D, and E).

Tables 1 through 4 show the measured DF values.

Because the skylight is centered in the space, DF readings are symmetrical around the center point.

Table 1 shows the DF distribution of the base case, which is the unglazed skylight. Average DF = 13.21%, maximum DF = 37.49%, minimum DF = 3.72%, min-to-max = 9.93%, and standard deviation = 9.54%.

Table 2 shows the DF distribution with the use of a clear glass sample with VT = 91.96%. Average DF = 11.60%, maximum DF = 34.55%, minimum DF = 2.91%, min-to-max = 8.43%, and standard deviation = 8.87%.

Table 3 shows the DF distribution with the use of a diffusing Plexiglas sample with VT = 61.89%. Average DF = 7.50%, maximum DF = 20.65%, minimum DF = 2.18%, min-to-max = 10.55%, and standard deviation = 5.24%.

Table 4 shows the DF distribution with the use of both of the clear glass and the diffusing Plexiglas with a combined VT = 59.79%. Average DF = 6.92%, maximum DF = 19.36%, minimum DF = 1.98%, min-to-max = 10.23%, and standard deviation = 4.92%.

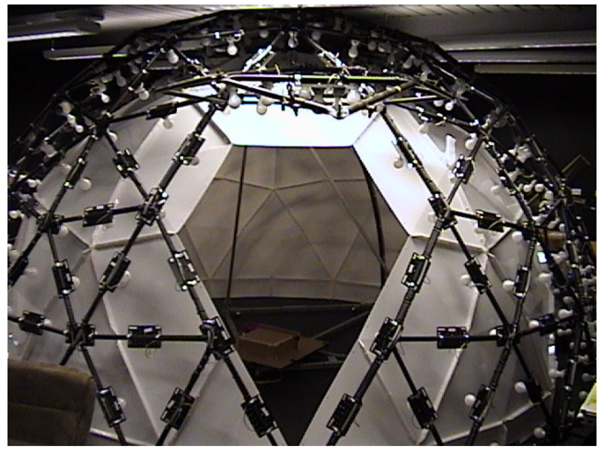

Figure 2: The Artificial sky dome

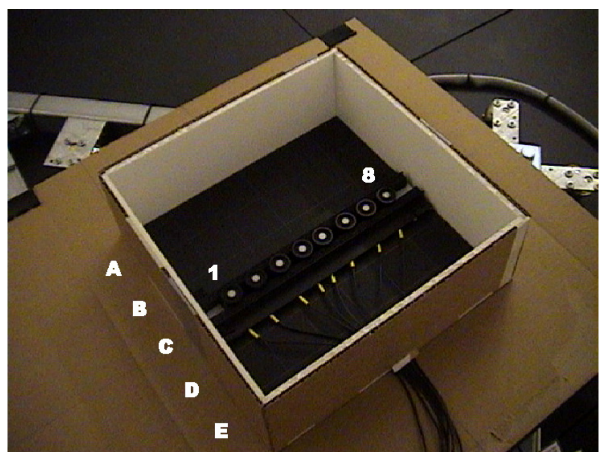

Figure 3: Light sensors inside the toplighting model

Table 1: DF distribution, toplighting, base case (unglazed skylight).

Sensor	*DF readings*				
	A	***B***	***C***	***D***	***E***
Sensor 1	3.72%	6.89%	9.06%	6.89%	3.72%
Sensor 2	4.89%	12.02%	16.86%	12.02%	4.89%
Sensor 3	6.22%	19.72%	28.88%	19.72%	6.22%
Sensor 4	7.12%	25.38%	37.49%	25.38%	7.12%
Sensor 5	7.12%	25.38%	37.49%	25.38%	7.12%
Sensor 6	6.22%	19.72%	28.88%	19.72%	6.22%
Sensor 7	4.89%	12.02%	16.86%	12.02%	4.89%
Sensor 8	3.72%	6.89%	9.06%	6.89%	3.72%

Average DF = 13.21%

Table 2: DF distribution, clear glass (VT=91.96%)

Sensor	DF readings				
	A	*B*	*C*	*D*	*E*
Sensor 1	2.91%	5.74%	7.68%	5.74%	2.91%
Sensor 2	3.95%	10.40%	14.92%	10.40%	3.95%
Sensor 3	5.12%	17.49%	26.40%	17.49%	5.12%
Sensor 4	5.96%	22.69%	34.55%	22.69%	5.96%
Sensor 5	5.96%	22.69%	34.55%	22.69%	5.96%
Sensor 6	5.12%	17.49%	26.40%	17.49%	5.12%
Sensor 7	3.95%	10.40%	14.92%	10.40%	3.95%
Sensor 8	2.91%	5.74%	7.68%	5.74%	2.91%

Average DF = 11.60%

Table 3: DF distribution, Plexiglas (VT=61.89%)

Sensor	DF readings				
	A	*B*	*C*	*D*	*E*
Sensor 1	2.18%	4.06%	5.05%	4.06%	2.18%
Sensor 2	2.87%	7.02%	9.43%	7.02%	2.87%
Sensor 3	3.62%	11.24%	15.98%	11.24%	3.62%
Sensor 4	4.16%	14.25%	20.65%	14.25%	4.16%
Sensor 5	4.16%	14.25%	20.65%	14.25%	4.16%
Sensor 6	3.62%	11.24%	15.98%	11.24%	3.62%
Sensor 7	2.87%	7.02%	9.43%	7.02%	2.87%
Sensor 8	2.18%	4.06%	5.05%	4.06%	2.18%

Average DF = 7.50%

Table 4: DF distribution, clear glass + Plexiglas (VT=59.79%)

Sensor	DF readings				
	A	*B*	*C*	*D*	*E*
Sensor 1	1.98%	3.71%	4.57%	3.71%	1.98%
Sensor 2	2.60%	6.44%	8.71%	6.44%	2.60%
Sensor 3	3.29%	10.39%	14.94%	10.39%	3.29%
Sensor 4	3.79%	13.20%	19.36%	13.20%	3.79%
Sensor 5	3.79%	13.20%	19.36%	13.20%	3.79%
Sensor 6	3.29%	10.39%	14.94%	10.39%	3.29%
Sensor 7	2.60%	6.44%	8.71%	6.44%	2.60%
Sensor 8	1.98%	3.71%	4.57%	3.71%	1.98%

Average DF = 6.92%

4.2. Comparative analysis

The quantitative analysis (in Tables 1 through 4) provides an understanding of the impact of different glass types on the efficiency of toplighting systems and the light distribution they provide.

Consistently, the measured overall efficiency of the daylighting system (compared to the baseline), is lower than what the glass VT may suggest. With the use of clear glass, the average DF = 87.83% of the baseline (11.60/13.21 = 87.83%), which is lower than the VT of the clear glass (VT = 91.96%). With the use of diffusing Plexiglas, the average DF = 56.73% of the baseline (7.50/13.21 = 56.73%), which is lower than the VT of the Plexiglas (VT = 61.89%). With the use of both the clear glass and diffusing Plexiglas, the average DF = 52.38% of the baseline (6.92/13.21 = 52.38%), which is lower than the combined VT of both samples (combined VT = 59.79%).

The reason for this range of approximately 4-8% reduction in the measured DF values seems to be the geometry of the sky dome as a hemisphere. Light received from the lower sky tends to be reflected off the glass because of its larger angle of incidence, which reduces the total amount of light that may penetrate into the space through the skylight.

Quantitative analysis of the DF readings also shows a better distribution (closer to uniform distribution) of light in space compared to the baseline. Standard Deviation in Tables 2, 3, and 4 is consistently lower than the 9.54% of table 1.

Tables 5 through 8 show the comparison between the relative light distributions due to the use of the three glass samples tested, compared to the baseline.

Table 5: Relative DF distribution, base case (unglazed skylight)

Sensor	Relative DF				
	A	*B*	*C*	*D*	*E*
Sensor 1	0.10	0.18	0.24	0.18	0.10
Sensor 2	0.13	0.32	0.45	0.32	0.13
Sensor 3	0.17	0.53	0.77	0.53	0.17
Sensor 4	0.19	0.68	1.00	0.68	0.19
Sensor 5	0.19	0.68	1.00	0.68	0.19
Sensor 6	0.17	0.53	0.77	0.53	0.17
Sensor 7	0.13	0.32	0.45	0.32	0.13
Sensor 8	0.10	0.18	0.24	0.18	0.10

Table 6: Relative DF distribution, clear glass

Sensor	Relative DF				
	A	*B*	*C*	*D*	*E*
Sensor 1	0.08	0.17	0.22	0.17	0.08
Sensor 2	0.11	0.30	0.43	0.30	0.11
Sensor 3	0.15	0.51	0.76	0.51	0.15
Sensor 4	0.17	0.66	1.00	0.66	0.17
Sensor 5	0.17	0.66	1.00	0.66	0.17
Sensor 6	0.15	0.51	0.76	0.51	0.15
Sensor 7	0.11	0.30	0.43	0.30	0.11
Sensor 8	0.08	0.17	0.22	0.17	0.08

Table 7: Relative DF distribution, Plexiglas

Sensor	Relative DF				
	A	*B*	*C*	*D*	*E*
Sensor 1	0.11	0.20	0.24	0.20	0.11
Sensor 2	0.14	0.34	0.46	0.34	0.14
Sensor 3	0.18	0.54	0.77	0.54	0.18
Sensor 4	0.20	0.69	1.00	0.69	0.20
Sensor 5	0.20	0.69	1.00	0.69	0.20
Sensor 6	0.18	0.54	0.77	0.54	0.18
Sensor 7	0.14	0.34	0.46	0.34	0.14
Sensor 8	0.11	0.20	0.24	0.20	0.11

Table 8: Relative DF distribution, clear glass + Plexiglas

Sensor	*Relative DF*				
	A	***B***	***C***	***D***	***E***
Sensor 1	0.10	0.19	0.24	0.19	0.10
Sensor 2	0.13	0.33	0.45	0.33	0.13
Sensor 3	0.17	0.54	0.77	0.54	0.17
Sensor 4	0.20	0.68	1.00	0.68	0.20
Sensor 5	0.20	0.68	1.00	0.68	0.20
Sensor 6	0.17	0.54	0.77	0.54	0.17
Sensor 7	0.13	0.33	0.45	0.33	0.13
Sensor 8	0.10	0.19	0.24	0.19	0.10

Data in Tables 4 through 8 show the contrasting impact of clear glass and diffusing glass, compared to the baseline. Table 6 shows relatively lower light intensities around the perimeter of the space due to the fact that the perimeter of the space receives its light from the lower part of the sky, from which light tends to be more reflected off the glass. However, Table 7 shows relatively higher light intensities around the perimeter of the space due to the fact that the diffusing glass tends to diffuse the light into space. Table 8 shows a very close light distribution to the baseline, most likely due to the fact that the two opposing impacts of clear glass and diffusing glass balanced each other.

4.3. Sidelighting

The scale model built to test sidelighting is identical in its dimensions and materials to the one built for toplighting. Instead of the skylight, a single window is placed in one exterior wall. The area of the window is exactly of the same area of the skylight. Refer to fig. 4 and 5.

The model was tested under the standard CIE overcast sky twice. First test was for an unglazed window to be considered the baseline for comparison. Second test was for a window with the same clear glass sample used for the skylight. No test was performed for diffusing glass since this glass is unlikely to be used for windows

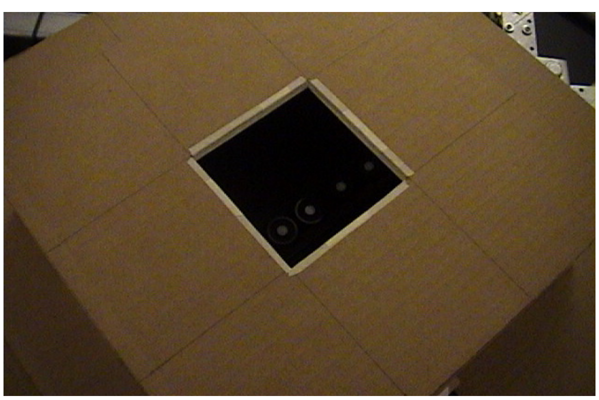

Figure 4: Skylight in the toplighting model (base case)

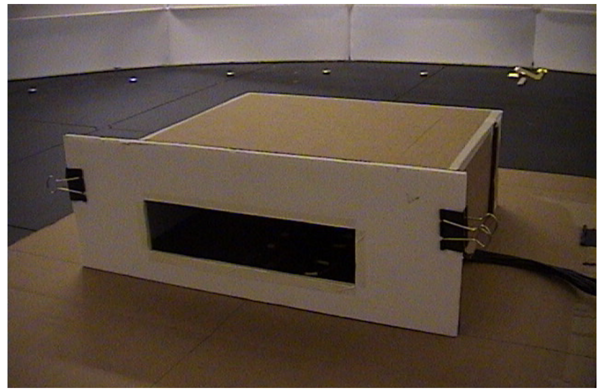

Figure 5: Window in the sidelighting model (base case)

Tables 9 and 10 show the DF values measured in the two tests.

Table 9 shows the DF distribution of the base case, which is the unglazed window. Average DF = 4.03%, maximum DF = 13.56%, minimum DF = 1.79%, min-to-max = 13.22%, and standard deviation = 3.06%.

Table 10 shows the DF distribution with the use of the clear glass sample. Average DF = 3.48%, maximum DF = 11.07%, minimum DF = 1.59%, min-to-max = 14.38%, and standard deviation = 2.56%.

Table 9: DF distribution, sidelighting, base case (unglazed window).

Sensor	*DF readings*				
	A	***B***	***C***	***D***	***E***
Sensor 1	6.58%	12.41%	13.56%	12.41%	6.58%
Sensor 2	4.96%	7.56%	8.06%	7.56%	4.96%
Sensor 3	3.55%	4.47%	4.81%	4.47%	3.55%
Sensor 4	2.74%	3.13%	3.29%	3.13%	2.74%
Sensor 5	2.34%	2.42%	2.50%	2.42%	2.34%
Sensor 6	1.96%	2.03%	2.11%	2.03%	1.96%
Sensor 7	1.86%	1.86%	1.94%	1.86%	1.86%
Sensor 8	1.79%	1.79%	1.83%	1.79%	1.79%

Average DF = 4.03%

Table 10: DF distribution, clear glass (VT=91.96%)

Sensor	*DF readings*				
	A	***B***	***C***	***D***	***E***
Sensor 1	5.64%	10.64%	11.07%	10.64%	5.64%
Sensor 2	4.28%	6.53%	6.72%	6.53%	4.28%
Sensor 3	3.13%	3.90%	4.05%	3.90%	3.13%
Sensor 4	2.38%	2.78%	2.82%	2.78%	2.38%
Sensor 5	2.06%	2.18%	2.18%	2.18%	2.06%
Sensor 6	1.73%	1.81%	1.81%	1.81%	1.73%
Sensor 7	1.66%	1.66%	1.66%	1.66%	1.66%
Sensor 8	1.59%	1.59%	1.59%	1.59%	1.59%

Average DF = 3.48%

4.4. Comparative analysis

The quantitative analysis (in Tables 9 and 10) provides an understanding of the impact of clear glass on the efficiency of sidelighting systems and the light distribution they provide.

Similar to the toplighting experiment, the measured overall efficiency of the sidelighting system (compared to the baseline) is lower than what the glass VT may suggest. With the use of clear glass, the average DF = 86.31% of the baseline (3.48/4.03 = 86.31%), which is lower than the VT of the clear glass (VT = 91.96%). The reason for this approximately 6% drop in overall efficiency is that light received from the higher part of the sky dome tends to be reflected off the glass.

Similar to the toplighting experiment, it seems that clear glass provides better distribution compared to the base case. This is evident when the standard deviation of 2.56% is compared to the 3.06% of the base case.

Tables 11 and 12 show the comparison between the relative light distribution due to the use of the clear glass sample compared to the baseline.

Table 11: Relative DF distribution, base case (unglazed window).

Sensor	***Relative DF***				
	A	***B***	***C***	***D***	***E***
Sensor 1	0.49	0.92	1.00	0.92	0.49
Sensor 2	0.37	0.56	0.59	0.56	0.37
Sensor 3	0.26	0.33	0.35	0.33	0.26
Sensor 4	0.20	0.23	0.24	0.23	0.20
Sensor 5	0.17	0.18	0.18	0.18	0.17
Sensor 6	0.14	0.15	0.16	0.15	0.14
Sensor 7	0.14	0.14	0.14	0.14	0.14
Sensor 8	0.13	0.13	0.13	0.13	0.13

Table 12: Relative DF distribution, clear glass

Sensor	***Relative DF***				
	A	***B***	***C***	***D***	***E***
Sensor 1	0.51	0.96	1.00	0.96	0.51
Sensor 2	0.39	0.59	0.61	0.59	0.39
Sensor 3	0.28	0.35	0.37	0.35	0.28
Sensor 4	0.22	0.25	0.25	0.25	0.22
Sensor 5	0.19	0.20	0.20	0.20	0.19
Sensor 6	0.16	0.16	0.16	0.16	0.16
Sensor 7	0.15	0.15	0.15	0.15	0.15
Sensor 8	0.14	0.14	0.14	0.14	0.14

CONCLUSIONS

Conclusions of this paper cover more than one aspect of the design of daylighting systems. Based on the test results of this experimental study, conclusions can be summarized as follows.

Design of daylighting systems:

- When testing scale models is adopted as the design-assisting tool to design daylighting systems, it is recommended not to perform the test with an unglazed aperture. It is recommended to use a small sample of the selected glass in the test.
- If using glass samples to perform the test is not possible (or not convenient), the designer may choose to extrapolate the final results based on the results of his/her experimental test of unglazed aperture and the results of this paper or a similar experiment.

Impact of glass types on the performance of *toplighting* systems:

- Compared to an unglazed skylight, clear glass tends to reduce the relative light intensities around the perimeter of the space. Compared to the baseline, up to 20% reduction was measured at the corners of the space. This reduction enforces the uneven distribution of light intensities inside the space.
- Compared to an unglazed skylight, diffusing glass tends to increase the relative light intensities around the perimeter of the space. Up to 10% increase was measured at the corners of the space. This increase helps achieve a more even distribution of light intensities inside the space.
- Compared to an unglazed skylight, all glass types tend to transmit less amounts of light than what the measured VT may suggest. A range of 4-8% additional reduction in the transmitted light was measured due to the glass samples tested.

Impact of clear glass on the performance of *sidelighting* systems:

- Compared to an unglazed window, clear glass tends to help mitigate the uneven distribution of light intensities inside the space. Marginal impact was measured.
- Compared to an unglazed window, clear glass tends to transmit less amounts of light than what the measured VT may suggest. A range of 6% additional reduction in the transmitted light was measured due to the glass sample tested.

Verification of glass visible transmittance:

- Since the VT value measured under the sky dome is found to be lower than the value tested under a beam of light, it is important to test the glass type, intended to be used for a certain application, under a sky dome. Then, use the lab-measured VT value in the quantitative analysis of the daylighting system. This measure should assure the accuracy of the analysis and avoid downsizing the system.

Green buildings rating systems:

- Developers of rating systems, such as LEED and Green Globes, may take note of the results of this research and bring it to the attention of architects who implement these rating systems.

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Collaboration in Architectural Research

Mediating spaces acting for the collaboration in the future school

Teräväinen, H., D.Sc.(Tech), Architect, Staffans, A., D.Sc.(Tech), Architect, and Hyvärinen, R., M.Sc. (Geog)

Helsinki University of Technology, Helsinki, Finland

ABSTRACT: In this paper we report the performance and preliminary results of studies carried out during the years 2007-2008 in a research project called InnoArch, Places and Spaces for Learning. InnoArch is a part of a large trans-disciplinary InnoSchool consortium (1.1.2007- 28.2.2010) aiming to develop a set of research-based good practices, processes, models and designs for the Future School Concept.

InnoArch research has focused partly on "place and mapping", which includes a place-based approach to pedagogical processes. On the other hand the research has concentrated on "space and experience", which includes architectural or spatial analyses of the building and the neighborhood. The spatial experience on each environmental scale is perceived with all senses: sight, hearing, taste, smell, touch and body awareness. Indoor studies are mainly about "creating and experiencing the space", something that has great bearing on architectural thinking when designing the future school.

The non-physical virtual space is seen as a mediator between the physical environment (neighborhood) and the PjBLL (Project Based Learning Lab at Jakomäki School in Helsinki). Places in the physical environment can be located on the commentary map, which will be constructed in the School Forum by teachers and students.

The pupils themselves have an opportunity to personalize the room which is here described as a PjBLL. The room provides possibilities to pursue video observation as well as participative observation and participative design research during architectural workshops. These studies were conducted together with teachers, the pedagogical focus being on TSL processes and the architectural view on physical and virtual spaces. Sustainability is within the focus of both the environmental studies as well as in life-long and life-wide learning processes. The pedagogical idea based on inquiry-based learning encourages to strengthen pupils´ epistemic agency in the local community and to empower them to be active stakeholders in it.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: learning neighbourhood, physical environment, school design, spatial experiences

INTRODUCTION

Finland has been successful in the OECD Programme for International Student Assessment PISA (PISA/OECD 2000, 2003, 2007). This programme assesses learning outcomes among 15-year-old students in mathematics, science, reading literacy and problem-solving. Finnish students were rated at the top end in all the lists of the key subjects, and differences between students, schools and regions were comparatively very small.

Good results implicate that there are some qualities in Finnish school system and society that enables quite coherent learning possibilities for pupils. This has inspired academic field to deepen the understanding of the success factors behind these results.

InnoSchool is a multidisciplinary three years (2007-2009) research project composed of four co-projects. InnoArch is a co-project led by the laboratory of urban planning and design (Department of Architecture, Helsinki University of Technology). Other co-projects are InnoPlay (Centre for Media Pedagogy, University of Lapland), InnoEdu (Faculty on Behavioral Sciences, University of Helsinki) and InnoServe (Simlab, Helsinki University of Technology). TEKES (the Finnish Funding Agency for Technology and Innovation) is the main financier of the project. Additional funds come from several partner companies and cities.

The goal of InnoSchool is to develop the Future School Concept: a set of research based good practices, processes, models and designs, and recommendations for their successful combinations. InnoArch research is concentrating on places and spaces for learning, with the focus on physical environment like school buildings

and surrounding neighborhoods. In InnoArch the primary goal to deepen the understanding of the interrelationship between a spatial experience and a meaningful learning process (TSL= teaching, studying, learning). The secondary goal is to develop a collaborative, inquiry based planning and design process for the future school. A pilot case for this is the new school of Opinmäki in Espoo that is planned to be built in 2010.
The contribution of InnoArch is to create new environmental design principles, concepts and models, which support inquiry based learning and pupils´ epistemic agency by means of architecture and through urban planning and design. InnoArch also aims to strengthen the role of school as a central actor in a learning community and promote shared understanding of our urban space.
Research material in InnoArch is gathered by various methods in collaboration with the existing comprehensive schools; their pupils, teachers and other staff. Project website is http://innoschool.tkk.fi/innoarch

Figure 1. The multi-disciplinary research of InnoSchool.

2. THE RESEARCH

2.1. Research questions

In this paper we are trying to answer to the following questions we have set earlier (in the abstract paper) in October 2008. As much as it is possible, regarding the ongoing phase of our research, it will mostly concern the first one:

1) What are the qualities required of a project based learning lab (PjBLL) for it to act as a collaborative and mediating space for both teachers and students?
2) How does the virtual space support linking the PjBLL space and the physical environment locally/globally?

2.2. Research study – phase 1 (2007)

In the earlier phase (2007) of the research project at InnoArch we have organized several collaborative planning and design workshops at Arkki (a special School of Architecture for Children and Youth in Helsinki). The purpose of the workshops was to examine children's visions for a future school and its spaces. Students in two age groups (7-11 and 12-18) were producing ideas of their own in scale models, texts and drawings for the school building and the environment. In that phase our main interest was not only the spaces and places pupils were planning and designing, but also the process: In what ways can the collaborative planning and design process with children act as a tool for active citizenship and cultural learning, and how is this collaborating with the real planning and decision making process? (see appendix 1)

Figure 2. Working around the table at the Arkki School.

2.3. Research study – phase 2 (2008)

In autumn 2008 we organized a new and different set of architectural collaborative planning and design workshops. This took place at a normal Finnish comprehensive school and consisted of one workshop of three hours for each group of pupils. The pupils were in two different age levels (10-11 years and 14-15 years) and they came from four different schools in Helsinki.
This time pupils worked in groups and built and designed their own ideas for the future's learning space ("laboratory" or "project based learning lab"). Every group of 4-6 pupils made their own scale model of the room (~1:6) and personalized it according to their own ideas and desires - after an active discussion and problem solving together. The workshops were actually organized in the very same room that is going to be built into a showcase of future's learning space in spring. Later the pupils are going to work in their projects of different topics in the new space, using the new interior and also new technology with virtual space.
The re-designed space will be later renovated into a project based learning lab (PjBLL) and used further in our multi- and trans-disciplinary research "as a boundary object" (Star & Griesemer 1989) for the process and network analyses conducted in the other co-project (InnoServe). The space will also be used as a learning space (InnoEdu).

Table 1. Research Study with children's workshops 2009

Chidrens workshops 2008 making "the space" for their own place and for the future learning	
Quantity of children	180
Quantity of workshops	6
Age of pupils in the workshops	10-14 years
Quantity of scale models	43
The space as one (1 or whole)	28
The space divided in 2 areas or rooms	8
The space divided in 3 or more rooms	9
Smaller rooms inside the space	5
Quantity of models with furniture for group work	28
Quantity of models with furniture for individual work	12
Flowers, water or some other elements of nature in the models	11

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Figure 3. A group of boys (age 10) constructing their " new learning space".

Figure 4. A group of girls (age 10) thinking together materials and furniture in their " learning space for the future".

2.4. Research method

All these different workshops at schools (at Arkki, the Architectural School for Children and Youth, and at the four different comprehensive schools) are conducted according to a method called *Collaborative Workshop*. This could also be described as Collaborative Action Research, which of course is also many other things. Action Research is more of a holistic approach to problem-solving, rather than a single method for collecting and analyzing data.

In these workshops we used two kinds of simultaneously documentation: photographs and videotaping. Discussions and reporting (the researchers, assistants and the pupils) were also used in the workshops. All the material/artifacts the students produced during the meetings have been photographed; drawings also being scanned in digital data. The digital video material and digital pictures have been analyzed both separately (the researcher, the teacher) and together (the students, group of researchers). In the digital video observation we have used Elan multimedia annotator (http://www.lat-mpi.eu/tools/elan).

The TSL (teaching studying learning) method used here and generally in Finnish architectural and environmental education for children has its ground in "learning by doing" (John Dewey) and also in experiential and reflecting learning as well (see Kolb 1984). Hence it is extremely important to give each student / group of pupils a chance to present his/her/their own work (larger audience via video recordings); while explaining they also learn to clarify their thoughts and to know their rights as members of society, hereby raising children's epistemic agency.

Video taping is also useful in taking notes on how children described their ideas and drawings for the future's learning space. The possibility to document their speech, to listen to their intentions and explanations and to review this material several times in different groups has turned out to be fruitful. This would not have been possible by analyzing only the pictures students created in the workshops.

Further questions regarding video research, such as what do we learn from our investigations while videotaping, editing, and analyzing video - things that we might perhaps never find out without this medium - have been uncovered. It appears to bring to the table a new way of understanding not only those we study, but ourselves as documentarists. Repeated viewings of the tapes are not only an affordance but also a challenge. When should one stop reviewing; how much is enough? These problems are perhaps not all unique to video, but in the least they present themselves in a different way. Many researchers talk of how confronting the medium affects and changes the culture one is studying from the moment the camera is turned on (Goldman etc. 2007). The video camera is a representation of the researcher, in some ways more present than a person and often ubiquitous to an absolutely different level.

One can also ask whether the use of video in research is only an evidentiary tool or also a media form that records stories, convincing viewers and readers of emerging texts and enabling them to understand what happened as the research was taking place. Through an ethnographic lens we can see, as Geertz (1973) has told us, “the importance of being there”. We understand, following post-modern ethnographers, that convincing the reader that she was there is not the Truth, but partial truth, a construction of what she experienced and how she interpreted that experience into a textual narrative. (Goldman etc. 2007)

3. THE THEORETICAL BACKGROUND

3.1. Socio-cultural and pedagogical basis

As a theoretical background InnoArch shares the socio-cultural and pedagogical (Vygotsky 1962, 1978) perspective with other co-projects in InnoSchool. We understand the concept “culture” according to the definition of Clifford Geertz (1973, 4-5). He has the idea of culture as “a system of inherited conceptions expressed in symbolic forms by means of which people communicate, perpetuate, and develop their knowledge about and attitudes toward life". The function of culture is to impose meaning on the world and make it understandable for the people living in it.

Lev Vygotsky investigated the development of children and how this was guided by the role of culture and interpersonal communication. Vygotsky observed how higher mental functions developed through social interactions with significant people in a child's life, particularly parents, but also other adults. Through these interactions, a child came to learn the habits of mind of her/his culture, including speech patterns, written language, and other symbolic knowledge through which the child derives meaning and affected a child's construction of her/his knowledge. This key premise of Vygotskian psychology is often referred to as cultural mediation*,* but the specific knowledge gained by a child through these interactions also represented the shared knowledge of a culture.

Like Piaget (1926, 2002), Vygotsky emphasized the way in which knowledge and understanding are constructed by the learner from their experiences. This is known as constructivist theory. Unlike Piaget, who saw experience as personal, Vygotsky, however, emphasized the social components of experience. His theory underlined the contribution to learning made by others, and is known as a social constructivist view. It has been associated with an apprenticeship approach where the learner learns from someone more experienced or competent. Key ideas in a classroom then become conversation, play and opportunities to follow interests and ideas during the collaborative workshop.

3.2. Basis in human geography

We at Innoarch are focusing our research on places and spaces. Our conception of them is here based on the writings of human geographers, like Y. Tuan (1974, 1975, 2001) and E. Relph (1976). According to them, places are not neutral, objective segments of the physical terrestrial reality but sites of concrete human involvement. Places are those ‘pieces’ of terrestrial-spatial reality that have been claimed by human intentions.

The interactions and implications between "space" and "place” are the basic components of the lived world, seen from the perspective of human experience. Interesting way of thinking is Tuan’s idea of the place representing the security and the space the freedom. The experiences of the subject in space are most important: how the human being – one who is an animal, able to fantasize and connected to computers - experience and understand the world.

> Place is a centre of meaning constructed by experience. Place is known not only through the eyes and mind but also through the more passive and direct modes of experience, which resist objectification. To know a place fully means both to understand it in an abstract way and to know it as one person knows another. At a high theoretical level, places are points in a spatial system. At the opposite extreme, they are strong visceral feelings. Places are seldom known at either extreme: the one is too remote from sensory experience to be real, and the other presupposes rootedness in a locality and an emotional commitment to it that are increasingly rare. To most people in the modern world, places lie somewhere in the middle range of experience.” (Tuan 1975,51)

Tuan is defining “space” and “place” by each other. He also presents how the space is transforming into place (Cresswell 2006,8).

> “What begins as undifferentiated space becomes place as we get know it better and endow it with value… The ideas “space” and “place” require each other for definition. From the security and stability of place we are aware of the openness, freedom, and threat of space, and vice a versa. Furthermore, if we think of space as that which allows movement, then place is pause; each pause in movement makes it possible for location to be transformed into place.” (Tuan 1977, 6)

Figure 5. Portugal brought into the class room: hammocks and a book shelve on the sea shore.

3.3. Sensory design

InnoArch research studies are partly concentrating on "place and mapping". This includes place-based approach to pedagogical processes and addresses how they are taking place. And on the other hand we concentrate on "space and experience", which includes architectural or spatial analysis of the building and the neighborhood. The space experience on each environmental scale is perceived with all senses: sight, hearing, taste, smell, touch and body awareness. Indoor studies, like the workshop series at Arkki School are mainly about "creating and experiencing the space", which means architectural thinking when designing the future school. John Dewey's famous "learning by doing" includes also the importance of the experience, both practical and aesthetic. In architectural philosophy, we also like to see in this context the importance and meaning of the spatial experience. (Dewey 1925, 1934)

What if we designed in order to please all of our senses? Suppose for a moment that sound, touch, and odor were treated as equals to sight; and emotion considered as important as cognition. What would our built environment be like if sensory response, sentiment, and memory were critical design factors, the equals of structure and program? Sensory Design (Malnar and Vodvarka 2004) could explore the nature of our responses to spatial constructs - from various sorts of buildings to gardens and outdoor spaces, to constructions of fantasy. This kind of thinking is also involved in the Finnish architectural familiarizing for children; one that could be seen sharply contrast with the Cartesian model of seeing that dominates the architecture today.

Figure 7. A fireplace brought into the class room.

Cartesian way optical visuality is of course necessary. But it's only half of vision. Haptic visuality , according Laura U. Marks (2000, 2002) sees the world as though it were touching it: close, unknowable, appearing to exist on the surface of the image. Haptic images disturb the figure-ground relationship. Optical visuality sees objects as distinct, distant, and identifiable, existing in illusionary three-dimensional space. It maintains a clear, crisp relationship between figure and ground. Optical visuality is necessary for distance perception: for surveying a landscape, for making fine distinctions between things at a distance. That's how the object of vision is constituted in optical visuality. But by including the haptic vision in design it is possible for architects to understand better the user and his or her spatial experiences and needs. In InnoArch research group was done a master's thesis (two articles) on the area of spatial intensity, concerning haptic visuality (Mäkitalo 2008).

4. PRELIMINARY RESULTS FROM CHILDREN'S WORKSHOPS

Here are some preliminary observations of how the learning (TSL) places or the future school would be if the children themselves could be designers: The big centre hall surrounded by smaller spaces came out several times. Many times the rooms were very high and they had balconies, bridges and many levels inside. There were living areas on the roofs, sometimes in open air. It seemed to be important to have access outside directly from every class room. Nature elements like stones, or water elements like fountains, ponds and brooks were placed between the class rooms. Cluster shape appeared and also attempts to share round shape into cornered rooms.

It was marked out that squares or cube-shaped rooms or buildings were issued hardly at all. The students (children) liked to draw round or varying organic shapes. Their imagination seemed to have no limits after they had liberated their thoughts from their contemporary schools. There were no big differences between those children who had been already several years at Arkki School and those who just began this hobby in the autumn.

A student of architecture, Sini Meskanen, who was teaching in the workshops (2007) has afterwards, in her master thesis, presented *new typologies of the future school.* She developed these on the basis of the data gathered in the workshops, which she analyzed in several forms during the spring 2008. The five typologies were Piazza, Stoa, Series of Atriums, Roof garden and Heart, Bridge and Clusters. The names describe the main findings or ideas in the material produced by the children. (Meskanen, 2008).

In the architectural workshops organized in 2008 at the Jakomäki Comprehensive School there were about 180 children building scale models of the class room. This room was supposed to become a future learning space for the children themselves. After six very hectic collaborative workshops (three hours each) in groups we had 43 models. In 28 models the space (the class room they were working in) was kept as one room, but in 17 models the pupils had divided it in two or more areas or even rooms. Mostly it seemed to be that the children wanted to have different kind of learning furniture for their studies: sack chairs, sofas, hammocks or other swings to accompany the usual desks. Most of the models favored the contemporary Finnish learning system of working in small groups: 28 models featured different kind of tables or other systems for collaborative working and mutual social sharing. Five models suggested smaller rooms or little houses inside the class room. Children want to rest or have own privacy when learning individually.

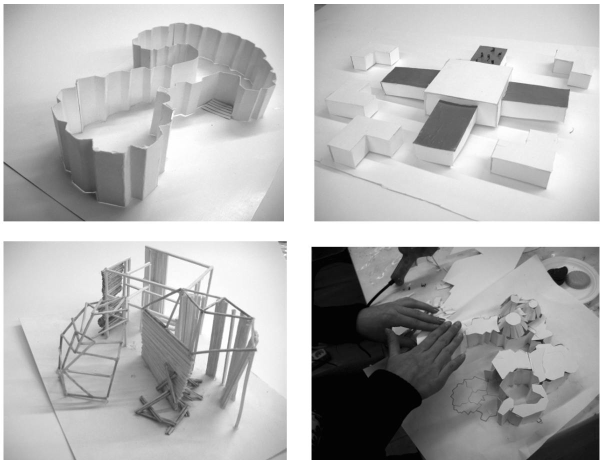

Figure 7. Models and modelling at Arkki School.

In the workshops one year earlier, in 2007, children “designed” the whole school, but part of their assignment was also to plan learning spaces (rooms) for diverse groups or individuals inside the school house. In these spaces there were more round and soft forms than in the brief modeling workshops in 2008 (naturally because the form of the room as a given= rectangular shaped scale model of the class room they had during this they had during this period). Also more windows and light, with nature coming in to the room, was featured. But the non-existing limits of the imagination of the children seemed to be the same both at the Arkki School and the normal comprehensive school (without any add-on art education).
In these Jakomäki workshops we have to also remember the social status to be a little bit lower there and the prominent proportion of immigrant families living in the area. Some of the children had yet no shared language or possibly they had not learned to read and write (even if they were already 12-14 years old but having moved to Finland only recently). In Finland we are used to think that every child can read and write after the first year at school (age 7-8; of course some learn earlier). Those boys and girls who were not having language skills could quite nicely use their handwork skills. Foreign countries were brought in to the learning space: Turkey and Portugal were mentioned (perhaps memories from vacations with families) but we saw images also from Russia and Somalia in Africa, from where some of the children were immigrated. In a few models was a foot ball field inside the class room: children can also learn by moving and playing; or some boys had just brought their favorite place in to the space to make it their own.

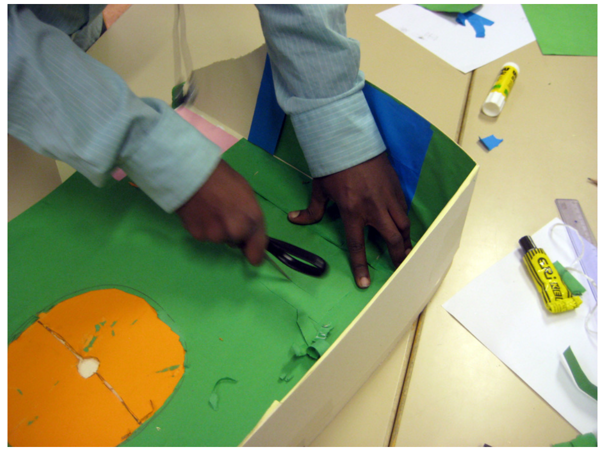

Figure 8. The space (the scale model of the class room) evolving into a foot ball field.

5. CONCLUSIONS / *MEDIATING SPACE*

On the basis of above-presented we have here three preliminary findings of different ways how to see *“the mediating space”* when planning the future school (learning space and place) with children. The children are active learners at school. The space which is activating them in learning, is considered a mediating space.

- First we present this process as a personalizing process of the *space*, *“place making”* (Tuan 1977 etc.): to children (pupils) have a possibility to bring their own memories, hobbies and ideas into the “space” (the class room) and it will become a *place*. In making this – when “memorizing” their favorite places – the pupils can be advised to use all senses, fearlessly. Without fear, although with the will to find culture within the body, there is no “untamed”, uncultured experience; embodied experience is already informed by culture, be it a culture that denies it or one that fosters it (Mäkitalo 2008, 100). And like L.U. Marks is putting it in her text: “Although much of sensory experience is presymbolic, it is still cultivated, that is, learned, at the level of the body” (2002, 145).
- Vygotsky said that people are also thinking in “a roundabout way”, by using *mediating tools* (Vygotsky 1994, 61; here Säljö 2007, 26). Vygotsky mentioned among the most ancient symbolic mediators “casting lots, tying knots, and counting fingers” (Vygotsky 1978, 127). Beyond these primitive tools lie the vast areas of higher-order symbolic mediators including different signs, symbols, writing, formulae, and graphic organizers. Cognitive development and learning, according to Vygotsky, essentially depend on the child’s mastery of symbolic mediators, their appropriation and internalization in the form of inner psychological tools (Kozulin 1998; here Kozulin 2005, 24)

We accept the human mediation (collaboration) to be important, but we try examine the role of the space (class room); could it act as *a mediating tool* or *a mediator.* Feuerstein (1990; here Kozulin 2005, 26) has presented, in the context of the socio-cultural educational theory, the *MLE, Mediated Learning Experience.* According to Feuerstein and colleagues (1980, 23) the acquisition of MLE does not depend on either the content or the modality of interaction: they used examples of instruction in a preliterate society, and wrote that it is possible for the mediation to take a non-verbal form. The mediator can illustrate his actions to an interested observer with only limited verbal, and even less semantic, interaction occurring. They also argued that the changes occurring as a result of nonverbal mediation transcend both the content and the means by which the content is transmitted.

Following Feuerstein, we argue that the process in which the space became a place in the workshops was a *Mediated Learning Experience*. In this *MLE* pupils learned to work together and they had possibility to tell about the places, which are meaningful and important for them, first they could tell it non-verbally (drawings and model workshops 2007, models 2008) and then also in speech (video tapes). In this paper, we present as *"Mediating Space"* the space which is transforming into a meaningful place in the Mediated Learning Experience; *we see in this preliminary phase the Mediating Space to act as a mediating tool in the learning process.*

- We are expecting children's epistemic agency to grow in this MLE, which is a part of the learning process. We see the purpose of learning as not only to preserve knowledge but also to expand and renew it (Engeström 2001).

And of course, the pupils (children or students) learn in this kind of processes, in long and in shorter ones, how to participate and to tell their opinions. As in town planning, where we ask people to collaborate and participate, design process of the school should also allow children (as well as adults like teachers) have the right to come and be part of it.

Participation represents an important strategy in sustainable development. In Finland, citizens' participation in urban planning processes is defined in the Land Use and Building Act implemented in 2000. Since then the planning process has been under intensive development. However, planning is still strongly a game of adults. Environmental psychologists Horelli and Kyttä (Horelli 1997a,b; Kyttä & Horelli 1997, Kyttä 2003) have made efforts towards recognizing children as citizens, and accepting their right to participate in environmental planning. It is evident that children's competence and their contribution to design are not sufficient to make children legitimate participants or "agents of urban policy".

When we accept childhood as a social category, not merely a transitional phase towards adult life, then we have to ask children and youth their desires and opinions of the environment; and more precisely, as done here, to what kind of learning environment do they long for.

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Meetings	Date/ Dates	Topics	Preliminary observations
1. workshop	26.9.2007	1. What should be changed at school?	More fun, new technology and beauty. More day light. More windows.
		2. A nice place	A café, a round places, sofas and soft chairs
2. workshop	2.10. & 3.10.	Future space (own) to work and learn (1)	PCs, smart boards, screens. Round shapes, transparent walls and cupolas, roof like the sky, green nature and bright colours, futuristic shapes in the furniture, ball-shaped chairs, sofas; separate moveable spaces, learning modules also outside.
3. workshop	23.10. & 24.10.	Common places at Future School	Halls, corridors, lunch rooms, great (festival) halls, jumping halls. Open doors and walls, glass walls, windows.
4. workshop	30.10. & 31.10.	Meeting points and routes	Entrance and centre halls and all the other big halls like for physical education and feasts. Currents of people.
5.workshop	6.11. & 7.11	The outside environment of the school	Students were longing after nature: and works of art. Places to stay were cosy and peaceful, bordered by green belts. Many seats. Water in many different elements: ponds, rivers with bridges, falling waters. Plants to see and eat. Different surfaces, different materials, labyrinths, various levels: staircases, ramps etc. Roofs as playgrounds and gardens.
6. workshop	13.11. & 14.11.	The future curriculum and the new subjects. Specific spaces.	Future subjects: physics-astronomy, design (art, craft and mathematics), technology, architecture, medicine and so called “multi creativity”.
7. workshop	20.11.& 21.11.	Future Spaces to study and learn (groups) (2)	Organic shapes. Cell shape came out and also attempts to share round shape into cornered rooms. The big centre hall surrounded by smaller spaces (class rooms) came out several times. Rooms were very high with balconies, bridges and many levels inside. On the roofs open air living areas. Access outside directly from every class room. Nature elements like stones or water elements like fountains, ponds and brooks, were placed between the class rooms.
8. workshop	27.11.& 28.11.	Future Spaces to study and learn (clusters) (3)	
9.workshop	4.12.	Shaping and modelling the school house. Photographing the models.	Organic, morphological, sculptural shapes. Stairs like Guggenheim’s, rhythm like Reima Pietilä’s. A lot of greenery and water. Pilotism. Bridges between houses on pillars. Multi-shaped buildings. Houses resembling rocky stones. Many interesting roof windows. Steps with lawn. Shelters and sun awnings. Round buildings divided in sectors etc.
10. workshop	11.12. & 12.12,		
Seminar at Arkki School	19.12.	Discussion about all topics and creations together with parents	A huge amount of fantastic drawings and models. The overall picture was cleared up to, when everything was repeated and analysed together. The students (pupils) had again opportunity to explain their solutions to the audience.

Appendix 1. The workshops at Arkki School 2007.

The collaborative research sampler plate for informed design and enhanced Body of Knowledge

Jane L. Nichols

Western Carolina University, Cullowhee, North Carolina

ABSTRACT: The academic's experience in conducting research adds several layers that inform and enhance design outcomes, and effect result validity and generalizability to future projects. As practitioners' pressure grows to be productive, efficient *and* creative, their ability to remain abreast of current research decreases. Collaboration with academia can be valuable and necessary in serving the best interests of clients, and there are many pathways for conducting and coordinating design research. Synchronization and mutual respect between design practitioner and academic is critical to both design and research results, and methods should be conferred and formulated in tandem. This paper outlines seven case study methods, offering a sampler of strategies for the researcher or practitioner planning a project. Cases include: Post-occupancy evaluation; Feasibility and resident needs survey; Participatory action-research; Exploratory-descriptive research; Action research; Pre-test and post-test methods; and a Meta-analysis for sustainable community planning.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: evidence-based design, collaboration, place-attachment, methods, assisted-living

INTRODUCTION

Industries as competitive as architecture, interior design and planning (ADP) must continually seek to minimize project timelines, expenditures, and manpower schedules to maximize their efficiency and profitability, while still maintaining design excellence and profile. Even in the best economic conditions, ADP firms seek out a niche market position that differentiates them and adds layers of expertise to their repertoire of services; assuring prestige and guarantee of future clients. The dual-function of providing research-informed evidence-based design can give a firm the edge they need to distinguish their superior designs and services from their rivals. From decades ago through today, pre-design research and case-study evaluations are critical to programming and essential for design decision-making (Friedman, Zimring & Zube 1978).

Collaboration between environmental researcher and designer enables this, bringing benefits to both. Research partnerships in the facility planning process enhance scholarly validity, and result in better-informed designs and more user-friendly spaces. The time commitment required to stay abreast of current studies is an obligation that few designers are willing or able to fulfil, while research is 'de rigueur' to the academic. Coordinating the environmental planning process with the academy can add value to projects and lead to design innovation and 'buildings that learn' and can evolve to suit changes in user needs over time (Brand, 1994). This 'sampler plate' of collaborative research is intended to stimulate new directions and partnerships.

Frank Lloyd Wright defined design as 'Art with a purpose'. But how does one merge, or even *reconcile* the process of design, considered "off the page from facts" while research is "a fact-based activity"… Design is 'subjective research', only an opinion (Dickey, quoted by Groat & Wang 2003:101). Objectivity, in contrast, demands competent inquiry by imposing standards of validity and reliability while scrutinizing methods and conclusions for bias (Creswell 2003). How we engage with and make meaning of the world guides our interpretation of it, and our unique perception, regardless of our profession, is "generalized [from the] relations in which each individual's everyday world is embedded" and offers a "standpoint giving a perspective" (Smith 1987:185). The production of meaning develops through our interaction with humanity (Creswell 2003). But the modus operandi individuals routinely exercise determines how one decodes, deduces, construes and ultimately uses information.

There are distinct differences between the cognitive activities of researchers and designers. Designers operate from tacit knowledge, and "make high-risk decisions" that clients and users have to live with (Groat & Wang 2002:51). Researchers seek to validate data and improve comprehension, adding to an endorsed body of knowledge (BOK), which is however "shaped by the researchers' own experiences and backgrounds" (Creswell 2003:9). By blending the perspectives and approaches, the collaboration enhances the 'problem-seeking' process more precisely defining the problem and resulting in a better design solution (Friedman Zimring & Zube, 1978). The earlier and more consistently researchers can test environment-behavior (EB) concepts and generate new knowledge, the stronger the BOK becomes; thereby benefiting designers and end-users by affording immediate access to information that may be significant in establishing the design criteria (Zeisel 2006; Groat & Wang 2002). It is through this transdisciplinary synthesis of subjective and objective evaluation that the "User Needs Gap" is bridged (Zeisel 2006:50).

Opportunities for collaboration can be cultivated at any point in the design process, but commonly occur in the imaging/programming, presentation/review or in the testing/post-occupancy evaluation (POE) phases (Zeisel, 2006; Groat & Wang 2002). In order for researchers to frame the design problem and impact its solution, it is preferable to get involved in the initial design process; to disseminate information, deliberate on it, and ultimately affect the judgments made (Zeisel 2006). It must not be the researcher's intention to hijack creative evolution or impinge on intellectual territory, but rather to motivate collective and dynamic toggling between left and right brains, and inductive and deductive reasoning. Additionally, the methodological approach to a research project imparts consequences to the study's direction and its findings (Dilani 2009), and constructing a standpoint as a 'perspectival' framework entails a sequential procedure (Smith 1987), which requires rigor and precision. It is generally agreed that there remains a "Need for rigorous environmental design evaluation" (Friedman, et al. 1978).

The foundation of a good research study, like that of good design, is a solid grasp of the theoretical groundwork that drives it. The theoretical base of valid and reliable research entails metaphorically 'standing on the shoulders of giants' through a thorough literature review (Creswell 2003). Previous research evidence supports what the new hypothesis stands upon, drawing on the work of others' questions and findings. Many studies that environmental researchers cite derive from environment-behavior research (Friedman, et al. 1978). Coming from the social sciences, most are highly structured for internal consistency and external validity by controlling for setting differences (Harris, et al. 2008). Environmental evaluations require exactitude and should be systematic in order to be considered reliable and useful (Creswell 2003; Groat & Wang 2002; Zeisel 2006).

And if ethnomethodology is utilized, the researcher has to consider both contextual data and the ideological mediation of institutional processes (Smith, 1987). Researchers should also account for organizational culture and the operational objectives of an institution while conducting qualitative studies (Nichols 2004; Regnier 2002). Finally, the protocol for analyzing data needs to be highly organized and consistent, whether employing statistics or simply identifying patterns and categorizing themes (Harris, et al. 2008). The evidence-based design process should profit from all available literature and study findings to provide a rich data base from which a design team can define problems and develop solutions (Harris, et al. 2008). Information enlightens and empowers us, although it is also "open to multiple interpretations" (Harris, et al. 2008:17)

Interpreting the results of a study enables the researcher to translate what was learned into a textual form for the reader; interpretation is considered both science and art. Highly regarded researchers Graue and Walsh state, "In social sciences, there is only interpretation" (1998:160). Miles and Huberman (1994) regard data analysis in stages, as data reduction, display, and verification. Strauss and Corbin (1987) depict the phases of induction, deduction and verification as "deconstruction, capture, bracketing, construction and contextualization". The interpretive action is both analytical and reductionist, then progresses toward an integrated fusion; it is where objective and subjective siblings play, fight, and make-up eventually. Interpretation in its scientific realm is categorizing, coding, sorting, sifting and labeling. In the poetic, it is "transformative, it illuminates, throws light on experience…refines, as when butter is clarified" (Denzin 1978). As beauty is in the eye of the beholder, interpretation is in the mind and heart of the investigator, who likely operates from both brain hemispheres. And as we accept the dichotomies of subjective and objective, science and art, deduction and induction, we must resolve the dark and light of interpretive analysis, embracing its yin and yang and discovery from all angles. After all according to Friedman, Zimring and Zube, "The principle underlying all analytical methods is understanding" (1978: 27).

1. EVIDENCE-BASED DESIGN

While some ADP professionals may "worry that evidence-based methods limit creativity" or leads to "cookbook" designs (Hamilton, AIA.org 1/3/2009), others find it a 'calling' (Stichler 2008). As researchers discover and create knowledge about how the built environment can impact users (Coile 2001), organizations evolve and journals emerge whose primary goal is to advance and legitimize evidence-based design. These include The Center for Health Design, the Health Environments Research & Design Journal (HERD), and its accreditation and certification arm-EDAC. The Center has been a centrifugal force in codifying evidence-based design, supporting research and publishing White Paper Series. A valuable tool in particular has been the contribution of "*A Review of the Research Literature on Evidence-Based Healthcare Design*" (Ulrich, et al. 2008), which extensively covers healthcare environment case studies, but is applicable and generalizable to other facilities and environmental settings. Case studies are naturally embedded in context, and can be regarded as descriptive or exploratory (Creswell 2002). They lend themselves to evidence-based design as they can bridge the 'synthesis gap' (Zeisel 2002) between research and design. In the pre-design, programming, design

development and post-occupancy phases, designers continually reference existing cases that inspire and regulate their design process and solutions.
In this paper, the author frames for the reader a series of case studies that demonstrate various pathways for coordinating and conducting design research studies in tandem with design processes and projects. The case study is useful when comprehension about a single yet complex setting or phenomenon is sought after (Groat & Wang 2002). The cases are relatively complex but are summarized briefly; the objective is to provide a 'sampler' of research settings and methods which other researchers and designers can learn from and replicate, perhaps with greater precision, could modify, or find inspiration for new research. Because some of the studies are ongoing and findings cannot be released, the facility names are coded.

2. THEORY

The theoretical framework of the following studies are multi-layered and include theories from gerontology and successful aging, organizational culture and management theory, place attachment and place-making theories, and leisure/recreation theory. Another strand of theoretical groundwork lays in sustainable development and ecology. One assumption is that we need to build and live in the smallest eco-footprint possible (www.opl.uk. 7/21/2008). Other assumptions are rooted in the belief that successful aging is dependent upon remaining socially, physically and mentally active and that one's development along the life course dynamically continues (McGuire, et al. 2004). While independently aging in place may be the preference of many elderly, the potential for daily socialization is a protective mental health attribute of congregate or assisted living. Increased social contacts demonstrate physiological benefits, and psychosocial medical research correlates an engaging social environment with human health (Deasy 1985). The senior congregate environment then becomes a prosthetic and compensates for loss in individual functioning, based on the selective-optimization-compensation theory (Baltes & Baltes 1990), while providing a venue for social interaction and cultural integration. However, the social interaction patterns that occur in a given setting are defined and enhanced by the organizational culture of place (Hofstede, et al. 1991; Heek and Marcoulides 1996).
Relocating from independent community living to congregate living is a major adjustment. Environmental and communication barriers must be eliminated as the resident is oriented to a new facility and programs, and an engaging and upbeat staff can set the tone (Regnier 2002). Ultimately, community building cannot be imposed upon residents by external forces, but the impact of leadership, coupled with fitting organizational culture and a deliberate invitation to participate are cogent factors (Ryden 1993; Canter 1991). A management-healthcare provider team that prioritizes engaging residents in activities enables place attachment and can also create stakeholders of residents who become part of the activity programming. Place-making and community building, the sense of interconnectedness (Schneekloth 1995) that creates an identity with place and others, is reinforced through attendance at town-hall meetings, coordinating and volunteering in resident activities, and acts of self-expression (Sancar 1993) through programming and participating in leisure pursuits.
Therefore, providing and orchestrating occasions for residents to be activity planners and leaders is uniting, and harnesses the unique and often underutilized skills that most older residents possess. Developing to one fullest capacity and growing in dignity is the underlying philosophy for operating an activity program in a senior residential setting. The place-based experiences that transcend space and impart meaning to a setting (Tuan 1980) occur on multiple levels. Physical, cognitive, emotional, social and spiritual domains constitute a framework of understanding of place, and its culture is holistic. A congregate living facility for the elderly can provide those opportunities and activities to make the connections between place, people and good experiences, ideally through dynamic recreation-based programming. The events and settings enable new friendships to be developed, and attachment to community grows (Jorgensen & Stedman 2001; Hummon 1992).

3. CASE STUDIES

3.1. Case-BG:

3.1.1. Post-occupancy evaluation

The environment-behavior (eb) variables examined were numerous, and the researcher elected to study the relationships between variables "Through the lens of leisure activity services" (Nichols 2004). The post-occupancy evaluation (POE) methods were triangulated by utilizing interviews, surveys and observation. A limitation of the study was that all three methods were undertaken by only the single researcher, injecting some risk of bias. The research questions in this study were:

- What are the elements of place that promote bonding; connection to place and community?
- How is social interaction and activity constrained or supported by the environment?
- What role does organizational culture play in the maintenance of residents' self-identity, self-continuity and quality-of-life (QOL)?

The research was conducted at two assisted living/skilled nursing (ALF) facilities under the same corporate management, and one independent living unit (ILU) facility operated by city of Phoenix social services and housing agency. All facilities were located in the same Arizona County, but in different locations; one ALF was south-east (SE), one ALF north-west (NW), and one centrally-located facility-the ILU.
A questionnaire was designed for simple short-answers, and served double-duty as a talking-points interview instrument. Resident participants were invited

to share as little or as much information as they were comfortable with. Activity directors and facilities administrators were interviewed at the conclusion of the resident study to elucidate the findings or verify dementia. Observations occurred over four weeks. Visits were scheduled on various weekdays, weekend days, and times of day for a broader view. It was requested that the researcher not visit during the pre-dinner and post-period periods as these often coincided with 'sun-downing'-the periods during which many residents experienced high-anxiety and demanded more from the staff. Observations on weekends included examination of social and familial interactions of residents with visitors.

3.1.2. Analysis and findings

Findings from the surveys showed dramatic differences between the ALF's. Residents of the SE ALF were considerably less involved in planning and implementation of leisure activities, and in fact were not aware they were able to. The Activity Director queried residents at town-hall meetings about the activities they wanted but got little response, and had few attendees. Conversely, the NW ALF Director easily conscripted residents in both planning and facilitating leisure activities, co-creating a sense of neighborhood. This sort of engagement in the home-neighborhood is key to place-making and community building (Shilbley 1995). Developing a sense of place is significantly correlated with actively 'creating place', an outcome of personal involvement in deciding what, how and where to do things, a 'response to everyday place-based issues' (Relph 1976). Residents participating in this collegial process felt part of the neighborhood they were building; like members of a 'club' or the 'tree-house'.

Interviews and observations revealed that residents of both ALF's who *chose not to* participate in recreational/social activities were not persuaded or patronized by staff in any way. Provider-staff and management completed respected their privacy and the desire to live their lives as they chose, including to choosing to live in solitude. This indicated a high degree of autonomy. The downside is that residents could become too solitary, and miss opportunities to bond with their community and environment in the way actively engaged residents seemed to. But while residents who *chose not to* engage in recreation activities were left alone, the *invitation to choose* participation occurred more frequently at the NW ALF, with caregivers and administrative staff promoting the events verbally and personally. Both ALFs alerted residents through posted calendars and flyers.

In studying the ILU alongside the ALF, it was found that the typology was too dissimilar to reliably compare, with the residents living at a much higher level of independence. Therefore, a quality-of-life comparison of the ILU with the ALF's was designated irrelevant.

In summary, the study revealed a strong correlation between resident engagement, perception of QOL and the facility *management* rather than the facility *design.* While the environment supported the leisure programs, it didn't dictate popularity or frequency of participation, or resident satisfaction with social activities or events. Social interaction was impacted by the cultural milieu, which comprised the organizational leadership style, healthcare-provider teams, and resident stakeholder positions toward activities planning.

3.2. Case-FH Village:

3.2.1. Feasibility study

FH Village (FHV) was developed as an intentional virtual community 'network' serving the needs of an actual physical retirement community in Tryon, North Carolina. The research was fashioned as a feasibility study to be utilized by a FHV medical provider group to determine the needs of the community residents. Members of the physical community of Tryon were invited to join the Tryon FH Virtual Village network for plugging into venues that fill gaps in services not currently provided by others. The services menu could include such items as rides to appointments, housekeeping, yard-work, home repairs, and pet-sitting, and would be offered on a volunteer basis from the provider 'network'. The service provider-volunteer would receive vouchers for their service, which they in turn could 'cash in' for services they may need, either currently or in the future. Voucher credits could be 'banked' (the essential vision and perceived value of the FHV virtual community) as people volunteered when they are younger, and cashed in as they aged in the community.

Community-bonding in the traditional sense is difficult and lacking in Tryon because it's a newly evolving retirement community of neighbors migrating from elsewhere. The friendly, helping networks and social capital that builds over time hadn't occurred, presenting a need that FH Village hoped to fill virtually.

The researcher discussed with the medical group FHV's plans and the information the group required to launch a successful virtual community helping network. An informational meeting was planned and highly advertised, resulting in approximately 400 attendees. The intention of the study was announced at the meeting, and the researcher passed out surveys for willing participants to complete there or to mail back in the stamped return envelope provided. The survey purpose was two-fold; data was gathered in part to assist FHV with a gauge of resident needs, and in part to assess environment-behavior relationships of FHV residents with those of non-virtual community types.

The research was based on the same theoretical grounding as the BG study, with primary differences in community-neighborhood scale. The 'neighborhood' in an ALF is bounded by the building shell or campus footprint, including the external walls, courtyards and accessible gardens. The Tryon physical community is marked by finite town boundaries, landmarks such as the local hospital, and nodes such as main street shopping and a town park. But in a virtual community members primarily interact via communication media such as an online network; it exists in cyberspace and in the minds of individuals, each who define the community according their individual personal meaning.

While the medical provider group was interested in service provision needs for network members, the other layer of the research focused on social interaction, themes of reciprocity and the creation of social capital.
At the core of theories about place attachment is social interconnectedness (Schneekloth 1995), a community bond that defines spatial boundaries by identity with place. The social glue that binds neighbors to each other and their community occurs through the multiple routines of everyday living and interacting with one another. The same activities cannot occur in a virtual community. Although in cyberspace there are venues for discussions through blogs and chat-rooms, the face-to-face chance meetings and spontaneous conversation is missing and vacant. In providing a menu of services for a community, what differentiates the virtual community provider 'network' from a service that's available by other means and accessible via word-of-mouth, print or online advertising: *Does FHV fill a need*? How does the virtual community service 'network' *become* a community?

3.2.2. Analysis and findings

At its heart, FHV's real value is the 'insurance' it provides, namely that if one volunteers now, while still able, one will have others to care for one's own needs later. For the convenience and assurance of assistance for aging in place, the preferred lifestyle choice of most seniors, FHV members must pay a membership fee of $500 annually. The survey research concluded that the "greatest community needs" were first for rides or shared transportation, and the important secondary need for adult day care. Home repairs, maintenance assistance, and jobs were also community needs mentioned frequently in the survey research (Fig. 1).

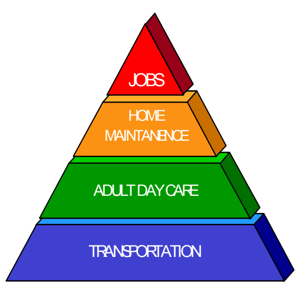

Figure 1: FHV survey research conclusions.

Retirees who move to new communities, leaving their families and friends behind, need to be engaged in activities with new neighbors, particularly in the absence of informal interaction at the street level of sidewalks. In order for FHV to succeed, planned events for socialization among members and to recruit new members would go far in promoting the virtual village. Residents become stakeholders in their home, and develop attachment to place through activities and recognition of the culture of place. Stakeholder "sense of ownership" is promoted through participation in neighborhood events or activities, whether manifested in cyber or physical space, and ties members to each other. Kin networks and close proximity can fortify place attachment, but for older adults relocating, the physical, and emotional breaks from their home can cause psychosocial disruptions, leading to dysfunction in community attachment (Fried 2000). The loss of self-continuity that relocation can bring impedes the process of building ties to neighborhood.
The FHV virtual community services network implemented these findings as pre-marketing research for their programming and advertising. Although FHV and the researcher believed they appropriately identified the community needs and the feasibility of a services 'network', after several months of recruitment, the membership did not grow enough to make the project financially viable. It is not known whether community residents didn't recognize the value in the product, weren't comfortable with the mechanism of the 'network', were in age-denial, or simply were not ready to join a virtual community. Future studies in the area of virtual communities will illuminate this topic.

3.3. Case-A Cohousing Village: participatory-action research

The research was conducted over 15 months in order to establish design criteria for a newly forming co-housing community. Phases of the planning process included individual housing and common-house design, which began in committee and progressed to the whole community. Characteristics idiosyncratic to the project were a strong commitment to sustainable design, prioritizing resident preferences, and limiting points of contact for design communication with the architect and developer. Achieving consensus on community and housing designs for 20 potential co-housing families is no small feat, and only possible by establishing a finite matrix of needs from a long wish-list of 'wants'. Additional resident criteria included acceptable costs and baselines for integrating eco-design elements.
For the co-housing community to envision and birth the community, much investigative research had to precede planning. As a member of the co-housing core planning group, the researcher became a participant-advocate researcher, moving from the data gathering and analysis process, to weighting and discussing decisions based on the data findings, to implementing the findings in the final co-housing community design.,
The participatory planning process is universal to all co-housing projects, even as the size, ideology, location and population of them can vary dramatically (Durrett, 2005). The process is a new way of interacting with others and the world-one that takes us beyond our individual schema and forces us to view things through others' eyes. The decision-making process for co-housing communities is often consensus, for which training and a good facilitator are required. The ability for groups to debate and solve problems is more critical to a co-housing community's success than the right land, location, developer, design or any other physical manifestation-it is in the creation of a community bond that is greater than the individual (Durrett 2005).
Learning to listen in communication, cultivating tolerance and patience are benefits of the participatory

planning and design process required for co-housing development (Scotthanson & Scotthanson 2005). This alone enables one to grow as a human being. The lessons continue as one lives in co-housing, a very different lifestyle than most Americans are accustomed to, as the members create their version of a "coherent, fair thoughtful group process" (Durret 2005:111).
Important questions to ponder are the amenities and proximity of these to the co-housing site, as well as how much socialization versus privacy is wanted, and how to design to accommodate that. AC Village's objective was to reduce the eco-footprint of its members and it desired a central location with access to public transportation and community-based ride-sharing. The researcher visited, observed and surveyed Tryon, a traditional community, and two existing co-housing communities-Westwood in North Carolina and Elderspirit in Abingdon, Virginia. Thirty-five people participated in the informal surveys. Fig. 2 demonstrates the differences in the "Occurrence of Spontaneous Chatting" in Tryon and in co-housing.

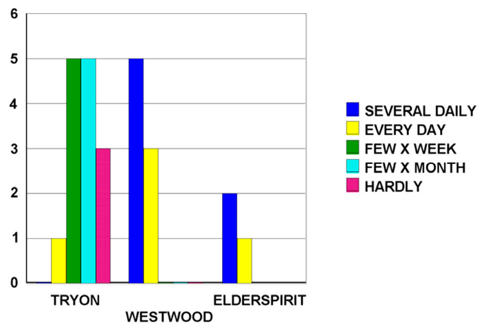

Figure 2: Differences in the occurrence of Spontaneous Chatting.

The next table indicates the "Frequency of Ride-Sharing" in the three communities (Fig. 3). The co-housing communities share rides at a much higher frequency than the traditional single-family home community.

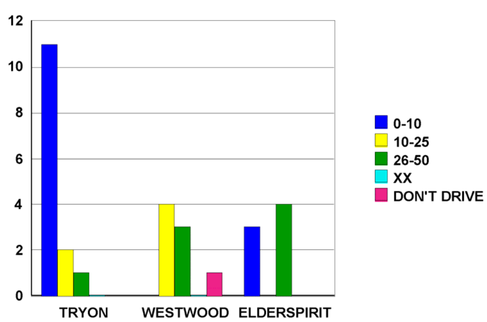

Figure 3: Frequency of ride-sharing.

Co-caring was a major concern for AC Village, and the evidence indicated that co-housing residents felt more confident that "A Neighbour Would Help Care for Me" if needed, as shown in Fig. 4.

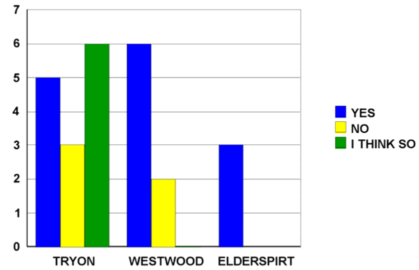

Figure 4: Level of confidence that a neighbour would help care for me

While survey sample sizes were very small, they showed a pattern that AC Village Co-housing members were able to utilize in their participatory decision-making process. And while this research cannot be generalized due to sample size, its inclusion here demonstrates another *survey* example of environment-behavior research.

3.4. Case-CV Main Street: exploratory-descriptive research

According to Zeisel (2006:93), descriptive studies "describe and measure as precisely as possible one or more characteristics and relations in defined groups". In the exploratory research conducted for CV's 'Main Street', a group of 20 design students was directed to conduct a literature review of the characteristics of patients with Alzheimer's and dementia, in addition to doing case study research on 'Main Streets' in America.
A pattern emerged in their findings that indicated a correlation between familiar environments, such as a typical 'Main Street', and cognition. This is supported by other research (Schwarz & Brent 1999). The client considered renovating an existing continuing care community to incorporate a 'Main Street', and was looking for several concepts and validation for the investment. The students' research evidence informed their 'Main Street' designs as they integrated their findings, which they shared with the client. Through the descriptive research-based design, students were able to identify and describe for the client the links between their 'Main Street' plans and potential resident behaviour and QOL. This pro-bono, course-embedded evidence-based design provided students with real-world design opportunities, while generating a wide array of design concepts for the client's use.

3.5. Case-AB Village: action research and pre and post tests

Similar to the preceding environment type, AB Village is also planning the addition of a 'Main Street' to their facility. At considerable cost, the clients are interested in measuring and documenting the success (or failure) of the renovation to determine a return-on-investment (ROI). The ROI will not be measured directly in financial terms, but instead will be determined by how the addition reinforces or changes the existing organizational culture, impacts to resident care and perceived resident QOL.

In 2008, preliminary interview, case study and focus group research was conducted with administrators and residents to establish a design criteria and program. The project is currently in design development phase, with construction slated for spring of 2009. In early 2009, survey, interview and focus group research is planned that will establish baseline metrics for five of seven “cultural values” of the Village during pre-construction. Two examples of the values include lifelong learning and maximized social interaction for health and well-being.

A repeat of this sequence will take place after construction is complete, utilizing the same instruments, while controlling for variables (such as switching group facilitators to avoid questions answered to gain facilitator approval). The results of pre and post construction research will be compared. The triangulation of methods will enhance the study validity and reliability (Creswell 2002; Groat & Wang 2002; Zeisel 2006). Upon hearing about the AB ‘Main Street’ project, the design-researcher intentionally contacted the practitioner for the purpose of collaborating on this research, specifically to use critical testing to build a body of e-b knowledge (Groat & Wang 2002). Action research and evidence-based design is to be conducted and employed throughout this project.

3.6. Case-CV Corridor Renovation: action research and behaviour mapping

Action research balances data-driven research, collaborative analysis and problem solving within a cooperative inquiry process. The result allows for predictions and action toward organizational change. The research methodology for a corridor renovation at CV continuing care community entails a temporary build-out of period-style entrance fascias for the residential unit doorways of an internal corridor. The designer’s intention is to create “neighbourhoods” in wings of the facility, which has long and narrow corridors with little definition and poor lighting. Lighting will be incorporated in the entranceways and improve wayfinding, as well as creating and enhancing place identify, correlated with self-identity (Nichols 2004).

The research will be conducted in stages as entranceway fascias are constructed in partial wings. Behavior mapping and observations will be augmented with interviews to gauge residents’ impressions of the environmental changes and preferences for styles. The renovation will be costly, but less so than a complete building remodel. The building is slated for demolition in five to ten years, prohibitive to a major re-build investment. The surface improvements will add beauty and personality to the corridor wings, thereby increasing resident satisfaction and potentially improving long-term cognition through memory triggers. By conducting the action research, residents are made stakeholders in the design-decision process (Sancar 1993), ensuring buy-in and fostering the likelihood of a successful renovation. The researcher recommended the action research as a participatory design ideation strategy. While this lengthens the timeline of the project, the client prioritized cost savings over haste and anticipates greater resident approval and satisfaction due to the active and participatory approach.

3.7. Case-Sustainable Desert Community for Elderly and Persons with Disabilities: meta analysis

Primary research can take many forms. The research paradigm typically begins with a research question, and in e-b research, the methodology is informed by the setting and the population to be studied. These elements dictate to a degree the methods best suited for seeking answers. Other pragmatic influences play in to the methods decisions of researchers, such as time, resources, expertise and availability of sites and participants. When the setting and population cross boundaries and scales and the multiplicity of variables become unwieldy, traditional survey or interview procedures are not appropriate. In a case study of investigating models of community planning, many typologies must be included and examined; at a macro-global scale, meso-region or town scale, and micro-housing or individual scale. To duplicate studies undertaken by teams of researchers across the world and over decades is an impossible feat. In these instances, a meta-analysis is the appropriate method.

Meta-analyses are frequently used in medical research (Oliver, et al. 2008). Authors conduct systematic reviews of studies within a category and analyze the data in order to draw a cumulative conclusion that healthcare providers can utilize. It is one way of enabling the profession to keep abreast of a rapidly changing field. While community development moves at a slower pace, the breadth of data is immense and the number of variables substantial, making a typical correlational study impractical. The researcher opted for a diagnostic study approach, as a “tradeoff between precision in favour of breadth… [for] insights into structure and dynamics of whole” (Zeisel 2006:93). When seeking understanding of a broad range of evidence in a holistic manner, the meta-analysis provides a whole-systems view of a complex research problem and solution.

For this case study, the researcher explores planning models that include New Urbanist, Eco-City and OnePlanetLiving and overlays these with the Liveable Communities study done by AARP. A matrix of sustainability indicators was compiled via an extensive literature review, much like the abstracts table developed by Ulrich, *et al*. (2008) for the Center for Healthcare Design. The review comprised literature in sustainable development, city/neighbourhood planning, housing design, place-making, successful aging, disability theory, organizational culture and facilities management theory, and others.

The content analysis of the meta-data, collected over 20 months, results in recommendations for sustainable community planning that closely align with the city master plan. These will be ‘virtually’ applied to a case-study existing environment and examined for strengths and weaknesses, then modified and offered to the city planning department for consideration.

CONCLUSION

As indicated in the findings and summaries of these cases, collaboration between design researcher and practitioner improves the outcomes of the design and benefits end-users, while underscoring clients' understanding and buy-in of the design solution. Synchronization in initial stages leads to better research protocol and results that can be generalized to other settings. Optimistically, ongoing study results will defend and demonstrate cooperative associations of researcher and designer that provide a foundation for quality evidence-based design, while adding to the BOK--a secondary but important consequence of the collaborative research process. The author hopes the methods outlined here will inspire new alliances and serve to initiate novel research directions.

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Citizen's words are not just idle talk: Collecting stories for giving ground to the project

Jean-Michel Roux[1, 3], Nicolas Tixier[2, 3]

[1]Institut d'Urbanisme de Grenoble, France
[2]Ecole Nationale Supérieure d'Architecture de Grenoble, France
[3]BazarUrbain, collectif pluridisciplinaire d'action et de réflexion sur l'espace urbain, France

ABSTRACT: This paper is concerned about the way we as architects approach a project on ordinary urban spaces. Changing such spaces takes more than just a clear political vision guided by strong architectural design. The people are already settled there, the place is a *palimpsest* of buildings and of personal stories. We make the hypothesis that better design needs to take the existing condition into account and giving an account to the place and its inhabitants can help reaching it. This story telling of the genius loci is both singular and plural. It gives an account of social practices, ambiances, and history(ies). It mixes past, present and the future. It gives voice to the ordinary citizens in the same way as it does to the politicians or the urban managers.
We make the hypothesis that hybridizing techniques and expertise from practical and research fields in architecture/urban design can help developing a project. Many methods coming from the research world can be adapted to urban design: "commented visits", observations, etc. Recounting photographing drawing or filming are multiple ways of telling the stories of a place. Each place, territory or project needs its very own set of techniques. The voice, ordinary and expert at the same time, is given on the spot. These methods make it possible to reveal the characters of a place. These make it possible to gain a better mutual understanding between all stakeholders of a project. If they are not the project yet, they give stronger foundations to (the development of) the project.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: ordinary spaces, stories, project, urban design

INTRODUCTION

It is not an ordinary thing to be interested by ordinary things.
Going into a project on ordinary urban spaces such as brownfields, derelict lands, suburbs, urban fringes need special tools and attitudes. Changing such spaces takes more than a clear political vision guided by a strong architectural design. People are already there, settled and the place is a palimpsest of buildings and personal stories. Giving an account of the place and its inhabitants can help getting into project. This story telling of the genius loci is both singular and plural. It gives an account of social practices, ambiances, and history(ies). It mixes the past, present and future. It gives voice to ordinary citizens in the same way as politicians or urban managers.
Better design on such spaces needs to take into account the existing conditions. We make the hypothesis that hybridizing techniques and expertise from practical and research fields in architecture/urban design can help getting into project. The following paper presents one of our projects regarding a 300-social-dwelling neighbourhood in Hem, France, as an example of the results of our 8 years of research, urban projects and developments, for which we were awarded the price of "Young Urban Designer of the Year" by the Ministry for Sustainable Development and Planning in 2007 (BazarUrbain 2007).

1. *IN SITU*… FIRST OF ALL

For us, the field is a sine qua none for both analysis and project purpose. Being in situ is about walking around the places or meeting their users. It is also about making the site a necessary third party for all the participants of the project… the residents, the designers, and the project managers.
This position we use for all our studies entails developing specific methods to help "reveal" the place through a multi-faceted prism: the story-telling, the observation, the measurement taking, and the urban reading. This methodology is further supported by analysis concepts that enable us to name and organize these sensitive, technical and practical *corpora*.

1.1. Telling the story of a place

Influenced by the Perec style attempts (Perec 1974)

and Kevin Lynch (Lynch 1960) or Pierre Sansot's early researches (Sansot 1986), the story-telling appears to be one of the essential modalities for apprehending a place (Thibaud and Tixier 1998). The Cresson laboratory has developed numerous space recounting techniques, from Jean-François Augoyard's early PhD works in the seventies on the Villeneuve neighbourhood in Grenoble (Augoyard 1979) to the "commented visit" method theorized by Jean-Paul Thibaud (Thibaud and Grosjean 2001). We applied these techniques to the project to recount the place and involve its stakeholder.
"Situated story-telling" is a certain speech describing the place and its heritages, given right on the spot, which thus allows the immediate comparison between one's representation of a place and the “reality”. "Shared story-telling" which takes place within a group on site, helps inserting the time, the bodies and the customs in real-life situations. It also makes people aware of individual and collective representations (of the place) and allows laying the foundation of a common experience.

Figure 1: “Commented visit” – Saint-Etienne. Source: (Bazar Urbain 2001)

"Commented visits" resulting from research lead to "collective visits", which we almost systematically organize with the stakeholders associated with a given place: city officials and technicians, professionals who manage urban activities (lenders, teachers, postmen, city policemen, garbage collectors, people in charge of parks and green spaces and road maintenance etc.), users, representatives of associations or residents.
The comments from the participants provide us with practical experiences, perceptions, desires, the attachment to a place, complete dissatisfaction, etc. Photographs are systematically taken and then selected by the participants themselves. "Visit albums" are then put together to restitute words and images under various forms depending on the actions: portfolios, ABC books, flip books, urban albums, etc.
The principle is to always give things in return to those who have given their comments, stories and time. The "albums" as well as a synthesis document with the

Figure 2: “Collective visit” with technicians who manage urban activities. Source: (Bazar Urbain 2007)

statement of the purpose of the work may be handed over at a public meeting.
The individual comments are multiplied by those of the others, and thus become “polyglot”. The experience is shared; the knowledge of the place is built with small touches that will then be refined through other approaches.

Figure 3: “A square for three neighbourhoods” - 2007 - Djamel Klouche's and Jan Kopp's project following the BazarUrbain study (2005). Source: (Bazar Urbain 2007)

Telling the story of a place enriches the project by finding its seeds in the competences of the residents (original experiences, know-how and imagination, heritage etc.). Far from slowing things down, taking the time to talk accelerates the project as the participants' different views are rapidly absorbed. Without being an extravagant or even unnecessary expenditure, story-telling gives the possibility to involve residents in the project rather than apply the project to them. With such an approach, the sponsor is a priori assured of a better project feasibility within due time while reducing risks of being at odds with the residents.

1.2. Observation, Statement and Measurement through urban reading

Being *in situ* is also a way of observing and measuring, a way we apply through the notion of site reading. In French, reading (*lecture*) implies an analysis or a rigorous, progressive interpretation of a text, a road, or a landscape. For that matter, read and link have the same Indo-European root, *leg*, meaning to “gather”, to “choose”. When we read a map or an urban landscape, what we do is decipher its constitutive elements to link them one to another in order to reach a general meaning.

Although reading city maps is crucial to urban analysis, one should not forget to read a place with one's own eyes by going on the spot, pacing up and down and "measuring the site". As Bruno Queysanne noticed

> To our wonderment, the Latin meaning of the word read, before taking on today's underlying meaning, also means going through space, wandering, sailing along the twists and turns of the coast. Thus, there would be a first reading which would not merely decipher signs deriving from a two-dimensional plan but which would entail exploring a three-dimensional space with adventurous connotations as whether by land or by sea, space would be read along winding routes. Therefore, reading space would imply gathering it by walking through it, by travelling its length and breadth. The spatial form cannot be given in one go, but won over little by little (Queysanne 1983: 4-5).

As far as we are concerned, visiting/reading occurs at different speeds, depending on the means of transport (on foot, by bus, by car), in order to apprehend territorial scales ranging from site to country. This kind of reading helps ascertain whether such a neighbourhood is far away from or close to the city centre or shopping areas, how much time is gained and how much energy is saved by walking through pedestrian passageways or by walking up stairs, whether a given public transportation line is efficient or not etc.

2. PAYING ATTENTION TO THE ORDINARY MAKING OF A CITY

It is necessary to look closely at how a city is designed and continuously re-designed. Rather than the work of one architect, one urban planner or one politician, a city is made day by day, by capillarity, through an anonymous accretion of actions by a vast number of individuals. Understanding the city so as to work on it requires paying attention to the ordinary making of the urban environment.

This attention further leads to a postulation: the territory carries in itself the qualities and elements that are necessary for construct a project, particularly in its urban fabrics, its customs or its ordinary heritage.

2.1. The urban fabric

Making the urban fabric the subject of research, an analysis or a project entails being interested in the context, the site, the trivial things just like Marcel Poëte (Poëte 2000) J.W.R. Whitehand or Philippe Panerai (Mangin and Panerai 1999) invite us to do. The urban fabric is not interested in exceptionalness or in great urban works that are just singular elements, *i.e.* remarkable features such as monuments, palaces, churches, etc., but in the very structure of the city. It means understanding how an urban organization shows a strong solidarity among its various elements yet at the same time has the capacity to adjust, alter or transform itself.

This involves thinking about how elements can be renewed and continuously substituted without distorting the coherence and efficiency of the city as a whole. Lastly, working on urban fabrics is to also admit that there are multiple fabrics co-exiting side by side in the city and, in theory, forming the unified whole. This forces one to constantly ask the question of weaving links between the urban fabrics of different periods.

Figure 4: Residents reading Echirolles' urban fabrics – “visit album”. Source: (BazarUrbain, 2004)

2.2. Customs and ordinary heritage

The city is not only one or several urban forms but it is also one or several social forms. In order to understand one entails taking an interest in the other. When a city is made by men's anonymous and daily actions, it is essential to take their lifestyle into account. We postulate that the residents and users as the "experts of their daily lives".

Appropriate techniques (walks, guided visits, free-conversation style speeches) make it possible to put residents in a situation where they can tell what makes sense for them in their living place. Gradually, they manage to expose those elements of the heritage that are apparently very ordinary, such as the views, the gardens of the working class, the moments of celebration or “insignificant” buildings that are in fact full of meaning (craftsmen's houses, factories etc.). This is how the professionals acquire the elements of the project from conserving and enhancing the heritage.

This approach questions the very nature of “inheriting”. We manage to stay away from the traditional well-known works and artefacts, which are usually identified through classical listings. Heritage is not only in the

beautiful freestone, but also in everything in the city, in life, that are full of meaning and remarkable for their spatial, sensory (view, sound, insulation…) and user-friendly qualities. It can be, of course, the spaces or, more exactly, the configurations of senses as well as the temporalities and customs: so many heritage elements that are difficult to express, to qualify and to be recognized.
The techniques used enable us to conduct inventories by noticing what lies there, seemingly ordinary, yet having created the delights in our everyday urban life… They allow us to consider the residents' experience as active and respectful inheritances. They give us the possibility to project a future without denying today's customs or falling into automatic conservatism. This way, we hope to avoid going through what could be caricatured as the "murder of the customs".

3. BEING IN PROJECT… THREE MODES OF ENTRY

We usually enter in a project by considering the three following modes: customs, atmospheres and the play of scale.

3.1. Mastery of custom, mastery of customs - (*Maîtrise d'usage, maîtrise des usages*)

With consultation having legal force in France, residents and users are gradually seen as a possible third mastery for projects alongside the conventional (parties of) project management and architects. Accepting such an attractive but dangerous idea of "mastery of custom" entails knowing exactly what consultation should (and should not) be about and which balance ratios should be reached among the three parties.
The willingness to see the residents participate in urban projects is not enough. Participation is not something that can be decreed. A clear position must be adopted about the whole project, just as about its available tools and process of realization. The willingness of local councillors is often undermined by inexperience. Furthermore, the overflowing enthusiasm of young architects / urban planners who supported participation architecture during the urban struggles of the seventies gave way to scepticism among professionals over the interest of consultation when putting together a project.
First of all, when conceiving of the residents' participation, the elected representatives, the professionals and the residents must learn to get to know each other and work together, but at the same time to preserve their exclusive territories. Even if a resident is involved in the life of his/her city (e.g. as the head of an association or a member of a neighbourhood authority), even if he/she can boast a professional experience in city management, he/she cannot expect to play the role of an elected representative or urban planner. It is up to elected representatives to make decisions, which will be binding on the community, and up to the urban planner to implement the territory project.

That said, conducting a survey on customs helps understand the possibilities of a place on a large range of scales from the house and its backyard to the road systems. "Mastery of custom" enables us to revitalize the way we look at project management and project ownership.
Users dismantle some myths and planning reflexes. Their aesthetic vision may surprise tasteful experts. The same goes for the way people look at the "necessity" of standardizing a road. Although no driver is against road improvement, some will still mention the pleasure they feel when driving on old highways, as opposed to driving on the new highways.

Figure 5: "embedded journey" with the patrolman on the motorway. Source: (BazarUrbain, 2007)

3.2. The notion of *ambiance* as a principle of disciplinary crossing

Our desire to cross masteries' or disciplines' points of view raises the question of the principles of hybridization. This step is made possible by the notion of architectural and urban *ambiance*, which is created through the research.
The *ambiance* lies at a crossroad of various dimensions that help to apprehend and understand it. This concept, was developed more particularly at the Cresson and Cerma laboratories, notably by Jean-François Augoyard (Augoyard 2007) or Pascal Amphoux (Amphoux 1998). This concept situates either a phenomenon or a place to be analysed at a crossroad of several dimensions: the sensory dimension (what appeals to our senses, what we feel), the technical dimension (buildings, road system, technical engineering) and the social dimension (practices, imagination of a place).
This concept is particularly interesting for projects because if we position ourselves at a crossroads of different dimensions for the reading of a place and the development of its project, decisions are made by taking into account the complexity of the existing situation rather than in favour of an exclusive dimension that would only correspond to a partial vision of things. Building up a project by using all these data is more complex but also richer and more interesting in terms of

Figure 6: Multi-actor workshop. City of Saint-Etienne. Source: (BazarUrbain, 2001)

proposals, as it allows all participants to play a role in relation to their competences.

3.3. Interscalarity: principle of multi-scale action and reflection

The approach to a site, by placing the participants in the place, leads us to enter a project on a scale where the body becomes rooted into the field, while taking on various postures and moving itself. It is the scale of the body and of the sensory modes, the scale immediate, the scale of the single parcel, the block, or even the neighbourhood. It is the scale of proximity, where the users' competence, their daily expertise, is relevant. When using the scale of the body, one is not necessarily situated in a public space, but may be in a private space, a collective space, or in the street around one's place of living and working. This type of scale uses methods such as the wandering and the commenting while walking.
Even if this scale is extremely important to us, we do not, however, ignore the other scales, which refer to neighbourhoods, cities, suburbs or even the country. From the closest to the furthest, the project must take into account the experience acquired at these various scales in order to propose and build up a coherent system by alternating between these different scales. A project on a block of houses should not ignore the coherence of the neighbourhood nor its inscription within a larger scale…

4. CONCLUSION

Such ordinary yet expert comments take place in situ most of the time. The place then acts as a third party between the speaker and the interviewer. Such methods are not really consultation tools, but firstly they set out the characteristics of a site with its ambiances and reveal the various elements of its ordinary heritage. Secondly they enable all the stakeholders to be aware of everyone else's representations and issues during the conversation. Lastly, by synthesizing this information, these methods allow us to discover issues, identify levers and make an inventory of ideas for the project.
However, these words gathered on site will gain a more special meaning when, some time later, they return materially to their speakers. This is done via three systems: the transcription of their own stories (full text, pictures etc.), the editing of the elements making up the stories of others (ABC book, photo albums with comments, polyglot itineraries, etc.) and the thematized synthesis that reveals characteristics and issues of the place. Attention given to these ordinary words, the possibility of reading stories of oneself again or those of the others and reacting again turns the interviewer into the interviewee. Citizen's words are not just idle talk…

5. CASE STUDY: HEM (FRANCE)

5.1. Recitation, exhibition, and design: 3 modes of action for a neighbourhood

Figure 7: Hauts-Champs neighbourhood before renovation. Source: (BazarUrbain 2005)

The Hauts-Champs neighbourhood is made up of strips of house blocks, which belong to the Logicil (CMH group) social landlord and is located in Hem, in northern France. Right in the middle of the blocks, more than 400 garages were built as mineral, closed spaces and dead ends. These dilapidated garages, separate from the houses, are sometimes used for unlawful activities. The way they are positioned has contributed to develop a feeling of insecurity that has been slowly enhanced by the vacancies of the garages.
The objective of the study, for which BazarUrbain was appointed, is to take from the problems of the garages to a "shared project" of the evolution of the neighbourhood. This aim is reflected in a report on daily life issues, a proposal of several project scenarios and a master plan for each block.
This approach is based on three work principles:

- A principle of scales: working on the project by using several scales: object – building – block of houses – neighbourhood – city

- An interdisciplinary principle: analyzing and suggesting courses of actions by balancing social dimensions (customs), sensory dimensions (ambiances) and technical dimensions (constructions) in the best possible way
- A principle of involvement: implementing a process in which the project management, the architects and the residents can get involved, express themselves and be heard.

Figure 8: Entrance of a collective backyard. Source: (BazarUrbain 2005)

Three modes of action make up the project. Every action is defined in close relationship with the project management and gives rise to a public meeting during which a document is handed over to all stakeholders, including the residents.

- **The *recitation*** consists in reading and telling about the place so as to lay the foundations of the project. This is about establishing the urban and social aspect of a place: urban reading (forms, regulations, customs), organizing collective visit specifically with the project management, architects and residents and setting up interview-based visits at the residents' private homes. Every block of houses is subject to a report synthesizing the three different readings of the place (data base, topic mappings, thematized speeches) and announcing the challenges of the forthcoming project.
- **The *exhibition*,** which aims at reversing images, consists in collecting the story of a place and the memories of its residents and stakeholders (local communities, lender…) in order to help improve the neighbourhood and elevate its residents. This activity, which runs across each block, will be completed in Spring 2009 and a book, which combines the words and stories of the residents, the photo footages and the materials from the archives of the original project (in the late 50s) with its developments, will be published.
- ***The design*** consists in producing the scenarios of developing the hearts of the blocks and then the master plans which takes into account the residents' lifestyles as well as the urban reality with its developments on every scale (urban organization maps, cross section of a street, housing approval proposals). At this phase, the residents' contribution are crucial to precisely identify the local issues (e.g. the need of storage spaces), to rely on existing practices (rainwater collection…) and pinpoint the challenges and the scales of necessary transformations.

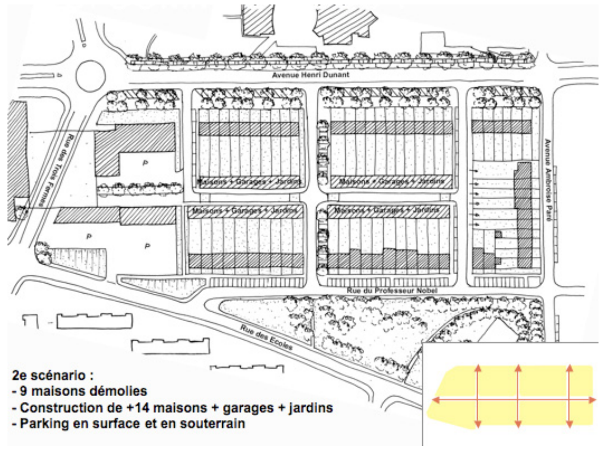

Figure 9: Plan of a scenario - project. Source: (BazarUrbain 2007)

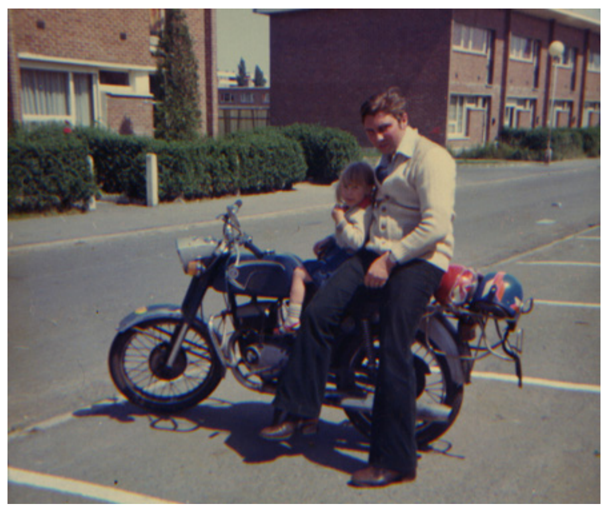

Figure 10: Photo extract from a family album – exhibition book. Source: (M. Arnaud and BazarUrbain 2006)

Figure 11: Overall plan - project. Source: (BazarUrbain 2008)

5.2. From public meetings to participative workshops

As regards the housing scale, we set up workshops in collaboration with the residents to best define the specifications of two objects which are useful for everyone and contribute to change the neighbourhood image: a multi-function console in the front of the house and a garden shelter at the back. The latter, which can be used in different ways (storage or DIYs space, additional room etc.) allows collecting rainwater and even the dew water.

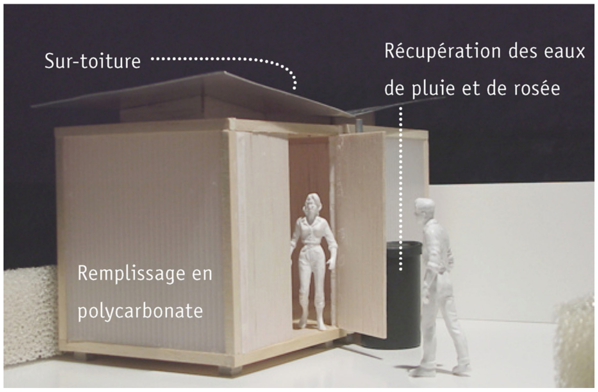

Figure 12: Garden shelter - project. Source: (BazarUrbain 2006)

ACKNOWLEDGEMENT

The authors would like to thank all members of BazarUrbain (www.bazarurbain.com) and Lilan Pan for her contribution.

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Case Studies of High Performance Buildings

Harm A. Weber academic center, post-occupancy building performance and comfort perceptions

Keelan P. Kaiser[1], David M. Ogoli, PhD[2], and Malcolm Cook, PhD[3]

[1]The School of the Art Institute of Chicago, Chicago, Illinois
[2]Judson University, Elgin, Illinois
[3] Loughborough University, Leicestershire, United Kingdom

ABSTRACT: The Weber Center at Judson University, a mixed mode, naturally ventilated building in a continental climate, has been in operation for just over a year, with initial occupancy in August 2007. This paper compares the design objectives and building performance expectations against the first year of actual energy consumption in a first of a series of post-occupancy evaluations. The paper contrasts the building performance with general user satisfaction and perceptions of comfort through a post-occupancy evaluation of user surveys and interviews. The innovations involved in this building, particularly mechanical strategies atypical in contemporary practice within this climate and region, have introduced some interesting problems that have been documented in the post-occupancy evaluation process, while confirming many of the original intentions of the design.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings
Keywords: post-occupancy evaluation, building performance, comfort, natural ventilation, daylighting

INTRODUCTION

The Weber Center, designed by Short and Associates (design architect) and Burnidge Cassell and Associates (record architect), is a first of its kind in the continental climate region of Chicago, IL. The result of a winning entry in a 2001 invited design competition for a new School of Art, Design and Architecture combined with a Central Library, the four story building occupies approximately 88,000 gross square feet on the Judson University campus along the Fox River in Elgin, IL. Construction commenced in 2005 and concluded in July 2007, with final commissioning and occupancy in August 2007.

The facility employs a hybrid natural ventilation strategy that reduces heating and cooling loads during swing months of the spring and fall; and uses night flushing accompanying a high thermal mass of pre-cast concrete. Other passive strategies, including modest passive solar and shading, in conjunction with significant daylighting reduces loads on heating, cooling and lighting (Fig. 1). An extensive landscape architecture complements the new facility with on-site storm water management and native prairie and habitat restoration.

50% of the carbon emissions generated by electricity usage of the building is offset through a local renewable energy certificate agreement.

Pre-construction modeling was conducted early in the design stages, and included computational fluid dynamics modeling (De Montfort University Institute of Energy and Sustainable Development), as well as

Figure 1: Exterior southwest view. Source: (Author 2007)

experimental and theoretical modeling of key aspects of the building integrated photovoltaics and natural ventilation in the south facade (University of Cambridge BP Institute for Multiphase Flow). The preliminary modeling provided the basis for design decision-making by the record architects and particularly their consulting mechanical engineers KJWW.
The facility houses a professional architecture school and a central library making it a remarkable learning context that positions sustainable building as a core architectural education priority (Fig.2).

Figure 2: Architecture studios. Source: (Author 2007)

One of the promising values to the institution during the competition selection process in 2001 was a proposed energy savings of 42-47% over a conventional academic building proposed by the Short scheme. The competition jury, composed of a cross section of users, administrators and trustees of the University, perceived that these savings were valuable not only economically, but also philosophically as an institution. Ultimately, the prospect of the institution building an architecture school that would be “one of a kind” because of its environmental approach according to jury moderator Carol Ross Barney, FAIA, was the kind of distinction the jury responded to, and the Short scheme was selected.
The process of design and construction was not without its challenges. Neither the record architect nor the construction manager/general contracting firm had built a high performance building to date, and neither had any experience whatsoever with such an unusual natural ventilation approach. The mechanical engineers had some experience with ventilation strategies but certainly not at the scale pursued in the Short scheme. The entire design team, and it was a collaborative process by necessity if not design, entered into a steep learning curve. While the process remained in a fundraising stage between 2001 and 2003, the design team, pursued many iterations wedding the specific programmatic needs with the energy scheming, some of which were at odds (e.g. library uses and humidity occurring in naturally ventilated air).
Ultimately a pre-cast concrete structure that was exposed to the interior and insulated and sealed on the exterior was developed (Fig. 3, 4).

Figure 3: Pre-cast concrete structure. Source: (Author 2006)

Figure 4: Pre-cast concrete structure with return air stacks during rough framing. Source: (Author 2006)

The building employs two primary types of natural ventilation circuits. The central library/architecture studio block employs an edge in/center out type. The academic wing employs an edge in/edge out type (Lomas, 2007). The two types function independently of one another in the complicated mixed program of open library and cellular academic functions (Fig. 5).

Figure 5: Pre-cast concrete structure with supply air ducts (left) and return air duct/stack (right), during rough framing. Source: (Author 2006)

Figure 6: External fresh air intake supplies the lower level insulated ceiling plenum (air travels from right to left in this construction photo). Source: (Author 2006)

Fresh air is drawn into the building through the ceiling plenum at the ground level. Intake filters, screens and automated dampers control the intake air at this area of the building envelope. Hot water unit heaters occupy the ground level plenum space for tempering of air during the swing seasons when outdoor temperatures are between 42-60 degrees Fahrenheit. Air is then supplied through the four-story structure through a glazed central atrium (Fig. 6, 7).
The stack elements that pull the ventilation throughout the building are applied to the exterior of the pre-cast structure in most situations, and exhaust air above the roof in three multidirectional termini types (Fig. 8).

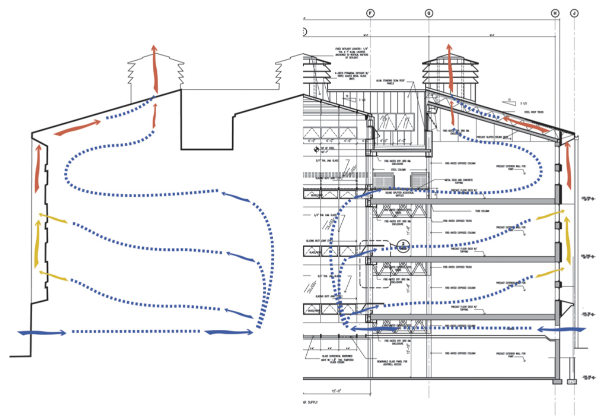

Figure 7: Airflow diagram through intake supply, central atrium, individual floor plates, and roof exhaust at library/architecture studios. Source: (Author 2006)

Figure 8: Stack exhaust termini types. Source: (Author 2007)

1. ENERGY PERFORMANCE – YEAR ONE

One component of this paper is the evaluation of the overall energy performance over a twelve-month period between 2/08 and 1/09. This date range provides the most accurate and complete twelve- month data set available during the first 18 months of operation. The data was drawn from the building management system and compared against utility bills for accuracy.

1.1 Energy cost budget – predictions

The mechanical engineers prepared energy cost budgets for the building comparing a base case against the design case. The software used to calculate the energy cost budget was TRACE 700 v6.1.1. These budgets estimated a conventional ASHRAE 90.1 total annual base case energy consumption of 7423.3 MBtu, including 5621.0 MBtu in electricity and 1802.3 MBtu in gas. The design case energy consumption total was estimated at 6061.7 MBtu, with 5026.4 MBtu in electricity and 1035.3 MBtu in gas. The anticipated electricity savings were modeled at 10.6%, while gas savings were modeled at 42.6%, for a total predicted energy savings of 18.3% over the base code (Table 1).

Table 1: Annual energy use budget: base case vs. design case, % difference

	ASHRAE Base Case Energy (MMBtu)	**HWAC Design Case Energy** (MMBtu)	**% Difference from Base Case**
Electricity	5621.0	5026.4	10.6%
Gas	1802.3	1035.3	42.6%
Total	7423.3	6061.7	18.3%

The predicted gas savings were comparable to the original design goals of the Short scheme (42-47% savings in the earliest design modeling in 2001). The electricity savings were not as easy to achieve in the design case model. Some of the barriers, according to the mechanical engineers, included: 1) programmatic flexibility in the spaces required increased density of plugs and fixtures, 2) most of the automatic lighting was value engineered out of the project due to budget constraints and predictions that manually operated fixtures by aware users might yield better performance, and 3) some of the savings originally anticipated by reduced fan use were not able to be realized. As a result, the design case anticipated a modest 18.3% savings.

1.2 HWAC actual energy use

Collecting data from the building management system during the months of 12/08 – 12/09, an estimated total energy consumption of 6203.7 MBtu was tracked during the twelve-month period between 2/08 – 1/09 indicating a reasonably accurate energy use prediction during the first year. The actual usage differs from the predicted usage by approximately 2.3%. Compared to the base case energy model, HWAC operated with a 16.4% energy reduction (Table 2).

The building performance in electricity is quite good, while there appear to be chronic issues in gas consumption.

Comparing the actual energy use with the design case shows an understandably narrower margin of energy reduction in electricity use, and further spike in gas use. This resulted in a 2.3% increase in overall energy use (Table 3).

Table 2: Annual Energy Use Comparison: Base Case vs. Actual Use, % Actual Energy Difference

	ASHRAE Base Case Energy (MMBtu)	**HWAC Actual Energy Use** (MMBtu)	**% Difference from Base Case**
Electricity	5621.0	3324.7	40.9%
Gas	1802.3	2879.1	159.7%
Total	7423.3	6203.7	16.4%

Table 3: Annual energy use comparison: design case vs. actual use, % actual energy difference

	HWAC Design Case Energy (MMBtu)	**HWAC Actual Energy Use** (MMBtu)	**% Difference from Design Case**
Electricity	5026.4	3324.7	33.9%
Gas	1035.3	2879.1	278.1%
Total	6061.7	6203.7	102.3%

While the total energy use amount seems good at first glance, it should be noted that the design case energy predictions were far below the 2001 estimates of 42-47% overall energy savings. The revelation of actual gas use against the modeled predictions has prompted diagnosis of the problem by the mechanical and commissioning engineers. Some preliminary considerations include leaky dampers or building envelope, damper operating errors, boilers not running as efficiently as designed, the system waiting too long to switch from natural to mechanical mode, and the possibility of poor energy modeling due to the uniqueness of the building. More work fine-tuning the system is underway as a result of this paper.

1.3 The important role of thermal mass

One performance factor central to the operation of this facility is the presence of a significant amount of internally exposed pre-cast concrete for use as thermal mass. In a mixed-mode building of this kind, this is an important mechanism for maximizing the period of natural ventilation to reduce the cooling load. This is accomplished by a combination of exposed thermal mass, night flushing, and mechanized supply and exhaust damper. While it remains unclear the degree of energy saving due to night flushing for passive tempering of supply air, it is clear that the system is moving air through the building as intended.

The following overviews of temperature measurements and comparisons over three typical seasons and periods of time demonstrates the stabilizing power of thermal mass in passively affecting the heating and cooling loads of the HWAC.

During summer months, the continental climatic conditions require air conditioning to control the temperature and moisture of the incoming air. During these periods the air temperature inside the HWAC is controlled to within the range of approximately 72-76°F (Figure 9).

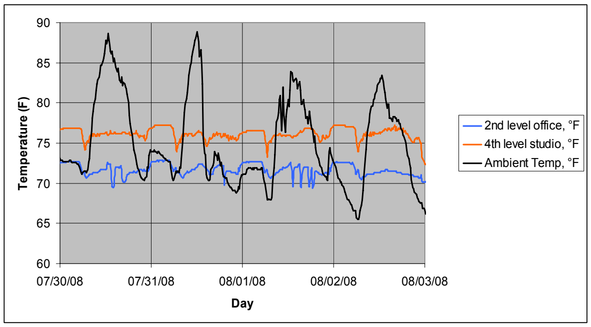

Figure 9: Temperature measurements during a 4-day summer period

During the swing months of spring and fall, where little or no air conditioning is used for the majority of operating hours, the temperature inside the building is determined by the combined temperature of the air entering the space as well as the temperature of the surrounding thermal mass (Figure 10).

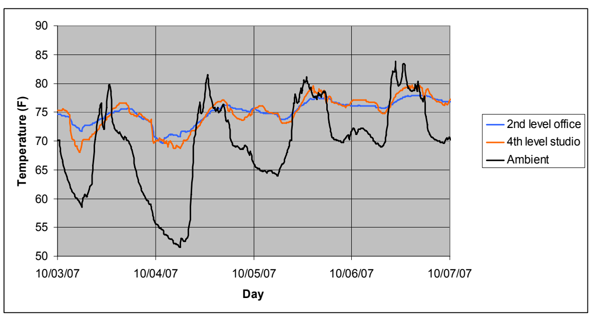

Figure 10: Temperature measurements during a 4-day fall (swing) period

The winter months engage the mechanical system more fully, representing a more conventional comparison of internal and external temperatures. The role of the thermal mass is neutralized as air temperatures are stabilized due to constant mechanical treatment of air (Figure 11).

The figures show how internal air temperature 'lags' behind the ambient temperature due to the thermal mass of the building, thus providing passive cooling during the early hours of the following day and reducing the need for air conditioning. Note that the temperature perceived by the occupants (the operative temperature) could be lower than the (air) temperatures shown if the surrounding surfaces are cooler than the incoming air temperature. This is likely to be the case following successful night ventilation.

Substantial work remains to efficiently manage the building systems to realize both energy savings and ensure adequate user comfort. The original design set points of 70-77 degrees Fahrenheit were reduced and narrowed to 69-74 degrees Fahrenheit due to user comfort concerns. Periodic user complaints about warmth, humidity, and/or airflow rates during the summer illuminate the need for further refinements in operations.

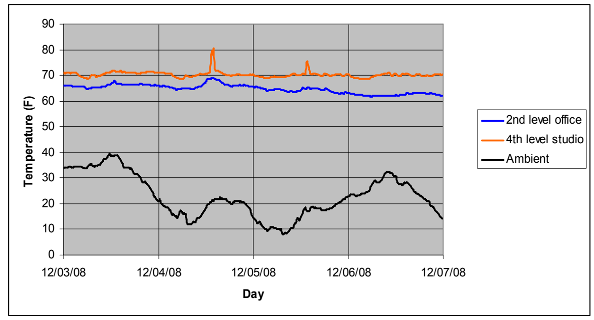

Figure 11: Temperature measurements during a 4-day fall period

1.4 Energy use conclusions

The energy use by the HWAC facility during the first year of operation was approximately 70.5 KBtu per gross square feet per year and approximately 17.7 MBtu per person per year based on an average occupancy of 350 users. While both of these estimates are of limited value because of the complexity of the programmatic uses and hours of operation, they do provide initial benchmarks for usage rates for future comparisons.

Future energy use calculations will focus on comparative studies of similar building type and scope (e.g. De Montfort University Queens building, et al) as well as finer grain studies of building performance, particularly in the swing months where the HWAC is expected to deliver its most notable performance of minimizing mechanical cooling needs and the summer where night flushing promises some performance benefit.

2. USER PERCEPTIONS

The second component of our study draws from user awareness of energy conservation measures in the HWAC and user perceptions of comfort. Questions related to comfort were administered through a survey. The survey was collaboratively generated with a colleague in Social Sciences, and sought to capture base perceptions broadly defined as awareness, comfort, behavior and assessment. Each question used a differential scale ranging from 3 to 5 points, distributed via email through an interactive digital form. The completed surveys were emailed to the authors for tabulation (Table 4).

2.1 User awareness

To establish an understanding of the degree to which building users are aware of their environment, we shaped questions that measure awareness of energy conservation concepts as they relate to the built

Table 4: Sample voting graphic, 5-point scale

SCALE	COMORT	VOTE
+2	Very Satisfied	
+1	Satisfied	
0	Neutral	
-1	Slightly Uncomfortable	
-2	Very Uncomfortable	

environment. We assumed that a range of awareness would result based upon the user knowledge, level of education, or staff role. Questions probed knowledge of energy consumption in buildings and carbon emissions, conservation goals of the building, technologies employed within the building, actual energy savings, and their own behavior. From these responses, we expected to gain a better understanding of the building user, their awareness of energy conservation as a broad subject, and their specific concern for this particular building performing well.
These questions were followed by inquiries regarding building systems awareness. They included inquiries regarding knowledge of the unique mechanical system at work in the building, whether or not they were aware of the building making automatic adjustments (e.g. audibly noticing dampers opening and closing), and a perception whether the system was operating properly in their area of survey (Table 5).

Table 5: Overall awareness of energy measures in HWAC

Very Aware	Aware	Unaware
42.4%	35.3%	22.3%

One area of intense user awareness is that the building is changing throughout the day. Actuators open and close dampers, airflow rates change periodically, and lights turn on when entering offices. 65.2% of respondents reported being “very aware” of mechanical systems changes throughout the day. Conversely, the same amount of respondents was unaware of actual energy savings for HWAC to date; a nod to the need for more attention to informing users of building performance.

2.2 User comfort

User comfort is more ambiguous and requires further investigation. Anecdotal information suggests general satisfaction with the building thus far in its operation with some notable exceptions. Temperature regulation seems difficult in many spaces, set points are spread wide resulting in spaces not maintaining steady temperatures from day to day. Airflow regulation in specific areas, like the main classrooms, is disruptive at times due to changes in airflow or slight howling in the ducts as air moves through them. The most vexing problem to date however is the acoustic issues that plague the new building. The exposed pre-cast concrete thermal mass has its consequences: a very acoustically live building.
However, building users are very satisfied with perceptions of comfort, health and wellness related to daylighting. 56.5% of respondents noted that they were either satisfied or very satisfied with daylighting in their spaces.
While many of the noted items can be adjusted, some may require significant adaptations. Still, for this initial survey at least, user comfort as a whole seems moderately good (Table 6).

Table 6: Overall comfort using HWAC

Very Sat.	Sat.	Neutral	Slightly Uncomf.	Uncomf.
19.9%	34.8%	16.1%	21.1%	8.1%

2.3 User behavior

The survey also attempted to measure the degree to which building users changed their behavior as a result of working within the HWAC. Early in the design of the facility numerous conversations with the designers touched on user comfort and user ranges of comfort. Because of the nature of uses involved in the building, a library and academic classrooms, studios and office, a calculated risk was taken to begin operations with a wide range of set points, beyond the conventional ASHRAE requirements. Unfortunately, the outdoor temperature and humidity levels in August 2007 at initial occupancy were brutal, users were not comfortable, and set points were tightened as noted above. As the building has continued in operation from those early adjustments, we wanted to try to measure user adaptation to the unique demands of the building. Were users layering clothing more than previously to modulate their own comfort? Were users more tolerant of the wider temperature set points because of their awareness of the potential energy saving benefits? We found that the building has changed the general behavior of 1:2 users (Table 7).

Table 7: Changed behaviors as a result of HWAC

Yes	No	N/A
47.8%	42.4%	9.8%

More investigation into this area will be pursued in the future, especially given that the users who report uncomfortable conditions are sometimes modulating their spaces with small space heaters in the winter and desktop fans in the summer. These are, of course, barriers to energy performance and would not be necessary if discrete cellular spaces were both performing optimally and comfortable to work in.

2.4 Assessment and values

The final question set in the survey addressed the degree to which users appreciated a connection between their health and wellness and the built environment of the HWAC. Questions probed user perceptions of relationships between health and wellness with: fresh air, daylighting, energy efficiency, and knowledge of the technologies deployed. We found that survey respondents did make a soft connection between their own perceptions of health and wellness, and the features of the HWAC (Table 8).

Table 8: Value health and welfare aspects of HWAC

Very High	High	Neutral	Low	Very Low
7.8%	32.2%	35.7%	11.3%	13.0%

From a perspective of tracking values of users, one can see that though increased air changes and daylighting both increase health and wellness as a general principle, the respondents were soft in linking them together in this case. For example, only 34.8% of the users perceived that their health and wellness was highly improved because of the natural ventilation and 39.1% of the users perceived that their health and wellness was highly improved because of daylighting in the building. The mean scores are just slightly above neutral. It remains unclear whether these rankings reflect a lack of education on health and wellness issues, or the building is not explicit in its value-added role.

CONCLUSIONS

It is clear that the first eighteen months of operation of the HWAC facility have yielded mixed results. One immediate value of this study was the identification of poor performance in the category of gas consumption. The subsequent troubleshooting of the deviations between the energy model and actual performance are of immediate value to the owner. This is a testimony to the value of the measurement and verification exercise taking place post-commissioning when the performance of a building can be studied over time. Without this study, the excessive gas consumption of the building may have continued for some time without notice.

It is also clear that the daylighting strategies for this building have yielded success in terms of energy consumption (apparently), even though some automated controls were sacrificed during value engineering. A valuable follow up to this study is the monitoring of the lighting loads for the building isolated from the rest of the electric loads to evaluate how the design case modeling of 1.75kW/s.f. compares to actual usage.

Another follow up study should be engaged that tracks the first 1-3 years of natural ventilation mode operation. This study would yield valuable information regarding the cost benefit of including the hybrid natural ventilation system. It remains unclear whether this system is competitive with conventional geothermal, for instance. It could very well be that since the two are more or less mutually exclusive (in that they both benefit from energy savings in swing months), that geothermal may be a more successful design strategy in the continental climate. More study into the subtleties of the strengths and weaknesses of these and other renewable energy strategies seems warranted before the hybrid natural ventilation model can be called a legitimate approach in this climate.

Also, it remains clear that building user education was underestimated at initial occupancy of the HWAC, and more concentrated work remains to be conducted in this area. While it is encouraging to observe that building users in general do feel moderately comfortable and have adapted, or not, to the unique nature of this building, energy usage may drop further and user perceptions of comfort may increase with a more robust user education/information program.

ACKNOWLEDGEMENT

The authors would like to thank KJWW engineer Wade Ross for his assistance in evaluating some of the data contained in this paper and Dr. Marsha Vaughn, Judson University Department of Social Sciences, for assistance in editing the environmental comfort survey. Finally, the authors commend the work of Judson University graduate students Matt Ackerman and Ken Nadolski in assisting with the preparation of data for this paper.

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Building learning: making a carbon neutral campus in McCall, Idaho

Frank Jacobus, and Keith Bickford

The University of Idaho, Moscow, Idaho

ABSTRACT: At the University of Idaho, an interdisciplinary group of faculty and students have created a design-build workshop sequence focused on the development of a carbon-neutral learning center at one of the university's field campuses in McCall, Idaho. Located adjacent to Ponderosa State Park, an area populated by mature Ponderosa pine trees, the field campus is managed and directed by the McCall Outdoor Science School (MOSS), whose mission is to use the outdoors as a context to teach intermediate and high school students from the state of Idaho about science, place, and community. The new sustainable design curriculum, in the form of interdisciplinary workshops, aims to design and construct buildings at the field campus that will eventually embody the sustainable values taught by MOSS. The inaugural design workshop in the sequence began this semester with construction scheduled to begin in the summer of 2010. The intent of the design-build workshop sequence is to redesign and rebuild the field campus over a period of several years using carbon neutral design as an overriding goal. Passive design, in lieu of using heavily embedded technologies, will be a teaching focus in an effort to achieve the workshop and campus objectives. Because of the alpine forest campus location the workshop will have an additional focus on issues of fire-wise construction, snow management, and a use of underutilized materials in the built work. In addition to these aims, and in accord with the MOSS mission of using the outdoors as a teaching tool, the buildings themselves will act as 'learning instruments' for the young visitors, making explicit the sustainable principles embedded within. The eventual goal is that the entire campus will attain carbon-neutral performance and will set an example for future learning environments around the globe.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings
Keywords: carbon neutral, design-build, zero energy

PROJECT BACKGROUND

In 2006 an interdisciplinary group of faculty at the University of Idaho collaborated on a carbon neutral design studio. The design studio's goal was to redesign and eventually rebuild the University of Idaho McCall Field Campus in an effort to make it carbon neutral in terms of its annual energy consumption. The McCall Field Campus is operated by the McCall Outdoor Science School (MOSS), whose mission is to use the outdoors as a context to teach intermediate and high school students from the state of Idaho about science, place, and community. A number of building types were looked at during this studio and a new campus site plan was developed. It was determined that a central biomass co-generation plant would be constructed, providing the heat and electricity for the campus. This strategy was based in large part on the abundance of available wood from the continual clearing of undergrowth in nearby Ponderosa State Park. As a result of the work of this studio, in the Fall of 2007, an EPA P3 grant was awarded to the University of Idaho. In April of 2008, P3 honourable mention was awarded to the McCall Campus design team at the EPA P3 Expo in Washington D.C. As a continuation of the 2006 studio effort, a carbon neutral design-build studio was formed in the Fall of 2008. The design-build studio's task was to design a single living facility that would house up to 16 students.

This paper will outline the work of the Fall 2008 studio, addressing the studio structure and approach, and will describe the studio findings with regards to design approaches and preliminary energy calculations for the building.

1. THE DESIGN STUDIO

1.1. Introduction

We began the Fall 2008 carbon neutral studio by conducting precedent research in three areas: carbon neutral design, design-build, and building types. We divided the class into three teams of five students each, dedicating approximately one week to these preliminary research efforts.

The students on the carbon neutral research team focused on definitions of carbon neutrality, means of carbon neutral certification, examples of embedded and passive systems, and methods of measuring carbon neutrality during the life cycle of a building. This team also looked at several carbon neutral building precedents such as the Aldo Leopold Foundation Center, designed by Kubala Washatko Architects, The Lighthouse, by Sheppard Robson Architects, and The Beddington Zero Energy Development (BedZed), by Bill Dunster Architects. We understood from day one of the project that many of the embedded systems employed in the aforementioned projects were not going to be possible at the McCall, Idaho campus due to the natural solar shading and wind block in the Alpine Forest landscape. However, there were other passive methods employed in the precedent projects that we were able to learn from and implement into the new bunkhouse design; we will focus on these in more detail later in the paper.

1.2. Design-build research

The design-build team focused their research on academic design-build groups such as Studio 804, The Rural Studio, Parsons Design Workshop, Yestermorrow Design/Build School, and the Tulane GreenBuild Studio; all of whom have produced successful projects that meet timelines dictated by the academic calendar. The particular areas of focus for the design-build research team dealt with issues such as number of students participating in each design and build effort, length of design time, length of build time, average building size, and average building cost. Being that this was the first time a major design-build effort was being undertaken by the University of Idaho as a part of a studio sequence it was necessary to establish precedence for how the entire effort would be structured using models that had proven to be successful in the past. We found most of the projects to be between 800 and 1,200 square feet; though the largest projects were 1,900 to 2,000 square feet. There was anywhere from 11-17 students involved with both the design and build phases of these projects with a construction schedule that ranged from 10 summer weeks to a full academic semester. This information paired with our knowledge of the requirements of the building program helped us determine that we should keep the building footprint to a range of 1000-1200 square feet.

1.3. Building type precedent research

The Building Type Precedents group looked at Eco Shed, a 280 square foot house located in Vancouver, British Columbia, and a materials testing facility designed by Bisby and Associates, also located in Vancouver. The group also studied two house prototypes: Mini Home by Sustain Design Studio, and Blue Sky Mod designed by Todd Saunders. As a class we discussed each of these projects in relation to the bunkhouse program we had been assigned and continued to refer back to them throughout the semester. A number of design principles learned through precedent study helped us establish our own unique design direction based on the program at hand. For instance, we discussed the use of FSC certified materials in Eco Mod and eventually sought out these materials when we finally reached the design development phase of the project. Studies of both Eco Mod and BedZed brought up a number of discussions about air to air exchange systems and their importance in designs that employ a tight building envelope. The size and character of many of the precedent dwellings helped us visualize how we might economize space without a loss quality of life. The precedents were a continual point of reference as we underwent design exercises throughout the semester.

1.4. Site analysis

The second week of the semester was dedicated to travel to two sites. The first field trip we took as a class was to Islandwood, an educational campus whose mission is to teach young people about the environment and sustainable practices. The Islandwood site had been referred to us by our client (MOSS) and was the basic model that they envisioned the McCall campus following. Our next trip was to the McCall campus itself to see the site where our building will eventually be located. The trip to McCall was essential for obvious reasons, not the least of which was that it made the students aware of how difficult it would be to design a carbon neutral building in an environment too wooded to allow for either solar or wind energy generation (at least to the extent that would provide power and heat for an entire facility).

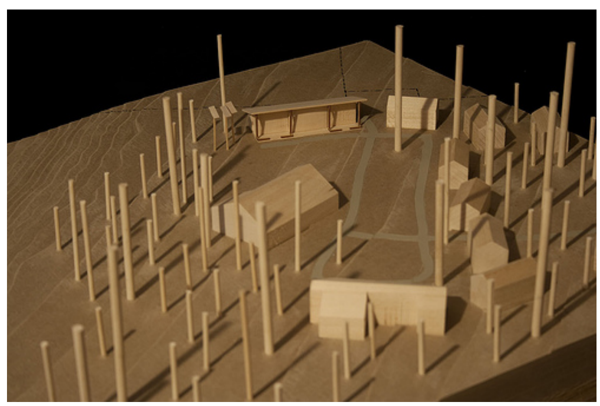

Figure 1: McCall campus site model.
Source: McCall carbon neutral studio

1.5. Plan diagramming

During the third week of studio the students were asked to develop plan diagrams as individuals. Each student was asked to design five layout strategies that worked with the given program. The students were asked to list a square footage for each type of space within the bunkhouse plan. The four main spaces were the mudroom, the bunkroom, the bathroom, and the common area. It was important that we establish a goal in terms of square footage for each space for several reasons. First, as mentioned earlier, keeping the building to a minimum was vital, as we only have a ten week summer academic session to frame and dry it in and the budget we are dealing with is very restricted. Second, we wanted to ensure that the client was aware of the size of each of the spaces and how each space fit into the overall budget. For example, there was an ongoing question as to whether the restroom area was a necessity – we took it as our job as the architect to keep the client informed of the implications of adding a restroom in terms of increased building size, increased cost, potential environmental implications, etc. When we began the project we had little sense of what it would take to accommodate the number of students that were to stay in the bunkhouse.

Figure 2: Plan diagrams.
Source: McCall carbon neutral studio

Originally, the objective was to use the summer session to build a space to house 30 plus students. It quickly became apparent, through the plan diagramming along with the design build precedent information discussed earlier, that we were not going to be able to accomplish the 30 plus student goal over the course of one summer with the resources that we had. The plan diagramming helped considerably in eliminating schemes that were too space intensive or wasteful and also afforded good discussion of potential plan layouts in relation to site strategies in order to maximize passive solar gain.

1.6. Construction type research
Week four of the semester was dedicated to Construction Type research. As mentioned previously the original project and studio goals were to examine 'alternative' building technologies for a couple of very specific reasons. First, we wanted to gain an understanding of which construction type worked best in the McCall environment. Second, we felt that by using alternative construction technologies we would be accentuating the building as a 'learning instrument', as it would more easily be noticed by campus visitors who are not used to seeing these building types in their daily routines. The initial discussions involved three main alternative building types: straw bale, cordwood, and rammed earth. During my preparation for the semester I began to fear that we were limiting our inquiry too much and so I added 'alternative contemporary' materials (such as SIPS and ICFs) and 'recycled materials' to the list of building types giving us a total of five material categories. The students were divided into five groups and each group was asked to study a different building type from the list. Though this period of construction type research did not eliminate any particular types from consideration it was becoming clear that students were beginning to gravitate toward one building type or another.

1.7. Schematic design: phase I
For the next couple of weeks the students were asked to group themselves based on the construction types they were interested in dealing with and develop schematic designs for the bunkhouse using that particular type.

Figure 3: Team 1: schematic bunkhouse model.
Source: McCall carbon neutral studio

This seemed like an effective approach because it allowed the students to be involved with a material system that they felt compelled to work with and were interested in learning more about. At the end of this two week period the students had developed schematic designs that included plans, sections, perspective renderings, a physical building model, and a bay model. The review for this phase of the project was the first opportunity for the MOSS group to see and provide feedback on the five team projects.

Figure 4: Team 3: bay model.
Source: McCall carbon neutral studio

1.8. Schematic design: phase II

Following the first schematic design review we spent another two weeks modifying the team designs based on the comments from the MOSS group. Part of our time during this period was spent dealing with issues that we realized we had neglected during phase I of the schematic design. Items such as mechanical room size, specific handicap accessibility issues in the restrooms, and detailing and construction issues that had not been given enough attention were looked at more carefully during this phase.

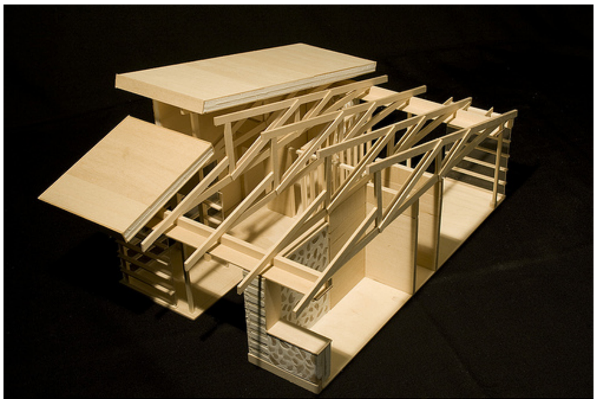

Figure 5: Team 1: schematic bunkhouse model.
Source: McCall carbon neutral studio

We then had a second schematic design review and received additional feedback from the MOSS group. This was a critical review in that it was understood that a single design was to be chosen by the client for the class to then pursue for the remainder of the semester. Following the review and after a discussion with the MOSS group it was determined that there were aspects of several schemes that were preferred and that no single scheme had yet solved the problem entirely. Immediately following my discussion with the MOSS group the class got together and began to unify the schemes based on the client's comments. A general parti was established and we then divided up to work on specific aspects of the project making overall design refinements over the next few days.

2. FINAL DESIGN

Once we had established a single design the students were asked to sign up for teams in the following categories: design development, construction documentation, physical model making, digital models and presentation, and energy analysis. The design development team was charged with locating materials and vendors, figuring costs, and determining product feasibility.

The construction document team organized all of the CAD files, dealt with all code issues, and developed the title blocks and construction document set. The physical model making team was responsible for four models: a site model, a framing model, a full building model, and a bay model. They were also responsible

Figure 6: Final design: bay model.
Source: McCall carbon neutral studio

for any schematic modelling exercises that were going to take place before the final models were started. The digital models and presentation group was responsible for all digital models and renderings, as well as the studio book layout. The energy team was responsible for testing the building in various energy modelling programs such as HEED and Balance Point. It was understood that there were still a number of design issues that needed to be resolved and that we would all work together as a team to get the issues addressed. The students from each group were asked to keep the other groups informed of any information that could have an effect on their work.

2.1. Foundation

The foundation system that we opted to employ is an insulated slab on grade with high fly ash content. There will be 2” of rigid insulation beneath the slab and aligning the inside and outside edges of the grade beams. The slab will have integral piping to deliver radiant heat throughout the building. Radiant heating will be the only mechanical heat source in the building. The perimeter of the north, east, and west sides of the slab will have a stem wall that rises 2’ above grade to help protect the building’s straw bale envelope from moisture penetration. The slab will be poured on site by an outside contractor and will be in place and ready to build upon when the students arrive in May.

2.2. Building envelope

When designing the building envelope we looked closely at rammed earth, cordwood, and straw bale construction. In conjunction with our efforts, Crystal Van Horn, an MSArch student at the time, was looking in more detail at the three construction types and their feasibility and carbon costs for our region. Though this paper will focus only on the general criteria that helped us determine the most appropriate construction type for our project, each construction type was looked at in great detail.

It was determined fairly early in the process that rammed earth was not a suitable form of construction in our region for a variety of reasons. While rammed earth provides excellent thermal mass properties it was determined that, because of our particular climate, our priority should be to design a building envelope with the highest possible insulation value. Strategies were explored wherein we experimented with two 8" wythes of rammed earth with an 8" layer of rigid insulation sandwiched between. The sandwiched rammed earth envelope provided an adequate R-value but was determined to be problematic in terms of construction time and cost. In talking to several rammed earth contractors we determined that the cost of rammed earth, when constructing a structural wall built with pneumatic tamping devices, in most cases exceeds (and in some cases doubles) the cost of cast-in-place concrete. Moisture protection also becomes a critical component of rammed earth construction and the winter and spring months in McCall see an abundance of snow and rain. No calculations were made as to the carbon costs of rammed earth due to the fact that it was found to be inadequate as a construction type in our region.

Cordwood was a viable option due to the abundance of this material in our region. Its low cost was immediately cited as an advantage and our ability to use wood from the thinning of undergrowth in nearby Ponderosa State Park would result in low embodied energy for the material. Although there are many advantages to using cordwood in our region, there are a number of disadvantages as well. First, the cordwood construction process is very labor intensive and requires a great deal of wood and mortar to construct. Second, an effective cordwood envelope requires wood that has been air dried for up to three seasons. Because of this it was determined that cordwood is a viable future option but that it is not suitable for this year's project.

Alternative contemporary systems were also looked into. SIPS proved to be the most ideal system due to its high R-value in relation to its wall thickness. Ultimately, the fact that our client wanted the building to act as a learning instrument led us away from SIPS and toward straw bale construction due mostly to the latter's overtly tactile quality.

Figure 7: Building envelope.
Source: McCall carbon neutral studio

After studying the potential construction types it was determined that straw bale was the best option for the summer build. Straw bale as a building material met our desire for fire-wise construction and helped us achieve up to an R-33 insulation value. The north building envelope and approximately half of the east and west building envelopes will be constructed with straw bales. Through our precedent studies we found that, compared with a number of other building materials straw bales are relatively low in embodied energy, readily available in our region, and fairly easy to construct with inexperienced laborers. Straw bale is an abundant and renewable resource and straw bale homes require about 30 times less energy than homes with standard wood frame walls. (Chiras, 2000)

2.3. Roof

The roof of the bunkhouse will be constructed of 8" thick SIPS panels and will be an R-45 construction. SIPS was selected as a roof material for a few reasons. First, the panels are easy to install and can be custom ordered to any size to meet our roof framing layout. Second, we were able to achieve a high R-value relative to roof thickness and significantly limit our thermal bridging. Lastly, the SIPS panel's OSB underside provides a finished surface for the bunkhouse interior which is to remain relatively rustic.

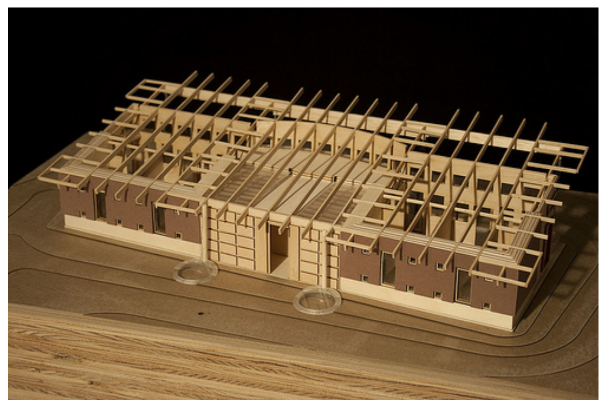

Figure 8: Roof system.
Source: McCall carbon neutral studio

2.4. Mechanical systems

Radiant floors that circulate hot water fed by a wood fired boiler will be the only source of heat for the bunkhouse. The wood fired boiler is paired with a solar array located nearby on site that will heat the water when it is able. When the PVs are not providing enough energy the system will automatically switch to the wood fired option.

A heat recovery ventilation (HRV) system has been specified that will ensure that the building is properly ventilated.

3. ENERGY MODELLING

Energy modelling was performed to predict the energy savings and green house gas emission reductions associated with replacing the existing log cabins at the McCall Field Campus with new energy efficient buildings utilizing Straw bale walls, a SIPS roof, and extensive south facing glazing for passive solar.

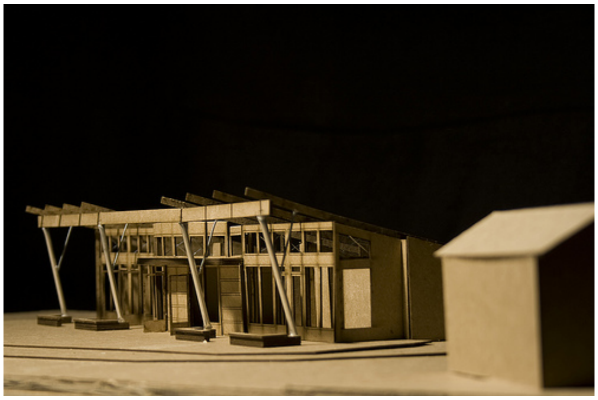

Figure 9: Final design: schematic model.
Source: McCall carbon neutral studio

heating. These studies suggest the new building will achieve a reduction in energy consumption of 45% over the existing buildings

3.1. Energy modelling programs

The energy modelling procedures for the McCall campus involved computer based simulation programs to estimate energy usage and resultant green house gas emissions throughout a typical calendar year. For this project we used three computer based energy-modelling programs in an attempt to quantify energy consumption and carbon emissions of the existing and proposed structures. HEED is a standalone program developed by the Energy Design Tools Group at UCLA Berkeley (HEED). Autodesk Green Building Studio is a web-based energy analysis service that works in conjunction with Autodesk Revit (Autodesk). VE-Ware is a building energy usage and carbon dioxide emission assessment software package available from Integrated Environmental Solutions (IES).

Of the programs evaluated, HEED proved to be the easiest to obtain and the simplest to operate. HEED uses very basic user input building parameters and a user supplied climate file unique to the region. A climate file for Salmon, Idaho was used as no climate file was available for McCall. Salmon and McCall are at the same latitude with similar temperatures, but differences in precipitation, days of sunshine, wind, etc. may substantially change results.

3.2. Energy modelling procedures

The greatest challenge in energy modelling using any of the evaluated programs was the absence of alternative building material information within the program, such as straw bale and cordwood and their associated thermal properties. Obtaining thermal properties for alternative building materials was also challenging, as explained below.

HEED uses various thermal properties of a building material to determine effective thermal mass and R-values for the entire structure. Two key thermal properties essential for the modelling program were difficult to obtain for alternative building materials. Time Lag is the duration of hours it takes a temperature wave to move from a building material's inner surface to its outer surface, or vice versa (HEED). Decrement factor is the proportional damping of temperature as it moves through a massive material (HEED). For quantifying these values, UCLA Berkeley's Energy Design Tools Group provides the program Opaque. Opaque calculates decrement factor and time lag based on several other material properties. These include: density, R-value, specific heat, conductance, and thickness.

Approximate values for the walls in the existing log cabin were obtained from Colorado Energy (Colorado). Many assumptions were made. The species was assumed to be white pine. The thickness was assumed to be eight inches and continuous (not round logs). Grout was not accounted for. Calculations based on these assumptions would make the building appear to perform better than it actually does. Therefore, actual energy savings of new structures would be greater than those predicted.

Several scientific studies have been conducted to determine the R-value of straw bale construction (Stone, 2003). This paper suggests a range of R27 to R33 for a typical straw bale wall. A conservative value of R27 was used for modelling the straw bale components of the proposed structure. Values for manufactured products were obtained through the manufacturers. These values were assumed to be accurate.

3.3. Energy modelling results

The existing 732sf cabin is a simple rectangular design consisting only of bunk beds. The proposed 1216sf bunkhouse is 40% larger than the existing cabin and has two ADA compliant restrooms, two common areas, and a mudroom.

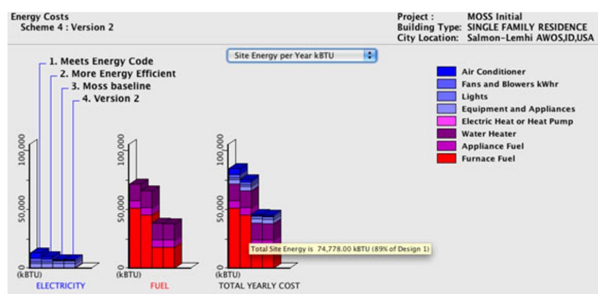

Figure 10: HEED calculations graph
Source: HEED software, Keith Bickford

HEED suggests an energy savings of 45% in the new bunkhouse, not considering additional energy consuming devices such as a hot water heater which the log cabins do not have. The existing log cabins utilize a separate building for showers and restrooms. It is assumed that the existing shower/restroom building will remain until all other living facilities are replaced with new buildings containing restrooms. According to HEED predictions, electricity consumption in the existing cabin is 67,767 kBTU annually, and the proposed bunkhouse consumption is 37,485 kBTU annually.

Summary Table

Project : MOSS Initial

A 1,216 Square Foot SINGLE FAMILY RESIDENCE in Salmon-Lemhi AWOS,ID,USA

		Energy Costs			Savings Compared
	Scheme Name	Electricity	Gas	Total	to Scheme 1
1.	Meets Energy Code	$508.48	$776.47	$1,284.95	
2.	More Energy Efficient	$357.89	$705.53	$1,063.41	17%
3.					
4.	MOSS Initial	$267.88	$398.09	$665.97	48%

Figure 11: HEED calculations summary
Source: HEED software, Keith Bickford

HEED calculates CO2 emissions with user provided emission rates, and uses California emission factors as a default. HEED suggested a CO2 reduction of 10,107,837 lbs based on California emission factors. An external calculation was performed using the North West Power Pool's emission factor of 0.92 lbs C02/kWh for purchased electricity and 14.268 lbs/therm according to the Greenhouse Gas Protocol Initiative (GHGP). These calculations suggest a reduction in CO2 emissions of 3,348 lbs. Data values are provided in Figure 12.

	Existing Cabin	Proposed Bunkhouse	Difference		Source
Elecricity	67767.42	2959.43	64807.99	kBTU	HEED
NatGas		34525.56	-34525.56	kBTU	HEED
Total	67767.42	37484.99	30282.43	kBTU	HEED
HEED CO2	10108627	789.69	10107837.31	LBS	HEED
Electricity	9861.49	867.36	8994.13	kWhr	HEED
CO2 (0.92 lbs/kWh)	9072.5708	797.9712	8274.60	lbs	GHGP
NatGas		345.26		Therms	HEED
CO2		2.237		Tonnes	GHGP
CO2 (14.268lbs/therm)		4927.312775		Lbs	
Total CO2	9072.5708	5725.283975	3347.29	Lbs	

Figure 11: CO2 emissions calculations provided by Keith Bickford

CONCLUSION

There were a number of areas to draw lessons from in the McCall carbon neutral studio effort. First, a great deal was learned in terms of how to structure a studio project of this magnitude. It is my belief after having directed the class that a studio project of this size and scope should be a two semester endeavour. The first semester should be spent getting students grounded in carbon neutral design principals, site and climate analysis, and schematic building design. Efforts should be made to calculate energy implications during the design process though we have not yet found a seamless way to undergo energy calculations without disrupting the flow of the material, formal, and spatial design process. The second semester should be spent with an interdisciplinary group, including at minimum Mechanical Engineers, Structural Engineers, and Architects, all working toward the same goal of minimizing (if not negating) the building's negative environmental impacts. The fact that our carbon neutral facility is slated to be built had an enormous impact on the studio structure and the time that needed to be dedicated to each task. Time spent working on construction documents could have been spent in increased energy modelling efforts. During the Spring of 2009 we will be continuing the McCall project, working with an interdisciplinary team of capstone students from the University of Idaho and Washington State University. Our goal will be to refine the building design based on the expertise brought in by each discipline with the ultimate goal of carbon neutrality for the facility. It is our hope that in continuing to test and experiment with the carbon neutral studio we will refine our methods of inquiry into carbon neutral building techniques and eventually as architects and educators meet the goals of the 2030 challenge.

ACKNOWLEDGEMENTS

Energy modelling charts produced by Keith Bickford using HEED software version 3.1.3. All model photography courtesy Brian Henry.

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Zero energy houses for China: prefabricated sustainable housing for disaster relief

Edgar Stach, Barbara Klinkhammer, Chen Li

The University of Tennessee, Knoxville, Tennessee

ABSTRACT: The design team proposes to develop a prototype for a sustainable prefabricated Zero Energy House for the Sichuan Province in China. Sichuan Province in China was recently struck by a major earthquake which left millions of people homeless. In the next six months, the Chinese housing market will provide one million housing units to the affected region as a disaster relief reconstruction effort, and a large percentage of these units will be completely or partly prefabricated. Sustainability in terms of alternative energy strategies and use of sustainable materials is largely not addressed in standardized prefabricated dwellings. Current strategies for disaster relief shelter commonly involve tents and plastic membranes because they are economical, easily transported, and flexible enough to accommodate various situations. While they are appropriate and convenient for immediate response, they do not provide adequate protection from extreme conditions or offer long-term solutions for housing. Combining sustainable practices with well-planned design addressing production and transportation costs, shipping and production times, assembly, ability to cool in hot climates, and inclusion of cultural and social norms, sustainable prefabricated housing offers better solutions for long-term transitional or replacement housing.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings
Keywords:

INTRODUCTION TO SICHUAN

Sichuan Province is located in southwest China, with Chengdu as its capital city. The province has a high degree of geographical diversity: plateaus, mountains, ravines, basins, hills, plains, rivers, lakes, hot springs, waterfalls and limestone caves. Most of the rivers in Sichuan belong to the Yangtze River system.

1. CONTEXT

1.1. Economy

Sichuan has historically known as the “Province of Abundance”. Its agricultural output is greater than that of any other province in China; its grain yield in 2000 was 35.69 million tons. Also in 2000, its provincial GDP was 401.03 billion yuan and the gross output value of industry and agriculture reached 563.759 billion yuan. However, because of Sichuan’s large population, the per capita GDP was only 4,805 yuan. The total volume of imports and exports was US $2.55 billion, with a total revenue of 23.386 billion yuan.

1.2. Government

Like all other governing institutions in mainland China, Sichuan’s government has a dual structure, sharing power between the Governor of Sichuan and the Communist Party of Sichuan. Sichuan Province has 21 cities, including Chengdu. The Governor of Sichuan is the highest ranking official in the people’s Government of Sichuan. However, in the province’s dual party-governing system, the Governor has less power than the Sichuan Communist Party of China Provincial Committee Secretary; colloquially termed the “Sichuan CPC Party Chief”.

1.3. Demographics

With a population of 87,730,000 as of the end of 2006, Sichuan Province is the third most populous province in China. 34.3% of the people live in cities, giving Sichuan’s eastern plains their higher population density compared to the western hilly areas. Two counties within the province, Wenchuan and Beichuan, were razed to the ground by the earthquake.

1.4. Geography

Sichuan is situated at 26'03"-34'20" degrees north and 97'22"-110'10" degrees east with an area of 567,000 square kilometers, accounting for 5.1% of China's total area. Sichuan is higher in altitude in the west and lower in the east. Generally speaking, the western part is made up of plateaus and mountainous regions some 4,000 meters above sea level, while the eastern part features basins and hilly land with an elevation between 1,000 and 3,000 meters. Plate tectonics formed the Longmeng Shan fault, which lies under the

Figure 1: A school in Wenchuan after earthquake (www.news.sohu.com)

north-easterly mountain location of the 2008 earthquake.

1.5. Epicenter: May 12. 2008, 2:45PM, 60Sec.

The epicenter of the recent earthquake was in Wenchuan County, 80 km northwest of the provincial capital of Chengdu, a city of 105,436 people and 4083 square km in area. Wenchuan is a small county with several ethnic minority groups. Surrounded by 3000-meter mountains to the west and north, 48% of Wenchuan is covered by forest. The Min River flows from the north of Wenchuan to the southeast, and all of the county's most economically productive areas are along this river. Because of the county's specific typography, only one national highway connected Wenchuan with other cites, and this highway was destroyed by the earthquake.

Beichuan County, 160 km from Chengdu, was also seriously affected by the earthquake. Beichuan is located on a steep slope, with its northwestern side 460 meters higher than its southeastern side, and is crossed by numerous rivers.

Figure 2: Houses in Wenchuan after earthquake (www.news.sohu.com)

Wenchuan and Beichuan were similarly developed counties before the earthquake. Both had 14-15 middle schools, 170- 200 elementary schools, 50-60 kindergartens, 40 health institutes and one library.

Figure 3: A residential community of prefabricated houses (photo: Xinhua)

There are hundreds of towns and villages affected in lesser measure by the earthquake than Wenchuan and Beichuan, though the big cities in Sichuan were not severely affected.

1.6. After the earthquake

80% of the buildings in the old town and 60% in the new town of Beichuan collapsed in the earthquake. The province-wide death toll was nearly 70,000, and the number of people listed as missing and injured reached 17,939 and 374,640 respectively. The mountain landslide at Beichuan after the earthquake also caused extensive damage. Besides buildings, a great deal of important infrastructure such as transportation, electricity, communication, water supply systems stopped working.

Ten million quake survivors had to move into makeshift houses by August 6th, 2008. About two thirds of the households chose to build their temporary homes by themselves, subsidized with 2,000 yuan (US $300) by the government, while the remaining third moved into houses built by construction workers from other provinces and municipalities. The government-built prefabs were relatively concentrated, with public bathrooms, clinics, laundries and supermarkets in close proximity.

1.7. Current situation

Soon after the earthquake, tent villages were set up in Wenchuan. Each tent village has a water intake site for people to retrieve water, though regular electricity has not been restored and diesel generators are being utilized to provide energy.

The Urban Planning Department of the Ministry of Housing and Urban-Rural Development has made the decision to rebuild Wenchuan at a different location within Wenchuan's administrative region. The roundtable discussion and reconstruction effort led by CPN emphasizes the long term nature of the rebuilding and restoration after the disaster, focuses on the role of planning, and asks how the academic community can contribute to the rebuilding of the destroyed towns and villages and the restoration of normal life activities. The agenda for the roundtable discussion included the rebuilding of houses, public facilities, industries, eco-environment in the quake zone and issues about the reconstruction funds. According to the agenda, the reconstruction work would cover an area of 132,596 square kilometers, which had a total population of more than 19.8 million at the end of 2007. Restoration and reconstruction would require a total of 1 trillion yuan (US $145.8 billion) according to previous evaluation.

1.8. Housing types

Before the earthquake, residents of Wenchuan towns and cities lived in 5- to 6-story apartment buildings, while village residents lived in single family houses which were usually simply made, built by the residents themselves or passed down in families. Apartment buildings in towns are usually designed by local architectural design firms and do not have any elements indicative of local culture or tradition.
Single family houses are characterized by their large tile roofs. The highly populated eastern part of Sichuan has a warm climate with hot summers and high precipitation, and this climate is a main factor affecting the layout of houses. House roofs generally extend far out beyond the walls of the house, even touching the roofs of adjacent houses, in order to shelter from the rain. Courtyards are found in the single family houses of Sichuan, though they are usually very narrow due to the combination of a large population and limited land.
The large-scale relocation of residents from the quake zone has not been specifically planned, but still the estimated cost of the reconstruction efforts is about 1 trillion yuan.

1.9. Climate

Sichuan Province’s climate is highly variable. The Sichuan Basin (including Chengdu, the capital) in the eastern half of the province experiences a subtropical monsoon climate with long, humid, warm to hot summers and short, dry, cloudy, cool to cold winters with China’s lowest sunshine totals. The western half of Sichuan has a mountainous climate characterized by very cold winters and mild summers, with plentiful sunshine. The earthquake happened between the two areas. In winter, Sichuan's climate is dry with little rainfall. Eastern Sichuan gets abundant rainfall from April to October, but in western Sichuan the rainy season is from May to September. Generally the eastern areas receive more rainfall than the western, and the basin areas get more rain than the plateau regions.

Figure 4: A typical village house in Sichuan (www. blog.163.com)

In terms of average temperatures, Sichuan's four seasons are quite distinct. In spring, temperatures range from between 10 and 21.9 degrees Centigrade, and above 22 degrees in summer. Autumn temperatures vary between 10 and 21.9 degrees. In winter, the average temperature is below 10 degrees centigrade. The western Sichuan plateau is quite cool and has an average annual temperature of less than 8 degrees centigrade. The average temperature is 5 degrees below zero in January, 5 to 10 degrees in April, 10 to 15 degrees in June and 5 degrees in October. In fact, western Sichuan has almost no summer.
Sichuan's southwestern mountainous regions have average annual temperatures of between 15 and 20 degrees in valley areas, and 5 and 15 degrees in mountain areas. In January, the average temperature is about 5 degrees Centigrade, 10 to 24 degrees in April, 15 to 26 degrees in June and 10 to 20 degrees in October.

2. SUSTAINABLE STRATEGIES

2.1. Introduction

The goal of the Zero Energy Houses for China/Sichuan is to develop a sustainable materials database as well as passive and active strategies for prefab houses for Sichuan Province. The focus lies on advancing innovative technologies and further lowering costs. Among the goals of energy research are the enhancement of efficiency and production, the increased share of renewable energies in overall energy use and the reduction of greenhouse gas emissions. For the field of energy-optimized building that means measures to reduce the energy demand of houses.
Two categories of strategies are used in zero energy design.

2.2. Passive systems and strategies

Passive strategies in architectural design take advantage of natural conditions to minimize energy use without the aid of machines or human intervention. Integrating the passive strategies of day lighting, natural ventilation, and solar gain heating into the design process creates interior space with a greater connection to the environment, lowers energy costs, and requires less maintenance while contributing to conservation and improved comfort.

- Day lighting

Day lighting is a passive strategy using natural lighting to illuminate interior spaces. The benefits from day lighting range from improved aesthetic qualities, including better color balance and connection to the outdoors, to increased energy efficiency.

- Natural ventilation

Natural ventilation is a passive strategy using both wind and temperature differences to cool or ventilate spaces. The benefits from natural ventilation include improved air quality and increased energy efficiency.

- Solar gain heating

Solar gain heating is a passive strategy using radiant heat from the sun to warm spaces. The benefits from solar gain heating include increased energy efficiency and the opportunity to offset day and night temperature variations with thermal mass.

2.3. Active strategies

Even after passive design strategies have minimized the need for mechanical systems, a home typically needs additional energy for heating and cooling, for daily needs such as hot water, and for appliances and lighting. Active strategies use human intervention or technology to provide for these needs and improve the effectiveness of the passive strategies already designed.

- Climate control

A heat exchanger is a mechanical ventilation system that exhausts stale building air and imparts the waste heat to an incoming stream of air, also known as an air-to-air heat pump. When heating the space, a refrigerant absorbs exterior heat and warms a liquid medium, and a fan blowing air over the heated liquid warms the interior air; when cooling the space, the refrigerant extracts interior heat, thereby cooling the liquid medium, and the heat is exhausted to the exterior as the fan and coil unit cools the space.

Evaporative cooling within the cooling unit uses a fan blowing outside air over a wet sponge, evaporating the water and cooling the air.

Active solar space uses collectors to absorb heat from the sun directly into water, which is transferred to the storage tank or to the heat exchanger. Here the water can be used to pre-heat hot water, heat air in a fan-forced system, or can be run through the floor for a radiant heating system.

- Solar systems

Automated sun space: when heating the living space, the thermal blanket is lifted to allow direct gain; at night the thermal blanket is pulled down, trapping the heat inside. When direct gain is unwanted, the thermal blanket can act as a barrier. Operable vents in the sun space either prevent or allow convection depending on heating or cooling needs. Thermal mass absorbs heat from direct gain during the day. At night, both radiation and fan forced convection through the heated thermal mass warm the living space. Thermal mass is cooled by drawing in night air. Interior air is recirculated through the mass during the day to cool the living space.

- Components

Components such as phase change materials, evacuated tube technology, thermocouple actuators and mini-split heat pumps use natural forces to their advantage to aid a larger passive or active system without connection to the utility grid.

- Energy harvesting

Energy harvesting systems collect energy from the natural environment to provide electricity. These systems harvest energy either through an electrical process powered by the sun, a kinetic process powered by the wind, or a chemical process powered by biomass.

- Water

Active water strategies help to reduce water and electricity usage. These strategies include harvesting rain for water supply, absorbing heat for the hot water supply, absorbing heat as a thermal mass, and recycling or limiting water usage.

- Lighting

Supplementary technologies increase the efficacy of day lighting strategies by using either artificial lighting or reflected natural light.

- Control systems

Control devices manage active systems by optimizing energy use. These technologies can be as familiar as a thermostat to control heating and cooling, or as advanced as occupancy sensors to limit energy use when a room is unoccupied.

- Appliances

Energy-efficient appliances help reduce energy costs and promote conservation. Minimally, all appliances should meet Energy Star requirements, using the least energy possible without sacrificing performance.

3. GOALS AND METHODS

3.1. Introduction

Sustainable prefabrication allows for the opportunity for both global development and regional production of disaster relief housing. This provides advantages over current solutions: advanced planning incorporating global development allows for quicker, more effective response when disaster strikes; both socially and environmentally sustainable strategies can be integrated into the planning, production, design, and construction of housing; adaptive designs can allow for regional production and quick construction in various areas; disassembled homes can be reused for other relief efforts; and, finally, well-designed houses are more resilient shelters against extreme conditions.

Goals include:

- Research and development of Zero Energy housing strategies for China/Sichuan addressing economic, cultural, social and political factors as well as material issues, enabling the local housing industry to develop and fabricate better houses for the local market.
- Research and development of low cost and low tech technologies for sustainable housing adapted to local conditions (i.e.: PV cells, heat recovery, thermal insulation, solar hot water systems)

3.2. The following key issues will be analyzed

- Production: Regional and central manufacturing centers in China can take advantage of available green power sources as well as off-peak rates. The controlled environment of the manufacturing center allows for precise construction as well as providing access to a stable workforce skilled in the application of the latest building technologies.

- Transportation: Central manufacturing facilities reduce the amount of material and worker transportation. Only regional manufacturing centers can reduce the distance traveled by the finished components to the job site. Building components may be shipped disassembled to reduce bulk or CAD files may be sent to local fabricators.
- Assembly: On site construction is minimized to limit time and energy expenditure. Building components are designed to be fastened together without the need for power tools.
- Disassembly: The design of the housing units would make use of reusable structural and envelope components that could be easily disassembled and reused. Other materials unsuitable for immediate reuse could be coded for recycling.
- Operation: Housing should be designed to take advantage of passive strategies such as solar space heating, day lighting and natural ventilation. Active strategies could include photovoltaic, solar hot water heating, high efficiency appliances, and ventilation.

3.3. Sustainable materials

- Availability: A regional approach to prefabrication would make use of locally sourced material. This serves the dual purpose of reducing transportation needs and the preservation of regional differences in construction.
- Efficiency: Due to the controlled environment of the manufacturing center, computer aided manufacturing may be employed to reduce waste. Any waste streams may be diverted for recycling.

3.4. Social and cultural sustainability

- Economic: The global need for standardized housing must be tempered with the local need for jobs. Regional centers could provide stable factory jobs without robbing opportunities from the local work force.
- Cultural: Regional focus would allow for fine tuning of prefab structures for cultural norms such as family size, relationship to land, and building type. Mass customization has the ability to offset the homogenizing tendency of standardized production.

4. Project

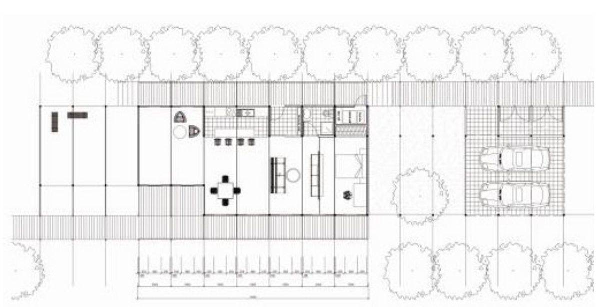

Figure 5: UT zero energy house floor plan

4.1. Why sustainable prefab?

As world demand for housing increases so does the percentage of prefabricated units. Though some manufacturers are beginning to offer more options, the industry standard is inefficient in its use of material and energy. Equally as important as sustaining resource supplies for future generations is the promotion of economic stability and diversity of regional culture. A system that combines the techniques of prefabrication with sustainable principles has the potential to be both efficient and responsive to social issues. Flexible strategies of regional manufacturing and mass customization offer the best alternatives to either current building methods or centralized production of standardized prefab units.

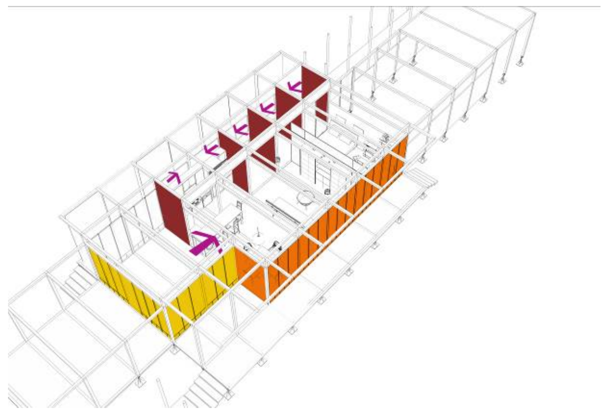

Fig 6: UT zero energy house heating

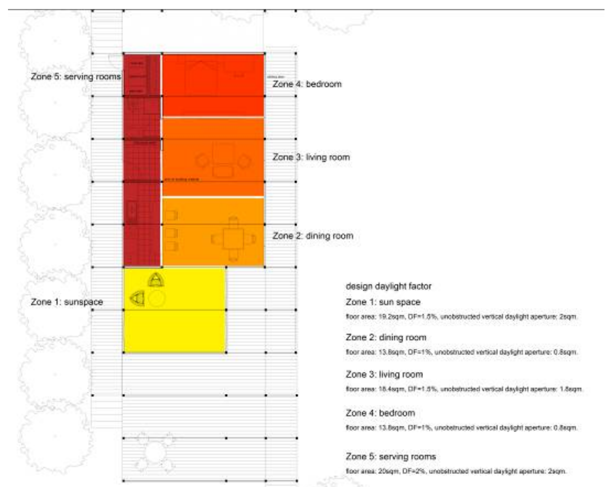

Figure 7: Day lighting zoning

The original configuration of the project derives from two basic units, one of which is a solid box, 1.5 meter x 2 meters x 3.6 meters, working as serving space; the other of which is an open space, 4.8 meters x 2 meters x 2.7 meters, working as served living space. All serving space is organized on one side with served space connected with it, but two served units without

Figure 8: Zero energy apartment

serving unit are put in the front. The aim is to keep the served space working as the center of the house with a good view to the outside; to make the serving space the buffer zone protecting the served space from the climate; and to have the front units as a sun space.

The primary structure of the house is the columns and beams which constitute the supporting grids. The secondary structure, which includes the walls, roof, floor and glazing, works as the thermal envelope. The solar envelope that provides the solar energy is the tertiary structure. The construction sequence of the house is: piers, columns, A beams, B beams, floor, wall panels, glazing panels, shading devices, solar panels. The exterior materials of the house are metal to make sure that the structure is light; while the interior material is wood in order to establish a homelike feeling.

Sliding devices are used to separate the serving space from the served space in the house, which makes the indoor space very flexible. They are also applied at the division of interior and exterior to make the house as open as possible when wanted.

First of all, the house has three heating zones. The south-facing winter garden is a sun space, the southeast-facing rooms get direct heat gain, and the northwest-facing serving rooms function as a buffer zone. Second, heat is collected and distributed between the zones. Sun space and glazing areas collect heat, thermal mass on the floor stores it, and the air flow helps distribute it.

Both cross and stack ventilation are created in the house. Openings placed at diagonal in both plan and section make the cross ventilation efficient. Inlet at the lower part of east and outlet at the higher part of west make stack ventilation possible.

The covering of the porches by tinted glass is the main fixed shading device. Operable shading is provided by the sliding panels along both sides of the house and the interior blinds in case that heat is needed in winter.

Outdoor panels on both of the east and the west make the backyard comfortable in summer. The transparent material makes sure the landscape is still viewable.

Active strategies are applied to compensate when passive strategies are not sufficient. A photovoltaic power system generates electricity through the use of PV panels. Apricus water heating tubes that absorb the sun's radiant heat in an insulating layer of air-evacuated glass provide all the hot water for the house, including the water for the radiant floor. The floor is made of a high density wood composite which distributes the heat evenly across the surface. Passive and active strategies work together to make the gained and consumed energy balanced.

Figure 9: Zero energy house, PV cells on flat roof

Figure 10: Traditional Sichuan housing type with sloped tile roofs, PV cells along roof overhang

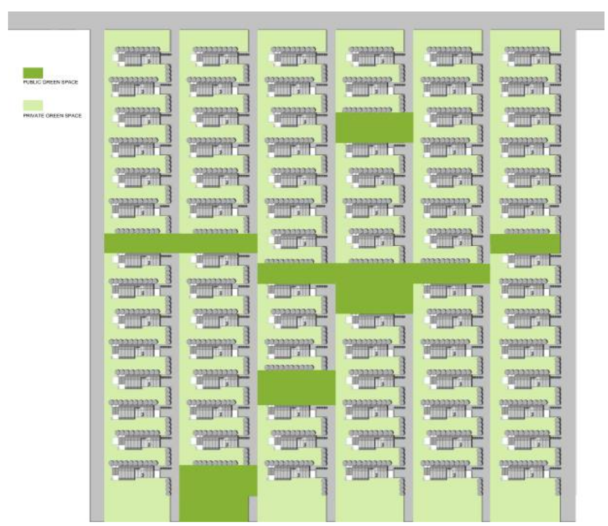

Figure 11: Zero energy community – Based on organization found in the traditional Chinese Hutong

Figure 12: Zero energy community in context

CONCLUSION

By combining sustainable practices with well-planned design, sustainable prefabricated housing can solve previous problems and offer better solutions for long-term transitional or replacement housing. The Zero Energy House for Sichuan Province has the potential to become a future model for sustainable prefabricated family dwellings. Advanced planning of sustainable prefab housing should occur on a global scale, allowing the collaboration of various countries to develop innovative technologies and adaptive strategies in energy conservation and social sustainability.

Prefabricated housing should be produced regionally to reduce transportation costs, use local materials to incorporate regional differences in construction, and incorporate local customs and norms. Depending on necessity, regional manufacturers have the option to produce kits of building components or service modules containing plumbing and air supply.

Sustainable prefabricated homes aren't appropriate for immediate shelter, but can provide solutions for long-term planning for disaster relief. Because the homes will arrive as kits of building or technology components, the construction will be quicker than on-site construction, and the displaced victims can be involved in the construction of the homes, giving them a sense of self-reliance and ownership.

Low cost housing in the US has to address similar problems to those addressed by housing in developing countries. In both cases, owners face economic pressure due to rising energy costs and poorly designed houses. By addressing energy conscious design strategies, low tech sustainable technologies, and material, social and cultural sustainability, sustainable prefabricated housing can positively impact the well being of the owners, the economy of local businesses and the local and global ecology (depletion of natural resources, global warming etc.).

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Day lighting diagram (www.arch.utk.edu/Zero_Energy/default.shtml)

Natural ventilation diagram (www.arch.utk.edu/Zero_Energy/default.shtml)

Solar gain heating diagram (www.arch.utk.edu/Zero_Energy/default.shtml)

Active solar system (www.arch.utk.edu/Zero_Energy/default.shtml

Design project, by Chen Li, graduate student of University of Tennessee

BLOOMhouse: a zero net energy house

M. Garrison, R. Krepart, S. Randall and A. Novoselac

The University of Texas at Austin, Austin, Texas

ABSTRACT: The 2007 University of Texas Solar Decathlon House is called the BLOOMhouse because it represents the “seed” of new ideas for zero net energy housing. The University of Texas student team developed a prefabricated 7.9 kW stand-alone solar-powered modular house that sits lightly on the land and forms the superstructure for photovoltaic technologies and a sustainable approach to the building envelope. The prefabricated house can be adapted to a specific site and modified for the needs of a different site within a different climatic zone, and client context. Recognizing that consumers look to Solar Decathlon entries for ideas of how to integrate renewable energy technologies into their own homes this house will serve as a working example to homeowners, homebuilders, and architects.

The Solar Decathlon is an international initiative and University competition sponsored by the U.S. Department of Energy, designed to stimulate research, industry and education to advance renewable energy technologies, with a specific focus on building-integrated photovoltaics. Now entering its fourth cycle, the Decathlon provides a unique opportunity to envision, fabricate and test the possibilities of highly efficient modern dwellings. Our team of architecture and engineering faculty and students under the direction of Professor Michael Garrison, Professor Samantha Randall, Professor Atila Novoselac, and Lecturer Russell Krepart constructed a completely stand-alone solar-powered home that serves as a catalyst for change, leading the residential housing industry toward more sustainable practices while addressing the need for well designed, appropriately diverse, economically viable, and environmentally responsible housing. Through use of solar power and energy efficient design, this project offers homeowners the means to directly participate in the energy economy, moving from energy consumers to energy producers.

Conference theme: Green and sustainable architecture
Keywords: photovoltaics, solar design

INTRODUCTION

The Solar Decathlon competition occurs every two years and is run by the National Renewable Energy Laboratory, which requires a portable structure of a fairly modest scale, with a dual prescription for both exhibition and inhabitation. The Program calls for the design to appeal to the normal modern American lifestyle of the general public -- the solar decathlon house is designed to support all the power needs of a typical household, including lighting, cooking, heating and cooling, and telecommunications. There should also be enough energy remaining to charge an electric vehicle for getting around. The competition requires the construction of the home "offsite". It should have a maximum dwelling footprint of 800 square feet, suitable for two people and mobile, so that it can be transported for a temporary exhibition "village," on the National Mall. The home has to be installed in four days, occupied and tested during the competition and then subsequently removed and shipped back to Austin. The University of Texas has participated in the competitions in 2002, 2005 and 2007.

The new rules for the 2007 Solar Decathlon competition added “market viability” as another part of the contest. Jurors assessed how well and easily the house could be brought to market and also whether the house had market appeal, is livable, has a flexible layout and is affordable. To respond to the requirement for a broad- based market appeal the 2007 UT Solar D team adopted an interdisciplinary approach. Although the student-led team remained under the Architecture, it also included a diverse partnership of faculty leads from different disciplines from Engineering, Marketing, and with Advisory Council of business and industry professionals. In response to “market viability” the team developed a 7.9 kW PV array with a skin-based design strategy that responds to orientation, climate and culture.

1. DESIGN

The 14-foot-wide x 50-foot-long streamlined, singlewide design was determined based upon shipping dimensions and speed of construction.

The BLOOMhouse is constructed of 6" thick Structurally Insulated Panels (SIP's) with an R-24 insulation value that reduces heating and cooling loads to 1 ton per 960 square feet. Metal-faced SIPs perform structurally as stress skin panels, and act as a thermal and moisture barrier.

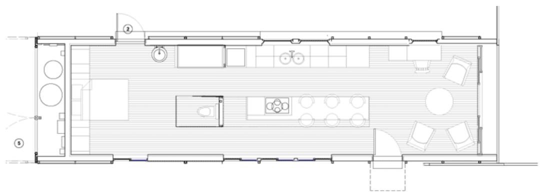


Figure 1: Open floor plan of the BLOOMhouse

Because the house is made using lightweight, metal-faced SIPs as a single airtight envelope, the infiltration load was reduced to less than one-half of air change per hour. An Energy Recovery Ventilator (ERV) was incorporated into the house to ensure adequate amounts of fresh air.

Figure 2: South Elevation Bloomhouse (photo by NREL)

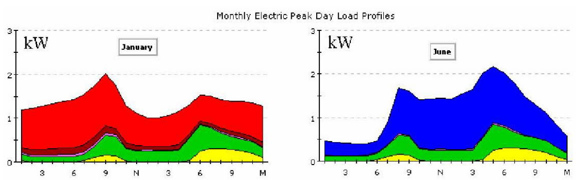
The photovoltaic panels, together with a steel carriage form a butterfly roof-shading device. The PV panels are mounted in racks of 5 over the flat roof to speed up on-site deployment time. These racks are supported on vertical steel frames on the north and south façade of the house. The steel frames are called "moment frames" which pick up lateral forces on the long sides of the house and allow for the elimination of interior sheer walls to achieve an open free flowing spacious plan arrangement. The openness of the design simultaneously facilitates daylighting, effective cross ventilation and a fluid indoor/outdoor relationship with the outdoor decks that surround the house. As a consequence a house of a fairly modest scale appears large and spacious.
The house was prefabricated by the student team headed by Alex Miller under the construction direction of Russell Krepart in a hangar at the old Mueller Airport in Austin. The house was shipped by truck to Washington, D.C. as a wide-load transport and modified on the National Mall using a system of hydraulic jacks. On site labour was reduced in this design scheme to the installation of the solar collectors and landscape decking.
The energy-saving features of the house integrate strategically placed shading devices, cross ventilation, daylighting, advanced Energy Star appliances, and LED lighting prototypes. Solar systems include a 7.9 kW PV system and an evacuated tube solar hot water heating system with a warm floor heating system that discharges excess heat into a hot tub. The excess energy from the 7.9 kW PV system is used to charge an electric vehicle with a goal of meeting the needs of commuters who put as many as 19,000 miles a year on their vehicles.

Figure 3: BLOOMhouse interiors (photos by Alex Miller)

2. ENERGY DESIGN AND ANALYSIS

The engineering student team led by Professor Atila Novoselac performed an energy analysis using several software packages. The software included, DOE2, PV-F-Chart and PV-DesignPros-S. The software was used to model window and shading devices, wall and ceiling structure and material properties, air infiltration/ventilation rates, thermal mass and building daylight and energy performance.
The results of the analysis showed that double-pane windows limited to 25% of total wall area and with a reflective coating, shading device (SHGC = 0.2) and exterior architectural shading devices on east and south facades optimized energy use performance.
Parametric analyses showed the optimum R-value of the walls that were specified for the BLOOMhouse to be 25 h.ft²ºF/Btu. This corresponds to a 6" structural insulated panel. Analysis showed that additional increases could lead to an increase in interior temperatures due to internal sources of heat gain.
The effect of infiltration and/or ventilation rate on energy use was also studied. For the selected windows, shadings devices, and R-value, for the BLOOMHouse the air exchange rate was reduced to.35 air changes per hour. In order to minimize the air quality problems for a house this airtight a mechanical

energy recovery ventilation (ERV) system was added to assure adequate amounts of interior fresh air.
Because the BLOOMhouse needed to be lightweight, in order to be transported to the National Mall, thermal mass was reduced in the use of construction materials while relying on a solar hot water powered “warm floor” to achieve radiant heating during winter conditions.
Additional analysis indicated that lower exterior surface absorption for walls affected annual energy consumption. Therefore light colored exterior surfaces with an absorption index between 0.8 to 0.4 were specified. These energy conservation measures, coupled with energy star appliances, an energy-efficient lighting load of .5 W/sf, and a mini-split Heating, Ventilation and Cooling (HVAC) system, determined that the peak HVAC load would be less than 2 kW in order for the BLOOMhouse to meet the competition’s strict comfort zone design requirements of 72º - 76˚F and a relative humidity (RH) of 40-55%.

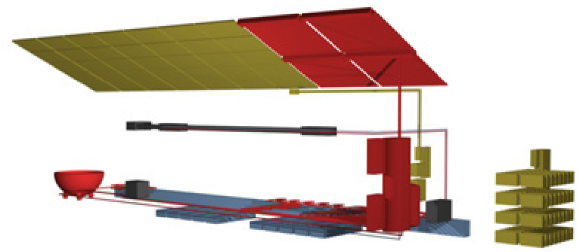


- **Red- Heating**
- **Blue-Cooling**
- **Green-Appliances**
- **Yellow-Lighting**

Figure 4: Energy Load of the BlOOMhouse

2.1 Solar Hot Water System
Evacuated-tube solar collectors provide the energy for the water heating for the kitchen, bathroom, dishwasher, clothes washer and the warm floor heating system. This system requires two tanks (40 gallon and 120 gallon capacity) for hot water storage and a control system that regulates the energy flow in-between these two tanks. For Austin, Texas evacuated tubes positioned on the roof, with an area of 60 square feet, provide enough energy to heat the domestic hot water needs during the year and provide additional energy for warm floor heating during the heating season. Total annual savings of electrical energy is reduced from 7340 kWh to 6560 kWh, therefore: the annual savings of electrical energy attributed to the “warm floor” heating is estimated to be 780 kWh for Austin, Texas.

2.2 Solar PV System
Roof-mounted photovoltaic panels are oriented towards the south with a tilt angle of 18°. This low tilt angle was determined by the Solar Decathlon competition requirements, related to the height of the house. The PV system consists of 42 BP Solar photovoltaic panels. The efficiency of the panels is 15.1% resulting in a maximum power output of 7.9 kW. The photovoltaic panels convert light directly into electricity which is sent to a controller which distributes the energy between storage in a battery bank, used to charge the car, or used to run the loads of the house. The system is connected to four SMA Sunny Boy Inverters, which are used to convert the DC electric power from the photovoltaic array to AC power required to run household appliances. The battery bank was sized to store enough electricity for 5 consecutive “dark days”. Approximately one-third of the PV power system is used to power the house and two-thirds of the PV power system is used to charge the battery car.



*solar electric
*solar water
*ductless HVAC
* floor SIP

Figure 5: BLOOMhouse Mechanical Systems

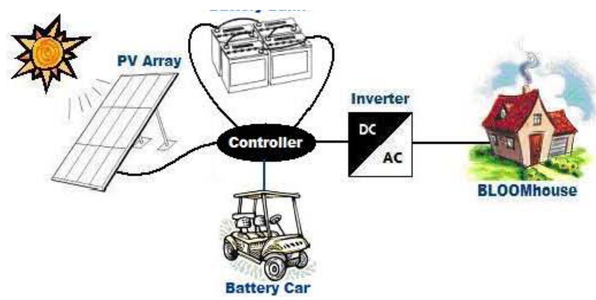


Fig. 6: Photovoltaic power system

2.3 Operation
The house maintained comport conditions throughout the competition and the University of Texas Team placed 10th in the overall competition out of twenty teams. The University of Texas team placed 2nd overall in Engineering, was 3rd overall in the Comfort Zone portion of the competition and placed 1st in the solar hot water competition. The University of Texas team won a special award for being the first team on the National Mall to have their house operational and also won the BP Solar Award, for the solar decathlon house that demonstrated the best overall integration of photovoltaic roof panels.
After the competition on the Mall, the house was disassembled and shipped back to Austin, Texas. It was eventually shipped on to McDonald Observatory near Ft. Davis, Texas where the house was reconstructed on the Mount Locke site of the Millimeter Wave Telescope. The BLOOMhouse is being used for staff housing and to power scientific experiments. Future plans include a display at the Frank N. Bash

Visitors Center to feature information on the BLOOMhouse, and solar energy.
The combination of the solar water system and the 7.9 kW PV system enables the completely off the grid, stand alone house to remain within the comfort zone, in Washington D.C. Austin, Texas and at McDonald Observatory.

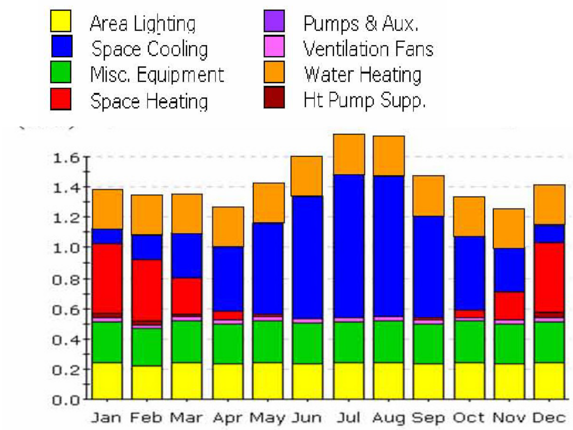
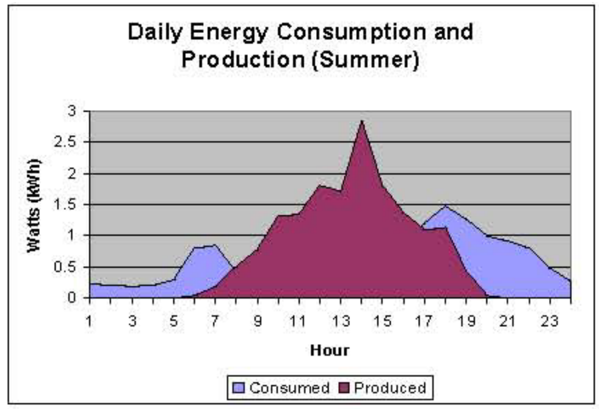


Figure 7: Annual Energy use (kWh) for the BLOOMhouse

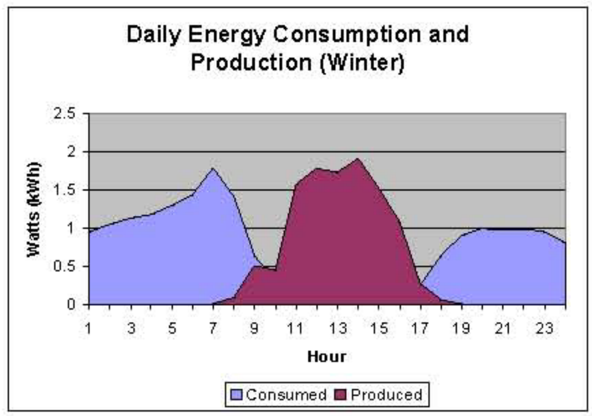
3 PERFORMANCE

The performance of the BLOOMhouse established that a well-designed 7.9 kWh PV powered house could adequately meet the energy demands of the modern American lifestyle, in Washington D.C., Austin, Texas and in Ft. Davis, Texas. The house receives enough PV power to run the entire house, and to charge two electric-powered vehicles. At McDonald Observatory, the vehicles are used to transport astronomy staff members to and from the house to the telescopes. Excess power from the PV system is stored in batteries during the day for use at night. They also power an adjacent staff house.

Figure 8: BLOOMhouse at McDonald Observatory



a) E Summer in Austin, Tx



b) Winter in Austin, Tx

Figure 9: BOOMhouse daily winter/summer energy consumption and production

4 CONCLUSION

In assessing the Solar Decathlon competition, as process, pedagogy, and product, it becomes clear that the challenges and possibilities of the Solar Decathlon are not solely engaged in questions of renewable energy. In fact, *logistics*, *material assemblies, inhabitation, building code integration and education* became the driving concerns that focused the project around the broader questions of collaboration and sustainability as an environmental, technical and social practice. These issues are critical to presenting the feasibility of solar energy technologies to the general public, and are closely inter-related. While there is no one solution, experience has proved that by blending design questions with logistics questions and performance questions with social questions, we ultimately turn an environmental challenge into environmental research which is based upon *principles of collaboration* -- between a homeowner and the home, between a building and its environment, between ecology and economics.
The team's investigations suggest that progressive technologies offer solutions to the serious emerging

challenges of energy efficiency and sustainable development and thereby become a strong design shaping force. These progressive technologies integrate photovoltaic systems; passive solar heating, solar-induced ventilation, daylighting, water use efficiency, regenerative waste management, smart energy management systems, and other low-entropy open building systems that contribute to "green" architecture. This study of building systems also includes the principles, conventions, standards, applications and restrictions associated with the manufacture and use of existing and emerging construction materials and assemblies and their effect on the environment. These technologies serve as catalysts for change.

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Evidence-Based Design

Benchmarking the effectiveness of universal design

Gary Scott Danford, Michael Grimble, and Jordana Maisel

State University of New York at Buffalo, Buffalo, New York

ABSTRACT: Evaluating the effectiveness of universal design is typically done through case studies conducted by experts in field settings. The logistics and costs of such case studies, however, inevitably constrain not only user participation but also the environments studied - further compromising case studies' already limited generalizability and frustrating evidence-based universal design practice. This paper proposes a method for benchmarking the effectiveness of universal design that removes these constraints and enhances case studies' generalizability by moving them from the field to the internet.

Conference theme: New methodologies in architectural research
Keywords: universal design, effectiveness, benchmarking, evidence-based practice

1. EVIDENCE OF EFFECTIVENESS

The most direct evidence of the effectiveness of any environmental design is the degree to which the environment enables the performance of salient activities by its users. For an environment that purports to comply with the *Principles of Universal Design* (Connell, et al, 1997) that would mean enabling comparable activity performance by all users (Danford, 2001; 2003) – i.e., facilitating full participation, inclusion, integration and equality regardless of any limitations associated with users' age, size, gender, abilities or circumstance.

Consequently, one might presume that evidence of universal design's effectiveness for all users could readily come from case studies of those users' experiences with such environments. But case studies on universal design are often designed to serve other purposes – e.g., as demonstration projects to provide examples of universal design's claimed benefits or as hypothesis tests to evaluate and refine universal design theory. As valuable as those purposes are, however, the data from such case studies have limited utility for the development of the translational research required for *evidence-based practice* (Hamilton, 2006).

Even those case studies that are specifically designed to generate evidence that facilitates translation from research to design – e.g., *action research* to solve an existing situation-specific problem (Lewin, 1976; Susman, 1983) and *post-occupancy evaluations* (POEs) to provide "feed forward" to the next design iteration (Preiser, et al, 1988) – are limited because the type and quality of data such studies gather are not standardized. Because both the type and quality of data vary so from one study to the next, the development of a cumulative body of evidence through meta-analysis (Cornell & Mulrow, 1999) is frustrated.

With the development of a cumulative body of evidence so impacted, there is little empirical basis for predicting an environment's effectiveness or even for comparing one environment's effectiveness against another's. Such data make it virtually impossible to benchmark the effectiveness of universal designs that evidence-based practice necessarily requires.

An equally large obstacle to such case studies' translation from research to evidence-based practice is their external validity. Case studies' constraints raise formidable obstacles to the generalizability of the evidence they gather (Groat, 2002). Even with action research and POEs, pragmatic issues of logistics and costs inevitably work to restrict the users involved to small numbers and/or to delimit the environments that are available for study.

And, of course, case studies of universal design innovations that do not yet exist present their own unique obstacles to translation from research to evidence-based practice. Even when issues about internal validity that inevitably arise when such proposed environments are simulated (Catalano & Arenstein, 1993) can be satisfactorily addressed, threats to external validity attributable to yet additional issues of logistics and costs associated with developing and using simulations ultimately remain.

The most fundamental challenge to the generalizability of case study data, however, is that every case studied is inevitably confounded by unique situation-specific factors. Consequently, simply applying evidence gathered by single case studies to other user-environment situations is inherently problematic. At best, such applications run the risk of unintended consequences; at worst, they yield poor *user-environment fit* (Gifford, 2007) and/or maladaptive outcomes.

Evidence-based universal design practice requires the development of a cumulative body of evidence on environments' effectiveness in providing comparable user-environment fit for all users. Research data on such effectiveness mined from diverse users' experiences with varied environments are required for an evidence-based practice of universal design that enables full participation, inclusion, integration and equality for everyone.

2. PROPOSING A NEW STANDARD

While traditional case studies on universal design pose numerous obstacles to conducting the translational research that evidence-based practice requires, it is possible to hurdle those obstacles by developing a new standard.

This new standard would have to produce case studies on universal design that (1) do not restrict user participation or delimit the environments that can be studied, (2) gather uniform data on diverse users' experiences with all environments, (3) generate evidence of environments' actual and relative effectiveness, and (4) strengthen the generalizability of that evidence to other user-environment situations.

To hurdle the obstacle posed by case studies' logistic- and cost-based constraints on user participation and the environments that can be studied, the traditional practice of bringing users to (or relying on users already present in) the environments to be studied could be reversed – e.g., bring the environments in simulated form to users via the internet. Not only would this enable almost unlimited user participation but also remove virtually all logistic- and cost-based limitations on the environments that can be studied. Expenses would be negligible compared to the prohibitive costs of the traditional case studies that would be required to generate comparable evidence.

To hurdle the obstacle posed by case studies' lack of uniformity in the type and quality of the data they gather, all case studies on universal design could gather the same evidence of user-environment fit for all users and environments – i.e., the incidence of problematic activities as a direct indicator of environments' effectiveness.

This standardization in the type and quality of data gathered also hurdles the obstacle posed by case studies' inability to generate the empirical evidence (as opposed to expert opinion) of effectiveness required by evidence-based universal design practice. By benchmarking the incidence of diverse users' problematic activities for each universally designed environment, empirical evidence of such environments' effectiveness can be gathered.

To hurdle the most fundamental obstacle faced by case studies – i.e., that every case studied is inevitably confounded by unique situation-specific factors – validated visual simulation methods such as line drawings (Stamps, 1993) could be used to bring all environments to all users. Supplemented by narrative descriptions to accommodate users who have vision conditions, the visual simulations would be able to control confounding factors and thereby enhance the external validity of case studies' evidence.

3. APPLYING THE PROPOSED STANDARD

An internet-based study of universal designs' effectiveness as indicated by activity performance begins with an accessible, W3C-complaint webpage that invites individual participants to complete anonymous online surveys about problems they have performing routine activities commonly encountered in everyday environments (e.g., public buildings, public streets, residential environments, etc.). While accessibility studies are typically focused on individuals who have mobility, sight, hearing or cognitive conditions, universal design studies also focus on individuals who do not have those conditions since the goal is to gather evidence of the designs' capacity for enabling full participation, inclusion, integration and equality for *everyone*.

The research design involves three phases. The first phase's *problematic activities surveys* establish the baseline incidence of problematic activities in each environment for each user group. The second phase develops *universal design proposals* for each environment intended to remedy those problematic activities. And the third phase's *design effectiveness surveys* then evaluate those design proposals' effectiveness by benchmarking their reduced incidence of problematic activities for each user group. All surveys are presented in accessible formats to enable ready use even to novice users of screen readers as well as individuals who have difficulty using a mouse or touch pad.

All participants begin by giving *informed consent* – i.e., agreeing to participate in the study as described on the website. An *Institutional Review Board for the Protection of Human Subjects* will typically consider this type of research *exempt* as long as it asks only innocuous questions that pose no risks to the anonymous participants. Even so, the general purpose of the study as well as the nature of participants' involvement completing the surveys are nevertheless explained – all without reference to *universal design* per se to avoid any biases, pro or con.

After providing informed consent, each participant's internet browser is automatically routed to a short *tell us about yourself questionnaire* where they provide standard demographic information about themselves. More importantly, they also provide information about (1) any sensory or functional conditions they have (e.g., limitations in mobility, vision, hearing, cognition, etc.) and (2) *how often* each condition affects their performance of routine activities by choosing the response option closest to their answer (e.g., *always* = 100% of the time, *usually* = 75% of the time, *sometimes* = 50% of the time, *rarely* = 25% of the time, and *never* = 0% of the time). These data are later linked to participants' responses to the subsequent *problematic activities surveys* and *design effectiveness surveys* to facilitate analyses specific to each user group.

The initial *problematic activities surveys* all ask participants *how often* they typically have a problem performing each of the listed activities by choosing the aforementioned response option closest to their answer. Participants are then invited to explain their answers in terms of *why*.

The participants' *how often* and *why* responses are then analyzed to develop *universal design proposals* that reduce the incidence of the most problematic activities in each environment for all users.

These design proposals are then delivered back to participants through *design effectiveness surveys* that use both narrative descriptions and line drawings to communicate each proposal. All participants again begin by providing *informed consent* as well as the aforementioned *tell us about yourself* information in the event that their conditions and/or circumstances might have changed since completing the initial *problematic activities surveys*.

The *design effectiveness surveys* all begin by asking participants to reconfirm *how often* they typically have a problem performing each targeted activity. Participants are again invited to explain their answers in terms of *why*.

The *design effectiveness surveys* then present a neutrally-worded narrative description and simple line drawings of a proposed design that participants are told *might* improve their experience performing the activity. Line drawings are used to present the design proposals because they provide demonstrably valid simulations for the types of responses requested (Stamps, 1993) and can readily control potentially confounding situation-specific variables.

To test whether participants are actually responding to the narrative descriptions and line drawings, several design proposals meant to negatively impact performance of less problematic activities are purposely included in each *design effectiveness survey*.

Participants are then asked *how often* they would have a problem performing the activity in question if they were to encounter the proposed design by choosing the aforementioned response option closest to their answer. Participants are once more invited to explain their answers in terms of *why*.

4. PROBLEMATIC ACTIVITIES INDEX

To provide easily communicated and interpreted evidence of each universal design's effectiveness, a single index number is generated. This number, called the Problematic Activities Index (PAI) score, is based on (1) *how often* the participants' condition typically affects performance of routine activities in an environment and (2) *how often* the specific activity in question is problematic.

The PAI score is an index number that indicates how problematic an activity associated with an environment is on a scale from 0 to 100. The higher the score, the more problematic the activity and the less effective the environment.

The significance of a PAI score is always relative. The meaning of a score for an activity in one environment for one condition depends on how it compares to the scores for other activities, environments and/or conditions. For example, a low PAI score of 20 for an activity in one environment could nevertheless be worse than the PAI score for the same activity in a second environment, indicating that the second environment is more effective.

Activities' PAI scores enable the environments with which they are associated to be ranked on their effectiveness both within and across users' conditions. By knowing which activities present the greatest problems for various user groups in an environment, one can develop universal design solutions for that environment that improve participation, inclusion, integration and equality for everyone.

A two step process generates the PAI score for an activity based on the percentage of users reporting that a condition *always*, *usually*, *sometimes* or *rarely* affects their performance of routine activities who also say that their performance of the activity in question is *always*, *usually*, *sometimes*, *rarely* or *never* a problem (see Figure 1).

STEP 1: The number of users saying that the activity in question is *always*, *usually*, *sometimes*, *rarely*, or *never*

	A	B	C	D	E	F	G	H	I	J	
1	STEP 1:		CONDITION		CONDITION		CONDITION		CONDITION		1
2			Always	Always %	Usually	Usually %	Sometimes	Sometimes %	Rarely	Rarely %	2
3	ACTIVITY	Always	#	C3/A8*100	#	E3/A8*100	#	G3/A8*100	#	I3/A8*100	3
4		Usually	#	C4/A8*100	#	E4/A8*100	#	G4/A8*100	#	I4/A8*100	4
5		Sometimes	#	C5/A8*100	#	E5/A8*100	#	G5/A8*100	#	I5/A8*100	5
6		Rarely	#	C6/A8*100	#	E6/A8*100	#	G6/A8*100	#	I6/A8*100	6
7		Never	#	C7/A8*100	#	E7/A8*100	#	G7/A8*100	#	I7/A8*100	7
8	SUM(C8+E8+G8+I8)		SUM(C3+C4+C5+C6+C7)		SUM(E3+E4+E5+E6+E7)		SUM(G3+G4+G5+G6+G7)		SUM(I3+I4+I5+I6+I7)		8
9	STEP 2:		ACTIVITY		CONDITION		PROBLEMATIC ACTIVITIES INDEX SCORE				9
10			How Often	Multiplier	How Often	Multiplier					10
11			Always	100%	Always	100%	SUM(D3*D11*F11)+(F3*D11*F12)+(H3*D11*F13)+(J3*D11*F14)				11
12			Usually	75%	Usually	75%	SUM(D4*D12*F11)+(F4*D12*F12)+(H4*D12*F13)+(J4*D12*F14)				12
13			Sometimes	50%	Sometimes	50%	SUM(D5*D13*F11)+(F5*D13*F12)+(H5*D13*F13)+(J5*D13*F14)				13
14			Rarely	25%	Rarely	25%	SUM(D6*D14*F11)+(F6*D14*F12)+(H6*D14*F13)+(J6*D14*F14)				14
15			Never	0%			SUM(D7*D15*F11)+(F7*D15*F12)+(H7*D15*F13)+(J7*D15*F14)				15
16							SUM(G11+G12+G13+G14+G15)				16
	A	B	C	D	E	F	G	H	I	J	

Figure 1: Problematic activities index formulas

STEP 1:		CONDITION		CONDITION		CONDITION		CONDITION	
		Always	Always %	Usually	Usually %	Sometimes	Sometimes %	Rarely	Rarely %
ACTIVITY	Always	125	44	0	0	22	8	0	0
	Usually	0	0	0	0	0	0	0	0
	Sometimes	22	8	0	0	65	23	0	0
	Rarely	0	0	0	0	0	0	0	0
	Never	23	8	0	0	27	10	0	0
284		170		0		114		0	

STEP 2:	ACTIVITY		CONDITION		PROBLEMATIC ACTIVITIES INDEX SCORE
	How Often	Multiplier	How Often	Multiplier	
	Always	100%	Always	100%	48
	Usually	75%	Usually	75%	0
	Sometimes	50%	Sometimes	50%	10
	Rarely	25%	Rarely	25%	0
	Never	0%			0
					57

Figure 2: Problematic activities index for using stairs for 284 participants with mobility conditions affecting legs and feet

problematic are placed in columns C, E, G or I based upon the participants' reports of *how often* their condition typically affects performance of routine activities. These frequency counts are automatically converted into percentages to normalize the counts on a scale from 0 to 100 in columns D, F, H and J.

STEP 2: The percentages in STEP 1's columns D, F, H and J are then weighted twice by (1) first multiplying the percentage by *how often* performing the activity in question is a problem (i.e., *always* = 100%; *usually* = 75%; *sometimes* = 50%; *rarely* = 25%; *never* = 0%) and (2) then multiplying by *how often* their condition typically affects performance of routine activities (i.e., *always* = 100%; *usually* = 75%; *sometimes* = 50%; *rarely* = 25%). The formulas for weighting the percentages are listed in G11-15. The sum in G16 is the Problematic Activity Index score for the activity in question that indicates the effectiveness of the environment with which the activity is associated – i.e., the lower the activity's score, the higher the environment's effectiveness; the higher the activity's score, the lower the environment's effectiveness.

5. THE PAI IN APPLICATION

The method for benchmarking the effectiveness of universal design proposed in this paper is currently being applied in a federally funded research project that is studying the effectiveness of universal design in various environments.

Figure 2 contains preliminary data from that project that demonstrate how an activity's PAI score is generated. Two hundred eighty-four participants with mobility conditions affecting their legs/feet reported *how often* their typical experiences using stairs in public buildings were problematic. These participants' answers were limited to three response options (i.e., *always* = 100% of the time, *sometimes* = 50% of the time, and *never* = 0% of the time).

Among the 170 participants who reported that their mobility condition *always* affects their performance of routine activities, 125 said that their typical experience using stairs in public buildings was *always* problematic, 22 said it was *sometimes* a problem and 23 said it was *never* a problem.

Among the 114 participants who reported that their mobility condition *sometimes* affects their performance of routine activities, 22 said that their typical experience using stairs in public buildings was *always* problematic, 65 said it was *sometimes* a problem and 27 said it was *never* a problem.

The resultant PAI score for this user group's typical experience using stairs in public buildings is 57 on a scale from 0 to 100. This establishes the baseline PAI score for this activity that a universal design proposal for stairs in public buildings would lower by reducing the incidence of this activity being reported as problematic by this user group.

Such PAI scores have numerous applications in evidence-based universal design practice. For example, PAI scores for activities within or across user groups can be readily computed to score universal design alternatives' relative effectiveness enabling comparable activity performance for everyone.

CONCLUSION

Logically, evidence of universal design's effectiveness should come from case studies of users' experiences with various environments. But traditional methods of conducting case studies on universal design are inconsistent with the requirements of evidence-based practice. These inconsistencies present obstacles to the development of the translational research that evidence-based practice requires. By adopting a new standard for the conduct of case studies on universal design, however, those obstacles can be hurdled.

This new standard creates internet-based virtual case studies on universal design that (1) do not limit user participation or constrain the environments that can be studied, (2) gather uniform data on all users' experiences with all environments, (3) generate evidence of environments' relative effectiveness, and (4) strengthen the generalizability of case studies' evidence to other person-environment transactions. By adopting this standard, universal design can hurdle the traditional case studies' obstacles that otherwise will continue to thwart direct translation from research to evidence-based practice.

ACKNOWLEDGEMENT

The method for benchmarking the effectiveness of universal designs described in this paper was developed in part with funding from the National Institute on Disability and Rehabilitation Research (NIDRR), U.S. Department of Education, through the Rehabilitation Engineering Research Center on Universal Design and the Built Environment, a partnership between the Center for Inclusive Design and Environmental Access (IDEA) and the Ontario Rehabilitation Technology Consortium (ORTC).

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New methods of researching healthcare facility users: the nursing workspace

Karen Keddy

Ball State University, Muncie, Indiana

ABSTRACT: This study is entitled *Embodied Professionalism: The relationship between the physical nature of nursing work and nursing space.* The analysis is based in a critical examination of existing approaches, assumptions, and attitudes in the research literature about who, what, and how to study the person-environment relationship in healthcare facilities. New methods of studying how nurses experience their work, their workplace and the objects in their workspace are needed in order to address important issues of this person-environment relationship. Nursing work is re-conceptualized as *embodied professionalism* which acknowledges the interconnections between the physical labor of professional nursing work, time, and space. This is a qualitative case study of nursing activities on a surgical unit that are invisible, marginalized, and unaccounted for in the research literature. Instead of studying how nurses' efficiency and productivity could be increased through design interventions, this study examines the physical nature of nursing work and the physical setting from the nurses' perspective. Instead of viewing the healthcare facility as solely a place for healing, this approach views the healthcare facility as a place for working. A nurse's goal can simply be the desire to 'get the work done.' A qualitative research methodology and a mixed method approach is used in this study. The methods include structured interviews, location mapping, photo-documentation, architectural inventories, place-centered behavioral mapping, and focused observations. In order to get a better understanding of how nurses experience their workspace, an image-based visual research method, the *experiential collage,* was designed. The findings from using these methods reveal the significant role that the physical activities of moving, searching, and recovering play in gaining insights into nurses' socio-spatial experience of the nursing workspace.

Conference theme: Human context: social, cultural, and economic studies
Keywords: visual research methods, nursing workplace, healthcare design, qualitative research

1. INTRODUCTION

For the patients, the hospital is a place of healing; while for nurses, the hospital is a workplace. This study provides a conceptual framework of understanding nursing work and the spatial implications of nursing work. This study illuminates the hidden and invisible activities such as searching and moving that are embedded within many of the caregiving nursing activities that nurses do on a surgical unit. This study demonstrates the value of studying physical activities in order to understand the spatial aspects of the workspace.

Evidence-based design is a recent approach to healthcare design that is informed by research data from a variety of sources (Hamilton, 2003). Evidence based design is used to create healthcare facilities that improve patient outcomes (Ulrich, 2003). In addition to studying how the design of healthcare facilities affects patient outcomes, studies that focus on the hospital unit as a workplace are also needed. For decades many studies have been done from an institution's point of view for the purposes of improving the 'efficiency and productivity' of healthcare professionals in the hospital setting and typically that is what is studied when analyzing the person-environment relationship in healthcare facilities. Adam (1995) states that being efficient is "to produce something or to perform a task in the shortest possible time" (p.100). Weiss et al (2002) define efficiency as "producing more in less time and with fewer resources such as personnel and equipment" (p.107).

However, we need to study how the design of a hospital unit and the location of objects in that space impact the work experience of staff nurses. In particular, we need to use research methods that help us understand how nurses use their workspace from a nursing perspective which fits with their goals of 'getting the work done'. What is meant by 'getting the work done,' is being able to accomplish the caregiving work that one is assigned by the end of the shift.

We can learn about how a space is experienced by nurses by studying the *activities* and *behavior* that occurs in the space as well as its meaning and significance. This study demonstrates the value of analyzing the physical activities that nurses do in order to understand the spatial aspects of the workspace. Conversely, there is value in studying the spatial aspects of the workspace and the objects in the workspace in order to understand the activities.

1.1. Embodied professionalism and the research question

The socio-spatial relationship that I call *embodied professionalism* calls attention to how the physical nature of nurses' work is embedded within the nurses' sense of professionalism. This is how professionalism manifests itself in hospital nursing. Embodied professionalism is a hybrid of manual labor and high-level professionalism, connecting the physicality of nurses' work and 'getting the work done' with the intellectual and scientific component of nursing professionalism. It is about "getting the work done" and how the nurses get it done – by doing the work, by laboring, by working together, by using their bodies to do their work. It is also about the need to recover from the physical labor of the work. The role that design plays is central to nurses' ability to fulfill their own professional expectations of 'getting the work done.' In this study embodied professionalism is how the professional nurse experiences her lived body in relation to space, the objects in the space, the people in the space, and time.

There is one major research question driving this research inquiry. The primary research question asks, *how do the socio-spatial characteristics of three types of spaces in hospital nurses' workplace and nurses' experience of embodied professionalism shape one another?* Because of the nature of the relationship that the staff nurses have with their physical workspace and the semi-fixed objects within it, the three major findings of *searching*, *moving*, and *recovering* provide answers to this question. The caregiving activities of *searching* and *moving* illustrate the physical nature of the work while also needing the resting activity of *recovering* from the physical aspect of nursing work.

1.2. Research design

This research was undertaken on a surgical unit at a regional hospital in Nova Scotia, Canada. The surgical unit was chosen for this study because the nurses on this unit frequently engage in physical labor, there is a high incidence of nursing injuries, the nurses work at a fast pace because of the nature of the work, and this unit does not have a nursing lounge for its' staff nurses. Another important consideration was that the nursing staff is comprised of nurses with different credentials which includes LPNs, RNs, and BNs. This was important for a study on an embodied professionalism because the data includes different types of physical labor involved in caregiving activities.

A *heterogeneous purposive sample* of nine diverse female staff nurses was selected, which allowed for different viewpoints as well as some commonality among the nurses in experiencing their workspace. These nine nurses have different nursing credentials (LPN, RN and BN), and differ in age, length of time since graduation, and length of time that they have worked on this surgical unit. In this unit the nursing staff works in teams of two (an LPN and an RN). This is relevant to a study of embodied professionalism because of the extent of physical labor in the nursing work done by nurses with different credentials.

This surgical unit is divided up into five smaller units and has different types of patient rooms and the unit. There is a four-bed Intermediate Care Unit (IMC), which has patients who require close medical attention and cardiac monitoring. There is a section on the unit with seven beds for patients who are almost ready to return home but still require nursing care. The rest of the unit has a variety of private rooms, semi-private rooms, and two 4-bed wards. All of these patient rooms except for the IMC are segregated by gender.

2. DATA COLLECTION METHODS

2.1. Overview of data collection methods

To discover how staff nurses experience their workspace, both conventional and non-conventional qualitative methods were used. Detailed architectural inventories of the fixed and semi-fixed features of the surgical unit space were conducted. As well, photo-documentation was done of the surgical unit and the public spaces in the hospital that the nurses frequented such as the gift shop, art gallery corridor, and the cafeteria. As Table 1 indicates, more than one data collection method was used to help answer the research sub-questions. The methods of inquiry included one-on-one structured interviews, two types of location mapping during the interview, photo-documentation, and focused observations. Each participant was asked to construct what I call an *experiential collage*. Each research method was pilot studied and modified before being used in the field.

The interviews and the experiential collages proved to be useful in helping answer all of the research sub-questions. The location-mapping instrument helped with answering the fifth sub-question about the socio-spatial characteristics of their workplace as shaping impression management behaviors in different settings. The instrument was especially helpful in generating where nurses do various nursing activities and in which spaces these activities occur.

2.2. Interviews and location mapping

Each participant was required to commit to a three-part process that included the initial interview with two types of location mapping, a collage workshop with the construction of a collage, and finally, the collage explanation meeting. The in-depth, one-on-one structured interviews in the research study lasted from one to two hours. The interview included two types of location mapping: *activity location* mapping and *impression management behavior location* mapping. The maps were miniature copies of blueprints of hospital floor plans. There were two types of 8.5" x 11" miniatures: the surgical unit floor plan layout and a floor plan layout of each hospital floor.

Table 1: The relationship between the research questions and the data collection methods

PRIMARY RESEARCH QUESTION
How do the socio-spatial characteristics of three types of spaces in hospital nurses' workplace and nurses' experience of embodied professionalism shape one another? How do these characteristics operate?

RESEARCH SUB-QUESTIONS	DATA COLLECTION METHODS
1) What are the nursing activities in each of the three types of spaces: the spaces of stationing, care giving, and resting?	Individual interviews Location mapping by participants during interviews Experiential collage Observation Place-centered behavioral mapping
2) How do nurses define and evaluate embodied professionalism in themselves and each other?	Individual interviews Experiential collage Observation
3) How do nurses perceive the physical nature of their work impacting their bodies?	Individual interviews Experiential collage
4) How do nurses perceive the designed environment as affecting the physical nature of their work?	Individual interviews Experiential collage
5) How do nurses perceive the socio-spatial characteristics of their workplace as shaping different types of impression management behaviors and settings?	Individual interviews Experiential collage Location mapping by participants during interviews

Each interview began with several basic demographic questions which asked about the participant's nursing credentials, number of years since graduation, age, how long she had worked on the surgical unit, and what types of hospital units had she worked on besides surgical. A set of ten interview questions followed, each with several sub-questions and probes. The first two interview questions asked how she judged whether or not she was doing a good job and how she judged whether or not another nurse was doing a good job. The next two questions asked what nursing activities did she consider to be physical labor and did she experience restrictions on being able to go to the bathroom, eat, or have a drink when thirsty.

The next three interview questions included the *activity location mapping* part of the interview. Two types of location mapping corresponded with related sections of the interview. For each type of mapping, information was collected for both the 12-hour dayshift and the nightshift, on two separate maps. Each of these questions asked if there was anything about the physical space (the layout of the unit, the size of the space, the furnishings, etc.) that influences how she acts in the space. The participant was asked to look at both a floor plan of the surgical unit and a floor plan of the entire hospital while she answered questions about three types of activities (stationing, caregiving, and resting). She was asked what activities she did in these places and to place a colored sticker on the floor plans to indicate where she did these activities. Small round colored stickers were used: red for stationing, blue for caregiving, and green for resting. She was asked to point out where the nurses listen to the change-of-shift report and where the medication carts are parked in the corridors. The participant was also asked to indicate where else in the hospital she carried out these activities and to place a corresponding colored sticker at those locations.

The last three interview questions included the *impression management behavior location mapping* part of the interview. These questions again related to stationing, caregiving, and resting spaces. This time questions were asked about how the nurse acted in these spaces and if she acted differently depending on who was present in that particular space, the time of day, the shift, the week, the season, and the physical space. An explanation of the 5-part sticker legend was provided and the participant was asked to assign numerical values between 1 and 5 to the ways she acted in these three different spaces. Five was the most formal (most professional) while 1 was the least formal (least professional). This five-tiered scale relates directly to Meyrowitz's (1985) five levels of impression management behavior (forefront, front, middle region, back, and deep back). The participant was asked to write the number on a yellow sticker and place it on the floor plan on the space where she would do this particular activity. There were both dayshift and nightshift floor plans. For each space of stationing, caregiving, and resting, the participant was asked to place stickers with the numbers in the activity space on the floor plan.

2.3. Experiential collages

After the in-depth interview, the participant signed up for a collage workshop and was asked to construct an *experiential collage*. I call this collage an experiential collage because the theme of the collage is about the nurse's socio-spatial experience of the physical nature of her nursing work. The interviews provided an opportunity for the nurses to say what they *think,* and through observations the researcher is able to see what the nurses actually *do*. However, the collages provide insights into how a nurse actually *feels* about what she thinks and what she does as well as what it *means* to her. The process of constructing the collage provides a nurse with a block of time devoted to reflecting upon her own different perspectives about the socio-spatial nature of nursing work *visible*.

The collage method was designed to achieve the above objectives. Unlike the ZMET collaborative experiences of the physical nature of her work. Finally, the collage provides a means of making method (2002), the participant constructs the collage by herself without assistance from the researcher.

Unlike the collage method employed by Williams (2002) it is not meant to be used in a group discussion. At the beginning of the collage workshop the participants were shown examples of collages, collage principles (metaphor, scale, literal representation, etc), and collage construction techniques. Then each participant spent approximately two hours making her collage. All collage-making materials and a large variety of magazines were provided. Each participant was given the same open-ended theme to base her collage on, which was to 'express the physical nature of your work as it relates to time and space.' This type of collage is often referred to as a 'magazine theme collage,' and has proved to be a very accessible type of collage for participants (Leland & Williams, 1994; Williams, 2002). Several participants personalized their collages by creating a *story* that had smaller pieces to it and often included a few smaller collages (what I call mini-collages) within the larger collage (see Figure 1). After completing her collage, the participant was asked to explain the meaning of each image and each piece of text in regards to the theme of the collage. Several questions about the process of making the collage were asked and a written record was made of the participant's explanation of her images and text. The primary purpose of the collage explanation meeting was for the researcher to come away with a clear understanding of what the participant was trying to express in her collage as it related to the theme.

2.4. Architectural inventory

Informal observations of the surgical unit were conducted to understand the spatial layout and the relationship of the spaces to one another. Photography was used as another method of observation and documentation of the physical characteristics of the surgical unit. Photographs were taken at different times of the day and on both site visits. Photographs of all the rooms and corridors on the surgical unit were taken to visually document the fixed and semi-fixed features of three types of activity spaces (stationing, caregiving, and resting). Photographs of the interior spaces of the hospital were also taken to become familiar with the location of the cafeteria, elevators, main staircase, courtyard, vending machines, chapel, gift shop, museum, and the nurses' locker room with showers. Photographs of the exterior spaces of the hospital were taken to become familiar with the location of the entrance to the hospital, the designated smoking areas for staff, parking lots, the helicopter landing pad, etc.

2.5. Observations

In the second stage of the study, focused observations of two caregiving nursing activities were conducted: *searching* and *moving*; as well as the nursing activity of resting and *recovering*. Also, the social dynamics among the staff were observed as well as the impression management behavior in the three activity spaces (stationing, caregiving, resting).

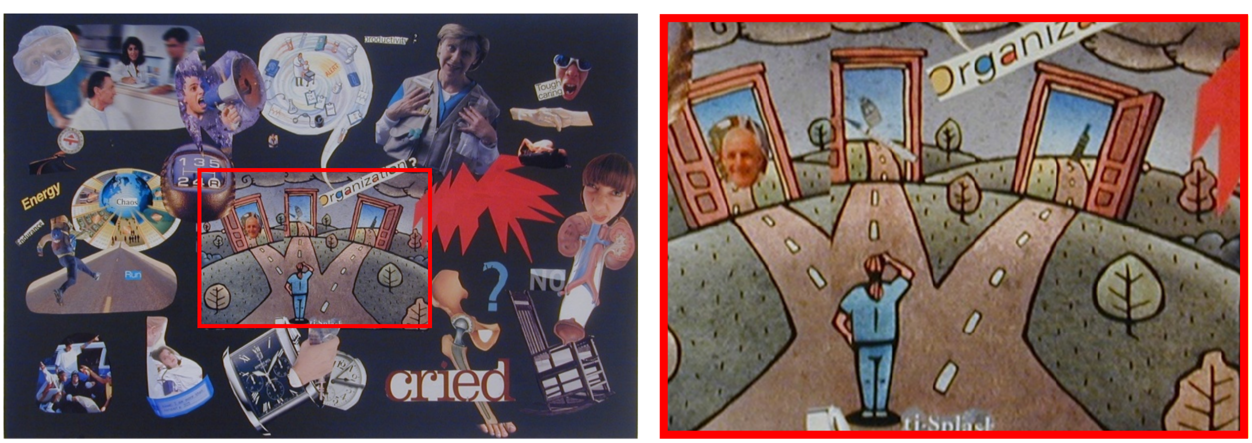

Figure 1: Janice's collage and mini-collage expressing searching for supplies (Keddy, 2006)

There were two types of observation checklists designed for observing and recording: the *sample activities observation checklist* and the *specific activities observation checklist*. The first type of observations was focused on the nurses' movement in space and in particular, the activities of moving. How the nurses moved in the corridors and utility rooms of their environment was observed and in particular how they moved different types of objects around in their environment. How the nurses carried small objects on their persons and how they interacted with larger objects such as patient transfer equipment and patient room furniture was also observed.

The second type of observations was focused on recording and observing specific caregiving nursing activities that the nurses talked about in their interviews and collages such as moving patients from one room to another on the surgical unit. This *Specific Activities Observation Checklist* was designed for these observations. Both checklists included spaces to make notes about the activity spaces and their locations, the date and shift, the start and finish times of the observation, the fixed features of the space, and the semi-fixed features (furniture and equipment). There was also a space on the sheet to sketch the location of the semi-fixed features that occur in the activity space such as the hampers, medication cart, linen cart, and recliners. At the bottom of the checklist was a space for comments and impressions. The *Sample Activities Observation Checklist* had a second sheet with spaces for the time, activity, actors, and social dynamics. This included verbal interaction and non-verbal expressions. The second sheet of the *Specific Activities Observation Checklist* had a space to write the purpose of the specific activity being observed and a space to write the parts of that activity.

These observations occurred at different times of the shift, for different durations of time, on both the dayshift and nightshift as well as on both the weekday and the weekend. These observations included three types of activity spaces (stationing, caregiving, and resting), the actors, the physical nature of the nursing activities, the fixed and the semi-fixed features, the social dynamics between the actors (impression management behavior), and the body expressions of the actors in these activity spaces. The semi-fixed features of space have four levels: portable, design finishes and hardware, adornment of space, and inhabitation of space. The inhabitation of space is further broken down into institutional artifacts, personal artifacts, and gifts to the nursing staff.

The three types of activity spaces were observed on the surgical unit, regardless of whether the spaces were designed for these activities or not. *Place-centered behavioral mapping* was used for observing how the participants used these three types of activity spaces. Sommer and Sommer (1997) define a behavioral map as a "chart of individuals' locations and movements, how they actually distribute themselves in a particular area or location" (p.358). As they point out, a behavioral map illustrates where and what behaviors actually occur which may contrast with what was planned for the space. A place-centered behavioral map is one in which the observer stations him or herself in one place to watch what is happening for a specific period of time (Sommer & Sommer, 1997). Behavior mapping has been used previously in health care settings to measure activity (Esser, Chamberlain, Chapple, & Kline, 1967; Field, Hanson, Karalis, Kennedy, Lippert, & Ronco, 1971; Fisher, 1982; Ittelson, Proshansky, et al, 1967; Kennedy, Fisher, & Pearson, 1988; Trites, Galbraith, Sturdavant, & Leckwart, 1970).

The place-centered behavioral mapping done in the corridors and nursing stations were not limited to observations about the nurses' locations, movements, and behaviors. The locations of objects in the corridors were also noted such as the medication cart, the linen hamper, recliner chairs, the linen/supply cart, wheelchairs, and stretchers.

3. CONCLUSION

As stated in the Introduction, the primary research question asks, *how do the socio-spatial characteristics of three types of spaces in hospital nurses' workplace and nurses' experience of embodied professionalism shape one another?* The research methods employed provided findings that answered this question in regards to 'getting the work done' and the three major physical activities of *searching*, *moving*, and *recovering*.

An exploration of *searching activities* illustrates that a surgical unit environment and the objects in the space are a key factor in nurses' ability to fulfill their own professional expectations of *getting the work done.* Neglecting the activity of searching when studying nursing work inadvertently denies the physical labor of the activity, and also ignores the *time* that it takes to search for equipment, use the equipment, and return the equipment to the space where it is stored. In other words, the issues of retrieving and returning are marginalized in the research.

While some objects have characteristics that allow one to easily predict their location, there are others that are more difficult to find because their locations are more fluid, ever changing, and dependent on several different variables. For these objects, there are multiple places where the object could be. Frequently a nurse must search in more than one place because a caregiving activity requires more than one object or the object that she is searching for is not found in the first place that she looks. Furthermore, it is not uncommon for a nurse to have to go to another unit in the hospital to borrow the object that she is looking for. Typically supplies are likely to be stored in one to three nursing support rooms, but the equipment may be found anywhere on the unit including the corridors, any of the nursing support rooms, or in one of many patient rooms. This means that a nurse must rely on remembering several cognitive maps for the multiple parts of her searching venture.

The searching activity with both the cognitive and embodiment components illustrates the connection between the mind and the body in order to 'get the work done.' The cognitive maps include the unit wing that a nurse is assigned to that shift, the other wings on the surgical unit, the entire surgical unit itself, and the other units in the hospital. The cognitive maps differs from the one that the floor plan implies and so a nurse is required to remember not just one cognitive map but multiple cognitive maps of her workspace. Some of the edges of these "maps" are not delineated with fixed features but rather, they are designated with semi-fixed features such as medication carts and linen/supply carts. Other times, the edges of an area are even more ambiguous and remain in the nurse's cognitive understanding of the space. Consequently, the boundaries between the areas can be blurred or fluid in nature.

The nature of *moving activities* as they relate to nursing work and 'getting the work done' is that the nurses are constantly moving patients and objects. There is often a heavy workload on the surgical unit. The nursing assignments factor in the physical capabilities of the nursing staff. The nurses work within several different types of time frameworks, schedules, and a certain unpredictability that is common to surgical units. For the most part, the nurses feel that they are racing against time and that they are always trying to 'get the work done' without falling too far behind.

A large part of the moving activities that the nurses do is moving objects from one place to another. This includes the carrying of objects on their persons, and moving in a crowded and cluttered workspace as they squeeze among the many semi-fixed objects in their space. The nurses do as many as nine within-unit transfers per day in which a small group of nurses will move a patient and his or her entire set of objects (furniture, bed, patient belongings) from one room to another. Most of the nurses in this study stated that the most physically laborious activities that they did were these within-unit transfers.

Because the storage space on the surgical unit is inadequate to accommodate all the necessary semi-fixed objects, the nurses are frequently re-arranging objects and moving objects from one place to another. Because the space in the patient rooms barely accommodates the basic patient furniture leaving little room on either side of the bed or between the foot of the bed and the wall, the nurses often find themselves squeezing in-between semi-fixed and fixed features in their workspace. The findings of this study indicate that the nurses need enough space in the corridors and the nursing utility rooms to accommodate a dynamic landscape of objects. Also, there are many different types of objects in the nurses' workspace that are difficult to move and therefore, create potential for injury.

The nature of *recovering activities* were found to be influenced by a nurse's perspective about surveillance, self-surveillance, entitlement, and accessibility which contributed to her decision about when and where she will take her break, and whether she can take her entire break. A nurse's experience of the space as private or public, back stage or front stage will also contribute to a nurse's decision about her break. The main nursing station and the patient lounge were found to be two spaces on the surgical unit that have fluid characteristics because the spaces are experienced differently on the night shift versus the day shift. Also, there were nurses who felt differently about whether the space is public or private and whether they are entitled to be in that space or not, regardless of the shift. Hence, a nurses' spatial experience is shaped by her sense of embodied professionalism.

4. THINKING BEYOND HIERARCHIES AND DICHOTOMIES

To be inclusive of the workspace issues that are significant to staff nurses, it is important that hospital staff nurses and nursing researchers are an active part of a multi-disciplinary approach towards the design research of nursing workspaces. This research study addresses a longstanding problem in healthcare design research, which is that staff nurses and their experiences of the workspace are marginalized in the literature and in healthcare design research. Researchers and designers would benefit from finding out from the nurses directly what to measure and what their design needs are. The valuable insights that staff nurses can bring to a successful workplace design are long overdue. The extensive knowledge base and lived work experience that a staff nurse possesses as a *user* of the hospital setting has often been neglected in the process of designing healthcare facilities for patients. As confirmed by this study, there is a strong relationship between nursing work, the objects in their workspace and the design features of the hospital unit.

This research has demonstrated that an *embodied professionalism* that is inclusive of the physical nature of nurses' work is an essential part of a hospital nurse's conceptualization of professionalism in her everyday working world. While this research served the purpose of exploring nursing work and nursing space, it also challenged the limitations posed by dichotomous thinking when analyzing person-environment relationships. Researchers need to be aware of the insidious hierarchies that are embedded in academia. Whose point of view is dominating the discourse? Whose yardsticks are being used to measure nursing actions? As this study progressed it became obvious that there are two distinct perspectives and different actors apply different meanings and significance to terms and words that come out of the design research domain. The nursing actions that can result in efficiency and productivity are termed different and experienced differently by staff nurses.

Healthcare design researchers in the fields of architectural and environment behavior design need to educate themselves about the nursing profession. This is recommended in order to augment a knowledge base that is deficient in understanding the way in which hospital nurses work, their nursing credentials, and nursing professionalism. More studies should be done at the scale of the everyday experience of the laboring body of the nurse.

This study has demonstrated how a study of space is inseparable from human activity and the experience of that space. An analysis of space needs to be inclusive of the body and time dimensions of these spaces as well as the nature of the nursing work itself and the activities and behaviors that occur in these spaces. Healthcare design researchers do not so much need more studies on user preferences but rather, new studies on how the space is used and experienced. Importance should be given to nursing activities and in particular, the hidden activities which are not measured or even included in such inventories as work sampling. A study of the activities can illustrate the differences between the different types of hospital units and the differences between medical conditions of the patients and what they require in terms of supplies and equipment.
This research presents a new way of conceptualizing the person-environment relationship that goes beyond measuring the impact of design on the productivity and efficiency of the nursing staff. The utilization of these qualitative research methods can lead to greater insights about how nurses experience their workspace which can then serve as generators for other studies that are both quantitative and qualitative in nature. The conceptualization has salient theoretical and research utilization significance that is transferable to studying other types of nursing units, other socio-spatial experiences such as privacy and territoriality, the study of institutions and workspaces, and to other occupations such as office workers. This study also contributes to future research on the nurse-patient relationship, the efficacy of nursing care, employee sick time and injuries, comparisons of male and female nurses, and working conditions in the hospital setting.

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Design standards for Muslim prayer facilities within public buildings

Ahmed Mokhtar, Ph.D.

American University of Sharjah, Sharjah, United Arab Emirates

ABSTRACT: The construction boom in the Arabian Gulf region has resulted in an inflow of consultants from around the world. Most have little or no experience of the particular requirements of the residents of the region, who are predominantly Muslim. One of these requirements is to have prayer facilities in public buildings to accommodate practicing Muslims who pray five times a day. The design requirements of such facilities are described only vaguely in commonly-used books on architecture design standards. The result is that inadequate design of such facilities in many projects causes discomfort to users. This paper describes an effort by an academic to support the profession with recommended standards for the design of prayer facilities. It covers not only the basic functional requirements of a prayer facility but also other issues such as fire protection and the relationship with supporting amenities such as ablution space. The research uses several methods to derive the recommended design standards. It draws from those few standards that already exist for the design standards of mosques and adapts them to prayer facilities within public buildings. It capitalizes on the author's experience as a space user who also has analytical capabilities in architecture design. Hence it studies well-designed spaces, identifies their strengths and incorporates them into the recommendations. It also studies poorly-designed spaces, identifies their weaknesses and recommends their avoidance. The purpose of the paper is to trigger more discussion on the design standards of such critical spaces in a region where there is a large population of users. The intention is to change the long-established practices of the many local and international consultants who design prayer facilities on an ad-hoc basis.

Conference theme: Human context: social, cultural, and economic studies
Keywords: architecture design standards, Muslim prayer halls, design of ablution spaces

INTRODUCTION

Practicing Muslims pray five times a day (with Dawn, Midday, Afternoon, Sunset and Night prayer times). Each prayer has a time window for its performance and for this reason may occur when a practicing Muslim is at work, shopping, visiting a museum or using any other public building. In many Islamic countries, this translates architecturally into the provision of prayer facilities in public buildings. While there is no data available on the percentage of practicing Muslims - who regularly perform prayers - among the general Muslim population, anecdotal data obtained from observation at mosques and prayer spaces indicates that it is high, particularly in the Arabian Gulf region. Therefore, we can say that prayer facilities in public buildings in the region do serve a large number of people and consequently constitute an essential component of the design program of any public building.

Unfortunately, the architectural designs of prayer facilities are frequently deficient, which results in spaces being uncomfortable and unsafe. This is particularly true for international design offices that are asked to design public buildings in cities such as Dubai, Abu Dhabi and Doha. Apparently, the reason for deficient design is the lack of adequate standards that guide designers' decision-making.

1. REVIEW OF RELATED WORK

Reference books on architectural design standards, such as *Architectural Graphic Standards* (American Institute of Architects 2007), *Neufert Architects' Data* (Neufert 2003) and *Metric Handbook* (Littlefield 2008), provide useful but basic data for some aspects of mosque design. *Architectural Graphic Standards* focuses on the space requirements for mosques in western countries. *Neufert Architects' Data* covers basic categories of mosque design as it has appeared historically in various regions of the Islamic world. The book also provides some description of the design of various mosque components, but more from the points of view of history and traditions. The *Metric Handbook* suggests basic elements for the design of a mosque, focusing on the symbolic value of the elements. It also covers aspects of ablution space design. The author of this paper has reservations regarding the book's statements about ablution spaces and the dimensions recommended for ablution station. The three reference works do, however, provide useful Arabic terminology that is commonly used to describe mosque components.

More comprehensive reference works on mosque design standards exist (Directorate-General for Yanbu Project 1999, Ibraheem 1979, Nofel 1999). These provide detailed information on design standards at the urban planning scale and/or at the architecture scale. However, all appear only in the Arabic language, which presents a barrier to many international consultants. In addition, some design standards, such as the relationship between different spaces, do not receive sufficient attention.

Generally, all of the above-mentioned reference works focus on the design standards of purpose-built mosques and hence do not address the special issues related to prayer facilities within public buildings. In addition, none attempts to explain the reasons behind the design standards. In the case of international reference works this may be due to a lack of knowledge, or to text size limitations. In the case of the works in Arabic it could be due to an expectation that the reader already knows the reasons behind the design standards.

2. OBJECTIVE AND METHODOLOGY

The objective of this paper is to help architects design Muslim prayer facilities within public buildings through the recommendation of design standards for these facilities. These design standards occasionally differ from those of purpose-built mosques. The author has developed them using several methods. Existing design standards for mosques are looked at critically and are used where appropriate. The author's experience as an architect, a space user and an analytical observer of how people use prayer spaces are capitalized on so as to study well-designed spaces, identify their strengths, and incorporate them into the recommendations. These experiences are also used to study poorly-designed spaces, identify their weaknesses and recommend their avoidance. The author's discussions with some international architects have revealed their need to understand the functions performed in these spaces. This paper, therefore, sets out to address this need.

3. DESCRIPTION OF FACILITY FUNCTIONS

Each of the five daily prayer periods starts with the call for prayer (*Azan*). Depending on national culture and the building's function, some public buildings in some Islamic countries announce the *Azan* via loudspeakers. Building's designers may recommend the installation of an automated *Azan* system as part of the building's audio system. Upon hearing the *Azan*, people begin to go to the prayer facility (males and females have separate facilities); the first group prayer usually begins between five to 20 minutes after the *Azan* (with the Sunset prayer starting the earliest because of the short window of time assigned to it). The location of the prayer facility within a building is therefore important. The architect needs to give provision for timely and convenient access to the facility, particularly if the building is large. A decision for having one central facility or several distributed ones needs careful study.

Upon arriving at the prayer facility, and guided by religious rulings, a person will do one of the following:

a. Take off shoes and go directly to the prayer hall
b. Take off shoes and go to the ablution space to perform the ablution routine (taking approximately 1.5 – 2.0 minutes), then go into the prayer hall
c. Visit the bathroom, which typically necessitates a subsequent visit to the ablution space, and then go to the prayer hall.

As will be shown, architecture design has implications for both comfort and hygiene for a person using prayer facilities.

Within the prayer hall, various activities are possible. Without going into any religious detail, these activities can be abstracted as follows:

a. Start or join a group prayer
b. Pray alone
c. Sit on the floor reading the *Quran* or carry out a similar quiet activity.

The time required to perform a prayer varies, but it is in the range of five to 10 minutes. No furniture is required. Therefore, the space can be utilized for all the above activities simultaneously. However, as the prayer hall fills with users, this flexibility may create circulation problems while users leave the hall, as will be discussed. After leaving the prayer hall, the user puts on the shoes and returns to regular activities.

An understanding of the various functions in the facility helps recognize the design requirements for the spaces identified in the following section.

4. DESIGN OF FACILITY SPACES

4.1. Prayer hall

This is the main space in the prayer facility. It is simply an open space, empty of furniture, used for the performance of prayers. However, in designing this space, several issues need to be considered. Some of these issues reflect religious rulings for prayer performance.

• People perform the prayer facing the direction of Mecca (*Quibla*) in unbroken rows that are entirely filled one after the other. The rows must be parallel and carefully aligned. It is recommended, therefore, that the flooring material clearly indicates the lines where people place themselves while praying (see floor lines in Fig. 1). To allow for a comfortable prostration position (as shown in the group prayer in Fig. 1.), the distance between these lines is 120cm. Because of this dimension, it is recommended that the clear depth of the hall be measured in multiples of 120 cm.

• It is preferable that the rows of people at prayer should be long and uninterrupted. Therefore, it is recommended that the prayer hall be free of structural columns. It is also recommended that the hall be rectangular in shape, preferably having the long side of the rectangle facing the direction of Mecca (*Quibla*).
• In selecting the location of the prayer hall inside a public building, it is highly recommended to have the walls of the hall parallel and perpendicular to *Quibla* direction. Any other configuration will result in discomfort and waste of space, as is the case in Fig. 1.

Figure 1: Sample of a prayer hall in a public building

• As mentioned in section 3, several activities can be performed simultaneously in the prayer hall. However, a religious ruling forbids a non-praying person to pass closely in front of a person who is praying. This creates a circulation problem during times of crowding. Those users who finish group prayer earlier than others are always in the front rows, with the result that they have difficulty in leaving the prayer hall without passing in front of those in the back rows who have not yet finished praying. One successful design solution to this problem is to have a perimeter zone in the prayer space of different – and usually cooler - flooring material (see Fig. 2). This different material gives users an indication that the zone is not part of the prayer area and should be kept free of people at prayer, thus allowing those in the front to leave via this zone.
• Because the front prayer lines must be filled first, and because people should not pass in front of those who are praying, it is better that entrances to the prayer hall are located at the back of the prayer hall (opposite *Quibla*). Side entries are acceptable, but are better located away from the *Quibla* wall. No entrances should be on the *Quibla* wall. Nevertheless, locations and distances between entrances should conform to fire regulations for high density assembly spaces.
• It is preferable that the prayer hall entrances be wide and without doors to ease simultaneous entry and exit during busy times. If doors are necessary for operational reasons, they naturally need to have sufficient operable width and open to the outside, as mandated by fire regulations.
• While the performance of prayer requires no furniture, some accessories may be provided in the hall and can be used to enrich the hall's design. These accessories include:

a. Cabinets or shelves to house copies of the *Quran*
b. An indicator of the direction of Mecca. This usually takes the form of a curved wall or partition, and is called the *Mihrab* (see Fig. 1 and Fig. 2). The *Mihrab* is the place where the leader of the group prayer - who also faces Mecca – commonly stands. The curve provides better reflection of sound, particularly in large halls. However, there is no religious requirement for the design of the *Mihrab*, and the use of loudspeakers eliminates the need for a sound reflecting element.
c. In the event that the public building is expected to host the weekly ceremonial group prayer on Friday, a piece of furniture at which a speaker stands facing the people may be installed. This is called a *Minbar* and there are generally no religious requirements for its design (some schools of thought make minor requirements). It would be, however, very unusual to host this Friday prayer within a public building as it typically takes place in purpose-built mosques.

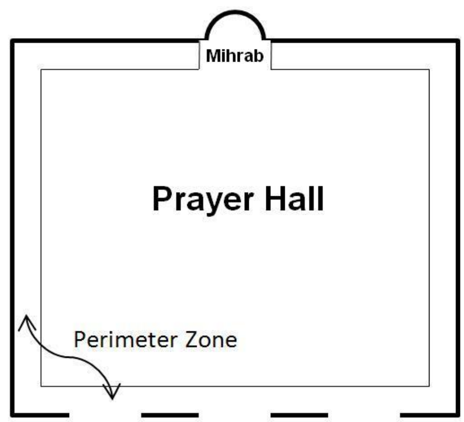

Figure 2: Plan showing the perimeter zone that facilitates exiting the prayer hall without passing in front of others.

• A critical design decision is the prayer hall's floor area. A small area results in overcrowding, while a large area wastes space. Determining the floor area depends on two pieces of information:

a. The area needed for one person to comfortably perform prayer
b. The number of people who are expected to use the prayer hall simultaneously

The first piece of information can be easily acquired from a study of human dimensions. A person requires a rectangular area of floor with an average dimension of 60 cm wide by 120 cm deep. This results in an area of $0.72m^2$ per user. It is important to note that some reference works suggest an area of $1m^2$ per user. A larger area is more appropriate in a hall used for the Friday ceremonial prayer because users sit down when

the speech is being given. The average width of a sitting person is 80cm (as opposed to 60cm for a standing one). It is also important to consider that the leader of the group prayer uses one full line.
The second piece of information, regarding the number of people who are expected to use the prayer hall simultaneously, presents more of a challenge. Rules of thumb that help estimate the expected number of users in a purpose-built mosque serving a particular community are available in reference works (Ibraheem 1979). However, sizing a praying hall within a public building depends on factors other than those appropriate to purpose-built mosques. This matter requires investigation by the design team, but the following equation provides a basis:

The number of people expected to use the prayer hall simultaneously = A x B x C x D

Where:
(*A*) is the near peak number of the building's users. This number depends on the building's nature. The reason for using near peak and not peak is to avoid over sizing.
(*B*) is the ratio of Muslims among all users. This ratio depends on the location and nature of the building. A public school in Riyadh, Saudi Arabia, expects that 99% or so of its users are Muslim, while a shopping mall in Dubai, United Arab Emirates, may expect that 50% or so of its users are Muslim.
(*C*) is the ratio of practicing Muslims among the served Muslim population. This ratio depends on the building's location. For example, it might be expected that there will be fewer practicing people in an urban location than in a rural one.
(*D*) is the ratio of people who will pray at the prayer hall simultaneously. This ratio depends on the building's schedule. If the building operates at a time when the Sunset prayer is performed then this ratio is expected to be high because the window of time to perform the prayer is short. Similarly, an office tower where the lunch break is the same for all users will result in a high ratio.
Unfortunately, no research has been found that addresses the required ratios. For this reason, the recommended approach that will enable the designer to acquire these ratios is to observe buildings that are of a similar nature and in a similar location.

4.2. Shoe removing and shoe rack space

This is usually the most under-designed space in the prayer facility. Here, users take off their shoes, put them in shoe racks and enter the prayer space. Simultaneously, other users collect their shoes from the racks and put them on. The space also serves as the lobby of the prayer facility. Therefore, it needs to be of a size that can accommodate large numbers of users. It is recommended that the design provides sufficient space in front of each shoe rack to allow the simultaneous activity of one person taking off his/her shoes, one person putting on his/her shoes, and one person moving. This requirement translates to a space width of around 200cm in front of each shoe rack. The provision of as many seats as the space allows (outside the 200cm) is also recommended.
As can be expected, shoes may present a source of air pollution. The shoe rack space, therefore, needs to be well-ventilated in the case of a naturally ventilated building. In an air-conditioned building, the space should have negative air pressure (suction), connected directly to an exhaust. Placing the suction grills near floor level is important so as to keep any odour below the level of users' faces.

4.3. Bathrooms

The design requirements of bathrooms that serve prayer facilities are no different from those elsewhere in Islamic countries. However, because of religious rulings, two additional issues need to be considered (Nofel 1999).

a. Water closets - and urinals if they exist - should not be in line with the orientation towards Mecca and should preferably be perpendicular to that direction.
b. Bathrooms should not be located behind the *Quibla* wall or above the prayer hall.

In general, bathrooms in Islamic countries require the following design considerations:

a. Individual cubicle walls and doors should provide good visual - and preferably acoustic – privacy. However, there are no religious requirements as to how this should be achieved.
b. In relation to international standards, more water closets and fewer urinals should be provided. This reflects the fact that several religious schools of thought discourage the use of urinals.
c. Hygienic water sprays (douches) should be provided at the right side of each water closet to facilitate the religious cleansing requirement.
d. The aspect of the easy cleaning of the bathroom needs to be sufficiently considered.

4.4. Ablution space

As described in section 3, the ablution space is used optionally (as determined by religious rulings). If carried out, the ablution activity includes - among other requirements - cleaning the feet with water. Therefore, if not well designed, the ablution space can become dangerous and messy. A variety of issues needs to be considered when the space is designed. These include the provision of comfortable dimensions for various models of ablution station (see example in Fig. 3), the selection of materials, and water conservation. (Mokhtar 2006) provides further information on design standards for ablution spaces; there is also a video covering the same topic (Mokhtar 2004).

5. RELATIONSHIP BETWEEN SPACES

A problematic relationship between the above-mentioned spaces is one of the main causes of uncomfortable and unsafe prayer facility design. The bubble diagram in Fig. 4 gives an example of the ideal relationship. The diagram indicates a clear separation between two design zones - clean and non-clean. The clean zone includes the spaces in which the users are not wearing their shoes. Therefore, the shoe removing and shoe rack space is located just outside the line separating the two zones. This separation line is typically defined architecturally by a change in material (see Fig. 5) or a door. Occasionally, designers choose to use low fence for this separation. However, it is advisable to avoid the low fence solution on account of the needs of the physically challenged and the potential evacuation problems in the event of fire.

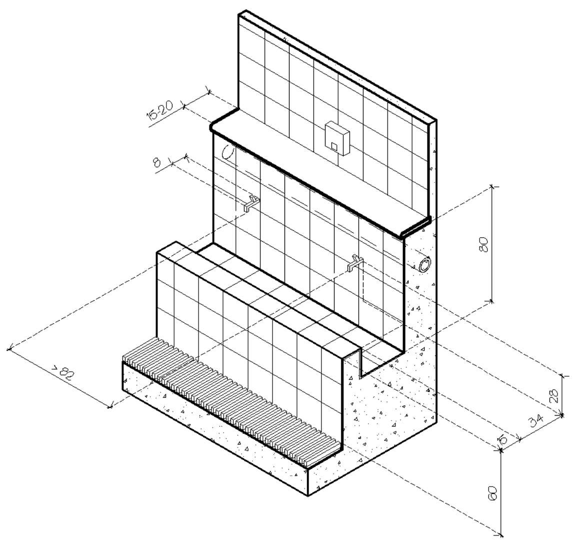

Figure 3: Proposed comfortable dimensions for an ablution station model (Mokhtar 2006).

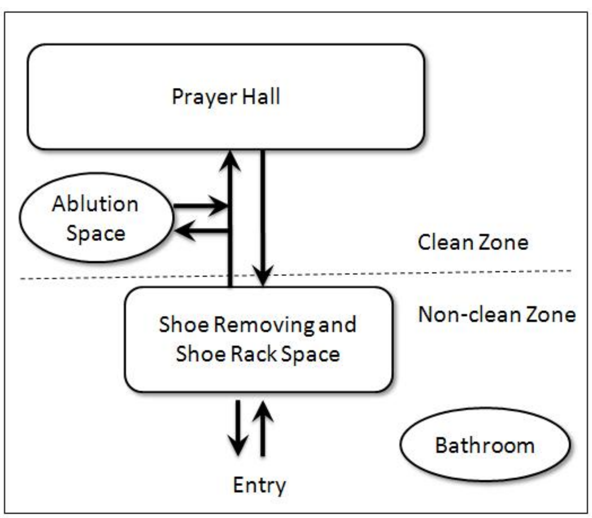

Figure 4: Relationship between spaces in the prayer facility (Mokhtar 2008).

Fig. 4 shows the ablution space inside the clean zone. Unfortunately, many designers put this space outside the clean zone. As a consequence, users have to take off their shoes, put on communal slippers to walk to the ablution space, perform their ablutions, and return to the line separating the clean and non-clean zones with wet feet. The wearing of the communal slippers, which become wet, not only makes the floor of the entry space wet and messy but also aids the spread of skin diseases (Raboobee et al., 1998).

Fig. 4 shows the location of the bathrooms outside the clean zone and not linked to the entrance or the shoe removal space. Unfortunately, many designers locate the bathrooms inside the entrance and very close to shoe removal space (see case study in Fig. 6), or even inside the clean zone. The expectation of these designers is that users who take off their shoes will put on communal slippers at the entrance of the bathroom space, and remove them before leaving it. As can be imagined, this results in the creation of unhygienic conditions. Inevitably, communal slippers used in the bathrooms become mixed with those used for ablutions, a situation which works against religious rulings regarding purity.

Figure 5: The change of material visually defines the separation between clean and non-clean zones.

Fig. 4 also shows that there is no direct access from the ablution space to the prayer hall. Rather, there is a lobby or a corridor that leads to the entrances of both spaces. This is important as it provides control over the transfer of water and humidity from the ablution space to the prayer hall. The floor of the lobby or the corridor needs to be finished with a material that helps dry peoples' feet as they move from the ablution space to the prayer hall.

6. CASE STUDY

The purpose of this case study is to review critically the design of a prayer facility and to identify issues that illustrate both good and problematic design decisions. This aids the better understanding of the design standards recommended in the paper. Fig. 6 shows the design of a prayer facility provided to the author for review by a major international consultant. The design is part of a project in the Emirate of Abu Dhabi in the United Arab Emirates. The prayer facility serves both genders and has the typical spaces mentioned in section 4.

• One of the advantages of this design is the clear separation between gender accesses to the facility. Yet, the facilities for both genders are close-by, which makes it convenient for couples and various family members to use the facilities. The provision of one or more waiting spaces close to the two entrances will help family members who are waiting for one another. However, the separation of genders inside the prayer hall itself is confusing for several reasons:

a. The partition that separates males and females appears partial and allows people to pass between the two prayer places. While there is no religious ruling against this, in practice it makes users feel uncomfortable and it is therefore likely that the partition will be extended to reach the walls. However, in this case the designer's intention of having two prayer hall exits to accommodate fire regulations are defeated.
b. The division of the prayer hall between the two genders creates a functional problem. In the event of a group prayer that involves males and females (in separate halls), a male leads the prayer in accordance to a religious ruling. However, another ruling prevents anyone from being situated in a line that is front of the group leader (in relation to Mecca). Yet, the design in Fig. 6 allows this to happen. A better design would be either to separate the two spaces acoustically - so that no group prayer involving males and females can occur - or to divide the space so that the female prayer hall is behind the male one.
c. The relative area of the male prayer hall to that of the female one seems more appropriate to a mosque than to a prayer facility in a public building. Mosques are sized for the Friday ceremonial prayer which females – unlike males - are not required to attend. Consequently, the prayers halls of females in mosques are much smaller than those of males. However, this is not the case for prayer halls in public buildings (unless the number of males in the building is expected to be higher for some reason). Religious rulings make the expectation of the numbers of females attending daily prayer less than males, but only about 25% less. The design in Fig. 6 is expected to result in a female prayer hall that is relatively overcrowded.

• Another important advantage of the design is the orientation of the prayer hall so that its walls are perpendicular and parallel to the direction of Mecca *(Quibla)*. However, a wall in the female prayer hall forms an angle with the *Quibla* direction*,* resulting in loss of space and the creation of confusion in the forming of prayer lines.

• One of the problems in the design is the lack of a defined clean zone. As Fig. 6 shows, the benches where users sit to take off and put on their shoes are in the walkway between the ablution space and the prayer hall. This results in the mixing of dirt from shoes with the water transported by users who have used the ablution facilities. The outcome is a dirty floor and ultimately the transfer of dirt to the prayer hall. A better solution would be to define a clear line separating the

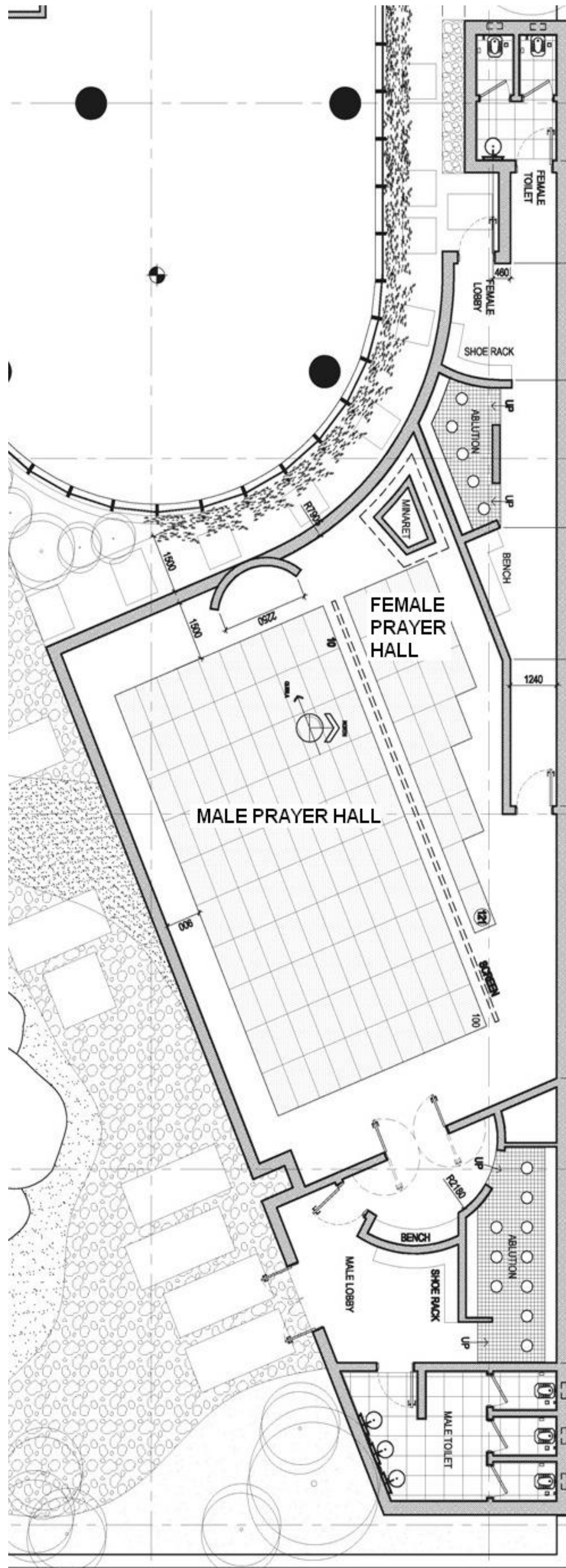

Figure 6: A sample design for the prayer facility critically reviewed by the author.

clean zone (that includes both the prayer hall and the ablution space). In this case, the benches should be relocated to near the shoe racks outside the defined clean zone.

- Another problem in the design is the possibility of accessing the bathrooms from within the prayer facility. As discussed in section 5, such a design poses a health risk. A better design would have the bathroom doors opening outside the prayer facility. This makes the bathrooms accessible to other users of the building and at the same time forces users to use the bathrooms while wearing their shoes.
- One safety problem is the raising of the ablution space floor by one step. While a one step difference between two levels is generally dangerous, having that in a place where people's feet are wet can easily cause slipping and results in injuries (Mokhtar 2006).
- One advantage of this design is the clear indication of the direction of Mecca by a curved wall (the *Mihrab*). However, the female prayer hall seems to have no such indication – an omission which may cause users to pray facing the wrong direction.
- Another advantage of the design is the placing of a strip of different material around the perimeter of the prayer halls to facilitate exiting. However, this material should not continue in front of the curved *Mihrab,* as the prayer leader uses this area to prostrate. A better design solution is shown in Fig. 2.

7. SUMMARY

Existing works of reference for the architectural design of mosques lack a number of design standards that are required if architects are to provide safe and comfortable Muslim prayer facilities in public buildings. This paper covers several of the missing standards and also provides architects with a better understanding of the functional requirements. A case study is used to illustrate some of the recommended standards. More discussion on this subject is needed to help improve the design of these spaces.

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Topological configuration in wayfinding and spatial cognition: a study with real and virtual buildings for design relevance

Saif Haq, Glenn Hill and Adetania Pramanik

Texas Tech University, Lubbock, Texas

ABSTRACT: This paper is concerned with the role of topological configuration of building layouts in wayfinding and spatial cognition and with associated design strategies. Topological configuration is the structural hierarchy of *individual spaces* in a layout that arises due to the topological relationship of each space with all other spaces in the layout. This can be objectively measured by Space Syntax theories and methods. The paper discusses the beginnings of the concept and traces its development in cognition literature. It then describes a series of experiments done in three real hospital buildings and in a copy of one hospital that was produced in a virtual immersive reality (VIR). Those studies were reported individually in previous publications. In this paper a comparative analysis is presented which suggests that (1) wayfinding behavior is very similar in real and simple virtual settings, (2) topological properties of layouts as determined by Space Syntax analysis are important predictors of wayfinding use of spaces and (3) Euclidian and metric properties in spatial cognition do not develop easily in simple VIR's, but they do not hamper wayfinding. The first has implications in using computer models for data collection. The second is important for architects because investigations of topological configuration may suggest design moves to achieve wayfinding friendly plans. The third is important to cognition and wayfinding researchers as it brings attention to the relationship between topological configuration and wayfinding success. Implications of the results in light of the design professionals are also included.

Conference Theme: New methodologies in architectural research
Keywords: plan analysis, design evaluation, wayfinding, spatial cognition, space syntax

INTRODUCTION

Spatial configuration is generally understood as the arrangement of unit spaces in a layout. Such arrangements can be studied by taking into account *relationships* between spaces. Consideration of Euclidian relationships lead to Euclidian configuration, and its cognition is usually understood as mental maps having both distance and direction knowledge (Devlin, 2001; Golledge, 2003; Piaget & Inhelder, 1967; Siegel & White, 1975). In contrast, considerations of direct and indirect connections between spaces lead to topological configuration (Kuipers, 1983; Remolina & Kuipers, 2004). Since the classic work of Piaget & Inhelder (1967) topological properties of spaces have been considered important in cognition studies. However, methodological advances to *objectively quantify* spatial properties based on topological relationships are a more recent phenomenon. Attempts by Best (1970), Braaksma & Cook (1980), Kuipers (1983), O'Neill (1991, 1992), Rovine & Weisman (1989) etc. are noteworthy in this regard, but their efforts resulted in a *single value for an entire layout* and values for *individual constituent spaces* could not be calculated. In contrast, Space Syntax quantifies unit values for *each space* based on its direct connections to immediately adjacent spaces, secondary connections to spaces one 'step' removed, tertiary connections to spaces two 'steps' removed and so on, until all the spaces in the layout has been considered and the values 'normalized' by comparing with a standard layout (Hillier, 1993, 1996, 1999; Hillier & Hanson, 1984; Hillier, Penn, J. Hanson, & Xu, 1993).

This paper investigates the association between topological configurational values of unit spaces as obtained through Space Syntax analysis of building plans with experimental data of wayfinding and spatial cognition. The experiments were carried out in three real hospital buildings and comparable virtual immersive reality (VIR) model of one of them. The analyses suggest that (1) wayfinding behavior is very similar in real and simple virtual settings, (2) topological properties of layouts as determined by Space Syntax analysis are important predictors of wayfinding use of spaces and (3) Euclidian and metric properties in spatial cognition do not develop easily in simple VIR's, but they do not hamper wayfinding. Among them, the second one has relevance for architects and is highlighted at the end of this paper.

1. BACKGROUND

Environmental cognition is concerned about the way we acquire, store, organize, and recall information about the environment (Gifford, 2002). A subset of environmental cognition is spatial cognition. Spatial cognition helps us wayfind, estimate distances and directions, recognize route cues, make and read maps, and generally understand the relative location of different places (Gifford, 2002). It is an important prerequisite to wayfinding, and conversely, wayfinding can be taken as an indicator of spatial cognition (Golledge, 2003). Spatial cognition research have generally concentrated on three themes: (a) understanding the relationships between the form of the physical world and mental representations, (b) linking space to action and (c) creating alternate methods and approaches for studying environmental cognition (Zimring & Dalton, 2003). This project is concerned with the first. Specifically, it seeks to investigate the association between *relational properties of physical space* with wayfinding and cognition.

Research into the cognitive aspects of the relational properties of space perhaps began with Piaget & Inhelder (1967). From their study about spatial learning in children, they had suggested that *cognitively* important relationships between spaces are topological; projective and Euclidean, and that ontogenetically, understanding of topological relations precedes projective and Euclidian ones. Unfortunately these authors did not have a favorable attitude regarding topological relationships and had also suggested that "…it is impossible for relationships of this type to lead to comprehensive systems linking different figures together by means of perspective or axial coordinates, and for this reason, they are bound to remain *psychologically primitive*" (p. 153, author's italics). The relational characteristics of spatial knowledge was later addressed by Siegel & White (1975), through their concept of 'configuration'. They used the term in the cognitive sense to describe what they called 'a sophisticated wrinkle that gives its owner an advantage in … organizing experience" (pp. 24). In this case, the authors seemed to have had some difficulty in describing this integration of spatial representations, and in the process, perhaps unwittingly set up a perplexity between topological configuration and survey/Euclidian configuration; one that has remained unqualified in subsequent literature. For these authors, configurational knowledge is that which comes from 'landmarks-connected-by-routes" (p. 24) and "…when the routes become interrelated into a network like assembly … becomes configurational" (p. 30). They also discussed varying degrees of integration or gestaltness of that spatial representation (p. 24). Configurational knowledge contains "… a perceived outline of a terrain (e.g. the outline of a United States map); a graphic skeleton … and a figurative metaphor (e.g. the 'boot' of Italy)". Unfortunately, being unable to be more specific, they moved on to describe 'sketch mapping' experiments done by other researchers and their categorization of those as route maps and survey maps (Appleyard, 1970; Shemyakin, 1959). With this, they arrived at the concept of cognitive survey maps and described them as "… coordinations of routes within an objective frame of reference. That is, survey maps become possible only after routes and an objective frame of reference exist" (Siegel & White, 1975:43).

But, what is this objective frame of reference? To many authors, this is Euclidian; and they generally agree that spatial cognition are spatially dominant, metrically scaled and interrelated into a global allocentric reference systems (Hirtle & Hudson, 1991; Montello, 1998).

Another group of researchers have suggested that such a frame of reference can also be topological. For example, Kuipers (1983) said that knowledge of topological relations is distinct from metric relations and that travel is possible without metric knowledge, but not without topological knowledge. Freundschuh (1991) is of the opinion that 'topological configuration begins early and develops into 'topology+metrics' configuration. Topological relationships are non-metric and are maintained under elastic distortions (Newcombe, 1989). Some properties associated with space are proximity, order, separation & connectivity, and continuity & containment (Piaget & Inhelder, 1967). At this point a common sense description of a person immersed in a large scale environment is described. Note that this description only includes the notions of

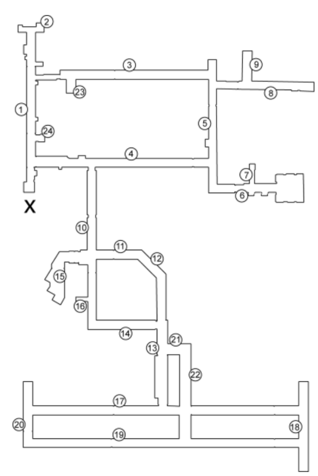

Figure 1: Corridor plan of City Hospital

continuity & containment. Consider the corridor plan of 'City' hospital in figure 1, whose entrance is at point X. As a person enters through the door s/he will get an overview or 'containment' of corridor 1 and, because a spatial system is continuous, a sense of 'connectivity' to other corridors; for example to corridors 2, 3, 4 and

24. If s/he turns to corridor 4, connectivity to 10, 5 and 1 will be available, and from corridor 10 connectivity to 4, 11, 14 and 16; and so on. Every change in direction will make connectivites to different corridors available. Since topology is not about metrics or geometry, the spatial relations described above can be indicated by a system of nodes and connections as in figure 2 a, b, and c for corridor numbers 1, 4 and 10 respectively. Now, since the subject is moving, s/he will reach corridors from more than one entry points, and will bring along knowledge of connections developed in previous corridors visited (spatial cognition). Thus, instead of a simple set of direct connections, a set of secondary, tertiary and sequentially deeper connections will also be understood. This is cognition of spatial ‘ordering’ and are shown in figure 3 a and b for corridors 1 and 10 respectively. Now, if the focus is shifted from the person to the environment, then the same information can be described in a different manner. For example, corridor # 10 is directly connected to corridors 4, 11, 14, and 16; has a secondary connection to corridors 1, 5, 12, 13, and 15, a tertiary connection to corridors 2, 3, 8, 16, 17, 21, and 24, and so on (see figure 3b). In comparison, corridor 1 has a different topological relationship to all other corridors in the hospital building (compare figures 3a and 3b). Similarly, all corridors are connected to all others through varying degrees of connections. Analysis of plan drawings from this point of view can provide a sense of hierarchy of corridors that is based on its topological relationship to all others. This is topological configuration. To make a distinction, while layout is the overview of spaces with scale and geometry, topological configuration is the structural hierarchy that arises due to their connections with one another.

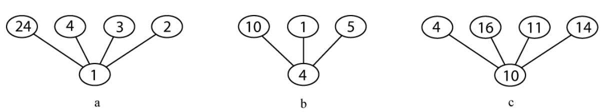

Figure 2: topological relationships to adjacent corridors from (a) corridor 1, (b) corridor 4, and (c) corridor 10

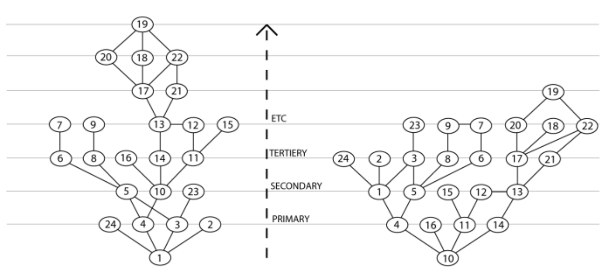

Figure 3: Justified graphs (Hillier & Hanson, 1984) showing topological relationships to ALL corridors from (a) corridor 1, and (b) corridor 10

At this point two things need emphasis: (1) despite Piagian reservations, topological connections can be the frame of reference for configurational knowledge and (2) Space Syntax is the tool to measure topological configuration.

Space Syntax recognizes unit spaces (corridors in our example) and quantifies their topological relations with all other spaces in the layout (Hillier, 1996; Hillier & Hanson, 1984). This topological relationship of each corridor to all other corridors is described through a mathematical concept called ‘integration’. A corridor with high integration is, on an average, closely *connected to all other corridors* in a given layout. Conversely, a corridor that is *distant from all other corridors*, on an average, is called ‘segregated’. There are also intermediate levels of analysis. For example, integration-3 considers the relationship that each corridor has with only those that are connected *through two intervening corridors*. Space Syntax researchers have also developed various software to calculate integration. An analysis of City hospital using Spatialist (Peponis, Wineman, Rashid, Bafna, & Kim, 1998) is shown in figure 4. In the image, the corridors are shaded such that higher integration-3 values are shown by the darker shade and vice versa. It should also be mentioned that Syntax analysis provides numerical values for each space of a given layout. In this way, architectural plans can be explored with statistical tools. Now, the interesting question to be posed is this: what role do topological configurational values (integration and integration-3) play in spatial cognition and wayfinding? The research is described next.

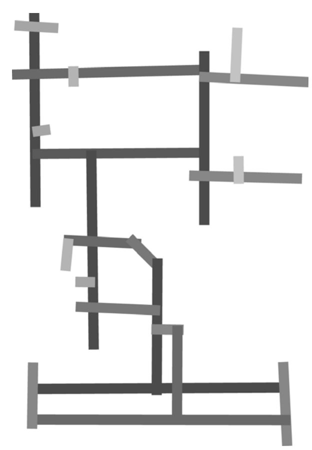

Figure 4: Space Syntax analysis of City Hospital

2. RESEARCH DESIGN

This research included two phases. The first was carried out in three real hospital buildings named Urban, University and City hospitals. The entire floor accessible from the main entrance was used. It included public areas, inpatient zones, outpatient clinics, and administrative sections. However, corridors that had a ‘Do Not Enter’ sign were omitted. A total of 128 subjects (32, 29 and 67 for the three hospitals respectively), 62 males and 66 females, having a mean age of 19.5 years participated. None of the participants had been in the hospital where the experiment was done, nor had they visited any hospital in the previous six months. After completing a self-report survey regarding their wayfinding strategies (Lawton, 1996), the subjects explored one floor of the hospital for 15 minutes (exploration). Then they were asked to sequentially wayfind four pre-selected destinations. These were chosen so that they were located in integrated and segregated corridors; some had directional signage from other areas and some had none. The tasks were counter balanced so that each location was used both as an origin and a destination for wayfinding. As participants reached each destination, they were faced west and asked to point to previously visited but unseen areas. This was performed by using a circular cardboard with angles marked on it in 10 degree intervals and a pointer attached to the center. Finally the participants drew a sketch map of the hospital floor focusing on the corridors and locations on a 8 ½ by 11 inch paper. Pointing and sketch mapping was done in City and University hospital. The corridors traversed by each subject were mapped on a plan drawing by the researcher who followed along, and from these exploration maps ‘total use of corridors’ (TUC) data was compiled. From wayfinding maps, ‘total use of redundant corridors’ (TURC) was gathered. Redundant use was counted when a corridor was used even though it was not in the topologically shortest path between an origin and a destination. TUC and TURC were taken as a measure of exploration and wayfinding difficulty. From sketch maps, drawn corridors were added to get ‘appearance of corridors’ data. To make sure that the occurrences of corridors in the maps were correctly accounted for, two independent raters in each hospital judged a sample of the sketch maps. The researcher judged all of them. In University Hospital two raters and the experimenter rated 10 maps; i.e. each rater had to judge 320 corridors. They agreed 239 times, or 74.69% (Cohens Kappa=.4937). Average agreement per map was 23.9 times (out of 32) -- maximum 31 and minimum 15. In City Hospital, two raters and the experimenter judged 25 maps that included 600 corridors. Here they agreed 499 times or 83.16% (Cohens Kappa=.6633). From pointing tasks, the deviation in degrees from actual position, called ‘pointing errors’ were complied. The correlations of corridor use in both exploration and wayfinding with their topological configurational values were high and statistically significant at p=<.05. See table 1. Earlier, Peponis et al (1990) and Willham (1992) had also found high correlations between wayfinding use of corridors and integration values in experiments carried out in a geriatric hospital using both young and old volunteers.

Regarding spatial cognition, corridors with higher integration values were also featured in more sketch maps. The correlation of corridors appearing in sketch maps and integration-3 values were also high (table 1) A similar work done in an urban area by Kim & Penn (2004) demonstrated that integration-3 values were also correlated to sketch map variables at r=.728.

Table 1: Comparison of results in the different hospitals

	Relates to topological configuration				Relates to Euclidian configuration	
		Correlation (r values) of Integration-3 and various experimental data (p=<.05)			Average Values	
HOSPITAL	**SUBJECTS**	**TUC**	**TURC**	**CORRIDORS IN SKETCH MAPS**	**POINTING ERRORS**	**SKETCH MAP ACCURACY**
Urban	32	.805	.636			
University	29	.829	.743	.561		
City	67	.775 (60%)	.657 (43%)	.697	39.52	57.92
City Virtual	32	.702 (49%)	.692 (48%)	.823	56.03	37.5

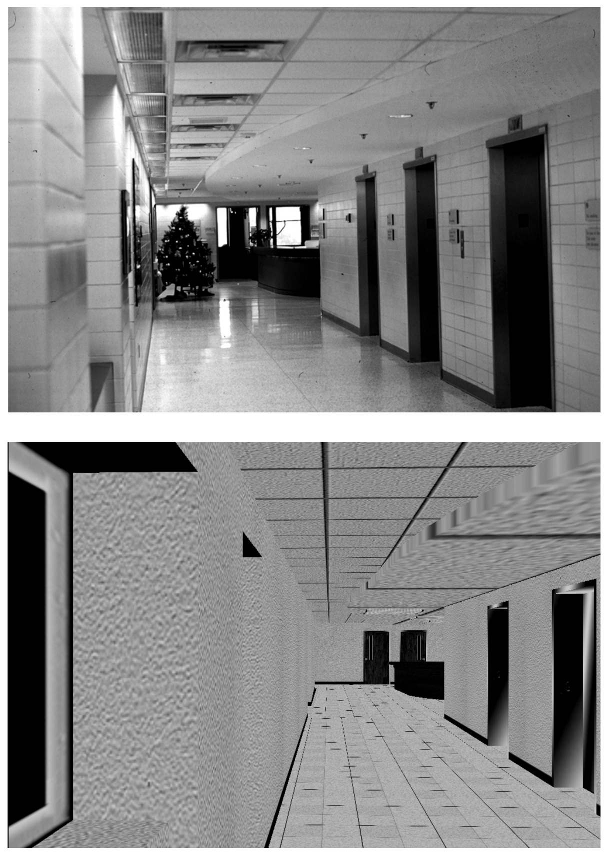

Figure 2: Comparison of real and virtual environments in City Hospital

From these results it was argued that (1) topological values can be used to describe configuration, (2) spaces described from such analysis are predictors of exploration and wayfinding and that (3) they have a cognitive presence. The fact that very similar results were found in very different layouts (in both building interiors and outdoor urban areas) provides credence to such a claim. Unfortunately, one valid criticism remained. The experiments were all done in real settings and there were no 'control' of extraneous environmental variables. As such, the extent of the role of topological configuration remained unclear. To examine this variable, another experiment was devised in a *virtual immersive reality* (VIR) using only the plan and dimensions of City hospital. This VIR model was built from very simple geometries (rectangular shapes). *Here all environmental factors were controlled*. For example, all the corridors had the same floor finish, same wall surfaces, same ceilings and the same ambient lighting conditions. Obviously there were no people to overhear or follow, and certainly no smells (see figure 5). Invisible boxes providing collision detection were inserted so that the users could not 'walk through' the virtual walls. A joystick was selected as the user input interface. Witmer & Kline (1998) had commented earlier that the VIR user has the ability to relate the movement of the joystick with the movement in the virtual world (e.g. pushing the joystick forward means the user move forward). The joystick was calibrated not to go faster than the speed of a walking person. Before conducting the experiment, a pilot study was undertaken with 12 subjects and various configurations of hardware.

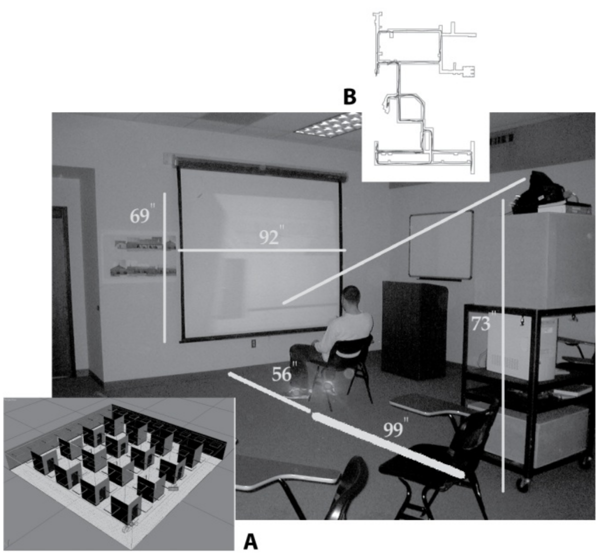

Figure 3: Experimental setting

The experiment consisted of six phases. In the beginning, the participants filled out a self report questionnaire about their wayfinding strategies. (Lawton 1996). The second phase was pre-training, i.e. getting comfortable using the joystick and navigating within a generic VIR environment for 5 minutes. For this purpose, a 72 feet by 72 feet virtual environment was developed containing 10 corridors (5 x 5) arranged in a grid pattern (see figure 6 inset A). The third phase was similar to the open exploration done in the real hospital. The users were taken to the entry door (same location as in the real building) and were asked to navigate within the model for a maximum of 15 minutes. At this time, they were also asked to pay attention to four colored doors (red, green, blue and magenta) that corresponded to the four locations used as destinations in the real building. After completion of open exploration, each subject was asked to perform wayfinding searches similar to that done in the real environment (fourth phase). A new VIR file was opened which positioned the user in any one of the four colored doors and then was asked to 'walk' to another colored door. Like the experiment in the real building, they were given a maximum of 10 minutes. If, after that time, the destination was not found, the researcher would stop the experiment and escort the user to that destination. There, another VIR file was opened which put the user in the same location. S/he was turned to face west and asked to point to the location that s/he had come from and those that s/he had visited before (fifth phase). This procedure was repeated four times until the user had walked to all four colored doors. Finally, (sixth phase) the user was asked to sketch the hospital corridors as s/he remembered it on a 8½ by 11 white sheet of paper.

A computer tracking module was developed to report positions of the participant in the VIR. The x and y position data was transferred into AutoCAD software as lines which illustrated the paths each participant completed (figure 6, inset B).

Data was collected from 32 undergraduate students (9 males and 23 females). Two persons could not complete the experiment. This was mainly caused by motion sickness. However, based on Stanney (1998), the two that dropped out (6%) was not unexpected. Twelve of the subjects never had previous experience of using a joystick. Nevertheless, they could all complete the experiment.

Exploratory behavior was characterized, as before, by the 'use of corridors' (TUC) and wayfinding behavior by the '*redundant* use of corridors' (TURC). 'Pointing accuracy' was also calculated in the same manner as in the real hospital. However, sketch map analysis was done in two ways. First, 'appearance of corridors' was done as before. Additionally, a second variable, 'sketch map accuracy' was compiled. Since this was not done in the maps drawn from the real building, both sets of sketch maps were analyzed. This was calculated by an independent rater not familiar with the building. First, the hospital was considered as three sections (the layout of the hospital 'afforded' this. Refer to figure 1). Each map was looked at by sections and then as a whole. After comparing with an actual plan, a grade from 0 to 25 was given to each section. A deduction of 5% was made for each error in each section of the map. The maps were also judged as a whole (0-25) and 5% was deducted for errors in direction or connection of each section in relation to the whole. The same rater also rated the sketch maps in both the real environment and the VIR experiment. It would have been preferable to have more raters evaluating these maps, but time and costs prevented this. However, there can be some confidence that maps from the two experiments were rated by the same person. A final set of data collected was ‘percentage of wayfinding successes’. At this point, one distinction needs emphasis. TUC, TURC and corridors in sketch maps were analyzed from the point of view of topological configuration. Pointing errors and sketch map accuracy were indicators of Euclidian properties in spatial cognition.

3. DATA ANALYSIS AND DISCUSSION

Data from the virtual and the real environments was compared through two-sample t-tests assuming unequal variances (see table 2). Since the p-values are much less than 0.05 in all the cases, it seems that there is a substantial difference between the two datasets. On the other hand, the average use of corridors in open exploration in both the environments demonstrated a similar pattern (see figure 7). The average wayfinding success was 79% in the real environment and 76% in the VIR with variations in the individual searches (see figure 8).

Table 2: Results of two-sample t-tests (assuming unequal variances) showing the relationship between various experimental procedures in the real and the virtual world.

		t values	P values (one tail)	Relates to
Open Exploration	TUC	1.889	0.0332	Topological Configuration
Directed Search	TURC	2.866	0.0035	
Cognitive Tests	Appears in Sketch Maps	5.957	<.0001	
	Pointing accuracy	-2.503	0.0079	Euclidian Configuration
	Sketch Map Accuracy	3.402	.0006	

The correlational analysis of corridor use data and integration-3 values between virtual and real hospitals were also remarkable similar. The scatter-grams and values are shown in figure 9 a and b. A side by side comparison shows that they are not only statistically similar, i.e. their r values are very close (TUC pair .775 and .725, TURC pair .657 and .692. Figure 9a and 9b), but also, the scatter plots are very comparable. Finally, appearance of corridors in the sketch maps drawn in both the real and the virtual environment was correlated with integration-3, and these too were very similar (see figure 9c). *These results support the argument that topological configuration, as modeled by Space Syntax is an important predictor of both exploration and wayfinding behavior in real and virtual settings.* This is especially significant when we remember that one set of data was obtained in a virtual setting where all kinds of extraneous environmental variables were controlled and layout was the only predictor. The importance of topological configurational variables in wayfinding and spatial cognition is not a new proposal and has been reported before (Haq, 2003; Haq & Zimring, 2003; Kim, 2001; Kim & Penn, 2004; Kuipers, 1983; Ortega-Andeane, Jimenez-Rosas, Mercado-Domenech, & Estrada-Rodriguez, 2005; Peponis et al., 1990; Willham, 1992) What is novel is the fact that the same experimental procedures when undertaken in a real and a virtual environment have produced very similar results (Haq, Hill and Pramanik, 2005).

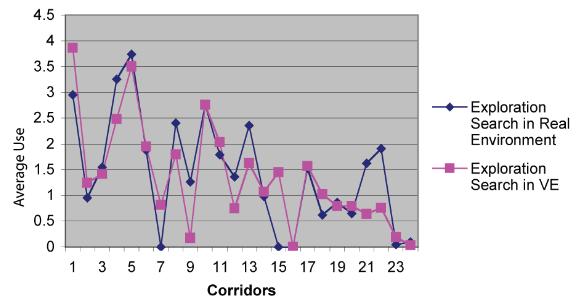

Figure 7: Average use of corridors in open exploration

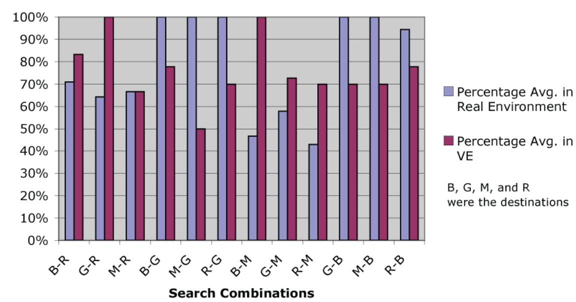

Figure 4: Percentage of wayfinding success

The analyses also provide clues towards the distinction between topological and Euclidian configurational learning. Pointing to previously visited but unseen destinations and sketch mapping of the corridors are indicators of Euclidian learning. The average pointing error inside the real building was 39.52 degrees while inside the VIR it was 56.03 degrees. Sketch map accuracy in the real building was 57.92 degrees compared to 37.5 degrees in the VIR. Furthermore, two-sample t-tests assuming unequal variances revealed a substantial difference between the two data sets (p-<.0079 for pointing errors and p=.0006 for sketch mapping accuracy, see table 2). Therefore it can be safely assumed that *Euclidian learning in the virtual environment was less than that in the real world*. Thus, one might say that in an environment devoid of all other cues except layout, and where FOV was only 61 degrees, Euclidian understanding develops slowly. On the other hand it has been demonstrated that wayfinding successes were similar and so was the reliance on topological configuration.

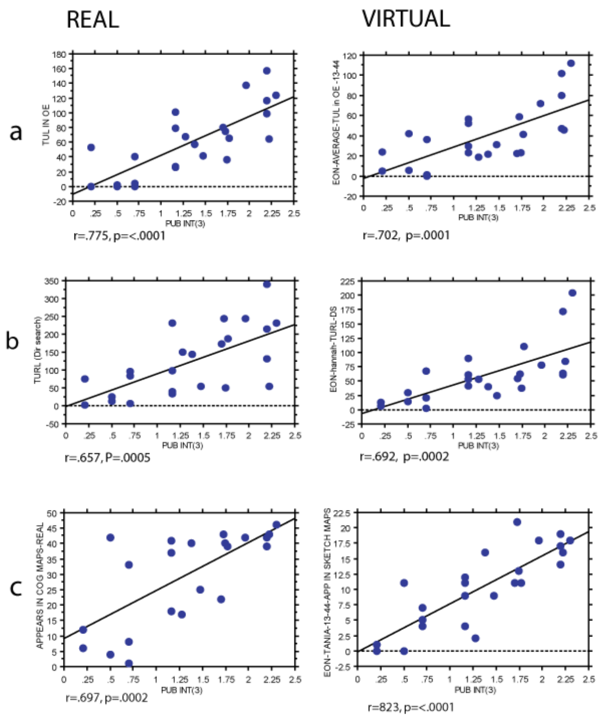

Figure 5: Comparison of correlations between experimental data and Integration-3 in real and virtual environments.
a. Integration-3 with TUC, b with TURC and c with Appearance in sketch maps.

4. FINAL COMMENTS

This is perhaps the first attempt to compile data obtained from exploration, wayfinding and cognitive tests in both a real environment and its virtual counterpart. Furthermore, the virtual world was developed to control all kinds of extraneous variables so that the plan remained the only independent variable. This was highlighted further by the VIR *not* being fully realistic; it did not provide all environmental properties and nuances; nor did it provide a reasonable human field of vision (FOV). Nevertheless, the results show that the two environments produced similar wayfinding behavior when considered from the point of view of the plan. Topological configuration values of corridors obtained by Space Syntax analysis of building plans predicted about 49% of wayfinding and exploratory use of those corridors. In other words, higher the configurational values, the more they are likely to be used. Admittedly more experimentations and comparisons need to be carried out; but one aspect stands out clearly. This is that a building plan, especially the corridor layout, has a tremendous influence on the way spaces will be used by visitors. Since a similar pattern was seen in three real hospital buildings and one virtual environment, and in previous reports by Peponis, Zimring and Choi, (1990) and Kim and Penn (2004), there can be substantial credence to the fact that the plan matters in a significant manner to immersed visitors in a large building. The layout and its topological configuration provide the framework for 'natural' movement and wayfinding. Since layout analysis can be done easily from a plan drawing, even before more detailed design is developed, architects may avail the opportunity of testing their initial designs from the perspective of an immersed visitor and make adjustments accordingly for wayfinding friendly designs. Additionally, overall shape of the plan and corridor system, distribution of public and private areas, locations of desks, kiosks etc. and other design features may be investigated with confidence.

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Architectural Research in PhD Programs

Water and identity: an urban case study for densification along Los Angeles River's Rio Hondo Confluence

Jeffrey C. Vaglio

University of Southern California, Los Angeles, California

ABSTRACT: When Los Angeles was founded in 1781, the mountains, river and shore formed the landscape. Today, street grids and a superimposed network of meandering freeways blanket the valleys while clusters of high-rises emerge periodically to provide underpinnings of the city's identifiable neighborhoods. Only the Los Angeles River is invisible, reduced to concrete-lined drainage channels, denuded of riparian vegetation, bounded by rail lines, hidden behind industrial plants and beneath freeways. What is a river without water?

Throughout landscapes, urban and rural alike, rivers and infrastructure intertwine like tendons to connect cities to natural resources and each other. This dance is particularly evident in an 11-mile stretch of the 51-mile river referred to as Reach 2 where the 710 Long Beach Freeway parallels, elevates, and hurdles the concrete-lined depression of the barren riverbed. Ten cities comprise Reach 2, which fail to garner the attention of Downtown Los Angeles to the north and the Long Beach estuary to the south. As a result of this intermittency, these cities suffer from social and infrastructural neglect, while struggling to develop positive community identity. In modern multi-city metropolitan areas, governmental centers dominate the political infrastructure. Meanwhile, physical infrastructures, such as freeways, often divide these cities. This research seeks to invert these paradigms in an effort to celebrate city identity at political borders, and transform physical divisions into cultural connections.

Research and a design prototype were developed in a unique multi-disciplinary graduate studio environment. Reach 2 is compared to Tokyo to extract potential community identities to support dense and vibrant future development. Additionally, an innovative four-dimensional land-use analysis is conducted across the region to identify voids/opportunities for optimal multi-use development. These investigations culminate in a design prototype at the Rio Hondo Confluence.

Conference theme: Urban design studies
Keywords: LA River, density, identity, land-use, master-planning

INTRODUCTION

Worldwide, cities that were founded on great well-known rivers are rediscovering and revitalizing their riverfronts. The Los Angeles River has progressed from an unrestrained, meandering river delivering a valuable source of water for early inhabitants, to a major flood control waterway. River revitalizations brings many and varied opportunities – including: recreation, trails, parks, neighborhood identity, nature, jobs, community development, tourism, and civic pride.

Long before the first Europeans arrived, the Los Angeles River flowed and was the only source of water for Los Angeles. As Los Angeles grew into the world-class city it is today, the water was diverted from the river to the pueblo through a complex system of zanjas (ditches), which permitted agriculture to thrive in the region (Gumprecht 1999:369)

The Los Angeles River carried very little water in the dry season – however, flooded frequently during the winter rains. Two major floods in the 1930's killed over 50 people and damaged a significant amount of property. In the 1950's and 1960's, the federal government straightened, deepened, and reinforced the river with concrete (Morrison 2001:128). This concrete structure has saved countless lives and prevented costly property damage – however, this river is now not particularly welcoming to humans or nature.

The Army Corps of Engineers created the concrete encased river bed and banks to serve as flood control, however, the channel remains dry most of the year, except during winter rains. The laminar flow characteristic of the channel serves as an efficient artery to transport stormwater, but with that comes a direct connection for trash, contaminants, and pollution to flow into the Pacific Ocean with little to no filtration through soils or natural processes. Today, environmental groups support the removal of the concrete channel in an effort to restore the River ecology, natural vegetation, and wildlife. River revitalization efforts are also attractive for the resulting parks and riverfront development that are possible in what are currently predominantly desolate industrial zones.

The Los Angeles River remains extremely similar to the River Reyner Banham described as “re-routed, tamed, and channelled” (Banham 1971:32). Since documenting his perception, Los Angeles has sprawled outward while improvements to the River ecology remain deprived and unchanged. Los Angeles is a city in perpetual infrastructural crisis, and water infrastructure is no exception. With a state-wide water crisis, environmental concerns, and water demand well in excess of regional water supply, the Los Angeles River is in need of great attention and creative methods of ecological restoration which are innovative, economical and sustainable for future generations.

1. LOS ANGELES RIVER

1.1. Organization

The Los Angeles River extends 51-miles (82 km) which travel southeast through the San Fernando Valley, to Downtown LA, out it’s mouth in Long Beach. The River’s primary source-waters flow from the San Gabriel Mountains. The River is divided into six stretches referred to as *reaches*. Notable reaches include Reach 3 – Downtown, and Reach 1 – Long Beach. The City of Los Angeles contains a 32-mile stretch of the River, the longest of any city (Fig. 1). The other 19 miles are primarily shared between the 10 cities of Reach 2, and Long Beach of Reach 1. Most of the current river revitalization plans encompass key segments within the City of Los Angeles.

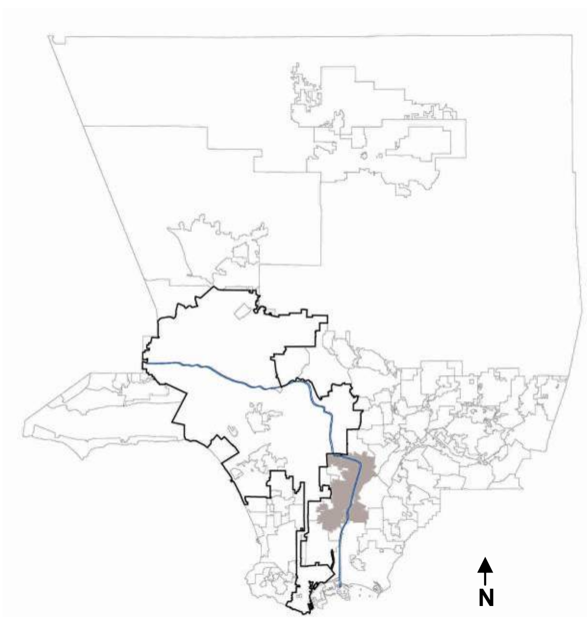

Figure 1: Los Angeles County with city boundaries and the LA River; Reach 2 is highlighted.

1.2. Existing Revitalization Initiatives

Visions exist for River ecology to be restored as an integral catalyst to downtown revitalization. Residents and government officials often refer to the San Antonio River Walk as the lively environment to aspire to in the transformation of the symbolically stark channel. Such improvements require coordination of many entities, public and private, infrastructural and natural. How can these visions become realities while still maintaining the flood-control capacity achieved by the original Army Corp of Engineer’s design?

In the 2007 Los Angeles River Revitalization Master Plan, the recently established Los Angeles River Master Plan Advisory Committee placed priority to establish the following goals:

> Establish environmentally sensitive urban design guidelines, land use guidelines, and development guidelines for the River zone that will create economic development opportunities to enhance and improve River-adjacent communities by providing open space, housing, retail spaces such as restaurants and cafes, educational facilities, and places for other public institutions, improve the environment, enhance water quality, improve water resources, and improve the ecological functioning of the River, provide public access to the River, provide significant recreation space and open space, new trails, and improve natural habitats to support wildlife, preserve and enhance the flood control features of the River, foster a growth in community awareness of the Los Angeles River, and pride in the Los Angeles River.

The organizing principles and their supporting goals reflect important values that have been expressed by residents throughout the River Revitalization Master Plan process. Residents have articulated a strong desire for a *greener* Los Angeles that may be experienced by everyone. Key values shared in the public participation process were environmental responsibility, social and geographic equity, community engagement and support, designs that are based on sustainable economics, and a system-wide perspective toward the Los Angeles River watershed (***Los Angeles River Revitalization Master Plan*** 2007).

Environmental principles and values—such as restoring natural systems and remaking human environments—have exerted a strong influence on the Master Plan. The Los Angeles River is both a real and symbolic source of life for the City (Gumprecht 1999:369). As such, restoring the River’s environmental functions and making it the spine of a stronger green space system are integral to the planning effort.

The revitalization of the River cannot transpire without extensive and enthusiastic community encouragement. This Plan was developed by and for the residents of the City, and requires their support to be successfully executed. The City is privileged to have strong support for River revitalization at every level of government. As the project plan is implemented and progresses, it is imperative that this support be continued to guarantee a permanent dedication to River revitalization.

Efforts are happening throughout the watershed to supply financial support for water-quality compliance activities, ecosystem restoration, community reinvestment, transportation improvements, and for recreational amenities. Lessons from other cities that have revitalized their riverfronts illustrate that changes of the type recommended here necessitate confidential/private investment and initiative (*Los Angeles River Revitalization Master Plan* 2007). Design standards and guidelines for development within a proposed River Improvement Overlay (RIO) will be established to support the Master Plan, so that reinvestment may occur in an environmentally-sensitive and sustainable manner.

Efforts to advance environmental circumstances within the watershed of the City and County of Los Angeles have been occurring for decades. While this Master Plan balances and strengthens these efforts, it is imperative to comprehend that it single-handedly cannot resolve all of the watershed's problems (*Programmatic Environmental Impact Report* 2007). Since the context for the Master Plan is the River Corridor within the City of Los Angeles, it is beyond the scope of the Master Plan to provide detailed solutions to watershed-wide issues, such as water quality, habitat values, densification, industrial land use, and affordable housing. The Master Plan addresses these matters within the context of the River Corridor, and makes recommendations when connections exist to other planning efforts, such as those for water quality, habitat corridors, and flow reduction (*Los Angeles River Revitalization Master Plan* 2007). The proposed 3-tiered River management structure can facilitate longer-term partnership that would promote a broader conversation and more regional benefits.

Implementing the Los Angeles River Revitalization Master Plan will require the ongoing engagement and support of the many people and groups that have collaborated in its creation. The River management structure that is proposed in the Master Plan is designed to create a short- and long-term strategy that is fundamental to moving this proposed agenda forward. The proposed structure is designed to address River revitalization in a holistic manner, focusing on governmental management, entrepreneurial stewardship through the Revitalization Corporation, and philanthropic leadership through the River Foundation.

The Los Angeles River Revitalization Master Plan provides both a long-term vision and implementation guidance for revitalizing the River. It is aimed as an outline, creating the vision and guiding principles for executing, yet permitting considerable opportunity for the details of specific projects to be shaped through community and neighborhood strategy developments.

1.3. Opportunities for advancement

The existing revitalization plans confine their scope to the segments of the Los Angeles River within the City proper. The cities most effected by the decisions and actions of the City of Los Angeles are the cities immediately downstream – specifically the 10 cities of Reach 2. These cities are home to nearly 500,000 people, of which, 46% are foreign born. These communities suffer from social neglect due to their intermittency between the Downtown Los Angeles and the Port of Long Beach. Additionally, the cities are fragmented amongst themselves, and can be characterized by poverty, unemployment, crime, and exposure to unhealthy levels of air and water pollutants as a result of smog and proximity to the Alameda Corridor which transfers imported goods from the Port by rail and truck throughout the country.

In order to revitalize the River in the *holistic* manner described in the Master Plan, it is necessary to consider the whole River. An improved level of collaboration amongst the smaller municipalities is required to successfully implement a true River revitalization effort across these conflicted communities. Before implementation begins, there are tremendous opportunities for advancement in the Master Plan to integrate the entire river and proximate communities.

2. OBJECTIVES

2.1. Design/Research Studio

Investigate and propose innovative master plans for the entire 51-mile Los Angeles River. The designs should invigorate discussion and challenge the traditional paradigm of river revitalization models.

2.2. Reach 2

Develop a master plan for the Reach 2 (Fig. 2) which creates community identity, density and a synergistic integration of infrastructure and landscape.

Figure 2: Reach 2's master plan scope.

Additionally, develop a prototypical architecture for three significant typologies to support a sustainable River community.

3. METHODOLOGY

3.1. Design/Research Studio

The 51-mile Los Angeles River was divided amongst six teams of three graduate students. Each team chose one of the six *reaches* of the River, resulting in six individual, yet interdependent projects. The research and design was conducted over an 18-week semester with a multi-disciplinary, collaborative instruction model (Fig. 3).

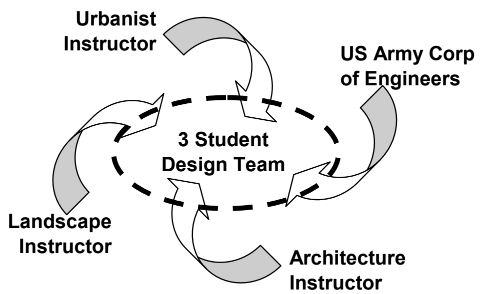

Figure 3: Conceptual studio instructional model.

Each design team received instructional advisement regularly from at least one of the individuals described above, and often times two or more. The urban instructor was present for approximately 75% of the course/review sessions, landscape 50%, architecture 25%, and external Army Corp of Engineers-Los Angeles River representatives were present every 4-weeks for significant review sessions. This model of diverse advisement resulted in research-driven design initiatives which emphasized ecology and dense hybrid-development. The instruction and process proved comprehensive and innovative.

3.2. Reach 2

A master plan was developed for Reach 2 by executing the following:

- Identify the master plan scope through development of an urban conceptual logic
- Develop a strategy to promote density
- Characterize the existing nature of each city
- Research and profile a dense, urban precedent
- Perform a knowledge transfer to suggest future interdependent Reach 2 city identities.

Three prototypical hybrid architectures were developed by executing the following:

- Locate a site which encompasses primary topics
- Develop programs based on the needs of the River, infrastructure, and adjacent city identities
- Design architectural elements which are integral to the landscape and sustainable community.

The master plan and hybrid architectures are described in greater length in following sections.

4. CONCEPTUAL DEVELOPMENT

The master planning development began with a conceptual strategy which first located existing physical divisions within Reach 2. These physical divisions included, but were not limited to, freeways, railroads, and the River. Next, the city boundaries for each of the 10 cities were located. The corridors along these borders are often lost between governments, but this concept seeks to celebrate the boundaries as areas to project positive community identity and bridge boundaries with infrastructural connections. Diagrammatically, these two are inverted, to create a concept which makes invisible boundaries visible, and transforms physical divisions into infrastructural connections. The master plan scope is narrowed down to the physical divisions, such as the river and freeway, and the infrastructural connections along city borders (Fig. 4). When superimposed, a series of programmatic opportunity areas is revealed.

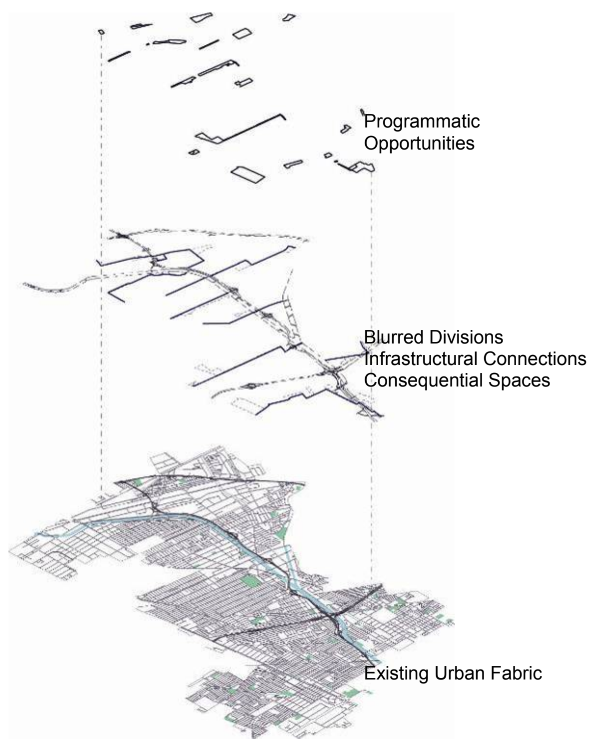

Figure 4: Reach 2 conceptual development layers.

5. REACH 2

Reach 2 is comprised of an 11-mile stretch of the Los Angeles River through 10 cities (from north to south) – Vernon, Commerce, Maywood, Bell, Bell Gardens, Cudahy, South Gate, Lynwood, Compton, and Paramount. These cities, and the Reach as a whole, fail to garner the attention of Downtown LA to the north and the Long Beach Estuary to the south. In order to propose methods of urban densification and identity development, the existing context, and the role of the River within these cities, was researched.

5.1. Population Increase

The population of Los Angeles has been increasing at a steady rate of 3% each year. This continual sprawl patterns however have yet to create substantial density within the Los Angeles agglomeration. The density of each city within Reach 2 varies drastically due to the residential nature of cities like Maywood, compared to primarily industrial land use in Vernon (Table 1).

Table 1: Reach 2 cities' population profile.

City	Population (2007)	Density (People/Sq Mile)
Vernon	81	18
Commerce	13,537	2,050
Maywood	28,714	24,341
Bell	37,332	15,157
Bell Gardens	45,285	18,167
Cudahy	24,873	22,352
South Gate	98,434	13,435
Lynwood	71,061	14,678
Compton	95,701	9,445
Paramount	56,369	11,955

Los Angeles is approaching crisis as environmental concerns such as increasing global carbon emission and temperature are compounded over the existing infrastructural (transit, water, etc.) issues the region faces. As Reach 2's population increases between now and the year 2050, 25% of the total land mass must become green space in order to maintain the existing green space per capita. This expansion (and not contraction) of urban open space square footage will drastically add to the densifying effect related to population increase.

5.2. Commuting Profile

A city's tax revenue is directly affected by its working population's location of employment. Currently, the majority of workers in Reach 2 travel outside of its 10 cities for work (Table 2). If the new master plan proposal reduces travel distance to work by 50% by creating employment opportunities within the region, the entire Reach will benefit from over $200,000,000 in tax revenue annually through spending retention.

Table 2: Reach 2 cities' commuting profile

City	Local Resident Worker, (%)	Commute Time (min.)
Vernon	47.2	23.0
Commerce	21.1	25.7
Maywood	8.3	29.2
Bell	10.5	28.5
Bell Gardens	10.9	30.1
Cudahy	7.3	29.8
South Gate	11.9	30.5
Lynwood	11.6	30.7
Compton	15.3	29.0
Paramount	14.8	27.1

In order to make a reduction to the travel time of Reach 2 with simultaneous population increase, the existing commute patterns must be understood. Each city's commuter *splat* is mapped to show the impact each city currently has across Los Angeles County (Fig. 5). The mapping factors in destination, and percentage of residents within the city commuting to that destination. A best-fit curve is used to bound the data points, thus generating the commuter impact area for each city. This analysis reveals that the City of Lynwood has the greatest commuter impact across the region, while Vernon has the smallest.

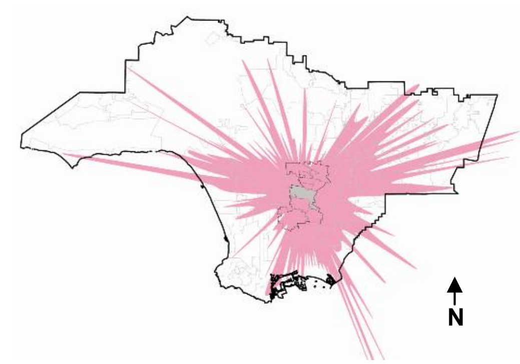

Figure 5: Commuter splat summary for South Gate.

5.3. City Profile Mapping

The potential for infrastructural interdependency requires a strong understanding of each component's existing strengths. In an effort to extract existing identities from the 10 cities of Reach 2, a zoning profile (Table 3) and an amenity profile mapping (Figure 6) reveal concentrations, linear connections, and areas of particular amenity emphasis. The zoning profile summarizes the land-use dedicated to each zoning category (i.e. industrial or residential) as a percentage of the total city land area.

Table 3: Reach 2 cities' zoning profile. Data presented as a percentage (%) of total land area.

City	Industrial	Manufacture	Commercial	Public	Residential	Recreation	Other
Vernon	86	0	6	0	0	0	8
Commerce	0	68	1	5	7	0	19
Maywood	6	0	9	2	59	1	23
Bell	1	0	17	3	78	1	0
Bell Gardens	0	7	17	0	68	3	5
Cudahy	0	0	20	0	78	2	0
South Gate	17	0	8	9	52	0	14
Lynwood	0	18	10	4	67	1	0
Compton	0	25	10	2	58	5	0
Paramount	0	31	6	3	53	4	3

Additionally, the amenity profile mapping locates and quantifies the services available within each of Reach 2's ten cities. This reveals strengths, weaknesses, and potential interdependent relationships amongst the cities. For example, the city of South Gate has a much greater emphasis on education facilities than adjacent cities Cudahy and Maywood. These cities rely on South Gate for such facilities, and therefore, the city has characteristics of an educational core.

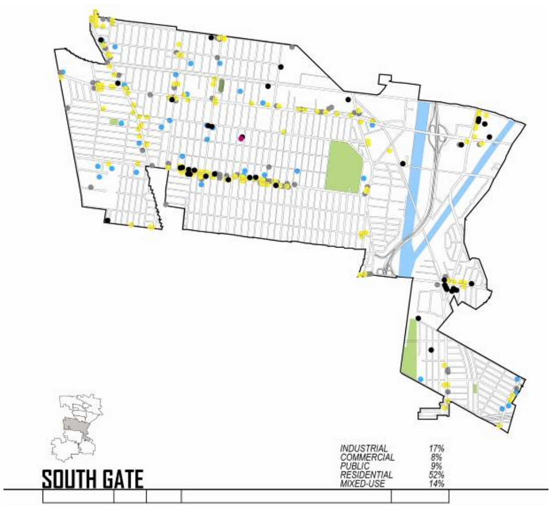

Figure 6: City of South Gate amenity profile mapping.

Google™ Earth software was used to identify and locate amenities and services for each city within the following categories; *cultural* (museums, auditoriums, community centers, and galleries), *retail* (department stores, clothing, books, records/cd, and sporting goods), *entertainment* (restaurants, café/bakeries, bars, amusement places, movie theatres, and video rentals), *domestic retail* (grocery stores, supermarkets, banks, gas stations laundry, pharmacies, and gyms), *education* (art/music, preschool, K-12, college, business, and computer), and *other* (hospitals, and government facilities). The results are summarized:

Table 4: Reach 2 cities' population profile.

City	Cultural	Retail	Entertainment	Domestic Retail	Education	Other
Vernon	1	3	6	15	0	1
Commerce	0	1	11	15	0	5
Maywood	2	8	18	20	2	3
Bell	2	2	15	25	0	2
Bell Gardens	0	14	74	33	12	0
Cudahy	1	4	6	12	0	1
South Gate	1	36	185	93	35	1
Lynwood	1	31	127	67	26	1
Compton	2	5	98	75	25	1
Paramount	0	7	61	32	14	1

City profile mappings often reveal strengths or amenity axis, but another analytical method is required for cities which lack strengths, and possess no clear sense of community identity.

6. DENSITY AND IDENTITY

In order for the 10 cities of Reach 2 to prosper in the future will require sustainable growth by means of higher population density, an increased level of economic retention, and multi-city interdependency infrastructures. Instead of developing interdependent city relationships through a subjective process, the design team studied an existing high-density city to project what the identities should be in the future for the Reach as a whole.

6.1. Tokyo Study

Tokyo was examined as a high-density case study because of its similar density to Reach 2's projection for 2050, and for the unique identity of and relationships between its wards. The 23 special wards of Tokyo were studied, mapped and diagrammed as relationships between infrastructures, amenities, and open space (Fig. 7). Unique characteristics for many of the wards were identifiable and informed the design team of integral elements of a successful, high-density environment.

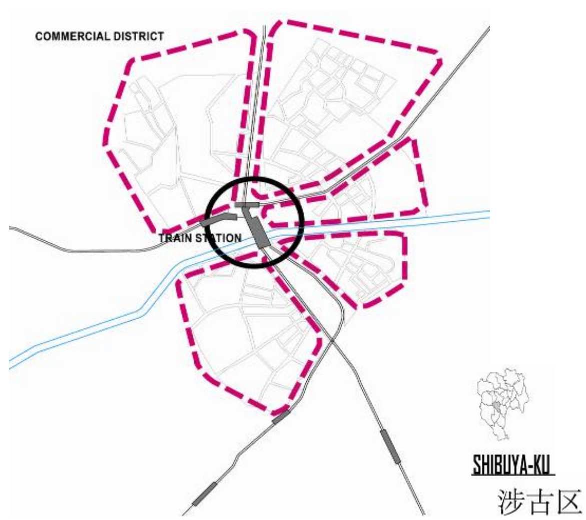

Figure 7: Tokyo study excerpt: relationship diagram of Shibuya-Ku's commercial district.

6.2. Identity

The previously developed city profile mappings were compared to the Tokyo ward relationship diagrams to see what community identities may be possible using existing infrastructure and strengths. This knowledge transfer then created an interdependent Reach 2 with 10-cities, each with individual strengths to compliment those of adjacent cities and existing infrastructure. Several examples of new proposed city identities include Commerce as a governmental center, South Gate as the educational core, Compton as an international business corridor, and Lynwood as an Entertainment Center for the Reach. This research strategy, including profile mapping and precedent study, resulted in a diversity of applied city identities, and optimized existing strengths of each community.

7. MASTER-PLANNING STRATEGIES

The design team developed a four-dimensional land-use analysis method to optimize environments through collisions of necessary infrastructure and programmatic voids. This method sought to evolve beyond the traditional paradigm of zoning designation as a two-dimensional mapping, an evolution which is necessary for the high-density environments of the future.

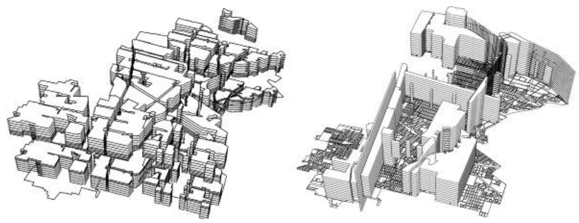

Figure 8: Reach 2 four-dimensional land-use analysis: residential (left) with Tokyo Injection overlay (right).

The master conceptual development proposes a network of optimized programs at all locations along the scope of city borders, and along physical divisions, such as the river and freeways. When the conceptual and research studies are overlaid in a three-dimensional model with a z-axis mapping time, programmatic windows are located both physically, and within a time frame. The vertical axis acts as a time scale allowing existing zoning to be mapped as a programmatic element through the course of a 24-hour day (Fig. 8). Allowing programs to exist within a subdivided time range generates unique hybrid programs which optimize the site and land-use performance. Using time as the fourth-dimension within environment mapping advances beyond volumetric relationships and designations of space, to a realm of sustainable performance environments.

8. DESIGN CULMINATION

The Rio Hondo Confluence is a collision of a 710-freeway interchange, Los Angeles River, and Rio Hondo River. The site was selected as a prototypical study for its shared boundaries between South Gate, Lynnwood, Paramount and Compton communities, and its complex interaction between the river and freeway (Fig. 9 and 10). This hybrid development is a prototype of how such an overlapping river and freeway interchange might exist in complex harmony.
Programmatic optimization is achieved between engineered islands by a series of inflatable dams that retain water in evaporative cooling zones adjacent to residential and educational buildings, while allowing for riverbed occupancy in intermediate dry zones. For example, in the riverbed zone adjacent to the school, synthetic field turf is used as recreational space during the great majority of the year, when the river is at minimal capacity (Fig. 12). The islands subdivide the 300-foot gap of the existing channel, mending communities across a public river landscape.

Figure 9: Proposed Rio Hondo Confluence site plan.

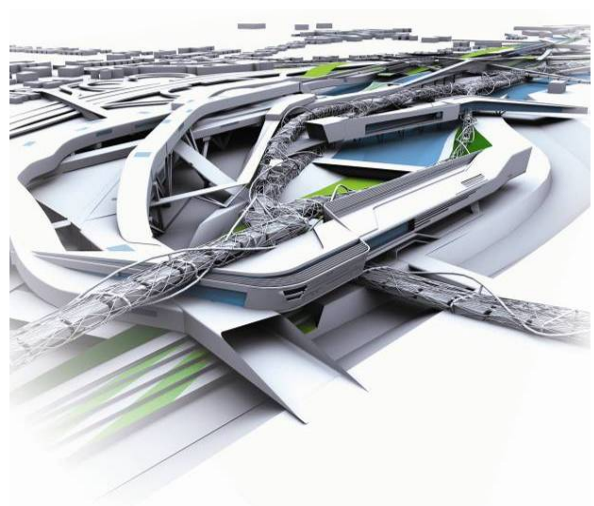

Figure 10: Rio Hondo Confluence's hybrid overlapping of infrastructure, landscape, and programming.

This collision of two traditionally isolated programs is part of a proposed paradigm shift which is inevitable as population density increases, and necessary infrastructures are upgraded or constructed. This shift forces new adjacencies which have previously been unthinkable, but will be necessary as societies continue to concentrate in metropolitan areas. The following hybrid programs are prototypes explored at the Rio Hondo confluence:

8.1. Transit + Farm
To accommodate the anticipated population growth, new transit centers and mass transportation systems are in great need for everyday travel, and an estimated 1 billion hectares of new land will be needed to grow enough food to feed them.

Figure 11: Interaction of landscape and infrastructure.

8.2. Pedestrian + Residential
Open green space within the ultimate interchange is accessible through linear housing developments which double as a pedestrian network. By proximity and linkage, new housing brings life and activity to the river in provocative human and nature interaction (Fig. 11).

8.3. Water + Identity
South Gate is the educational core of Reach 2, and therefore a water treatment plant is paired with an education facility. As a hybrid program, the treatment facility/school is always working programmatically for the city's residents. By combining two inverse time block activities, the water treatment would occur at night, offset from school hours. This overlap of operations is vital to Reach 2 as population increases.

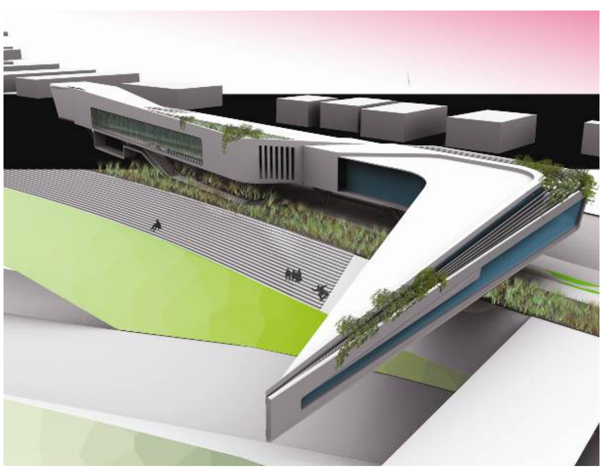

Figure 12: K-12 school atop a water treatment berm.

CONCLUSION

The design studio model was successful in integrating the entire River within a complex multi-disciplinary environment of research and exploration. Specifically, Reach 2's research and design proposal challenge traditional master planning methods, and addresses density and land-use, something that was *beyond the scope* of the Revitalization Master Plan. The embryonic methods and designs are in some ways conflicted, but they are the bi-product of innovative alternative design and planning strategies.
As urban centers sprawl or densify, water remains the foundation upon which great cities, like Los Angeles, are built. Networks of streams and rivers are every bit arterial as the freeways which bridge them. Improving urban connective tissues requires an appreciation for the role of water and a hybrid-urbanism where the boundary is blurred between engineering and landscape design to generate working landscape processes for a sustainable future.

ACKNOWLEDGEMENT

The Reach 2 design team was comprised of Yunnan Allen, Jeffrey Vaglio, and Zhi-ya Wu. Their research and design contributions are gratefully acknowledged.
Research and design advisement was received from Professors Eui-Sung Yi, David Fletcher, Selwyn Ting, and the Army Corps of Engineers – Los Angeles, throughout the development of this project.
Statistical data for each city was derived from the U.S. Department of Labor – Bereau of Labor Statistics.

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A film studies approach in architectural research: urban space in three Iranian films

Sara Khorshidifard

University of Wisconsin Milwaukee, Milwaukee, Wisconsin

ABSTRACT: Architecture and film studies are interrelated disciplines, and architects can take advantage of existent commercial, dramatic, comedic or documentary films for inspiration and historical research. As examples of how existent films can be utilized innovatively in architectural research, this paper critically examines three contemporary Iranian films: *"Ten"* (2002), a realist docudrama directed by *Abbas Kiarostami,* "*Chaharshanbe-soori*" (2006), a melodrama directed by *Asghar Farhadi,* and "*Dayere Zangi*" (2008), a comedic urban drama directed by *Parisa Bakhtavar*. Through this examination, the paper argues that the lens through which a filmmaker looks at buildings and urban settings is unique, and that in every film, from the most abstract to the least, and whether the film maker is actually conscious of it or not, there is an underlying exploration and documentation of the way architecture affects and (re)shapes society. In Iran, film has always been one of the few poetic, enlightening, and powerful ways to explore, among other social and cultural phenomena, the issue of power in urban public space. Contemporary Iranian cinema has proven itself able to depict the natural and built environments as the loci for both private and public presentations of self, and these films reveal many suppressed, typically unexamined, issues surrounding the multiple meanings of place and identity. This research shows the aptitude of these filmmakers, or any filmmakers, to present views of contemporary society, supporting a broader understanding of contemporary urban life than is officially permitted or can be academically achieved. Hitherto, no other media has been found to be as great a resource as film to "freeze frame" the flow of life in an urban setting, or time in a space. With their unique lens, filmmakers are architects' fellows, making possible the observation of potential topics of inquiry; for instance, ethical and socio-political themes related to space and power.

Conference theme: Collaborative and interdisciplinary research, education, and design
Keywords: film, architecture, urban public space, urban life, power

1. ARCHITECTURAL SPACE IN CINEMA: NATURE, TECHNIQUE, METHOD, AND FUNCTION

There are primarily two different ways that architects can use film to enhance their work. The first and most common is the employment of cinematic techniques, which includes animation and virtual modeling as well as actual videos of their projects, to (re)create both virtual and real experiences of an architectural space. These techniques are wonderful tools for architects to present their design concepts to non-architects, the public users of space and/or the clients. Through these media, architects can offer, for example, walk-throughs of a space, and views of people interacting with it, whether in the virtual computer mock-ups, the animations, or in the real films showing the phenomenology of the built environments. A second and less common way that architects can take advantage of film is simply to use existent commercial, dramatic, comedic or documentary films for both inspiration and historical research. This paper claims that the lens through which a filmmaker looks at buildings and urban settings is unique, and that in every film, from the most abstract to the least, and whether the filmmaker is actually conscious of it or not, there is an underlying exploration and documentation of the way architecture affects and (re)shapes society.

In every society, its architects, urban and landscape designers, or any scholars studying the built environments, can take advantage of existent films as they incorporate fragments of memories, still breathing, and they can fit in pieces of histories about the cultures for and the society within which they are produced. As architect Juhani Pallasmaa describes, the physical space created within film is the "architecture without architect", and the filmmaker is the "architect without client." A filmmaker, like a novelist or a painter, provides "the human event he is presenting a setting, a place." Thus, as he puts it, a filmmaker "performs a job of architectural design without a client, structural calculation, or a building permit." (Juhani Pallasmaa 1986: 451) As examples of how existent films can be utilized innovatively in architectural research, this paper will critically examine three contemporary Iranian films. In Iran, film has always been one of the few poetic, enlightening, and powerful ways to explore, among other social and cultural phenomena, the issue of power in urban public space. As Hamid dabashi puts it, Iranian cinema is the perfect measure of Iranian culture in living memory. (Hamid Dabashi 2007) Contemporary Iranian cinema has proven itself able to depict the natural and built environments as the loci for both private and public presentations of self. Further, as case studies, three films are selected for the paper, revealing many suppressed, and typically unexamined, issues surrounding the multiple meanings of place and identity.

The first case study is "*Ten*" (2002), a realist docudrama directed by the internationally acclaimed auteur, *Abbas Kiarostami.* It includes ten interrelated stories, all taking place inside a car passing through the streets of Tehran. Interestingly, the entire scenario is filmed from just two camera angles, the driver's side and the passenger's side. The second film is, "*Chaharshanbe-soori* (Fireworks Wednesday)" (2006), a melodrama directed by *Asghar Farhadi*, showing the overlapping life stories of three women coinciding on the day of *Chaharshanbe-soori,* a culturally important Persian ceremony, celebrated on the last Wednesday night of every Persian year, bringing to the streets of Iranian cities its particular urban spectacles and collective memories. The third case study, "*Dayere Zangi*" (2008), directed by *Parisa Bakhtavar,* is a comedic urban drama, in which the narrative space illustrates some underlying challenges and conflicting interactions between neighbors up on the roof of an apartment building in Tehran. In this film, the semi-public realms of the building become places of tension, contradiction, and ultimate reconciliation. In short, this paper will show the aptitude of these filmmakers, or any filmmakers, to present views of contemporary society that support a broader understanding of contemporary urban life than is officially permitted or can be academically achieved. Hitherto, no other media has been found to be as great a resource as film in Iran to "freeze frame" the flow of life in an urban setting, or time in a space.

2. EVERY FILM A DOCUMENTARY: LOCATION, A CINEMATIC SPACE BETWEEN FILM AND REALITY

In every film, reasons why filmmakers might prefer a location to another and different ways they treat such physical spaces in their films, whether they choose real or studio-based locations, along with the organization of cinematic *mise-en-scenes,* are enlightening facts in representing many aspects related to architectural space and life within urban/rural environments. Hence, whether the physical settings are realist that nothing has been added to their existence or they are film production studios, together with the reasons why filmmakers chose them as their preferred locations, the physicality of location turns into a prolific research material for architects and urban designers. In particular, location treatments in films open up new possibilities for the phenomenological analyses of space. Therefore, through the nuances of locations, in conjunction with the fact that cinema can make possible the use of human bodies' and objects' close-ups and panoramic representational landscapes, films, more than any other form of art, posses the competence for architectural research. Mainly, by bringing objects and landscapes to the sight's foreground instead of keeping them in background and by providing all-encompassing wide perspectives, any film from any genre, realist or fictional, commercial, dramatic, or comedic, turns into a unique documentary, with its unique and more dynamic generic definition(s).

Let's say, there are documentary aspects to any films that can at least reveal some portions of the spatial realities out there, the aspects that are almost related to the documentations of physical space as the location. Any film embodies certain levels of reality, in terms of the location (physical space) it (re)presents or (re)produces and/or the relationships between temporality and space. As film scholar Thomas Shatz and Rick Altman argue, film genres are not static, they are dynamic phenomena ought to be viewed in wider socio-cultural contexts. According to Altman, a new critical strategy is required in genre study, a poststructuralist criticism that can simultaneously examine the contradictory forces in-between genres. He argues for a semantic/syntactic approach to genre study which, according to him, is a dual approach that not only considers the textual but also the contextual meanings of different genres, and explores the interconnections of micro-level semantic features and the macro-level socio-cultural aspects. (Rick Altman 1984) Further, Thomas Schatz also theorizes that film genres and cultural systems are interrelated; thus, any theory must analyze a twofold nature of genres, its "static deep structure" as well as "dynamic surface structure." (Thomas Schatz 1991) Therefore, these theoretical assumptions address contradictory forces within different genres and explain that any film can at the same time be included in or excluded from one genre. Thus, these theories can support the argument that any films in general can be embraced by documentary genre and approached according to their narrative spaces, historical contexts, and ideological perspectives. As a result, such a theory in film makes possible the exploration and documentation of how, on the one hand, the physical space is organized and, on the other hand, how it can affect and (re)shape the society.

Compared to other arts, cinema is a superior one in portraying architecture and urban space; it is seen as the closets art to architecture. Further, there are also intimate relations between a filmmaker and an architect. On the one hand, in Juhani Pallasmaa's words:

> The presentation of architecture in other arts is the "pure looking" of a child's way of experiencing things, for the rules of architectural discipline do not regulate the experience or the way it is presented. (Juhani Pallasmaa 1986: 451)

As he asserts, although other arts like the novel writing, painting, and photography can also illustrate buildings, landscapes, and structures symbolically, film is quintessentially the most pristine art. Film is the closest art to architecture given that architectural spaces are (re)produced within the films and through the documentation of their elements of physical existence. (Juhani Pallasmaa 1986) Moreover, as the architect and film theorist Siegfried Kracauer argues, physical space (re)constructed in film is a more powerful setting than that of the photography in that, with the contribution of cinematic techniques and devices, settings in films can, more than any other medium, "represent reality as it evolves in time." (Siegfried Kracauer 1960: 293)

On the one hand, it is necessary to correct the notion that it is not only with the contribution of cinematic techniques and devices that, according to Kracauer, representations of reality as it evolves in time might become possible in film. The initiatives of cinema, as Andre Bazin puts it, are based upon cinema's "original myth," a myth that has made possible the existence of cinema as a superior art. Cinema, as Bazin asserts, has always dwelt in the soul of every human being, and longing for it in the hierarchy of human desires. In his words, "the real primitives of the cinema" exist "in complete imitation of nature." As he puts it:

> Every new development added to the cinema must, paradoxically, take it nearer and nearer to its origins." (André Bazin 1946: 202)

As theorized earlier in this paper, every film has some portions of documentary aspects to it, and as a result, it incorporates certain levels of reality related to its represented or reproduced physical space. Thus, not only the realist cinema, which Bazin argues for, is the most relevant source of material for architectural research, but also the *mise-en-scenes*, narratives, and character types in any film genre are amongst the dynamic research materials. On the other hand, referring to the intimacy between filmmakers and architects, as Mehrnaz Saeed-Vafa alleges, there is even a significant portion of reality beyond filmmaker's choice of location:

> For the filmmaker, the choice of location is a cultural and at time a political statement, which consciously or unconsciously reveals aspects of the filmmaker's personal identity as well as his or her attitude toward the dominant culture. The location and its cinematic representation by the filmmaker constitute the world of his/her films. They reflect the filmmaker's state of mind, as well as that of the characters, and can pass a metaphor for his or her cultural and emotional situation at the time of filming. (Mehrnaz Saeed-Vafa 2002: 202)

3. THE FUNCTIONS OF CINEMATIC SPACE

With their unique lens, filmmakers are architects' fellows in that they can make possible the observation of potential topics of inquiry such as ethical and socio-political themes related to space and power. In any films, objects and landscapes passing across the screen are not mere backgrounds for the narrative plots and characters. By comparing architecture, as a profession and a unique functional art form, to the art of filmmaking, one can locate many similarities in that cinema is also a functional art, and much like architecture, a dynamic profession. According to Siegfried Kracauer, cinema has three "revealing functions." First, it reveals "things normally unseen," small things through close-ups and big things such as "masses" of people and vast landscapes through wide camera angles, as well as the most transient elements of the environment and least permanent impressions, attitudes, and behaviors. Foremost, films reveal to us the "phenomena which figure among the blind spots of the mind," where "habits and prejudice prevent us from noticing them." Second, films help to identify, without distortion, the "phenomena overwhelming consciousness," those such as catastrophes and wars. Finally, films disclose the "special modes of reality," which are the physical realities that might appear to "individuals in extreme states of mind". (Siegfried Kracauer 1960: 296) In addition to Kracauer's three "revealing functions" of films, "things normally unseen," "phenomena overwhelming consciousness," and "special modes of reality," there is a fourth dimension, another revealing aspect, to cinema related to film's functions and the spatial organization of a movie theatre. This aspect, described by Michel Foucault in his essay "Of Other Spaces utopias and, Heterotopias," deals with the spatiality of a movie theatre as an uncanny type of architecture; Foucault suggests that a movie theatre is a type of Heterotopia, a physical place capable of juxtaposing multiple incompatible spaces within its rectangle. Movie theatre is a rectangular space at the end of which one can see "the projection of a three-dimensional space" on a "two-dimensional screen," where one observes an intact "series of places that are foreign to one another." (Michel Foucault 1967) Therefore, the cinematic spaces, generated on the screens of movie theatres, are mysterious heterotopias, extraordinarily uncanny rectangular spaces at once functioning as present-time real definable spaces and counter-sites, stimulated in imagination and memory, their locations not easily definable in reality.

3.1. Heterotopics of the Iranian Cinema: Definition, Production, and Screening

Whether before or after the 1979 revolution, the cinema of Iran has been a heterotopia, parallel to Michel Foucault's sense, a simultaneously definable space and a counter-site stimulated in imagination and memory. Further, as Hamid Dabashi puts it, for the young people before the Islamic revolution, to go to the cinema or to watch a movie was "an act of defiance." (Hamid Dabashi 2007) I would say that it has been a sign of insubordination and opposition to either the patriarchal society or some of its traditional and religious value systems, or as a political statement, against concurrent constitutions of power. According to Dabashi, in the height of the 1979 revolution, the revolutionaries' belief was that cinema was an apparatus of the west and Pahlavi kings, so they set many movie theatres, including the Cinema Rex in Abadan, on fire against westernization and as an emblematic protest against Pahlavi's corruption. (Hamid Dabashi 2007) Since 1979, right after the formation of the Islamic republic government in Iran, veil has become compulsory for women in public and many Islamic revolutionaries, who had deplored cinema as an apparatus of Shah's corrupt policies, as Hamid Naficy asserts, have advocated that cinema should only be used for the purpose of teaching "Islamic values, traditionalism, monotheism, theocracy, and anti-imperialism." (Hamid Naficy 1998:230) Between 1980 and 1987, during the Iranian Cultural Revolution, the Ministry of Culture and Islamic Guidance established in 1982, and became the responsible organization required of assessing and censoring film those synopses and screenplay stages which do not conform to the necessary codes of conduct. Since 1979, this ministry has been watching over the Islamic codes of conducts, issues such as women's proper veiling patterns in media as well as their modesty, that should be, according to the established codes, the only aspect of women's life authorized to be displayed in films.

Despite the fact that, since the 1979 revolution, the central government has owned all the means and resources of the film and media production, the cinema of Iran has not only sustained the limiting obstacles of the state, but also flourished, not only through the filmmakers' creativity, poetic imagination, and wisdom -- those making films inside the country as well as the ones in exile -- but also due to its imaginative and intuitive audience. Islamic codes of conduct and women's veiling rules of modesty, along with the economical crises as the aftermaths of both the revolution and the eight-year devastating Iran-Iraq war faced this cinema with many obstacles. However, besides the entertainment and pleasure aspects of watching a film, cinema offers to many Iranian cinemagoers, both inside and outside the country, other opportunities; cinema can instigate "an act of defiance," as Dabashi puts it, as well as its narrative plots and storylines can present means of closure and functional spaces by the help of which the audience might escape many social injustices, political tensions, and even their own vulnerabilities. Sometimes the audience walks into a movie theater with the hope of making their everyday lives more bearable; they watch a film either to forget their own problems in life or to remind themselves of many existing social realities they and their fellow citizens go through in the course of their everyday lives. Thus, the way spectators look at the cinema of Iran is itself one of the aspects that can make the entire cinema of this country distinctive. As Dabashi asserts, Iranian cinema today, with its "global, urbane, and emancipatory" characteristics, is a unique one. (Hamid Dabashi 2007) Hence, one of the functions of the Iranian cinema is that it is a mirror to the contemporary society of Iran, reflecting to its audiences their life styles, beliefs, problems and hopes, a notion that brings us back to Kracauer's revealing functions of cinema. Cinema of Iran reveals many everyday life realities of its people, urban/rural communities and the social environments that, in the real life, might normally be taken for granted and/or become unseen, the day-to-day realities that might become overshadowed, not because of their lack of importance, but due to the facts that people are so engaged with their routines that their habits, problems, and/or prejudice prevent them from noticing them. As it is required of architects and urban/landscape designers, responsible about their societies, to consider many design factors such as the social, cultural and historical phenomena, and the fact that they might as well be overwhelmingly engaged with the routines of their own everyday life issues, cinema as a mirror can help such professionals out to better notice the realities of their built environments.

3.2. Iranian Cinema: Space and Time, Place and Memory, and the Nuances of Urban Life

There are two general categories for the cinema of Iran, the art cinema, known as the New Iranian Cinema, and the popular culture cinema. On the one hand, "New Iranian Cinema" is more associated with the "Italian New Realism" and the "French New Wave," characterized by the use of natural locations, usually outdoors, non-actors, relatively accurate real-time durations and blurring lines flanked by fiction and documentary, drama or docudrama, as well as telling the stories of the everyday struggles of many ordinary people. Furthermore, according to Shohini Chaudhuri, Iranian neorealist films narrate particular stories such as the meandering journeys or quests, symbolisms inspired by Persian culture, and closing freeze-frames. (Shohini Chaudhuri 2005) On the other hand, Stephen Weinberger views this cinema as the "neorealism, Iranian style." According to Weinberger, there are distinctive differences between Iranian and Italian versions of neorealist cinema by which, he asserts, Iranian filmmakers "made neorealism their own;" these two cinemas diverge in two different aspects, in film endings and in "their connections to their societies." Although, similar to the Italian neorealism, in the Iranian version also characters will remain with their problems unresolved up to end of the film, the film endings in the Iranian version are more optimistic, as Weinberger puts it. These endings will let the audience see that neither the problems they face are beyond their abilities to neither resolve nor "the social order is at fault." In other words, as the author argues, Iranian neorealist cinema is very different, or let's say, more humanistic, spiritual, motivating; this is a style in which the last scenes are not relatively sad, as they are in the original Italian version. As he asserts, the two styles also differ in their associations to their societies; in 1949 Italy, the Andreotti Law banned the export of realist films as they introduced the country as an unfavorable place to the international audience. However, as Weinberger claims, the circumstance in Iran has been the polar opposite; besides the fact that the popular image of Iran, for instance in other medias, might often be shown as "extreme and hostile," these Iranian neorealist films offer a very different, yet positive, stance of the country. Neorealist cinema of Iran portrays a view of the country which is the closest to its reality than any other media can and/or wants to show, a poststructuralist lens to look at things. However, later in his arguments, Weinberger claims that the reason why the Iranian government has always been pleased to support neorealist films is totally understandable, as they always depict a gentle, humane, and decent view to the country. (Stephen Weinberger 2007) Although an invaluable statement, as an insider, I assert that this cinema is neither a naïve pessimism/optimism nor always "gentle and humane." There are different reasons why the current regime in Iran might supports this cinema for the purpose of export and not for being shown inside Iran; many of these films has been banned from being screened and/or distributed inside the country. There can be a twofold explanation here, either the authorities are not aware of the critical, yet metaphorical, meanings behind the somewhat gentle and humane narratives, not able to *read between the lines*, or they assume that the international audience of these exported films might not be able to understand those metaphoric, but political statements, the films' deeper structures which can be, according to Kracauer's argument, the simplest realities often unseen or unknown, every so often intimidating, miserable, and/or pessimistic.

New Iranian Cinema is a true realism, akin to Andre Bazin's description of "true realism." It is not as an exact reproduction of reality, an absolute historical and/or materialistic reality, imitating the natural world to serve abstract, theatrical, ethical, or ideological purposes. It discloses the simplest realities, often unseen or unknown, the underlying concepts of being and the world, and in essence, it is an "ontological position" and a phenomenology, contrariwise to the expressionist realism and the exhibitionist cinema. (André Bazin 1953) New Iranian Cinema is less about the expressionistic *mise-en-scènes* or dramatic time periods, artificial and abstract durations of narratives. It is about using the existent physical settings, real locations, those humble appearances as well as arrogant, sometimes aggressive, manifestations of being and reality. Thus, it is highly expected from its audience to deconstruct their lenses and search more for connotations, the mythological concepts rooted in the Persian literature and culture, the socio-cultural and historical implications of realities of the realist physical environments as the mirrors to the Iranian society. In addition, it is also required of the audience to look at the peoples' interactions with the depicted cinematic space in films given that this cinema is almost about ordinary character types, not necessarily non-professionals, but those whom their existence can equate with the people in the street. First, they perform in the natural locations, narrative spaces that are away from studio settings, artificial lighting and decorations. Second, characters play within the narrative structures with an almost actual duration of events, approximately parallel to real life timing. In short, the total film assemblage in Iran is less about fiction as films do not normally add many things to the existing and credible realities.

Nevertheless, it is not to argue that only Iran's art cinema reveals the unseen and has documentary aspects to it, but the entire cinema of this country can be taken the same. Any film, within any specific genre, can depict the blurring boundaries and many contradictions that exist between the meaning of *private and public space and self*. Further, these films divulge many realistically treated urban exterior scenes, along with the psychological status of characters, as real people interacting within such exterior spaces. As a whole, the challenges that exist between inner and outer spaces of characters are amongst the most important realities that the whole cinema of Iran offers, an aspect that can be criticized in terms of its socio-cultural meanings. In other words, cinematic locations in these films are meaningful narrative spaces, the heterotopias in Foucault's expression, that can put adjacent to one another an assortment of real spaces, urban/rural structures, and architectural elements, and ultimately reveal realities related to lifestyles and cultures, mentalities and traditions, socio-political conditions, people's everyday struggles, politics of bodies and appearances, and foremost, the burring boundaries between public and private space and self.

There are certain, relatively unique, aspects to locations in Iranian films which make them relevant to architectural research and urban studies. First and foremost, as Mehrnaz Saeed-Vafa argues, this cinema is highly associated with real locations, mainly due to the specific case of its low-budget non-studio-base characteristics; most films are shot on "location with minimal intervention or alteration by the filmmaker," real places with "realist treatment of the social environment." Second, in Iranian films, relationships between characters are defined by "their surroundings and the places they live in or travel to." (Mehrnaz Saeed-Vafa 2002: 202) The third aspect, which will be thoroughly discussed through the examination of three case studies in this paper, is the predominance of exterior locations, together with the preference of filmmakers in using them over other interior type private spaces. Let's say, by filming in public or semi-public locations, filmmakers might become able to avoid some of the limitations defined by the state, and as a result, make their films even closer to the reality of society.

Filmmakers in Iran face with many restrictive factors, from which they try to evade by locating their narrative plots in less private and more spaces; instead of showing the private bedroom of a couple, filmmakers prefer showing the couple's interactions inside cars, city parks or urban public spaces. For example, women must be veiled in the public spaces while veil is not obligatory in the private ones such as in one's home; therefore, narrative plot would be less realistic and more incredible if a filmmaker shows a female character head to toe covered at her private bedroom, sleeping with a scarf on her head. In addition, for the Iranian spectators, such appearances are not only seen as unrealistic treatments of physical space, but also cheating on the audience, well-informed about the social norms and less deceivable by such a fakeness of space. To remove the barriers put for the filmmakers in Iran, they use various tactics, more or less related to their personal identities, ideological stand points, and approaches towards the existing cultural values. Since in Iran people are not allowed to give a speech unsupportive of the regime; for instance, they are not authorized to criticize the government in public, some filmmakers, like Abbas Kiarostami, might lean towards the more semiprivate locations, as metaphors of social spaces, semiprivate places where characters can talk fairly freely about many of the socio-political realities they face in the course of their everyday life. However, there are problematic boundary lines, not easily definable, between private and public self and space. Hence, the (re)presentation of these problematic challenges are enlightening phenomena to be explored in this paper, as portrayed in three Iranian films cases. Selected from different genres and cinematic techniques, each of which attracting a different type of audience, these films represent various aspects of the space and life in Tehran. As Ali Madanipour asserts, Tehran is a megapolis with the largest immigrant population in the country, a city of strangers with less collective emotions and further individualistic behaviors, an ever-growing city which is always in transition, for which the social relations of individuals have always been with uncertainty and tension. (Ali Madanipour 1998)

3.3. Private Self in Public Space: Location in a Kiarostami's Zeitgeist Film Ten (2002)

To illustrate the point, let us consider Ten briefly, a film that has hitherto attracted a lot of audience, though prevented from being shown inside Iran in case there would be a message for its local audience that current authorities in Iran don't want to get out. The auteur, Abbas Kiarostami, features everyday real-life situations of a woman in *Ten*, neither as a role mother nor a lover, and neither as a heroine nor as someone who is oppressed and long-suffered. The narrative space in the film, the interior room of a car driven through Tehran, is a semiprivate space, the *only* place this film's entire socialization takes place. To some extent, this semiprivate space of the car becomes the only comfortable and legitimate tribune, not just for democratic social interactions, but also for harsh criticisms and idea clashes. In a complex metropolis such as Tehran, this cinematic location turns into a place to discuss many existing social realities and clashes between generations, together with the manifestation and fluidity of ideological positions and values; for instance, juxtaposition of a freedom that this immature kid has to liberally critique, as he believes, the self-centeredness of her mother and the fact that she disregards family values by getting divorce with the mother's speech, on the one hand, to convince the kid about her right to decide for her life, and on the other hand, to prove to herself not to perpetuate a sense of guilt for causing problems for her son by her divorce decision in this film location makes it unique. The car, intentionally chosen by the filmmaker, is the feasible space to portray the social status and challenging consequences of the main female character, interacting with different passengers, her son and older sister, a new friend and a prostitute, and an old religious woman. Furthermore, multiple readings are possible given that the car, moving in the entire film, becomes a metaphor for a society in transition, between tradition and modernity, ideology and secularism, and traditional family values and modern individualism. Divorce and the possibility of sex outside marriage, issues that have long been taboos in traditional Iranian society, were not so common subjects to be discussed in the public realm of media, become legitimate topics and possible to be talked about only in the semi-privacy of the car as location.

Figure 1: Mother-son interactions

Amongst the ten interrelated scenes, three depict the social space of mother-son interactions. The 7-year-old aggressive son in figure 1 acts up, without respect, and blames his mother for divorcing his father and getting married again with his current step father whom, despite his mother's insistence, he refuses to live with. Source: (DVD cover, Author Unknown)

Instead of the film's narrative plot, this section focuses on location's explicit and implicit meanings. Symbolically, Kiarostami portrays car as a dynamic place for socialization and an urban space type analogous to "third places," in Ray Oldenburg's term. According to Oldenburg, "first place" is where one lives, "second place" is where one works, and "third place" is an important place used for leisure time activities, where one can freely take part in the social life of the community, broaden many creative interactions with other people, and ultimately, establish a "sense of place." (Ray Oldenburg 1989: 58) Deliberate action of the filmmaker, portraying no other "third place" than a car itself an abnormal place for socialization, is his socio-political and existential statement. It might be true that, by excluding other types of third places from the scenes and replacing the car instead, the filmmaker alleges levels of indifference about and ignorance of the urban space, which he portrays as rather impractical for community and useless for collective interaction.

In the scene in figure 2, the female driver gives ride to a young girl, coming back from worshiping in mausoleum Ali Akbar. In the car, they become friends. On the right, the mausoleum's entrance gate, seen through the driver's window, instigates memory and creates a

Figure 2: Female driver gives ride to a young girl

sense of place. In this film, the mausoleum becomes a meeting place for both secular and religious groups, a location and urban node making the city graspable, a place to which personal and cultural identities are belonged. Religious places become, to some degrees, secular meeting places; yet, interpreting the filmmaker's unconcluded position and ideological standpoint towards the significance of such places in cities remains unanswered; he neither appreciates nor ignores their existence, and just accepts their reality as it is.

Although not a devout Muslim, the young girl (fig. 2), emotionally desperate, as she broke up with her boyfriend, with whom she wanted to marry, regularly visits Ali Akbar mausoleum and prays to god for a reconciliation. In the ninth scene, the main character, not a devout Muslim either, coincidently meets the girl again beside the same mausoleum. Surprisingly, the main character tells the girl that, since they first met, it has been her second time visiting the place. When asking about the girl's relationship with her boyfriend, she recognizes that the girl shaved her hair due to finding no hope for a compromise. Shaving, an action with multiple meanings in various contexts, can have different interpretations for the spectators -- divine, profane, defiant, or fashionable.

In figure 3, the interpretation of the filmmaker's general statement is in this scene tricky, portraying a revealing action, striking scene where the girl takes her scarf out and shows her totally shaved hair to the driver. Taking out scarf in public in Iran takes multiple readings and ramifications. The particular condition of women in Iran is to be veiled in public, but free to be unveiled if hairless. Based on Islamic rules, woman's hair is the important catalyst for man's gaze to commit sins. The action can be examined as an opposition against restrictive social factors in public and the undemocratic conditions of women in Iran. Shaving the hair becomes either "an act of defiance" or "closure."

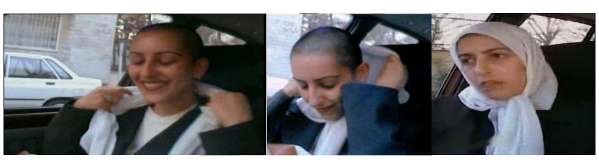

Figure 3: Girl takes her scarf out

3.4. Density, Crowding, and Privacy: a Drama of Location in *Chaharshanbe-Soori* (2006)

Chaharshanbe-Soori is a drama portraying in-depth emotional uncertainties of a wife, Mojdeh, distrustful of a husband having secret love affair with a divorced neighbor, Simin, who also runs a beauty salon in the same rental apartment where she lives. On the one hand, there is a negative perception about Simin, a relatively attractive single woman who might be looked at as a danger to wives in this high density apartment building. On the other hand, a negative social perception about female beauticians makes her lifestyle a subject to neighbors' doubtful and exclusive attitudes. Based on Kracauer's third function of cinema, this film reveals particular "modes of reality," physical realities appearing to characters, such as Mojdeh, in their "extreme state of mind." In addition, the film becomes a space appealing to the heightened sentiments of the audience.

Film's Melodramatic plot, about crises of characters with failed emotional circumstances, strained familial situations, and tragedies of everyday life, embraces doubts and fears of a suspicious wife, loosing a husband, family, and social stability, and the hopelessness of an intruder, a socially excluded beautician and a divorced mother with an unhappy loveless life given that she can rarely see her daughter; Simin's miserable life is seen as one of the reasons behind her having a love affair with a married man. In addition, the drama shows paradoxical personal identities of this married man, trying to hide the truth. Besides the dramatically conflicting associations between and within these characters, the main character, who is also the narrator, through the experience of whom spectators perceive the entire cinematic space, is Roohangiz, a young girl from a westerly lower-class town in the outskirts of Tehran. Like other small towns in the country, hers incorporates a traditional environment where family and kinship is the social space to facilitate marriage, a meeting place for young couples. She is a housecleaner and commutes back and forth every day to work in Tehran on the motorcycle of her fiancé, Abdolreza. Not having enough job opportunities in their hometown, they are amongst the daily immigrants of Tehran, adding to its population during the working hours.

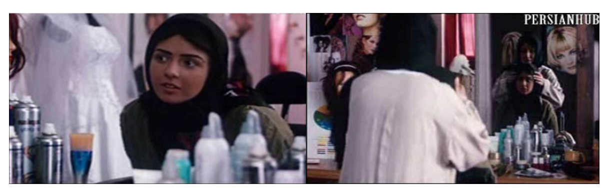

Figure 4: Roohangiz enters a low-quality high-density middleclass apartment building

As a housecleaner, Roohangiz enters a low-quality high-density middleclass apartment building in Pasdaran, a neighborhood in northeast Tehran, and into the chaotic life of a couple and their not-yet-cleaned home. Before getting in, watching the broken window of their home, she realizes something wrong. Later, she is exposed to a one-day reality of this couple's life and habitual fights. At the end of the day, this previously unsophisticated and naïve girl from province become mature as she encounters the urban

reality and not-always-happy side of marriage.
Now let us move from film's narrative plot to narrative and temporal meanings of its space. On the one hand, the entire film takes place in the last Wednesday of the year when, throughout the country, people celebrate the feast of *Chaharshanbe-Soori.* The film's one-day duration, close to a real time, instigates cultural and historical memory as temporality becomes a historic phenomenon for national collective memories. On the other hand, the film's dominant location, a middleclass apartment building in Tehran, portrays an uncomfortable place with high density, undesirable crowding, and lack of privacy. Such inefficiencies, along with the encroachment of business activities into this residential building, for instance, Simin's beauty salon, changes the way people interact with each other and their level of social tolerance in space. Hence, the location is a documentation of how self and identity, and privacy and security play in urban space, and further, shows how inefficiencies in physical space lead to the deterioration of the social quality of built environments. Density, crowding, and privacy inefficiencies related to this cinematic location are to be seen as the phenomena that, by bringing ambiguities and tensions to social interactions, negatively affect the social life of the neighboring communities. In the film, spectators recognize how, for instance, lack of parking space in this medium-rise building creates unhealthy interactions between neighbors. In a scene, a neighbor intentionally punctures another neighbor's vehicle as it is parked in front of the garage entrance through which no one can pass to the street.
In general, this film also shows characteristics of the family structure, social polarization of city, and dilemma of identity, and describes tensions and uncomfortable interactions in a middleclass building in Tehran. One integrated function of this film is that it manifests, yet explicitly, many socio-spatial realities of the physical space in terms of community and neighboring relations, and in the macro scales, the film location represents fragmented social fabrics and family structures, social polarizations, and the dilemma of cultural identity in Tehran. The film is considerably engaged in distorted boundaries between public and private self and space, for example, windows of the building, extrovertly open to a busy street, and the lack of socializing spaces and definable public realms in this building depicts lack of public participations in the management of the city. In summary, this physical space in the film explores the existence of more-than-bearable residential densities and weak local governments, lacking power and control over many unproductive property developments and inefficient city management.
In figure 5, Mojdeh sends Roohangiz to Simin's beauty salon to spy to see whether Simin really have the love affair with her Husband. Roohangiz gets married in few days, during the Persian New Year holidays, so she finds picking the eyebrows, for the first time in her life, as a good excuse to get into the beauty salon. Picking eyebrows, based on her family values, is only acceptable when getting married. Besides Roohangiz's negative perception about Simin, gained through

Figure 5: Mojdeh sends Roohangiz to Simin's beauty salon

Mojdeh's gossips, this unsophisticated girl finds Simin trustful and pleasant; she cannot believe that Simin is the sort of woman, having affairs with married men. Before leaving the salon, she tells Simin her neighbors do not like her and want her out of the building.

Figure 6: Simin and Mojdeh's husband together

Figure 6 is the first and last scene to see Simin and Mojdeh's husband together. The entire scene occurs in a car, a semiprivate meeting place and the space for this socially unacceptable relationship. Simin, determined enough, terminates the secret affair and encourages the man to go back to live with his wife in peace. At the end, with the relationship ended, Simin leaves the man desperate and unhappy.

3.5. Urban Space and Cultural Identify: the Case of the Film Dayere Zangi (2008)
"*Dayere Zangi*" (2008), the first movie directed by *Parisa Bakhtavar,* is not a mere comedy, but also an urban drama on the content of which one can criticize the manifestation of culture and identity crises in a capital city such as Tehran. The film is an accurately tangible and realistic image of Iran's contemporary society. This film is an account of many social issues related to a multicultural, diverse, and sometimes disorganized, society. As a result, a documentation of a somehow inefficient urban environment, this film shows existing cultural differences between different Iranian families and conflicts between traditional and modern lifestyles, in general, between ideology and technology. In the film, the filmmaker and scenarist bring up the issue of installing satellite dishes in Tehran, a global phenomenon with its many challenges for a still-in-transition society of Iran, from tradition to modernity. Accordingly, this film discloses contemporary confrontations between multiple ideologies and lifestyles in Tehran and presents dramatic demographic changes happening in the last 3-4 decades as a result of immigration. Hence, the film reveals a need for a more culturally diverse housing patterns and more adaptable apartment buildings to diminish the tensions and increase more healthy community interactions.

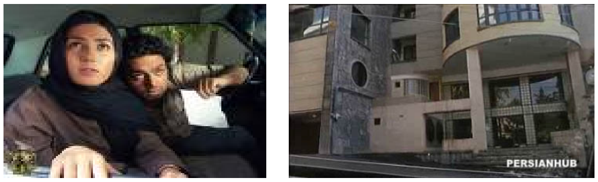

Figure 7: Shirin, the bad girl of the story,

In figure 7, Shirin, the bad girl of the story an "escapee from home," created, one night before, a fender-bender with the car she had stolen. Together with her recently-found boyfriend, Ramin, a satellite dish installer, hey enter an apartment building in north Tehran, a neighborhood where affluent, yet at some levels, nouveaux riche residents live. Satellite installing is an illegally underground economy for some youths in Tehran where other job opportunities are rare. Shirin lies to Ramin about the stolen car, that it is her father's car for which she has to earn money in order to compensate the damages; otherwise, her father gets mad at her. The unsophisticated boy from downtown Tehran, where mostly poorer families live, believes her and attempts to earn money for her by installing satellite dishes in this particular apartment building and fixing the dishes of the residents, flipped due to the windy and rainy weather of Tehran one night before.
The scene in figure 8 is about the government's control over even the private and semiprivate spaces. When the police force is seen in the street, the neighbors run down, from the roof to their apartments, and try to hide the satellite dishes. Almost all the residents in this building have satellites, except for some families, who are either very religious and don't want their young kids be exposed to the western culture or fearful of the state; having satellites is an activity defined against the law and formally unauthorized by the Islamic regime. One' home, although a private place, is under the observation of the state's power.

Figure 8: The government's control over even the private and semiprivate spaces

In some scenes, location becomes a chaotic space and a metaphor for a frantic urban life in Tehran. In addition to the excitements and unpredictability of this metropolis, a city of immigrants and strangers for both secular and religious groups, the film portrays some existing conflicts between citizens, uneasy relationships between families, with multiple and sometimes polar opposite ideologies and cultural values. According to some underlying differences between citizens, their cohabitation and juxtaposition in a compact high-density building is not without controversies. Like the city itself, *Dayere Zangi* is a crowded, and full of dialogue and character film, describing many realities of the urban space of Tehran, the physical realities which are, back to Kracauer, amongst "things normally unseen," "phenomena which figure among the blind spots of the mind," where "habits and prejudice prevent us from noticing them." (Siegfried Kracauer 1960: 296) The film shows clashes of ideas, ideologies and identities in space and a simultaneous reconciliation, communications, and community interactions where public space consequently becomes a democratic place to learn from each other how to tolerate existing differences.

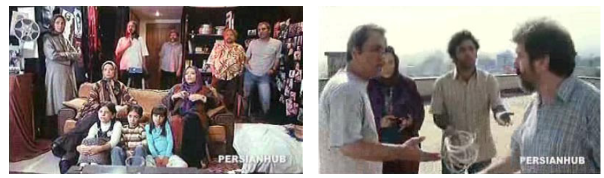

Figure 9: Contradictions in space

In figure 9, the scenes show contradictions in space. A religious family in the building uses the roof to dry cloths under the sun, the same behavior pattern it had in its previous courtyard house, to which it tries to adapt the lifestyle of this modern building. There are conflicts between neighbors in defining the public vs. private space. The religious family cannot tolerate other neighbors putting satellite dishes on the roof that is a semiprivate space in this building. This family has the belief, like that of the government, that it has the right to tell others what to do and not to do. Ultimately, what happens is reconciliation in space; all the neighbors get together in the religious family's apartment to watch a movie.

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From academic research on museum galleries to practice-based research for planning shopping malls

Ipek Kaynar Rohloff

The University of Michigan, Ann Arbor, Michigan

ABSTRACT: This paper explores how findings obtained from case study research on museum gallery layouts provide insights for shopping mall planning and design. The case studies investigated the effects of gallery layouts on visitors' movement patterns in museums, drawing upon the Space Syntax methodology. In the case studies, the local visual cues are considered as important as global spatial structure, and the effects of spatial layout on pedestrian movement are investigated on the basis of both top-down and bottom-up characterizations of space. The case studies analyzed two exemplary museum gallery layouts, the Yale Center for British Art (New Haven, CT) and the Museum of Modern Art (New York, NY). This exploration was able to explain the prediction of movement patterns by different visibility properties that shaped in morphological characteristics of these museums. In this study, understanding the impact of local visual information such as visual cues perceived in space aids understanding possible effects of attractors (i.e. popular displays) on movement. This paper argues that the results obtained from the museum case studies research can provide insights on how pedestrian movement is distributed with the effect of layout and attractors in shopping malls, and aid formulating further research on movement in shopping layouts. The two museum layouts analyzed can be illustrative of two types of shopping mall layouts. Our results suggest that type of shopping layout illustrated by YCBA may be more desirable for visitors as it facilitates encounters and offer clarity in grasping the layout, and the latter may be more advantageous for manipulating visitors with strategically placed attractors.

Conference theme: Building case studies
Keywords: case study research, effects of spatial layout, visibility relationships, spatial experience, and pedestrian movement

INTRODUCTION

Museums and shopping malls have similar design objectives and share some characteristics in their layouts. Both are designed to be experienced through movement, and their design objective is to facilitate visitors' contact with displays. In museums, visitors' exploration of space and their contact with displays can be important to convey the exhibition narratives. In shopping malls, exploration of the entire space is desired for more critical reasons: pedestrian access to the stores should be equalized to optimize rent rates (*Shopping Center Development Handbook*, 1999). Previous studies focusing on space-use in shopping malls and museum layouts have investigated the influence of spatial layouts on pedestrian movement by considering the effects of displays as attractors. This paper discusses how a research study exploring the influence of spatial layout on pedestrian movement in museums can explain the potential of spatial layout together with attractors, and thus informs design and planning of shopping malls.

1. STUDIES ON PEDESTRIAN MOVEMENT IN SHOPPING MALLS AND MUSEUMS

1.1. Theoretical Explorations on Movement and Buildings

Museums and shopping malls are interesting environments to understand how a spatial activity, in particular pedestrian movement relates to built environments. This relationship between movement and layouts is the central argument of the Space Syntax methodology. The theory of Space Syntax argues that "buildings are fundamentally about movement, how it is generated and controlled" (Hillier, 1996; Hillier & Penn, 1991; Hillier, Penn, Hanson, Grajewski, & Xu, 1993). On the basis of this argument, the Space Syntax methodology conceives of buildings as systems that consist of spatial units and the local and global relationships between them. Accordingly, buildings can be represented as configurations consisting of nodes corresponding to spatial units and links corresponding to topological relationships between the nodes. This graph representation of buildings, called *justified graphs*, is used to represent these relationships within the logic of network. In graphs representing spatial configurations as nodes and links, nodes refer to the spaces which are characterized by occupation, and links refer to potential movement from one node to another.

By analyzing the patterns of movement through spatial analysis techniques, the Space Syntax methodology relates space and human activity to each other in two ways: spatial layouts may either (1) *reflect* the existing social structures, or (2) *generate* new structures in society. In the former case, a spatial layout can reflect or embody culturally or programmatically given pattern of usage, such as layouts of vernacular houses or a law court building. In such layouts, potential movement through spatial units is determined by building program. In a law court building, entries and exits to certain court rooms are predetermined before the spatial layout is conceived. In the latter case, movement patterns are not predetermined by a culturally given structure or a building program, and thus space can shape a social pattern by facilitating new encounters through permeability relationships. For example, settings like office buildings are designed for more flexible usage, and do not impose a strict usage pattern determined by a program.

On the basis of these definitions, Space Syntax distinguishes settings that reflects existing social structure from the settings that generates new encounters by calling the former "strong program" and latter as "weak program" (Hillier & Penn, 1991). According to Space Syntax, in "weak program" buildings movement is determined by the structure of the urban or building configuration itself rather than by the presence of specific attractors or magnets." (Hillier, 1996).

Within this framework, shopping malls (as well as museums) can be considered "weak program" environments where visitors' movement is not dictated by a program. Yet, the way in which attractors or specially designated stores are positioned within the program consideration may manipulate movement and movement can be shaped with the effect of attractors as well as the layout. Depending on the dominance of attractors, shopping malls can be closer to being strong program buildings.

1.2. Studies Examining Movement in Shopping Malls

As discussed in literature, one of the motivations behind developing retail environments is to create a space with *sense of place* which attracts suburban inhabitants and enlivens commercial activity (Kliment, Barr, & Jerde Partnership International., 2004). *Sense of place* in shopping malls is associated with opportunities to encounter others in space. A more programmatic concern of retail developers is the rent yield due to the attraction of visitors to certain stores, as movement is an index on which rent increases are estimated (Fong, 2003). Therefore, planning and design of shopping malls can be guided by creating opportunities of encounter between people, and with the intent to equalize the pedestrian movement exploiting the placement of certain retail groups. However, the spatial hierarchy engendered by design, such as the more central location of some retail groups, may attract higher number of people and thus have a strong influence on pedestrian movement.

The dynamics between spatial layout and potential attractors in shopping mall layouts have been explored by a number of studies. Analyzing visitor's perception of shopping mall environment, Dennis and Newman (2005) argue that general layout is one of the attributes that can be influential on shopping activity. Another study suggests that pedestrian flows and presence in a public market can be explained by layout and visual stimuli (Zacharias, 1997). In a study focusing on the in-store environments, Newman et al (2002) discuss that customers often look for clarity in shopping environment. In ambiguous environments, frequent and unexplored changes in the merchandise can be detrimental to shopping activity. This implies a negative effect of the visual cues that bring ambiguity to retail environments.

A number of other researchers use the Space Syntax methodology to explore to what extent the space-usage in shopping environments, in particular pedestrian movement, is influenced by spatial layout versus attractors. One of these studies, Hossain (1991) analyzes a case where attractors are deliberately created by profit motivated developers by inserting special types of retail. That study suggests that in shopping environments created with programmatic concerns, strategically positioned stores can manipulate pedestrian movement to spatially segregated areas, and thus the effects of spatial layout and attractors on movement would complement each other. Another study, Fong (2003) considers main attractors of the shopping mall layouts, and explores whether placing these attractors to the polar ends of mega-shopping mall blocks would really attract pedestrians over the influence of spatial layout, and thus they would equalize the movement rates in the shopping environments. This study reports reasonable evidence that that spatial configuration has a direct relationship with the distribution of movement within planned, artificial shopping centre environments, however, spatial layout is not a single isolated factor that would explain the movement alone; but overlapping effects of spatial layout and attractors should be considered. According to Fong, the inevitably created spatial hierarchy can be balanced using the attractors (Fong, 2003).

Parallel to these explorations focusing on the shopping malls, a fair number of studies focusing on museum galleries explore the effect of spatial layout on visitor movement as an independent property and suggest that the gallery layouts predict visitors' movement (Choi, 1999; Psarra, 2005; Psarra, Wineman, Xu, & Kaynar, 2007). Only a few of these studies consider the effect of attractors, and they report stronger association between spatial layout and movement by excluding the attractors (Psarra, 2005).

The studies focusing on museums and retail have an interest in understanding the effect of spatial layout on the basis of global and local syntactical layout properties, such as *integration* and *connectivity* measures. In the Space Syntax methodology, *Integration* as a global property describes the extent to which spatial units in a layout is physically or visually connected to the every other units in that layout *Connectivity* as a local property measures the extent to which spatial unit is connected to the other units in the neighbourhood. Theoretically speaking, the integrated spaces are those that can be reached (or seen) by crossing the least number of spaces from all other spaces, and therefore those spaces are likely by visited most frequently. In a similar way the highly connected spaces are in direct relationships with a higher number of spaces and therefore they are more likely to be used. In the research investigating the influence of spatial layout on the movement, the collected data of users are compared and correlated with the integration and connectivity measures of the spatial units. The studies investigating these correlations in the museum layouts found strong evidence that the visitors' movement is associated with integration and connectivity properties (Choi, 1999; Psarra, 2005).

In the body of architectural research, most of the studies exploring effects of layouts on movement (using the Space Syntax methodology) explain the impact of a layout on the basis of a top-down characterization of space, such as the likelihood of movement paths in highly integrated parts of a layout. As discussed by some recent studies, a peripatetic observer can only absorb a limited amount of information and entire syntactical relationships may not be apparent to the observer at any point. If one considers that the visual cues perceived at individual spaces can work as a reference for a peripatetic observer's navigation (Psarra & Grajewski, 2000), visual information may be in effect at a local level on the distribution of movement. Therefore, exploring the effect of layout on the basis of a bottom-up characterization of space referring to visual cues is also valid to understand how spatial activity is formed. As a result, investigating the effect of layout on the basis of both top-down and bottom up characterizations through investigating the syntactical and non-syntactical properties can provide a more concrete explanation of how and to what extent observers use visual information in their explorations. This method of investigation can potentially illustrate whether movement is predicted by layout or by attractors, or else the way in which attractors are exposed to observers.

2. A CASE STUDY RESEARCH EXPLORING THE EFFECTS OF MUSEUM GALLERY LAYOUT'S ON MOVEMENT

2.1. Scope of the case study

We now discuss our case study research focusing on museum layouts and exploring their effect on visitor movement. The aim is to see what insights can be obtained from the findings that would inform the planning and design of shopping malls, or shape further research exploring distribution of movement in shopping malls.

The motivation of the research study focusing on museums was to explore to what extent the layout properties influence the space use patterns and thus to understand how morphological characteristics of museum galleries may shape the museum experience (Rohloff, Psarra, & Wineman, 2009). This study examined the effect of visibility relationships as a layout property, and addressed this investigation in two art museum gallery layouts selected for a case study. These gallery layouts are the main galleries of the Yale Center for British Art (YCBA) and the Museum of Modern Art (MoMA). These two cases presented contrasting results due to the variation in their morphological characteristics that reveal different local and non-syntactic visual cues to visitors.

2.2. Anecdotal Observations

As can be seen from their floor plans (Fig. 2), the MoMA and the YCBA gallery layouts share key spatial attributes such as having atria voids visually linking galleries across space and room configurations allowing multiple routes. The gallery layouts also show variations in their morphologies which are determined by the location of atria voids in the gallery space and their relationship with the gallery rooms in third dimension, such as openings to the rooms and their relationship with periphery and centre.

The YCBA and the MoMA's galleries exhibit paintings and sculptures from different art history contexts by utilizing various display strategies. The YBCA's gallery layout exhibits British painting and sculpture from sixteenth to mid-nineteenth centuries, which include mostly figurative works such as portraits. The works of art are installed somewhat strategically in the gallery by exploiting some of the architectural properties, such as

Figure 1. Interior views from the YCBA (on the right) and the MoMA (on the left) galleries.

symmetrical arrangements, parallel promenades and framed views through atria openings. During the observations in the gallery, these works did not appear to attract visitors or modulate their movement patterns. Yet, it is observed that the works placed to be seen through atria openings captured visitors' view from a distance. The MoMA's fourth floor exhibits on painting and sculptures of the Late Modern and Pre-Contemporary art. Among the displayed objects are well-known masterpieces such as late Post-Cubist works of Picasso, and mural paintings of Jackson Pollock and critically acclaimed examples of Pop-Art such as Andy Warhol's *Campbell Soup Cans.* The displayed objects have an iconic power due both to their fame and their geometric and non-figurative appearance in space. In fact, this potential is recognized by the curatorial team and the paintings are placed at the end of visual axes through gateways in order to attract visitors to the adjacent rooms. The anecdotal observations suggest that this strategy worked and visitors are attracted towards the displays viewed through doorways.

The anecdotal observations in the galleries suggest that visitors' exploration in the YCBA is at a slower pace and is synergized by experiencing the architecture. In contrast, the visitors' exploration in the MoMA was at a faster pace and seemed to be more akin to experience in shopping malls motivated by finding and viewing well-known masterpieces. In other words, explorative movement in the MoMA seemed to be more manipulated by displays than in the YCBA.

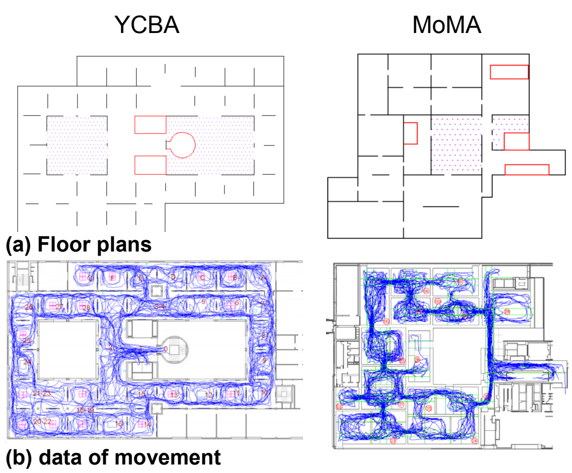


Figure 2. Floor plans of the analyzed layouts and the movement data collected.

2.3. Methodology of the Study

To investigate the potential influence of gallery layouts on visitors' patterns of explorations in the YCBA and the MoMA, this research study analyzed movement patterns and compared measures of those patterns with visibility relationships in the gallery layouts. Data of visitors' explorative movement was collected through detailed observation studies conducted in the YCBA's and the MoMA's fourth floor galleries. The visitor data samples include the records of 35 randomly selected individuals' movement paths. The patterns of spatial exploration were observed in paths of movement entering the gallery rooms and the proportion of movement lines directed to the available directions at the choice points.

In this study, visibility relationships engendered by the gallery morphologies are described and visualized through computer aided spatial analysis techniques developed within the Space Syntax methodology. These techniques apply a visibility polygon, "isovist," to the syntactical analysis methods. An isovist (visual field) is a polygon that defines the visible area from a vantage point in 360 degrees; in other words, the boundaries of an isovist are descriptive of the region where the radials of sight projected from a vantage point can permeate until they meet physical boundaries (Benedikt, 1979) (Fig. 3). In order to describe visibility relationships syntactically in a configuration, the Space Syntax methodology devises computational applications to generate isovists (visual field) from points of a grid designated in floor plans (Dalton, 2001; A. Turner, Doxa, O'Sullivan, & Penn, 2001). Using this technique computer applications calculate visual fields overlapping throughout the space and obtain syntactical measures that describes visibility relationships (A. Turner, 2003, 2004; J. Turner, Wineman, Psarra, Jung, & Senske, 2006). The resulting graphs are able to demonstrate "visibility structure" in floor plans of a configuration through colour rendered graphs and quantified measures (Fig. 3). These applications enable researchers to compare visibility structure with potential movement and other human spatial activity in built environments.

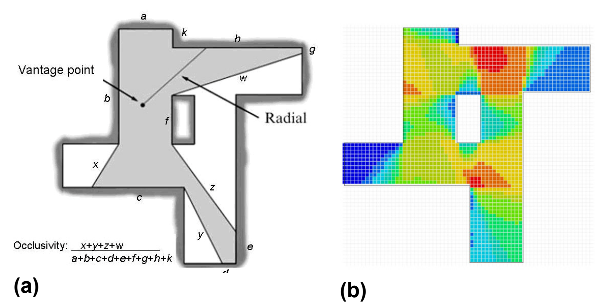
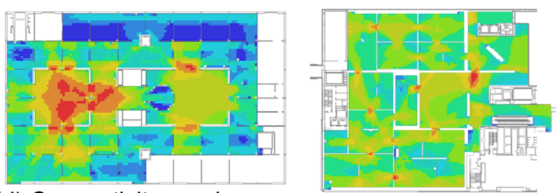


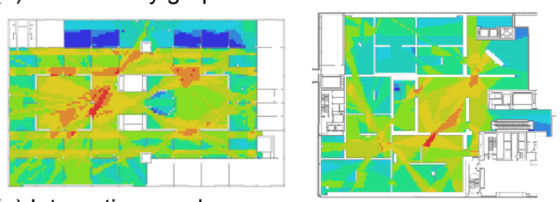
Figure 3(a). Visual field polygon and occlusivity measure (Source: Benedikt, 1979), **(b)** A sample visibility graph analysis by *Depthmap*.

One of these computer applications, *Depthmap* creates visibility graphs by calculating visibility relations between grid points on the basis of various syntactical analysis measures. Among these, visual connectivity and integration measures are most meaningful to examine the visibility structure in museum gallery layouts and shopping malls. Visual connectivity is based on the mutual visibility of the assigned grid points and represents the degree to which pairs of grid points can see one another. The areas that have a higher degree of connectivity are considered advantageous areas in terms of visual access, which is the information reached from a particular location (Archea, 1977). For museum buildings, visual access indicates the degree to which observers have direct interaction with pieces of art in their neighbourhood. Visual integration as a global measure indicates the extent to which an entire gallery layout would be visually accessible using the fewest number or steps (or through the shortest paths) (Hillier & Tzortzi, 2006). For museum layouts, visual integration is a significant measure as it indicates through which areas an observer might capture a vision of the entire exhibition and spatial layout with minimal effort.

YCBA MoMA



(d) Connectivity graphs



(e) Integration graphs

Figure 4: Comparison of Gallery Layout in terms of their Spatial Layout Properties

In addition to the examination of the gallery layouts with syntactical measures (visual connectivity and integration) the study discussed here also investigated the role of non-syntactical visibility properties on the prediction of space use patterns. To this end, visual field measures are used to demonstrate the extent of visibility from vantage points. The extent of visibility can be described in various ways through visual field polygon measures such as *area*, *perimeter*, *occlusivity*, and *compactness*. *Area* denotes the size of visible region and *perimeter* is the total length of the edges of a visual field. *Occlusivisty* is the ratio of the length sum of the occluding portion of the perimeter to the entire perimeter (Fig 3.). This interesting measure describes the occluding portion of the visual field perimeter that is not defined by real walls, and thus denotes the information behind the corner that could be seen as moved further. *Compactness* is the ratio of area to perimeter, and describes the degree to which edges of a visual field meanders.

2.4. Analysis

If we examine visual integration and connectivity graphs of the YCBA and the MoMA, we can see how visibility structure in each layout is characterized through their morphologies. In the YBCA, two atria voids are largely open to the gallery space with atrium openings at their four sides, higher visual connectivity values are around the atria openings. The atria openings enhance the capacity of seeing neighbouring locations around the atrium. The two atria spaces also concentrate the visual integration in the diagonal direction through the west atrium towards the southeast direction inside the Main Galleries. The room configuration around the two atria defines physical and visual continuity along the longitudinal direction, and moderately high integration values are extended through the gallery doorways in that direction (Fig 4).

In the MoMA, central regions and doorway areas of the gallery rooms are moderately connected to due to visual access to neighbouring locations through doorways. The relationship of gallery spaces to atrium space is very limited; atrium is more generously open to the circulation space than gallery space. This enhances the capacity of seeing neighbouring locations only in the circulation hall, and brings high integration to the south gallery room which is likely visited last in most visitors' itinerary. The interrelationship between the rooms and atrium locate the other visually integrated spaces along the east-west and northwest-southeast (diagonal) directions in the south galleries. As a result, half of the gallery rooms are poorly connected to the rest of the layout.

To investigate the gallery layout's influence on exploratory movement, the visibility properties of each room is correlated with the number of movement lines crossing the rooms. The analysis comparing and correlating the space-use measures with syntactic and non-syntactic properties provided interesting results that explain the influence of the gallery layouts on the space use. The results suggested that in the YCBA's gallery layout movement is strongly associated with visual integration property whereas less strongly related to connectivity. In the MoMA the results are opposite: visual connectivity has a stronger role on the prediction of exploratory movement, but the effect of visual integration is quite weak. These results suggest that the gallery layout of the YCBA predict the exploratory movement through the gallery rooms' capacity of being seen from every other space in the layout. In contrast, the MoMA guides visitors through the visual access to neighbouring spaces, in other words by revealing the visual information step-by-step to visitors (Table 1).

Another interesting result obtained from the analysis of the MoMA is that visitors' explorative movement in scale of visitors' individual space is influenced by minor variations of visibility in gallery rooms. In other words, they are sensitive to changing levels of visual information.

The comparison of movement lines with non-syntactical properties helps understand through which aspects of local visual information, movement might be modulated in layouts. The results show that in both YCBA's and MoMA's layout, *occlusivity* and *perimeter* measures are correlated with movement lines. *Occlusivity* measure denotes the occluding portion of the entire perimeter, and implies the hidden regions behind the corners. The correlation between movement and *occlusivity* suggests that visitors are drawn to the potential to discover the hidden places. The correlation with *perimeter* at the same time suggests that visitors are drawn to exposed wall surfaces (Table 2). These results suggest that the wall surfaces that include displays, along with hidden regions have important roles in modulating movement. These results are quite consistent with the results reporting the influence of visual properties on the direction of movement that standing visitors would choose (Table 3). According to the results, in both YCBA and the MoMA, the potential to explore hidden regions is still an important property that attracts visitors. Along with this property, in the MoMA the exposed wall surfaces attract visitors.

Table 1: Correlation of movement lines & syntactic visibility measures in each gallery in the YCBA and the MoMA

		Visual Integration	Connectivity	
Number of movement lines crossing each gallery	YCBA	0.76	0.60	*R*
		0.000	0.000	*p-*
		0.58	0.36	R^2
	MoMA	0.43	0.68	*R*
		0.047	0.000	*p-*
		0.18	0.46	R^2

Table 2. Correlation of movement lines & non-syntactic visibility measures in each gallery in the YCBA and the MoMA

		Occlusivity	**Perimeter**	
Number of movement lines entering each gallery	YCBA	0.67	0.69	*R*
		0.000	0.000	*p-*
		0.45	0.48	R^2
	MoMA	0.64	0.72	*R*
		0.001	0.000	*p-*
		0.41	0.52	R^2

Table 3. Correlations between Path Ratio and Isovist Division Ratios in the Available Movement Directions at the Choice Locations

		Peri.	**Occl**	**Compac.**	
Movement line ratio in available Directions	YCBA	-	0.58	0.40	*R*
			0.002	0.044	*p-*
			0.33	0.15	R^2
	MoMA	0.45	0.39	-	*r*
		0.012	0.031		*p-*
		0.20	0.15		R^2

3. DISCUSSION

3.1. Implications of the Results obtained from the Museum Case Study

The results provide strong evidence that both the YCBA's and the MoMA's layouts predict the space use patterns through visibility relationships. However, the visual integration as a global property that describes relation of spaces to every other space is not the absolute property that would predict the movement. Instead, the way in which the spatial layout predicts the space-use is very much related to how the morphological properties reveal the visual information in those spaces. These results can be understood further by comparing the YCBA and the MoMA in terms of visual intelligibility and the ways in which local and global visibility properties are distributed.

In the theory of Space Syntax, spatial *intelligibility* is described as the degree to which a gallery layout can be understood through its individual units (Hillier, 1996). This description technically refers to the degree to which global spatial properties of a layout (described by integration measure) can be grasped by an observer through local spatial properties (Hillier, 1996; Hillier & Tzortzi, 2006). With this definition, the spatial intelligibility of a layout is measured by the correlation between its global and local measures. Thus, visual intelligibility of a layout could be described by correlating its visual integration and connectivity values. With this in mind, visual intelligibility values of the YCBA and the MoMA are described by correlating their visual integration and connectivity graph values. The correlation values indicate that in the YCBA's fourth floor, 67% of visual integration values are predicted by visual connectivity values, whereas this value is 56% for the MoMA's fourth floor (Table 4). The stronger correlation found in the YCBA's layout suggests that this layout is visually more intelligible than the MoMA. In addition to intelligibility we can compare the YCBA and MoMA in terms of mean connectivity and integration values along with the number of grid cells designated in each floor that indicates the analyzed

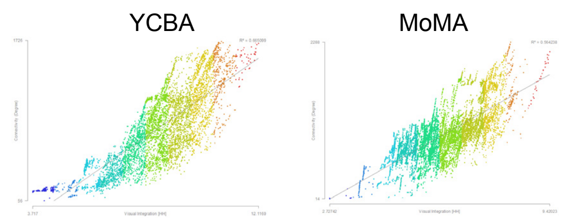


Figure 4. Scatter grams of visual connectivity and visual integration measures in the three gallery layouts

Table 4. Comparison of visual Intelligibility, Mean Connectivity and Mean Integration measures along with the gallery areas measured by number of grid cells

	YCBA	**MoMA**
r	0.82	0.75
$\boldsymbol{R^2}$	0.67	0.56
Mean connectivity	782.58	916.46
Mean integration	8.24	6.08
N. of grid cells	6466.00	11033.00

gallery area. Accordingly, the YCBA layout has lower mean connectivity value in a smaller gallery area than the MoMA has. This is consistent with the gallery layout area denoted by the number of grid cells; the bigger gallery layout would have higher connectivity values in general as the cells would see a higher number of cells. When the mean integration values are compared, we see that the YCBA is generally more integrated than the MoMA. Together with lower visual integration, the weaker visual intelligibility in a larger gallery area indicates that in the MoMA's fourth floor gallery observers would need to explore a larger amount of space in order to grasp the entire layout, as the local properties do not reveal the global properties. In contrast, the highest mean value of the YCBA and highest visual intelligibility makes the YBCA's fourth floor layout can be much easily grasped.

These observations indicate that the YBCA's high capacity to visually link most of the spaces to every other space guides visitors in their exploration. The richness of visual interrelationships between the galleries and the ability to grasp the layout enable visitors to read the displays by visually comparing them with the others across distance and understand the layout without confusion. In this spatial exploration, exposed wall surfaces as well as hidden regions behind the corners attract visitors. In other words, spatial layout can be grasped by visitors through local properties which include directly available and hidden regions. The MoMA's poor capacity to reveal visual information through global properties reinforces the importance of visual information of neighbouring locations. Thus, in the MoMA, the galleries are explored by being guided by visual information revealed step-by-step.

The results concerning the effects of visibility on movement in smaller scale suggest that visitors are sensitive to minor variations in visual information in the scale of their personal space. This can be explained by higher variation of visibility levels in the MoMA's bigger gallery rooms as well as preciousness of visual information within crowded spaces. In the MoMA, exposed wall surfaces seem to be an important aspect of local visual information to guide visitors. This property may explain the potential of displays on the walls to be attractors modulating visitors' movement.

This investigation exploring the effects of syntactical and non-syntactical visibility properties in two illustrative museum layouts confirms that the effects of attractors and layout on movement can be inseparable and synergistic. The layouts can be distinguished in the ways in which they reveal displays which can work as attractors. This difference between the two layouts stems from the layout's capacity of releasing visual relationships from central locations to peripheral ones through atria spaces and room configurations.

3.2. Insights for Planning Shopping Malls

In the case study research discussed above the YBCA's and MoMA's gallery layouts are illustrative of two shopping mall layout types. The YCBA corresponds to a layout where the shopping environment is legible through local visual information to visitors and layout can be grasped without much effort. Opportunities to relate the visited space to every other space help recognize other displays and facilitate encounters with other people. The MoMA illustrates a layout that would guide visitors by revealing the visual information through a temporal progression, grasping only the parts a few steps away during navigation in space.

Both shopping layouts have different advantages depending on design objectives of a retail developer. The former type can be advantageous to offer users opportunities to grasp the space in its totality and feel a stronger sense of community through encounters. In this case, there might be higher chance to be aware of attractors across distance. In the analysis of the YBCA, it is not explicitly observed that the British art displays have effects as attractors. However, if a similar potential of grasping and understanding the space was available in a shopping mall layout, the result could have been different. Visitors in such a shopping mall layout might be attracted to a number of stores of their interest by seeing the iconic store signs from distance. This may create highly explorative behaviour weakening the likelihood of attention to stores in visited locations. On the other hand, visitors in such shopping layouts might be less likely overwhelmed and tired due to easier way-finding and less confusion in the orientation. As can be understood from these potentials, a shopping layout similar to the YBCA's fourth floor gallery might be advantageous for visitors' experience of space as it may evoke the sense of place and motivate exploration, but could be less advantageous for individual retailers to manipulate pedestrian movement to particular stores.

In shopping malls that show properties similar to the MoMA, the layout may reveal only the attractors in the neighbourhood, and global properties may not be grasped until an entire tour is completed. This may provide visitors with opportunity of focusing on the displays in the visited rooms and recognizing mostly the stores in the neighbouring locations. As the total size of the layout gets bigger, limited capacity to view other spaces and the inability to grasp the entire layout may be more overwhelming and thus way-finding and orientation can be problematic. If a shopping mall like MoMA's layout has store units with sizable rooms visitors' movement in small scale can be manipulated with minor changes in visual information, such as visibility of certain displays within crowd or other visual obstacles. With these features the gallery layout with the potentials of the MoMA could be advantageous for retailers whose concern is to attract visitors and facilitate their attention to certain stores or displays, yet could be less advantageous for visitors who need good levels of orientation and who value getting a sense of place and community during a shopping experience.

CONCLUSION

Good levels of legibility and sense of community in shopping mall space increase the popularity of those malls. These qualities may conflict with retail developer's objectives of attracting meandering visitors and thus achieving increase in sales. In shopping mall projects, architects may be asked to develop the shopping mall design fulfil both ends. Shopping malls as popular places increase the potentials for commercial activity, while attracting visitors to certain stores might be important to define the popularity of those stores and optimize rent rates. In order to achieve these ends, a shopping mall layout may need to integrate properties that would bring good levels of legibility, with other properties which limits the global information and makes easier to manipulate pedestrian movement. Our analysis suggests that layouts tend to prioritize one or another property. However, a further study taking the effects of specific attractors associated with certain retail groups into consideration within the methodology proposed in this paper may produce different results and bring a more in depth understanding of how effects of layout and attractors can be utilized to shape user behaviour.

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Use of discrete event simulation in hospital capacity planning

Zhengwei Li, Yeonsook Heo, and Godfried Augenbroe

Georgia Institute of Technology, Atlanta, Georgia

ABSTRACT: In recent years, the healthcare industry is undergoing a rapid expansion in the United States. For healthcare facilities, resource planning at early design stage is a critical step before architectural design. The 'resources' here refer to both long term resources (pods, rooms, beds, configuration of one pod) in terms of capacity and configuration, and short term resources(staffs, equipments) in terms of capacity and allocation. To achieve performance targets defined by the clients, such as staff/equipment/bed utilization efficiency, average waiting time of all patients, turn away rate, an assessment and verification at the preliminary planning stage is necessary. There are at least two methods to solve this problem. The first is analytical in nature, relying on queuing theory, and falls under the industrial engineering field. The other is computational in nature, relying on process simulation, and specifically discrete event simulation. While queuing theory is easier to conduct, usually requiring less data, and providing more generic rules than simulation, simulation methods result in detailed information about patient flow modeling and deliver more accurate results. This paper is divided into three parts. The first part introduces queuing theory and discrete event simulation in terms of their principles, features and applications in healthcare planning. This is followed by a case study in the ED using discrete event simulation to plan pod configuration and number of pods for an emergency department. During this process, the simulation tool is introduced as an example instrument for advanced DES simulation. The paper ends with a discussion of outcomes. (1) DES is capable to differentiate between alternatives with small changes, and can be widely used to do capacity planning for healthcare facilities. (2) the chosen simulation tool supports the modelling and analysis steps well.

Conference theme: Innovations in architecture for health and related facilities
Keywords: healthcare, capacity planning, discrete event simulation

INTRODUCTION

In the United States more than $20 billion will be spent on construction per year by the end of the decade (Roger Ulrich, 2004). Increasing patient satisfaction has become an active research theme, one of the goals set by these researches is to reduce waiting time patients spend in hospitals (Jones, 1994; Anthony, 2001). On the other hand, maximizing resource utilization efficiency is a critical operational target of hospitals. Some resources like rooms/pods depend on long term static investments, whereas other resources are based on short-term and flexible investment decisions such as equipment and staff. These two goals typically conflict with each other, therefore, a detailed capacity planning process needs to be conducted before preliminary architectural design stage.

Traditionally, there are two methods to do resource capacity planning for healthcare units. The first method uses queuing theory. Methods in queuing theory can further be divided into either simple queuing theory (typically there is only one queue), or queuing network theory (composed of several queues). A simple queuing model has only one queue and one server, but it can be extended to multiple servers and priority queuing. As early as 1971, Gupta et.al (Gupta, 1971) used queuing theory to solve the problem of multi-server, single queue problem. Daniel G. Shimshak et.al (Shimshak, 1981) conducted a staffing analysis for a pharmacy unit using three models (normal queue without priority, priority queue with non-preemptive service, priority queue with preemptive service). Green(2002) concluded that as a general model M/M/s is widely applied to service industries for capacity planning purposes. This model assumes an unlimited queue with n servers. Typical assumptions are that arrivals occur at a Poisson process, and service time has an exponential distribution. On the other hand, queuing network theory is a more complex theory, in which servers are represented as nodes, all the nodes are connected in a network, the status of the network is represented by the number of customers in each node. It has been used to help analyze a regional hospital system in Philadelphia (Koizumi N, 2005). Compared to one queue problem, the solution process of queuing network theory requires much more effort.

Compared to queuing theory, discrete event simulation has the advantage that simulation can optimize resources or schedules by comparing different alternatives, while queuing theory can only get an optimized value (Lowery, 1998). Jun et.al (1999) divided this research area into three categories: patient scheduling and admissions, patient routing and flow schemes, and scheduling and availability of resources.
In the patient scheduling/arrival study, Smith and Warner (1971) found that with a uniform arrival rate, the average length of stay can be decreased by over 40%. Ming Guo et.al (2004) used the average/maximum patient waiting time, and staff utilization level as main performance characteristics, to compare several out-patient scheduling types. Similar work can be found in Klassen(1996), but with different simulation approaches. Blake et.al(1996) used DES to analyze the emergency room of a children's hospital, they found that using 'fast track' and increasing physician hours can decrease the patient waiting time.
Another active application of DES is resource planning. Giorgio et.al (1987) used DES to simulate a children ward in Italy, to give optimal number of beds and number/organization of nurses. Harris et.al(1985) use DES to plan the bed requirements for a operation theater in South Wales. Klafehn et.al (1989) find that moving a nurse from a regular emergence area to a triage position reduces the number of waiting patients.
However, the simulations mentioned above basically run behind the screen, they didn't deploy visual animation. Advances in software industry have made this possible in recent extensions. Some of them have been particularly applied to healthcare industry, such as MedModel (Deney,1997; Charles ,2000), ProModel(Charles,1992) and Arena(Guo,2004).
To summarize, both DES and queuing theory can be applied to solve resource planning problems. Queuing theory is more straightforward, requires less effort, but has limitations in handling complex healthcare environments. On the other hand, DES is capable to solve complex problems but requires more time to deploy, in particular to build the process model. However, with the advances in software industry, the time taken to build the model is tending to reduce. This paper explores the use of a more recent simulation package on healthcare planning processes, using the real life ED planning for a new hospital as a case study.

1. CASE STUDY

1.1. Problem Statement

The new hospital is in the design programming stage. We focus on the ED of the hospital, where both ambulance patients and walk-in patients arrive randomly. The total patient arrival rate is assumed to be known, based on the data from previous years (Fig. 1). The ratio of ambulance patients and walk-in patients is assumed to be 1:9. Also assumed to be known are the patient disease distribution (Table 1) and patient ESI (Emergency Severity Index) level distribution (Table 2). An ESI level is an index associated with a patient, to group him/her into five groups, from 1(most urgent) to 5(least urgent). The patient flow process is shown in Fig. 2. In all the queues of the system, patients with ESI level 2 have higher priority than patients with ESI level 3 and 4.
The first design question is: what is the best pod configuration? One possible choice is 'pod without sub-waiting room', where each patient occupies the bed until he/she is discharged. The competing choice is 'pod with sub-waiting room', where each patient releases the bed when he/she leaves the pod for other care processes, after comes back, he/she will occupy another bed in the same pod. In case that there is no bed temporarily available, he/she waits in the sub-waiting room.
The second question is related with the first one. After the best pod configuration is chosen, how many pods in the ED and how many beds in a pod are optimal? Because the hospital needs at least one pod for gynecology patients and one pod for psychiatric patients, these two pods are fixed in this study.

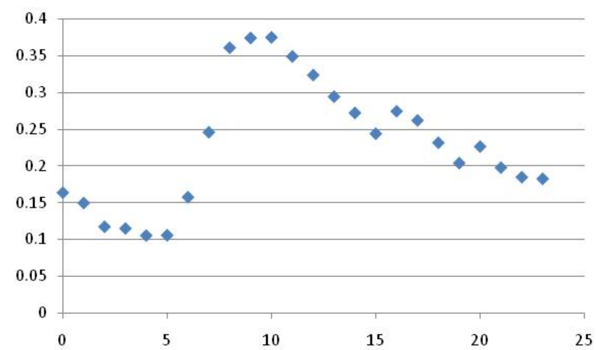

Figure 1: Total Patient Arrival Rate (unit: per/min)

Table 1: Patient Disease Type Distribution

Disease Type	*Walk-in*	*Ambulance*
Psychiatric	0.15	0.15
Gynecology	0.04	0.04
Trauma	0	0.005
Other	0.81	0.805

Table 2: Patient ESI Level Distribution

ESI Level	*Walk-in*	*Ambulance*
1	0	0.005
2	0	0.295
3	0.107	0.7
4	0.763	0
5	0.13	0

1.2. Simulation Approach

We conducted a discrete event simulation to solve these two problems using Anylogic 6.3.1, a java based simulation package from X-logic. Fig.3 illustrates the process flow charts of this model. The top shows the overall flow chart. Each patient enters the process from a source, then goes through care processes based on

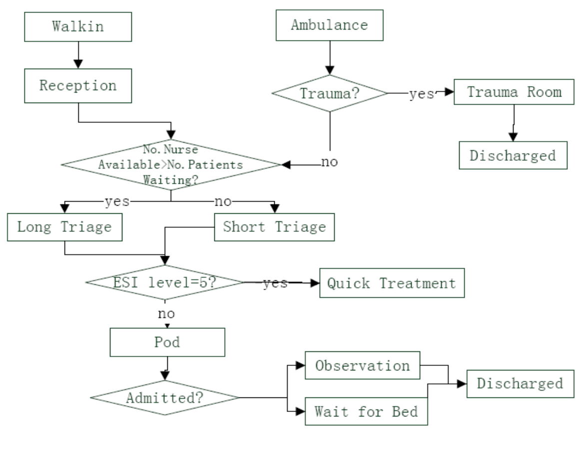

Figure 2: Patient Flow Process Chart (walkin and ambulance)

Figure4: Model Runtime Screenshot

his/her disease type and ESI level. Sub-processes (reception, triage, examination…) are modeler created blocks, composed by software built-in components. For example, reception block is composed by two smaller blocks: waiting_checking and action, both of them are made by basic components(See Fig.3). Using this modularized modeling approach, debugging becomes much easier.

Another advantage of the software is the ability to change resource parameters real-time. One can, for example, change the number of nurse back and forth. In this way, it is easy to find where the bottleneck is. An example of animation screen is shown in Fig. 4: on the left is the animation screen, and on the right top are the radio buttons, by which the number of nurses can be changed during the runtime, and at the bottom shows the average utilization rate of doctors and nurses during the running simulation.

1.3. Simulation Results

As said above, simulations are set up to provide answers to two questions:

(1) What is the best pod configuration?

There are three options as candidates:

- 10 examination room without sub-waiting spaces
- 8 examination rooms with 5 sub-waiting spaces
- 6 examination rooms with 5 sub-waiting spaces.

(2) For the best pod configuration, how many pods are most cost effective?

It is recognized that different pod configurations should be compared under the assumption that the total number of beds is the same or at least close. To answer question 1 and 2, a total number of 14 scenarios are modeled and simulated:

- 10/11/12/14/16 pods, with each pod having 8 examination rooms with sub-waiting space for 5 patients
- 12/13/14/16 pods, with each pod having 6 examination rooms with sub-waiting space for 5 patients
- 10/11/12/14/16 pods, with each pod having 10 examination rooms.

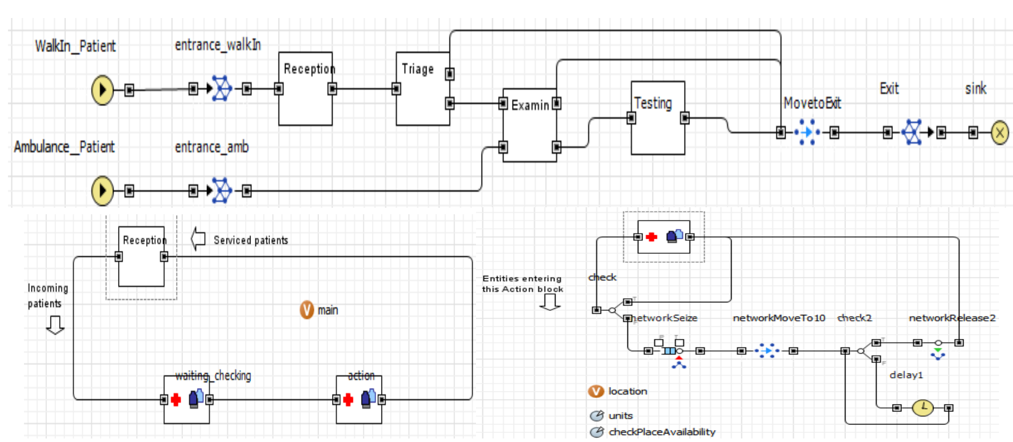

Figure 3: Process Flowcharts in Anylogic

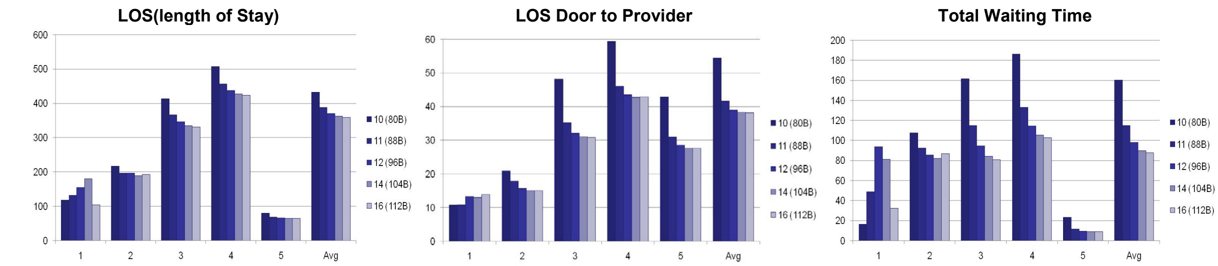

Figure5: LOS, LOS Door to Provider, total Waiting Time for 8+5(units: mins)

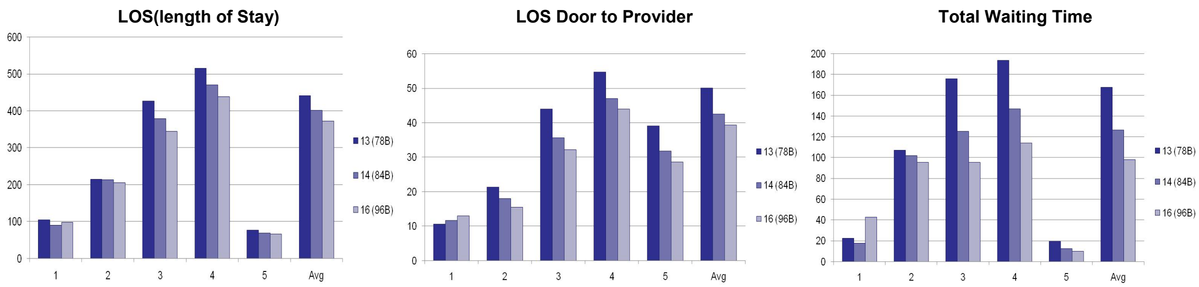

Figure6. **LOS, LOS Door to Provider, Total Waiting Time for 6+5(units: mins)**

To measure the through-put performance,six criteria are introduced. They are

- Average LOS (length of stay)
- Average LOS from Door to Provider
- Average total waiting time
- LOS for each ESI level patient
- LOS Door to Provider for each ESI level patient
- Total waiting time of each ESI level patient

1.3.1. First Configuration: 8 exam rooms with 5 sub-waiting spaces

The performance results are presented in Fig.5. Level 1(trauma) patients are treated differently compared with other patients, so they are not discussed in the following part. Level 5 patients don't go through any testing process, and the treatment process is very simple, so their LOS and waiting time are the lowest. Among level 2, 3 and 4 patients, level 2 patients have the lowest LOS, LOS door to provider, and waiting time, due to their higher priority in getting resources.

From Fig 5, it can be seen that increasing the number of pods from 10 to 11 has the biggest impact on performance, a further increase of pods has basically no effect on the performance. Therefore, for this configuration, the optimal number of pods Is 11, the corresponding bed number is 88.

1.3.2. Second Configuration: 6 exam rooms with 5 sub-waiting spaces

The performance results are shown in Fig.6. It can be seen that from 13 to 14, and from 14 to 16, there is a steady increase in the performance. It is estimated that further increase from 16 will have only minor impact on the performance. This is not studied here, because the maximum number of pods was initially limited to 16 based on other considerations in the planning phase

1.3.3. Third Configuration: 10 exam rooms without sub-waiting spaces

The results for 10 exam rooms without sub-waiting spaces are shown in Fig7. Increase from 10 pods to 11 pods makes the LOS door to provider and total waiting time apparently lower, however, the total LOS is almost not affected. Increase after 11 pods has no further effects.

1.3.4. Comparison Of Different Pod Configurations

- 8+5 v.s. 6+5

From Fig.8, it can be seen that the configuration 8+5 and 6+5 basically follow the same rule: bed number determines the capacity, although there is one exception that 8+5 with 80 beds has higher LOS door to provider than 6+5 with 78 beds.

Considering the overall performance, it is fairly safe to conclude that there is no significant difference between these two configurations

- 8+5 v.s. 10+0

For configuration with 10+0, only 10 and 11 pods cases were simulated. It can be seen that although 10+0 with 10pods has higher bed number than 8+5 with 12pods, it has poorer performance in both LOS and LOS door to provider. In terms of total waiting time, there is no significant difference between these two configurations. Based on this result, it is concluded that 10+0 configuration is not as good as the other two configurations.

To summarize, pod configuration with sub-waiting spaces have higher performance than those without sub-waiting spaces. There is no obvious performance difference between configurations with 8 beds per pod and 6 beds per pod.

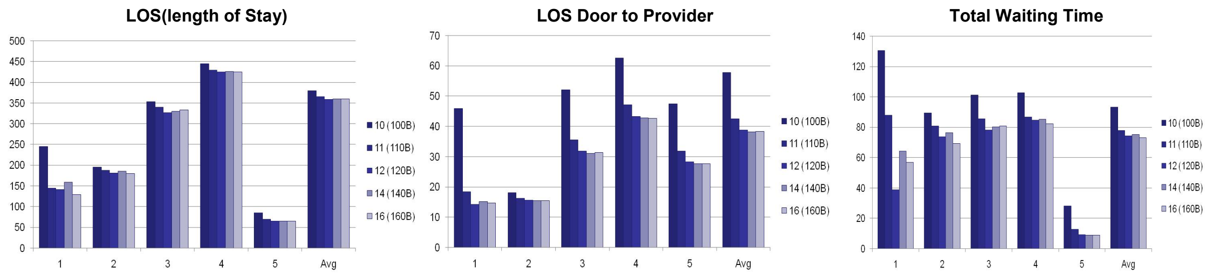

Figure7. LOS, LOS Door to Provider, total Waiting Time for 10+0(units: mins)

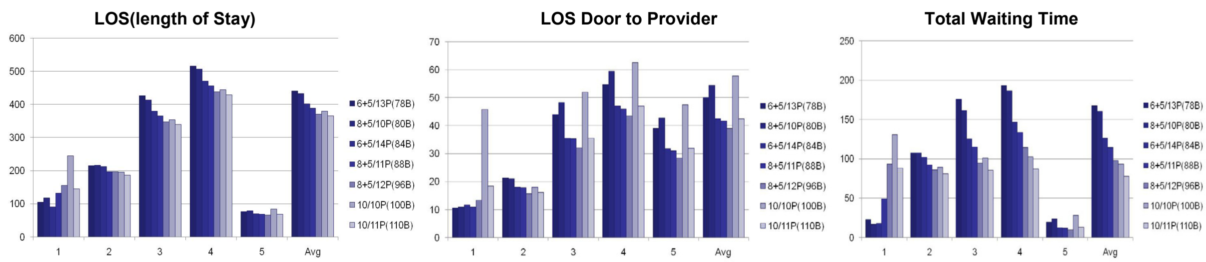

Figure8. Comparison of all three configurations (units: mins)

Based on the findings from the simulation, our answers to the question 1 and 2 is that, using either the 6+5 or the 8+5 case, the optimum number of pods is either 14(6+5) or 11(8+5).

CONCLUSIONS

In this study, an ED case study is used to demonstrate how DES can be used to support general capacity planning problem. Three performance measures: Length of Stay, Length of Stay from door to provider and total waiting time are used to compare different alternatives. It is found that configurations with sub-waiting spaces perform better in terms of LOS and LOS door to provider. The total waiting time is affected dominantly by the total number of beds. Based on the performance, either 14 pods with 6+5 configuration or 11 pods with 8+5 configuration is recommended. A further check to whether the 6+5 or 8+5 variants score better on other design outcome criteria requires more detailed information, which can't be known at the planning and design programming stage.
Further work is planned that will deal with those stages, inspecting cost benefits of different layouts, staffing, etc.

ACKNOWLEDGEMENT

The authors sincerely thank Prof. David Cowan in the Health System Institute at Georgia Tech for his great help and contribution. Also thank all colleagues and students that are involved in this project.

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Architecture Design & the Historic Landscape

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Lisa M. Tucker, PhD

Virginia Polytechnic Institute and State University, Blacksburg, Virginia

ABSTRACT: A group of Minnesota architects created the ASHSB in 1914 to provide a solution for the shortage of middle class housing in the U.S. By 1919, the bureau had offices throughout the U.S. and received the endorsement of both the American Institute of Architects and the Department of Commerce. During this time, the members of the Bureau produced hundreds of plan sets and monthly bulletins to assist homeowners with their housing choices. The monthly magazine *The Small Home,* in conjunction with the published plan books--*Your Future Home* and *How to Plan, Finance, and Build Your Home*--dispensed valuable information to potential homebuyers across the nation. To date, one master's thesis (Lisa Schrenk, University of Virginia 1990) and an article (Thomas Harvey, 1991) have been written about the ASHSB. Neither one discussed the relationship of this group with the AIA, a key endorsement agency.

This research involved extensive archival research at the AIA. Records from the early 20th century were analyzed to determine the relationship between the AIA and the ASHSB in the early 20th century. This relationship provides insight into the current lack of architectural involvement in single-family house design today.

The single most prevalent building type in the U.S. is the single-family house, yet architects are little involved in the design of most of them. Architects have the ability and training to create sustainable, affordable, and well-design single-family houses and yet they do not. This paper seeks to provide one explanation through the interpretation of the historic relationship of the AIA to the ASHSB.

Conference theme: Architectural design and the historical landscape
Keywords: architects, house, design, practice, history

INTRODUCTION

This paper examines the relationship between the Architects' Small House Service Bureau (ASHSB) and the American Institute of Architects (AIA) in the first quarter of the twentieth century. The historical positions adopted by members of the AIA during this period of time have had a significant impact on the current single-family house design market in the United States. Of examination of these issues underscores the need for architectural leadership in this arena both in the past and today.

1. BACKGROUND

1.1. Architects Small House Service Bureau

Following World War I, there was a critical shortage of housing in the U.S. In an effort to improve the design of the single-family house and capture a new market share for the professional designer, a group of four architects from Minneapolis, Minnesota started the Architects' Small House Service Bureau (ASHSB). To date only two publications have been written about the ASHSB. These include a master's thesis completed by Lisa Schrenk at the University of Virginia in 1988 (parts of which were later published as a preface to the AIA reprint of an ASHSB plan book in 1992) and a short article in *Landscape* by Thomas Harvey in 1990.

1.2. The American Institute of Architects

The American Institution of Architects was the first iteration of an organization for architects. The Institution first met in 1836 and highlighted the lack of distinction between architects and builders—including both constituents--and was short-lived as a result of the internal and territorial conflicts. Charter members of the American Institution of Architects included William Strickland and Robert Mills as well as Thomas U. Walter and John Trautwine representing office-trained architects and Asher Benjamin, Minard Lefever, Alexander Parris and Ithiel Town, representing the master builder-turned architect contingent. The tensions between these two groups of men resulted in the organization's demise the following year. The goals of the Institution were to stress the scientific principles of architecture that made it a viable profession. They encouraged testing of architects in order to become a member (Woods 1999).

In 1857, Upjohn's office hosted a pilot meeting for the second iteration of the professional organization, now renamed the American Institute of Architects (AIA). Most of the early members worked with or were associated with Upjohn's office. One notable exception, Richard Morris Hunt, received his training at the École des Beaux Arts. The two primary issues upon which the association focused were fees and competitions (Woods 1999). Both of these issues related to the realities of practicing architecture within the American capitalist system. Members attempted to create a framework whereby AIA members could receive compensation for competition entries that multiple government agencies solicited for free. In addition, the AIA members worked several years to establish a fee schedule to insure all members charged the same rates. (This was later repealed on the basis that the AIA was violating anti-trust law.)

Restructured in 1866, the AIA had dropped in popularity by the 1880's. Many architects viewed the organization as a gentlemen's club and as not very representative of all architects. Western architects such as Louis Sullivan, Dankmar Adler, Daniel Burnham, and John Root created their own association in response to the AIA. The Western Association of Architects, founded in 1884 and centered in Chicago, included 100 architects from fourteen mid-western states (Woods 1999). The Chicago-based group focused their attention on architectural design competitions (like the AIA) and, unlike the East coast architects, licensing. After a few years of vigorous conventions, the WAA merged with the AIA in 1889. Architects in the mid-west continued to pursue their licensing cause, however, and by 1897, the first licensing law was established in Illinois. By 1900, fifteen other states followed suit as licensing was replaced by registration laws. Despite this, the AIA resisted endorsing licensing for architects voting down measures to do so in both 1904 and 1906 (Woods 1999).

According to the AIA website, the AIA actually began when Richard Upjohn held a meeting of thirteen architects in his New York City office on February 23, 1857 (AIA website 2008). One of the first actions of the group was to restrict the use of the term "architect" which until this time was used by masons, carpenters, and builders. This move helped to limit membership in a way that the Institution had not done in the 1830s. At the first meeting, the original members created a list of sixteen additional architects to invite to join the Institute with the goal of elevating the profession (AIA website, 2008). By the late 1870s the organization had chapters in Chicago, Baltimore, San Francisco, Washington D.C., Philadelphia, and Boston. The first AIA convention was held in 1861. At this time, the AIA had thirty-two members and four associate members. Annual convention meeting proceedings were published until 1931 (AIA website, 2008). Membership grew gradually and with the advent of formalized education for architects in the university system that produced more architects, membership had grown to 11,500 by 1957 (AIA website 2008).

The Headquarters of the AIA moved to Washington D.C. in 1898 and operated out of the historic Octagon House (AIA website 2008). The current headquarters building is located behind the Octagon House, still owned by the Institute. The archives of the AIA are stored in the new headquarters building in Washington D.C.

1.3. AIA endorsement of the ASHSB

Initially, the small house issue was referred to simply as "housing." The first overt use of the terminology "small house problem" appears to occur in 1919 when the AIA voted to endorse the Architects Small House Service Bureau (ASHSB). From this point until well into the late 1930s, ordinary single-family house design became known as "the small house problem." The terminology evoked the complexity of the situation that stemmed from a pronounced shortage of housing following World War I coupled with the shoddy construction across the nation that resulted from efforts to meet this need.

Shortly after this term was first used, the board of the AIA created the "House Committee" that later became the "Small House Committee" or the "Sub-Committee on the Small House." The Board of the AIA charged this committee with addressing the "small house problem" and with suggesting solutions. Until 1933, the Small House Committee's concerns were aligned with and to some degree addressed by the ASHSB. In 1934, however, the AIA voted to revoke its endorsement of the ASHSB. At this time the Small House Committee undertook to create its own group to provide plan services headed by the AIA. Specifically they addressed whether architects could and should be involved in single-family house design, and if so, how.

Finally, near the time of the convention of April 1935, the Small House Committee was absorbed into the larger body of the Housing Committee. At first reports were given by the Small House Committee and the General Housing Committee (that focused more on large-scale housing). By the 1940s, the Housing Committee dropped its interest in the small house specifically and became more engaged in the issue of large-scale housing developments, particularly multi-family housing blocks.

For a brief time in the early twentieth century, the AIA chose to outsource the small house problem and aligned itself with a group of residential architects. Between 1919 and 1934 the AIA endorsed the Architects Small House Service Bureau. Although the endorsement was brief, this represents the only time in history when the AIA members voted in favor of a uniform solution to the single-family house design problem, as they perceived it, in the U.S.

The primary reasons many AIA members cited for revoking the AIA endorsement were as follows: (1) The ASHSB was in competition with AIA members and (2) The AIA could not control the quality of the ASHSB drawings and designs. Some members hoped they could recreate their own version of the ASHSB under AIA control and supervision. A leading proponent of small house design was Walter McCornack who chaired the Small House Committee during the 1930s.

Following the Great Depression, the endorsement was ultimately revoked on the grounds that it amounted to direct competition with individual architects (Schrenk 1988). The ASHSB itself finally disbanded in 1942 having never recovered from the lack of continued AIA endorsement.

1.4. Themes found in the documents

A careful analysis of documents from the early twentieth century records of the AIA reveals the complexity of the issues facing the architecture profession with regard to the ordinary single-family house. These issues include the relationship of architects to builders, the prevalence of easy to obtain pattern books and house plan designs, the education, training and culture of architects and how this impacted their views about architecture, and the manner in which houses are constructed in the U.S.

The majority of the themes found in the AIA documents focus on the search for solutions to the house design problem, albeit with an underlying pessimism. It becomes apparent from the documents analyzed that architects could never fully agree on the importance of the issue or that the problem could and should be solved by the AIA. Some went as far as to say architects were not even qualified to engage the issue.

Many of the documents revealed several of the same themes or codes. A notable exception to this included the earliest documents mentioning small houses reviewed where some of the early codes changed in later documents. The first mention of small houses and their possible relationship to architecture occurred in 1914 in a letter from W.A. Etherton:

> There has been a great demand for the working drawings and specification of the little four room house published last spring. These are being prepared and will be published. Just how far to go with this kind of work we have yet to decide, and I have hoped to have the assistance of the Institute in this matter." (Etherton 1914)

The immediate response to small house design was an outpouring of enthusiasm wherein architects viewed small house design as their civic duty as architects in a democracy. Everyone deserved a safe and well-designed house to live in and architects could provide this service.

> The Housing Book, which has now been published is meeting with a steady and increasing sale and the committee looks forward with confidence to the ultimate distribution of thousands of copies of this book and the fast and increasing number of men and women who are now ready to cease the superficial methods with philanthropy and charity have approached the problem of the past and adopt, instead, a broad program of constructive character, such as will be in consonance with the ideals of democracy. (Proceedings 1918)

The first resolution with regard to single-family houses made by the American Institute of Architects membership took place in 1918.

> Be it Resolved that the Board of Directors request the proper Committee of the Institute to formulate a plan looking toward the development of a better and more harmonious architectural character in small dwelling houses throughout the country; and to recommend the best means for the education or instruction of the public as to what it should have and may get in inexpensive houses. (Proceedings 1918)

At the time of the resolution, there was no appropriate committee to handle the charge. As a result the issue was left to the new incoming Board, and in 1919, the Small House Committee was formed.

In 1922, Edwin H. Brown of Minnesota addressed the AIA convention with the purpose of requesting the AIA's recent endorsement for the Architects Small House Service Bureau (ASHSB). In his address, he refers to the resolution of 1918, the committee formation of 1919, and how the ASHSB meets the needs of the AIA. At the time, the ASHSB reached two million readers a week with its house plans and questions and answer columns in newspapers around the U.S. (Proceedings 1922).

1.5. 1919-1934: the endorsement he ASHSB

The AIA membership did come to an apparent agreement about how to approach the single-family house design problem for a few years when they voted to endorse the Architects Small House Service Bureau.

Unfortunately, the original sense of enthusiasm and duty by AIA members on behalf of the single-family house was short lived. By 1924, interest in the ASHSB by AIA members was still minimal. In the meeting minutes from that year, the Small House Committee Report read as follows: "The Board regrets that so few architects have taken a real interest in this valuable movement and that Architectural magazines as well have shown no interest." (Proceedings 1924). At this time fewer than 100 architect members were involved in the ASHSB. While the AIA continued its endorsement for another nine years, the fate of the ASHSB was sealed. By the beginning of the 1930s, the issue of the ASHSB became an openly contentious one. Several members spoke in favor of continued endorsement citing several reasons to participate: working with people on a small house may lead to larger commissions, this type of work was fun for architects, and this type of work could educate people about what an architect could provide. Even those speaking on behalf of the ASHSB within the AIA acknowledged however that there was no money to be made in this type of endeavor and that many local chapters had not been able to participate with the ASHSB as a result. Thus, what had once seemed a civic duty of architects did not appear to be a viable option in practice for many individual architects.

As economic times worsened, architects in the AIA opposed to the ASHSB became more verbal. In 1934, several architects spoke out against continued endorsement of the ASHSB. "The main reason it [the ASHSB] has not succeeded is because architects with initiative and ability to design, refuse to become subservient to the stock plan idea." (Meetings minutes 1934). Another architect speaking on the subject reported the following:

> Most people buy their small houses already built. The Bureau has not been able to control this class of construction to any degree. The individual who thinks enough of his future home to buy a lot and build his own house should be discouraged from purchasing his stock plan from any source whatever. (Meeting minutes 1934)

This discussion ultimately led to the following resolution by the AIA National Convention attendees:

> RESOLVED That the Institute's endorsement of the Architects' Small House Service Bureau be withdrawn as soon as is practicable and fair to do so, but no later than October 1, 1934 and be it further
> RESOLVED that the institute continue its efforts to improve the design of the American small house; and that the special committee be continued and urged to make a thorough study of the entire small house problem in all its aspects. (Proceedings 1934)

Following the AIA's revocation of the endorsement, the AIA membership continued to discuss the "small house problem" for several years. The emergent themes from this time period between 1934 and the 1940s were highly consistent. The document review led to many codes associated with problems and outside forces over which architects seemed concerned that they may not have control. These included the need to educate builders, clients, industry, lenders, and the government about architecture and the value of the architect's services, the need to make money in the single-family house market, and the need to come up with a plan to get this type of work. The focus codes developed as a part of this document review are as follows: lack of architects' involvement, warning to architects about their lack of involvement, the pros of working on the small house problem, the need for better small house designs, the solutions found by working with others, the hope for a solution, the need to educate others about architecture, and the analogy to the medical profession.
For the next five years, members of the Small House Committee worked diligently to come up with such a plan. These plans were frequently met with member suggestions and complaints. Several members felt that the AIA should educate others about what architects do.
AIA members frequently cited education as the single-most important thing that the Institute could do with regard to single-family housing design and architectural involvement. They mentioned the need to educate government officials, the public in general, builders, industry and lending agencies. Through education, those they educated were expected to then hire an architect once they knew what an architect provided. The AIA members viewed their value as self-evident and once appreciated, it would lead to work.

In the 1934 Report of the Special Committee on Small Houses, the members communicated the following to the board of the AIA

> The Committee believes that the best contribution the Institute can make toward the improvement of small house design is the publicizing of the value of architects' services. Stock plan service offered by commercial agencies is generally incompetent and inadequate. In opposition to such service the Institute should undertake to educate the builders of small houses and those who finance their construction to a realization of the economic value of good design and sound construction; to an understanding that good design involves not only competent planning of the house but also its relation to the lot, to adjacent houses, to the neighborhood, and the landscape treatment. (Report to the Special Committee, no date)

The 1938 Report of the Sub-Committee on the Small House Problem recommends: "Let's spend an equal amount of effort and money to educate the public in appreciation of architecture." Dalzell, the author and chair of the committee at the time, provides several means by which this can be accomplished including Architecture Appreciation Courses in all centers of adult education, architecture appreciation in high school curricula, cooperative advertising with manufacturers, taking a greater interest in architectural education at the college level and increasing licensure requirements for architects (Report 1938).
Interestingly, even when architects were successful at educating others of their value, they did not necessarily gain market share as a result. The May 1935 Report of the Committee on Small Houses, demonstrated this result in the following "…the officials of the Federal Housing Administration are convinced of the value and desirability of architectural advice and service for those who finance home building under the F.H.A. guarantee, but that they cannot *require* such service." (Report 1935). In other words, some AIA members realized that even with education, they were unable to claim a monopoly on design services.
A particularly poignant example of a failure to educate was noted in remarks made by McCornack:

> …the Committee referred to a point this morning regarding the value of service rendered to the American pubic on the theory that 56% of the laws of this country are written by legislators who are without the benefit—and I might say, without the knowledge of an architect; and I am inclined to think that the continued refusal of the profession to recognize the fact that we have a small house problem in communities where no architects exist, or where they do exist where they have no experience with the small house, would be suicide. Whether you believe it or not, we are facing in this country, the profession is, a very dangerous situation. (Remarks, no date)

While acknowledging the need for architects to take the small house problem seriously, McCornack also points out that the majority of laws being written were composed without a knowledge of an architect's role in the building process. This failure to educate the legislators had a direct correlation to the ultimate failure of architects to create and maintain a monopoly over building design services. McCornack further warns AIA members "12,000 architects cannot afford to sit idly by and see the great mass of the American people continue without proper service and without knowledge of what the profession can do for them." (Remarks, no date). He continues with an example of government regulation of the profession:

> We are facing, also, this situation—that government agencies are taking away from the profession the right to supervise, and when you realize the definition of an architect, that he is a 'master builder', and when you take away from him the experience of putting his plans into materials, you simply take away the life of architecture. (Remarks, no date)

As laws and building codes were put in place across the U.S., some architects realized their roles were being controlled through legislation that came without an understanding of what an architect did. Powerful lobbies on behalf of builders, engineers, and corporations argued for their rights to provide design services on par with architects and ultimately succeeded in convincing lawmakers that this was true.

As a relatively new profession, the AIA membership made several references to the medical profession as a model for educating the public and as a profession that was well understood. These AIA members felt that if they followed this model, they too would be a valid profession in the eyes of the general public. An example of such a reference occurs in a letter from W. R. McCornack, the Chairman of the Housing Committee at the time to Albert Mayer of New York City: "I feel that the first duty of the profession is to the building public and that we must solve the problem of extending architectural service to all small home builders in America. The medical profession is finding a way to give medical attention to most of our people today." (McCornack 1936).

Unfortunately for the architecture profession, few codes related to how to accomplish these goals. There were several instances of disagreement and, in some cases, polarization of beliefs as to whether architects should produce plans for ordinary single-family houses. An example of a typical negative comment by a committee member is as follows: "If architects wish to enter the small house field, they should learn something about housing. Nine tenths of the Architects are decidedly ignorant and unqualified." (Document 1938). This animosity led, in some instances, to minority reports without full committee support as well as the final dissolution of the Small House Committee that had attempted to address the issues for nearly thirty years.

Throughout the documents, multiple members of the AIA discussed the lack of architectural involvement in single-family house design. Among the reasons for this were apathy, a lack of money to be made, a preference for larger and more public commissions, and that builders already had most of this market in hand. A typical example can be found in the 1934 Special Committee on Small Houses Report: "The Committee now reports its inability to devise a practical method of distributing the plans of the Bureau [ASHSB] only to and through qualified architects for the following reasons, some of which will be recognized as having been advanced by the former Committee…" (Report, 1934). The reasons listed included an inability to define what a qualified architect was, not enough members of the Bureau, impossibility of competing with existing stock plan services, and an inability to make any money doing this type of work.

Another example of this occurs in a memorandum for all the members of the committee on housing dated December 9, 1935 from R. H. Shreve, Chairman of the Committee on Housing. "…in other words, failure up to this time to get Architects into the field of the Small House is thought to be due to the Architects themselves rather than to any lack of opportunity."

It becomes clear that some architects in the AIA were struggling with wanting to change the situation yet not having the means or knowledge of how to go about it. Those vocal members who did not want to participate in the first place further complicated the issue, as demonstrated in dissenting views contained within the April 1939 Sub-Committee Report.

> Frankly, I cannot see what the furor is about. Good small house plans are published in the professional home building magazines. These plans are available from architects who design them. If supervision is required in the localities where there are no architects let it be done by one who would do it under the Home Loan Bank plans. (Report 1938)

A much more blatant sentiment is expressed in an opinion solicited by the Small House Committee for the same report "I am unalterably opposed to our Committee endorsing any stock plan service, or any other half-way service. If it does, I will submit a minority report at the Convention." (Report 1938).

Other members of the AIA went so far as to warn architects about their lack of concern over the small house problem. One such warning was found in a memo to each chapter president dated March 8, 1937. "Unless some action is taken by architects, they will find themselves gradually being eliminated from the home building field and supplanted by plan service departments in government agencies, or by industrial or financial groups organized to supply plans." (AIA document 1937). This memo continues with a section entitled "Importance to the field" and one enumerating the reasons why architects should be involved in house design. The memo concludes with a statement that describes the results of ignoring the small house problem.

> If the architects do nothing then the consequences are obvious and disastrous. The trend is towards group housing, and if architects continue to ignore the single house and its owner, who is too often the victim of unregulated agencies operating on a basis

> of self-interest, the architects will be forgotten when group housing developments come. We spend a lot of time tying to eliminate government architectural agencies after they are created. This affords us an opportunity to prevent the formation of any more. (AIA Document 1937)

This memo highlights the situation at the time where no one was protecting the consumer in the house building market. This was true in 1937 and remains predominantly the case today.

In another instance, Kenneth Dalzell, Chairman of the Sub-Committee on the Small House Problem wrote the following in April 1938: "It is time for the architects of this country to wake up, or we will all be practicing architecture at draughtsmen's (sic) wages for a lot of illiterate speculators with whom the public seems to prefer to do business." (Report 1938).

The primary benefit that architects voiced in support of participating in the small house market repeatedly cited for working on single-family house design was that it provided a good opportunity for young architects first entering the field. It was also seen as a way to provide work in offices during slow times, particularly in the early 1930s. This is stated clearly in a report of the Small House Committee:

> The Committee believes that a plan can be worked out which will start the young architects in this country on their careers and may lead them into smaller communities where there are opportunities for them. The Committee also calls attention to the fact that many architects starting in the small house field gradually broaden their practice into other types of work. (McCornack 1938)

Architects routinely spoke of the need for better design in single-family house design. In a memorandum for the Members of the Committee of Housing, R. H. Shreve summarizes this perceived need: "Improve the standards of construction which they [the Government] believe will be accomplished by the engagement of competent architectural service…" (Memorandum 1935). Architects also equated their own services with the solution to this need. Other specific needs which architects spoke about at annual conventions included the need for plan sets in rural locations where there were no architects, the need for architects to provide drawings because stock plan sets were incomplete, the need in general for architects, the need for an economic solution to the issue by which architects could make money, and the need for better housing.

Less clear from the documents were any solutions that could be provided by architects. In fact, most proposed solutions relied on someone else's cooperation with architects. For example, working with government officials to make them want to hire architects was seen as the solution for better housing under government programs. Architects also proposed that they work with lending agencies, again, so that architects would be required for single-family houses designs in order to get a loan. These objectives are included in a draft report of the Committee on Housing of the AIA:

> The first step accomplished in the direction of better service in this field has been to establish cooperation between the Federal Housing Administration, the Federal Home Loan Bank Board, the Owners' Loan Corporation, and The Institute, in beginning the study for a program or service to the small house owner on a basis satisfactory to the profession and within the scope of sound business procedure and the standards of our practice…It is quite obvious that plans, specifications, and supervision will be provided in some degree for the great mass of prospective house builders in this country by some agency, either in the governmental bureaus or outside of them, or by the architectural profession. (Draft Report 1937)

Ultimately, these efforts proved unsuccessful and the federal programs would not make architectural services a required component of their individual house design and lending programs.

Almost yearly during this period, some architects would express hope that a solution could be discovered to improve single-family house design in the U.S. While there was a great deal of discussion over the need for and the hope of a solution, less discussion focused on actual solutions beyond the ones mentioned above. Combined with the hope for a solution was frustration over disagreements about a solution. McCornack—who had headed the Small House Committee-- expressed this in a letter to the Executive Committee of the AIA written in 1939: "It is to be hoped that the program, slowly taking form, will end for all time the controversy over the small houses program." (McCornack 1939).

Throughout the AIA documents, there is recognition that architects are not designing the majority of single-family houses and that speculative builders were responsible for most houses. A survey conducted by the Executive Committee of the AIA and sent to all State Chapter Presidents in 1938 revealed that perhaps 5% of all houses were designed by architects and that local builders were using stock plans and interpreting them without the benefit of architectural services. Furthermore, it was estimated that 90% of all houses were being built by speculative builders using stock plans (Survey results 1938).

CONCLUSION

Thus the major themes identified in the documents demonstrate the complex issues confronting the architecture profession as it related to single-family house design: the need to educate an ignorant public which included clients, the government, lenders, and builders; the polarization between those who believed architects could engage in house plan set design and those who adamantly opposed this as suitable architecture; and finally the recognition that single-family house design was already far outside the reach of architects even in the early twentieth century. Underlying these conflicts was a difference of belief between architects from the northeast and architects from the Midwest about the value of plan books services to the public. Midwestern architects were happy to contribute to better-designed housing stock through publishing plans that could be distributed in plan books. This idea was opposed by vocal architects from the northeast from the very beginning and ultimately their view won out.

ACKNOWLEDGEMENT

Portions of the AIA documents were reproduced here thanks to the AIA archivist, Nancy Hadley.

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Between politics and expertise: architectural agenda in the debate of Beijing urban development during the early communist era

Xiao Hu

University of Idaho, Moscow, Idaho

ABSTRACT: During the 1950s, Chinese architecture underwent a significant change. The newly-founded communist state employed a centralized system in both architectural practice and research. The connection between Chinese modern architecture, which was inspired by the Modernist approach in the West, and the architectural development in the West had been cut off. Most Chinese architectural professionals and scholars who were trained in North America and Europe continued to work for the new regime even though both professional and academic practices were reshaped and reoriented.

Architectural research and practice were challenged by not only the economic shortage of resources but also the newly instilled socialistic ideologies as well as their applications. When the new state pondered on the strategic plan of Beijing development, a large debate occurred between architectural scholars and professionals. One side led by Liang Sicheng and Chen Zhanxiang, both educated in the West suggested to preserve the old Beijing while building new urban centers west to the old urban core. On the other side led by the Soviet advisors and some West-trained Chinese architects and scholars advocated replacing the old Beijing with the new developments. Both groups presented their research analysis and conclusions, which focused on different aspects to define the value of a capital city. The three-year long debate was ended when the central government decided to support the latter opinion. This debate was considered not only an academic debate, but also an indicator of the beginning of political engagement and control in architectural scholarship and practice. From then on, the socialistic ideology and concepts gradually replaced the initial Western versions of architectural understanding and models.

This paper examines what the contextual changes for architectural practice and research was in a new regime with more socialistic influence. Rather than investigating the historical event of this debate, this study focuses on how architects and scholars from each side interacted with the governing party members and what the criterion were for the communist party to judge different viewpoints and opinions. This study will provide a case study to better understand the relationship between architectural scholarship and a particular political and social setting, and imply useful strategies for today's scholars and professionals.

Conference theme: Human context: social, cultural, and economic studies
Keywords: communism, party, state, architecture

INTRODUCTION

Since the 1840s, generations of China's intelligentsia attempted to deal with the domestic chaos inherited from the fall of the Imperial Court and the challenges raised from the capitalist Western forces which, as Karl Marx predicted, served as "the unconscious tool of history" in breaking apart stagnant and tradition-bound society and in creating conditions for a social revolution in China. This attempt marked a significant stage in 1949 when the Chinese Communist Party (CCP) controlled the entire mainland China and proclaimed the founding of the People's Republic. With a highly disciplined and tightly knit organization of the Party cadres who had experienced more than two decades of armed struggles, a powerful central governance system was quickly built. This system combined material means such as technology, knowledge and learning with ideological sanctions in the Soviet totalitarian form, and therefore exercised broader and tighter control over Chinese society than any previous government in history. Under the communist rule in the early 1950s, all major sectors of Chinese population – workers, peasants, students, and professionals—were enrolled in a close-meshed system of mass organization (Harding, 1981.). As a result, all professions, including architects and architectural scholars, were quickly and effectively integrated into the new organizational system.

The structural transformation of architectural profession started at the first year of the People's Republic. As early as 1953, state enterprises were the primary employer of all architects as well as architectural scholars. In September 1953, the Vice-Minister of the Ministry of Construction, Wan Li, announced that all private enterprises in the design and construction industries would henceforth be prohibited from practicing in any government-funded project (People's Daily, 1953.) Three years later, private practice of architecture was effectively and entirely terminated and independent professionals had disappeared as legitimate economic actors. In the meantime, the Party also successfully redefined the social and ideological structures of architectural scholarship by a series of political campaigns and resource reorganizations. Therefore, it is not meaningful to examine any aspect of China's contemporary architecture except in the context of the Communist Party's efforts to change it.

Like other professions, the formation of architects and architectural scholars in modern China was derived from the adoption of Western learning and technology after China was forced to open its door to the West in the late 1800s. It was not until the 1920s when the first group of Chinese architects began their practices. All of them were trained overseas, mostly in North America and Europe. Although they were in small numbers – for example, only 55 members registered in the Chinese Architects Association until 1933 (Zou, 2001), these architects brought back the tradition of Western liberalism and academic autonomy, by which they conceived of their practices and research as actions free and independent of political control. In addition, unlike their counterparts in literature and arts, Chinese architects and architectural scholars were politically inactive. In China, as in the West, most architects and scholars normally lived in large cities, like Beijing and Shanghai, and were content to confine themselves to their areas of expertise and their practice and research interests. Meisner (1999) indicated that this political indifference actually originated from the deep disappointment towards the corrupt Nationalist regime which the Communist state replaced. Knowing little about the Marxism and communist ideologies, it was hard for Chinese architects to enthusiastically accept a government which proclaimed socialism and communism to be its aims. However, the dissatisfaction of former regime made them hope the new rulers could control the political and economical chaos and restore the national independence and reputation.

On the other hand, the communists also viewed Chinese professional practitioners, including architects, in an ambiguous and suspicious way. Zhou Enlai, the Premier of the new government once publicly announced that most of China's professionals and scholars has some degrees of bourgeois idealism and individualism (People's Daily, 1956). When the communists came to power in 1949, they were facing a continuous dilemma: they needed the skills and expertise of the professionals to rebuild and modernize the country while these professionals were not the most reliably loyal followers of the Party line (Teiwes, 1987). As a result, the Party took a contradictory policy toward the professionals: on one hand, the Party continuously indoctrinated the professionals with communist ideologies in a more comprehensive and intensive way; on the other hand, the Party had to stimulate the professionals to be more productive. Especially in these areas that the Party lacked of its own experts, like architecture, the new rulers had to rely upon these professionals left over from the old regime. Hence, seeing these professionals as "a hand-maiden to its own political goals" (Goldman, 1987), the Party needed to reform the thoughts of these professionals in order to gain their allegiance.

How were Chinese architects and architectural scholars inextricably embedded in an authoritarian ruling system and how was the Communist Party able to achieve the reform of these architects and scholars' political views through ideological re-education while encouraging them to contribute their skills and productivity to the country's modernization? This question is intriguing because by 1954 the Party did not employ drastic and large-scale political campaigns in architectural professional as what had been done in Soviet Union and other Eastern European countries. Rather, the Party mainly took a series of administrative approaches to gradually undermine the independent power base of professional practice and academic activities. Also, the group of architects and scholars started to form social stratum embedded in the communist ruling system. This led to a bifurcation of the professionals – some individuals still valued the autonomy of practice and research while another became a part of the Party's administrative apparatus. In fact, the Party took advantage of the struggle of these two groups and made effective progress to impose new rules and principles in architectural production and research.

This paper examines how the cooperation of China's architectural practice and research into bureaucratic alliances of the Communist Party ruling mechanism in the early 1950s. At the first part, this paper provides a theoretical framework of analyzing the institutional change of architectural practice and research and the new role of architectural scholarship in the new regime. Then, this paper discussed the interaction between the changing institution and the activities of architectural practice and research by focusing on the case of the strategic plan of Beijing development.

1. A THEORETICAL FRAMEWORK

The examples in Nazi Germany, Soviet Union and other eastern European countries has indicated that controlling capacity of a political system depends on whether this system can develop a set of institutions to control both public and private lives of architectural professionals. When analyzing the behavior patterns of architectural practice and research activities, a theoretical framework is established: architectural practitioners can be considered the recipients of the ideological, social and operational changes under the new regime. The ideological context focuses on the relationships of ideas, values, faith, and beliefs that individual architects and scholars accepted, supported or maintain the interaction with other ideas, values, and beliefs. The social context refers to various types of relationships that architects and architectural scholars constantly interacted in, including their relationships with the Part cadres, leaders, the relationships between individuals, and the relationships with other professionals and disciplines. The operational context focuses on the differentiation of positions, formulation of rules and procedures, and prescription of authority, by which architectural practitioners gained the materials and resources to exert their expertise and support their daily lives.

This paradigm indicates a hypothetical prototype to analyze patterns of architectural practice and research activities. A behavior could be predicted by these three forces of social, operational and ideological contexts. That is, how an architectural scholar's research activities depended upon his/her social relationships with the Party cadres and others who have strong influence on the research work, upon the availability of material resources to which he/she had accessed to support the research, and upon the degree to which he/she had either accepted or resisted the new communist ideologies. In addition, these three factors are also reciprocal. For example, the relationship between architects and the operational structure was heavily affected by how the individuals dealt with their own social relationship with others and whether they were expected to follow "appropriate" values and ideologies. Likewise, an architect's interpersonal relationship with significant others was partially dependent upon whether the significant other cooperated or competed in operational structure, and upon whether the significant other held the same or opposite values and beliefs. Hence, if the practitioner had a positive relationship with the significant others, and if the practitioner played an important role in the operation, he would easily accept the values and beliefs that he was expected to follow.

2. CHANGES IN THE EARLY 1950S

What differentiated the Chinese Communist Party's practice of the early 1950s from those of previous regimes was the degree to which lucrative or powerful positions were monopolized by the state sector and the inability of the highly educated to exit voluntarily from state employment. Having established the People's Republic in October 1949, the Party began to launch a series of efforts to restore the nation's war-torn economy suffered from severe inflation and unemployment. The first duty for the new state was to control key sectors of economy, which were owned by Western capitalists, mainly British, American and French firms. Secondly, the new state had to restore normal economic order, which required the government to impose managerial and supervising rules and regulations to organize economic activities. Then, the Party needed to instill its communist and socialist orders to guide economic growth. Hence, it was vital to reduce the conflicts between different economic sectors to a minimum and to establish an effective system to carry out the government's plans. As a result, nationalization of all private enterprises was not only important to build a socialist and communist order, but was inevitable in practice. The conduction of nationalization directly led to the changes in operational factors.

By 1950, most of foreign bourgeoisie were immediately confiscated or nationalized without any compensation. By 1952, most of the Western faculty and administrative staff had departed and all private control in higher education had been eliminated (Pepper, 1987). There were few foreign architectural firms in China during 1949. Most Western-based architects left China as early as 1937 when the Sino-Japan war started – some of them completely withdrew from the Asian market while some transferred their offices to Hong Kong or Singapore. Some major domestic firms which once thrived in China's design market had also moved their offices to Taiwan or Hong Kong right before the communists' arrival, including, Ji-Tai Associates, a major player in domestic market with more than 110 projects completed by 1949 (Yang, 2007).

The Nationalization of domestic architectural firms was actually initiated before the birth of the People's Republic in October 1949. The Communist authority founded the state-run Northern China Construction Company on August 10, 1949 as the first architecture and construction entity recognized by the new ruler (Zou, 2001). This company successfully recruited architects and engineers from all over China by offering better salaries and benefits. Zhuang Jun, who was a graduate from the University of Illinois and also founded the first domestic architectural firm in China, recalled that the communists cadres came to Shanghai and presented the job offer to invite him to work in the company in October 1949 –"they were asking me warmly and friendly to participate in a historical work of building the new capital for the people's government. They brought me a special offer of a provided residence with built-in bathrooms, which was luxurious during that period." (Fang, 2006). As a result, Zhuang closed his 25-years-old firm and joined this state company with his 50 subordinates and students. In October 1949, the Beijing Military Commission, which was the provisional governing entity of the city, planned to found state-run Yong Mao Construction Company with special emphasis on Beijing's architectural and construction market. Three major private enterprises were incorporated – Ji-Tai's Beijing Branch Office led by an elite architect, Yang Tingbao, a University of Pennsylvania alumnus, Long Hu Architects led by architect Zhu Zhaoxue, who was educated in France and Belgium, and Gu Chengpeng Architects from Shanghai (Zou, 2001). In December 1951, Chen Zhi, another University of Pennsylvania alumnus and one of the three principles of the Allied Architects, the largest domestic private architectural firm, received an invitation from his former students in the Shanghai Municipal Government to join a proposed state-run Eastern China Design Company. Chen discussed this with two other principals and all agreed to terminate private practice within six months and to join in the new company. All three principals refused special stipends from the new company (Guo, 2005). By 1953, most middle-size and large-size architectural firms had been either merged or re-organized into city-or province-based design institutes ran by the state. Prominent members of architectural professionals were assigned leading positions in the new entities with considerable benefits and privileges.

The nationalization was also completed in higher education. Most of architectural faculty remained in their positions while all prominent members found extra appointments in the governmental administrative apparatus. Liu Dunzhen, department chair of architecture at the National Central University (the name changed into the Nanjing University after 1949) and famed by his study in traditional Chinese architecture, was appointed in Nanjing City Cultural Commission and Jiangsu Province Cultural Commission. Liang Sicheng, a prominent alumnus of University of Pennsylvania and also the department chair at the distinguished Tsing Hua University, became the deputy director of the Beijing Urban Planning Committee, which was in charge of all planning, design and construction of Beijing.

Nationalization of architectural practice and research had produced two immediate consequences. First, all architects and architectural scholars became the state's employees, which had completely changed their working nature. It meant that they did not have the freedom to choose their works and occupations any more. Before 1949, they were able to move between sectors- sometimes by choice, sometimes by necessity- and such occupational flexibility gave this stratum a critical degree of autonomy from the state. After 1949, legitimate professional activities were limited to the public sector. Not only were disaffected professionals and managers unable to retreat to private lives, but they were also not even permitted to resign from their jobs without securing approval from the very superiors from whom they wished to escape. In addition, being state employees, architects and scholars must conduct their works in a well-defined institutional framework and circulate their opinions only through authorized channels. As the Party paid the salaries and took the responsibility for the living and working conditions of architects and scholars, it gradually imposed an operational control before an ideological conformity could be achieved. Secondly, the nationalization generated two strata of architects and scholars – the establishment ones and these who preferred independence. Establishment architects could enjoy protections and privileges only through their cooperation with the powerful state. As a result, "By playing assigned roles as supporters of the establishment and the servants of the state, they gain patriotic self-esteem, outlets for their publications, power over their peers, and opportunities for scarce commodities such as housing and travel abroad." (Israel, 1986). On the other hand, these who remained autonomy and independence would find it was extreme hard and dangerous to work in a way outside of the state's system and without bureaucratic alliances. It was obvious that during the early 1950s the Party considered transforming elite architects and prominent scholars into establishment ones the primary task to achieve the operational control.

The change of operational factors resulted in changes of social contexts. Before 1949, Chinese architects and architectural scholars usually established their socialization networks by their educational backgrounds – the schools that they attended, the teachers that they learned from, or the disciplines that they majored in. People tended to be closer to these who graduated from the same school or shared experiences of being one's students. The inner circle of personal relationships based upon educational background often determined architects' and scholars' career choices. For example, when Liang Sicheng founded architectural program at the Northeast University in 1928, he invited his classmates, Chen Zhi and Tong Jun from University of Pennsylvania to be faulty there. When the Northeast University was dismissed due to Japanese invasion in 1931, Chen Zhi, Tong Jun and Zhao Shen, all University of Pennsylvania alumni, founded Hua Gai Architects in Shanghai. These graduated from engineering programs while working as architects would feel difficult to enter the social circle of architects graduating from architectural programs. However, the nationalization changed the personal socialization circles. People from different educational backgrounds had to work together, which consequently resulted in conflicts among interpersonal relationships. For example, when serving for the Beijing Urban Planning Committee, Liang Sicheng, the deputy director, struggled with Hua Nangui, the chief engineer of the committee, about whether architects or engineers should take the major roles in urban planning (Liang, 1986).

In addition, the Party's special emphasis on the stratum of elite and its effort to transform them into establishment ones caused the spectrum of political participation in terms of the interpersonal relationships with high-level Party cadres. The elite architects and scholars were normally assigned high-level positions in the new-established administrative apparatus and therefore they gained more direct access to interact with high-level Party cadres. Some elite members, like Liang Sicheng and Hua Nangui, could not only have frequent chances to meet with senior Party cadres like the Mayor of Beijing or the Minister of Construction, but also had direct channel to communicate with the highest level Party leaders. In 1950s, Liang sometimes had written letters to the Premier Zhou Enlai when he found that he could not convince lower level cadres (Liang, 1986). The social status and personal connection played a determining role in architectural practice and scholarship. For expressing critical opinions in 1956, Liang Sicheng received drastic criticism while still remaining in his job. But Chen

Zhanxiang, a middle-level city design expert, was considered as a “rightist’ and was sent to a labor camp at Beijing’s countryside for re-education. The different treatment derived not only from the content of opinions and means of dissemination but also from the status of the two men.

For Chinese architects and architectural scholars, the transition to socialism meant less independence and freedom. The virtually objectives of the continuous changes in operational and social contexts were to subject Chinese architects and scholars to processes of thought reform and ideological re-molding. It was noted that unlike other political campaigns against “counterrevolutionaries” which were aimed to eliminate political dissent in general, the ideological campaigns focusing on Chinese professionals had specific goals of not destroying these social groups but rather establishing the political loyalty and preserving their expertise and talents to serve the new society. In 1951, the Party initiated the first political campaign towards all Chinese intellectuals to reorient them away from the Western theories and scholarships in which most of them had been trained and to transit towards Soviet theories and scholarships. The aim was to expunge Western liberal values and indoctrinate the intellectuals with Marxism-Leninism (Goldman, 1987). However, as this campaign targeted all Chinese intellectuals, these in literature, humanities and arts, who the Party was primarily concerned, were the most affected. This ideological campaign allowed Chinese professionals, scientists, and engineers more leeway as their works were more abstract and more theoretical and the Party lacked the knowledge and skills to understand. More importantly, these expertise and skills were crucial for the Party to restore and develop economy. Therefore, although Chinese architects and architectural scholars were inevitably affected by the Party’s ideological control and thought reform, there was a relative relaxation in the ideological contexts during the early 1950s.

3. THE DEBATE OF BEIJING DEVELOPMENT PLAN IN THE EARLY 1950S

After the Liberation Army took over Beijing in January 1949, the Communist Party leaders decided to choose Beijing as the capital city for the future People’s Republic (Mao, 1991). In April 1949, when the provisional city government, Beijing Military Administration Committee convened two meetings to discuss Beijing’s urban development for the new regime. All elite architects and architectural scholars who were in Beijing were called to participate in the meetings. Zhong Sen, a principal from a private firm -- Long Hu Architects, suggested setting up a governmental entity to act as the administrative role and make policies in Beijing’s urban development. The Party accepted the suggestion and established the Beijing Urban Planning Committee on May 22, 1949. The provisional mayor, Ye Jianyin (who became one of the ten marshals in Communist China later), was the director and several elite architects and architectural scholars, including Liang Sicheng, Hua Nangui, Zhong Sen and Wang Mingzhi, were assigned as members of the committee (People’s Daily, 1949). The reports about this establishment published by the Party’s main mouthpiece, the People Daily, was titled as “the People’s Government Invited Experts to Form the Urban Committee”, which demonstrated a fact that the Party had to face – although the Party possessed strong political powers armed by Marxism-Leninism, it still lacked sufficient capability and skills in some key areas, like city development. This caused the Party to primarily rely upon the Western trained professionals, one of the least politically reliable groups.

However, the first conflict occurred not between the Party cadres and the professionals, but rather, it was from the architectural scholars themselves. In June 1949, Hua Nangui, the chief engineer of the committee, presented his proposal of Beijing development “the Outline of the 1st Session of New Urban Planning of Beijing”. Hua proposed to rebuild the old city of Beijing by removing the city walls and preserving the most important traditional complexes, including the Forbidden City and the Temple of Heaven. Hua also considered developing modern traffic system the primary work. Liang Sicheng intensely opposed this proposal as he thought the city would be split by traffic systems. More importantly, Liang regarded both the old city and the city walls as the outstanding patterns of traditional Chinese architecture and it was vital to conserve all these structures as a living museum of architecture. In order to prove his opinion, in September 1949 Liang wrote a letter to Nie Yongzhen (who replaced Ye Jianyin in August 1949 and also became one of the ten marshals in Communist China later), the Mayor of Beijing, to stress that engineers were not capable of engaging in urban planning and the government should allow more architects to involve in Beijing’s urban development:

> “It is most important to understand the differences of capabilities and responsibilities among architects, engineers, and construction contractors. Most people do not know this…The knowledge of engineers is confined to construction structures and materials. On the other hand, in addition to understand building structures and materials, architects must take four to five years of rigorous studies to understand basic human needs. An architect’s work is to achieve possible maximum in spatial beauty and uses based on the minimum of materials and land… I hope our new government to understand this difference between architects and engineers first. “ (Liang, 2001).

Liang also implied that the Party should employ people with sufficient architectural experience to become the Party cadres who would lead architectural practice and urban development (Liang, 2001). Being the academic pioneer of traditional Chinese architecture, Liang considered Beijing, which had served as the Capital City of China for over 850 years, the best-preserved imperial city in the world with a large intact palace complex, the Forbidden City, the most complete city wall system, and a large number of traditional residential patterns of courtyard houses and Hutongs (Liang, 2001). Therefore, in February 1950, Liang and Chen Zhanxiang, a city planning expert trained from the University of Liverpool, presented a rough planning proposal and suggested building the new city center at the western suburban area in order to give rooms for new development while preserving the old city and patterns of traditional architecture. This proposal, called Liang-Chen proposal, pointed the main problems in the existing old city: 1) the high density of the old city (21,400 people per square kilometer) made no sufficient space for new central governmental offices and residence for their staffs, not ever mention land and space for future development; 2) having developed for over centuries, the old city of Beijing had already formed an intrinsic urban order with a definite south-north axis, the imperial palace at the center and all clear-oriented urban blocks; and 3) the existing city wall system was a major physical obstacle of further development for the old city (Liang, 2001). More importantly, Liang-Chen proposal studied the history of Beijing and demonstrated that the center of the capital city had changed various times in history according to new needs. Therefore, when a new regime was founded, it was possible to re-establish the city center in a different location. As what Liang described, the key of this proposal was "win-win" to "preserve the old city and to build a new and modern city." (Liang, 2001).

However, the Party was obviously not quite satisfied at this proposal. Liang and Chen had made more than 100 copies of this proposal and submitted to the Central Government, Beijing City Government, and the Beijing Branch of the Chinese Communist Party (Liang, 2001). There was no response at all. Two months later, Liang wrote a letter directly to the Premier Zhou Enlai to urge the decision-making. What Liang and Chen did know was that in the Party's eyes, the urban development of Beijing was not purely architectural and urban, but a political issue. First, Liang-Chen proposal ignored the importance of Tiananmen Gatetower, where Chairman Mao proclaimed the founding of the People's Republic and where the starting point towards the imperial palace – the Forbidden City. Building a new city center at the western suburban areas would definitely decrease the political meaning of Tiananmen. In addition, the south-north axis throughout the entire Beijing old city clustered the most sacred space – the center of political power -- in recent China's history. Continuously using this axis in the new regime gave a psychological benefit to the new rulers and also sent a strong message to the Chinese people that the communist party had fully inherited the governing authority all over China. Chairman Mao once complained that "why those old emperors could live there while I could not?" Secondly, the Chinese Communist revolution of 1949 was not a "proletarian revolution" defined by Marxism as the Chinese proletariat was still in small number and remained politically dormant. In the Communists' eyes, cities were viewed as bastions of conservatism, the strongholds of counter-revolutionary activities, the centers of foreign imperialism, and the breeding grounds for social inequalities, ideological impurities and moral corruptions. The Party considered itself not only the occupier, but also liberators of the cities. In 1949, there was only 4% Beijing residents were workers, far behind the average level for other socialist capital cities (Dong, 2006). Therefore, to build a "People's Beijing", it was crucial to increase the number of workers in this socialist capital city. The old city of Beijing had few factories as well as few workers. If building a new city outside of the old one, the lack of proletariat power in the old city would remain and the Party would feel hard to establish an effective control without a solid proletarian foundation. A city without sufficient number of workers, who were defined by the Marxism and Leninism as the backbone of people, could not claim itself "a people's city." In 1953, Chairman Mao asked Liu Ren, the Second Secretary of the Beijing Branch of the Communist Party, "if we do not have enough workers in Beijing, shall we consider to move our capital to another place?" (The Beijing Branch of the Communist Party, 2000).

In the meantime, a group of Soviet advisors had arrived in Beijing and brought the experience of building socialist capital of Moscow. In December 1949, the Soviet advisors presented a report, "Suggestions on Improving Beijing's Municipal Facilities", to the Beijing City Government. This report clearly stressed that Tiananmen Gatetower be the spatial core of New Beijing and also suggested building the state's new executive center along the Chang'an Street, the east-west oriented main street in front of the imperial Forbidden City, to form an east-west axis as a subordinate axis to the dominant south-north axis.

Based upon the Soviet report, some Chinese architects worked out a detailed design proposal. In April 1950, Zhu Zhaoxue and Zhao Dongri presented "the Opinions about the Capital Urban Development Plan", in which Zhu and Zhao supported to reuse the old city for the new city center by conserving some key traditional buildings while demolishing large numbers of decayed buildings for the new development. Zhu and Zhao's proposal highlighted the special meaning of Tiananmen Gatetower by continuing using it as the center of Beijing and suggested making good use of existing buildings for the new government. In addition, this proposal satisfied the economic needs – reusing the old city would be cost much lower than building a new city and maintaining an old one (Dong, 2006). More importantly, this proposal met the demands from both the Party leaders and the Soviet advisors. First, the headquarters of the Communist Party had stationed at the suburb Beijing. Reusing the old city would allow the Party leaders move into the old city of Beijing, offering them a more comfortable place than humble houses in the countryside. Secondly, most of the Party's cadres were from poor peasants so that they usually were intermingled with strong feeling of suspicion toward cities. This became a notion deeply ingrained in these cadres' mind when they perceived old buildings and traditional blocks, which were viewed as symbols of old society and old life styles and should be removed in the new socialist capital. Zhu-Zhao's proposal fulfilled their desires by replacing the old city with new buildings and development. Thirdly, the Soviet advisors considered that building a new city outside of the old one violated socialist principles as it resulted in gradually abandonment of the old city as well as its inhabitants. A socialist state should place priority on promoting people's lives and fulfilling their needs. Finally, the proposal demonstrated that it was possible to redefine the meaning of Tiananmen Gatetower as well as the Tiananmen Square from a imperial center of backwardness into a symbol of the socialist consolidation.

In a debate, a Soviet advisor released that it was actually Chairman Mao who had already decided to live in the old city:

> "We are informed by the Mayor, Comrade Peng Zhen, that he has discussed this issue with Chairman Mao. Mao told him that the major state apparatuses would be located within the old city while the secondary apparatuses could be located outside. We agree that it is a right decision, also the most economic solution." (Dong, 2006, p.8)

Although it was clear that the highest level authority had stated their attitude, the Party never announced publicly which proposal it chose. Also, there was no response to Liang-Chen Proposal. Behind the silence of the Party, the construction of building new governmental offices along the Chang'an Street had started, following the suggestions by the Soviet advisors and Zhu-Zhao proposal. During the entire debate, Liang and Chen actually underwent harsh criticism from their colleagues, most of which used political notions and terms. Some architects criticised Liang and Chen hold capitalist and exploiters' worldviews as their proposal did not aim to promote the life conditions of people living in the old city (Liang, 2001). Some questioned Liang and Chen's political attitudes as their proposal displayed strong affections towards the imperial honor of the past while disregarding the great revolutionary achievement of the present (Liang, 2001). More seriously, Liang and Chen were attacked to attempt to ignore the "importance of the Tiananemen as the political center and the symbol of the new regime's consolidation" (Wang, 2003).

However, the Party organ had not publicly criticised Liang and Chen, largely confining itself to reporting some opinions from both sides. The low key played by the Party demonstrated that the Party did not want to be blamed to make decisions mainly based upon political reasons. In order to restore the nation's industry and economy, the professionals' help and cooperation were vitally needed. Hence, in the early People's Republic era, the Party granted architects and scholars a degree of academic freedom in order to win their cooperation in economic development and to promote the Party's skills and expertise. But, it did not mean that the Party could tolerate any autonomy and independence in architectural practice and research. Once the Party had its establishment architects and its own architects recruited from young students, the Party could rely less upon these non-loyal professionals and possessed more deliberate means to reform them. It was what happened in China's architecture after 1952.

CONCLUSION

In the early Communist era, the working nature and conditions of China's architectural practice and research had been changed entirely. The communist party had gradually taken turns to change the operational, social and ideological contexts in which architects and architectural scholars fulfilled their expertise and skills. It was noted that the communist party took a step-by-step move to transform architectural professionals into establishment ones. The shortage of skills and expertise made the Party unable to assume a complete control of the profession in 1949. As a result, the Party first limited the Party's involvement in architecture while allowing other key aspects to be remained as before. First, in operational contexts, the nationalization made all architectural professionals the employees of the state. In addition, the nationalization had provided a system with less academic autonomy to force the architectural professionals to participate in this system for both practical and private lives. Hence, a professional could not withdraw to his/her studies or practices if he/she was not satisfied at the policies of the Party or the state. This system also defined the interpersonal relationships between professionals as well between them and other people. The elite and prominent architects and scholars were encouraged to be transformed into establishment ones. The Party also granted them more tolerance and more time for the transformation. The ideological campaigns would not be conducted until the Party achieved the strong control in both operational and social contexts. For these who had complied with this transformation, the Party would grant awards in terms of work position, income and other privileges. While those who resisted this transformation, they would undergo thought reforms conducted by not only the Party cadres, but also their colleagues who had completed this transformation.

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On the question of leadership: the postwar Department of Education and Research at the AIA

Avigail Sachs

University of California, Berkeley, California

ABSTRACT: In 1946 the American Institute of Architects established a Department of Education and Research (E&R), under architect Walter A. Taylor. The name given the new department signaled the importance of research for architecture, and the AIA's intended leadership role in promoting research-based architectural practice. E&R developed research policies under an advisory board and in 1959 convened a conference on research for architecture, funded by the National Science Foundation. But the AIA never assumed full leadership in research for architecture: The scope of the project was beyond the means of either academia or the profession, and postwar research policies remained decentralized. Although E&R played a role in directing applied research, academic institutions proved more able to assume leadership of basic research. This history illustrates the complexity of leadership in a field that bridges academia and professional practice, as well as the importance of multiple leadership roles.

Conference theme: New methodologies in architectural research
Keywords: AIA, Department of Education and Research, research policy, basic research, applied research

INTRODUCTION

As the call for papers clearly states, we are currently witnessing a resurgence of critical interest in the idea of research within the profession of architecture. This is not the first time that prominent architects have grappled with defining the knowledge produced by the profession and developing the means to collect and disseminate it. The role of research in architecture was a focal issue for leading thinkers and practitioners during the two decades following World War II.

In 1954, for example, the American Institute of Architects (AIA) published *The Architect at Mid-Century,* a four-year survey of the profession that identified research as one of the most important long-range concerns for the Institute (AIA 1954). Thomas Creighton, editor of the journal Progressive Architecture (P/A) and a vocal critic of the AIA policies, similarly promoted the idea of research. In his essay *Suggested Program for the AIA,* Creighton condemned the Institute for almost every failing of the architecture profession, but nevertheless urged it to continue, and expand, its research program (Creighton 1954). Commenting on this discussion, William W. Wurster (Dean of the School of Architecture at the University of California, Berkeley) remarked:

> 'Research' can have a rich and distinguished meaning if used sparingly enough. There has been a tendency for it to become a "catch word" and everyone recognizes it as one of the glamour girls of today and uses it with undue ease. . . . This morning all I should do is express complete agreement with the recommendation but follow it with the word of caution that we must not apply the word 'research' to each tendril of undocumented experience (Wurster 1954).

Indeed, post-war architects tended to use the term "research" to refer to any exploratory thinking connected to architecture and building. Underlying this broad interpretation was a positivist conception of research, as a scientific process yielding objective and generally applicable observations about the world *as it is*. This conception distinguished "research" quite clearly from design, understood as the formulation of specific proposals for the world *as it could be.* At the core of this conception was an ambitious vision: "that architecture, properly understood, could and should directly reflect social truths obtained through empirical research," and, moreover, that "this understanding would allow researchers to find law like regularities in human behavior that might then inform an instrumentalist architecture design to produce desirable behaviors" (Vanderburgh and Ellis 2001:110).

This approach promoted an empirical model of practice, prizing knowledge about the real world ("facts") over idealizations and generalizations. More specifically, it implied that only knowledge of the facts can yield overarching generalizations.

The idea of research thus became a central focus in the larger controversy about modern architecture. Most histories of American architecture focus on the "struggle" between traditionalist and modernist architects, but by the late 1940s architects were essentially engaged in discussion *within* the modernist "camp" (Anderson 1997). This controversy was publicly enacted in a 1948 symposium organized by Alfred Barr, Jr., at the Museum of Modern Art (MoMA) titled, "What Is Happening to Modern Architecture?" In the museum Bulletin, the symposium participants reported:

> The controversy was soon reduced to something much more basic: those who spoke in terms of style and standards, and those who denounced all labels and "isms" as secondary to the problem of production (Barr, Hitchcock et al. 1948).

With its pragmatic implications, "research" in architectural discourse was linked to notions of regionalism, social reform and collaborative practice. Walter Gropius, as professor of architecture at the Graduate School of Design (GSD) at Harvard, clearly recognized these connections:

> All in all the emphasis of my arguments is on the creative factor. That is, that a program of search rather than research makes the creative architect. Such a program, I believe, would lead the potential architect from observation to the delight of discovery and invention, and finally to an intuitive shaping of the American scene (Gropius 1951).

By the mid 20th century, "research" also had practical connotations. "Research" referred, sometimes interchangeably, both to the products of scientific, systematic inquiry in the natural sciences and to the technological development of new building systems. It also referred to the social sciences, where the city had become the locus of ground-breaking studies, with an accumulation of arsenals of "unbiased" information seen as relevant to architectural practice (Wright 2008). "Research" also comprised the work of New Deal and wartime housing reformers and planners, who claimed authority over a large portion of building in the US. These projects also had a "research basis," rooted in John Dewey's concept of scientific politics, in which learning from social experiments was regarded as fundamental to the development of a healthy society (Friedmann 1996). The term "research" was thus a powerful concept, capturing the complex mood of anticipation of the postwar period. It signified the enormous prewar changes as well as the promise of the future, and it represented a key concept with which American architects negotiated the changing conditions of their practice.

In the postwar period, the enthusiasm for research included on the one hand the concept of a research-based practice and on the other the development of academic research for architecture. Practitioners and educators became allies in this broad program, cooperating through correspondence, publications and conferences, but they also vied for leadership in the new field. In 1946, for example, the American Institute of Architects (AIA) established a Department of Education and Research (E&R) (see Figure 1.) Architect Walter A. Taylor, the Department's first Director, commented that many architects and other professionals "look to The Institute, and particularly to the Department of Education and Research, to create an active program of reporting, investigating and research" (AIA n.d.).

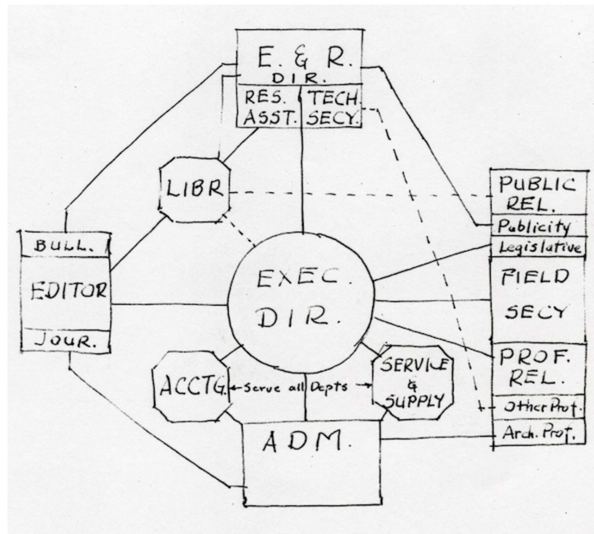


Figure 1: Diagram of structural changes at the AIA 1945. Source: (AIA Archives, Washington, DC)

In the context of the postwar military industrial complex, the question of leadership was essentially moot. The scope of the project of introducing research into architecture was beyond the means of either academia or the profession, and ultimately architects in both spheres assumed leadership for *parts* of the project rather than its entirety. More importantly, U.S. government research policies promoted a decentralized rather than centralized research effort. Positions of leadership tended to reflect available resources rather than any formal decision or theoretical advantage.

Under Taylor's direction, the E&R attempted to assume leadership in three spheres: to define architectural research as *composite* research; to direct *applied* research and product development; and to outline a program for *basic* research for architecture. These serious efforts to promote research and architectural practice were supported by practicing architects and academics, but their impact was small. The AIA held little sway in the building industry, and its program for basic research was eclipsed by the accomplishments of the emerging academic discipline.

Current philosophies of knowledge and science are a far cry from the positivist emphasis of the 1950s. But although many postwar research policies have long since been dismantled, research in the United States is still a decentralized endeavour. The history of the Department of E&R in attempting to steer research in architecture demonstrates the importance of multiple leadership roles — and of a model of *sharing* leadership responsibilities between the academy and the profession.

1. COMPOSITE RESEARCH

The public conception of research in postwar USA was shaped by what Roger Geiger has called the ideology of basic research. The premise of this ideology "was that basic research (also called pure or fundamental at the time) was the font of all technological advancement, and that this source was badly in need of replenishment" (Geiger 1993:15). In other words, in order to enjoy the social and economic prosperity warranted by the victory in World War II, America had to invest in the production of scientific knowledge itself — in research conducted by scientists. Once scientists had established this basic body of knowledge, professionals could apply it to social, economic and technological problems for the benefit of society. And indeed, in the twenty years following the war, intellectuals, and especially scientists, were welcomed into the centers of American power and influence and enjoyed an unprecedented status in American society (Bender 1997).

The clear distinction between basic and applied research was a practical as well as philosophical matter, since it played a role in determining research policies in the postwar military-industrial complex. During World War II the federal government had implemented a regimented, centralized model, in which the military, by necessity, set the priorities for research across the US. After the war many Americans, including Senator Harley Kilgore and his colleagues, called for a continuation of this approach. Kilgore argued that if the products of research were to benefit the nation at large, the patents that resulted from federally funded projects should belong to the agency that funded them, and that agency should direct future research. Kilgore worried that a research system that lacked central coordination would allow big business to gain control of the universities and would fail to develop technologies essential for the nation's economic and social welfare (Kleinman 1995). This position emphasized the importance of *applied* research.

The contrary argument emphasized the importance of *basic* science. If basic research was the most important intellectual endeavor, then scientists (as experts in science) should be given full responsibility for determining the scope of research projects. Moreover, they should retain the legal rights to their discoveries so that they have the incentive to pursue basic and fundamental questions. This approach was strongly championed by a powerful lobby led by the scientist Vannevar Bush. In his 1945 report, *Science the Endless Frontier* (Bush 1945), Bush outlined a systematic program for the Federal government, a decentralized model in which individual scientists would assume a leadership role.

American investment in research after the war was large enough to sustain more than one research policy, and the federal government supported a wide range of research projects through several different agencies. Bush and his colleagues, however, were successful in making the scientist-based model the basis of federal policy and introducing the ideology of basic science into American culture (Geiger 1993). This model was compatible with the decentralized system of higher education in the US, with no central agency to direct or standardize universities and technical institutions. In the decade between 1953 and 1963, the federal expenditure for "pure science" rose from half to three quarters of campus budgets (Graham and Diamond 1997). Although most of these funds went directly to principal investigators rather than to the universities, they established what has been called "Big Science": projects requiring big budgets, large staff, elaborate machines and complex laboratories. And they did so, to a large extent, within the universities.

In defining the goals of the Department of E&R, Taylor took these distinctions into account:

> The word "RESEARCH" is so broadly used, so widely abused, that for our purposes it needs to be defined and clarified, or at least classified. The customary over-simplified division into pure and applied science is quite inadequate for our time and our concerns. There are several kinds of activities which various people call "research" — several kinds of searching for knowledge and compiling of information. All of them have some bearing on, or are used in parts of the building industry and architectural design (Taylor 1954).

Taylor proposed a new category of research:

> X. Composite, Objective or Creative Research: Composite in one or both of the following ways: a. Two or more basic sciences or applied sciences involved, including more recently social sciences. b. Two or more basic types of products and/or engineering in combination in a building types or element (Taylor 1954).

Taylor's intellectually ambitious proposition clearly indicated the leadership role he assigned to E&R. His description positioned research for architecture as a unique enterprise, while emphasizing the creative emphasis in architectural practice. This definition, however, remained largely intellectual. In the polarized climate of the postwar military-industrial complex it proved difficult to garner support and funding for composite projects. While the AIA was willing to support such research itself, Taylor soon realized that the funds needed were beyond the Institute's resources. If the Department of E&R was to assume leadership it would have to do so within the existing framework — and focus on applied and basic research separately.

2. APPLIED RESEARCH

In the first few years following the end of World War II, the American building industry seemed poised on the brink of a major breakthrough. By transforming the methods of building construction, applied research would in effect unify the small building businesses across the United States into an industry as efficient and as profitable as those glamorous new stars of industry, cars and televisions. The excitement of this vision spurred architects to propose building systems based on materials and technologies developed during the war. Architects were motivated not only by the interest in developing novel and amazing solutions, but also by a social concern, to lower the cost of building to provide housing for a larger percentage of American society. By mid 20th century, the AIA had already assumed responsibility for some applied research, as Andrew Shanken describes:

> In the postwar years the AIA enjoyed a vital partnership with the Producers' Council, a national organization of manufacturers . . . The Institute also provided important technical information on products through Theodore Coe's Technical Department. It created a system of filing manufacturers' pamphlets, which was indispensable in an economy of constantly proliferating products (Shanken 2005).

Looking to capitalize on these assets, the Department of E&R set up an advisory service to act as a "listening post and reporting agency, clearing house and coordinating center, and the instigator of needed activities" (AIA 1947). Taylor and his colleagues spoke often of the architect's role in leading the building industry. They even lobbied the Producers Council to pay the Director's salary (AIA 1946)! More than this, they saw their work as a service to society, and argued that "because society as a whole will benefit through research for better shelter and environment, it should contribute major support through foundations, government agencies and elements of the building industry that are dependent upon the public for markets" (AIA Committee on Research for Architecture 1959).

The AIA's role, however, fell short of actual leadership. E&R did not endorse the products developed through the research conducted under its auspices. Without such an endorsement, the building industry looked elsewhere for a safer return on their investment, either within their own research departments or in the academy. The Advisory Service, moreover, was rapidly dwarfed by the work of the Building Research Advisory Board (BRAB), a private, non-governmental, nonprofit organization under the auspices of the National Academy of Sciences. In 1954 Taylor and his staff conceded to this larger entity and discontinued their own service.

Under Taylor's direction the E&R also worked to organize and disseminate knowledge developed within professional practice: architects' assessments of new building materials and systems. The project was neither efficient nor systematic, but it did reflect the organization of knowledge in many architectural firms and was under the complete control of the profession. In this program each architectural office was seen as a laboratory that produced knowledge that was valuable to the profession:

> It would be impossible for the architect to conduct all of the studies of methods and new products that he needs. Yet, to some extent, each office is a laboratory where building problems are solved in terms of building methods, products and equipment. Each acts as a research center where knowledge of existing technology and imaginative exploration of new technical resources are combined in the service of building . . . (AIA 1956).

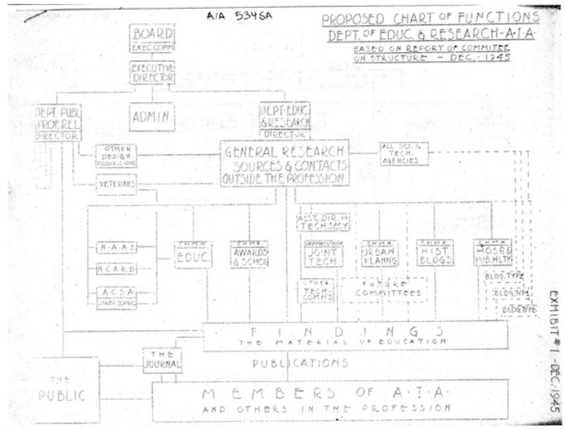


Figure 2: Chart of Proposed Functions of the Department of Education and Research, AIA 1945
Source: (AIA Archives, Washington, DC)

The Department's plan called for this information ("findings") to be filtered through "publications" and the AIA standing committees to the Department, where it would be organized and systematized before being disseminated to AIA members and the general public (see Figure 2.) In this scheme architectural practice *became* research; architects saw answering and compiling surveys as "doing research" (AIA 1959). In the 1950s the Department edited documents such as building type reference guides, technical reference guides, convention seminar reports, bibliographies, school plant studies and special technical articles. This material, disseminated through the AIA Bulletin, was important information for practicing architects. As with the advisory service, however, this publication project did not offer outside entities a return on their investment and was thus limited to the resources the AIA was willing and able to invest. Rather than become a leader in the field, the E&R project competed with commercial projects with similar goals and with the research power of publications such as Architectural Record and P/A. An internal AIA memo from 1960, which lists the meager accomplishments, also indicates the frustrations involved in this competition:

> 1. Index of Architectural Information- several years of study and refinement by committee but awaiting financing to become a service operation.
> 2. Selection of material- building Products Registry- now going full blast. Going to press after six years of study. Board finally agreed to put some capital into it. Some things should happen on Specifications Service.

> 3. Specification Service – Similar background of study, surveys, etc. Recently renewed relationship with the Construction Specification Institute should pave the way for early activation of this service (AIA 1960).

3. BASIC RESEARCH

In the late 1950's the AIA expanded its interest to the more prestigious basic research. Once again, the AIA hoped to lead in this field, as Robert K. Merton, a member of the AIA Committee on Research for Architecture (CRA) explained:

> If we raise our eyes from the ground on which we stand to look at the horizons that are even now visible, we will recognize that architecture is ready to enter a new phase in which it will, more systemically than ever before, formulate problems that in turn will activate new kinds of basic research in the underlying sciences. The first kind of basic research, then consists of generalizable investigations in the varied sciences fundamental to architecture, investigations which are in part stimulated by the formulations of problems arising in the field of architectural practice. A second kind of basic research in architecture is more nearly akin to what has been described as 'clinical research' in medicine. Here, the architect proceeds to synthesize the otherwise scattered bits of knowledge required to solve various types of architectural problems. Just as the medical internist is the 'generalist' in the field of health, so the architect is the 'generalist' in the field of design and construction. And just as clinical research in medicine only belatedly came to be recognized as basic investigation which was being carried forward by none of the underlying sciences, so too with architecture (Merton 1957).

Based on this conviction, the CRA, with the help of E&R, organized a conference of "recognized authorities" from diverse disciplines such as sociology, psychology, architecture and planning (see Figure 3 and 4). The conference was held in Ann Arbor, Michigan in 1959, funded in part by the National Science Foundation (NSF). The objectives outlined for the conference reflect the AIA's centralized approach to basic research: one goal was to establish a "method of coordination of research to insure maximum effectiveness of the total effort" (AIA 1958). This approach was cemented in the 1959 "Plan for Research for Architecture in the American Institute of Architects," which recommended founding a separate Department of Research:

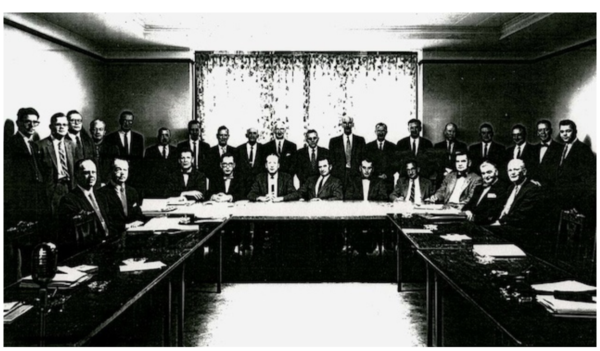


Figure 3: Participants at the 1959 AIA-NSF Conference on Research for Architecture in Ann Arbor, Michigan. Source: (AIA Archives, Washington, DC)

> The AIA Director of Research will be assisted and advised by the CRA and Advisory Council, and together must keep the program within manageable and expanding limits. Obviously this will require that projects be screened to determine whether they are researchable, whether they can be expected to yield useful material towards research goals, and if so, who should carry them out, how they can be financed and finally, through what medium results will be published. The plan outlines the recommended method or organizations, states the duties and qualification of the Director, and suggests financial responsibility and potential sources of funds (AIA Committee on Research for Architecture 1959).

The AIA plan was detailed and thorough, but it did not accord with the prevalent ideology of basic research — and the accepted framework of decentralized research policy. Opposition came from within the profession of architecture. William W. Wurster, Dean of the College of Architecture at the University of California, Berkeley, supported a research policy modeled on *Science the Endless Frontier* (Bush 1945) and championed basic research *conducted by independent researchers*:

> It has recently come to our attention that the research Committee of the AIA is thinking of establishing the position of Director of Architectural Research. I feel that the appointment of such a Director might well be contrary to the very idea of research and would do more harm than good. There is no holding the position of Director of Research for Chemistry, Physics, Psychology or Medicine and I can see no necessity for one in the architectural field. The appointment of a Director would lead Foundations to believe that architects were primarily interested in the development work rather than basic research. A true research approach is based upon the freedom of dedicated individuals to pursue their particular research interests and not in a directed program. These researchers should be supported in their work by a national organization, which could aid the individual and the profession by acting as a clearing-house for information, and may help to locate funds for the pursuance of research (Wurster 1959).

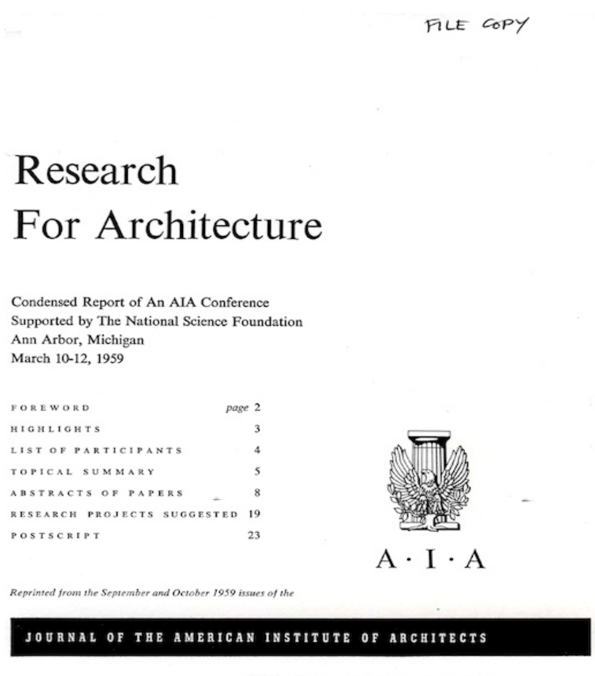
Wurster, supported by his colleagues at Berkeley, worked to establish the academic apparatus for supporting decentralized research. The departmental research committee, which was staffed in rotation by almost all the faculty members, produced a 60-page manual outlining how research was to be encouraged and supported. The policy clearly stated that:

> The selection of topics for research and the

formulation of research programs rest essentially upon *individual faculty members* interested in pursuing or participating in the development of their own proposed programs (University of California 1959).

The Berkeley faculty also recognized, however, the need for a clear set of criteria for judging these projects, if any focus or "cumulative effort" was to be achieved. The committee recommended that faculty seek extramural funds, while also working to secure funding from the university, to provide incentives for researchers, to protect their freedom of choice of topics for research and to support the collection of data so as to avoid duplication.

While the discussion of basic research in the professional arena reached an impasse, the decentralized academic discipline of architecture, based on the ideology of basic research, continued to grow. But as the presence of architectural research on campuses expanded, architect-researchers began to be socialized into the academic profession, organizing their research according to academic priorities. At the same time, it became clear that the discipline could not achieve financial independence. The funding available in tenured positions, grants and fellowships is not enough to sustain the scale of research envisioned by the pioneers of the discipline. The academy's leadership, moreover, is often questioned by practitioners: a recurrent theme in architectural discourse is the gap between the profession and the discipline, and between the professional and the schools (Crosbie 1995; Kroloff 1996).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Research
For Architecture

Condensed Report of An AIA Conference
Supported by The National Science Foundation
Ann Arbor, Michigan
March 10-12, 1959

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A · I · A

Reprinted from the September and October 1959 issues of the

JOURNAL OF THE AMERICAN INSTITUTE OF ARCHITECTS

1735 New York Avenue, N.W., Washington 6, D. C.

Figure 4: AIA Report on the AIA-NSF Conference on Research for Architecture 1959 Source: (AIA Archives, Washington, DC)

Walter Taylor left the AIA in 1960 to become Dean of the School of Architecture at Ohio State University. The AIA continued to promote and survey research for architecture; but as early as 1973, the authors of the AIA Research Survey acknowledged that the effort was stalled because architects, both in schools and in firms, did not recognize the need to share information (AIA 1973). In the early 1970s, the AIA established the AIA Research Corporation, which undertook the role E&R had fulfilled in the 1950s. Similar entities, at the AIA and elsewhere, have revisited Taylor's centralized project.

ON THE QUESTION OF LEADERSHIP

Assigning leadership assumes a mechanism that assures "followership." Ideas of research, objectivity and social responsibility have changed since Taylor and his colleagues discussed taking leadership, but the decentralized model of research has remained. This model has its advantages as well as disadvantages. Despite the prosperity and the attendant building boom of the 1950s, the AIA Department of E&R could not muster the resources to lead a comprehensive research project, in part because these resources were, *as a matter of policy,* scattered across institutions within the military-industrial complex. This holds true today, but we should think carefully before attempting to reshape that landscape. For example, "sustainability" can be examined either as a basic study in energy or as applied research into building materials — or in a "composite" approach, as a creative project of house design. We would probably not want to close off one of these approaches, in an effort to assign centralized leadership. Underlying the question of leadership, then, we will find a host of questions about current research policies, resources and opportunities — the realities that direct and shape our knowledge of architecture and architectural practice.

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Digital Approaches to Architectural Research

The Architecture of Phase Change at Mcgill
Pieter Sijpkes, Eric Barnett, Jorge Angeles, Damiano Pasini

Representing Ideas by Animated Digital Models in Architectural Competitions
Roberta Spallone, Massimiliano Lo Turco, Marco Sanna

Distance Daylighting and Digital Fabrication
Glenn Sweitzer, Joshua Vermillion

Observational Research and Digital Social Media: Route 66 and Amboy California
Kate Wingert-Playdon

The architecture of phase change at McGill

Pieter Sijpkes, Eric Barnett, Jorge Angeles, Damiano Pasini

McGill University, Montreal, Quebec, Canada

ABSTRACT: Montreal has a history of monumental ice construction dating back to 1885 when the first large-scale ice palace was constructed for the winter carnival. At McGill University, we have experimented with large-scale ice construction since 1972. In addition to the use of traditional ice blocks, we have built composite structures using suspended nylon fabric as a substrate for depositing vaporized water in the freezing winter conditions. Our largest structure was a scale model of the Pantheon, built with snow, and spanning 34 ft. Robotic CNC and rapid prototyping (RP) methods are opening up new horizons for the water-to-ice phase change process in architecture. Since 2006, we have been working at three different scales in this field, funded by a 3 year $174 000 SSHRC grant. A small Fab@Home rapid prototyping machine has been modified to make small 3D ice objects in a -20°C environment. One scale up, we are now working with an Adept Cobra 600 robot, producing very finely detailed 3D ice objects up to 30 cm across and 20 cm high. Both these machines are controlled by a personal computer and rely on a water delivery system with micro-valves, adapted for the purpose. The different melting temperatures of brine and pure water make it possible to use brine as scaffolding for the ice model, since the frozen brine can be melted away at a lower temperature than the ice. In 2010, we hope to scale up again, this time to the architectural scale with a new Macro robot.

Conference theme: Digital approaches to architectural design and education
Keywords: ice construction, rapid prototyping, path planning, double curvature

INTRODUCTION

> "Mon pays ce n'est pas un pays, c'est l'hiver"
> "My country is not a country, it's winter"
> Gilles Vigneault (1964)

The process of phase change has been exploited in architecture and engineering since time immemorial. The transition from liquid to solid has been the most profitable; adobe, glass and clay bricks, lime mortar and bituminous coatings come to mind as examples. In Canada, the transition from water to ice or snow has been put to work in igloos and in ice roads. In the late 19^{th} century, many cities, including Montreal, constructed massive ice palaces in winter as centrepieces of winter festivals, using 'natural ice' harvested from lakes and rivers. One of these ice palaces is shown in Figure 6. More recently, full-scale ice hotels have become quite successful, using the skills of ice artisans at many different scales.
In recent years, robotic methods of ice fabrication have been developed at McGill University; we have mastered working with relatively small robots in freezers inside our laboratory, though the plan is to venture out into the open in the winter of 2010 with a robot that can handle 'architectural scale.'

1. ICE ARCHITECTURE AT MCGILL

At McGill University, we have experimented with large-scale 'manual' ice and snow construction since 1972. Our relatively small campus lends itself very well for this kind of activity; it receives on average almost two meters of snow annually, and temperatures in the 'deep' January and February winter months rarely rise above freezing, dipping as low as -30°C. At the same time, water and power sources are readily available, and warm places to recover from the cold are close-by.

2. DOUBLE CURVATURE AS A STRUCTURAL 'LEITMOTIF'

During the 1970s and 1980s, experiments with large scale, double-curved surface structures using nylon fabric as a substrate, form-giver, and reinforcement took place at the McGill Campus. Some of the completed structures are shown in Figure 7Figure 9. Trees and buildings were used as support for steel cables, and nylon sheets were hung from the cables. Sometimes, the nylon sheets were casually stitched together, and other times they were carefully sewn. Finely vaporized water was sprayed on the structures. The spraying was mostly done at night to take advantage of colder temperatures. In order to cool the water as much as possible before it reached the ice surfaces, it was sprayed upwind into the air. That way, it drifted downwind, allowing the droplets to become under-cooled and freeze on impact, with no run-off.

A self-supporting triple hypar structure constructed in 1978 is shown in Figure 8. Pipes measuring up to 30 ft in length were used to form the edges of three hyperbolic paraboloid surfaces. The amazing property of hyperbolic surfaces is that they are elegant, smooth, and double-curved even though they can be generated by sweeping and rotating perfectly straight lines. These properties have pleased designers as varied in background as Antoni Gaudí (Lahuerta 2003) and Felix Candela (Faber 1963). Gaudí, the first architect to deliberately use hypars in his Sagrada Familia school design in Barcelona, exalted that the hyperbolic paraboloid is like the father (one set of straight edges). and the son (the other set of straight edges), forming the holy ghost (the double-curved surface). Pictures of our ice structures greatly pleased Felix Candela when they were shown to him while he visited McGill in the 1980s.

(a)

(b)

Figure 6: Ice palaces: (a) photo (McCord Museum);
(b) rendering (McCord Museum)

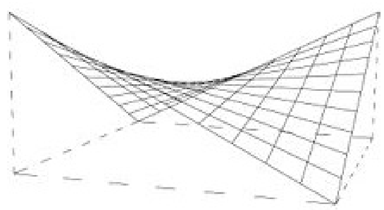
(a)

(b)

Figure 7: (a) Double-curved nylon-reinforced ice surface structures suspended from trees;
(b) Small-scale model

Figure 8: Nylon-reinforced, double-curved ice structure with free edges

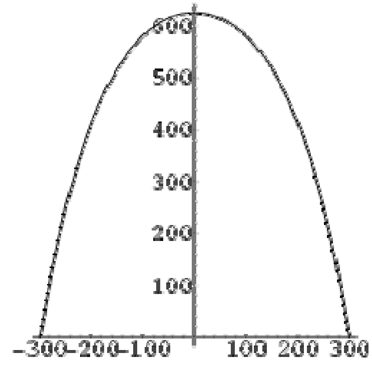
(a)



(b)

Figure 9: (a) Nylon-reinforced hyperbolic paraboloid ice shells with rigid edges, 1978; (b) diagram of a hyperbolic paraboloid

(a)



(b)

Figure 10: (a) 20 ft catenary ice arch, 1983; (b) diagram of the catenary shape

3. Pure ice, large-scale catenary arch

One winter, we experimented with pure ice structures, again using Gaudí's work as inspiration. Ice blocks were fabricated by letting water freeze in 2000 2-liter milk cartons. We laid these ice blocks on a plywood catenary formwork, and used snow slush as mortar to form a simple brick-like bond. The scaffolding measured 20 feet high and spanned 20 feet; the shape for the curve had been simply traced on a paper background, using a string suspended from two nails twenty feet apart and sagging 20 feet from the horizontal as our guide. The completed arch is shown in Figure 10.

This technique is age-old and is a wonderful example of how high mathematics has been part of construction long before math literacy was common. The general formula for a catenary, $y = k \cosh(x/k)$, was first derived in 1691.

4. One-fifth scale snow Pantheon model

For the centenary of the School of Architecture, we decided to construct a one-fifth scale model of that icon of gravity construction, the Roman Pantheon. Spanning 34 ft and reaching 34 ft in height at the top of the snow dome, this building served as the focus for the centenary celebrations.

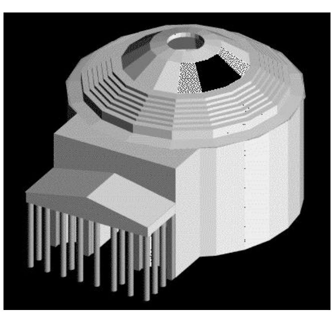
In order to provide maximum resistance to possible warm spells, the time-tested *pisé* method was used during construction: forms consisted of curved, removable four-foot high plywood walls, kept apart by easy-to-remove notched wood spreaders. The building was constructed in four-foot layers, and snow from all over the campus was dumped and blown into the forms by regular grounds-maintenance equipment like front loaders and snow blowers. Minor modifications were made to the forms to tilt them for building the dome's center. This was possible because the radius of the cylindrical base of the Pantheon is the same as the radius of the dome cross-section. In fact, the interior of the Pantheon can accommodate a perfect sphere that touches the floor at the center and coincides with the surface of the dome cross-section.

During construction, the four-foot thick walls easily withstood a five-day warm spell with temperatures several degrees above freezing (complete with heavy rain!), and the 34-foot dome was successfully constructed. Unfortunately, no time was left to execute the elaborate finishing of the interior and exterior that was planned. Only a carving over the front portico gave a hint of what might have been with more time. With a 34-foot clear span, this is still the largest snow dome ever constructed. Images of the completed structure are shown in Figure 11.

(a)

(b)

(c)



(d)

Figure 11: 34-foot span Pantheon snow structure, built by adapting the time-tested *pisé* method, 1996; (a) snow carving over the front portico; (b) exterior; (c) interior, (Rick Kerrigan); (d) CAD model

5. The use of robotics in ice construction

Computer numerical control (CNC) and rapid prototyping (RP) methods are opening up new horizons for the water-to-ice phase change process in architecture. Customers can request almost any 3D form and companies like Ice Sculptures Ltd. based in Grand Rapids, MI, and Ice Culture Inc. based in Hensall, Ontario, Canada will produce it using CNC. At the University of Missouri-Rolla, Prof. Leu and his colleagues have been experimenting with rapid prototyping with ice since 1999 (Zhang 1999 and Bryant 2003).

At McGill we have been working at three different scales in this field since 2006, funded by a three year $174 000 SSHRC grant. In Barnett et al., (2009), we give a detailed technical description of our current progress at the small- and medium-scales. Here, we summarize this work.

A desktop rapid prototyping machine, the Fab@home (FAH), has been modified to make small-scale 3D ice objects in a -23ºC environment. The FAH is controlled by a PC through the USB interface, and free software will import stereo-lithography (STL) files and customizable deposition material files to generate control commands for the FAH. The FAH comes with a screw-driven syringe deposition system, which can extrude viscous, colloidal materials such as silicone, epoxy, and frosting. For water to be used with this system, contact between the water drop at the nozzle tip and the built surface is required at all times to achieve continuous deposition. In practice, when the part is only a few millimeters high, small variations in part height cause this drop to lose contact with the built surface and any further deposition occurs in large, discrete drops.

To overcome this problem, we replaced the screw-driven syringe deposition system with a pressurized reservoir supplying a micro valve/nozzle system. The micro-fluidic components were all purchased from the Lee Company, based in Westbrook, CT. Also, the FAH signal used to control the syringe was converted to a signal suitable for the valve/nozzle using a BasicStamp2 microcontroller. The fluid lines and the valve/nozzle were enclosed in pipe insulation and heated with a temperature-controlled heating rope to prevent the water in them from freezing.

At the medium-scale, we are now also working with an Adept Cobra 600 robot, producing very finely detailed 3D ice objects up to 300 mm across and 200 mm high. The Cobra is faster, more accurate and more robust than the FAH. At the same time, it was not designed for RP, so much more retrofitting is necessary.

The heating and valve/nozzle systems for the Cobra are very similar to those used for the FAH, but the signal conversion for the valve is accomplished with a function generator rather than a microcontroller, because the Cobra has different output control signals from the FAH.

The tool path generation for the Cobra is one of the major retrofitting challenges we are facing. We have developed a path-planning algorithm in Matlab to import STL files and generate tool paths for the Cobra in a similar manner to that used in the FAH software. However, we have also tried to improve upon the techniques by making the paths generated smoother and automatically generating support structures when necessary. Elsewhere, we provide a detailed description of the path-planning algorithm (Ossino 2009).

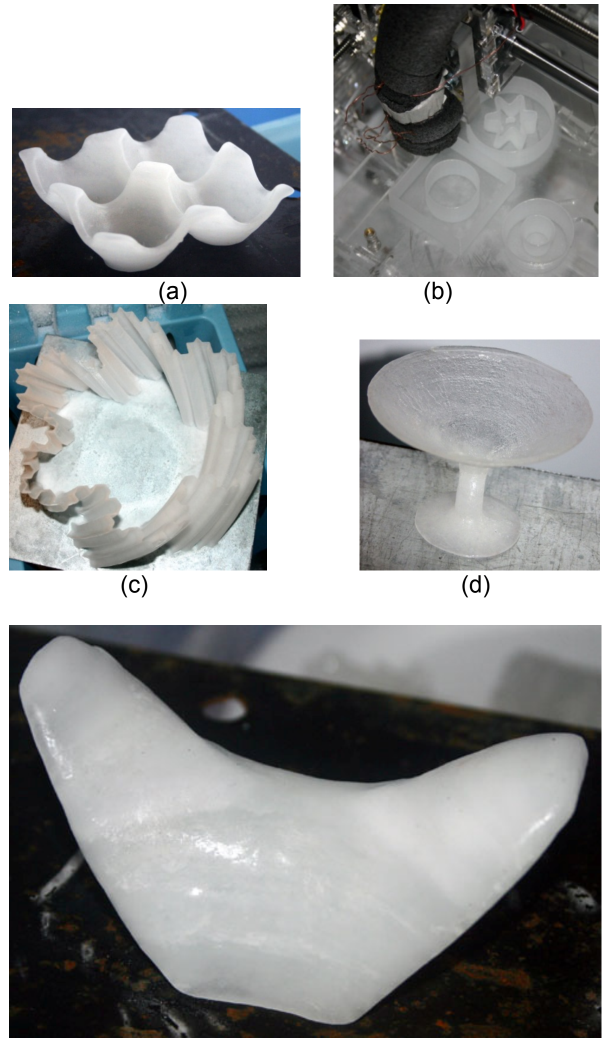
A support structure is needed to produce slanted or overhanging parts. We have elected to use a solution of potassium chloride in water (KCl brine), to build the support material. Both water and KCl brine freeze in our deposition environment of -23 ºC. When a part is completed, it is placed in a -4 ºC environment and the frozen KCl brine is melted away, leaving the finished ice part.

Figure 12 shows several ice parts we have built with our RP systems. For these parts, build times range from five to twenty hours. The deposited water path for the parts shown ranges from 0.1 to 0.5 mm in height and 0.8 to 1.5 mm in width. If the deposition rate is too high, the water will flow over the build surface, and previously frozen layers can be melted, significantly reducing build quality. The maximum rate of change of part height achieved is 20 mm/h.

In the winter of 2010, we plan to scale up again, this time to the architectural scale. We will use a larger robot having a reach of 20 ft, with a slush/snow delivery system, now in development. This system will be designed for outdoor deployment, using the natural freezing winter environment as its workspace. The varying outdoor temperatures, humidity and wind speeds will require the ability to continuously adapt the rate of flow and the speed of deposition to optimize the ice building process.

There are many architectural applications of the techniques we have developed. Small-scale ice models are very economical ways of producing intricate 3D models of architectural objects, be they scale models of buildings, site models, or building details. Rubber casts can be made from ice originals to produce high-quality copies at will.

Large-scale automated ice construction will be used to build ice buildings, particularly for the ice hotel and winter fair industry. The possibility of including robot-built intricate detailing (say a Moorish vault pattern in a domed roof) opens up a definite market in the winter recreational industry. It also allows students to produce full-scale models of their designs (in particular thin shell designs) and judge the spatial and structural qualities of their structures. The structural strength and weakness of a thin shell structure like a dome can be readily observed by the formation of cracks. The weaknesses of the ice structure can then be remedied and tested for new cracks after more water has been deposited to thicken the ice at the weak spots. A simple iterative process of testing and reinforcing can thus take place; students will be an integral part of the process, and they will benefit as they have in the past when they helped build our large hand-made structures.



(a) (b) (c) (d) (e)

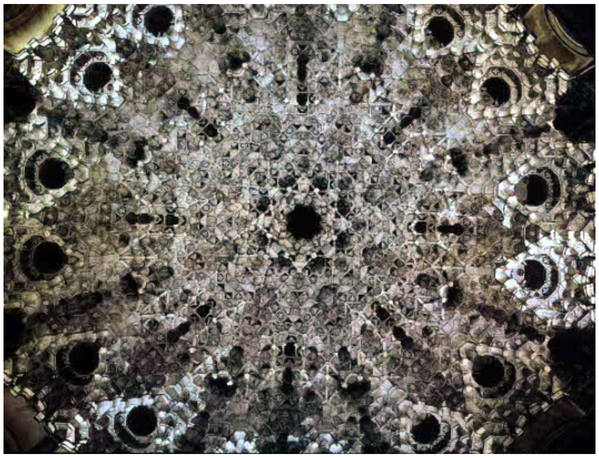
Figure 12: (a) Ice egg carton built with the FAH; (b) the FAH at work in the freezer; (c) “twisted” Koch snowflake built with the Cobra; (d) martini glass built with the FAH; (e) Hyperbolic paraboloid ice “saddle” built with the FAH

6. THE FUTURE

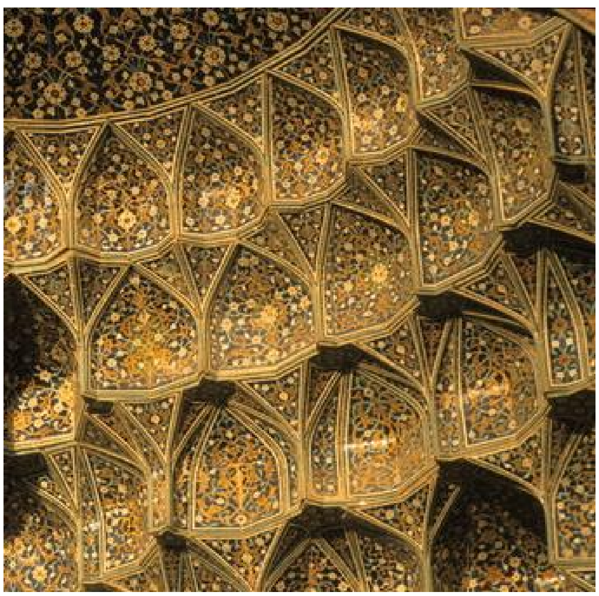
After scaling up to a larger robotic system, and with the experience we have behind us, there is no reason we could not build vaults as detailed as the Muslim examples shown in Figure 13.

CONCLUSION

The long history of ice and snow construction has been part of the larger history of the use of phase change in architecture and engineering. The recent introduction of robotics into this practice has opened up a large field of possibilities. At McGill, we have concentrated on additive processes like rapid prototyping, partly because subtractive methods like CNC are already well developed, and partly because we will be able to build certain parts using RP that would be very difficult or impossible to build using CNC. We plan to attack the architectural scale with a large robot in the winter of 2010. We will build on the techniques we have developed during our large-scale manual projects, some of which are now commonly used in the construction of ice hotels.



(a)



(b)

Figure 13: Muslim vaults: (a) Alhambra, Granada; b) Great Mosque Isfahan

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support received from the Social Sciences and Humanities Research Council of Canada (SSHRC), Le fonds québecois de la recherche sur la nature et les technologies, and La fondation universitaire Pierre Arbour. The generous rebate received from Adept Technology is dutifully acknowledged.

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Representing ideas by animated digital models in architectural competitions

Roberta Spallone, Massimiliano Lo Turco, Marco Sanna

Polytechnic of Turin, Turin, Italy

ABSTRACT: This paper presents the results of the research and of related didactic activity, about digital representation in contemporary architectural competitions. 3D digital models, and more recently requested animations, represent a powerful tool for increasing evaluation capability by jury members as well as knowledge and comprehension by common people. The high complexity in creating and animating 3D digital models has to face an unusual separation of jobs and responsibilities between atelier activities and rendering works. The research constitutes one topic of a teaching, given in the 1st degree of Architecture Sciences (Polytechnic of Turin -Italy) and involves also continuous updating about software potentialities. Aim of the didactic activity is to provide the students some critical and operative tools in order to give them the whole mastery of synthetic representation of their design ideas. We can foresee, in future architectural competitions, the implementation of 4D representation, also referring to its progresses and applications to other media, like cinema and entertainment.

Conference theme: Digital approaches to architectural design and education
Keywords: digital, modelling, representation, research, teaching

INTRODUCTION

> Who has had experience like a member of architectural competition jury panels composed by different experts, knows very well which confusion has done between the value of design and the fascination of representation considered as a painting… we will see in any year in which way video and virtual representation will act on communication in architectural competition. (Gregotti 1995)

In the last years digital representation has influenced the whole process of architectural design starting from the conception of ideas to the building drawing.
Some new tools of 3D modelling have approached the terms of *drawing* and *design*, leading them again to the etymological root, the Latin word *designo* (which meant both to draw and to design).
As Maldonado affirms, the syncretic nature of digital models offers new opportunities to scientific research and to architectural design. Tests and mistakes happen in a space in which our experience of problems is made fluent and immediate, for example in an architectural walkthrough. (Maldonado 2005)
The introduction of the dimension “time” into the traditionally static representation methods constituted a new powerful medium both in concept and in communication of design. As Lynn observes: "Contemporary animation and special-effects software are just now being introduced as tools for design rather than as devices for rendering, visualisation and imaging". (Lynn 1999:11)
As a new medium, architectural animation, is related to many disciplines, like Communication Sciences and Cinema Engineering and have to face to the traditional and consolidate peculiarities and techniques of film. This engages critical discussions on the ontological nature of films, on their narrative form, on their character of exploration of human emotions and involves the attention of architectural movies about perceptive aspects produced by the dialectic relationship between people and space.
Architectural competitions are one of the fields in which digital medium plays a central role as method and tool of communication. At the same time architectural competitions are both one of the most significant ways to obtain a professional charge and one of the most useful opportunities of didactic activity in teaching of Architecture.
The need of synthesizing and demonstrating the design ideas in a fixed and limited number of entry specifications is one of the peculiarities of communication in architectural competitions. These entries may consist in various iconic presentation media (besides written statements): boards, plastic models, 3D digital models, photographs, animations, films, digital presentations
All of them need digital tools (hardware and software) in their creation, manipulation, editing and blending.
3D digital modelling and animation represent a powerful tool for increasing evaluation capability by jury members as well as knowledge and comprehension by

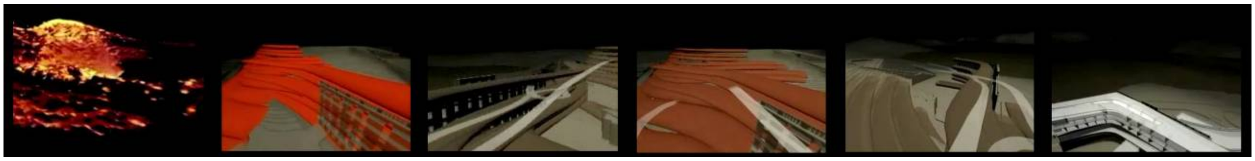

Figure 1: Hadid, Casino and Grand Hotel in Lugano, 1999 (http://it.youtube.com/watch?v=gGFxUetlzxM)

common people.
In this paper we present the results of our research and of related didactic activity, about digital representation in contemporary architectural ideas competitions. In particular we will develop some considerations about the elements of novelty introduced by animations in this kind of communication, with the purpose of expressing some proposals useful to the professionals involved in architectural competitions (architects competitors, organizers of competitions, jury panels) and of providing the students with some critical and operative tools in order to give them the whole mastery of synthetic graphic representation of their ideas.

1. DIGITAL MODELS IN ARCHITECTURAL COMPETITIONS: A RESEARCH ON ARCHITECTURAL PROFESSION

The high complexity in creating and animating three-dimensional digital models has to face an unusual separation of jobs and responsibilities between atelier activities and modelling / rendering / animating / compositing works. The relationship between atelier and rendering studios is accomplished in different ways: sometimes is made out of the atelier only the video compositing, some other the whole 3D work modelling. For this reason, sometimes, rendered images of 3D models and video haven't the same efficacy and don't transmit the same message of other graphic works processed inside the atelier.
Moreover specific creative languages and visual communication styles characterize the work of the main rendering studios overlapping to the architects' languages and styles.
We frequently observe the use of animation to convey a sense of space and poetry, obtained by a balance between realism and abstraction that creates a desire to be there, even when there doesn't exist yet. The buildings are definitely the primary subjects of the movies, but they're presented in a way that invites the imaginative participation of the viewer.
The task of video producers becomes not only to technically be able to understand the architects' design of the building, but to be able to imagine, using that knowledge, how the architectonic components of the building could animate and come together to form the building in its entirety in a way that stayed true to the architect's vision.
This chapter analyzes the meanings of digital representation in some of last ten years International Architectural ideas competitions, presented in chronological order. In particular we want to emphasize the potentiality of the new digital media to express and communicate architects' design thinking, also considering the technological developments of digital tools. In the development of this topic we take into consideration digital representations, in different kinds of architectural ideas competitions: landscape master plans, restoration and integration proposals, public new building designs…
Regarding the case studies below analyzed, has been collected some sources: the announcement (paying attention to the design requirements and to the requested submission entries), the subsequent acts of jury panels, the entries submitted by architects team related to their description of design thinking, the descriptions of competitions by architectural literature.

1.1. Case studies

Analyzing some architectural videos produced in the 90's, we noted that most of the works are characterized by a sort of standard movement with a fixed path of the virtual camera: using a simple walkthrough 3D they explored an empty architecture, very similar to "the scene of a crime" (quoting the words of Walter Benjamin to comment photographs of the streets without people of Eugene Atget).
Probably Zaha Hadid was one of the first architects that used digital tools as a method both for concept design and for representation. Themes of project like dynamism, fluidity, transparency, find in digital modelling a solution as regards to design and to representation (Schumacher 2004).
Besides 3D animations offer an opportunity to go beyond the two-dimensional quality of drawing and painting and move around the new, computer-generated world in buildings that are still at the design stage. Since the end of '90 she applied 3D animation to explain the process growth of her concept, like in the competition entry for the *Casino and Grand Hotel in*

Figure 2: Herzog & de Meuron, Munich football stadium, 2001 (http://it.youtube.com/watch?v=Akoz-mE1ANk)

Figure 3: Carbonara, Villa Reale in Monza and its Gardens, 2004 (http://www.studiodim.it/animazioni03.htm)

Lugano (Fig. 1). In the short video (0:58), realized in 1999 by Neutral, a magma flow freezes into an architectural extension of a natural topography, to envelop the existing buildings. The model is rendered in conceptual way: only by colours, red and white, that represent lava and ice. This kind of representation is fully in tune with drawing and painting style of Hadid.

Two years later Herzog & de Meuron won the design competition for the *new Munich football stadium* (Fig. 2). In the project the elegant 2D surfaces of their first works develop in a three-dimensional oval building, which polymeric façade can be illuminated in the colours of whichever home team is playing. The enclosure design evolved from a basket-like arrangement of woven ribbon elements to diamond-shaped pillows patterned in similar fashion to the Bavarian flag (Guardigli 2006). On arrival spectators encounter another unique architectural feature of the building, the geometrically extremely complex "cascade" of stairs that wrap around the perimeter of the building, just visible behind its glowing, translucent skin. Digital modelling demonstrates its efficacy to communicate these ideas, for its capability to represent the shape and to render materials and lightings. In particular the short video (1:35), by Neutral, shows the channelling of thousands of spectators which determines the geometry of the landscape leading to the football stadium and simulates the sport activities inside. Motion effects result from the blending of digital model with realistic film (car traffic, football teams' fan, mass of clouds) and from the simulation of colours and lightings changing.

In 2004 there was an announced International Design Competition for the *Refurbishment and Enhancement of the Villa Reale in Monza and its Gardens* (Fig. 3).

The survey of the whole complex has been prepared for generating materials to support the restoration. A 3D model of the whole Villa "has been realized to guarantee an almost complete accessibility for the winners of the competition. The advantage of this simple modelling resides in the potentiality that this integrated raster vector model gives in the projectual support, in the contextualization of new interventions, in their simulation and in the highlighting of the future distinctive hierarchies" (Achille, C. 2005:5). Very probably this model constituted also the basis for the digital movies expressly requested in the announcement. Carbonara, the winner of the competition, develops his idea in creating relationships between existing and new buildings, between the old villa with its gardens and the urban setting. The video (4:15), by StudioDIM, mixes various media and materials (in part presented also in the competition boards): satellite views, 2D drawings (site plan, horizontal and vertical section) static-photomontage and frames of film. It shows the different kinds and scales of intervention: from the territorial design, to the conservative and integrative restoration of buildings, to the requalification of gardens (Montini 2007).

In the same year, the architectural proposal by Hadid, awarded with the first prize, for a city's *new concert hall in Basel* (Fig. 4) has been represented also by digital models and animations. The digital models get off the conceptual abstractness that characterizes the works of Hadid. The video (4:19), again by Neutral, investigates the buildings integration into the architectural and cultural fabric of Basel, shows in which way the different levels of the square may become a continuous landscape and explain the idea of the new building, articulated by bulging the surface and by hollowing out the volume (Zaha Hadid 2006). New building and existing setting change from conceptual to quite photo realistically renders; in particular architectural context is simply modelled and textured with photographs of the façades. The video is very dynamic for changes of camera speed and of projection (zenithal, human-eye, bird-eye), by secondary animations (people, cars), by voices, sounds and music.

Gardens by the Bay International Masterplan Design Competition (Fig. 5) was launched at the beginning of 2006 with the request to create three distinctive waterfront gardens defining Singapore as the world's premier tropical garden city. Grant Associates, the winner team, specified that "The Gardens must have a physical, sensory and spatial expression that is unlike anything seen or yet imagined in the world… must be based on a total examination and expression of the future relationship between people and plants, culture and the natural world… the Gardens… should be an exemplar of integrated open space planning and

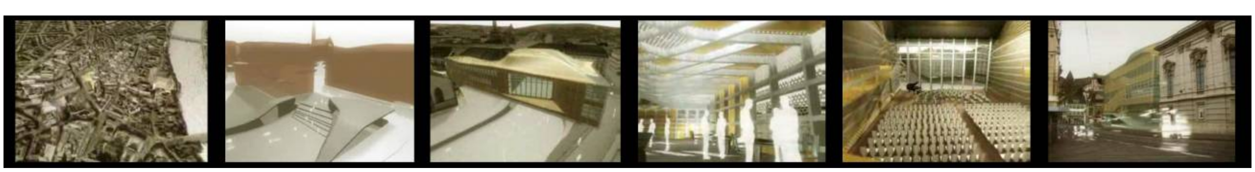

Figure 4: Hadid, Concert hall in Basel, 2004 (http://www.youtube.com/watch?v=v64vJkprMRs)

Figure 5: Grant Associates, Gardens by the Bay, Singapore, 2006 (http://www.squintopera.com/#/projects/?id=26)

management linking horticulture with living, recreation,science, art and culture, digital information and media, retail and commerce, food, leisure and education" (Grant Associates 2006:1). The two movies, by Squint/Opera, propose a fantastic reconstruction of the architect's process to build the structures a team of architects imagined. Imaginatively rich, the videos elucidate the scheme's ideas and inspirations. Animated sketches, paintings and doodles become, and sometimes inhabit, highly detailed three-dimensional animations, while views in plan and section are subverted in a humorously unscientific fashion. This approach, that distinguishes the production of the studio, fully expresses the architects team research of a emotional and sensorial experience obtained by combinations of nature and architecture. About this competition entry, the judges said: "The design concept… captures the essence of a Garden in a downtown setting, the experience of colour and vibrancy across 24 hours in a day, 7 days a week, all year round. This was achieved by the strategic location of display gardens and activity spaces, with careful consideration given to day and night programming" (Announcement 2006:1).

At the end of 2006 the "Philharmonie de Paris" announced an International Competition for the building of a *new large concert hall in La Villette* (Fig. 6), principally dedicated to symphonic orchestras. Located in an outlying zone, into a cultural park, the Philharmonie has to be an innovative architecture, equipped with an exemplary acoustics. The concept of enveloping hall has been considered useful to create a sort of intimacy between musicians and audience. (Concours Philharmonies 2007). We can compare the short videos, about 1:30, submitted by three of the six second stage competitors. In the short time at their disposal two of videos (Nouvel and Portzamparc) focus on the inside shape, while all count of the emotional effect of music which outlines the function of building. About his project Nouvel, the winner of this competition, "said that the novelty of his auditorium was to suspend balconies, they will be attached to the building by access passages, in a way that allows sound waves to circulate around and behind them. The idea is that the audience will be in the middle of the music" (Building a Paris Hall 2007:1). The video of Nouvel, by Artefactory and Odile Fillon, starts from the outside, but the first part is unclear. The written comments help to understand in a few seconds the structure; the idea of showing the digital model as a plastic model, in which are then applied various staging is original and effective. Many sections provide a significant help to understanding of the project.

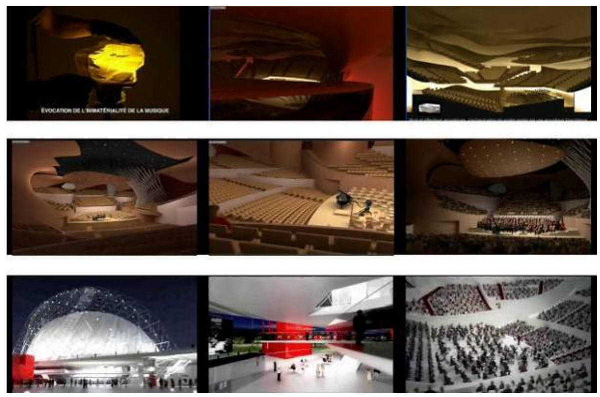

Figure 6: Nouvel, Portzamparc, Soler, Philharmonie de Paris, 2006 (http://www.lemoniteur.fr/video/)

The video of Portzamparc, produced by his atelier and Chuba 4 and composed by Bartproject, only shows the interior of the Philharmonie, with a camera movement characterized by a progressive approach to the stage. The animation is not continuous but fades continuously; doing that, it's possible to present many points of view (from the audience, the stage, the gallery) in a short time. As increasing the intensity of the music, the scene is completed by spectators, the orchestra, and a more exhaustive lighting system. The video of Soler, divided into three parts, begins with the approach to the project, exploring the urban context; the second part shows the foyer, while the third moves inside the hall.

The hall looks crowded with people: there is a secondary animation, limited to the orchestra. The hall is completely white, a solution that doesn't allows to appreciate in depth the geometry that characterizes the project. The end of the movie is focused on the context

Figure 7: 3xn, Headquarters building, Berlin, 2008 (http://www.cadpeople.com/galleri_berlin.asp?valgt=Berlin)

again, using a top view in a gradual moving away.The Design International Competition for a *new headquarters building for the German rail group* Deutsche Bahn at Washingtonplatz in Berlin (2008), won by 3xn with the “Cube”, awarded a project that combines the even-sided geometrical shape with diagonal arrays on the façades (Fig. 7). The basic structure of the Cube is a cross shape with four main cores. The cross is formed from fan-shaped floors rotated around the building’s axis, creating a natural movement that pulls up through the building like a spiral. The proposal represents, regarding to its dimensions and its massive shape, a building with a strong design that offers a strong message and a clearly designed landmark. 3xn are deeply involved in digital revolution. As they affirm, they “work with terms like scripting, animated, parametric and algorithmic design… With the advance of computers, our working procedures have changed radically. Today, we draw buildings which in the past would have been categorised as pure science fiction” (3xn 2008). In particular they are interested in “Design with time as a fourth dimension. It often involves software which is primarily used by the film and gaming industry. In animated design, volumes can be changed into dynamic objects / soft bodies, and be impacted by different force fields, which makes the design vivid and dynamic” (3xn 2008). 3D images and video (3:41) for the above mentioned competition entry, produced by Cadpeople, demonstrate close collaboration of producers with 3xn, understanding the ideas and following the graphic style. The video shows an original communication and visual approach. Using the shape of the cube like a “curtain” between different topics, it starts giving evidence to the context, the concept process, the accessibility. Then, in illustrating the project, uses particular camera motions alternating accelerations and stop image and singular representation’s techniques changing from conceptual visual style (in greyscale with some spots of primary colours) to soft rendered images.

2. DIGITAL MODELS IN ARCHITECTURAL COMPETITIONS: A DIDACTIC PROPOSAL

The research themes above presented constitute one theoretical topic of a teaching, entitled *Digital representation techniques for survey and design*, given by professor R. Spallone, assistant professors M. Lo Turco and M. Sanna, in the University 1st degree of Architecture Sciences (Polytechnic of Turin - Italy).
During the practical part of the course, students learn how to create 3D models, render, static photomontage and short animations, using principally the last release of AutoCAD, 3D Studio Max, Photoshop and paying attention to some useful plug-ins and open source software. Every year, about one hundred students, coming from 2nd and 3rd year of study in Science of Architecture, constitute the class. They have only basic skills about digital representation tools, in particular in

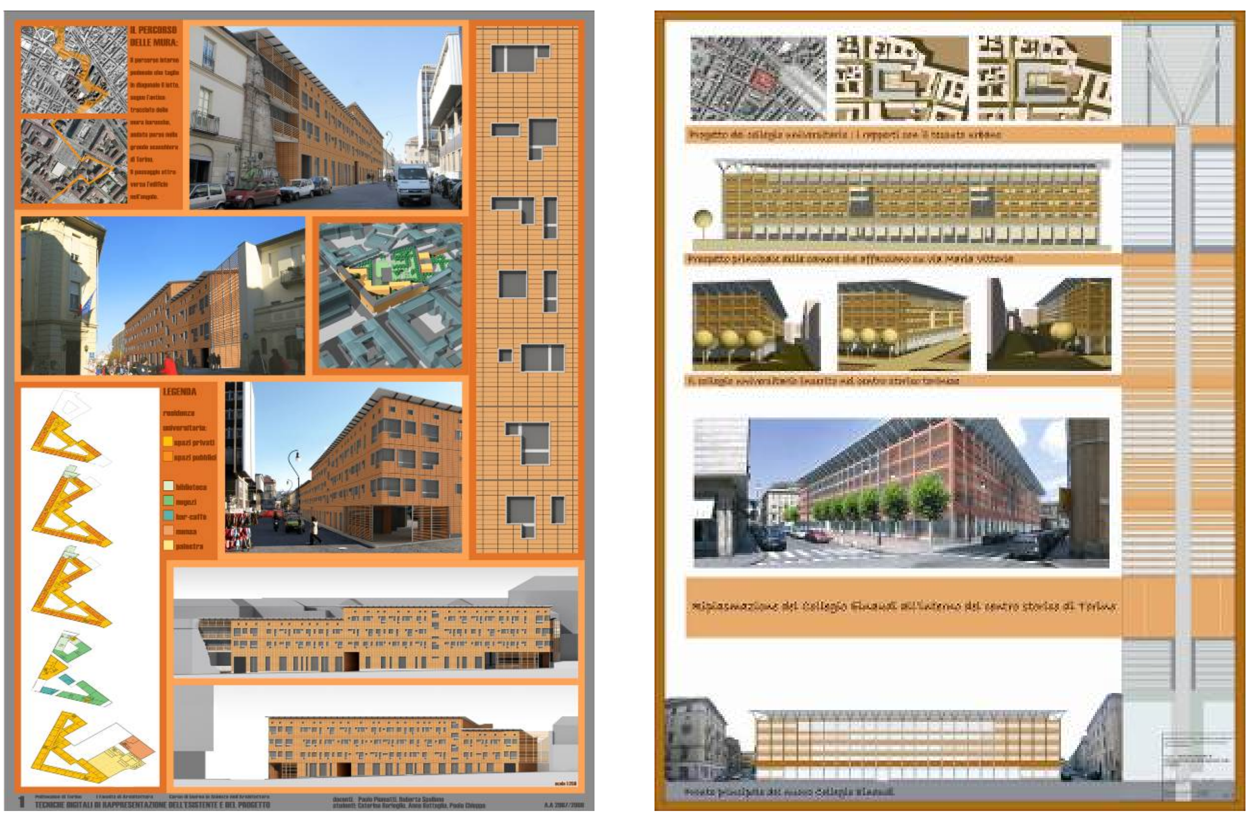

Figure 8: Architectural competition boards by students Boccuzzi and Del Boca

1st year they learned to use AutoCAD for representing, by 2D drawings and simple 3D models, the design developed in the 1st year Lab of Architecture - Town Planning. Therefore, aim of the didactic activity is to provide the future architects some critical and operative tools, achieved by the knowledge of techniques, methods, and processes of digital media, in order to form, read, and communicate design ideas.
For the final exam they have to realize two boards and an animated presentation in which they show one of their architectural designs, according to guidelines simulating a professional architectural competition, as below described. The works are evaluated on the basis of their efficacy and synthesis in the communication of design intentions.
The two boards requested, in A1 format, have to tell the design, above all, through images, highlighting the strengths and using different representations and techniques: from modelling urban context very simplified, to solar studies, from exploded axonometries, to thematic plans and sketches for describing the evolution of the idea, using design codes consistent with the theoretical contributions analyzed during the course. Even the design layout proposed by students follows the same rules, creating an additional feature to capture the attention of the viewers (now the teacher, in the future it could be the jury awarding) guiding them in understanding the peculiarities of the design proposed.
In the first couple of showed boards (Fig. 8), the layout is constituted by a very regular grid, recalling the scan, of regular prospects designed and the existing urban context. The first board is characterized by a general supervision, providing still a very simplified 3D model. The central part is devoted to a well done static photomontage, (excepting for cutting the top of the building and the absence of shadows of some parts belonging to photography, imperfections correctable in post-production). The second one deeply analyzes the project, viewing the internal college, highlighting the design themes: the solution of the angle of the building, the insertion in the urban setting, the analysis of a module of façades for the disposition of the openings. Even the layout colours are congruent with the design choice, in order to further standardize the message suggested.
The second pair of boards (Fig. 9) are related to a project inserted into a completely different environment: the relationship with the green, paths and the context of a country play a key role, as the design of the whole layout, both for the chromatic level and for the provision of various parts, forming an almost organic composition, which contrasts with the more rigid organization of the pair of boards earlier described. Also in this case the first board allows a wide urban environment analysis, in which the plans show different scale readings issues extremely effective. The model that combines digital and conceptual sketch has a great effect, seeming to emphasize that the process is a complicated phase that involves the use of many

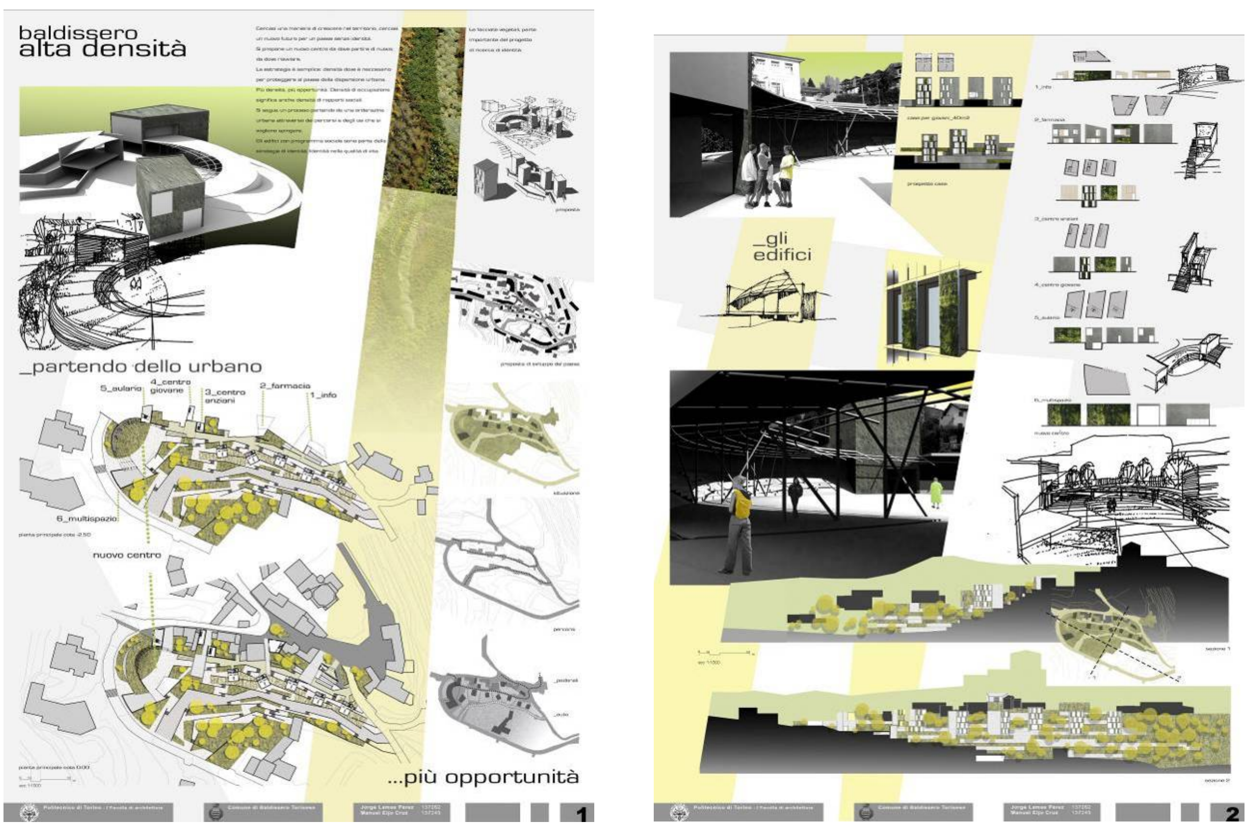

Figure 9: Architectural competition boards by students Lamas Pérez and Eijo Cruz

different techniques and knowledge. In the second board the attention is focused on buildings, classified by types, and displayed using a large scale through landscape sections. The design also involved a detailed study of common spaces, represented with perspective views in shaded and wireframe visualizations.
Many students are very enthusiastic about the world of three-dimensional modelling, as the basis for short animations production under the guidance of the teachers. For approaching to the professional works analyzed during the course, still supplementary contributions would be necessary, with some lessons related to different disciplines, (treating the movements of the camera, the transfer of different sequences, overlaps, nuances, and so on). Only in this way we could ensure a critical control of the whole ideative / creative process of a movie characterized by multiple effects added in post-production.

3. NEW TRENDS IN DIGITAL MOVIES: SUGGESTIONS FOR APPLYING IN ARCHITECTURAL COMPETITION

Computer aided design today encompasses also technologies incorporating animation, interactivity and immersiveness. Some of them, starting from interactivity, could be useful in architectural competition to allow to the juries free explorations of the project.
Different levels of interactivity, *linear progression* (the users get to understand the design by following a pre-set pathway) and *non-linear progressions* (the users freely decide where they will walk, and how they will interact with the objects) could be at juries' disposal.
Technologies coming to the world of entertainment, especially for videogames engines, allow to use a scenario developed with traditional 3D modelling software, with a high level of interactivity giving us the chance to explore a virtual environment randomly in real-life time. In addition to the gaming world, some film productions in recent years use special effects and spectacular shots with the technique of camera-tracking. Combining live-action footage and computer-generated elements becomes more common; match moving has taken on an increasingly valuable role in visual effects.
The camera tracking technology applied to the field of architectural representation is used in the creation of movies, in which the project is dynamically embedded within the existing framework, to constitute a kind of dynamic photomontage.
The competition movie, by Stack!Studios, for the *rehabilitation of the Palavela* (Fig. 10), designed by Aulenti, for 2006 Winter Olympics of Turin, makes a large use of this technology: a shoot taken from an

Figure 10: Aulenti, Palavela, Turin, 2005

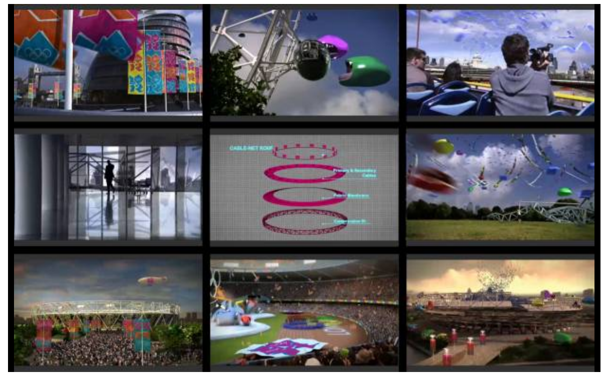

Figure 11: HOK Stadium, London, 2007
(http://www.squintopera.com/#/projects/?id=25)

helicopter is useful for appreciating the complete work using live-footage of the park Italia '61 and the city entrance.
Among the works of international video producers, new trends seem to emerge by those of Squint/Opera, studio in which the close collaboration among architects, designers, visual effect artists, writers and music composers produces a multidisciplinary approach to making short films about architectural designs, combining innovative visual effects and illustrative techniques with imaginative design, as below illustrated analyzing two their movies.
Abu Dhabi's Urban Planning video is very useful in analysing the four key features of the plan for the city's future (transport, green, habitation and sustainability), making use of huge letters from invisible strings hand in a city's streets, presented in the form of spots, to which follows the exploration of photorealistic digital model. Abu Dhabi's video is realised in detailed renderings that combine live action with an animated cityscape in stylised plan and cross-section; original tracking shots and sudden shifts in scale elegantly reveal different components of the master plan.
The video presenting *the design of the HOK Stadium* for the 2012 Olympics in London (Fig. 11), combining live footage with detailed animation, gives a sense of the project's scale by putting its components in impossible location; at the same time it communicates a surprising quantity of factual information on the structures. The kind of the movie, unlike others, is deliberately popular and instrumental in defining the Olympics in the public imagination. The motion tracking gives a more realistic animation of human movements (human motion tracking) and the inclusion of the project into the urban context (compositing video sequence filmed with a moving camera and computer-generated images).
Both of the videos reveal the nature of the studio, expert in film and media production operating within the film industry and architectural practice.
Other innovative techniques (real-time systems, augmented reality), still absent in architectural competition, could become future fields of research in communicating architecture.

4. BETWEEN ACADEMIA AND PROFESSION: FUTURE FIELDS OF RESEARCH

The search for new languages involves the employment of new technical experts to support the architects. Recently, this synergy between different fields is pointed out in architectural animation productions, rising up new communicative issues. As we described before it's easy to figure that advanced techniques now devoted to other areas may also soon modify the field of architectural competitions.
"Scholars of architectural design began to see computer-based media not just as "tools", but increasingly as the Method… After an extensive period of fine-tuning existing conventions, it is time for inventions. What is needed is a wholly new conception of the physical interface, which can stimulate the imagination and concretisation of new realities" (Breen 2008:138). Some themes we consider worthy of expansion in the near future, especially in architectural competitions, such as entertainment media (learning from game formats and theories), interactive interfaces and new 3D visions (new spatial experiencing). "Considering architecture as an art form, we might learn from other artistic disciplines (transmitting this knowledge to the students), such as *moviemaking* (cinematographic approaches, sequencing and animation), *theatre* (physical expression, interaction, improvisation) and *music* (rhythm, harmonic variation, but also digital recording and sampling). These may expand the *palette* of architecture (traditionally making use of drawings, models, pictures and symbols)" (Breen 2008:140). It's crucial to consider the contemporary game culture as a "serious medium": the interactivity and elegance of particular digital game applications are giving new incentives to the practice and education of architecture.
Moreover, a new development, which might be of considerable interest for the "digital architecture" community is 3D cinema. As formats such as 3-D IMAX and REAL D come into view, experts and students should get seriously involved. Although these techniques are initially target a broader "cinema" audience, one might foresee perspectives for architectural representations, developed by more specialised groups and potentially even becoming tools for the design studio and of the future.
We feel the need to involve into Academia some professional disciplines which focus on visual communication and digital presentation, useful to transfer their language to the students.
Another aspects is the need to renew, year by year, the contents of the course, "moving with times", both from the technical point of view (software used and open-source alternatives), and from the cultural one, transmitting to the students this importance of modernization.

CONCLUSION

It is easy to figure that in future such acquaintances will find a correct application also in the architectural competitions, whose demanded are renewing of equal step with the technological development.
What now represents the vanguard of the computer graphic, it could become an essential requirement for the participation to a competition: the production of navigable dynamic models (real-time), the realization of video interactive in augmented reality melting 3D model with some footages of the existing urban context, the real-time stereoscopic models.
We could hypothesize some possible scenarios for future architectural competitions, when the modelling phase and simple animation will not represent that the first step of the representative path.
Added materials given to the participants:
- 3D city context of the intervention area (buildings and terrain 3D) taken from some freeware applications such as Google Earth. 3D models online are increasing and soon they will cover at least the greater city centers;
- video footages of the existing area, in order to merge with them the project.

Requested materials:
- going through model in real-time on line;
- interactive model with the possibility to change some design variables, such as light systems (the natural and artificial ones), free standing equipments…;
- animation of constructive phases, in order to better understand the relevant design;
- animation with stereoscopic sight.

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Distance daylighting and digital fabrication

Glenn Sweitzer[1], Joshua Vermillion[2]

[1]Sweitzer LLP, Muncie, Indiana
[2]Ball State University, Muncie, Indiana

ABSTRACT: In this paper we assess the use of digital fabrication for a distance daylighting course. Precise scale-model components were digitally-fabricated locally to facilitate assessment and photo-documentation of solar access and Daylight Factor (DF). The goal is to extend, globally, use of limited, local daylighting laboratory tools. If successful, a wider distant student and professional audience could be served from the limited facilities that offer physical assessments.
Based on distance introductory lectures, seven distant student teams developed digital three-dimensional model files to specify sidelighting and toplighting schemes for a school classroom project. At the local site, the files were translated into two-dimensional pattern files to digitally-fabricate architectural scale model components. Following assembly, each completed scale model was tested (also at the local site) for solar access, using an adjustable-table heliodon, and Daylight Factor, using a mirror box.
Documentation of each local assessment, returned to each distant team, included a video file (solar access), still images (solar access and DF), and a digital contour map (DF). This enabled the distant teams to compare, for example, solar access given by digital modelling vs. physical scale models. The differences engendered vigorous online review discussions. Suggested changes to improve the process are discussed.

Conference theme: Digital approaches to architectural design and education
Keywords: daylighting, digital fabrication, distance education

1. INTRODUCTION

Architecture has been slow to embrace digital tools. Aircraft, auto, and ship building industries long ago replaced top-down, hierarchical, and linear assemblies of parts with integrated modules. Digital tools are now widely used to visualize, simulate, and manage the assembly of complex modules. Integration of digital technologies within design, prototyping, and production processes has helped produce products that are better, faster, cheaper - More for Less (Kieran & Timberlake 2004).
Digital tools are now gradually raising expectations for architectural education, practice, and building. Integrated Practice (IP) and Building Information Management (BIM) tasks, for example, require well-informed, competent, and team-oriented users of digital tools. Most architectural educators remain challenged, however, to use digital tools for teaching, locally or globally. Course content, sequence, teaching methods, and student progress are at stake.
Architecture curricula, specifically, have been slow to embrace the full spectrum of digital tools and their capacity to transform the design process. Initially, digital tools were used by architectural students for representing design work. Visualization and simulation advances followed.

1.1 Virtual Design Studios

Beginning in 1993, small groups of architectural students at different institutions around the world participated in collaborative design projects; their tools included CAD, Internet, and teleconferencing. (Bradford, Cheng, and Kvan 1994). This "Virtual Design Studio" (VDS), as it came to be known, enabled team members worldwide to work simultaneously together (synchronously) or separately (asynchronously). The latest state of each design would always be available in a shared database (Kolarevic, et al 2000).
Over time, the focus, structure and scale of tasks considered - and the tools used - in these collaborations expanded. They fit in a continuum, from conceptual theory to pragmatic application (Cheng 2003). For distant partnerships, generally available communication channels were used, including e-mail, web pages, listservs; desktop video-conferencing, and text chat, with or without voice. Different tasks of a project required different kinds of support, e.g., for text vs. graphics. Most critical, the means need to fit the participants (Cheng & Kvan 2000). That is, effective teamwork is considered a process of negotiation among its members, with rapport influencing outcomes. Accordingly, individual expectations for outcomes influences what is evaluated as successful (Cheng 2003).
While these conclusions may apply to several fields, it

is unfortunate that the literature reviewed for this paper focuses almost entirely on architectural education. Surely there is also relevant experience in the aircraft, auto, and ship building industries, each of which preceded architecture into the digital world.

1.2 Digital Technology

Transformative digital technology enables users to manage design constraints and decisions within a digital, three-dimensional model. By using a digital master model to design, each architectural component (standard or custom) can be described precisely, including instructions for fabrication and assembly. New forms of information can be extracted from this master model, to drive the digital exchange between designing and building (Mitchell 2001)—at model scale, or full scale—quicker and seamlessly. Evaluation can also become an integral part of this design process, but only when significant changes have been made in the way that information is collected, shared, and reused throughout the industry (Cohen 2000).

Advanced digital tools are now integrated with complex modelling software (e.g., CATIA, Revit, and Solidworks), and are used to derive forms in response to performance-based criteria (Kolarevic & Malkawi 2005). Digital technologies are transforming communication among agents in the building industry, by presenting opportunities for recording, managing, and distributing design information, for simulation, optimization, and production (Kolarevic 2003).

Digital-fabrication represents a pivotal transformation, between image and product and is expected to be commonplace in the near future. Accordingly, command of relevant digital tools must be integral to architectural education and practice (Cheng 2006).

1.3 Digital Competency

Digital competency requirements for using digital tools in accredited (e.g., US) architecture programs remain vague. Does this reflect the uneven use of digital tools among architecture students, and / or among faculty responsible for evaluating their work? The National Architecture Accreditation Board (NAAB), the sole agency authorized to accredit US professional degree programs in architecture, currently promulgates its position under Graphic Skills: "Ability to use appropriate representational media, including freehand drawing and computer technology, to convey essential formal elements at each stage of the programming and design process." (NAAB 2004). While these criteria are expected to be revised soon, precisely how is not clear.

1.4 Environmental Technology Course Potentials

Non-studio architecture courses, such as Environmental Technology (ET), can also benefit from digital tools, locally and globally. Unlike design studio, ET is most often presented in a lecture format, with up to 100 registered students per class. In addition there may be laboratory meetings when students perform exercises in smaller groups. This approach usually hinges on the availability of competent graduate student assistants. In any case, close contact with students who need it most is difficult to maintain. Following we describe use of digital-fabrication in our project-based ET course.

2. PROJECT-BASED ET COURSE

At Ball State University (BSU), from 2003-2007, we developed an alternative ET format for the required two-semester sequence, respectively, focused on passive and active ET topics. Each term, for ca. 80 students, 3-4 hands-on projects were assigned. Essentially, each was a short design project that required testing to meet performance-based criteria.

2.1 Team Projects

For each project, the students were divided into teams of two; with different students each project. Based on the prerequisite digital media course, digital-fabrication was encouraged, but not mandated, for constructing scale models for assessment. Interim and final reviews were conducted, each with a comparable weighting toward the final project grade.

For each review, each student was required to score all team projects, including their own, according to the criteria. By the final submittal of each project, each team was well aware of their standing in the class and of their impression of the project. The latter was captured in a questionnaire survey, before grading. This format gradually improved the quality of project submittals while reducing (instructor) grading time. Student feedback to the passive projects (daylighting, ventilation, and whole building energy assessment with focus on daylighting) indicated that the daylighting project contributed most to their learning, although it took the most time to complete. The students also concluded that application of the lessons learned would contribute the most, in practice, to sustainability. Indeed, daylighting is rated (e.g. in LEED) one of the most sustainable means for building (DiLouie 2007).

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2.2 Daylighting Models vs Software

For the daylighting project, scale models rather than software were used for assessment, for practical and pedagogical reasons. Daylighting was given three weeks in the syllabus, that is, 7.5 hours of contact time. Solar geometry, vision, and architectural lighting principles preceded the project introduction. The interim review was held after two weeks, and the final a week later. There was insufficient time, in addition, for the class to gain command of a high-fidelity lighting software, such as Radiance.

Pedagogically, precise scale models enable students to grasp daylighting issues more rapidly than through a series of "sweet snapshots", even though photorealistic. Changes in the distribution of incoming direct and reflected sunlight on interior surfaces for representative days of the year can be captured, efficiently, via short video clips. Images of violations can be isolated for study.

With each successive daylighting project, more and more student teams used digital fabrication for producing their components. The benefits were most evident in the assessments for solar access, made on an

adjustable-table heliodon. The precision also improved the appearance of the photo-documentation of the assessment for Daylight Factor, made in a mirror box simulation of a uniform overcast sky
Could this method be shared with a wider audience, given the urgency to practice sustainable means (2030 Challenge)?

3. DISTANT DAYLIGHTING COURSE

Based on our experience with the ET courses, we were able to test our method via a distant Architectural Daylighting course for architecture students at Taiwan National University of Science and Technology (NTUST), Taipei. The NTUST architecture curriculum is decidedly more Architectural Engineering (AE) oriented than architectural-design programs in the US. In addition, the (elective) class of 14 varied considerably by age, culture, mother language, and mastery of analog vs digital tools relevant to the course.
Initially, we planned to engage the students via video-conferencing, with visual and aural channels in each direction. By show time, this system was not available, and we were reduced to two-way voice and projected images. This limitation worked surprisingly well for those proficient in English, but less so for the others.
For all students, the course was effectively launched during the three-week onsite visit at NTUST by the instructor (first author). Through live face-to-face introductions and working together on two initial analog exercises, student engagement and confidence soared.

3.1. Analog exercise #1

The first analog exercise challenged students, at an unobstructed rooftop site, to hand-render daylighting in a shoe-box. The side- and top-apertures (opposite the viewing port) were limited to flaps that could be opened inward or outward or taped closed light-tight (Figures 1a – 1c). These limits enabled each team to explore alternative daylighting combinations before rendering an assigned sequence of 5 images. In addition, each team was assigned a different solar orientation, to provide varied outcomes of direct vs diffuse daylighting. Grey-scale tones were rendered to represent the brightness distribution on the (uniformly finished) interior surfaces (walls, ceiling, and floor). A stool was provided to support each shoebox, to maintain its solar orientation and fixed height, while the rendering time for each scene was limited to 10 minutes.

3.2. Analog exercise #2

The second analog exercise was to design and assemble hand-built sidelighting and toplighting components for a shared template model of a school classroom (Fig. 2). Based on the experience accrued with the shoeboxes, each team developed a scheme to be assessed, subjectively, outdoors. As with the shoebox exercise, visual adaptation was critical to appreciating each interior view, this time, via a porthole large enough for photographic documentation. Note that the lighting criteria for this classroom model was the same as for the digital models that followed.

Figure 1a: Unobstructed rooftop shoebox rendering site.

Figure 1b: Example shoebox interior with left, right, and top apertures.

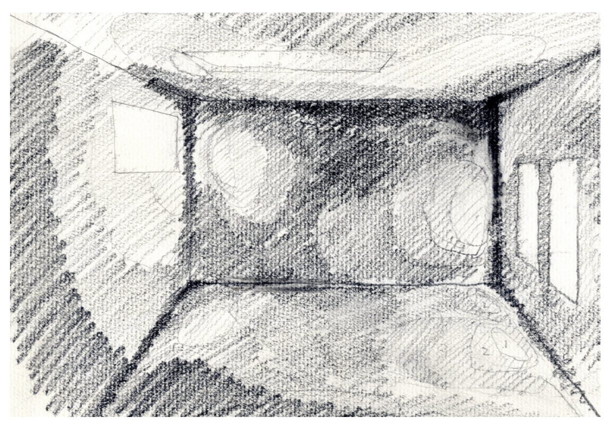

Figure1c: Shoebox rendering for same.

Figure 2: Analog Classroom Template Model.

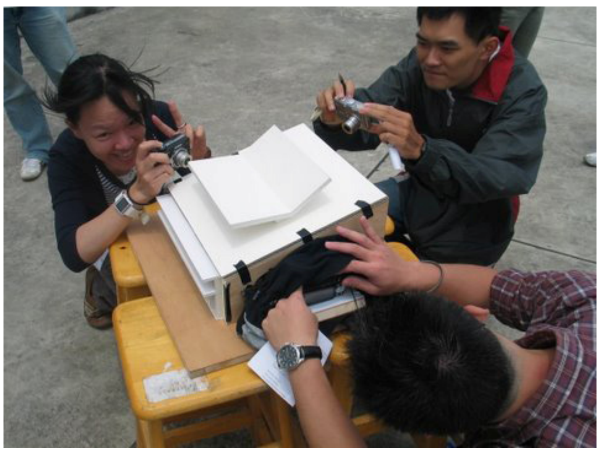

Figure 3: Rooftop model assessment.

3.3. Performance-based daylighting criteria

The assigned daylighting project involved a rectangular school classroom, with a sloping ceiling, extending upward from the south-facing window wall (Fig. 2). Any part of the south-facing window wall could be used for sidelighting, although at least one light shelf, extending outdoors and / or indoors, was required. East and west walls were blank (Note – the east wall board area was openable to facilitate photo-documentation under overcast sky conditions - see Fig.10), as well as the north wall up to the height of the south wall. The north wall area above could be used for sidelighting. Any part of the roof / ceiling area could be used to admit top-lighting.

The student desk area, the horizontal workplane, was designated by a continuous raised rectangular platform. A whiteboard, a vertical workplane, was located on both the east and west walls. The challenge was to prevent direct incoming daylight on either the horizontal or either vertical workplanes throughout the year, from 09:00 – 15:00. Each student team was assigned a different latitude, to generate varied solutions.

Figure 4: Sketchup digital model.

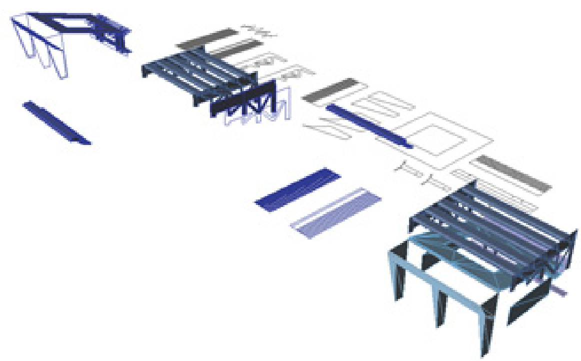

Figure 5: Preparing the digital files for laser cutting.

3.4. Digital modeling

Based on the results from the analog models, each NTUST student team constructed a digital model, using Sketchup (Fig. 4). Upon completion, the files were sent to the BSU student fabrication consultants for review prior to fabricating and assembling the models.

Component structural integrity, scale, geometry, and tolerances were reviewed to ensure light-tight fits with the BSU classroom template model. Once deemed adequate for fabrication, the BSU consulting team used Rhino, a 3D modeling software that facilitates the extraction and translation of surfaces into lines and curves, to prepare the files for CNC laser-cutting. Each scheme component was translated into vector-shape information to guide the laser cutter (Fig. 6 and 7). Nesting of the shapes within a standard size of material sheet stock minimized material waste from fabrication (Fig. 7). Assembly of each model was straightforward. Tolerances were tested beforehand to ensure a precise, tight-fitting model.

The two daylighting assessments followed.

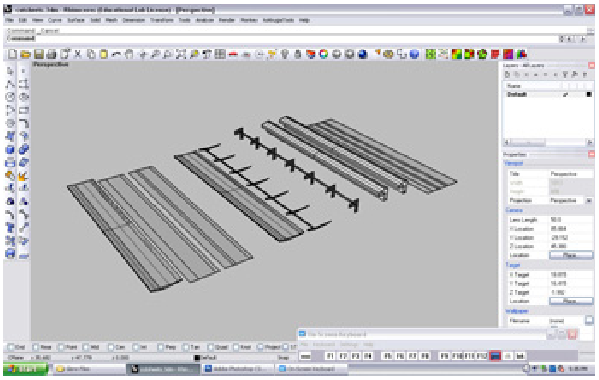

Figure 6: Preparing light shelf details for laser cutting.

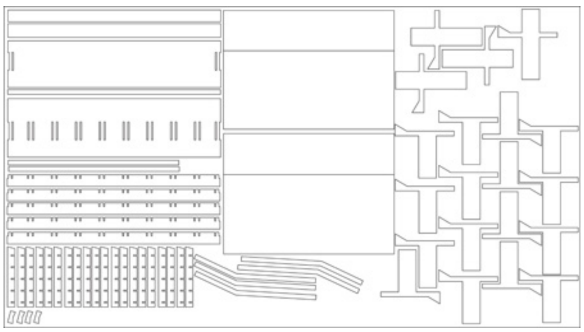

Figure 7: Nesting patterns for CNC laser cutter.

3.5. Solar Access Assessment (BSU)
Solar access (sun only) was assessed for each model using an adjustable-table heliodon (Fig. 8a). The (hinged) north wall was lowered to position a fixed video camera, to take in the full scope of the room and all three workplanes (Fig 8b). The play of incoming direct light was captured from 09:00-15:00, for the summer and winter solstices and the equinox(es). Through replay, any violations could be detected and remedies proposed (marked red in Fig. 8c).

3.6. Daylight Factor Assessment (BSU)
Daylight Factor, which assumes a uniformly overcast sky, was assessed for each model inside a mirror box (Fig. 9). Interior views were photographed with the horizontal workplane in place (Fig. 10). To measure horizontal illuminance at 25 positions throughout the classroom, however, the raised platform was removed. Five sets of measurements were made, each with 5 sensors aligned N-S on a paddle (Fig. 11) yielding a 5 x 5 matrix. The graphic output was a software generated Daylight Factor contour plot (Fig. 12), based on the ratios of the interior illuminances compared to the unobstructed exterior reference illuminance.
For each assessment, exterior and interior still photo-documentation was provided to each team for use toward their summary report. Written and graphic explanations were required, of 1) project intent; 2) project outcomes, and 3) explanation of the differences between intent and outcome, and what the team would do differently given another opportunity.

Figure 8a: Adjustable-table heliodon assessment.

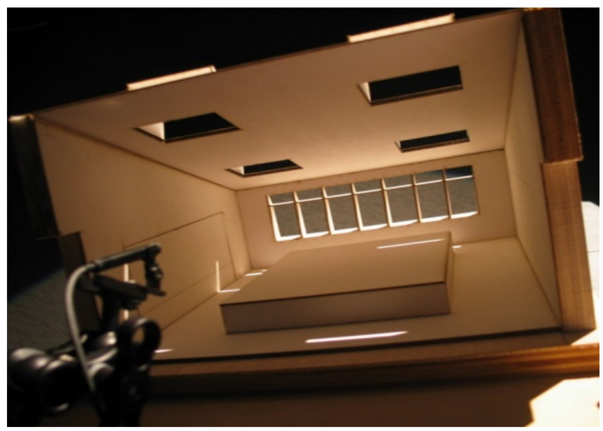

Figure 8b: Video documentation of solar access

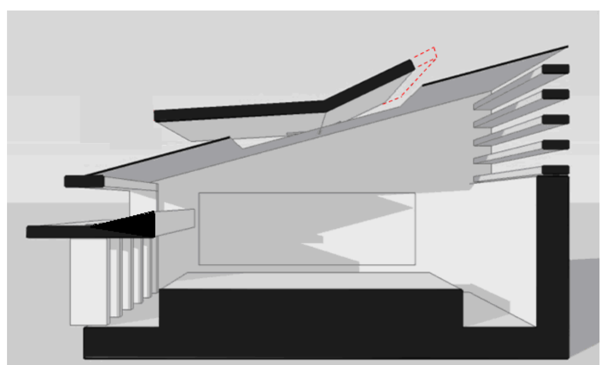

Figure 8c: Proposed changes (shown red) for light shelf & top.

Figure 9: Mirror box assessment site.

Figure 10: Interior under overcast sky from student perspective in NE corner.

Figure 11: Illuminance measurements using five-sensor paddle.

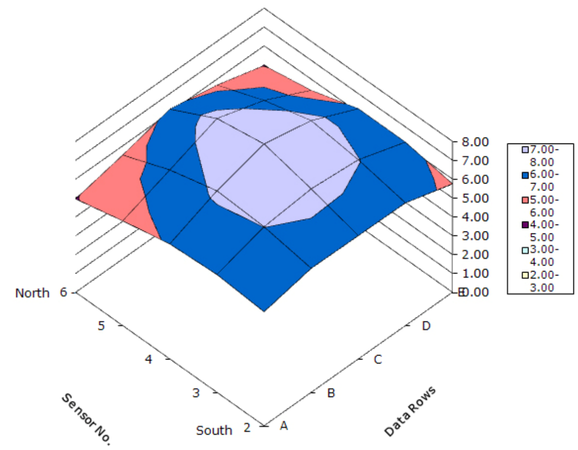

Figure 12: Daylight Factor Contour Plot.

4. DISCUSSION

Digital tools hold untapped potentials for ET in architectural education. Our first distant ET course was based on recent BSU courses that had benefitted from digital fabrication. The distant NTUST daylighting course differed from the BSU courses, however, by focus, student contact, model production, and review of outcomes. Following, we discuss these issues, each vital to improving outcomes for future distant and local ET courses.

4.1 References

Our literature search yielded no references that describe the use of digital fabrication for ET course projects. We found several references however that describe digitally fabricated building envelope components, including those for daylighting. In practice, for example, Foster & Partners and Grimshaw Architects are leading exponents of parametric design and digital fabrication. To develop our project further we intend to include parametric design, to help aid student understanding of optimization, in response to performance-based criteria (Burry 1999).

4.2 Course focus

The NTUST course focused exclusively on daylighting while in the BSU courses the daylighting project was one of four. The additional time in the NTUST course allowed for the two analog exercises, the shoebox renderings and the draft model. A couple of NTUST students considered the shoebox exercise to be the high point of the course: Both analog projects probably improved student understanding and confidence, critical to developing their digital models.

4.3 Student contact

Contact with the NTUST students was remote until the onsite period. Until then, there was little palpable chemistry among the students, and few questions. Afterwards, course interactions blossomed.

Had the onsite meeting been at the beginning of the course instead of mid-term, the students probably could have benefitted more.

4.4 Model production

Following completion of the analog exercises, the NTUST students relied on local digital fabrication and assembly of their models. Hands-on control was lost once they submitted their digital files. All files were edited locally, some much more than others. For example, dimensional changes were made to fit the model materials used, and, for structural connections necessary to realize their intentions, as shown in the digital files, but not adequately detailed to work in a physical model.

Materials are critical to the production and performance of scale models as well as real buildings. Errors were made by the BSU consulting team, in editing the files, and in fabricating vs. assembling the components. All three tasks may have been done by a single consultant, or independently, for example, by more than one. This points to the need to carefully organize digital fabrication, so that accountability is maintained throughout. For example, a lightshelf, which included exterior and interior components, was installed back-wards. As a result, the scheme violated the criterion for solar access. The error was flagged during the final review. Following correction, the scheme was retested; and the lightshelf worked as intended.

This example echoes what needs to happen in practice, from digital files to fabrication of full-scale elements. A two-way feedback loop, including materials and production logistics, is essential.

4.5 Final Review

The final review was online, via popular video chatting software (Skype). Each team had received in advance visual images of their project assessments, documented locally. This included video clips for the heliodon assessment of solar access and still images of the solar access and sky assessments. The video provided arguably the most telling and challenging images. It allowed comparison of the digital Sketchup shadow studies done initially by each team, with the physical assessments. The differences between these, flagged by the distant student teams, proved most informative, for the local team as well. These differ-ences showed the need for better coordination between the editing / preparation, fabrication, and assembly phases. It also showed the need to provide allowance for error between digital and physical models. It follows, that allowance should be provided in practice, between the precision of a digital model vs. the building.

CONCLUSIONS

1. The use of digital fabrication in ET courses is not widely reported. Further research and development of this potential could lead to improved integration and outcomes in studio and actual projects that include physical assessments of scale models.
2. Analog tools can yield valid bases for comparisons with digital outcomes. Analog exercises should not be dropped from architectural education, but rather taught along with digital tools.
3. Digital fabrication tools can save time (for iterative fine-tuning,) and resources (contributing to sustainability goals).
4. The daylighting project proved ideal for testing model performance, especially for solar access. The next logical step is the use of more advanced, parametric design tools to generate components that can be more readily optimized for daylighting performance. Para-metric design would allow for easier and quicker fine tuning and reconfiguration of envelope components.
5. Video-conferencing is ideal for distance lecture courses that require continuous visual and aural contact. Alternative free communication channels meanwhile can prove worthy for focused meetings, including those that involve images.
6. Sketchup, free for downloading and used worldwide, is an ideal program for creating basic digital files by students with beginning digital design skills. The shading option is a useful reference for comparing assessments of solar access for physical models. For preparing digital fabrication information, advanced modelling software (such as Rhino) can be used to post-rationalize Sketchup geometry into the appropriate information for laser cutting.

ACKNOWLEDGEMENTS

The authors wish to thank Professor Eddie Chiang and course assistants Ling-Mei Liao and Charles Sanchez Jimenez, in the Department of Architecture at the National Taiwan University of Science and Technology, Taipei. At Ball State University, we thank the Department of Architecture, the Institute for Digital Fabrication, and the Center for Energy Research/ Education/Service (CERES). We also appreciate the critical comments received from the anonymous reviewers.

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Observational research and digital social media: Route 66 and Amboy California

Kate Wingert-Playdon

Temple University, Philadelphia, Pennsylvania

ABSTRACT: Place-based research is an important component of understanding physical contexts. The range of information needed to understand places, from site measurements and data, to social data and cultural needs, requires a range of sources. Observational research methods are well established. Local information is essential - site notations, photographs, oral information gathered through conversation and interviews, and information gathered from local media can give a broad range of information and provide a clear and accurate picture of a place.

With an increasing amount of data and base information available on the World Wide Web, information from official and reputable sources as well as from unvetted sources is useful for place-based research. Information for the research presented here comes from a range of sources - from government map and data websites to social media sources such as blogs and photo storage sites. The increased use of social media web sites, archiving web sites, and a range of sources reflects a trend for information gathering that encourages many voices rather than one official source, a trend that works well in design research. Discussed here is an attempt to understand the strengths and limitations of the range of digital information sources for observational research that supports design inquiry.

Through the work carried out over the past two years that includes using social media for observational research, we have come to realize that design professions can take a lead in understanding the use of social media as an information source. The use of social media is becoming inevitable. Understanding how to engage it is essential.

Conference theme: New methodologies in architectural research
Keywords: Human context, social, cultural studies

INTRODUCTION

Web-based research is currently commonplace – digital information on the internet is easy to access and often a first source for inquiry. And it is increasingly possible to access information on the web that is accurate and substantial for research. In a search for place-based information, the use of web resources can be invaluable. Information about physical context ranges from maps and data to photos and descriptions. But although digital information is easy to access and widely used, reliability of sources is still often questioned. The range of reliable information available for place-based research is from official sources, such as government atlases or census data, through websites of cultural and historical organizations. At the other end of the spectrum of sources used for place-based research are websites that contain information that is unvetted and therefore according to academic and professional standards potentially unreliable. Among these sources are websites of enthusiastic amateurs in a variety of fields and social media sources. Information from unvetted sources might include inaccuracies, but can also be invaluable. When consideration of these sources is conceptualized in the spirit of Web 2.0 – where research is carried out through collaboration and sharing of information, its power resides in the fact that it is information from many voices and many sources that encourages a broad base rather than top down strategy for information gathering. The power of many voices is important, but the question of accuracy and reliability still remains.

The design research work described here uses a range of internet sources for design inquiry and place-based research. Digital information is gathered from official and reliable sources, and also unvetted sources, in particular social media sources including blogs, photo storage sites and video sharing sites. Over a two year period, in addition to gathering information about the physical and cultural nature of places, we have tracked the use of web sources with the goal of understanding the best-use of the range of information.

In order to measure and understand the use of social media sources for place-based research we followed methodologies of observational research.

Observational research methods are well established and universally used for design inquiry, however with the introduction of internet digital resources it is fair to say that relooking at observational research methodologies would be helpful. In particular we looked to the work of William H. Whyte – his observational and analytical studies of people using urban spaces in New York and other cities. Whyte's methods required what he called concern with the practical in the design and management of urban spaces, but also, as he put it the "less-practical" or fundamental research.[1] Fundamental research went beyond accepting the status quo, and questioned inherent issues of design of urban spaces that had been assumed but never tested. For example, overcrowding in cities was assumed to be a source of social ills. But the nature and place of crowds were assumed to be universally applied rather than particular to any context. Fundamental research here was looking carefully at the details of a situation. The assumption is that there are some universal attributes and behaviors but that local conditions are unique and can only be extracted through observation to understand both the context and the cultural norms. The interest in local information is important here. For the project described here we were examining sites where firsthand experience was not an option. But as an understanding of places was necessary we were interested in using internet research to understand local conditions. Moreover, internet sources presented an opportunity that is important to observational research. It allowed us to take disparate kinds of information – information on geology, popular culture and climate for example – and put them together. The multiple layers of information in juxtaposition to one another gives access to unexpected coincidences and allows unforeseen discoveries. This not only is a method that approaches what Whyte called fundamental research, it is a method that encourages design exploration and design thinking.

Whyte's interests were the behavior of people in urban settings as well as the settings themselves. The methods included: direct observation, analysis and notation, interviews and eavesdropping, and second-hand observation using still and movie photography. All of these, except direct observation, are methods that can be applied when using digital social media. We can visit publicly accessible photo storage sites, video sharing sites, oral history sites, and blogs. We can participate in conversations that can be structured as interviews, and notate and analyze information. It is important to note that this is not a study of the sociological implications of social media. Following on Whyte's techniques, social media is a source of what the web author might consider background information for the story being told, the settings for the primary subject of the story. The premise here is that social media can get at an understanding of the local conditions of a place. The hope is that this provides a balance to official information in understanding settlements. Using both kinds of information, we are assuming that the use of digital media provides an understanding of local attributes (both contextual and cultural) leading to comprehensive knowledge of a place and its particular design needs.

The work discussed here has led us to understand that, generally speaking with regard to place-based research, official sources of information can be used for data and for base information about a physical context. And in conjunction with this, social media can be used to gain an understanding of its local conditions including a sense of place, its culture, and spirit.

Below are examples of design research that use web-based digital information as primary resources. The examples outline the use of reliable graphic and written material such as web sites to access maps and data, online newsletters and organizations. Social media sources are also used. Information includes photos accessed on photo storage sites such as Flickr, videos available on YouTube, and conversations about places from blogs. The work is sequenced starting with projects that use official websites to projects that rely more on social media.

1. CONTEXTS LARGE AND SMALL

The research presented here focuses on the context of Route 66, considering its role as a *roadscape*. As a complete entity Route 66 was 2448 miles in length on its journey from Chicago west to Santa Monica. It still exists in fragments of usable roads, decommissioned roads, and roads that have been overtaken by the interstate highway system and although disjunctive, Route 66 is iconic and still thought of as a whole entity. The objective of the work is to find a way to envision Route 66 as a whole with significant settlements and landscapes playing a role in its character. Examples here incorporate the whole of the route as well as a focus on one town, Amboy, California. Amboy is a town in an isolated part of the Mojave Desert that was an important stop along Route 66. A ghost town at present, it was once an important travelers' destination with at least 300 residents, motels and cabins, gas stations, eating establishments, a post office and a school. The current owner is in the process of reviving travel services in the town and the context is complete enough to get a sense of its past. Amboy has had some colorful moments in its history, for example, it was until recently a place for Hollywood movie stars to fly in and out of for a hamburger and it was offered for sale on e-Bay. This kind of information, we discovered, was important to the culture of the place, but only available on unvetted internet sources. Amboy, therefore, is a great context in which to test the use and limits of social media for observational research.

The whole of Route 66 and the particulars of Amboy were examined by upper level professional program students in architectural design and research was done without prior engagement with or knowledge of the site. To goal was to gain an understanding of the cultural as well as physical aspects of this complex place in order to create a context for design. Although there is a vast

[1] Whyte, William H., *City: Rediscovering the Center,* Doubleday, New York: 1988, p. 2.

Figure 14: Route 66, 2448 mile graphic analysis of topography and ecosystems. (Andrea DeVico 2007).

array of sources about Route 66 in both print and web media, there is very little that can put together a picture of its cultural and physical landscape. The studio worked with both web and print information. The examples below present a range of strategies for understanding the physical contexts. Brief discussion about sources is included, and discussion of what we learned in the process is presented at the end of the examples.

1.1. Maps and data

One approach taken to envision Route 66 was to understand that the 2448 mile expanse of the Route 66 is not spatially unified and that the journey across the various landscapes was an important factor in envisioning Route 66 as a physical place. The graphic analysis in Figure 1 uses an exaggerated vertical scale, but emphasizes divisions – ecosystems, state lines, and time zones. The attempt is to take data in maps and present them in graphic form for a visual understanding of the linear roadscape. The data for this project came from government sources beginning with United States Geological Survey maps and atlas data.

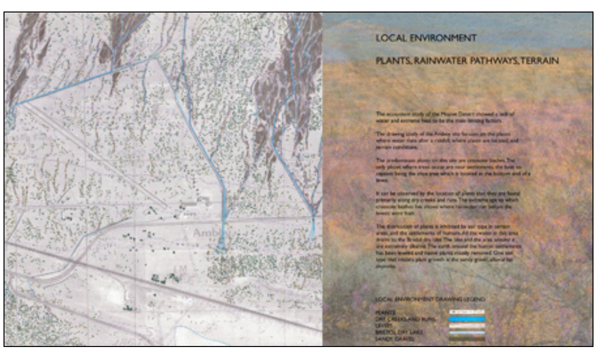

Figure 15: Surface Water (Tom Budinetz 2007)

Comprehending a settlement along the roadscape required that we find a way to understand its morphology. This meant envisioning the settlement and building patterns but also the macro structures of its landscape, geology, and systems. Similarly to the example in Figure 1, projects of this sort began with aerial photos, but also relied on data from USGS, BLM, and other related government information sources, but for these projects the focus was on the local character of places rather than the overall land features across a 2448 mile expanse.

The projects in Figures 2, 3 and 4 look at water, geology, and plant systems in order to place the human scale elements - architecture and people - in an environment. This analysis found Amboy to be specifically settled at its present site in the vast dry Mojave Desert because of its underground water and its location in an alluvial plain and watershed area.

In addition to the USGS website, the work relied on website information from the Desert Gazette and the Mojave National Preserve to explain the local and regional landscape and geological and water systems that formed the area and allowed the placement of the settlement. The online newsletters were a significant information source including its links to other sites with obscure but important information about the nature of the aquifers, the nature of underground and surface rocks, the wind tendencies that influenced the landscape features.

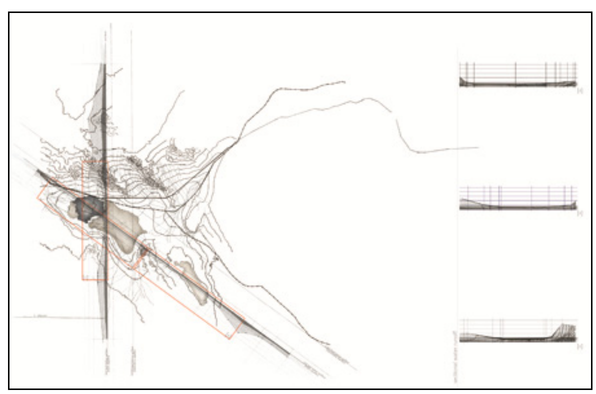

Figure 16: Topgraphy, surface and subsurface water (Bridget Gramlich 2007)

1.2. Comparative studies and information searches

The objective of the research shown in Figure 5 was to understand the scale and size of the town of Amboy, California. The town's location in the Mojave Desert made the scale of the settlement difficult to understand. The landscape is vast and as a partially occupied town the scale of the settlement was unrecognizable making any understanding of the place inconclusive. A comparison using aerial photos of the sites was used and a familiar scale established an understanding of the town's scale. Two sites along Route 66 were compared – the town of Amboy was overlaid to scale with the East Los Angeles Interchange (Interstate Highways 5 and 10) and its surrounding context including Dodgers Stadium. The interstate highway interchange of Los Angeles overlays directly onto the center of the town of Amboy. Route 66 aligns with Route 10 and Dodger's Stadium aligns with the Amboy Crater (an inactive volcano). In the written comparison quantities help to make the comparison, for example, where Los Angeles is filled with buildings, Amboy is empty of them. Distances and scales give direct comparisons. Understanding the scale of Amboy was essential for any understanding of the sense of place and this graphic analysis became the basis for other research about the place.

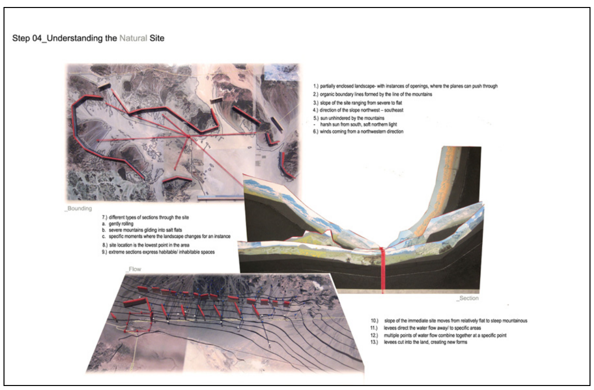

Figure 17: Landscape systems (Nina Gernesova 2008)

Comparison of the two contexts used graphics and statistics that highlight quantitative measurement. For the graphic comparison the primary sources were Google Earth and Google Maps.

An emerging advantage in web-based research is the availability of inventories and archival information. Web archives follow the logic of Web 2.0 use - that presenting and sharing information for others to use leads to innovation. The project depicted in Figure 6 uses a reliable archive source, the Center for Land Use Interpretation's tagged map of sites, for industrial uses in the dry desert environments of California.

The project builds on information about the various uses found in the dry and harsh environment of the Mojave Desert proposing future planning and growth of industries and occupation of the sites between Barstow and Needles to build an environmentally sustainable settlement. Industry includes agriculture, transportation networks, and energy production and the design research leads to speculation that these industries can be the basis for future settlement.

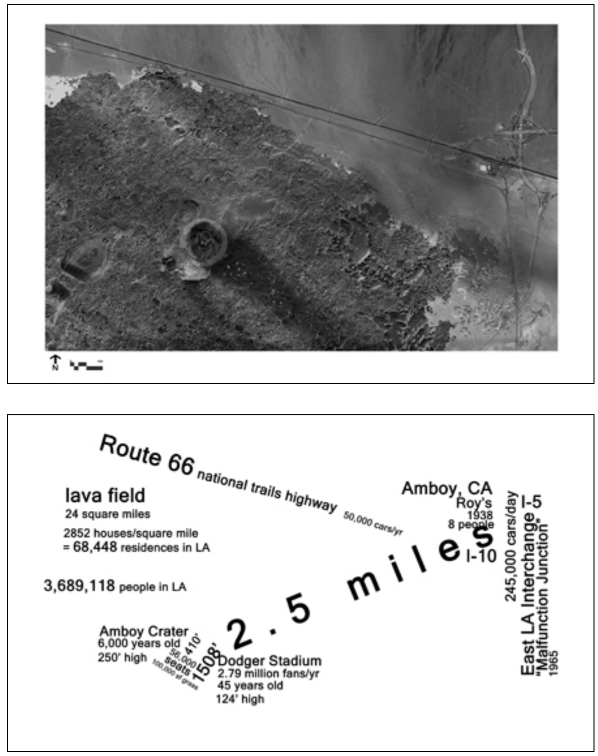

Figure 18: Comparison of Amboy and Los Angeles (Chris Willich 2007)

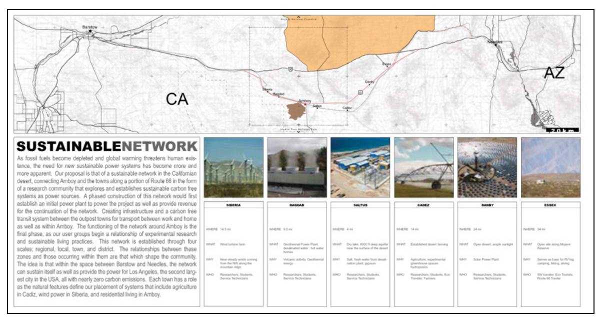

Figure 19: Proposal for Industry Network, Mojave Desert (Mike Villegas, Keith Stauffer, Hiroyuki Watanabe 2008)

1.3. Photographs: what other people see

Another approach to discovering the nature of Route 66 involved looking at signs. The premise for the project depicted in Figure 7 was that roadside signage is a cultural manifestation, portraying information about the site. Route 66 signs were compared with road signs from the parallel interstate highways. The comparison shows the nature of two roadways, reflecting aspects of road travel. Route 66 includes variety in its signage as shown in the top tier of Figure 7. Signs are individual projections of the places they represent. The attempt of settlements and individual establishments is to attract visitors. Along the interstate, signage is uniform as shown in the bottom tier of Figure 7. Place names and mileage are all indicated on green or blue highway signs, reflective of the interstate system where the objective of travel is to get as quickly and efficiently as possible from one place to another.

Photos of signs were obtained using Flickr and other photo storage web sites. Photos were called up according to categorical classifications, Route 66, Interstate 40 or individual place names along each route. The signs were then located graphically using an aerial photographs of Route 66 as the background for organization.

Another use of photo storage sites is indicated in the project depicted in Figure 8. Similarly to the project shown in Figure 1, the objective was to understand the varied landscapes representing ecological shifts along the roadscape, but this one went about the research differently. Where the project in Figure 1 used maps and data from government websites, the project in Figure 8 was interested in the visual nature of landscapes and used photos to classify the differences along the route. The project began with a broad understanding of ecozones along the roadscape and called up photos according to place names.

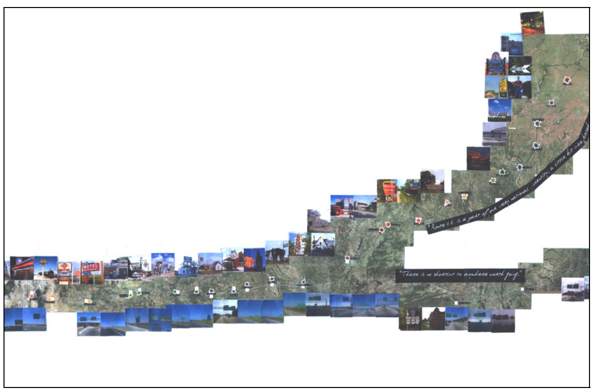

Figure 20: A portion of Route 66 / Interstate 40 sign comparison study (Kristy Simcic 2007)

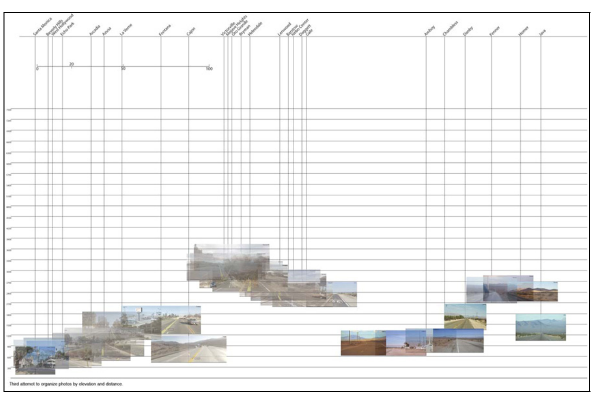

Figure 21: Landscape photos from photo sharing websites (Renee Trimarco 2008)

The difficulty here was in trying to find photos of landscapes in the vast spaces between towns. This is indicated in the distance between photos groups, located according to road mileage. Storage on shared photos sites tends to focus on nameable areas. A search strategy to look at photos sequences was employed. If, for example, you follow a traveler's sequence of photos between two towns you obtain photos of the towns and of places in between. Working with photos of more than one author, multiple sequences gave a more inclusive view of the context. Even with this strategy, photos accumulate around certain areas. A conclusion here is that sites of interest tend to be photographed repeatedly corresponding with prominent sites along the route.

1.4. Travelers' and residents' blogs

Given the scale of the context we were trying to envision (2448 linear miles), travelers turned out to be a primary constituency for information. Many kinds of travelers still traverse Route 66. The analysis depicted in Figure 9 was done to try to understand the nature of travelers along Route 66. In order to do this, travel blogs of individuals and groups were accessed. The blogs included journal entries and photos from the authors' trips. Different groups were classified – solo travelers and families, for example, and vehicle types were noted - car drivers, motorcycle tour groups, recreational vehicle travelers, and bus tourists. Comparative inventory of sites visited and named in the blogs indicated the idiosyncrasies of different kinds of traverses. Groups on motorcycles (shown in the top tiers of the image), for example, tended to stop less than other groups. Their blogs indicated they were traveling Route 66 for the freedom of the ride and open space on the backroads. Travelers with children stopped at tourist sites, places where signage was unusual, and spectacular scenic areas. And where the motorcyclists photos tend to focus on the group, photos by families tended to focus of the sites and objects along the roadside. This denotes different kinds of journeys for different kinds of travelers. In all there were 13 traveling groups studied through travel blogs, each represented in Figure 9 by a horizontal band of quotations and photos taken from their websites. The cadence of each travel group is notated, the data coming from their blog diaries. The line is scaled to the road and demarcated with photos and text according to the journal entries' indication of stops. To give an understanding of cadence, the image uses the group indicated by the bottom band as a norm for time measurement. The family started their trip in Santa Monica, traveled east towards Chicago in an RV and ended up in Chicago 66 days later. Of the 13 traveling groups surveyed in detail, there was only one site along the whole of the roadscape that was visited by all – the Cadillac Ranch outside Amarillo Texas (it is close to halfway along the route and therefore located in just about the center of the image).

Where travelers' blogs gave important insight in understanding the experience of travel and the whole of the Route 66 roadscape, blogs of occupants and former occupants of settlements were found to be a useful source of information when focusing in on towns. To discover the nature of daily life in Amboy California in its heyday[2] the project depicted in Figure 10 began a search to find information from former residents. Blogs that mention the town are abundant, as Amboy is still a prominent feature along Route 66 even as a ghost town in the vast and desolate Mojave in the triangular area between Twentynine Palms, Barstow, and Needles California. Blogs of former residents included reminiscences of events in their lives. Reminiscences were set in places such as the Amboy crater and the graveyard (landscape features), the Amboy School and the San Antonio chapel (buildings).

The project had the result of painting a picture of the culture and life of the town by placing the memories (in the form of quotes and photos) of residents and former residents in the physical context. In order to get enough content to understand the context this research it required looking at many sources for small amounts of information, short oral histories from many voices. Some of the information was lore rather than event and needed verification from other sources. Nonetheless, the information was essential to painting a picture of the place as it had been when occupied.

2. USES OF INFORMATION

The above examples are indicative of the kinds of sources that were used for design research about places. We found that there were some essential source materials. Google Earth and Live Local, for example gave us easy access to accurate base information. And the more we looked at aerial views as research progressed the more we understood and were able to conceptually 'enter' into places. The USGS, BLM, National Atlas, and other official sources of maps and data also proved to be essential as sources of base data for understanding sites.

Reliable sources are more and more available on the web. Online newsletters such as the Mojave's Desert Gazette are important hyperlocal sources. The data and information is accurate and the links are vetted. Sources like the National Parks Route 66 Cultural Resources website includes links that are vetted. This website and others like it have brought government historical surveys and information from state historical agencies, once buried in archives, to the web for easy access. Differently than in the recent past, the internet is now a powerful tool that allows for information searches for specific place-based material. The website of the Center for Land Use Interpretation (CLUI) represents a great emerging feature of site-based web research. The inventory of sites in the form of a digital archive, compiled as part of the CLUI's work with sites gives a broad and accessible view including varied information from the vast landscape of the United States. Sites are tagged to a Google Map and information is posted along with site photos, allowing the researcher the opportunity to bring his/her own questions to bear on what is seen and compiled. This kind of archive assumes that the work done to date by CLUI might be built upon by other researchers and scholars for future investigation. It is an interesting product of the digital world. Because of the vast ground that needs to be covered, an inventory of sites is an archive of intellectual content and virtual information about physical places rather than a more traditional archive of things. The CLUI web information is companion to information located at a physical place, but the web information is easier to access. These kinds of sites – an archive companion - did not exist in the non-digital world. Their presence has expanded research opportunities in a positive way.

Web-based photo storage sites and video sites also offer a powerful research tool for site-based research. Photos storage categories offer multiple ways to access information. A building, for example, might be listed by name, place name, type, or event. A search for photos in these categories will bring forth these and other photos that have also been classified in this manner. Photo sequences are useful in understanding a person's encounter with a site. And the number of photos of a site (by multiple authors) suggests importance or appeal. An example is Cadillac Ranch (depicted in Figure 9 above). The number of photos available on the web is reflective of the interest of travelers and therefore its importance as a landscape feature. Repetition of a photo marks important or typical views of the site. Views in other, atypical, directions at Cadillac Ranch give us an understanding of the whole site through the eyes of its visitors.

The use of blogs for place-based research gives us a way of finding out about the culture of a place through descriptions. The comparison of sites visited in Figure 9 above offers insight into the journey as seen through the eyes of the traveler. Here, the 13 traveling groups can be considered the subject of design and their interests can be charted and analyzed. Blogs with oral histories, such as those used to create the analytical map in Figure 10 include people's memories of places. The event is featured in this kind of blog entry. The place as the setting is remembered as an important aspect of the place. The written memories together with photos are located according to the town plan, giving dimension to the memories allowing the place to come alive.

CONCLUSION

We have discovered positive uses of social media in place-based research, but it is important to remember that this kind of information is only one form of measurement of a place – it is a way to gain insight into the qualities and life of a place. In conjunction with information that is more analytical in nature, a balanced view of a place is gained, one that conveys the scale and physical dimensions of a context and one that also depicts the culture and nature of a place.

[2] Amboy's heyday as a town and travel stop paralleled the rise of automobile travel – from the late 1920s until the late 1960s. In 1972 the opening of Interstate 40 north of Amboy impacted traffic through the town.

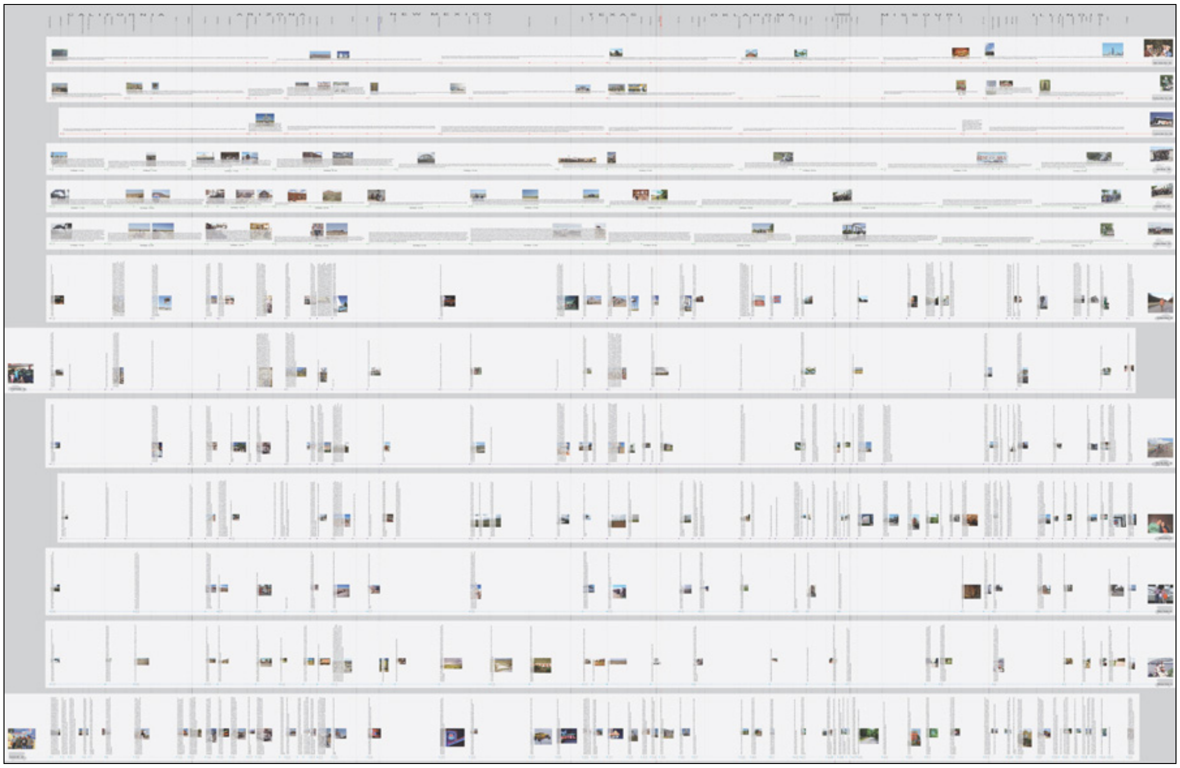

Figure 22: Charting Route 66 travelers' itineraries: motorcycle, automobile, bus, RV (Sam Wood 2008).

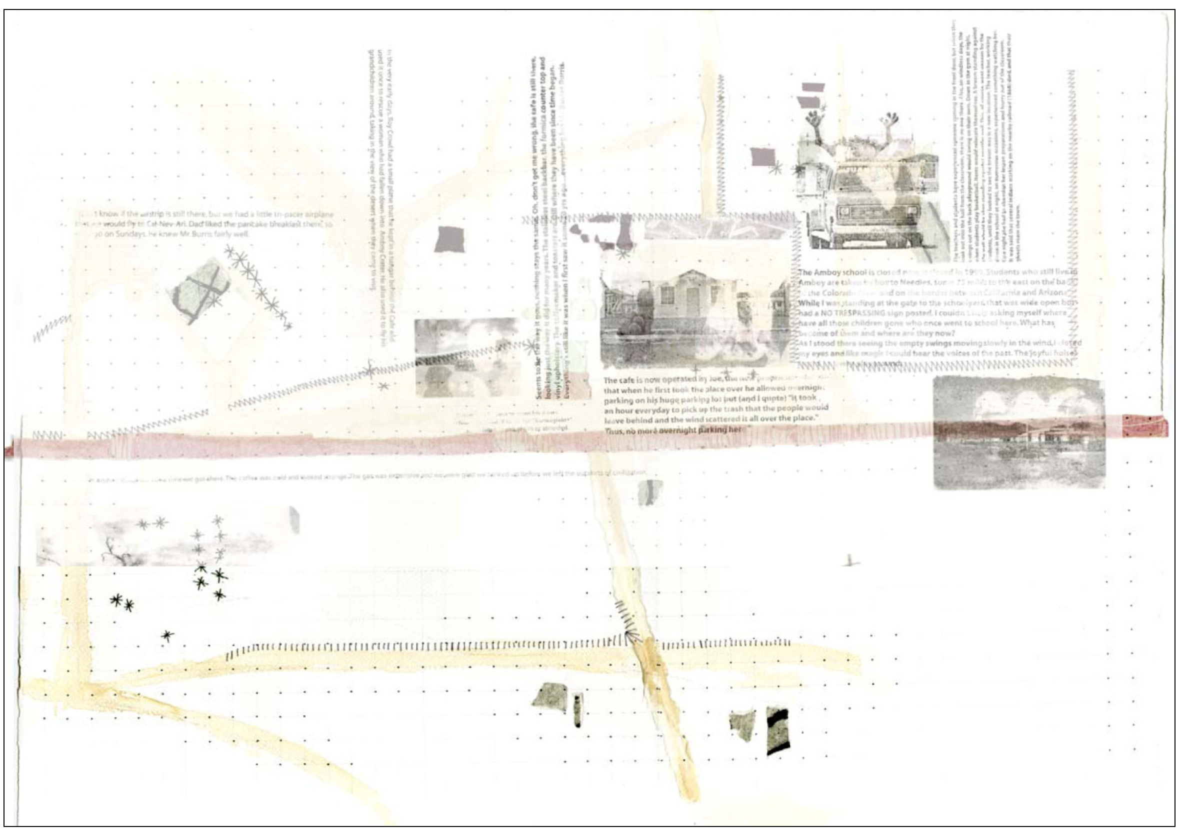

Figure 23: Memories represented in photos and text of events located on a plan of Amboy California (Emma Jesko)

The difficulties of social media as a basis for research arise in the lack of accountability for the information. Written forms of social media include lore, opinions, reminiscences, or information that is not checked for accuracy. But information from these sources can be used when checked against official sources. If the objective of using social media is to understand the setting and the culture of a place (the sense of the place), then fact checking would include the accuracy of the physical context. And written forms of social media can then be contextualized through photos and drawings of the place. The problems of personal memory, lore, and inaccuracies we found using social media are similar to problems encountered in site-based observational research. The use of blogs for finding data, for example, is not unlike the use of eavesdropping or reliance on personal interviews. In both cases, the setting and cultural understanding will be important background information but the facts or specifics about location, etc., drawn from memory might be best understood in relation to more factual information.

Another problem of inaccuracies of information can come from amateurs' websites. But some of what is found on these sites is invaluable – historical photos or personal reminiscences, for example, offer a hyperlocal view of information not found in other sources. Local community newsletters from amateur historians are another method of finding hyperlocal information. We were surprised to discover that many age groups were represented in social media. Because we were working with Amboy, a ghost town, and Route 66, the subject of many memorable encounters, there were oral histories recorded from elders as well as impressions of travelers from many age groups. The presence of family travel blogs suggest also that although we are currently working within a certain demographic range, we can anticipate an expanded demographic sampling from social media in the future.

Our initial conclusions about the use of social media for place-based research are that the method of working and checking information needs to be well established in order for the research to be of value. We have continued the Route 66 research but have expanded it by beginning to look at other towns in addition to Amboy. The specifics of methodology might change from site to site, but certain kinds of conclusions can be drawn. Official map, data, and historical information sites are primary sources for base information. Blogs, photo storage, and video sites are useful but depend on the author's knowledge and accuracy and information will need verification for it to be of any use. But all in all, social media gives us a way into observational research not unlike the methods used on site that are well established.

The use of digital information from the World Wide Web can be compared with other methods of observational research. And there is one more parallel that is important to note. Observational research as it was developed in the latter part of the 20th century assumed that local application of design principles might include universal premises and beliefs, but would only be successful if the local condition was recognized. We face the same challenge in using digital media for place-based research. But social media and hyperlocal sources focus on specifics and as such offer more than they detract in place-based research. The advantage using the web for information gathering is in the opportunity for many authors and many voices. The more voices that exists the easier it is to get at accurate information. In the current semester, internet sources are being used to study a socially vibrant area of Cape Town South Africa. In this context the role of many voices and the power of the internet to hear them is even more poignant; with so many residents of the city displaced during the apartheid era, memory of places they were forced to abandon is often the only record of settlements. In order to understand the social and cultural context, we depend on sources that have collected the stories of residents and their daily lives. Without this, we would know the place only through the physical context – the colonial architecture and the topography.[3] To a great extent using the web for research about Cape Town's settlements and Amboy's former settlement are similar. In both cases the web is used to support the virtual context held in memory and exhibited through stories as a means of really understanding the tangible and physical context. It is interesting to note the parallels of virtual worlds – the virtual world of the web to gain access to the virtual world of memory - to understand the qualities of a settlement.

Using digital information sources in the spirit of collaboration and sharing follows the non-hierarchical nature of web use amongst the emerging generation of scholars. This way of working is not uncommon in design inquiry and research. If this mode of research is considered in balance with the need for authoritative and official voices, we approach a form of scholarship and practice that is both accurate and inclusive. This presents an optimistic and interesting future for place-based research. Given the accessibility of sources and ease of information gathering on the web we have, as a premise, considered the use of a range of sources to be a reality for future scholarship.

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Department of the Interior, Bureau of Land Management, California: http://www.blm.gov/ca/st/en.html

[3] See, for example, the Center for Popular Memory's website: http://www.popularmemory.org.za/index.php?option=com_frontpage&Itemid=1

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Architectural Research & the Human Context

What comes first in sheltering needs? patterns of *Colonias* housing production

Azza M. Kamal

Morgan State University, Baltimore, Maryland

ABSTRACT: The communities along the US - Mexico border, although known for their isolation, poverty, and cultural homogeneity, have managed to provide a decent, affordable solution to the housing crisis in this region through self-build housing production. These communities are called *Colonias*, and were identified as peri-urban homesteads because of their location on the fringes of major cities. On the Texas southern border, *Colonias* have experienced explosive growth since the 1950s, particularly during the first half of the 1990s. Most borderlands are dominated by one ethnic and racial group; Hispanics are estimated to make up more than 95% of the population at the Texas southern border. For most, home ownership and better job opportunities provide the primary motive for moving to the borderlands. Affordability of land acquisition and convenient, yet often clouded, deeds make this goal feasible.

This study explores housing production means in the Texas-Mexico border's *Colonias* scattered around the fringes of the city of Laredo, with an emphasis on incremental stages of progress in construction. The study investigated the residents' approach to self-build housing construction, the chronological phases, and the patterns of household preferences for prioritizing the spaces considered at each phase. The study utilized review of relevant literature, and empirical data gathered through surveys of residents of Webb County's *Colonias* in Texas. Questionnaires were distributed during two community meetings in Rio Bravo and Los Altos. From the study, conclusion regarding a housing model identifying the patterns of housing production was achieved. The study also addressed the fact that two-thirds of the housing was incrementally constructed through short-term and long-term periods, and provided policy recommendations for housing financing. In addition, the study emphasised that the majority of residents built one or two spaces as an initial "core house," and employed further phases of construction throughout the years until completion.

Conference theme: Human context: social, cultural, and economic studies
Keywords: self-build construction, housing production, US - Mexico border, *Colonias*

1. BORDERLANDS

Borderlands worldwide share many functional commonalities with one another as frontier structures that have been formed by global events. Borderlanders, as explained by Martinez (1994), undergo many similar experiences regardless of their location or their inhabitants' economical status. Yet immigration studies have also acknowledged the existing differences with regards to the degree of assimilation, correlated movements of migration, evolved settlements, and economical and political influences. The US - Mexico borderland stands as an example of an interdependent border with asymmetrical influences from one nation to the other. This example allows the two nations (the US and Mexico) to benefit from migration movements, and the existence of the current economic climate, which permits borderlanders to pursue the expansion of development projects on both sides (Martinez, 1994). The result is a continuous movement of settlers who have shifted to settle rather than to commute, and who were attracted by the dream of home ownership, as well as the affordability that comes with indefinite land acquisition. Following the Mexican revolution, since the 1920s, newcomers have established settlements that are legally owned by their inhabitants, and that have gone on to attract even more acquaintances to their new, unplanned communities, knows as *Colonias*.

At their initial recognition in 1990, *Colonias* were characterised by the National Affordable Housing Act-(NAHA) as "identifiable communities" in Arizona, California, New Mexico, and Texas, all within 150 miles of the US - Mexico border (HAC 2000).

These settlements have expanded along the North side of the 2000 mile border between the US and Mexico, and continue to constitute a major concern for urban scholars because of their spontaneous growth and their late recognition by policy makers (*Colonias* problems were only addressed five decades ago) (Kamal 2006).

As such, the characteristics of *Colonias* replicate the common image of Third World slums, though they are distinct in a number of aspects. For instance, in the Colonias, the house and the lot are owned by the occupant and rental units are infrequent (Davies and Holz 1992). Recent statistics show that 85% of *Colonias* residents in the Rio Grande valley and in El Paso own their homes, which is the main achievement of their residents. However, the settlements share some of the globally common characteristics of slums and other informal housing areas such as a scarcity of services and substandard housing.

1.1 Settling Patterns and Problems

Having acquaintances in the area was considered an important factor in making the decision to move to a *Colonia* (Kamal 2005). This is an example of a pattern of settling generally identified through migration theory (Stalker 2004), particularly in informal and squatter areas. However, moving to be near acquaintances was not the primary motive for migration in the cases studied here. In an analysis of migration motives throughout the past five decades, Massey and Espinosa (1997) concluded that social capital formation is one of three factors motivating Mexicans to cross the border into the US, which occurs because those who are acquainted with pioneer migrants are more likely to migrate. The other factors comprise human capital formation, which includes negotiating job and housing opportunities in the US, as well as market consolidation, which encouraged Mexicans to pursue better jobs in the US.

Despite our knowing these motives, there is, however, a misconception that a large percentage of the border population is made up of illegal immigrants from Mexico. According to the 2000 Census, only 12% of border residents are non-US citizens, as compared to 7% for the nation as a whole (Purdy, J. 1999). Residents of the borderland have been absent from the attention of public policy makers as these households face severe built-environment problems including inadequate infrastructures and overcrowding of housing units. Figure 1 shows that 13% of border households live in crowded units, and among Hispanic households, 26% live in units with more than one person per room (HAC 2000). These numbers boost the crowding rate to four times the national rate. The aggravation of household living conditions is further driven by degraded infrastructure facilities, including a lack of road pavements, street lights, efficient drainage systems, curb-side garbage collection, and security. Health-related risks resulting from these conditions are addressed by Wilson and Menzies (1997), who emphasized the hazardous risks caused by the inefficient drainage systems individually established in each lot. The situation is exacerbated because of the small size of the lots, the average size of which usually range between 60 by 90 feet (US House of Representative 1990), and the absence of access to an outside sewage system; instead the residents only access substandard septic tanks and outhouses built inside their lots. As such, and because of the scarcity of water, individual wells, also built inside the lot, are usually located within 10 feet of these septic tanks, causing health problems when the wells water is used.

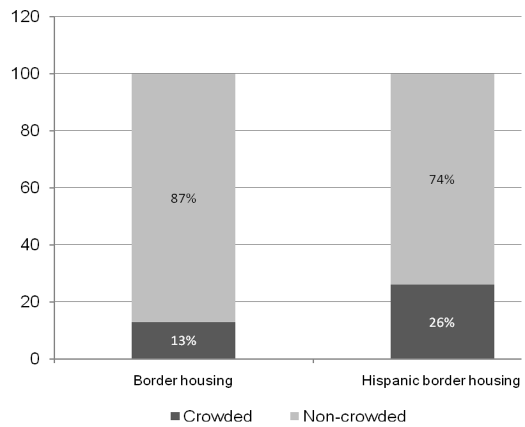


Figure 1: Percent of crowd in the Border housing
Source: Adapted from (HAC 2000)

1.2 Segregation and Homogeneity

Some *Colonias* are newly formed, but many have existed for over five decades. A few *Colonia* developments began as small communities of farm laborers employed by a single rancher or a farmer. Others originated as town sites established by land speculators as early as 1900. However, the majority of *Colonias* emerged in the 1950s as developers discovered a large market for aspiring homebuyers who seek affordability through conventional financing means (Rengert, K. and Lang, R. 2001)

The border's *Colonias* currently are growing at a rate of approximately 10% per year. Many residents of these communities experience geographic, social, and economic isolation (THHSC, 2002), and thus still homogeneous. However the *Colonias* were perceived according to two issues: difference and separateness. These two were a means of portraying a distinction between the inhabitants of the borderlanders from people in their own region (Martinez 1994).

These communities are practically invisible to the rest of America — so much so that their residents have been identified as the "forgotten Americans" (HAC 1987). Substandard living conditions such as these in the *Colonias* are a daily experience for thousands of families along the US-Mexico border. Houses are made up of dilapidated dwellings constructed from corrugated tin and whatever other materials can be found.

1.3 Housing Informality

The pattern of *Colonias* evolved over the past five decades via a process identified as uncontrolled, unplanned, and spontaneous development. Housing associated with this pattern emerged through self-build, autoconstruction, and autoproduction processes, and is - by all means - a successful alternative to the absence of affordable housing in the southern border region, and therefore, it introduces practicality, as well as social sustainability, as explained by Serageldin:

> Informal housing is a hybrid integrating contemporary technology [that entails] new form and reinterpreted traditional elements. It can be bland, awkward or whimsical, but it is always rational, practical and expedient (Serageldin 1988, p. 72).

2. LAND TENURE

Access to land tenure was always one problem that encouraged border households to seek land purchases in undesirable areas. Home ownership in the *Colonias* offered a status insuring a secured future for households through convenient means, which is a common characteristic of most informal settlements. This convenience was inseparable, though, from the risk of eviction, as the transfer of the deed only occurs when the final payment is made. The average *Colonia* lot is sold for ten to twelve thousand dollars, but can be acquired with no down payment, and monthly payments of only 100 dollars. However, no equity accrues for the buyer; and the ownership of the lot is subject to fulfilling all debt (Faulkner 1989).

Affordability, as well as a strong social capital through the opportunity for networking with acquaintances in the region encouraged people from Mexico and from other border *Colonias* to continue the flow of migration towards these *Colonias*, shaping an urban pattern typically known for its informality. With such pattern and growth, the settlements were always known for their complexity and hybrid status. A similar case study of unplanned growth in Mexico City's informal communities was explored by Ward (1984), who elaborated on the causes of the complexity in the process of formation, and described the following three methods by which informal settlements were created: 1) land is sold by interested agents (land-developers, as in *Colonias*, vote-catchers, radicals, or other politically-involved people) who sell the lots as informal subdivisions on marginal lands with inadequate services and infrastructure; 2) land invasions occur less frequently and are driven by political reasons or the poor's need for homes and land ownership; 3) land is sold by contracts for deeds to newcomers, through which they have the right-of-use. However, the land transfer occurs only after the last payment is made. *Colonias* as well as the settlements of Mexico City identified by Ward (1982) have shown that they can grow and improve over time. In addition, they contribute to the national economy through the ways in which their residents share in their housing provisions.

As a way out of their disempowered status, *Colonias* residents have continued to negotiate with the legislature and have advocated for their rights to affordable housing and a decent infrastructure. The legislature in Texas, throughout the past decade, has sought to curtail the inequities inherent in the contracts for deeds used for land transactions in these areas. In 1995, the Texas state legislature passed the *Colonias* Fair Land Sales Act-FLSA (HAC 2000). FLSA forced all developers to register contracts for deeds so that counties may keep records of them. This legislation was also intended to assure provision of a basic infrastructure by developers prior to selling.

3. HOUSING PRODUCTION

3.1 Self-build Production in *Colonias*

Informal settlers in most developing countries manage to secure low-tech and flimsy materials to construct their first shelters, upon arriving to these new settlements. Some would rather stay with their acquaintances or family on a rent-free basis by installing a trailer or constructing a small shack in their family's back yard, a solution which could help to secure some savings for a future lot purchase. Although it is a difficult process to estimate the number of these hidden residents, as well as to estimate the number of households grouped into single lots, the Housing Assistance Council (HAC 2000) has estimated that approximately 13% of the border's housing units are mobile homes, as compared to 8% nationally.

Home ownership rates are higher along the border than nationwide, and are comparable to home ownership rates in all non-metro areas. Housing values are much lower in the *Colonias* than elsewhere; however; the median housing value in the border region is less than half the national median. (HAC 2000)

Many *Colonia* residents embody a strong homeownership norm, but for them conventional financing methods are often inaccessible. They sought purchase in the *Colonias* despite the difficulties associated with the settlements' services. The scattered patterns and remote locations of all *Colonias* also enhance the difficulty and expenses involved in comprehensively delivering services and resources, especially to the settlements located a wide distance from the city's inner fabric. Construction of wastewater treatment plants for such small communities is economically inefficient. Likewise, the extension of water distribution and wastewater collection lines from existing treatment facilities to remote geographical locations tends to be prohibitively expensive (Singleman, J. 2002).

3.2 Incremental Process

The majority of these settlements of informal housing are built over a long period of time with heterogeneity in the housing production means. The result is - in most cases - a family-based product (Burgess 1985). Informal housing shares the same process of growth with squatter settlements. Mangin (1967) explained that as years go by and the stability of the residents is accomplished, residents put most of their capital into construction that might take many years to complete. Notwithstanding, housing in squatter settlements is still temporary and usually built upon the initial occupation of the land. The housing may stay temporary in nature for a long time, as a result of the inhabitants' fear of eviction. To achieve a fully-constructed house, most settlers must live on the sites in temporary houses or shacks during the construction period; however, a few choose to postpone moving to their lot until their house is entirely constructed (Mangin 1967). Some of them,

particularly in the early settling process, are supported by the community through providing free-hosting lots and houses.
With no public policy support for affordable housing in the borderlands, *Colonias* residents can generally only afford to construct poorly constructed shelters when they arrive at the settlements. Within a number of years, they become capable of consolidating their lots to improve their houses.

4. WEBB COUNTY COLONIAS

Empirical data for this study was part of a broader study of housing morphology, which employed systematic image-based analysis of housing morphology, survey questionnaires, and interviews with the directors of local community centeres. Data used in this study was gathered from eight *Colonias* in Webb County, located at the southern Texas border, linking the US with Mexico. The county was acquainted with the author's home institution in Texas during the time of undertaking this study, and was also a useful choice because of the high growth rate of its population. The state growth rate was 8% during the 1990s; nevertheless, the border counties grew by an average of 15%, with extreme growth displayed by Webb County at 22.4% (Chapa et al. 1996). The following aspects were also considered in the selection of the geographical area: 1) The county includes the city of Laredo, located on the Rio Grande river, which is a major access point to the United States, connecting highway 35 with other major highways and linking the US with Central America (Ward 1999). As such, the city, and hence the county, are major sources of immigrants to the US, a fact that raises the issue of affordable housing needs; 2) the city also is a home to the central Rio Grande regional office of the Center for Housing and Urban Development - CHUD, located in the home institution of the author during the period of this research, a fact which played a vital role in facilitating field access; and 3) the CHUD regional center, as well as the selected *Colonias*, were in close proximity to the author's institution, which is a time and money-saving factor. Two community centers, affiliates of CHUD, that are located on the Laredo city fringe, were selected as sites for distributing the survey questionnaires, which were administered by the author and a group of local volunteers.
Informal interviews with the directors of the two community centers of the Rio Bravo and the Los Altos *Colonias* confirmed that people from different *Colonias* in Webb County attend these monthly events. In addition, community meetings are a method of enhancing the response rate because they are a more effective alternate to the drop-off, mailing or phone surveys. Prior meeting with the residents, recruitment flyers were delivered to the community centers a week before the survey-distribution to inform *Colonias* residents about the research and its purpose. The survey forms were administered over two consecutive days during food distribution events sponsored by the Webb County Food Bank, and held in the community

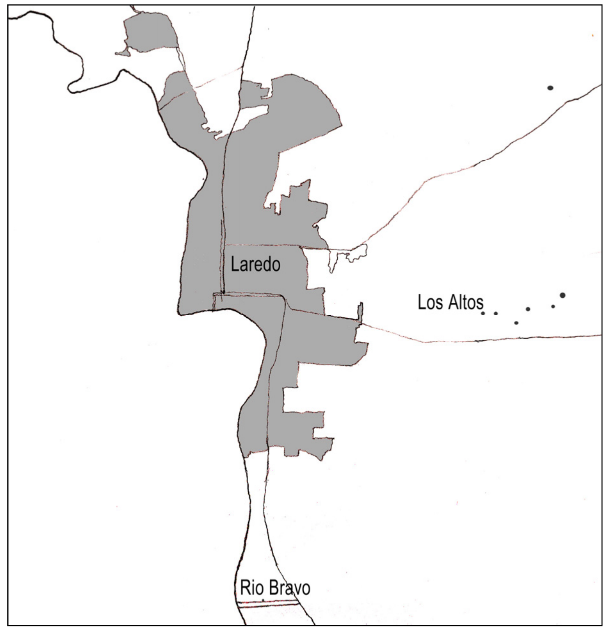


Figure 2: *Colonias* of survey participants and community meetings.
Source: Adapted from (TX-home town locator 2008)

centers of the Rio Bravo and the Los Altos *Colonias,* shown in Figure 2.
The process of selection of participants could not be on a random basis because of a lack of documentation as *Colonias* residents do not obtain home addresses unless they register their lots with the county, a process associated with consolidation. This situation, resulting from the housing informality, strongly advocated for the viable use of non-probability sampling by asking all residents attending the food bank event to participate (Kamal 2006). This selection was also based on an assumption of a high rate of absentee owners, as identified in Ward and Carew (2001), which enhanced the impracticality of conducting drop-off or face-to-face meetings with the residents at their homes.

Figure 3: Volunteers helping *Colonias* residents in filling out the survey forms

The survey covered multiple topics, three of which that are used in this study include: 1) the type of tenure (ownership vs. rent), 2) the household's characteristics (households/lot), and 3) the housing production (builder, increment, duration, and prioritized elements). Residents were encouraged to participate by announcing the availability of in-kind rewards distributed through drawings held at the end of each community meeting.

Survey forms were available in both Spanish and English, as not all participants were bilingual, and local leaders and volunteers were instructed on how to help the residents complete the forms (see Figure 3).

5. ANALYSIS OF FINDINGS

The survey data gathered from the Rio Bravo and Los Altos meetings showed that the 177 residents who participated in the survey descended from eight *Colonias* in Webb County (shown in Figure 2 as black dots), which included Los Altos and Rio Bravo, where the meetings were held. The Rio Bravo meeting was crowded with one, and only one, community representation. All participants were residents of Rio Bravo, while participants at the Los Altos meeting represented seven communities, mostly located on Highway 59. To establish a broad understanding of the housing features based on the investigated variables, data from the questionnaires conducted at both meetings with the *Colonias* residents were collected into one set. A "no-response" rate was documented and included in the analysis of the research variables.

5.1 Informal Sharing and Ownership

The review of literature showed that the population growth rate in Webb County is approximately triple to that of the state growth rate. Data gathered from the two community meetings showed that 46.9% of participants shared their lot with one or two other households, and only 37.8% of the households were living in their lots unaccompanied, as shown in Table 1. Home ownership is a valuable asset to the *Colonias* residents, as sharing the lot is a step towards moving to a separate lot when the household can afford to pay for their own lot, a prototype pattern of mobility and growth in informal settlements in the Third World. The data also showed that more than half of the households (53.7%) own their homes, while only 15.8% live in rental homes, and 2.2% don't pay a mortgage or rent (Cross-testing questions showed that this group of residents were living in trailers).

5.2 Participatory Construction

When participants were asked to provide detailed processes describing their house production, their response rate was not high. As shown in Table 2, 36.2% did not respond to the question asking them to identify their home builder, but the accounted for response was high enough for the questionnaires' methodology to be considered. Nearly half of the participants (49.7%) indicated that they adopted a self-build approach, building their houses by themselves or through their acquaintances. While more than one third (31.1%) of the total respondents confirmed the use of their own nuclear family as construction labor, 18.6% were assisted by their friends and extended families who also lived in the community. It was also emphasised that less than 10% of the total responses (6.2%) indicated that participants used a professional market approach, hiring a local contractor to construct their homes. Finally, those who indicated "other" in their responses (7.9%) were renting a home, or living in a trailer, or sharing other household's property.

Table 1: Type of tenure in Webb County *Colonias*

Home acquisition	N.	%
Ownership	95	53.7
Renting	28	15.8
Other	4	2.2
No response	50	28.3

Table 2: Self-built and other means of construction

House Builder	N.	%	Total
Self &/or husband/wife	55	31.1	Self-built: 49.7%
Kin assistance	33	18.6	
Hired local contractor	11	6.2	Other: 14.1%
Other	14	7.9	
No response	64	36.2	36.2 %

5.3 Prioritized Incremental Spaces

Housing production in the *Colonias* of Webb County was incrementally constructed. Table 3 shows that the majority of residents, approximately two-thirds (66%) of total participants, constructed their current houses through different phases. The residents in Webb County *Colonias* invested in their houses over time, which began as small shelters, and improved to accommodate the household and its future growth. For this purpose, the incremental process occurred through one of the following two periods: either a short-term or a long-term period of construction.

More than half of the residents (53.0%) built their houses over a period of time ranging from less than one year to twenty years. This group was divided into the following two categories shown in Table 4: 1) The first group, majority of the residents (41.2%), indicated that they constructed their houses over a short-term period not exceeding five years (17.5% built their houses in less than one year, and 23.7% built them in a period ranging from one to five years); 2) The second group, (11.8%) of the residents, constructed their houses over a long period, ranging from six to twenty years (9.0% built their houses in six to ten years, and 2.8% built their houses in eleven to twenty years). Only (4%) of total participants indicated that they built their houses on a period exceeding twenty years or over "other" period not identified in addition to (43%) of no response rate.

When the participants were asked to identify the patterns of preferences which they chose for prioritizing the spaces considered for the initial phase of construction, they indicated that the incremental phases that established their finalized houses included constructing a few elements, ranging from one to five spaces, followed by subsequent phases until the completion of the construction. As shown in table 5, over half of the participants (50.8%) indicated that the initial phase of construction included one; two; three, or four spaces could be considered as the "core house".

Table 3: Housing incremental construction

Construction Phases	N	%
Phases	117	66
No response	60	34

Table 4: Periods of housing construction

	Construction Completion (yr)	N	%	Total
Short-term	Less than one	31	17.5	41.2%
	One-Five	42	23.7	
Long-term	Six-Ten	16	9.0	11.8%
	Eleven-Twenty	5	2.8	
	More than twenty	0	0.0	4%
	Other	7	4.0	
	No response	76	43.0	

To identify residents' preferences regarding the types of space(s) considered to provide the "core house," five living spaces were assigned for participants to choose from. The spaces included a bed room, kitchen, water closet, living room, and guest room. Participants were asked to identify the space(s) they began with during the first part of their construction phase.

The majority of the participants (29.4% of the total residents) explained that they began with only one space, and 6.2% started their home by constructing two spaces. Also, 9.0% of the total responses showed that the residents built three spaces during the initial phase of their houses, while only 6.2% started with four spaces. Only 1.7% were either able to afford building five spaces as the start, or built six spaces at one time.

The spaces prioritized highest by the residents were built during the first phase of the construction, which is considered the "core house" phase. Figure 4 shows the spaces identified by each respondent's group. While the majority of residents who indicated that they built one space in their initial phase of construction built a bedroom first, the rest built a kitchen. While the majority of residents who built two spaces in the initial phase of construction built a bedroom and a kitchen, the remainder built a bedroom and a water closet. For the residents building more than two spaces, they followed the following pattern: three spaces were usually a bedroom, kitchen, and water closet; four spaces included a bedroom, kitchen, water closet, and living room; and five spaces included a bedroom, kitchen, water closet, living room, and guest room.

Table 5: Spaces in housing construction

Spaces	N	%	Total
One space	52	29.4	35.6%
Two spaces	11	6.2	
Three spaces	16	9	15.2%
Four spaces	11	6.2	
Five spaces	2	1.1	1.7%
All	1	0.6	
No response	84	47.5	47.5%

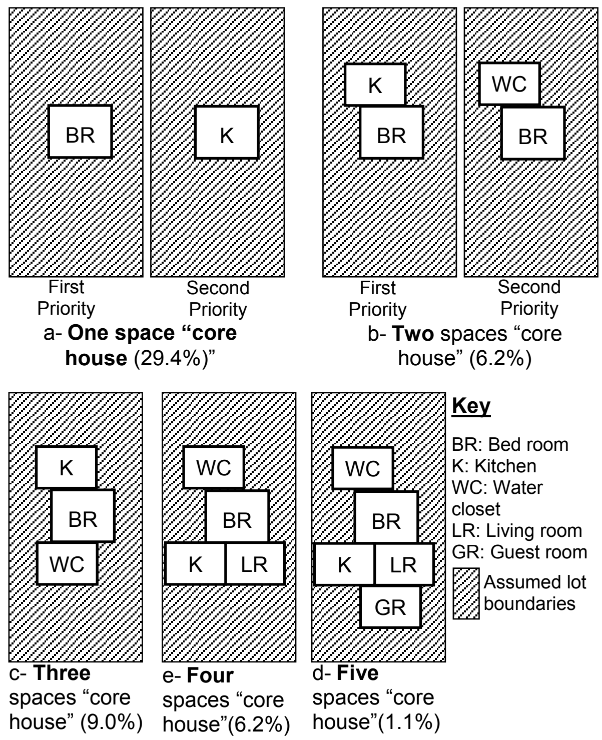


Figure 4: Patterns of prioritized spaces in the "core house" construction

CONCLUSION

Despite incorporating a small number of case studies through utilizing the data from the two community meetings, this paper establishes a crucial basis for the incremental self-build housing production in Webb county, Texas. The research findings, yet need to be tested on a broader sample prior validation, provide sufficient context-dependent evidence that is valid for the process of housing production by low-income households in Webb county who are eligible for the food bank donated food (see Flyvbjerg, 2004 for more information about case study research).

In the two investigated case studies of the Los Altos and Rio Bravo community meetings, the participants who resided in eight different *Colonias* identified their means of progressively producing their own houses through an incremental, self-build process.

This research argues the existence of a pattern for this type of housing production, and establishes a broad view regarding its principles and processes, as well as the associated factors that shape it. A model, shown in Figure 5, was compiled and its components were discussed. The model summarizes the research findings, and portrays the current methodology for this housing production, so this research can be adopted in future housing provisions. Shaded areas in the model reflect the significant findings, including self-build constructions, common phases, and residents' prioritized spaces. The following key points were deduced as the key components of the model:

- Home Ownership and Incremental Financing

Home ownership is the common trend of land tenure in the *Colonias* and, therefore, assistance needs to be improved when housing solutions are provided. Most of the Webb County *Colonias* are in different stage of consolidation, where residents have built their houses via short term phases ranging from less than one year to five years. Financial arrangements could be made with the residents to construct one or two spaces of the house, at a level and at a rate that they could afford to pay, for a period of five years. This principle would be in line with the sites and services approach, which was initiated by the World Bank in the 1970s as one of two development approaches (including slums upgrading).

This approach was successful and is currently employed in other countries.

- Characteristics of the "Core house"

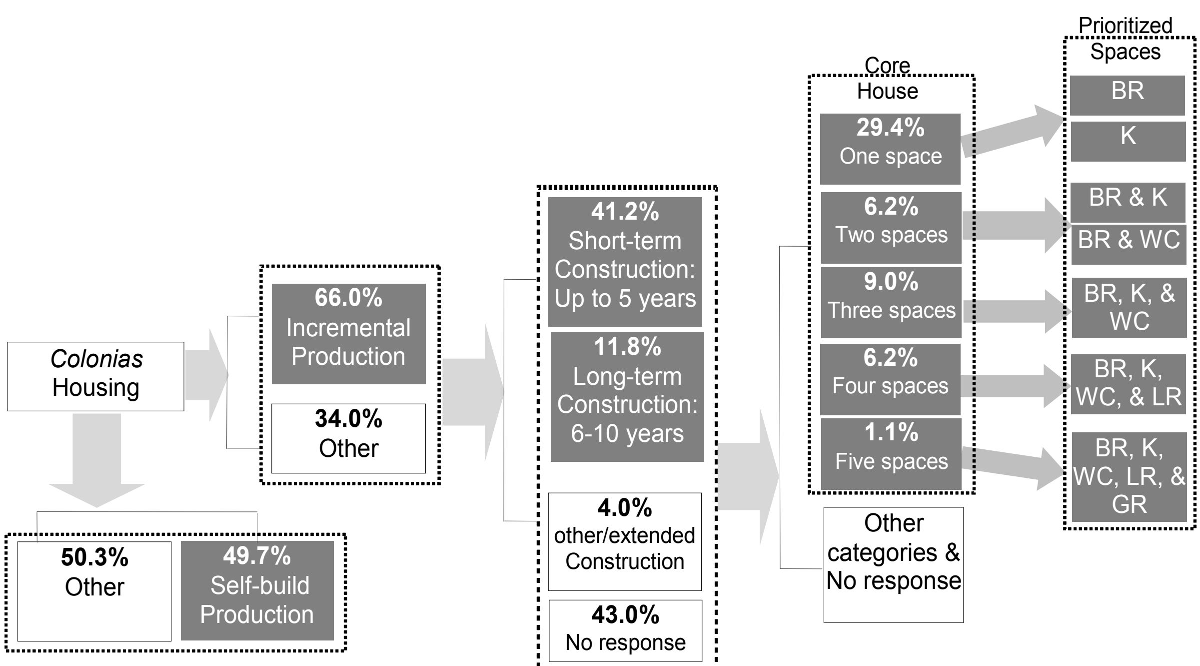
The *Colonias*, as is the case with most of these types of informal settlements worldwide, are a fast growing type of community in terms of both its population and its infrastructure needs. Residents build an initial phase identified as a "core house," usually built over a short term or a long term period. While short-term construction can range from less than one year to a five year period, long-term periods can range from six to ten years. The more commonly constructed "core houses" include up to four spaces built during the initial phase. However, one or two spaces are more the norm. The prioritized spaces include a bedroom or a kitchen (if one space is built), and both a bedroom and a kitchen, or a bedroom and a water closet (if two spaces are built). Housing agencies need to be familiar with and sponsor this means of incremental production.

- Participatory Building Process

Colonias residents replicate the prototype participatory construction method commonly known in informal areas in developing countries. Residents collaborated to construct their houses through employing themselves, spouses, and their families as free labor. Only a small percentage of housing is produced through hiring local construction labor. This participatory approach not only provides an affordable solution for low and very low-income households, but at the same time, this offers an opportunity for residents to participate in the economy through their informal finance of the construction costs, which reduces the burden on the public sector accountability in housing provision. At the same time this approach strengthens social ties among the community members and the acquainted groups.

- Policy Recommendation

Policy makers at the county, state, and federal levels need to consider an alternate approach for incremental financial support for "core house" constructions. This support could be followed up with subsequent arrangements to sponsor incremental home expansion, which would accommodate the anticipated growth of



BR: Bedroom; WC: Water Closet; LS: Living Room; K: Kitchen; GA: Guest Area

Figure 5: Incremental Housing Model in the *Colonias* of Webb County, Texas

the household and its finances, and at the same time assure the ability of a household to fulfil the full payment of the debit from previous loans. Such convenience financing and construction process should help to overcome the overcrowding problems and lack of housing affordability in the southern border region.

ACKNOWLEDGEMENTS

The author would like to thank the College Research and Interdisciplinary Council (CRIC) in the College of Architecture at Texas A&M University for partially sponsoring this study through the research grant that made this research possible. The author is also grateful for the assistance provided throughout the fieldwork by the Texas Health and Human Services Commission in Laredo, the Central Rio Grande Region-Center for Housing and Urban Development, the staff of the Rio Bravo and Los Altos centers, and the local volunteers.

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Built leadership: women administrators in architectural education

Margaret Dale Woosnam, Ph.D.

Texas A&M University, College Station, Texas

ABSTRACT: Of the 114 accredited architecture programs within colleges and universities across America, only 18 (or 16%) employed females at the highest administrative positions as deans, directors, chairs, or heads at the time this study was conducted. Despite this statistic, nearly 50% of all graduates from architecture programs are female. Little is known about women administrators in architectural education, perhaps because of the fact that there are so few.
The central question that guided this research study is as follows: What personal and professional factors characterize 10 women employed as administrators in nationally accredited architecture programs, departments, schools, and colleges in American institutions of higher education? Additionally, this study identified the women's career paths, and obstacles they overcame and sacrifices they made in order to advance in their careers.
The qualitative case study tradition was employed for this study. Ten women administrators of accredited architecture programs, departments, schools, and colleges within American institutions of higher education participated in the study. Interviews, documents, and observations were collected and included in the data analysis.
While feminist leadership theories were used as a lens and guided the current research, themes emerged from the study that point toward a potentially new, emerging theoretical construct. This emerging construct requires that pioneering female leaders in male-dominated fields be characterized differently than female leaders in other contexts. Specifically, the conclusions drawn from this study require characterizing pioneering female leaders in male-dominated fields as *built leaders* or leaders who have *systematically developed professionally as a result of unwavering ambition* but who employ a post-heroic style of leadership. In other words, these women fought their way to the top, but once there, use an up, down, and across hierarchical leadership style.

Conference theme: Human context: social, cultural, and economic studies
Keywords: women, architectural education, education administration, post-heroic leadership

1. INTRODUCTION

Of the 114 accredited architecture programs, departments, schools, and colleges in institutions of higher education across the country, only 18 (or 16%) had females filling the highest administrative positions as deans, directors, chairs, or heads at the time this study was conducted (National Architectural Accrediting Board [NAAB], 2006). Currently, approximately 50% of all graduates from architecture programs are females (Deutschle, 2003; NAAB, 2006; National Center for Education Statistics, 2005). Little is known about female administrators in architectural education, perhaps due to the fact that so few females hold these positions. Further, because research regarding females in these positions is limited, other females who may wish to pursue similar careers have little to look to for career guidance.

1.1 Study purpose

The purpose of this study was to uncover characteristics common to 10 women administrators in accredited architecture programs, departments, schools, and colleges.

1.2 Research questions

The central question that guided this research study is as follows: What personal and professional factors characterize females employed as administrators in nationally accredited architecture programs, departments, schools, and colleges in American institutions of higher education? The following secondary questions also guided the study:

1. What career paths did these women embark upon that led them to their positions, and how have their career paths impacted them professionally and personally?
2. What obstacles do these women believe that they overcame in their careers to achieve their positions, and how did the obstacles impact them?
3. What personal sacrifices, if any, did these women make in order to achieve their positions, and how

did these sacrifices impact them?
4. What are the women responsible for in their administrative position and how do they lead?

2. REVIEW OF LITERATURE

This study drew from existing leadership theories including gender-related and feminine leadership theories. Further, because this study covered an examination of female administrators in male-dominated fields within American institutions of higher education, an examination of literature on females within institutions of higher education is included.

2.1 Females in male-dominated fields

The topic of females entering male-dominated fields is one that has been widely researched since the 1970s, the time when females began entering institutions of higher education and the work force in marked numbers (Cohen, 1998). However, much of the existing research focused on females in particular fields, including engineering and medicine in the United States, and the priesthood within the United Kingdom (Aldridge, 1994; Bagilhole, 2003; Rose, 1996). The majority of the research on females in architecture dates from the late 1980s and early 1990s (Dietsch, 1991; Landecker, 1991; Solomon, 1991).

Nevertheless, research regarding female faculty members in the male-dominated field of architecture has been largely ignored, with only a few exceptions (Anthony, 2001; Gregory, 2006; Groat & Ahrentzen, 1997). Currently, approximately half of the student population in architecture programs nationwide is female; however, the attrition rate of females after graduation is high, perpetuating the male-dominance in the field (Gregory, 2006).

Research has attempted to uncover motivating factors and experiences of females who pursue careers in male-dominated fields. In a book entitled *Gender Roles through the Life Span* (Stevenson, 1994), Frieze and Olson (1994) contributed a chapter that addressed research conducted on the values that males and females assign to occupational fields. Frieze and Olson (1994) noted that the feminine professions were thought of as those that would allow the workers to help others, whereas the masculine professions were thought of as those that would allow the workers to demonstrate capability. Additionally, Frieze and Olson (1994) found that individuals' values strongly affected their occupational choice. Specifically, females in male-dominated fields placed value on gaining professional recognition, demonstrating capability, and making more money than did females in non-male-dominated fields.

Peng and Jaffe (1979) contributed one of the seminal pieces regarding females entering male-dominated fields of study in college. The authors noted that females in male-dominated fields tended to score higher on a work scale and lower on the community and family scales when compared to females in fields that are not male-dominated. This finding indicated that females in male-dominated fields of study were required to be more career-focused and less family-focused.

More recently, Steele, James, and Barnett (2002) examined the perceptions of female undergraduate students enrolled in male-dominated academic areas. Specifically, Steele, James, and Barnett (2002) focused on females in the areas of math, science, and engineering because, as they noted, fewer females earn undergraduate degrees in these fields. They found that females in these male-dominated areas of study: (1) experienced higher levels of gender-related discrimination, (2) anticipated higher levels of gender-related discrimination, and (3) felt threatened by gender stereotypes. Additionally, the researchers found that females in these areas of study were more likely to consider changing their major before they graduated than were males or females in female-dominated fields of study.

Bagilhole (2003) addressed the dynamic shift in hegemony within the Church of England that occurred in 1994, when the diocese allowed females to become ordained priests in the United Kingdom. Bagilhole asserted that the first few generations of females who entered male-dominated professions were "pioneers" (p. 361). She further contended that these females were "change agents" (p.361) of the organizational culture and structure in the Church of England.

Employing focus groups, Chu (2005) found that female engineering students experienced great difficulty in interacting professionally with their male cohort while remaining feminine in their actions. Further, she found that females in the engineering program were much more likely to consider a change of major than men because of the interaction difficulty. Chu (2005) drew upon the work of Brainard, Metz, and Gillmore (1999) and Seymour and Hewitt (1997) who examined the lowered confidence levels that females in male-dominated fields of study exhibited when compared to the males in their fields of study. The researchers found the lowered confidence levels, regardless of the grades the females had earned in their coursework. The researchers concluded that the females' lowered confidence had little to do with their classroom performance, but rather resulted from discouragement by professors, the workload, and the weed-out processes associated with male-dominated fields, including engineering and architecture.

Researchers who investigated entrepreneurs found that, in general, entrepreneurship is considered to be male-dominated (Chaganti, 1986). Additionally, researchers suggested that the majority of female entrepreneurs do not enter male-dominated fields (Moore, 1990; Scherer, Brodzinski, & Wiebe, 1990).

Several researchers investigated the utility of androgynous physical characteristics and behaviors by females in male-dominated fields. The majority of the research was completed in the 1980s. Specifically, Jagacinski (1987) examined the sex-typed traits of male and female engineers, and found that physically and behaviorally androgynous females reported higher levels of work-related responsibility, involvement in professional activities, and overall satisfaction when compared to female engineers who were not androgynous. Androgynous female engineers were also found to earn a higher salary than female engineers who were not androgynous. Lemkau (1983) examined the personal characteristics of females in male-dominated professions and non-male-dominated professions. Lemkau found that females in male-dominated professions were "tough-minded" and "assertive" (Lemkau, 1983, p.144), and exhibited characteristics that are associated with behaviorally androgynous females and masculine males. Rudman and Glick (2001) found that physically androgynous females were less likely to be discriminated against in performance-driven institutions.

2.2 Females in architecture

Although females have been practicing architecture for over 100 years (Almanac, 2004), females had not entered the profession in large numbers until the last several decades (Deutschle, 2003). The existing literature regarding females in architecture focused on females in the architectural profession. Little emphasis has been placed on females in architectural education and administration within institutions of higher education.

Solomon (1991) identified a shift in the proportions of females within corporate architectural firms. Solomon published data collected from a survey of 20 members of the AIA Large Firm Roundtable. According to these data, females were not reaching the top ranks in the profession (i.e., at the time of her study, 2% held principal positions). Solomon interviewed males and females in leading architectural firms in order to learn more about this phenomenon. She found that many males believed that females were not reaching the top ranks because the number of qualified females in the architectural profession was limited. The percent of female principals rose from 2% in 1991 to 21% in 2006 (American Institute of Architects, 2006).

Anthony (2001) completed survey research that indicated females in architectural practices experienced roadblocks and obstacles to advancement. Anthony also found that females in the field found the tasks of job interviewing, interning, and completing the licensing exam particularly intimidating. Additionally, she found that females in the profession often do not stay in the profession due to discrimination and harassment, pay inequity, and familial responsibilities.

Deutschle (2003) wrote about issues females face in the architectural profession. Her news report stated that nearly 50% of all American college students that graduate from university architecture programs are female, while only 13% of licensed practicing professionals working at AIA-member organizations are female. Notably, Deutschle's article was not published in a journal, but rather a daily newspaper, which indicated that this issue was noteworthy to the mainstream.

Landecker (1991) was one of the first to research the gender disparity in the architectural professoriate. In her article entitled "Why aren't more females teaching architecture," Landecker compared nationwide data on faculty in institutions of higher education with data on males and females in architectural faculties. She found that full-time male professors of architecture made up 19.5% of all faculty nationwide, while full-time female professors of architecture made up only 0.8%. Tenured male professors of architecture made up 33% of all architecture faculty nationwide, while tenured females made up only 2.8%. Landecker (1991) acknowledged statistics disseminated by the Association of Collegiate Schools of Architecture (ACSA) published in 1990 that reported an increase in the number of females in graduate programs of architecture. She interviewed several female professors of architecture and published their opinions regarding why females were not teaching architecture. She found that these female professors believed that, until females are promoted to top-level positions in higher education, the number of female faculty in architectural education will continue to wax and wane.

The females interviewed in Landecker's study stated that many females were not hired when qualified. Additionally, when females were hired to teach, they were given the marginal assignments, including teaching the 'soft' courses such as design, history, and planning, and they were required to serve on more committees and complete more service projects than their male counterparts. The females interviewed believed that, when females occupy the administrative positions in architectural education, female faculty will be awarded the more technical courses and will not be burdened with the extra service assignments.

Groat and Ahrentzen (1997) wrote about female faculty in architecture and addressed Landecker's (1991) idea of marginality. However, Groat and Ahrentzen did not suggest ways to overcome this marginality, but rather, suggested ways to use it as a tool. They suggested that these females use their service requirements and soft courses to challenge the "ideals of liberal education" (p. 274) and to forge "interdisciplinary connections" (p. 275) among other things.

2.3 Females in academic positions

Researchers found that females still face gender discrimination in institutions of higher education. This gender discrimination has manifested in various ways, including hiring and tenure discrimination, pay inequity, and pregnancy discrimination (Kaplin & Lee, 1995; Smallwood, 2001; Wilson, 2004).

Although in recent years, institutions of higher education have undergone significant diversification at most levels, the administrative positions have remained White-male-dominated (AAUW, 2004). As addressed in another section of this literature review, researchers indicated that females who achieved upper-level positions oftentimes exhibited more physically and behaviorally androgynous characteristics than their female colleagues (Jagacinski, 1987; Lemkau, 1983), and made more personal sacrifices than their male colleagues (AAUW, 2004; Williams, 2004). Additionally, females who achieved upper-level positions were subject to gender bias (Dreher, 2003; Eagly & Johannesen-Schmidt, 2001; Ridgeway, 2001; Rudman & Glick, 2001).

2.4 Feminine leadership

Scholars of feminine leadership theories claim different perspectives regarding females in leadership. Overall, researchers found that feminine leaders focus on relationships and participatory practices.

Feminine Leadership

Fletcher (2004) addressed the mostly feminine "post-heroic" form of leadership (p. 647). Fletcher (2004) found that feminine leaders employ post-heroic (or non-traditional) leadership that focuses on collaboration and social networking. Three specific characteristics that define this style of leadership are:

1) leadership as practice: shared and distributed, in which leaders rely on skill sets of enabling, supporting, facilitating and collective achievement, social networks, teamwork, shared accountability, collaboration, and blurred lines between the leader and the follower; 2) leadership as social process: interactions, in which leaders portray a dynamic, multidirectional, collective, egalitarian, mutual, less hierarchical style and are open to being led by others by being less competitive with a fluid boundary between self and other; and 3) leadership as learning: outcomes, in which leaders seek to establish mutual learning, collective understanding, and positive action in order to foster co-created and implemented collective learning. This final aspect of post-heroic leadership also relies on emotional intelligence, including self-awareness, empathy, vulnerability, and an openness to learning. In sum, Fletcher (2004) defined post-heroic leadership as distributed leadership; "up, down, and across" the hierarchy (p.650).

Jablonski (2000, p. 245) found that female university presidents employed "participatory" leadership styles. Jablonski (2000) indicated that the female presidents emphasized collaboration, communication, and shared decision-making.

Other researchers of gender-related studies identified that feminine leaders focused on relationships and participatory processes. Burstyn (1980), DiBrito, Carpenter, and DiBrito (1986), Funk (1988), Gilligan (1982), Miller (1986), and Morgan (1986) found that females in education emphasized communication and teamwork.

3. RESEARCH PROCEDURES

The research method used for the current study was the qualitative case study method. More specifically, the research method for this research consisted of a collective case study. Yin (1989, p. 23) suggested using the case study method when the research requires an investigation into a "contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used." Leedy & Ormrod (1997) indicated that case studies are useful when the researcher aims to learn more about a little known topic. Leedy and Ormrod (1997, p.149) also suggested using a collective case study method in order to "make comparisons." Comparisons were important in this study because they served to inform the researcher of the women's common characteristics.

This study employed the narrative research strategy defined by Creswell (2003) as "a form of inquiry in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives" (p. 15). Creswell (2003) recommended that these stories be re-told by the researcher in a "narrative chronology" (p.15). Because this study was designed to identify 10 women's career paths, obstacles they overcame, personal sacrifices they made, and their current leadership, their stories as they reflected on their journeys to leadership were a focus of this study. After the stories were gathered and then retold by the researcher, an analysis was conducted in order to identify characteristics common to the women, which was the overarching purpose of the present research study.

3.1 Data collection procedures

The eight women who were geographically located farthest from the researcher (Clemson, South Carolina) were asked to participate in telephone interviews and the two women who were geographically located closest to the researcher were asked to participate in face-to-face interviews held at both of the administrators' campuses. Although two women initially agreed to participate in face-to-face interviews, one of the women participated in a telephone interview because of scheduling conflicts during the period of data collection. Therefore, only one face-to-face interview was conducted.

Prior to the interviews, an interview protocol was developed and was followed for each interview. The protocol consisted of broad, exploratory questions designed to uncover thick, rich descriptions of the factors that characterize these women. Emergent insights continually directed and redirected data collection. Consistent with the constant comparison analysis technique employed in this study, new interview questions manifested after each interview and interview questions that were deemed inappropriate were deleted.

Using the interview protocol developed a priori, the researcher asked direct questions. However, the participants were asked to share and were allowed to do so freely. Follow up questions or questions of clarity were asked. Each interview was audio-recorded. Occasionally, the researcher emailed additional follow-up questions to the participants in order to address details that were not discussed in the telephone interviews or in the face-to-face interview.

3.2 Data analysis procedures

Because qualitative research is interpretive research (Creswell, 1994) and because the researcher intended to obtain a thick, rich description (or a "complete, literal description of the entity being investigated," Merriam, 2001, p. 29) for each case, the data were analyzed in tandem with the data collection, as specified by the constant comparison method (Creswell, 2003). The data analysis was based on "reduction" and "interpretation" (Marshall & Rossman, 1989, p. 114); as each typed interview was transcribed, notes were made of any overall tone, underlying themes, or subjects that were repeated throughout the interview. After all of the interviews were transcribed, commonalities within the characterizing factors were identified, emerging themes were reviewed, and conclusions regarding the factors and themes were made from the data.

Because interview data represent unstructured data, the eight analysis steps recommended by Tesch (1990) were used to allow the researcher the ability to engage in a "systematic process of analyzing textual data" (Creswell, 1994, p. 155). Both within-case and cross-case analyses were performed, respectively. A qualitative software package, NVivo 7©, that assists with the organization and analysis of interview and observation data was used to aid the researcher in the data analysis.

Tesch's (1990) steps were followed for analyzing observational data (when available) and documents for each case. In general, the documents and observations were used to learn more about the women, but were also used to supplement, complement, and "triangulate" (Creswell, 2003, p. 196) the findings from the interview data. After these steps were completed for each case, the researcher compared the emergent themes from each case across all of the cases.

3.3 Strategies for validating findings

In order to ensure the "trustworthiness" of the findings from the study (Creswell, 2003, p. 196), the researcher employed strategies identified by Creswell as necessary in qualitative research. First, the researcher "triangulated" the data sources (Creswell, 2003, p. 196) by analyzing the various forms of data collected for the emergence of themes. The researcher employed the "member-check" strategy as suggested by Creswell (2003, p. 196), which allowed participants to ensure the accuracy of findings by reviewing and approving interview transcripts and generalizations made by the researcher.

4. FINDINGS

The themes resulting from a cross-case analysis of the data (interviews, documents, and observations) for all the cases are detailed. The cross-case analysis findings are organized and presented by the secondary research questions.

4.1 Secondary research question one: Career paths

Formative experiences. Early childhood experiences with and exposure to architecture was the theme that emerged from the analysis of the interview data regarding why each woman chose a career in architecture. One participant said:

> In particular, I remember the luscious pencil drawings of Pennsylvania farmhouses that he was renovating on his desk. That was kind of appealing.

Education. Two themes emerged from the women's discussions of the institutions of higher education that they attended: prestige and minority. Most of the 10 women attended institutions of higher education that are considered prestigious in the United States. Six of the 10 women attended private, Ivy League institutions of higher education for at least one of their two degrees. Four of the six women who attended Ivy League schools did so for both of their degrees. Regarding minority, the women expressed the fact that they were one of few women on campus and particularly in the architecture courses. One participant recalled:

> I went to Princeton University and they did not have female students there for too long when I arrived.... And then I majored in a field that had mostly male students. So in any given class, I might be the only female student or there might be one or two others.

Field experience. The pervasive theme regarding the women's practical experience before returning to academia is that the women are entrepreneurs, but are aware of the fact that they are in the minority as practice principals. One woman stated:

> Principals are one thing. But firms that are actually owned by women and the principal architects are women -- almost none…. There was a time there were some, but slowly and surely they have just been absorbed...I honestly believe that even the most aggressive, tenacious, women – there are so few people who can take the constant isolation and beating. It's sort of the Hilary Clinton syndrome. You are distinguished by being alone and that aloneness just beats you up.

The majority of the women worked in firms that valued females, but experienced gender-related discrimination. One participant stated, "I was being paid vastly less than all the men with the same degrees." She said that, in that firm, she experienced "the glass ceiling, discrimination, under pay, and sexual harassment." Another participant recalled that all of "the men were making more money than the women, regardless of experience or qualifications." She continued, saying, men "were promoted to project architect or project manager," females were "backroom horses."

Preparation and advancement. The women's responses regarding what best prepared them for their work in administration varied. The theme that emerged from the women's discussions regarding their preparation for administration reveals that they were prepared both by aspects within and outside of their own control. The majority of the women indicated that they chose careers in higher education due to their desire to teach or be a part of academia. Additionally, two of the 10 women had a mentor or professor in college suggest that they consider teaching. While the majority of the women indicated that they aspired to administration, none of them said that they were actively seeking administrative positions. Most of the women have held their positions for less than five years. Seven of the 10 women were the first females to hold their positions at their institutions; however, most of them indicated that their being the first was a non-issue.

Personal life. Most of the women were married or in a long-term romantic relationship at the time this study was conducted. Half of the women have children and most are not caregivers for a loved one. The women spoke of their inability to care for an aging or ailing loved one due to their relocation for their current positions and consider this a personal sacrifice.

Demographics. The majority of the women are White. Six of the 10 women reported that they are White. One of the 10 reported that she is Black. One of the 10 reported that she is of European decent. One of the 10 reported that she is Hispanic. One of the 10 reported that she is Latin American. The average age of the women is approximately 52 years old. The youngest of the administrators is 48. The oldest of the administrators is 59. Many of the women's experiences regarding their entry into the profession may be similar because they are approximately the same age.

4.2 Secondary research question two: Past obstacles

Professional discouragement. While the majority of the women were discouraged professionally, they spoke of instances in which they used the discouragement as motivation. One participant remembered experiencing blatant discrimination from a male professor in college.

> I came out of it [meeting with her professor] not feeling like, 'Oh, change is impossible. Oh, I'm inferior.' I came out of it thinking, 'Oh, this guy [her professor] is a dinosaur. He's dying and about to retire. Clearly I can do this…there are still a few little societal quirks that have to work their way out.' So if anything, it kind of built my confidence.

Pernicious behavior. The theme that emerged from the women's discussions regarding the pernicious behavior they faced is that the women expected this type of behavior and did not allow it to stifle them professionally. One woman recalled experiencing unconcealed disdain for her as a female administrator by members of the faculty in her department.

> They did everything short of literally trying to kill me. They didn't actually do that, but everything else. They would devote 20 minutes at every faculty meeting to just screaming at me…these old guys with the veins popping out of their forehead. [I was] thinking, "You're going to have an aneurism right in front of me?"

Additionally, the women who experienced this type of behavior also indicated that this behavior was inevitable because of the prevalent gender-related issues or the academic undercurrents of competition.

4.3 Secondary research question three: Personal sacrifices

The pervasive theme that emerged from the 10 women administrator's discussions of the personal sacrifices that they made in order to achieve their current positions is that they sacrificed time with family for their careers. Seven of the 10 women indicated that they felt they made personal sacrifices in order to achieve professional advancement. Six of those seven discussed a sacrifice pertaining to family.

4.4 Secondary research question four: Current responsibilities and leadership styles

Regarding the women's current work responsibilities, the women are often overwhelmed by work, but are conscience of and sensitive to the human aspects of work and rely on social networks in their leadership. The women discussed their styles of handling conflict and conflict resolution and the majority indicated that they prefer to act as mediators, but only when intervention is absolutely required.

Regarding the women's interactions with their faculty, the majority of the women described their interactions as collegial. Additionally, many of the women described themselves as "in the trenches" with their faculty, as they also still teach courses, thus blurring the lines of leader (administrator) and follower (faculty).

5. DISCUSSION AND RECOMMENDATIONS

The 10 women who administrate in accredited architecture programs, departments, schools, and colleges within American institutions of higher education are *built leaders*, or leaders who have *systematically developed professionally* as a result of pioneering the field of architectural administration for females, but also by consciously using negative experiences and discouragement to fortify their drive, and by choosing to sacrifice aspects of their personal lives to advance their careers.

In addition to the obstacles the women faced because of the gender imbalance in the institutions of higher education they attended, the women faced similar obstacles once they entered the architecture profession. The majority of the women discussed hardships they faced due to the organizational and societal culture of the architectural firms in which they practiced soon after their graduation. The women also indicated that appearing professional was important to them, however, they desired to remain true to themselves in their appearances, behaviors, and priorities. Existing literature addressed some of the discrimination that females in architecture face (Anthony, 2001; Deutschle, 2003; Solomon, 1991). The current study supports the existing literature that indicated that females in the field of architecture and in institutions of higher education battled gender discrimination, pay inequity, and sexual harassment (Anthony, 2001; Deutschle, 2003; Kaplin & Lee, 1995; Smallwood, 2001; Solomon, 1991; Williams, 2004).

Not only did the women in this study overcome the hardships they faced while working in architectural practices that were male-dominated, the majority of the women said that they currently own or owned architectural practices. Entrepreneurship in general is considered to be male-dominated (Chaganti, 1986), and researchers of existing studies suggested that the majority of female entrepreneurs do not enter male-dominated fields (Moore, 1990; Scherer, Brodzinski, & Wiebe, 1990).

Most of the women described occurrences of discouragement and pernicious behavior toward them because of their gender; however, these women did not allow these negative experiences to cause them to waver in their ambitious pursuits. Many of the women spoke of the negative experiences as having a propelling affect on them professionally. They worked harder in order to prove their naysayers wrong. The existing literature regarding negative experiences of females in male-dominated fields focused on discussions of the negative impacts those experiences had on the females studied (Chu, 2005; Frieze & Olson, 1994; Peng & Jaffe, 1979; Steele, James, & Barnett, 2002). The current study adds to the literature by identifying that discouragement and pernicious behavior experienced by females in male-dominated fields can be motivational tools for unwaveringly ambitious females.

The women were and are the first or only females in many aspects of architectural practice, education, and administration. Additionally, the women faced obstacles head on, and they used the obstacles as motivation.

In summary, this study supports the findings of the studies on the first females in male-dominated fields (Aldridge, 1994; Bagilhole, 2003; Rose, 1996) that indicated that these women are pioneering and change agents in organizational structure and culture. Additionally, the findings of this study identified a new, emerging theoretical construct that requires characterizing pioneering women in male-dominated fields differently than females in existing leadership theories. In sum, the women in this study maintained a focus on individual, professional success as they sought career advancement; however, they employ a leadership style that emphasizes shared learning and social networks of influence after they achieve that advancement.

5.1 Recommendations for females who desire a similar career

The findings of this study indicate that females who wish to pursue similar career paths should seek to experience early career exploration, earn Master's degrees from accredited colleges or universities, become an entrepreneur and principal of an architectural practice, and should be ready to endure and even thrive from the discouragement and obstacles that are still inevitable.

5.2 Recommendations for future research

The findings of the current study proposed a new, emerging potential construct that requires that pioneering female leaders in male-dominated fields be characterized differently than female leaders in other contexts. This potential construct should be explored. This research was limited to 10 women administrators in architecture programs; therefore, a study that incorporates women who administrate in various other male-dominated professions would provide a broad view of how these women achieved their levels of success.

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The end of drawing: narrative visualization and community-based collaboration

John Bass

University of British Columbia, Vancouver, Canada

ABSTRACT: That conventional design practice cannot substantively address many aspects of spatial production is beyond the concern of many architects and landscape architects, who would argue that the limits of their practice do not extend beyond the formal boundaries of buildings and grounds. It is at least arguable that growing anxiety about these limits led to the emergence of landscape urbanism, some practitioners of which employ a diverse array of graphic techniques not in the service of design, but instead to identify, analyze and describe problems and phenomena related to but beyond the self-imposed limits of building and ground.

Landscape urbanism's open-ended objectives expand the field of potential research subjects and the potential for community-based engagement. At least initially, many communities may require the skills, if not the standard products, of an architect -- skill sets learned during a design education -- one set rooted in graphic description and analysis (documentation), the other, in the graphic description of synthesized interrelationships (design). Two landscape urbanists using contrasting techniques, Fernando Romero (geographer) and Jane Wolff (storyteller), provide a useful reference point.

An open focus on the use of graphic skills is of benefit when working with aboriginal communities on British Columbia's coast. In that context, selecting which skills to use and how is dependent on issues that emerge from inside a collaboration rather than superimposed from outside, resulting in education, history, and legal evidence projects that are largely dependent on visual communication. These apparently simple acts of drawing have helped build trust between an academic and aboriginal community, and led to the development of other collaborative projects across environmental and social science disciplines. A wide-angle, open focus design practice of drawing research might be appealing to those unconvinced that building and ground are the practical limits of our disciplines.

Conference theme: Human context: social, cultural, and economic studies
Key words: media, representation, community-based collaboration

INTRODUCTION: REEXAMINING THE LIMITS OF PRACTICE

Among the lessons learned during an architect's education is the simple fact that architects do not build; they draw. Exceptions of great merit exist, but these only prove the rule. Architects draw. In design school, they learn how and what to draw. The education of most architects includes not only the technical aspects of construction and code but also basic theory and history of architecture. What a thoughtful architecture student finds in theory and history is that contemporary ideas have precursors, and can be connected directly to broad social and moral concerns present at a given historical moment. Typically, architects address these concerns through the act of making drawings of things, usually buildings, but also cities and regions. As the scale of subject increases, the drawings made by architects begin to resemble maps, a durable and persistent form of documentation and representation.

Among philosopher Karl Popper's (1986) most important ideas is that things inhabit one of three worlds: the physical world, the world of thought and ideas, and the physical results of thoughts and ideas. Architects and landscape architects certainly contribute to the second category of things, so why is it that many would argue that the limits of their practice do not extend beyond the formal boundaries of buildings and grounds? It is at least arguable that this self-imposed limit to these two practices led to the emergence of landscape urbanism, which distinguishes itself from other design practices in its comfort employing a diverse array of graphic techniques in an oblique, deferred service to design. With its wide-angle lens in hand, landscape urbanism identifies, analyzes and describes problems and phenomena related to but beyond the self-imposed limits of building and ground. As such, landscape urbanism points toward an alternative form of practice, the products of which remain an open-ended question contingent on interaction, collaboration, and process.

1. FACTS AND STORIES

1.1. Drawing and spatial practice

To the Dutch of the 17th century, maps and paintings were both science *and* art. "[C]hallenging texts as a central way of understanding the world," Alpers (1983) describes a Dutch culture in which mapmakers and painters employed figuration and narrative.

> Cartographers and art historians have been in essential agreement in maintaining boundaries between maps and art, or between knowledge and decoration. They are boundaries that would have puzzled the Dutch. For at a time when maps were considered to be a kind of picture and when pictures challenged texts as a central way of understanding the world, the distinction was not firm. What should be of interest to students of maps and of pictures is not where the line was drawn between them, but precisely the nature of their overlap, the basis of their resemblance. (Alpers 1983: 126)

Through maps and paintings, the Dutch told stories. Something similar is now occurring in some corners of landscape urbanism, where the reductive qualities of representation in architectural and landscape architecture are being augmented by other graphic conventions capable of describing the entanglements, contingent relationships, and temporal change associated with contested space. These situations are in essence stories that can be told in the form of drawings, narrative drawings are part of "a social practice, not just a form of representation." (Miller, et al: 596)

1.2. Mapping contested space

Two contrasting examples illustrate this trend in landscape urbanism. The focus of both is on a highly contentious landscape. Both explore temporal processes and change as both historical fact and present day risk. One describes facts as data while the other frames facts as stories, but both explain a variety of physical, social, environmental, and economic issues. Both extrapolate scenarios that do not predict the future but instead intensify the facts that they have described.

Fernando Romero's *Hyper-Border* (2008) is an exhaustively researched work on the U.S./Mexico border. Romero begins by placing the border in the context of global cross border dynamics including trade, migration and conflict. With the clinical precision and distance of an autopsy, using the graphic conventions of a geographer, Romero then describes the historical evolution and present day conditions, reactions to, and interdependencies of the "hyperborder" region.

After laying this groundwork, Romero produces thirty-eight scenarios that project into the near future a diverse array of possible and plausible events, from pirated Canadian drinking water intended for Juarez, to new U.S. guest worker program policies and bullet trains linking British Columbia to Mexico. The wealth of data and speculation produced in this work yields a compelling argument about the growing importance of this complex and tragic space, and is a usefully uncertain refraction of the space he has studied.

Jane Wolff's *The Delta Primer* (2003) is an equally exhaustive taxonomy of the California Delta region located between Sacramento and San Francisco. Wolff's book is organized as a deck of playing cards with "wilderness," "garden," "machine" and "toy" substituted as the suits. In her work, Wolff employs the conventions of Age of Discovery cartography, narrative painting and embroidered samplers (Bass and Wolff 1998).

In contrast to Romero's clinical style (associated with Rem Koolhaas and Bruce Mau on the cover notes), Wolff's folksy and artisanal hand-drawn graphic style seems to be a strategy for framing complex issues using media and conventions familiar to popular audience. Like Romero, Wolff does not end with a design coda. Wolff avoids the trap of false distinction between knowledge and art, or the impulse to offer art in the form of projection. Wolff's drawings remain within the comfortable skin of describing problems, confident that solutions to them is a separate, equally important, sort of effort, but an effort beyond the scope of her particular interest and objective.

If Romero's work tends to dissect his subject, Wolff's reassembles hers by giving it hierarchy and theme. The border is a complex and large space, while the Delta region's complexity is masked by its schematic agricultural landscape. In any case, despite their starkly different graphic and organization approaches, Romero and Wolff's work shares a desire to explore issues beyond the scope of most design practice. Romero's use of the scenario as a narrative device is complemented by Wolff's use of a thematic structure to tell her stories. In Romero's case, scenarios are described through words, while facts are told through charts and other diagrammatic forms. In Wolff's example, stories are told through drawings annotated with text, shifting the emphasis to graphic narrative forms (Tufte 1997).

While the contrasting style of these two projects is evident, both produce a tension between between documentation and projection. Easterling (2003) exposes this tension in her essay *Error*, where she identifies in some who practice landscape urbanism the tendency to conflate *data* with *form*. It is important to emphasize that Easterling's criticism is not meant to force us to make a Manichean choice between form and fact. Instead, her argument is much like Alpers' observation on Dutch puzzlement.

2. NATIVE SPACE IN BRITISH COLUMBIA

2.1. Historical context

Romero's and Wolff's work are but two examples of the emergence in recent years of a great variety of participatory forms of spatial practice (Miessen 2008). "Stories," as Michel de Certeau remarked, traverse and organize places; they select and link them together; they make sentences and itineraries out of them. They are spatial trajectories.

For the aboriginal people of coastal British Columbia, this narrative is one that was profoundly altered in the early 19th by British colonial occupation. To the great credit of Canadian civil society, this narrative remains open, and subject to ongoing processes of negotiation, compromise, and exchange. These processes, implicating economic, spatial, and historical issues, are precisely the sorts that drawing can engage.

Since the 1870's anthropologists and ethnographers (who often doubled as artifact collectors for museums around the world) have been studying the aboriginal people of coastal British Columbia (Boas 1897, 1925 and 1934; McIlwraith 1948). This has produced weariness in subsequent generations, who have become inured to the results of countless "studies" while they experience firsthand the effects of poverty and the inequalities of assimilation. Experience tells them to resist social scientists and academic figures that wish to conduct new and potentially useful collaborative research.

2.2. Drawing as an objective of research: Bella Coola

Research that results in drawings provides an alternative to this experience research fatigue, and has utility in contexts that affect the community/subject with immediacy and meaning. Graphic techniques in the work of Romero and Wolff are applicable in the context of collaboration with aboriginal communities in British Columbia.

These communities are financially limited, and producing drawings has played a key role in building trust between academic and aboriginal communities, opening the door to collaborations between social and environmental scientists and aboriginal communities. This essay will however limit its focus to a making the case for research methods that use drawing as the primary mode of describing and projecting the results of careful observation. The drawing techniques employed include the graphic translation of anecdote, an analysis of historic images, paintings, and surveyors' documents with educational and legal content, and research and development of culturally specific housing types.

The first interaction between drawing and an aboriginal community occurred in Bella Coola, British Columbia, with an elder and historian of the Nuxalk Nation. Figure 1 describes a practice common in the experience of suburban gardeners in many parts of the Vancouver metropolitan area, which developed on the traditional territories of several First Nations, who of course had been there for a very long time before the colonial era. The drawing (Bass 2005) illustrates how artifacts unearthed during everyday gardening are relocated to the gardener's fireplace mantel, and not repatriated or transmitted to government archaeologists. No family wants their backyard turned into an archaeological site. The drawing, an example of a graphic translation of anecdotal information, was shown to the Nuxalk historian, who immediately understood its significance. He then asked for assistance in resolving a dispute over his nation's reserve boundary, which, he believed, was moved to the disadvantage of his people.

2.3. Open-ended collaborative projects

The historian's request resulted in two separate actions. The first was to take place in the Provincial archives and land title office, where survey records, sketch maps, and other documents were examined for any evidence of a shift over time in the reserve boundary. The second act was a collaboration between the historian and a group of architecture graduate students, who produced a series of narrative drawings on the Bella Coola River and its estuary (Fig. 1). The drawings were organized in book form, copies of which were presented to many people in Bella Coola (Bass 2006).

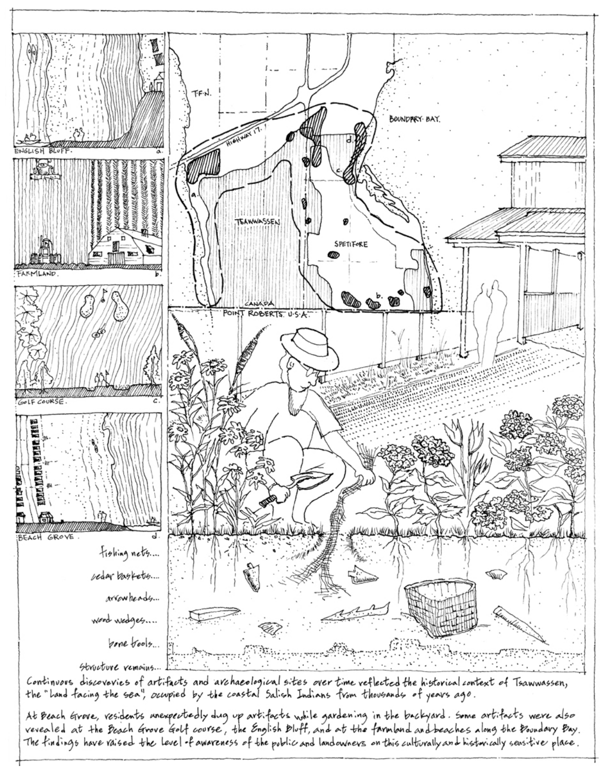

Figure 1: The Gardener's Dilemma. Drawing by Jing Xu. (Bass 2006)

While the results of the archival research were inconclusive, the two projects that resulted from the drawing of the gardener established the beginning of what has evolved into a robust collaboration by the Nuxalk with social and environmental scientists colleagues in a Community-University Research Alliance (CURA) funded project. Collaboration with the Nuxalk has also now extended to more typically architectural forms of activity. A culturally and environmentally specific house type is now being developed (Maclean 2008), and government agencies have expressed interest in supporting the project.

2.4. “Reconstructing” Fort Rupert

The Nuxalk historian’s interest in boundaries and space was a preview of a much more extensive research project that was done in collaboration with the Fort Rupert Kwakiutl Band of Fort Rupert, British Columbia. This project began after the Band’s economic development office attended a presentation describing narrative drawing to a local town council. He asked for assistance in developing a “vision” for the reconstruction of a Hudson’s Bay Company fort (the fort gave the Band its name) adjacent to the Band’s reserve. The economic development office, an outsider who had begun to develop a reputation for negotiating contentious large scale, resource extraction projects within the Band’s traditional territory, envisioned the fort project as a tourist attraction, an income and job creator. But it was obvious that the great majority of the native community he worked for did not share his vision. However, a project that studied the fort’s history and relationship to the native culture within which it was established – that project was of great interest to all.

2.5. Building a knowledge foundation

Upon signing a memorandum of understanding, access to the Band’s collection of photographs, interview transcripts, archaeological findings, and other resources provided immediate and useful information. The fort, built in 1849, brought many visitors to this part of the Pacific Coast, and those visitors began to establish a photographic record that begins in 1866.

The great numbers of images made of Fort Rupert allowed the careful viewer to note the changes to the physical settlement, and to record these changes in drawn form. This process began by producing a series of plates outlining facts associated with an image, including date and photographer, position of camera, and notable built features visible in the image (Fig. 2).

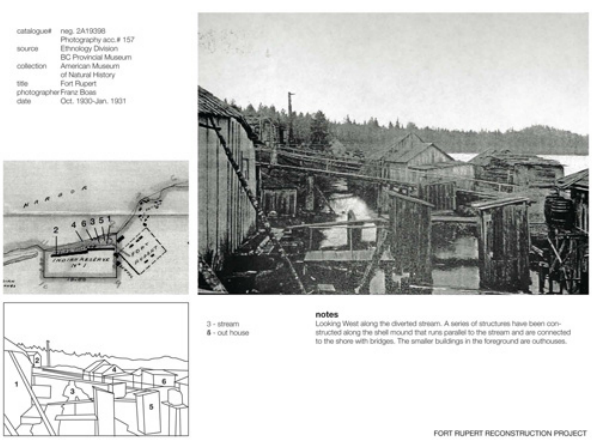

Figure 2: Example of photograph analysis plate. Plate by John Bass and James Eidse. (Bass 2007)

This analysis of the 19th and early 20th century photographs led to a series of site plan drawings (Fig. 3). This time-based set of drawings, seen at right, shows how the fort gradually lost its defensive boundaries and the gradual assimilation by the native

Figure 3: Fort Rupert, British Columbia. (top to bottom, 1850, 1870, 1900) Drawings by John Bass, Heather Maxwell, and Jing Xu. (Bass 2007)

village of its space. The phased site plans also provided a base to map the symbolic dimensions of the native village and its various carved poles (Fig. 4). These drawings, along with a series of narrative drawings and an accompanying essay, were organized in book form and presented to the Band (Bass 2007). The Band is currently working with representatives of the Provincial education ministry, seeking to publish the work and have it integrated into secondary education programs in the region.

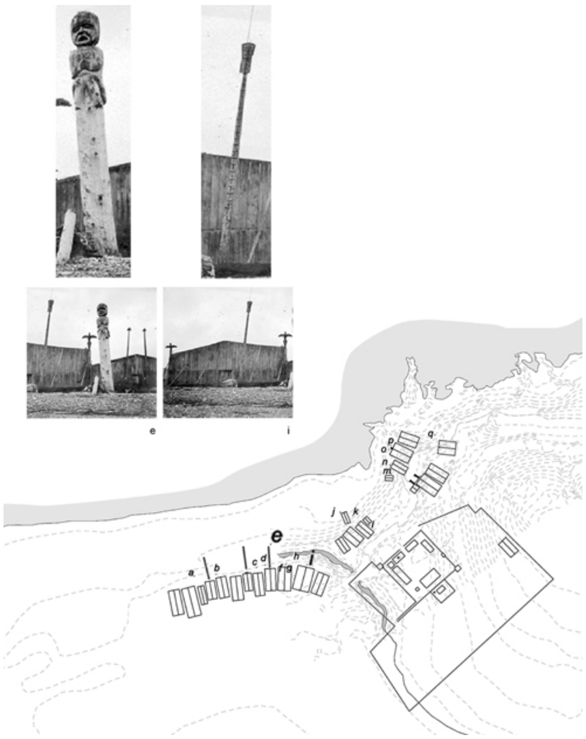

Figure 4: Pole location diagram. Drawing by Jing Xu. (Bass 2007)

2.6. Drawing and analysis as a legal tool

The analysis of the photographs and their translation into quite conventional site plan drawings benefited from the skills of close observation and documentation that are at important parts of an architect's education. While the work previously described was original in that it produced new knowledge, it was of a straightforward, not to say cursory, character. It has however led to other, potentially more provocative projects, one in particular that can be described here.

Among the earliest photographs of Fort Rupert was a three-image panorama taken c. 1866 (Fig. 5 and 6). The year 1866 was pivotal in Fort Rupert's history, and the photograph, which on first glance appears to be a document of an early colonial landscape with many interesting features, is in fact a tableau.

In the central middle ground, dressed in a hoop skirt, stands a woman. Her arrival at the gates of the fort is being witnessed by a dozen or more natives, who sit on the wharf above her, watched over by two guards within the fort's walls. Her presence in this highly posed photograph is an indication of a negotiation over territory between colonial and aboriginal cultures, a claim that requires a certain amount of elaboration.

The image was taken eight months after the British navy asserted its control over the Fort Rupert Kwakiutl

Figure 5: Panorama, Hudson Bay Co's Fort & Store House at Fort Rupert, V.I., c. 1866, Frederick Dally, photographer. (Courtesy, Toronto Public Library)

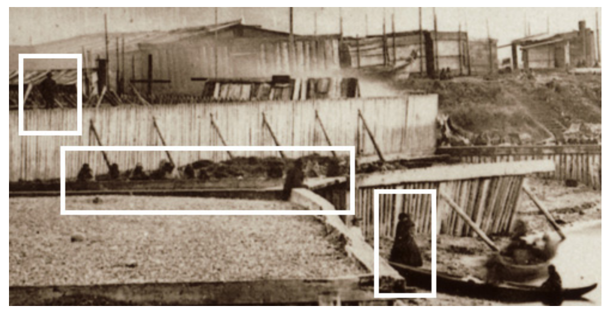

Figure 6: Detail of above, showing the arrival of a woman dressed in a hoop skirt, natives and guards.

by destroying much of their village. Indeed, the panorama indicates that the village was still being reconstructed or that parts had been abandoned. An 1863 survey of Fort Rupert suggest that the Hudson's Bay Company, agents of the British colonial government, was attempting a complicated three-way real estate deal with Roman Catholic missionaries and a family group within the Fort Rupert Kwakiutl Band.

This negotiation was being conducted by the HBC and the colonial government despite the fact that it is quite clear in the historical record that there were native settlements on the land proposed for the real estate. This fact should have made this land unavailable for conversion to private property by settlers, missionaries, or anyone.

Figure 7 represents the fundamental spatial order of the Canadian west during the middle part of the 19th century. It inverts the representational strategy implemented by colonial and later, provincial agents, in which "the maps of the Indian Reserve Commissioners who laid them out, reserves were displayed rather like insects on pins, exhibits mounted on blank sheets." (Harris 2002: 271)

These are some of the historical events and artifacts of an ongoing project involving drawing, photographic and cartographic correlation and interpretation, and archival research. This project is an inquiry into the spatial organization of Fort Rupert's colonial and native space during the period from 1857 to 1866, the time when the initial conversions of land into property occurred in Kwakwaka'wakw traditional territory. Once completed, this work will be transferred to the Band in book form, and it is likely that the Band will forward copies to lawyers who have been advocating their interests in treaty negotiations for many years.

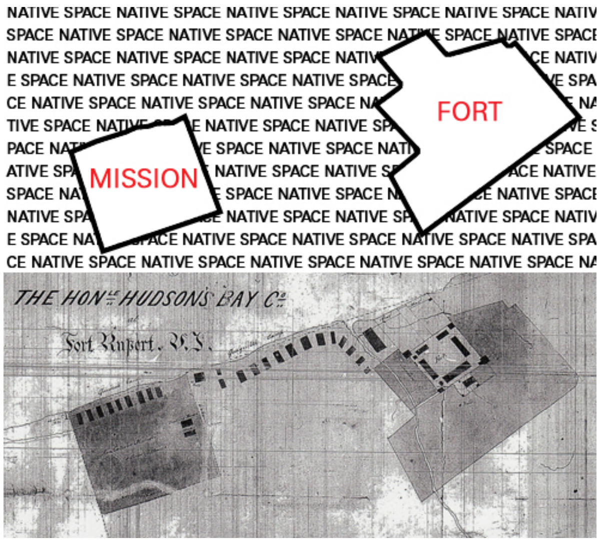

Figure 7: Property negotiation diagram, Hudson's Bay Company and Oblates of Mary Immaculate, using a detail from a 1863 survey/development proposal. The survey detail shows fourteen "Quagiulth" big houses between fort and mission, and nine "Quicoah" big houses with the mission's property. Diagram by John Bass. (Survey courtesy of Fort Rupert Kwakiutl Band).

2.7. Open-ended outcomes

There are other drawing research projects beginning to emerge that may contribute to the land claims of the Fort Rupert Kwakiutl Band. In 1855, a British naval officer visiting Fort Rupert noted the presence of a shell midden, a manmade structure formed by the casting off of shells and other material during food gathering activities, that he estimated to be "two miles long, half a mile wide, and fifty feet deep." This midden is now lost, having been developed into a subdivision decades ago, but the onetime location and dimensions of the midden are known, and can be drawn.

How much material does a person shucking clams cast away in a day? How many days a year are spent harvesting clams and other midden base materials? What is the volume of a midden two miles long, half a mile wide, and fifty feet deep? Assume five hundred people on average contributed annually to the midden's creation, each of them producing five cubic feet of midden (not shells, but much more compressed shell fragments) per day during a hundred day season. Also assume that the total volume of the Storey's Beach midden was approximately six hundred ninety six million cubic feet. Doing a calculation based on these admittedly very rough numbers, it would take approximately two thousand seven hundred and eighty eight years to create the midden.

Archaeologists have estimated that aboriginal culture had occupied this beach for roughly the same length of time. Apart from the value of the midden structure as an index of occupation, there is also the question of the economic value of that material, which was removed and used as a substrate for a Canadian Armed Forces landing strip during World War II.

Many conversations about everyday concerns and future aspirations are taking place during the time spent developing the visual history of Fort Rupert. These discussions often return to the question of how the old HBC fort could or should be reconstructed, the answer to which there is no community consensus. It has taken time to develop the friendships and trust necessary to be perceived as an honest broker even if an outsider, especially when the initial community perception is sceptical. After producing work of educational, historical and possibly legal value to this community, it has now become possible to have conversations about the fort's reconstruction, and to put forward ideas about it that integrate the unique spatial and temporal practices (Galois 1994) with the contemporary needs and desires of the Kwakwaka'wakw people. Ultimately, a project resembling those associated with more conventionally architectural activity will emerge out of this collaboration, much like it has with the prototype house project in Bella Coola.

CONCLUSION

Precise and focused drawings are among the skills closest to the core of an architect's education and practice. The discipline of drawing does not, however, need to be subordinate to the ultimate objective of building. Drawing can be an end in itself, or more accurately, be produced in the service of alternative ends.

Contemporary architectural (and landscape architectural) practice is a complex, multi-faceted undertaking, and whether practitioners like it or not, it often involves contentious processes of public negotiation and debate. This political and educational function of practicing in this complicated environment has intensified tensions between an architect's responsibilities to the public and professional obligations to a client.

If it hasn't happened already, and it is arguable that it has, these tensions will ultimately explode practice into ever more specialized professional roles. Landscape urbanism, with its highly interdisciplinary engagements, is pointing to new models of practice, new networks of collaborators. Included among these new roles will be a practice with open-ended objectives in which drawings are produced to tell stories, to visually describe events, change, and possibility, to and of communities seeking to understand the space they are producing before they produce it.

ACKNOWLEDGEMENTS

The University of British Columbia based Coastal Communities Project has supported this research. CCP is a community-university research alliance (CURA) project funded by the Social Sciences and Humanities Research Council of Canada.

I also wish to thank research assistants James Eidse, Amaury Greig, Aaron Knorr, Heather Maxwell, Ouri Scott and Jing Xu for their work on the Fort Rupert project.

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Representations of architecture in children's drawings: a study of children's art in Jordan

Rima Al Ajlouni

Texas Tech University, Lubbock, Texas

ABSTRACT: Beginning with the birth environment, adults create and control the physical conditions in which children live and experience the world. This fact lays a great deal of responsibility upon planners and designers, to whom the authority of making decisions, on behalf of children, is considered to be a difficult task. In this research, children's drawings are seen as a primary source of knowledge, upon which the investigation of the child's power of thinking is based. The objective is to investigate some aspects of the relationship between children and their architectural environments, through analyzing their graphic representations. The aim is to reach some understanding of the typology of thinking that might help the designers understand how children experience, appreciate, and assess their environments.

Data was collected by means of survey questionnaires supplemented by interviews. The subjects of study were chosen from the same neighbourhood, totalling (47). The children were all 7-12 years old. Each child provided seven drawings of seven different architectural settings. The investigation was conducted using two methods. The first method used statistical analysis, of a set of defined variables, to identify broad patterns in the data. These include two main categories: typology analysis; and gender analysis. The second method, supported by available literature, qualitatively examines the statistical results to understand why the broad patterns emerged.

Analysis of the different settings, displayed a wide range of representations; from the most centralized and orderly (the room and the house) to the most disperses and non-hierarchical assembly of elements (the city). It became evident that this range verifies the child's knowledge of the drawn setting. The child's understanding of these settings becomes more limited with the increase of physical scale. The study also concluded that the typology of objects, within a space, represents the most recognizable features to the child. Different objects present themselves in different ways according to the kind of experience the child has with them.

Conference theme: Human context: social, cultural, and economic studies

Keywords: children, design, perception, cognition, graphic representation

INTRODUCTION

Making places for children must be a participatory process. It is a process where children, parents, planners, and designers must all work toward a shared vision of the future; a common image of what makes a good place. The core challenge lies in how to get children involved in this process and how to elicit the necessary information that best manifests their thinking and assessment of their built environments.

For this purpose, it is essential to maintain a view of the child as a conscious, active person who is actively trying to understand its social and physical reality. The child does not merely react as a passive object to the environment; it ignores some of its aspects and selects others to suit its personal responses and creative power (Newman and Newman 1978, Morcos 1991).

Children's graphic representation provides an important tool for examining the child's power of observation and analysis, its capacity for synthesis thinking and judgment. Its content may provide insight into their feelings and thoughts about the world. It represent an important tool of communication, through which children can indirectly participate in the design and planning of their settings, which should inspire the creation of more engaging, exciting, and meaningful places for them.

This research takes as its main focus of interest, the use of a language of art in the investigation of categories of thinking about the visual world. Children's drawings serve as a primary source of knowledge, upon which the investigation of the child's power of thinking is based. The aim is to investigate some aspects of the relationship between children and their architectural environments, looking at which aspects of these environments held particular meaning for them, hopping to reach some understanding of how children experience, appreciate, and assess their environments.

1. BACKGROUND

Perception, cognition and representation usually form a triangle that is hard to disentangle. This triangle serves as a framework, which can be utilized to examine mental images of the environment, translation of the environment into graphic forms, and interpretation of graphics.

1.1. Perception

According to Jean Piaget and Barbel Inhelder, perception can be defined as:

> A system of relationships organized in an immediate whole. But the equilibrium of this whole depends not only upon real relations (i.e., actually perceived), but also, like a mechanical equilibrium, upon virtual relations which refer to earlier or contingent perception (Piaget and Inhelder 1956: 14).

Perception is much more than sensation, for it includes both a conception of the object and also an immediate conviction of the object's present existence (Boring 1970). The problem of how children perceive the visual world can be divided into two aspects, the perception of the substantial or spatial world and the perception of the world of useful and significant things. The visual stimulus is thus, neither an object nor an experience of that object, but something which stands in between (Gibson and Carmichael 1977).
The study of the psychology of vision indicates that seeing is selective from the start (Gombrich 1984). Vision deals with the raw material of experience by creating to corresponding pattern of general forms. It became evident that overall structural features are the primary data of perception (Arnheim 1974). Piaget and Inhelder explained that every perceptual field is organized in accordance with the same types of structure. This organization is supposed to be of a geometrical character right from the start (piaget and Inhelder 1956). It is thus important to understand that the idea of space develops under the influence of motor and perceptual mechanisms. Moreover, the study of how children estimate size or measure objects is particularly interesting because operations involved in measurement are so concrete that they have their roots in perceptual activity and at the same time so complex that they are not fully elaborated until some time between the age of 8 and 11 (Piaget *et al.* 1960).

1.2. Cognition

Cognition however, is extremely broad term that refers to any internal mental processes, including attention, perception, memory, language formation and development, reading and writing, thinking, problem solving, intelligence, creativity, imagination, expectation, intention, and belief (Dworetzky 1996). Cognitive theorists have contributed three important concepts to our understanding of childhood. First, they suggested that the child's strategies for organizing and interpreting the environment, are qualitatively different from strategies used by adults. Second, they emphasized the link between the structural properties of the sense receptors, the brain and the nervous systems, and the capacity to know the world. Third, the acquisition of knowledge is seen as an active, on going process. Cognitive development is the combined result of the maturation of the brain and nervous system and the experience that help individuals adapt to their environments (Piaget *et al.* 1960, Dworetzky 1996). Cross-cultural studies of perception and cognitive development find a significant degree of variability from one culture to another (Newman and Newman 1978). According to the social cognitive theory of Lev Vygotsky, a critic of Piaget, each person is born with a set of unlearned elemental cognitive functions, such as the ability to attend, perceive, and remember. Each culture then transforms these elemental abilities into higher cognitive functions, largely through social interaction, especially through the teaching and use of language (Dworetzky 1996). The language of vision operates in a broader field of social and linguistic values. In order for designers to take command of this broader field, they must begin to understand the relations between visual form and language, history, and culture (Lupton & Miller 1993). Based on Hall, language represents a major element in the formation of thought (Hall 1982) Words, spoken or written and images are components of the environment and sources of stimulation (Gibson and Carmichael 1977). Children and adults, are all influenced by the kind of images they see around them; on film and television, in the street, in shops and galleries, in books and magazine, etc. (Cooke *et al.* 1998, Hamdi 1981).

1.3. Representation

Representation is different from what is generally understood by the terms, perception and cognition. It is wider in scope, and may be considered to contain the previously described processes of perception and cognition. It involves the active production of visible signs for the purposes of human communication.
Through the process of child development, knowledge changes from a total dependence on experience to a gradual formation of rules and principles that are viewed as more reliable than experience itself (Newman and Newman 1978). Such experiences are represented in several symbolic systems: language, play, drawing, imitation, and mental imagery. The drawing, like the mental image, is not simply an extension of ordinary perception, but is rather the combination of the movements, anticipation, reconstruction, comparison, and experience (Piaget & Inhelder 1956). It is important to identify this graphic creation as a creative activity, which provides a home ground for visual thinking (Arnheim 1969, Abu-Dayeh 1994). Representational image making involves careful looking, critical thinking and decision making (Cooke et al. 1998, Freeman 1980).

1.4. Drawing as message

Drawing is a mean of expression and is fundamental to all visual communication. Its evolution is the expression of the development of the child's perceptual order (Eng

1954, Cooke *et al*. 1998). Children draw what they find important or beautiful to them, which appears to depend greatly on their cultures (Dworetzky 1996, Willats 1985, Cooke *et al*. 1998). Because of their relative subjectivity, drawings allow greater space for individual interpretation of the environment. They allow presentations to be controlled, as elements in a drawing may be explicitly included or omitted, emphasized, embellished, or distorted. Children's drawings are the result of considerable effort, solving many planning and performance problems. They provide a tangible evidence of careful planning and well defined intentions (Freeman 1980), and, therefore, are indicative of the child's power of observation and analysis, its capacity for synthesis, thinking and judgment (Eng 1954).

A study of the child's drawing, may, therefore, help to understand its individual character, its problems and special needs (Eng 1954). Understanding the content of children's drawings may provide insight into their feelings and thoughts about their world (Crook 1985)

1.5. Understanding children's drawings

Representational drawings can become part of a process of symbolization, in which the image created holds meanings beyond the form of the object depicted (Cooke et al. 1998, Arnheim 1974). It seemed that young children appear to be concerned with representing their knowledge about the object rather than their view of the object (Davis 1985). The young mind operates with elementary forms, which are easily distinguished from the complexity of the objects they depict (Arnheim 1969). Children's drawings are very economical in their style; few lines are deployed to capture the general scheme of scenes. Children often give rough approximations of the shapes and spatial relations they intend to depict (Crook, 1985, Arnheim 1969). Elements in the drawing are often related to one another according to specific principles, where every element is depicted with its own space, independent from the rest (Goodnow 1977).

It is also important to note that, the child draws by making use of mental pictures stored in the memory. It draws objects which it has mastered, and then makes modifications and arrangements using them. For example, it draws a house using already practiced rectangular shapes (Eng 1954).

When children draw, they are influenced by a set of perceptual and performance biases. Understanding these biases can help us understand and interpret their drawings:

Stereotypy: often, the child uses a limited number of graphic formulas "Stereotypy" from its graphic vocabulary, attempting to use them on many occasions (Allik and Laak 1985). Stereotypy does not imply that drawings always turn out to be identical. Often there is a great range of variability in certain aspects of a drawing, while maintaining a good deal of consistency in the organization of the core of the drawing (Freeman 1980). Stereotypy indicates that there are certain aspects of drawing that are stable enough, within individuals and across samples, which might give a point of departure for inquiring into issues relating to how children represent the world mentally, revealing their feelings and understandings of what they see (Meadows 1993).

Incorrect orientation and incorrect synthesis: is shown when parts of the drawing are arranged together in a manner not in accordance with reality (Eng 1954). Children often seem unable to put parts of a drawing together to make a whole; they cannot, when occupied with drawing the details, retain a grasp of the whole. The parts are drawn piece by piece without taking the total effect into account (Freeman 1980).

Proportion: The child emphasizes, in its drawings, what appears interesting and important to it, frequently by making it particularly large (Eng 1954). Exaggeration of certain aspects or parts of a given subject can emphasize certain importance (Hamdi 1981).

Color & ornament: It is not until the age of six that decorative drawing appears and children begin to carry out their drawings in color more frequently (Eng 1945). The use of color and ornamentation is a chief motive for the child's attempts to draw and it emphasizes what appears interesting and important to it (Eng 1954).

Perspective: Piaget and Inhelder, and based on their experiments on perspective drawing of children, concluded that it is not until the ages of 7 - 9 years old, the stage of visual realism, that perspective is applied systematically to drawing and a clear distinction is drawn between different points of view (Piaget and Inhelder 1956). Perspective representation requires a capacity for abstraction and complex naturalistic synthesis (Eng 1954). Nevertheless, the three-dimensional world depicted by the child, is a world of an undefined volume of space surrounding every object (Duthie 1985). The child finds it easier to depict separate objects as three dimensional than compound or complex objects.

Transparency: The child's tendency to look inside objects and draws them as if the external shell is made of glass (Gibreen 1981). Elements are often drawn transparent to reveal what is hidden.

Side-by-side arrangement: the child draws details which are in reality part of a whole, side by side and distributed over the paper.

Mixed views in a single scene*:* children draw using mixed views in a single scene.

2. METHODS OF INQUIRY

The objective of this research is to investigate some aspects of the relationship between children and their architectural environments, through analyzing graphic representations of seven architectural settings: the bedroom, the house, the neighbour's house, the playground, the neighbourhood shop, the neighbourhood and the city (Amman).

As a first stage, a pilot study was conducted, with the aim of testing research techniques and questionnaires. The pilot questionnaire was distributed among 20 children, randomly selected from different environments, backgrounds and with different age groups. Based on which, the final research techniques, questionnaire design and sampling procedure, were defined.

2.1. Sampling procedure and data collection

Research participants were chosen from the same neighbourhood area located in west Amman, Jordan. The choice of a single neighbourhood aimed at keeping the social, educational, and economical backgrounds constant, in order to establish a common base of comparison. The sample's age group was defined between the ages of 7-12 years old. As it was established in the reviewed literature, the age between seven and nine, marks the stage of visual realism, where children start to realistically depict, perspective, proportion, colours, ornaments, measurements and distance. Based on this age group and the physical area of the neighbourhood, the final sample size was automatically defined to (47).

Data was collected by means of survey questionnaires supplemented by interviews. Distributing the questionnaire was done through children's parents, to whom the aim and the importance of the study were explained. It was made clear that children should have the freedom to choose any drawing media they please and also to be given all the time they need to complete the seven drawings. The collected data was elementary examined, photographed, and classified. Based on this examination, five Participant's questionnaires were excluded. The final sample size was set to 42 valid questionnaires: (19 males, 23 females).

2.2. Questionnaire design

The final design of the questionnaire consisted of two sections. The first section contains questions related to the child name, age, sex, type of residence, and a brief introduction on the importance, aims and procedures of the study. In the second section, children were asked to draw seven architectural settings related to their direct environment. These include: I draw my room; I draw my house; I draw my playground; I draw the neighbour's house; I draw the neighbourhood shop; I draw my neighbourhood; and I draw my city. For each drawing, a white square paper (size 300mm * 300mm) was provided. Square shaped paper was chosen in order to avoid the bias of orientation, which was obvious in the pilot study.

To help reach appropriate understanding and interpretation of children's drawings, non-structural interviews, with the children and their parents, were conducted. The collected verbal data was used to understand the depicted representation as compared to the actual setting.

2.3. Documenting the physical settings

To establish a base of comparison, the area of research and the different targeted architectural settings were documented using photographs, areal photos, sketches, and maps.

3. ANALYSES AND OUTCOMES

Analyses of drawings were conducted using two methods:

1. Statistical analyses were used to identify broad patterns in the data. These analyses were based on the number of occurrences in each examined issue of research. Two main categories were investigated: typology and gender related issues. Typology analyses were focused on defining patterns of representation, which might illustrate a common way of thinking and also looking for diversity and uniqueness of representation, which might illustrate creative impulses of the child's way of thinking. Typology analyses investigated biases related to stereotypy, transparency, drawing arrangement, point of view, orientation, synthesis, proportion, colour, ornament and perspective. Gender analyses focused on examining gender differences within the typology analyses.
2. Qualitative analyses examined the statistical results in order to understand why the broad patterns or uniqueness emerged. These analyses were supported by available literature and by comparing children's representations to the actual settings.

3.1. Analyses of bedroom's drawings

These analyses were divided into two main components. 1. Analysis of the architectural setting, which included: boundaries, areas and spaces, walls and ceiling and colours. 2. Analysis of furniture and other household items, which included: furniture objects, furniture arrangements, colour and detail and method of representation.

3.1.1. Outcomes

- %96 of children drew their rooms' spaces in terms of arrangements of separate objects, forming the overall space (Fig. 1). For most children, identifying space as a three dimensional volume, was a challenging task, instead they could more easily identify separate objects and areas.
- For the child, in its process of learning and discovery, various objects of furnishings present a variety of types of experiences: wardrobes standup and conceal; chests of drawers contain and induce classifications; beds provide the unlimited tactile experience; doors define boundaries and stimulate inquiry about mechanisms of movements; keyholes and windows provide an opportunity for voyeurism, both from inside-out as well as from outside-in (Fig. 3). A substantially higher percentage of the male children included windows and doors in their drawings (70.58%), than females (43.40%).
- Accessories and tactile objects were among the most represented and emphasized elements (94.80%). They were drawn with all their details; shapes, colors, textures, sizes, and ornaments. Accessories were represented as points of control and instruments of change. Such items, therefore, should be designed carefully in terms of their shape, color, size, and location. The ease with which a switch or a handle can be reached, relative to the age, size, or physical ability of a child, creates an experience of success or failure.

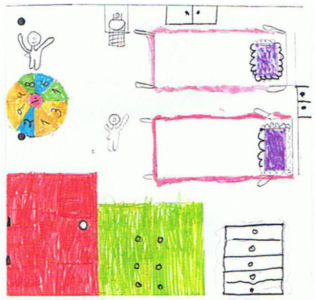

Figure 1: Interior drawing of the bedroom by Raed, age 9; representation of various objects and accessories.

3.2. Analyses of house's drawings
These analyses included drawings of the child's own house and the neighbour's house. The discussion was built according to the methods of representation presented by children, which basically fall under two main headlines. 1. Mapping the interior, which included; plans, and furniture arrangements. 2. The outside image, which included; two dimensional views (elevations, sections), and three dimensional views.

3.2.1. Outcomes

- Almost %70 of children represented their houses as a vertical independent being, located at the centre of the page. It was presented with its frontal facade and its basic geometric shapes (Fig. 2). This facade was represented as a clean background surface housing all the elements of importance.
- Some patterns of representation were found: 1. Simplicity in shape and design. 2. Clarity of using the basic geometrical forms. 3. Attention to details. 4. The importance of typology in forming the child's vocabulary of elements, upon which the image of the house is formed in the child's mind. 5. The ease with which the child read an elevation is linked with its ability of perceiving the different geometrical shapes connected to the main background plain.
- Doors, and windows, were one of the most depicted exterior features. These elements open the way into the inside (Fig. 3).
- Privacy, territoriality and ownership were among the very important issues that strongly influenced the child's image of his house plan. These issues are mainly controlled by patterns of social interaction, which is controlled by culture and religion. By comparing the represented maps to the actual house plans distributions, 92.30% of children separated the public zone (main entrance and guest areas) from private zones (family areas and bedrooms).
- Apartments were mainly represented by the interior setting, rather than the exterior (Fig. 4). This might be due to issues related to territoriality and ownership.

3.3. Analyses of playground's drawings
These analyses investigated some basic issues related to children's play environments. These issues include:

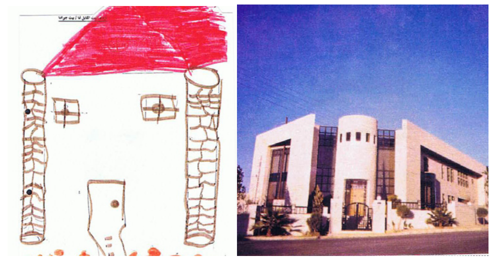

Figure 2: Left: drawing of the child's house by Diana, age 10; Right: an image of Diana's house; representation of basic geometric shapes

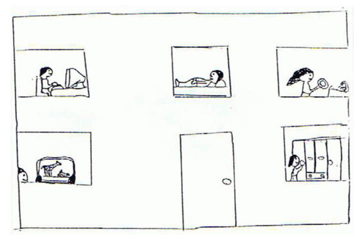

Figure 3: Drawing of the child's house by Zaid, age 9; windows into the inside.

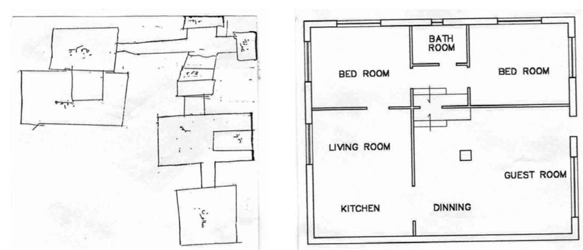

Figure 4: Left: drawing of the child's house by Abdula, age 7; interior representation. Right: the Actual plan of Abdula's apartment

1. Active and passive. 2. Hard and soft, natural and people built. 3. Open and closed. 4. Private and public. 5. Colour and detail. 6. Space shape and size.

3.3.1. Outcomes

- For children, the power of roles is not as important outside the immediate context of home and school. Away from home children have the chance to direct their behaviour and to observe the consequences. Accordingly all drawings neglected any connection with any part of the house. Most of the represented play grounds where drawn in complete isolation.
- While most female children (%78.7) drew boundaries to define their playgrounds, 70.59% of male children drew their playgrounds with no edges at all. Research experiments strongly link privacy and territoriality as socio-environmental phenomena (Bowers 1979). The male child seeks rich, sensory stimulation of large-muscle activities which only open spaces can provide, he often looks for opportunities to manipulate or mess about in the setting, unlike the female child who usually can be

more tidy, content, and less active. Moreover, girls are far more likely to have their movements restricted due to social boundaries in the Jordanian society (Bisharat 1996).

- Four main different shapes of playgrounds were drawn by children: the rectangular shape (%62.5), the circular shape (%5.0), the linear shape (%20.0), and the irregular shape (%12.5).
- Football games were the most popular play activities among male children, and were represented often in their drawings. Unfortunately dangerous spaces were, often, depicted as legitimate play spaces. For example, when boys temporarily lay stone goal posts across a street to play football (Fig. 5). Designers and planners need to structure the physical environment to help avoid sex-stereotyped representation. It is important to provide a world, in which boys and girls can choose from the greatest possible range of roles and behaviours.

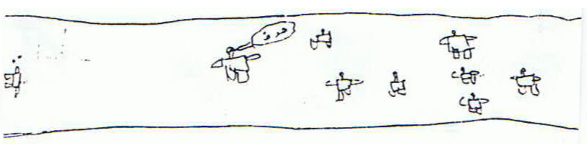

Figure 5: Drawing of playground by Abdula, age 7; the street as a playground.

3.4. Analyses of the neighbourhood's drawings

These Analyses included three main principal neighbourhood characteristics: Size and boundaries, identity and character and components and details.

3.4.1. Outcomes

- According to drawings, the child's definitions of its neighbourhood in terms of size, boundary, and identity were not represented clearly. No clear image was found of the neighbourhood character, the only way to present the uniqueness and identity of the neighbourhood was by singling out certain local landmarks which acted as types of point - reference. Landmarks were used as clues of identity. This was done to mark the distinction and singularity of the child's own neighbourhood's territory (Fig. 6).
- The boundaries of the neighbourhood, as represented by children, were not defined in terms of physical or visual definitions, but rather according to the child's social relation, and freedom of movements.
- The components of the neighbourhood's image were a combination of houses, paths, and landmarks. The image of the house dominated the neighbourhood structure. The neighbourhood was often represented as a group of iconic "Stereotypy" representation of houses (52.5%).

3.5. Analyses of neighbourhood shop's drawings

The discussion of this section was built according to the typology of drawings presented by children of their neighbourhood's shop. These analyses basically discussed representations of the internal image and the external image of the shop.

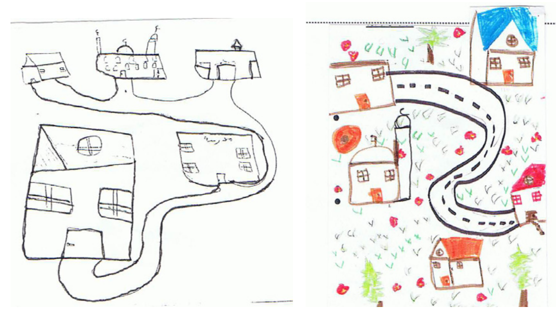

Figure 6: Left**:** drawing of the neighbourhood by Hadeel, age 7. Right: drawing of the neighbourhood by Diana, age 11; the mosque as a landmark.

3.5.1. Outcomes

- Based on children's representations, "order" represented the key characteristic in describing the inside space of the shop; objects were arranged on shelves or within wardrobes according to a systematic categorizations. Each group of items was grouped together according to its size, colour, shape, and function (Fig. 7). In order to classify a group of objects, a child must be able to coordinate two dimensions that make up the concept class. First, the child must single out the criteria that define the class; second, the child must select all those objects that fit the criteria (Newman and Newman 1978). Moreover, colours present children with a very important tool of classification (Fig. 7).
- The prominence of signs in children's representations provided an easy way for communicating the idea of the neighbourhood shop. Signing systems provided important features of the shop's external image. It was clear that children took pleasure in representing the colourful display of signs (Fig. 9). Transparency also represented an important quality of the outside shop's facade.

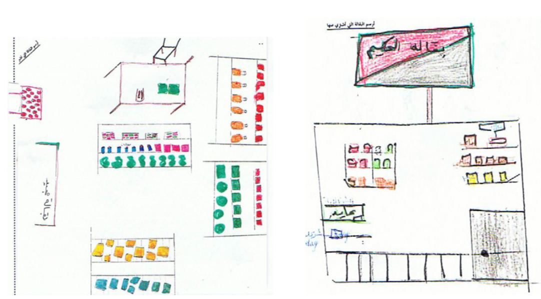

Figure 7: Left**:** drawing of the shop by Worood, age 12; classifications and colours. Right: drawing of the shop by Dana, age 11; transparency and signage.

3.6. Analyses of city's drawings

It is the aim of this section to understand how children, as one population group, perceive their city, and to

evaluate the components of perception, upon which the image of the city is built. It is increasingly clear that the city environment is perceived differently by different population groups. Variations in motivation, familiarity, cognitive skills, travel mode, and information sources, etc., all affect urban perception (Goodnow 1977).
These analyses were divided into two main categories: imageability analyses and city elements analyses. The Imageability analyses were based on understanding the component of imageability of the city, as recognized by Harrison and Haward (Harrison and Howard 1980): the physical components, which include location and appearance and the cultural components, which include meaning and association. The city elements analyses followed Lynch's classification of the city elements: paths, edges, districts, nodes, and landmarks, which, according to Lynch, form the basic components of building the mental image about the city (Lynch 1960).

3.6.1. Outcomes

- The representation of the city, as evidenced in the drawings, displayed a wide range, from the most centralized and orderly, to the most dispersed or non-hierarchical assembly of volumes or elements. In between, lay a percentage (17.5%) of representations that employed type of drawing using roads as datum. This latter type stands in-between the most orderly and centralized, and the least orderly and hierarchical assembly in the direction of a labyrinthine representation of the city.
- Based on the analyses, children represented their city in terms of separate entities, while struggling to connect these elements to each other or even to the actual reality. Because children are accustomed to travel in the city by automobiles, the circulation image seemed to be the dominant one (Fig. 8). Moreover, because children are not allowed to move freely within the city, but only within the boundaries of their neighbourhoods, the image of the neighbourhood dictates the main characteristics of the image of the city. As a result many children represented the city dominated by high-rise apartment buildings (Fig. 9).
- Nodes, baths and landmarks were the most represented elements in the city (Fig. 8).
- The cultural components of imageability seemed to be the dominant component which affects the child's image of its city.

Figure 8: Left: Drawing of the city by Mustafa, age 11. Right: Drawing of the city by Zaid, age 9; paths, landmarks and nodes dominated the city's image.

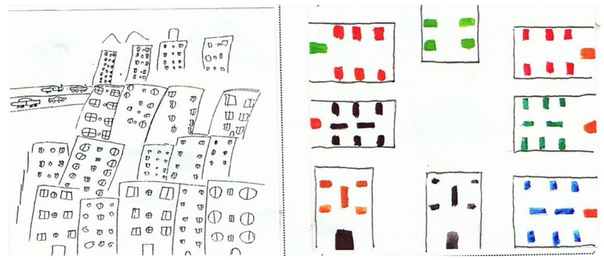

Figure 9: Left: Drawing of the city by Suliman, age 9. Right: Drawing of the city by Ruba, age 9; high rise apartment buildings.

CONCLUSION

The study concluded that the typology of objects, within a space, represents the most recognizable features to the child. Different objects present themselves in different ways according to the kind of experience the child has with it. These experiences represent the main contributor in building the child's image of different objects. The spatial dimensions, as we understand it, were represented as a byproduct of the positioning of objects. Indeed in this way it is the left over space between objects; exactly that which we as architects usually consider a drawback in any design. Thus in matters pertaining to interior furnishings for children, it would be advisable to place higher importance and significance on the design of the objects themselves rather than the customary attitude of integrating furniture with the space defining elements, such as the case of build-in furniture. Therefore, so-called integral or integrated furnishing (build-in furniture) would be undesirable because it eliminates the uniqueness of each object.
The study also concluded that male children were more realistic in their representations and more capable if representing the three-dimensional world, while female children were found to be more iconic in their overall graphic representations. This difference might be accepted as the natural product of the two different types of gender play; male children often seek rich sensory simulation of large-muscle activities, which can only be provided by large open spaces. This gender difference can also be linked to the child's patterns and freedom of movement. The more extensively children are permitted to roam and explore, the more accurately they can conceptualize the spatial relationships on their environment.
Once it is established that the cause of these gender differences is cultural and not inherent or natural, it becomes extremely crucial to underline that children of booth sexes would need the different sensory experiences provided indoor and outdoor play. The child, male or female, can never become fully developed without the exposure to the range of activities provided by the open world. Designers and planners therefore need to compensate for the lack of physical activities by creating play areas that provide visual simulation, and the equal chance to exercise open-field play activities. Further investigation of the

relationship between mobility and spatial visualization is recommended.
The analysis of the different settings, displayed a wide range of representation, from the most centralized and orderly (the room and the house) to the most disperses and non-hierarchical assembly of elements, in the direction of a more labyrinthine representation of the city. It became evident that this range of representation verifies the child's knowledge of the drawn setting. The child's understanding of these settings becomes more limited with the increase of physical scale.

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New Models for Architectural Education

Collaborative Research: A Paradigm Shift in Architectural Education?
Joyce M. Noe, Marja Sarvimaki, and Samuel D. Haagenson

Interdisciplinarity as a Sustainable Pedagogical Tool
R. Todd Gabbard

Closing the Implementation Gap: A Critical Model for Architectural Research
Ash Ragheb

Searching for a New Paradigm in Architectural Education
Irina Solovyova, Upali Nanda, and Frances Downing

Collaborative research:
A paradigm shift in architectural education?

Joyce M. Noe, FAIA, Marja Sarvimaki, D.Sc., Samuel D. Haagenson, D.Arch

University of Hawaiʻi at Mānoa, Honolulu, Hawai'i

ABSTRACT: The 2009 ARCC Spring Research Conference question, ". . . how can we foster a more integrated research culture between academia and the profession?" is an opportunity to examine the curriculum development at one School and stimulate discussion for expanded application. Since 1993 our School has endeavored to develop mutually valued connections with international professional leaders to meaningfully engage practicing professionals as teachers in a professional degree program. The concept of 'leaders teaching leaders' with practitioners as teachers and research as a major component of the learning collaboration is one unique program focus. The strategic location of the School coupled with technological advances in the built environment process offer opportunities for students to experience global cultural influences, a second distinct program focus. The innovative approaches undertaken for over a decade were in part necessitated by the School's overarching goal to institute a new accredited doctoral first professional degree program which was accomplished in 2002. The effort to sustain credibility as a Doctor of Architecture (D. Arch.) program continues today.
Innovations bring successes and risks. This paper examines the curriculum evolution to date and plans for future development from the viewpoint of the current Professional Practice Coordinator [Introduction, Professional Practice Curriculum, Program Evolution, Assessment, Conclusion] and the Doctorate Project Coordinator [Introduction, Program Evolution, Other D. Arch. Projects]. Reflections of the impact of our curriculum on one student's professional advancement relative to opportunities and challenges encountered while engaging in research collaboration with practicing architects is discussed by a graduate of the program, who is now a practicing intern. In addition, the paper offers an overview of other elucidating D. Arch. projects exemplifying the diversity of research topics and foci of the program on collaborative research, global culture, mentoring, and technology.

Conference theme: Innovative approaches to architectural education
Keywords: curriculum development, D. Arch, global culture, interdisciplinary research, mentoring

INTRODUCTION

In 1993 Professor W.H. Raymond Yeh, FAIA was appointed Dean of the University of Hawaiʻi at Mānoa (UHM) School of Architecture (School). He recognized the School's strengths as worthy of developing into a first professional Doctor of Architecture degree program and led the faculty to accomplish this vision. Short and long term action goals from a 1993 Faculty Retreat relevant to this paper include:

- Actively engage professional architectural firms as teaching units with principals serving as adjunct faculty members to provide students with experience in a professional practice setting.
- Establish an overseas program network with schools and professional communities in the Asia Pacific region
- Establish the [School] as a leading US school, known for educational and research programs for the Asia Pacific region.

Based on the experiences in developing the first NAAB accredited Doctor of Architecture program, the intention of this paper is to offer background for the future development of analogous programs by reviewing some elucidating doctorate projects and lessons learned in the process of creating the program for Doctor of Architecture as the first professional degree; not a Ph.D., nor a M. Arch. During this process, the UHM School of Architecture has witnessed a wide range of applied research explorations into architecture varying from conventional precedent case studies and (post)positivist approaches, to naturalistic/hermeneutic studies on design methodology and theory, ending in polemic/emancipatory perspectives on the dynamics of power. These projects typically focus on issues critical for the Asia Pacific region; such as climate-specific sustainable design in (sub) tropics, indigenous Pacific cultures, and Hawaiian sense of place; and also often address education and practice of architecture more generally.
It is, of course, not possible to delve into all of the many

interesting projects here, and therefore we concentrate on those dealing with cross-cultural and/or interdisciplinary (whether multi-, cross-, or transdisciplinary) applied research, as it is our belief that those approaches offer most potential in developing new research typologies and paradigms in the pursuit of achieving fresh insights into the architectural education, design and practice, and/or of expanding the research resources within the discipline of architecture.

1. PROFESSIONAL PRACTICE CURRICULUM

Over a decade ago, the Professional Practice Director (current title 'Coordinator') was appointed to chair a committee of faculty and practicing architects with teaching experience. The committee's charge was to investigate and propose an exceptional professional practice program appropriate for a doctoral degree

1.1. Design studio with practice focus

The committee's first action was to identify and engage practicing professionals as teachers for a 300 level design studio to integrate research and practice issues into the design process. A workshop facilitated by James Franklin, FAIA, Resident Fellow of the American of Architects National office, provided the entire full time faculty, and the architects who participated as studio mentors the opportunity to evaluate the course. This course was not approved for further development. One concern was that practice issues inhibited beginning design skills.

1.2. Professional practice research

In Spring 1994, in response to the evaluation of the 300 level studio and to encourage International student admissions, an upper level lecture/seminar course was developed. Students enrolled in this course are placed in architecture firms for a minimum of sixteen ten hour weeks to conduct design research under the guidance of a principal of the firm who acts as teacher / mentor while providing access to people, projects, literature, public hearings, etc. for the research development. Arch. 406 Design Research in Firms course (Fig. 2) successfully demonstrated that design research learning can be achieved in firms as classrooms. This is a crucial clarification for NAAB and NCARB rules.

Placement in the professional office in lieu of the typical classroom allows opportunities for students to observe practice as a reality rather than hypothetically, resolves the desire of international students to experience U.S. practice methods first hand, and results in applied research results that students take back to their country or base their final project and practice focus on. Weekly meetings with the School faculty and students placed in different firms serve to discuss applied research methods as well as provide opportunities for debriefing, comparative learning and progress checkpoints. Required course products are a research paper, a journal record of selected practice issues introduced by the mentor, and a graphic presentation to the firm at large which includes traditional as well as electronic analysis of the research effort. This course was the model for the Practicum Studio and final research courses and is now an upper level elective.

1.3. Introductory and intermediate research

One basic premise agreed upon by the Professional Practice committee was that practice issues should be introduced early and reinforced often with emphasis on collaboration with practitioners.

This led to creation of a 200 level professional practice course in which students visit local architecture offices and project sites. Principal architects of firms conduct the visits which focus on practice issues. The expected learning outcome is student exposure to firms to learn to conduct comparative research analyses of diverse architecture offices and design methodologies as well as to complete case studies of various project construction and design processes. (Fig. 1)

	ETHICS PROFESSIONALISM	5 FIRMS: DIVERSE SIZE, PHILOSOPHY, PRACTICE FOCUS, PROJECT TYPES			SUMMARY SUBMITTAL
		OFFICE VISITS	PROJECT STUDIES	DISCUSSION, ANALYSIS, COMPARATIVES	
	Lecture by Architect	Design/Practice	Pertinent Lesson	Verbal, Written, Critical Thinking Skills	Paper, Course Log
PRODUCTS	SKILLS, KNOWLEDGE ACQUISITION ACTIVITY				
Journal	Lecture notes, sketches, questions, thoughts and photos				
Assignments	Resume, professional goal statement				
Correspondence	Thank-you letters, memoranda, field reports, e-mail exchanges, research, visiting lecturer notes				
Readings	Text, handouts, firm and architect bios and brochures				
Research	Library, Internet research, firm and architect bios and brochures				
Final Submittal	Comparative analysis paper with bibliography, references				
	Course record binder with research data, Internet downloads, contact list, all assignment with drafts & digital files				

200 INTRODUCTION TO PRACTICE

Office visits project studies discussions   Tour construction sites   Post occupancy evaluations

Figure 1

FIRM: 80 HOUR MINIMUM CONTACT HOURS					
SoA 1X WEEK RESEARCH METHOD	ORIENTATION	RESEARCH	ANALYSIS	SCENARIOS	FINDINGS
General Methodology	Firm/Student Goals	Data Collection	Synthesis	Alternatives	Summary of Findings
Conceptual Design	Employment Interview	Interviews	Consolidate	Selection(s)	Pertinent Data
Programming	Set Hypothesis	Library/Internet	Comparatives	Clarify	Alternatives
Analysis	Scope/Schedule	Precedents	Format		Future Possibilities
Demographics			Charts/Diagrams		Graphic Layout
Statistics					Verbal, Digital, Paper
Research Plan					Case Study Analysis
Case Study Research					

406 DESIGN RESEARCH IN FIRMS

ARCHITECT MENTOR
Leadership , research conferences

CONSULTANT, COMMUNITY
Presentations

JUNIOR ARCHITECT MENTOR
Daily guidance, design research reviews

Figure 2

In response to the National Architecture Accrediting Board (NAAB) requirement for a comprehensive studio, a 400 level project management course was developed to augment the studio. Case study research of firms/projects is a learning objective for this course which is now an elective course. The introductory and intermediate professional practice courses were initiated as pilot courses prior to institution as required or elective courses. This process allowed explorations in collaborative course content, research methodology, practicing architect teaching strengths and availability, and impact on student learning outcomes. The ultimate objective was to develop a Practicum Studio and post practicum research and seminar courses to prepare students to successfully complete and publish meaningful written research or design D. Arch. project

1.4. The practicum studio (Fig. 3)

> The primary goal of this 24-credit two-studio sequence is to provide students with first hand exposure and experience with professional responsibilities, opportunities, and comprehensive skills, and to support development of their professional leadership abilities". . . "An equally important goal . . . is to better equip students to practice architecture in a global community, especially in the Asia Pacific region... (Sakata 2000:1)

SOA PRE-PRACTICUM SUPPORT SOA: INTERNSHIPS TRAVEL WORKSHOPS - MATCHING, PLACEMENT, LOGISTICS, PLANNING FIRMS: INFORM, VERIFY, COORDINATE						
SOA: 1X WEEK	FIRM: 18 WEEKS FULL TIME					
DISTANCE SUPPORT	ORIENTATION	TRAINING	ACADEMICS	RESEARCH	SERVICE	SUMMATION
Monitor:	Employt Interview	Unit Competency	Assignments	Alternatives:	Alternatives	Firm Presentation:
Progress	Firm Orientation	Training	Advise	Design Research	Resource Access	Activities
Compliance	Present Self	Leadership	Review	Case Study	Advise, Review:	Findings
Performance	Resource Access	Professionalism	Evaluation	Resources Access	Scope	Knowledge
Evaluation	Agreements:	Evaluation		Advise, Review:	Schedule	Competency
Coordination	Schedule			Scope	Review	Personal Growth
Process:	G&A Plan			Schedule	Evaluation	Evaluation
Final Paper	Units: Training			Review		
	Units: Assignment			Evaluation		
	Research					
	Service					
	Readings					
	Extra-curricular					

500 PRACTICUM STUDIO IN FIRMS

GENSLER OFFICE LEED STUDY
San Francisco, California

NEW ENGLAND RESEARCH LAB
Chelmsforth, Massachusetts

BUILD HOUSING FOR DEVELOPING COUNTRY, Kendal, Cambodia

Figure 3

A major requirement of each Practicum Studio is to conduct and document comprehensive design research in collaboration with the Practicum Faculty on a topic of mutual interest to the Student and the Practicum Faculty/Firm. Qualifications for Practicum Faculty/Firm appointments include global practice experience especially in the Asia Pacific region, teaching experience, interest in student research development, ability to integrate theoretical knowledge and practical application, and demonstration of leadership skill within the firm and in the larger community. Simple research strategies, including the case study method, are utilized. Assessment of the student research is conducted by the Practicum Faculty and other firm mentors via a performance evaluation, as well as a critique by the firm at large per the requisite semester-end presentation of the research findings. In many instances, students have the opportunity to present to larger community and civic groups when the research topics are relevant to current issues.

It should be noted that the Practicum Studio was developed by Carol Sakata, FAIA, a practitioner who is a graduate of the inaugural class of the Architecture Doctorate program. Her accomplishment and that of one of the co-authors of this paper are examples of the applied research products that are invaluable resources for the School and the future of the profession.

1.5. Post practicum seminars

Upon return to campus after the Practicum Studios, students enroll in two seminar courses intended to build on the Practicum experience: 1) Forms and Frames of Practice –compare student practicum experiences and relevant contemporary practice. 2) Doctoral Seminar – discuss future of the profession issues. These courses were instituted to augment and reinforce student research interests developed in prior courses and as forums to share findings and knowledge to date as students concurrently commence their final doctoral research projects.

Both courses include guest speakers from related campus departments as well as Practicum Faculty CEO's from a diverse range of worldwide firms.

2. PROGRAM EVOLUTION

2.1. Changes

Since 1993, the curriculum has been modified in response to student needs, learning outcomes and practice demands. One valued change is the introduction in 2005 of a required Research Methods course to be completed prior to enrollment in the Practicum Studio. The course was intended to prepare students to conduct meaningful research explorations during their Practicum year as a basis for moving into the final doctoral research project courses.

Changes instituted by recently appointed Dean Clark Llewellyn, promise further exploration per the modified School's mission to offer

> a global collaborative approach to improving the built and natural environment founded on intellectual inquiry, creative problem solving, and outreach with a commitment to prominence in innovative architectural education, design excellence, sustainability, and research with a focus on Hawaii, the Pacific and Asia. (Mission Statement 2008)

			ARCHITECTURE STUDIES					GENERAL STUDIES			
	YR	SEM	DESIGN	PRACTICE	TECHNOLOGY	HIST/THEORY	ELECTIVES	REQUIRED	REQUIRED	ELECTIVES	CR.
PRE - PROFESSIONAL	1	F	ARCH 101[4] Basic Arch Studio A			ARCH 100[3] Intro to Built Environ		ENG 100[3] Writing	HIST 151[3] World Civilizations	ART 1xx[3] Freehand Dwg	16
		S	ARCH 102[4] Basic Arch Studio B		ARCH 235+L[2+1] Computer			MATH 140[3] Trigonometry	HIST 152[3] World Civilizations	ELECT 1xx 2xx [3] Hawaiian Focus	16
	2	F	ARCH 201[4] Inter Arch Studio A			ARCH 271[3] World Arch + Urbanism		PHYS 151 [3] College	LANG 101 [4] Foreign Lang.		14
		S	ARCH 202[4] Inter Arch Studio B	ARCH 200 [3] Prof Pract of Arch		ARCH 272[3] World Arch + Urbanism		SCI LAB [1] Science Lab	LANG 102 [4] Foreign Lang.		15
	3	F	ARCH 301 [4] Adv Arch Studio A		ARCH 320 [3] Intro to Arch Sys A	ARCH 474 [3] Theories of Arch + Urb			LANG 201 [3] Foreign Lang.	ASAN 312 [3] Contemporary Asia	16
		S	ARCH 302 [4] Advanced Arch		ARCH 321 [3] Intro to Arch Sys B		ARCH 400 [3] Elect Office Research		LANG 202 [3] Foreign Lang.	ELECT 3xx [3] Interdisciplinary	16
	Comprehensive Portfolio Review for Advancement										
TRAN.	4	F	ARCH 401[4] Asia Pac Urban Studio	ARCH 431[2]+L [1] Adv. Computer	ARCH 316 [3] HVAC + Mech Sys					ELECT 3xx-4xx [3] Interdisciplinary	16
		S	ARCH 402 [4] Focus Studio					BIO SCI [3] Elective	ORAL [3] Elective in Oral	ELECT 3xx-4xx [3] Interdisciplinary	16
											125
	BA Degree Granted from Arts and Sciences In Interdisciplinary Studies [Requires plan and approval by Interdisciplinary Studies and School of Architecture]						ELECT 5xx-6xx [6]	Taken in any summer after BA Asia Pacific Study Abroad - Two courses at 3 credits each OR University Study Abroad - One Course for 6 credits			6
PROFESSIONAL	5	F	ARCH 501 [6] Comp Arch Studio A Asia Pacific	ARCH 433 [3] Prof Pract Law and Ethics		ARCH 573 [3] Asia-Pacific Architecture					15
		S	ARCH 502 [6] Comp Arch Studio B Asia Pacific	ARCH 600 [3] Research Methods Seminar	ARCH 518 [3] Advanced Systems		ELEC 5xx 6xx[3] Asia Pacific Issues				15
			All coursework above, required workshops and documents must be completed to enter practicum [See also Prerequisite Chart]								
	6	F	ARCH 504 [12] Arch Pract Studio A								12
		S	ARCH 505 [12] Arch Pract Studio B								12
	7	F	ARCH 507 [6] Arch Doc Studio A	ARCH 534 [3] Forms + Frames Prac			ELEC 5xx6xx[3] Asia/Pacific Topic			ELEC 5xx 6xx[3] Open Elective	15
		S	ARCH 508 [6] Arch Doc Studio B	ARCH 535 [3] Arch.D Seminar			ELEC 5xx 6xx[3] Asia/Pacific Topic			ELEC 5xx 6xx[3] Open Elective	15
			80	21	21	15	18	13	23	24	215

Figure 4: Program Chart Prior 7 Year Architecture Doctorate (Arch. D.)

			ARCHITECTURE STUDIES					GENERAL STUDIES			
	YR	SEM	DESIGN	PRACTICE	TECHNOLOGY	HIST/THEORY	ELECTIVES	REQUIRED	REQUIRED	ELECTIVES	CR.
PRE- PROFESSIONAL	1	F	ARCH 101[4] Basic Arch Studio A			ARCH 100[3] Intro to Built Environ		ENG 100[3] Writing	HIST 151[3] World Civilizations	ART 1xx[3] Freehand Dwg	16
		S	ARCH 132[4] Design Communicatn				ELECT 2xx [3] Oral [O Core]	MATH 140[3] Trigonometry	HIST 152[3] World Civilizations	ELECT 1xx 2xx [3] Hawaiian Focus	16
	2	F	ARCH 201[4] Arch Studio	**ARCH 200 [3] Prof Pract of Arch**		ARCH 271[3] World Arch+Urbanism		PHYS 151+L [4] College	LANG 101 [4] [L Core]		18
		S	ARCH 235[4] Comp App in Arch		ARCH 320 [3] Intro to Arch Sys A	ARCH 272[3] World Arch + Urbanism		ELECT 1xx 2xx [3] Conc Req or Elec	LANG 102 [4] [L Core]		17
	3	F	ARCH 341 [4] Int Arch Studio A	**ARCH 433 [3] Prof Pract & Ethics**	ARCH 321 [3] Intro to Arch Sys B	ARCH 371 [3] Design Theory			LANG 201 [3] [L Core]		16
		S	ARCH 342 [4] Int Arch Studio B		ARCH 322 [3] Sustainable Systems		ARCH 3xx4xx [3] Conc Req or Elec [W]	BIO SCI [3] Bio Sci Core	LANG 202 [3] [L Core]		16
	4	F	ARCH 415[6] Asia Pac Urban Studio					ELECT 3xx-4xx [3] Conc Req or Elec		ELECT 3xx-4xx [3] Conc R or Elect [W]	12
		S			ARCH 3xx4xx [3] Conc Req or Elec	ARCH 3xx4xx [3] Conc Req or Elec	ARCH 3xx4xx [3] Conc Req or Elec	ELECT 3xx-4xx [3] [Soc Sci Core]		ELECT 3xx-4xx [3] Conc Req or Elect	15
			Summer coursework required for incoming 2nd Degree Students with insufficient prior architecture coursework								126
			ARCH 540 [6] Architecture Studio I Intro to Design	ARCH 531 [3] Adv Design Commmunication I	ARCH 522 [3] Architecture Systems Intro to Systems	ARCH 571 [3] Architecture HIstory					15
PROFESSIONAL D. ARCH	1	F	ARCH 541 [6] Architecture Studio II	ARCH 533 [3] Adv Design Communication II	ARCH 523 [3] Arch Systems II Wood & Steel	ARCH 575 [3] Asia-Pacific Arch Hist & Theory	ARCH 551 [1] Architecture Topics				16
		S	ARCH 542 [6] Architecture Studio III		ARCH 524 [3] Arch Systems III Conc & Masonry	ARCH 575 [3] Arch & Urban Design Theory	ARCH 551 [1] Architecture Topics			ELECT 5xx-6xx [3] Open Elect University Wide	16
	2	F	ARCH 543 [6] Arch Studio IV Urban Design	**ARCH 545 [3] Advanced Practice**	ARCH 525 [3] Arch Systems IV Sustainability	**ARCH 539 [3] Research Methods Seminar**	ARCH 551 [1] Architecture Topics				16
		S	ARCH 544 [6] Arch Studio V Comprehensive	**ARCH 546 [3] Doctorate Project I**	ARCH 526 [3] Arch Systems V Integration		ARCH 5xx6xx [3] Arch Elective				15
	3	F	**ARCH 547 [12] 549 [12], 550 [12] Professional Studio**	**ARCH 554 [3] Professional Studio Topics**							15
		S	**ARCH 548 [9] Doctorate Project II**				ARCH 5xx 6xx[3] Arch Elec				12
			45	12	12	9	9			3	90
											216

Figure 5: New D. Arch. Four + Three Program Chart

Dean Llewellyn directed the curriculum toward a four plus three format to convert the established seven year Doctor of Architecture degree program into a four year Bachelor of Environmental Design degree followed by a three year Doctor of Architecture first professional degree. The intent of the change is to offer students choices in several concentration areas:
Architecture, Urban Design, Construction Management, Historic Preservation, and Interior Design.

2.2. New curriculum (Fig. 5)
The new curriculum is expected to have a positive impact on research collaboration with professionals. Highlights of the changes that impact research include:

- The research methods course is offered in the sixth year just prior to the first Doctorate Project research course.
- The Practicum is now one of three Professional Studios, from which students can choose. This means Doctoral students are now required to spend only one semester in a setting off campus.
- The Forms and Frames of Practice Seminar is no longer a required course. It has been replaced by an Advanced Practice course in the sixth year.
- The 200 level introductory Professional Practice course student learning objectives now include understanding of primary practice models in the environmental design disciplines.

Previously, in the maturing stages of the UHM SoA doctorate program, one of the biggest problems was that several students were unable to complete their D. Arch. project in the preferred two semesters, leading to endless re-enrollments in either one of the doctorate project studios. The primary reason for this shortcoming was that they were not prepared well enough to start working on a doctorate project; in many cases, it wasn't until mid-semester when they finally had come up with a project topic, submitted a D. Arch. project proposal, and formed their doctorate committee – needless to say, the rest of the semester was not sufficient to complete the first part of the project. As a solution, a research methods seminar was implemented and composed so that it directly addresses the issues of a D. Arch. Project, in addition to the actual research methodology. Thus, the actual *process* of working on a doctorate project now starts with the Research Methods Seminar (ARCH 539). As the name implies, the course deals with research methodology in a seminar setting, focusing on analyses of the built environment. The goal is to engage the participants in critical thinking, discussion, reading and writing about contemporary issues in architecture, in addition to studies on research methodologies, to form a preliminary basis for a D. Arch. project. Each student is required to be active with formulating one's own D. Arch. project topic, carrying out preliminary background research for it, and producing a D. Arch. project proposal.
In this course, writing is emphasized as a primary tool in conducting general research work and preparing for any scholarly project, in order to underscore its significance for an articulated, logical, and eloquent

presentation of ideas. The course thus involves written coursework on the investigation of various ideas for a doctorate project; on the development of a specific research topic; on the review of relevant scholarship and literature; on the formulation of research questions, arguments, and hypotheses; and on the selection of appropriate methodology for research and/or design analyses; followed by a detailed plan for the D. Arch. project.

The focus on methods in this course, in turn, is intended to make the participants conscious of their thoughts and approaches and to take those up as rational, not merely as intuitive acts, in terms of both architectural research and design. The intent is to allow the fullest exploration of ideas and subject matters for the D. Arch. project by literature reviews on the existing body of knowledge, by studies on the design and research precedents, and by experimentation with various research methods and topics of inquiry.

The sequence of the Doctorate project studio I and the Professional studio, as well as the format of the latter, have recently changed, too. From the very beginning of the UHM SoA doctorate program, an elemental part of the curriculum was the Practicum studio conducted in the School's Practicum firms, or in alternative settings (e.g., Architecture for Humanity or other self-directed experiences), during two off-campus semesters preceding the Doctorate project studios. But lately other professional experience options have been added, preferably taking place between the Doctorate project studios. Now all these constitute the Professional studio with three options: Community design (ARCH 547), Practicum (ARCH 549), and Alternative experience (ARCH 550).

Although the Professional studio contents are otherwise not the focus of this paper, it is important to note that especially the scholarly component of the Professional studio is thoroughly incorporated with the D. Arch. project as it was in the Practicum before. Also, the students are strongly encouraged to choose the Professional studio option, and within that option the location, available expertise, etc., in correspondence to their doctorate project topic. As the new Professional studio options weren't established until a good year ago, it is difficult to say how these new procedures will affect the D. Arch. projects, though it is anticipated that the research conducted during the Professional studios will have a positive impact on the scope, width and breath of the doctorate projects prior to their completion.

2.3. Doctor of Architecture final research project

Like before, the pedagogical centerpiece of the UHM SoA Doctorate of Architecture program is the independent D. Arch. project that is the academic culmination and capstone experience demonstrating advanced understanding of the chosen topic. In general, the doctorate project is to be a scholarly contribution to the knowledge in the field of architecture by presenting research and creative activity that has been conducted by the student under the supervision of a doctorate committee.

The doctorate project may take the form of a primarily written document which represents research and conclusions in written form that may or may not be supported by graphic data and information, or may take the form of an architectural design project which presents research in written form complemented by architectural design solutions presented in graphic form. In short, the D. Arch. project is expected to be principally concerned with creative explorations into architecture supported by research.

Whichever form a D. Arch. project takes, its research component is a vital, required element of the exploration; either leading to theory development or informing a design process during the final stage of the process, or any combination thereof. An integral part of the UHM SoA D. Arch. program also is the related research conducted during the Professional studio semester/s in which research activity is combined with professional experience occurring in an off-campus location, prior to the completion of the doctorate project and the doctoral candidate's entry into professional practice and/or academic service. In other words, the final D. Arch. project is the culmination of research collaboration of students with professionals. Students invite faculty and practicing architects to sit on their doctoral project committee. The responsibility of the committee is essential to assure that the research is appropriate and utilizes the most current resources.

Similarly to the earlier-mentioned problems in *starting* the research in the Doctorate project studio I, the doctorate candidates have faced great difficulties in *finishing* the project in a timely manner within the semester of the Doctorate project studio II (ARCH 548). The primary reason is that the doctorate project must be completed by April/November 15 for the graduation by the end of the semester in question, making the final term one month shorter than "ordinary" semesters.

A solution was the Pass/Fail defense added around the mid-semester in order to create a milestone helping in scheduling the stages of completing the degree requirements. The Pass/Fail defense has, indeed, facilitated most students in facing the even tougher final weeks of the semester. Those who pass the Final defense by April/November 15, have submitted the complete doctorate project document material by the due date (the last day of instruction of the semester), and have met all other degree requirements, are awarded the Doctor of Architecture degree at the end of the appropriate semester. At that point, even those of the graduates who were confronted with obstacles, delays, harsh criticism or other difficulties admit that overcoming all that was worth the fight, as in the end, being proud of one's project is what counts. This holds true especially after the graduation, as at last then one can apply the expertise gained in the doctorate project process to the future endeavors in the profession of architecture.

The following is one student's reflection on his academic research experience with emphasis on the collaborative support and guidance he received directly or indirectly from the many architects who support the School's research efforts.

3. INDIVIDUAL PROGRESSION

As a recent graduate of the Doctor of Architecture (D. Arch.) program at the University of Hawai'i at Mānoa (UHM), I (Samuel Haagenson) am able to offer a first-hand account of an individual progression through the program. This section will focus on my personal journey through the UHM program and how the research curriculum provided me with a unique link to professional practice.

3.1. Undergraduate curriculum

The research curriculum in the original D. Arch program begins with the undergrad courses. (Fig. 4) Electives that fulfil the credit hour requirements provide many opportunities to tailor one's education to individual interests. I personally chose to focus my education on traditional culture, its effects on architecture, and the possibilities it creates within the field of architecture. This was accomplished through elective coursework on topics such as general history, cultural history, art history, and architectural history, and focus more directly on the culture(s) that I was most interested in by enrolling in specific language and cultural practice and history courses. During this time, I was concurrently completing standard architectural education coursework and general university requirements. The result was a great accumulation of knowledge in my particular area of interest by the time I completed the undergraduate curriculum, more than would have been possible with less freedom in the elective coursework.

3.2. Practicum program

While I was a student at the UHM, each student spent two consecutive semesters enrolled in a Practicum Studio. This studio is a unique form of a research-based unpaid internship at different reputable firms located around the world. The School places the student at firms based upon their personal research interests having a correlation with the firm's history, experience, research, or current projects. Although part of the Practicum involves "typical intern work" in various areas of practice aligning with NCARB's IDP requirements, the Practicum Studio is made unique by the research and one-on-one interaction with the firm's CEO(s) and/or upper level management. It is through this direct relationship that the student is able to discuss one's research and collaborate with a highly respected and experienced professional within the industry.

3.2.1. Practicum Studio 1 - Kober Hanssen Mitchell Architects (KHMA) in Honolulu, Hawai'i.

For my first Practicum semester, I was placed by the School at Kober Hanssen Mitchell Architects (KHMA) in Honolulu, Hawai'i primarily because of my interest in traditional culture and its relationship to architecture, in particular my interest in traditional Hawaiian culture. KHMA has a history of successful projects that reflect traditional Hawaiian culture, and was at the time working on the design of a Hawaiian cultural center. Also, the firm's CEO, Kurt Mitchell, is Native Hawaiian and has a strong understanding of traditional cultural values and practices.

During my time at the firm, I conducted research on indigenous Hawaiian vernacular architecture. My goal was to gain a better understanding of why indigenous architecture took on the forms and functions that it did, and how the cultural values and practices directly impacted these forms and functions.

I performed the research using traditional research methods, such as producing a literature review on existing publications and other written documentation, finding material evidence in museums, and conducting personal interviews with experts on the topics. I also had the opportunity to discuss my work on a regular basis with Mr. Mitchell, who helped me to view the investigation from an experienced architect's perspective. Through these regular discussions he pointed me in the right direction and helped me to refine the research. Also, as a student in the firm, I was able to travel to some of the other Hawaiian Islands to perform tasks for the firm, and at the same time visit historic cultural and architectural sites that aided my research. By the end of the semester, I had accomplished my research goals, and the firm was able to utilize my research on their current projects. This mutually beneficial collaboration is a unique aspect and goal of the Practicum research.

3.2.2. Practicum studio 2 – NBBJ: Seattle Washington

I was placed at NBBJ in Seattle, Washington for my second Practicum Studio because NBBJ had designed several buildings which in some form successfully integrated traditional culture into a contemporary design.

For my research project during this semester, I completed a case study on a building designed by NBBJ that integrated a traditional culture into the design of the Alaska Native Medical Center in Anchorage, Alaska. My goal was to understand how the firm researched culture and what methods were used to integrate the culture into the design. To complete the research, I interviewed the project architect and other members of the design team extensively. I was also fortunate enough to visit the project site in Anchorage and tour the building, interview various user groups for the building, and learn a little more about indigenous Alaskan Native culture through these discussions and fieldwork in area.

Throughout the entire semester, I was able to discuss my research with Jim Jonassen, Managing Partner at NBBJ. We had weekly discussions in which Mr. Jonassen was able to describe why certain decisions were made, how they affected the design of the building, and even how things perhaps could have been designed differently. Because of his significant experience and expertise, he was able to guide my research and writing process in a way that allowed it to be more focused and have a more successful outcome. NBBJ is still designing buildings for the same client in Anchorage, and the case study I wrote during this semester has now become required reading for new team members working on these projects.

3.3. D. Arch. project

My D. Arch. project (final project before graduation) was a continuation of the research I had begun during my undergraduate coursework and continued in the Practicum Studios. The title of my project was "Contemporary Design as a Tool for Cultural Preservation." Through all of my previous research, I had formed the personal view that traditional cultures are very important to the continued existence of humanity, and therefore need to be preserved. Rather than buildings simply reflecting or integrating the traditional culture of the land where they sit, I feel that buildings can take this idea a step further and actually be a tool in the preservation of the culture *as a whole*. The project therefore puts forth a prescriptive design process that uses design itself as a method of promoting the continued existence and vibrancy of a traditional culture, much beyond that of reflecting traditional architecture and built forms. This design methodology is a process that can be used for any culture and any building type.

The project had three distinct parts. The first consisted of two in-depth case studies examining existing buildings where the design was greatly influenced by the traditional culture. The first of these was the Alaska Native Medical Center, for which I did most of the research during my second Practicum Studio. The other was a case study of the National Museum of the American Indian in Washington, D.C. For this case study, in addition to literature search, I also interviewed and spent time with the project architect, Johnpaul Jones, FAIA of Jones+Jones in Seattle, Washington, who was able to explain in detail how traditional Native American culture influenced the design. This interview was made possible through Jim Jonassen of NBBJ, my Practicum Faculty. The second distinct part of the project was my thesis statement, which described the cultural design methodology in detail and how it can be applied. The third distinct part of the project was the implementation, which demonstrated the use of the cultural design methodology through the design of a specific project for a particular culture.

Although the D. Arch. project is a student's final demonstration and showcase of the research performed while attending the university, it is most definitely not an "individual" project. It is a highly collaborative process between the students and their D.Arch. Committees. The committee members are chosen by the student based upon their individual knowledge and expertise within a particular area of the student's research project. They are there to guide the student throughout the process, but also actively participate in open discussions, critiques, and presentations to help the student form one's hypotheses, analyses, and evaluations shaping the research.

My committee chairperson was Clark Llewellyn, AIA, who is the Dean of the UHM School of Architecture, and also experienced in designing buildings for Native American groups of people. Another member was Daniel Chun, FAIA, who is a prominent architect in Hawai'i with a great deal of experience in designing buildings for Hawaiian groups and organizations, and also has experience designing educational buildings, which was important as this was the type of facility I chose to design in order to demonstrate the application of the cultural design methodology. The third member of the committee was Davianna McGreggor, a professor at the University of Hawai'i who teaches various cultural studies courses. She is a published author of traditional Hawaiian cultural practices (the culture which I chose for the implementation phase of the project), and a respected cultural activist within the Hawaiian community. It was through the collaboration with this committee that I was able focus my research and complete it successfully.

3.4. Professional practice

The unique collaborative approach to research at the University of Hawai'i has provided a link for me to professional practice. After completing the Practicum Studios, I was hired by KHMA (the firm where I spent my first Practicum) to be a regular full time employee. I was hired partially because the firm was aware of my work ethic and particular areas of skill, but also because they felt that the research I had been working on could be of value to the firm.

There were two project teams in particular that I was placed on because of my research. One was for the ongoing design of a cultural center for the Kahoʻolawe Island Reserve Commission. Kahoʻolawe is an uninhabited Hawaiian island with very limited access and great importance to Hawaiian culture, and this project was to serve as a cultural center located on the island of Maui to teach visitors about Kahoʻolawe who will more than likely never have the opportunity to visit the island. The other project was the design of a remote self-sustaining shelter on Kahoʻolawe for environmental and cultural preservation teams visiting the island. The design requirements were made especially unique by the complete lack of modern infrastructure and the extreme cultural significance. For both of these projects, the research I had completed as part of the curriculum at UHM was applied in both the research process of the project and the implementation of the design ideas.

I am still an intern architect, although I hope to be licensed within the year, so I am unsure exactly what direction my career in architecture will take me. It is certain, however, that I will continue to practice and research the issue of contemporary design as a tool for cultural preservation in hopes of furthering the preservation of traditional cultural practices and values. It is because of the unique collaborative research processes incorporated into the University of Hawai'i curriculum that I have not only become interested in this area of architecture, but also have been given the tools to impact the future of cultural preservation.

4. OTHER D. ARCH. PROJECTS

4.1. From academia to profession

Similar to Carol Sakata's development of the Practicum Studio as her doctoral project, several other courses have been developed as D. Arch. research projects. The projects envision programs for the UHM SoA such as a Master of Landscape Architecture Program and a Project Management Program.

A forthcoming D. Arch. Project titled "Learning Leadership in Architecture: Teamwork, Collaboration, and Project Management" is expected to further strengthen our curriculum. Annette Salvador states that her goal for the project is

> . . . to develop an Academic strategy for two pre-professional student leadership courses in the Architecture Doctorate program. This paper will be a combined empirical, analytical, and case study investigative approach in strategizing how student leadership development in an architectural curriculum enriches the individual's personal and professional development.

Collaborative interactions are also reinforced via Todd Riches' committee members who were Carol Sakata, FAIA, and Ronald Skaggs, FAIA, both influential in the development of the Practicum Studio and accreditation for our doctoral degree. In his D. Arch. project "Starting an architecture firm: From academia to profession", Riches states: "Starting an architectural firm straight out from college seems a bit challenging, almost impossible" (Riches 2008: vii). Yet, doing precisely that is the goal of his doctorate project:

> This work is presented in the hope that by realizing what is required to establish a design firm, the graduate will be able to dispel the misconceptions of incompetency (in the area of business operations), acquire confidence in starting a firm, and either start a firm or become a greater hired asset from the day of graduation. (Riches 2008:vii)

To reach the realization, Riches begins with a tentative business plan, analyses the concerns and possibilities of starting a design firm, goes on presenting the history of leadership and various business structures, and compares case studies within three firm models (S, M, L). Next, he discusses the culture of start-up firms, consultant support structures (lenders, attorneys, accountants, etc.), functions of successful organizations, and ends in business planning with The Five Laws of Business Success: The Law of Frequency, The Law of Vision, The Law of Perception, The Law of Accountability, and the Law of Leadership (Riches 2008:117-118) and their applications.

Besides being an invaluable source of information for those recently graduated and, indeed, having the courage, competence and confidence to start one's own firm, working on this doctorate project certainly made Todd Riches courageous, competent and confident to do so; one of the many advantages the doctorate projects can bring along.

The lack of confidence in one's capabilities of stepping into the leading roles of the profession, most probably is the reason why very few doctorate candidates have had the courage to take the bull by the horns, both in terms of starting a firm soon after the graduation or addressing the issues of professional practice in a doctorate project. Homer Williams definitely did not have that problem when he enrolled in the UHM SoA doctorate program, after decades of experience in the professional practice as an architect and a CEO of large architectural firms (among many other responsibilities in the field of architecture) – a step perhaps better depicted as "from profession to academia".

Williams starts his D. Arch. project by stating that the "work has been in the making since I first worked on a bank project in the early 1960s and could find no reference guide or source available that described bank design" (Williams 2008: i) and, as there still wasn't one more than 40 years later, he decided to write "The design and planning of financial institutions". Without going into the very informative contents of the project, such as development of bank design and projections of its future, this study is not only a guide on the design of financial institutions, now finally available, but also an interesting record on the architect-client relationship. It also is an elucidating example of the valuable role of a doctorate program in attracting experienced practitioners to share their knowledge of the profession with a wider audience.

Another example of a well seasoned builder, architect, and educator is Phillip Gallegos who returned to the academia as a doctorate candidate to work on his D. Arch. project "Architects as master builders: One view of the profession and education", conducted at the UHM SoA in 2005-2006 when he also assisted the School as an instructor. His study is primarily concerned about the divorce between architectural schools and the current design-build services, and Gallegos calls for the architectural educators and practitioners to bridge the gap between education and work. The study is comprised of an overview of the celebrated "master builders", that is, architects *and* engineers from Vitruvius and Brunelleschi to Calatrava, followed by samples of the author's career as a designer-builder and as an educator of design-build studios, as well as a review of other current design-build programs in architecture schools. In conclusion, though based on highly critical analysis on most current practices in architecture schools, Gallegos is optimistic:

> It appears that the future will be one in which the architect, in the professional world and in the educational world, will create in an environment of collaboration. This is the one profound and significant finding of this exploration. The lessons of design and construction are the lessons of additional skills required in the delivery of high value design. It is a lesson of added value to the core activity of design in architecture. (Gallegos 2006:Chapter 8, 2)

A similar view of the profession of architecture, though from a different perspective, is presented in Melanie

Wong's D. Arch. project "Understanding collaboration: A journey through the public process of architecture". As her initial interest was community involvement in the planning and building process, that was addressed in both of her Practicum experiences preceding the doctorate project research. For the first semester, Wong chose a challenging Architecture for Humanity project in India as an alternative for any of the School's Practicum firms. Under the supervision of Purnima McCutcheon, AIA, LEED AP, she gained invaluable hands-on experience in working with a NPO and the local people building their community center. For her second Practicum semester, she, in her own words, "wanted something more traditional" (personal discussion, 03/05/09) and selected EHDD Architecture in San Francisco from the SoA Practicum firms primarily because of their involvement in community design. Together with her Practicum mentor, Charles Davis, FAIA, she did not only participate in the firm's decision making and design processes, but also in her Community service assignment Wong volunteered in helping yet another NPO, Rebuilding Together San Francisco, in renovating the Hunter Point Youth Center including budgeting, labor coordination, and other organizational tasks with the projects director, Kat Sawyer, a local community activist.

According to Wong, her Practicum experiences were very important part of exploring the rough idea for her final project and determining its scope. In her D. Arch. project, the point of departure is participatory design, existing method mainly in urban planning, while Wong's argument is that the same method is applicable to the built environment at a smaller scale as well. Her initial research question was:

> If the built environment is part of people's everyday life and the process of creating architecture is about discourse, can the people affected by the built environment be part of the discourse in creating architecture? (Wong 2008:i)

In order to find out the answer, she joined forces with a representative of a local Hawaiian charter school: "The collaboration was to be a journey of two actions, to discover possibilities for the school's permanent campus and an exploration of public participation in architecture" (Wong 2008:1). As this was a site-specific design project at the location of the school's temporary facilities in Honolulu's Makiki Valley, the research included site analyses, precedent studies, programming, and other conventional design methods, but important also was mapping the "cultural site" which overlapped with the actual participatory design process. This included frequent meetings with the school's representatives and the neighbors as the stakeholders of the school; among the latter the native Hawaiian community of Maunalaha, holding the respect as the original settlers of the land. The doctorate candidate functioned as the facilitator of the meetings, gaining real-life experience as part of her D. Arch. project, while the charter school gained a preliminary, conceptual master plan and capital campaign images.

Further, a significant part of the learning process for the candidate was the comprehension of the cultural values: "As [Maunalaha is] the only native Hawaiian community in the valley, following proper protocol and etiquette was vital to establish a connection" (Wong 2008:143). Although the author records many problems that occurred during the process, the challenges were, no doubt, educational and the methods of data collection, such as workshops, community exercises, and surveys (all documented in the appendixes of the thesis), offer valuable information for analogous projects in Hawai'i. Besides serving as an example of a participatory architectural practice and related design methodology, this doctorate project also exemplifies fieldwork as an elemental part of the design process.

4.2. Fieldwork and historic preservation

As fieldwork, originally associated with anthropological research, has normally been a useful means in cultural studies, it quite naturally also is the primary method in cross-cultural or culture-specific architectural research. Moreover, field studies have often been successfully incorporated in interpretive-historical research on numerous architectural phenomena; either as background studies for contemporary issues or as bases for historic preservation projects.

One of the very early doctorate projects completed at the UHM SoA that addresses all the above aspects is Neil Chapagain's study on adobe structures, applied to a historic preservation project of the remote walled settlement of Lomathang in the Upper Mustang region near the present Nepal-Tibet border. This project, titled "Earthen architecture of the Trans-Himalayan region of Nepal: Preservation and appropriate practice", was based on the author's extensive fieldwork in the area and collaboration with local preservation authorities already before he enrolled in the UHM SoA doctorate program. At first, his D. Arch. project includes an all-embracing overview of earth as one of the first building materials used by human beings, with detailed descriptions of its history, building types, energy efficiency, construction systems, and material analyses, exemplified by various examples in Africa, Asia, Central and South America, and Europe.

Second, Chapagain goes on analyzing the geographical, climatic, cultural, and socio-economic context as well as architectural typology of the Trans-Himalayan region, from where he proceeds to problematic issues, such as incorrect maintenance and repair efforts, seismic risks, and negative impacts of tourism in terms of social consequences and heritage preservation. This leads to specific recommendations for solutions to the above problems, demonstrated in a design project of the historic preservation of Lomathang. In it, the author not only addresses the preservation of both the tangible structures and traditional practices but also their appropriate incorporation into the contemporary context, including some new techniques, continuation of community participation in keeping the tradition alive, and re-establishment of the status of earthen buildings as part of the local identity as opposing to the perception of "buildings for poor" (Chapagain 2005:228).

As for historic preservation, a rather polemic approach is presented in the D. Arch. project “Changing the perspective of facadism within San Francisco” by Deidre Stevens who argues that facadism can be a valid type of historic preservation, although it is a highly controversial concept – according to Stevens “facadism, in fact, has been compared with ‘Satanism’ by preservationists” (Stevens 2008: viii). This project, too, includes interpretive-historical research on the topic’s background with several case studies across the world, added with extensive fieldwork; in this occasion in San Francisco with analyses of five preservation projects that can be regarded as facadism, followed by the author’s proposed standards for facadism’s “Do”s and “Don’t”s. Particularly interesting in this project, from methodological point of view, is the process from hypothesis (that facadism can be valid), to analysis (that it depends), to conclusion:

> Based on my current understanding of facadism after completing this research, I have come to the conclusion that facadism should only be used in historic structures in specific instances. Facadism should only be used when it is determined to be the most appropriate approach for a project. It can be justified when a historic property has been damaged beyond repair (by fire, earthquake or another natural disaster) and when most or all character defining features have been lost. (Stevens 2008:241)

In this project as well, the Practicum program was an integral part of the research allowing lengthy fieldwork in San Francisco. One of the firm’s Practicum Mentors, Katherine Petrin, Architect Historian, also served as a member of the doctorate committee bringing along invaluable insights of the city and its preservation practices and policies which functioned as an elucidating basis for the analyses and propositions of the final project.

4.3. Culture as form-giver

Among the forthcoming D. Arch. projects at the UHM SoA, that of Damon Gray does not only include extensive fieldwork as part of the design process in a historic, culture-specific neighborhood, but also embraces a wide interdisciplinary approach. As a matter of fact, the doctorate candidate only recently enrolled in the Doctorate project studio I, although the study has been going on already more than a year; if the Research methods seminar is counted, it started in fall 2007. This is because the D. Arch. project proposal, submitted in the end of the Research methods seminar, clearly indicated that survey questionnaire is one of the central data collection techniques for this project, but also its weakest link. Moreover, the scope of the project is very wide and ambitious.

Nevertheless, the candidate was willing to do additional studies as needed in order to carry out the appropriate research for the inquiry on a new typology of a community center, combining sacred and secular functions, in the Centro Historico of Puebla, Mexico. Therefore, he took a class in the Study of religion and another on Sacred places, at the Department of Anthropology he studied fieldwork methods, and at the Department of Sociology survey research methods. In summer 2008, he spent two months in Puebla, conducting the fieldwork and the survey (available online at www.encuestapuebla.com), and the following fall semester he was enrolled in the Directed study course for the analyses of the fieldwork. Now, in the first Doctorate project studio, the theory development for this new building typology is underway so that also programming is done before the completion of the actual design in the Doctorate project studio II in fall 2009. This doctorate project is far from typical, but it just goes to show how interdisciplinary research can be beneficial (if time provided) in the pursuit of achieving fresh insights into architectural design and in expanding the research resources within the discipline of architecture.

All culture-specific design projects, of course, do not have to include as extensive research as the one described above. One case in point is Claire Rohlinger’s D. Arch. project “Residential design for the Samoan way of life” in which her objective was to design affordable housing appropriate for the lifestyle and cultural values of the large Samoan community in Hawaii, or for anyone who desires communal life. In addition to the high living costs and scarcity of affordable housing in Honolulu, the problem statement was based on the observation, affirmed by the research on Samoan culture among the Samoan immigrants in Hawai'i, that the extended family system and community hospitality are still strong values:

> However, in the existing public housing in Honolulu, this is almost impossible because the physical size of the units is too small. They are designed in size to house nuclear families, not extended families. Yet, the [Samoan] families still take in others as needed and often end up violating housing regulations. They do this because the extended family is the support system and they are obliged to help each other whether it is financial, healthcare or housing assistance. (Rohlinger 2008:28)

Another significant outcome of the research was that social control in traditional Samoan society, provided by the open housing configuration, is not possible in the private, closed housing units of urban Honolulu, leading to the lack of community scrutiny and frequent domestic violence in the public housing complexes with Samoan population (Rohlinger 2008:29-32). It did, on the other hand, take some time to reach the proper theoretical background for the architectural solutions to these problems. As often happens in research, one source led to another and finally Oscar Newman’s *Creating defensible space*, discussed already in the Research methods seminar but then overlooked by the candidate, opened the deadlock, although not all of these theories were applicable in this context.

Quite interestingly, the initial hypothesis that courtyard typology is the housing solution for Hawaii, turned out to be part of the solution, even if the research at first did not seem to support that at all. (The candidate already discarded the idea.) But when compared the openness of Samoan housing to the concept of defensible space, it became apparent that a combination of pavilion and courtyard typology was the answer to the problem and led to very successful design both aesthetically and culturally, with minimal private rooms, maximal public areas, and multifunctional transitional spaces in between. This also reduced both the floor area per unit and the total building costs.

Different theoretical approach to design, and an interesting application of the memory sketch method within qualitative research, is presented in Sun-Young Rieh's doctorate project "Creating sense of place in school environments: The lived experience of elementary school children in Hawaii", though the end product is not a design project *per se*. Instead, the goal was to locate characteristics that enhance the sense of place in school environments, the Place Generators as the author calls them, and "provide critical design guidelines for successful school environment that promises positive child development in terms of sense of place" (Rieh 2007:v). The beginning of the study, thus, focuses on the definition of the concept sense of place that has attracted considerable attention ever since the "descriptive nature of the phenomenological approach opened a new paradigm in returning to foundations of meaning, things, and experience in the fields of human and built environments" (Rieh 2007:1), while the Place Generators were identified as follows:

> Since there are no consensus rules for when a space becomes a place, and qualification of place requires something beyond physical elements, these spatial configurations that seem to catalyze sense of place have never been put together seriously as a group. However, there are elements mentioned in various contexts, regardless of scale, by many scholars such as Heidegger (boundary), Norberg-Schultz (center, boundary, and path), Moore (path, pattern, edge), Lynch (landmark, district, node, path, edge), Relph (inside-outside), and Meiss (limit and threshold, path and orientation). These spatial configurations can be categorized as "boundary", "center", "path", "threshold", and "edge". (Rieh 2007:12)

These five Place Generators are further defined and analyzed primarily from the perspective of Claire Cooper Marcus's long term research related to memory sketches and Rieh's own experiments with her students' memory sketches. In the end of the study, Rieh tests her hypothesis of the Place Generators with the same method among children in three elementary schools in Honolulu, concluding:

> These spatial articulations [the Place Generators] must be combined carefully with other characteristics found to affect children's sense of place in this research, such as functional diversity, conceived aspects (including privacy), thermal comfort, articulated outdoor space and children's participation in the design and/or construction of the school setting. (Rieh 2007:148)

With regard to the different forms of D. Arch. projects, various types of design guidelines are a common outcome of those belonging between the purely research-oriented and design-oriented projects. On the other hand, as hermeneutic research requires rather advanced studies in philosophy, D. Arch. projects like the one by Rieh above are exceptional, though interdisciplinary studies hopefully will increase those as well. In this case, the author is a long-term architectural practitioner, theorist, and educator, who spent her sabbatical at the UHM SoA both as a doctorate candidate and an instructor. This, again, serves as an example of the doctorate program's potential in attracting seasoned architects to share their experience, knowledge, and inspiration with the faculty and the students.

5. ASSESSMENT

5.1. Pre-professional courses

All courses are evaluated each semester by students per University and School policies. Practicing architects who participate as adjunct faculty are requested to submit their assessment of the student performance as well as a self-evaluation in addition to the impact on their firm resources. In general participant architects tend to submit positive statements in writing and prefer to divulge negative criticism through verbal "suggestions for improvement".

5.2. The practicum studios

Since their inception in 1994 Practicum Studios have been assessed using several methods including:

- Discussions at each firm involving the Practicum Director, Practicum Faculty, Student, Unit Mentors and other firm staff participants in the teaching/research efforts.
- Gatherings at the School for Practicum Faculty, full time faculty, and students facilitated by a professional architect
- Interviews conducted by independent consultants and the Practicum Director
- April 2004 Practicum/Arch D Program Evaluation and Recommendation conducted by Adjunct Professor Richard Green, FAIA.

Major Practicum research related concerns cited:

- Expand the research portion of the program
- Improve communications between the School, the firms and the off-campus students by providing more resources and staff support.
- Develop more tangible methods to "give back" to the Practicum Firms (Practicum Faculty/Firms are not compensated) to assure continued participation.

The most recent facilitated evaluations occurred in the academic year 2007-2008. The evaluations were generally positive. However, based on the direction of the new curriculum the decision was made to reduce the required Practicum Studio to one semester rather than two and provide students two other choices in lieu of the Practicum. To many, this means a great loss of research experience in a practice setting.

5.4. Opportunities

- Students are offered multiple career path choices through the concentration areas offered
- Travel opportunities have increased
- A Community Design Studio has been established
- Expanded relationships with international Schools and firms extend the outreach of the School from Asia Pacific to the greater Pacific Rim and beyond
- Off-campus courses are managed by the Outreach College resulting in the tuition for such courses being credited directly to the School

5.5. Needs

- Due to budget cuts, some concentration courses are not currently offered.
- Courses that include travel require a minimum number of students and in some cases, such courses may not be offered
- Tuition costs for Outreach College courses are in general higher than normal tuition.
- Proper staffing is necessary to maintain the level of coordination initially expended to launch the practice strand to properly communicate with firms

6. CONCLUSION, FUTURE ASPIRATIONS

The revised curriculum promises exciting possibilities. However, one change in the new curriculum which should be reconsidered is the reduction of the Practicum Studio to one semester. According to Don Goo, FAIA, past Practicum Director, as stated in a 2006 Practicum Brochure

> In addition to individualized learning in two different office settings, Practicum students complete a research project and participate in a community or professional organization activity. The chance to choose among locations around the United States and the Asia/Pacific region provides graduates with a global perspective that is essential in today's practice.

This viewpoint is supported by other Practicum Faculty. In a 2008 discussion, Kurt Mitchell, AIA, a Practicum Faculty stated

> "Research knowledge is powerful, showing you know what to do on projects but also demonstrates a leadership style. Today's clients fund research on projects because they understand this will yield a better solution overall. The Practicum Studio allows students and firms to collaborate on research which might not otherwise be possible. "

The unique relationships developed between the School and nationally and internationally respected architects and their firms are valuable and fragile. The collaborative research work accomplished as a result of these relationships must be sustained. Current developments in technology and concern for the environment along with the awareness of global interdependency of nations make this an ideal time to advance the architecture profession. It is our belief that collaborative research is one way to bring the profession and the academy together to accomplish great advancements for the built environment. We offer these thoughts for discussion and look forward to creative solutions for the dilemmas of collaboration.

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Interdisciplinarity as a sustainable pedagogical tool

R. Todd Gabbard

Kansas State University, Manhattan, Kansas

ABSTRACT: It is well established that most sustainable goals require the cooperative effort of a variety of disciplines, both in regard to expertise and outlook. This tendency holds true regardless of scale of the problem. True sustainability is a delicate balance between competing paradigms of success. Solutions must take into account not only a large number of factors but must be able to predict, analyze, and control the interactions between these factors. Few specializations have the breadth of knowledge to adequately address all aspects of any sustainable issue.

Interdisciplinarity, much discussed among academic circles of late, is the condition of cooperation between strict disciplines to derive solutions to problems too complex to be adequately addressed by any one group or type of inquiry. Virtually every professional discipline requires some degree of skill in communicating and cooperating with other groups, yet this aspect of professional life is rarely specifically addressed in academia. Sustainable objectives almost always require a higher order of collaboration skills than normative practice. Descriptive words like “integrated” or “holistic,” often associated with sustainability, indicate the depth of inquiry required to fully address this goal.

This paper will explore two recent case studies of educational initiatives at KSU that were based on interdisciplinary collaboration. Issues discussed will include the problems addressed, the strategies created to foster collaboration, and the results of the efforts. Recommendations for incorporating interdisciplinarity in curricula will also be discussed.

If we are to adequately inculcate sustainability, we must not only focus on challenges, strategies, tools, and desired outcomes, but also invest in curricular paradigms that foster relationships across traditional academic disciplines. Exposing students to collaborative ventures as part of their basic curricular requirements will help better prepare them to address the complex problem sets prevalent in the pursuit of a sustainable world.

Conference theme: innovative approaches to architectural education
Keywords: interdisciplinarity, sustainability, pedagogy, design build

INTRODUCTION

In many ways, sustainability transcends traditional disciplinary boundaries, instead requiring the cooperation of several different constituencies. In an article discussing sustainability at a large scale, Neil Adger (et al) attempts to describe the scope of sustainable decision making. In essence, they argue that sustainable decision-making is “akin to policy-making,” that the resolutions derived from this process have impacts on many disparate constituencies (2003:1095). It might be argued that the same result set is true of large-scale decisions not based on sustainable metrics for success as well, and that sustainable decision-making only reveals the true extent of influence of seemingly innocuous or local resolutions.

Adger and his collaborators do not attempt to prescribe the conditions of decision-making in a holistic, integrative manner, but instead analyze the process of decision in an attempt to parse out metrics that can describe the relative success of various sustainable initiatives (Adger 2003). The technique this group has adopted to analyze the sustainable decision-making process is “thick description,” a term they borrowed from anthropologist Clifford Geertz (Adger 2003)

Thick description can be defined as meta-analysis that attempts to understand and evaluate complex constructs. For Adger and his fellow anthropologists, the constructs studied are social in nature – environmental decision-making at the level of policy, to be precise. This analysis attempts to identify many if not all of the factors and constituencies involved in a particular decision-making process. In order to fully account for these various factors, “a complete, or at least fuller or thicker, analysis of environmental decisionmaking would seem to necessitate interdisciplinary research” (Adger 2003:1096). Architectural theorist and researcher David Wang, in an effort to frame the range and scope of architectural theory, included thick description as a bracketed set of theoretical approaches to architecture (2006). These approaches straddle the line between purely scientific, “predictive” theories, in which a set of rules is established by which outcomes can be anticipated to a degree of accuracy, and "empathic" theories, which speak more to the intuitive, subjective nature of the discipline. Empathic or non-empirical theory concerns itself with framing data in a wide variety of ways, including manifestos, subjective observation, even storytelling (Wang 2006).

Interdisciplinarity, sustainability, and experiential learning models can each be described as "thick" approaches to problems. This shared quality is the basis for the link between them, and provides an avenue to move from one state to the other. In essence, the notion behind this paper is that through an interdisciplinary, experiential model, students can learn how to incorporate sustainable decision making into their approach to design.

Geertz advocated thick description as a way to counteract the proclivity of specific schools of thought in his discipline from unintentionally predisposing themselves to particular conclusions when studying various phenomena. He termed this tendency "universalization," a sort of homogenization of results and conclusions.

Adger et al extrapolate this idea. They state that universalization is not only an academic but an all too practical danger to which any decision-making body might be vulnerable (2003). Architectural designers, for example, might have a tendency to see every problem as a design problem, while building engineers might focus on technological issues. The tendency towards universalization of results is, Adger argues, a structural issue – an artifact of strict disciplinarianism.

> Single-discipline approaches to understanding environmental decisions have typically aimed to produce universally relevant observations and understandings. We argue that the emphasis on the universal can be counterproductive.... Approaches that emphasise the universal overlook the specificity and contextuality of environmental decisions (Adger 2003:1099-1110).

A far more desirable outcome is generalization, again defined by Geertz and adopted by Adger. Generalization is a middle ground, in which decisions are tempered by the acknowledgement of context and other localizing conditions (Adger 2003). Again, Adger and his colleagues were trying to identify a method to analyze environmental decisions made by others. This paper posits that the conditions desirable for the analysis of decisions can and should also be applied to the decision-making process itself.

In their final analysis, Adger and his colleagues identified four metrics with which to judge sustainable decisions: efficiency, effectiveness, equity, and legitimacy. *Efficiency* deals with the maximization of the strategy and the resources allocated to achieve it. *Effectiveness* indicates the relative success of a strategy to achieve its stated goal. *Equity* describes the notion of "distributive justice" – essentially, a study of the relative impact of decisions on affected constituencies. These impacts may be costly one or more constituent groups or beneficial, or both. Equity attempts to identify whether the environmental decisions made are balanced properly, or if they favour or disfavour certain parties. Finally, *legitimacy* measures the acceptability of decisions to the parties making the decisions as well as constituencies affected by the decisions, or simply those observing the decisions and their effects (Adger 2003).

These metrics possess several compelling attributes. First, each measure requires a breadth of analysis that seems to necessitate the review and input of several disciplines. Taking effectiveness, for example, from Adger:

> An economic interpretation of effectiveness relates to the cost of achieving a given goal, or to the outcome achievable for a given cost.... [E]nvironmental decisions (however) can be analysed for their effectiveness independent of economic welfare concerns (Adger 2003:1098).

Another attribute of Adger (et al)'s set of metrics is the potential for replicability and valuation. This approach incorporates the intrinsic properties of generalization into the analysis, and in doing so provides a framework that can be used to compare different instances of environmental decision-making.

It has often been said that architectural pedagogy, and the discipline of architecture itself, is on the whole not incredibly self-reflective. This state of affairs becomes of increasing concern when considering the requirements and potential impacts of sustainability, which often supersede the goals of a particular client or architect. Sustainable architecture attempts to balance client considerations, aesthetics, environmental impact, and social and cultural concerns. The metrics outlined above can be helpful in identifying the overall success of different scales of architectural endeavors, from specific projects, to the decision-making processes of specific firms, to the relative effectiveness (for example) of large scale organizations.

This paper will utilize this set of metrics to (in part) evaluate two projects that use interdisciplinary, experiential exercises as a means to inculcate the principles of sustainability in the participating students. Ideally, this analysis will reveal attributes that have some objective, repeatable value. The focus of the paper is the educational processes themselves. The results of the exercises – in one instance, schematic designs, in the other, a built work – will be exhibited as a means to evaluate the exercises. One artifact of the lack of introspection referenced above in the architectural realm is a tendency to "categorize" the final iteration of design projects (as described by Adger), as if their relative value was presupposed and self-evident. This paper will attempt to eschew this normative analytical technique in regard to architecturally pedagogical projects, and instead move towards the "golden mean" of generalization.

1. DEFINING TERMS: INTERDISCIPLINARITY & EXPERIENTIAL LEARNING

1.1. Interdisciplinarity

Interdisciplinarity is the communication or collaboration of two or more distinct disciplines. This cooperative approach is normatively established (or prescribed) to jointly pursue a common goal or objective. Interdisciplinarity has relatively recently been established as a viable model of practice, and as such there has been some encouragement for educators to institute opportunities for student designers to obtain experience working in tandem with their peers while still in the academy. The 2004 student performance criteria established by NAAB mentions both interdisciplinarity and the ability to work as a team as required educational objectives.

1.2. Experiential learning

Though in its broadest sense normative architectural studio education would be styled 'experiential' by educational circles, here experiential learning is offered as an alternative to traditional design studio offerings. While design studios do have some compelling educational attributes, requiring a great deal of investment on the part of students and teachers alike, Jay Garrott identifies the limitations of the conventional studio approach, which has been 'scarcely altered since its origins in the Ecole de Beaux Arts" (1983:116). This 'master-apprentice' model is an autocratic one, Garrott argues, substituting a very narrow set of values for empirical knowledge (Garrott 1983). Criticism of traditional studio settings continue to this day.

Garrott offers a different studio-based model: experiential learning. In essence, experiential learning requires students to be active participants in the learning process. This may mean that students may have to respond to non-academic objectives, such as a construction or real-world design project, or that they would be involved in crafting the assignments or evaluation aspects of the course.

> This experiential inquiry method stresses the facilitation of an action-oriented educational environment which promotes the skills of questioning and systematic problem-solving...unless an inquiry is perceived as relevant by the learner, no significant learning will take place (Garrott 1983:118).

Interestingly, the experiential learning model frames a new role for the educator – that of facilitator (Garrott 1983). This role may include directing students' efforts, providing a logistical framework, or validating student responses, but usually doesn't include roles such as disseminator or "master," as Garrott describes. To use an aphorism, students learn what they do.

1.3. Calibrating the metrics

As mentioned above, this author has co-opted the set of metrics Adger and his colleagues identified to establish a framework of analysis for the projects listed below. It should be readily evident that academically-based projects, however rooted in reality, have a somewhat different role than public realm projects. Academic projects, especially those that are curricular in nature, tend to be somewhat removed from, rather than completely embrace, the client constituencies they target. Perhaps the most compelling reason for this detachment is the dual nature of curriculum-based experiential projects – namely, that there are certain pedagogical objectives that must be addressed. These objectives seldom completely align with the requirements of a client group. This common state of affairs indicates that the metrics used to gauge fully realized projects fully engaged by a wide variety of stakeholders cannot be applied as is to the somewhat abstracted nature of academic projects.

Thus, the four metrics identified above have been somewhat modified to better fit the "local" conditions of academic projects, for the purposes of this paper. *Effectiveness,* in this case is concerned with the success of the pedagogical model, not with the end result of the exercise. *Equity* will examine the perceived and objective measures of satisfaction amongst the various groups participating in the project. What is the worth of the project to the students involved, contrasted against the amount of effort they invested? *Legitimacy* takes a critical view of the project. This measure incorporates reflection on the project from a position of some distance by a variety of groups.

2. CASE EXAMPLE: GREENSBURG ENVISIONED

2.1. The design problem

This project was prompted by the almost complete obliteration of the town of Greenburg, Kansas, by an F5 tornado in May 2007. Over 90% of the town's building stock was severely damaged or destroyed. Town leaders, local professionals, and FEMA collaborated on a "long term recovery plan" to chart the rebuilding of the town. The residents decided to adopt a sustainable approach to the revisioning of Greensburg. This sustainable approach was evident in a wide range of projects, from the scale of planning to individual buildings and landscape features.

The recovery plan identified a wide range of initiatives that the town would need to invest in to re-establish itself. The nature of most of the proposed projects made the collaboration of a variety of disciplines an extremely viable option. Two professors at Kansas State University, one in architecture, the other in landscape architecture, decided to collaborate to produce meaningful, comprehensive responses to the town's list of priorities.

2.2. The approach

It was agreed that the students' efforts would not be considered to be actual design proposals, but instead be a "pre-design" exercise. The projects would help the citizens and designers of the new Greensburg to identify possibilities, to see what form their town might take. The collaborative studio was seen as an ideal place for this to occur.

The professors were each responsible for separate design studio classes. It was decided that the two classes would work together in small teams to identify projects to develop. The professors would retain

Figure 1: Greensburg, Kansas: the aftermath of the tornado. Very little of the town was unscathed. Source: (FEMA 2007).

grading autonomy, but would otherwise integrate the two sections.
Students were encouraged to form groups of any size or type to tackle the project. The students arranged themselves in groups of one to four. Roughly half the groups were interdisciplinary; the rest were intradisciplinary. This self-selection provided a means to judge the results of the two group types, discussed further below.
Logistically, the studio maintained contact with building officials in Greensburg, but remained autonomous in regard to direction. The only document the students responded to was the long-term recovery plan itself. This allowed the students to focus their work on ideas, rather than respond primarily to any overly-exacting requirements of the client constituency. The notion was that the studio was in a 'brainstorming' rather than responsive mode of design.
The studio received some funding to cover travel and document production. It was understood that the final iteration of the project would be a gallery display of the work.

2.3. Student responses

As mentioned above, the students formed groups to engage the project. These groups chose a particular project from the long-term recovery plan to study. The only stipulation in regard to choice was to look for projects that were on the high priority list, as these would be most likely to be funded and prosecuted first.
An example of the work of an interdisciplinary team would be the group that chose to provide design direction for the new public school and recreation complex. Sixteen blocks in the southeast sector of Greensburg were allocated for a new elementary, middle, and high school, as well as a number of community-oriented amenities (FEMA 2007). The scope of the project included overall planning, large

Figure 2: Site plan of educational/community campus, with an elementary school at lower right and secondary school at upper left. The yellow areas would be reclaimed prairie areas that would serve as natural laboratories. A greenway with a natural stormwater swale cuts a diagonal between them (below). Source: (Gabbard 2007).

and small landscape development, and the schematic design of a number of building projects. From the recovery plan:

> The new school campus in conjunction with a new community park will strengthen the school's importance as a community-gathering place and allow convenient opportunities for shared uses and events (FEMA 2007:77).

The proposed scheme addressed all the various scales. A cohesive overall campus plan was created (Figure 1 above). The scheme was able to balance programmed buildings, recreational and natural areas. Moreover, the approach of the project was to link the educational and recreational programs to the restored natural areas, which would function in part as teaching labs for the schools. In order to maximize efficiency and use, the recreational features were shared by the schools and the public.
It appeared to the professors that this group integrated

well. The differing foci of the architecture and landscape architecture students allowed the group to tackle a wide range of issues; as a group they were able to balance their proposals and create a holistic design for the site. The students' individual strengths and emphases meshed rather than clashed, allowing the students to create a much more fully realized scheme than if they had undertaken the project separately or as independent disciplines.

2.4. Outcomes

Effectiveness. In evaluating the work of the various group types, it became evident that the interdisciplinary teams were far more successful in resolving their schemes. By contrast, teams of one discipline or individuals did not, on the whole, arrive at a similarly satisfactory resolution. Another project that was undertaken was a sustainable housing resource office (SHRO) within a newly established city park. The SHRO was conceived by the long-term recovery plan as "a 'one-stop shop' for sustainable information and resources (to support) the community goal to achieve the highest standards in energy efficiency and sustainability" (FEMA 2007:16) The site chosen for the office was a new city park, an amenity around which the new commercial and civic center of the town would be organized.

Two teams undertook this project. Each had two members; one consisted of architecture students exclusively, the other had one landscape and one architecture student. Figure 2 indicates the latter, interdisciplinary team, while figure 3 is representative of the former team's work. It was evident that the interdisciplinary team's work was not only more polished but exhibited a greater depth and resolution. Considering that all other variables were, more or less, the same, this seems to indicate that interdisciplinary collaboration does hold some value.

Efficiency. The basic issue here is this: does the extra layer of complication caused by the introduction of interdisciplinary collaboration as a mode of learning and working enhance or detract from the experience? At issue is the learning curve associated with not only working as a team, but finding ways to communicate with those outside one's discipline. Students had five weeks to work on this project – very little time to devise solutions to very complicated problems. The quick nature of the project may have deterred some from attempting to form interdisciplinary teams. It appeared, though, that those interdisciplinary teams that were able to navigate through the team building process were able to undertake more complex strategies, capitalizing on the strengths and perspectives of their constituents. This became evident to all involved.

Equity. Though there was a significant amount of effort on the part of the professors to manage the logistical aspects of the project, the students were given a relatively free rein in regard to project, group configuration, approach, and focus of their work. This dovetails with one of the precepts of Garrott's approach to experiential learning: "to assist students in their

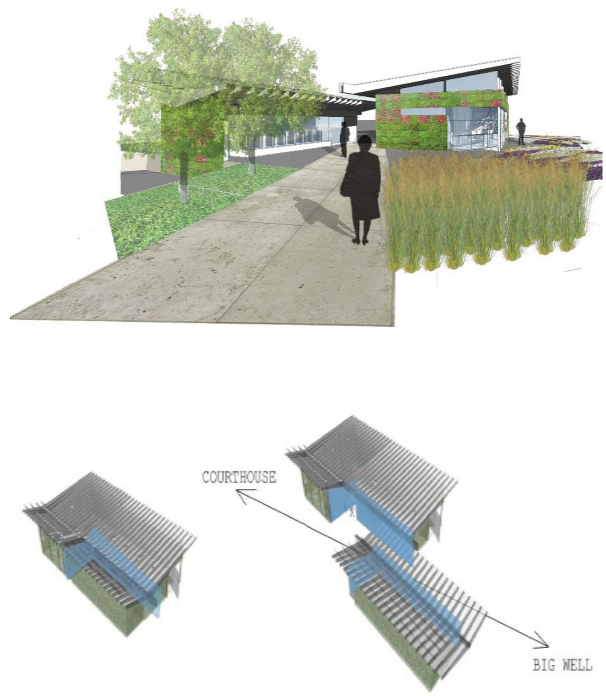

Figure 3. Proposal for SHRO by interdisciplinary team. At top, view of office from park with living walls evident. At bottom, diagram of building concept, split to allow linkage of important contextual features across site and to reveal normally hidden systems to the public. Source: (Gabbard 2007).

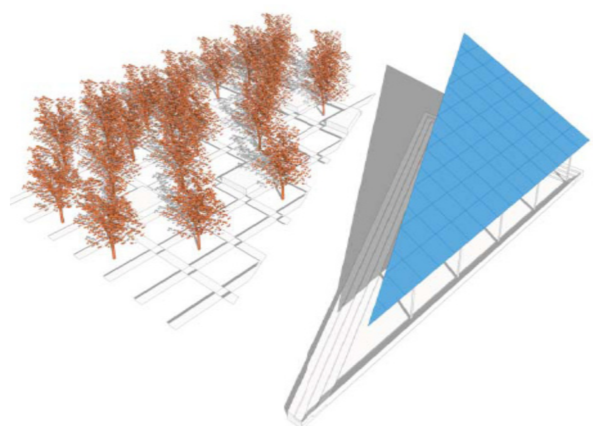

Figure 4. Proposal for SHRO by monodisciplinary team. Far less developed. Source: (Gabbard 2007).

understanding of personal values (and) ascertaining their particular strengths and interests" (Garrott 1983:118). In essence, students helped to formulate the format of the problem-solving as well as their own particular solutions. In essence, part of the students' charge was to step outside the familiarity of faculty-programmed projects, and to develop the frame for their own work. This state of affairs heightened both the responsibility and the ownership of the project for the students involved. The faculty embraced the role of “facilitators,” forcing the students into an active learning mode. Anecdotally, the level of satisfaction on the part of the students seemed to be directly linked to the level of self-direction the students were willing to invest. As Garrott quotes Postman, “No one will learn anything they don’t want to learn” (1983:120). This self-directed project underscored students’ willingness to participate in their own exploration and growth.

Legitimacy. This analysis is based on two factors: the legitimacy of the project to its constituents, discussed above, and the legitimacy of the process. Experiential projects in educational settings are obligated to both the curricular and the public realm. In regard to the former, the project was initially set up to help the residents of Greensburg envision how sustainability could be integrated into the planning of their town at different levels. At the beginning of the project, very little work had been done towards visualizing many, if any, of these projects. Many of the projects had not been realized beyond being identified as concerns. As such, there were not specific clients to whom the students could respond. In a few cases, design teams were contracted during the period the students were working on the project. Either condition served to marginalize the projects in regard to input to actual design processes – a trade-off for the freedom that characterized the process of the studio.

As a way to pedagogically introduce students to interdisciplinary work, the project did seem to hold value. The limited involvement with client groups helped to limit the scope of variables the students had to respond to. This softened this project, for many the first collaborative design project they had engaged in. In this case, then, the legitimacy of the project as an academic exercise is heightened as the legitimacy to the “client” is curtailed.

In regard to the inculcation of sustainability, this project did seem to expose students to the notion that many sustainable issues are enhanced by cooperative design. The “living wall” that was proposed by the SHRO interdisciplinary team, for example, was a landscape-based approach to the building envelope – a hybrid strategy. Including such a strategy became a negotiation between the disciplinary students – a cooperative venture. If nothing else, the exercise became a way for students to exercise this necessary aspect of sustainable design. “The insights provided by this experiential approach do not yield any clear and conclusive answer to the student. They make (the process) more complicated” (Phenix 1973:42). Collaboration simultaneously broadens the design problem, provides a wider range of solutions, and, ideally provides deeper solutions. None of these attributes simplify the learning process, but instead makes the process of learning begin to align with the process of doing.

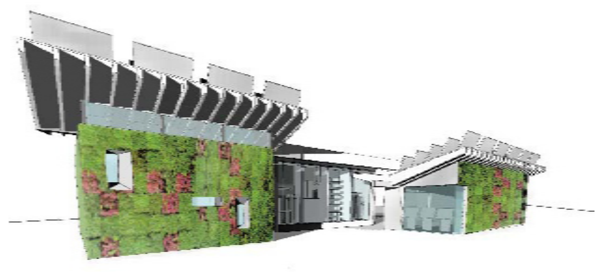

Figure 5. Close-up of living wall. Source: (Gabbard 2007).

3. CASE EXAMPLE: PROJECT SOLAR HOUSE

3.1. The design problem.

In November 2005, faculty from the College of Engineering and that of Architecture, Planning and Design proposed to compete in the 2007 Solar Decathlon. The Decathlon challenges university-based teams to design, build, and operate a small home powered exclusively by the sun. KSU was one of twenty teams selected to participate.

3.2. The interdisciplinary approach

This two year project required a great deal of organization. The basic strategy towards the project resolved itself into a network of constituent groups from a range of academic disciplines, chiefly design and engineering, but also including business and journalism. A project schedule was worked out so that particular academic units would be ‘activated’ when appropriate. This approach was taken for pragmatic reasons, so as to capitalize on the existing curricula of the various units. The overall requirements of the project were divided into chunks suitable for the various disciplines. For instance, the solar system was designed by electrical engineering students. Though work on the project as a whole began in Spring 2006, the solar system design wasn’t undertaken in earnest until Fall 2006, when the students involved took a solar system engineering class. It was at this time that the details of integration with the overall house design were resolved. The mechanical system design was undertaken by a group of mechanical engineering students as their task in a class called “interdisciplinary design projects.” This required class challenges student teams to take on real-world projects. Both of these courses, incidentally, were set up quite similarly to architectural design studios.

At the core of the project was a continuing series of architectural design studios. Students in these courses were charged with not only the overall design of the building but the integration of the various systems and other concerns being addressed by other academic units. Similar to the Greensburg project above, the design was ever more cooperative, as various system designs were undertaken. Each architectural student took on the added responsibility of acting as a liaison to an external academic unit, updating both groups as to the latest design details and concerns. This activity was imperative to the success of the project.

3.3. Student response

The final design highlighted the integration of active solar, passive solar, building envelope, and spatial systems. The solar array, for example, took on additional roles beyond its mandate to produce energy. It was used as a facade system. The requirements of the array (i.e. that it be tilted to maximize electrical production) deformed the shape and ultimately the interior of the house, affecting the composition and the experience of the house. The solar array also acted in conjunction with the shell design to provide a thermal barrier for the home, which helped to keep the home quite cool by absorbing the radiant energy from the sun. Only two openings were cut in the south facade, one to give access to a sun porch (figure 5) and one to provide reflected light to the bedroom.

Figure 5. South and west elevations, Project Solar House. Note the form has been canted to maximize solar production. Source: (Gabbard 2007).

In virtually every aspect of the design, the display of systems became a priority. The building shell, for instance, was composed of relatively thin, pure planes. The only interior partitions were around the bath and bedroom. The itinerary through the house was designed to expose visitors to all of the spaces of the house and many of the building's systems, including a building automation system.

3.4. Outcomes

Effectiveness. One measure of effiectiveness for this project would be whether or not the design was fully realized. The designs proposed, at the overall scale, as well as at the system, component, and detail level, were, in the end, successful. The various designed components and systems, by and large, met their stated objectives. One example would be the building shell. It was designed to drastically reduce the heat load on the house in the summer, often the period of time with the highest electrical demand. The design preferenced passive cooling techniques, especially by reducing radiant loads. When modelled, it was noted that the summertime energy requirements were far less than at other times of the year, essentially an inversion of normally constructed energy use curves. Another consideration would be whether or not the approach prescribed achieved its goals – to inculcate sustainable skills through the practice of interdisciplinary collaboration skills.

Efficiency. While effective, the design process was relatively inefficient. Most if not all students involved were uninitiated in many of the technological intricacies of the elaborate systems that comprised the house. Each student had a relatively steep learning curve to become competent in the components, systems, and processes they were charged with designing. It could be argued, however, that though this learning process made the project more inefficient, it heightened the efficiency of the learning objectives. Essentially, the students got more educational value from the project. One student's reaction:

> The experience also required me to gain the confidence to ask the important questions to the appropriate people, even if that meant contacting industry professionals. At my current job, I have to call at least one expert a day, and that is not always easy.

The exercise of designing these systems required students to adopt new forms of knowledge and modes of thinking and valuation outside pure design considerations, essentially "illuminat(ing) the diversity of values between themselves... and society" (Garrott 1983:39). In this project the inherent inefficiency of the process stood testament to the broadening attention being afforded to the demands of designed systems and elements.

Equity. Perhaps the least controlled aspect of the project involved this subject. The project was voluntary, in that students chose to participate by enrolling in classes that were charged with the solar house or some portion of it. As students were in classes, they could be held, to some degree, responsible for their actions. Without question, the project was a far more herculean effort than a more academically oriented class of similar type.

Certain inequities came to light as the project began to be constructed. The design of the house was a long process, involving periodically evolving sets of students. Each successive semester's participants took on the task of realizing the designs of the previous group, while their ability to influence the design lessened. Simply put, the earlier student designers were absolved of the responsibility of building what they had designed. In many cases, the designs were sufficiently detailed and integrated with the overall project as to be successfully translated into construction with a minimum of complication. Certain other systems, however, proved to be untenable when the realities of construction presented themselves.

Interestingly, the problems associated with systems and components that became issues during construction could be traced back to the zealousness with which student designers pursued the integration of their piece with associated systems. One example was the storage wall that ran alongside the short hallway connecting the living area to the bedroom. The overall design allowed that this casework would be used, partially, to house equipment associated with the solar system. As such, the student designer was charged with ensuring that the casework would be able to accommodate this equipment. Later on, it was discovered that the cabinets as designed would not fulfill this necessary function, requiring some extensive redesign during the construction phase.

Legitimacy. Again, legitimacy is concerned with two arenas: the ratification of the product and of the process. It is hard to frame a discussion of the house as an object due to its impermanence. The house was designed to be taken to the competition and then it was sold to an agency. It has yet to be reused.

Another aspect of product would be the competition itself. It was during this period that the building was most scrutinized by a large, varied group of examiners, including experts in engineering, interior and architectural design, energy, fire safety, and so on. While this project did not perform as highly as others, it was quite successful in some arenas. Its interior and architectural qualities were commended, as were the integrative strategies.

In regard to educational process, there were many learning experiences incorporated into the project. The interdisciplinary bent of the project was considered of great value by the students participating. One student stated the project “helped me consider the realities of the needs of other disciplines, not just assuming they would work.” Another mentioned “I would have to say (I experienced) a change of values when it comes to sustainability and collaboration. The importance of collaboration in any project cannot be emphasized enough.” These perceptions ratify the main thrust of the approach: that design imperatives need to be inclusive, holistic – the basic requirements of sustainable decision-making.

CONCLUSION

This paper has attempted to discern whether interdisciplinary projects can help inculcate sustainable design principles. While interdisciplinarity does not necessarily connote sustainability, it does appear that the processes associated with collaboration have a great deal in common with sustainable objectives. The cases seem to indicate heightened investment in sustainable features when students are organized in interdisciplinary units.

The author grants that the system used to evaluate the effectiveness, efficiency, equity, and legitimacy of the projects above has been used on an extremely provisional basis. It is hoped that this discussion will spark some discussion about how best to evaluate complex student projects. Determining some basis of generalisation of sustainable or experiential pedagogies can only benefit these growing fields of educational pursuit.

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Closing the implementation gap: a critical model for architectural research

Ash Ragheb

Lawrence Technological University, Southfield, Michigan

ABSTRACT: As design innovations become the center figure in architecture, teaching research methods and skills is gaining momentum in architectural education and in most architecture schools nowadays. This paper calls for the development of a model which encourages researchers, who utilize a range of methodologies, to acknowledge the values and assumptions implicit in human behavior with buildings. This demands attention to epistemological issues involving knowledge, its nature and forms, how it is acquired and how it is communicated, and pay attention to ontological issues concerned with the relationship between man and its environment. This paper introduces different methodological frameworks for architectural research in the past decades. Although there are a variety of orientations discussed, philosophical, conceptual, and technical, most studies reflect an understanding of people and objects as discrete entities interacting in a unilateral and passive way. This understanding is found to be the essential cause of the 'implementation gap' between architectural research and practice. For the gap to close, the development of a new research framework is needed which encourages researchers to acknowledge the ontological and epistemological issues associated with architectural practice, research, and education.

Conference theme: new methodologies in architectural research
Keywords: architectural research, design and practice, implementation gap.

INTRODUCTION

A conclusion of 'Research in Design Thinking' (Cross 1992), concludes the problem of knowledge transfer, from research to education and practice, to three main factors: first, the lack of a clear direction; second, the lack of a shared research methodology; and, third the lack of a broad theoretical framework. Closing 'the implementation gap' (Sommer, 1990) is a responsibility of researchers who are working in a 'critical' mode in architectural practice, education, and research. More closely, the paper calls for the development of a framework which encourages researchers, who utilize a range of methodologies, to acknowledge the values and assumptions implicit in human behavior with buildings. This demands attention to epistemological issues involving knowledge, its nature and forms, how it is acquired and how it is communicated (Cohen, 1989), and pay attention to ontological issues concerned with the relationship between man and its environment.

To introduce the argument for such an approach, the paper begins with a critical review of methodological research undertaken in architecture in the past decades. Around this time, researchers made extreme efforts to look away from architecture and its constituent elements and seek an external framework for their inquiry into the nature and development of design process and practice (Rowe, 1987). The review shows that research in architecture has operated, for the most part, with a dualist understanding of the world; an understanding which regards people and objects as discrete entities interacting in a passive and unilateral manner. Giving priority to an alternative dialectic view which asserts that 'people and their environment mutually include and define each other ' (Bognar, 1985), this paper, supported by the research review, suggests that it is the dominant dualist understanding with its associated conceptions of design, education and research that prevents 'the implementation gap' from closing. For the gap to close, researchers must be prepared to accept, as a holistic theme for their inquiry, the experiential and interpretive quality of human thinking, feeling and action.

1. CURRENT RESEARCH METHODOLOGIES IN ARCHITECTURE

In reviewing methodological studies in architecture, three main orientations emerge which are referred to as 'philosophical', 'conceptual', and 'technical' oriented researches.

1.1. Philosophical research: an espistemological focus

Influenced by modern science's rejection of metaphysics, philosophical inquiry has been largely epistemological in nature, that is, it has dealt with the basis of knowledge, its nature and forms, how it can be acquired and how it is communicated (Cohen, 1989). For the most part, these aspects of inquiry have been addressed exclusively by the method of inquiry. 'It was especially the idea of method, or of securing the path of knowledge in accord with the guiding ideal of certainty, that brought a unified meaning of knowing and knowledge to the fore (Gadamer, 1986)

From 1950s, the appropriateness of 'the scientific method' came under attack by an increasing number of researchers. The logical criticisms of Popper (1959), the sociological concerns of Kuhn (1962) were of significance for designer researchers. Abel (1982) argues against an explicitly laid down method of inquiry, preferring to adopt the extreme position that there should be as many approaches to design research as there are researchers. His argument rests on the belief that research is about self-enlightenment and self-fulfillment. In this sense, individual approaches to inquiry are seen to be more appropriate than those promoted by the research community; a view influenced by the earlier discussions by Kuhn of sociological barriers to methodological change.

Contributing to the understanding that design involves conjecture and analysis rather than analysis, synthesis and evaluation was research by Popper (1963). Counter to the traditional inductivist or deductivist views, Popper believed that scientific investigation proceeds by conjecture then refutation. While Popper concerned himself with the refutation aspect of research, design researchers (Hillier & Daley 1984) emphasized the conjecture element of designing. For them methodological research should concentrate on providing designers with knowledge on how human beings respond to objects, particularly designed objects.

1.2. Philosophical research: an ontological focus

Behind all research, including that of an epistemological nature, are assumptions regarding the relationship between human beings and the world. Despite extensive acknowledgment of these ontological concerns in sociology and psychology, there has been very little explicit response by the design disciplines such as architecture. Of the studies relevant to architecture, most have tended to borrow from research that is either rationalist oriented or empiricist oriented. Very few studies reflect holistic views characteristics of existentialist phenomenology and hermeneutics. Among the exceptions are studies by Coyne and Snodgrass, Schon, Dilnot and Norberg-Schulz.

Influenced by Gadamer and Heidegger's hermeneutic phenomenological philosophy and Dewy's pragmatism, Coyne and Snodgrass criticize the dual knowledge thesis traditionally attributed to design thinking. For them, the thinking associated with designing involves negotiation between what is expected and what is presented in the situation. In other words, Coyne and Snodgrass see designing as an experiential and interpretive process. A similar understanding of designing and professional practice in general, was conveyed in earlier studies by Schon (1983) who called on research to support designers in their reflective conversation with the materials of the situation. According to Schon, designers should be encouraged to analyze critically the tacit and explicit understandings of those involved in designing as well as the organizational structure in which design and designing are embedded.

Also of significance to architecture and a phenomenological understanding of design and designing is research to do with dwelling carried out in geography (Ralph, 1985) and philosophy (Mugerauer, 1985). Underlying these studies is research by the philosopher Heidegger. For Heidegger (1962), dwelling is a way of existing, or 'being-in-the-world'; a 'being' which originates in a person's everyday active involvement with the world. Subsequently, to understand the nature of this existence demands attention to the action and the context in which the action is grounded. An area of study which focuses on understanding in this way is hermeneutics.

Despite the apparent relevance of hermeneutics and phenomenology, very few studies have been undertaken in architecture. Of the studies undertaken, those by Norberg-Schulz are the most extensive. According to Norberg-Schulz (1980:5), 'man dwells when he can orientate himself within and identify himself with an environment, or, in short, when he experiences the environment as meaningful'. Rather than basing the design of a building upon general types and principles, Norberg-Schulz advocates that architecture should aim to concretize economic, social, political and cultural intentions in a way which captures the 'genius loci' or 'sense of place' of an environment.

1.3. Conceptual research: a psychological focus

There are two dominant types associated with conceptual research; a psychological focus, and a man- environment focus. Researchers adopting a psychological focus tend to see designing as one or a combination of the following: a 'rational' process involving information processing; a constructive process in which designers actively draw on knowledge from past experience, particularly past design experience; a creative process utilizing an intuitive form of reasoning.

Each of these conceptions in turn reflects a specific view about knowledge and subject-world interaction. For example, researchers who understand designing as information processing regard knowledge in terms of two basic types of information: substantive information, or 'facts' about the real (objective) world; and, procedural information which indicates how to arrive at a factual understanding of objective reality. For them, research is driven by the goal of matching knowledge with problem.

In architecture, research concerned with the nature of design problems (Rittel & Webber, 1973), problem definition and solution generation (Thomas & Carroll, 1984), and design knowledge (Drake 1984 &

Eckersley, 1988) reflects attempts by researchers to apply the theory of problem solving developed by Newell and Simon (1972) to designing. The descriptive model by Akin (1986) illustrates the result of such an attempt.

Describing the design process, Akin refers to it as a problem solving process comprising three major activities: problem representation; problem transformation utilizing a particular body of knowledge; and, searching which involves the designer in matching resources with the task at hand. Integral to these activities are three types of knowledge: representational knowledge, transformation knowledge and procedural knowledge. For managing the information there is a design information processing system (DIPS) similar to that proposed by Newell and Simon (1972). While the system has performed well in computer simulation tests, its use in a range of individually and socially constructed situations has yet to be demonstrated.

This model and others, including Mitchell's (1990), while psychologically framed, are ultimately technically oriented. Underlying and guiding their mechanistic approach to research and their 'technical fix' attitude to practice is an atomistic, deterministic appreciation of the world; a world where the relationship between people and objects is perceived as static and discrete.

1.4. Conceptual research: a man-environment focus

While some researchers have been concerned with the cognitive factors associated with behavior, other researchers have been working from a man-environment research, focusing, for the most part, on the social and cultural factors involved in individual and group behavior. In the 1970s, this research, together with an increasing awareness of social and environmental issues, influenced architecture and design in a number of ways. In response to the newly emerging awareness of 'social' reality and the growth of community-oriented programs, for instance, design researchers turned their attention to the collective rather than individual consciousness, to shared meaning rather than idiosyncratic meaning, to collaborative designing rather than autocratic designing.

In line with the conception of designing as collaborative, research focused on the development of methods and models that could support client/user participation in the design process. Wisner *et al.* (1991) provides a detailed overview of participatory and action research since its emergence in the 1960s, identifying among others the simulation games of Sanoff (1978) and the environmental models of Lawrence(1982). In general, the models developed reflect various dimensions of the conception of collaboration in designing. One typical dimension is the understanding of collaboration as a method to arrive at an inter-subjective understanding of the design situation. What is generally emphasized in these cases is communally shared information about requirements. Underlying this approach is a belief that reality for an individual is socially constructed and that individual behavior is determined chiefly by social and cultural norms.

In 'recent' studies of design practice Blau (1984), and Cuff (1991) highlighted problems caused by a discord between professional ideology and practice which has its own values, language, power structure and practices. According to Cuff's ethnographic study, these aspects of practice culture are reflected in the practitioners' theories-in-action. In many cases these theories are contradictory to the theory of practice as espoused by the profession and the various schools of architecture. From this understanding of architecture as a socially constrained process, Cuff called on educational institutions and professional bodies to encourage architects to 'reconstruct their vision of their task'.

Research by Cooper Marcus (1972) has also focused on the meaning of place; in particular how people feel emotionally and spiritually about specific designed settings. While the outcome of her studies of public housing such as Easter Hill Village have provided useful substantive information for designers, they also have contributed in a normative sense by highlighting the need for post occupancy evaluation, and in a procedural sense through the development of various techniques including participant and non-participant observation, focused and nonfocused interviewing and archival searching.

Research by Rapoport (1990), on the other hand, focuses on culture and its influence on built form. From studies of vernacular architecture, Rapoport has concluded that 'place' has more to do with social, cultural and psychological factors than it has with the built environment. At the basis of his research is an explicit desire to make architecture 'more scientific' by replacing it with a research emphasis. Rather than making research applicable for designers, ' . . . it was designers that needed changing, to see research as essential'. In effect then, design would become applied environment-behaviour research but with one major qualification; it must remain 'rational'. Consciousness raising, existentialism, phenomenology, holism and hermeneutics are not considered by Rapoport to be 'rational' and, consequently for him, do not constitute valid or valued research.

Despite a tendency for research such as that by Cooper Marcus to be deterministic through its attempt to identify patterns of behavior and to attribute cultural or social causes to these patterns, it is more aligned with a dialectic appreciation of man-environment interaction than the dualist conceptualization of Rapoport. Phenomenology is a methodology which has attempted to remain true to the view of human 'being' as dialectic. As opposed to seeing designing as a social or cultural process, phenomenological researchers in architecture understand it as a phenomenological process. Because of its ontological orientation, the influence of this methodology in architecture and architectural research is described in the following section dealing with philosophical research.

1.5. Technical research: a systematic focus

Technical research is distinguished from the other orientations by its emphasis on procedure as the main determinant of effective design. There were several factors that contributed to its emergence in the 1960s. Of these the most pervasive was the dominance of consumerism and industrialized production (Easlea, 1973). In this context, design knowledge was regarded as instrumental in improving the efficiency and reliability of production, in adapting and developing production procedures to suit particular products, and in the conceptualization and execution of 'designs' aimed at accommodating and stimulating consumer demand.

By the 1950s, architecture and the other design disciplines at the forefront of industrialization, engineering and industrial design, were finding it increasingly difficult to respond effectively to demands for improved production. Consequently, with performance as a goal, researchers began to look for ways to make the design process more efficient and reliable. In this respect, they were influenced by various substantive and procedural 'advances' in technology and science, particularly in management science, communications science, computer science and behavioral psychology.

Focusing on psychology, for instance, Rowe (1987) in his book, *Design Thinking,* identifies the doctrine of behaviorism as contributing to an understanding of design behavior as a process that " could be clearly and explicitly stated, relevant data gathered, parameters established, and the ideal artefact produced". Contributing, in turn, to the behaviorist understanding of behavior as environmentally determined was the scientist demand for detached observation, quantification and replication. Fundamentally, it was the emphasis on a 'rational' approach to knowledge acquisition that prompted design researchers to conceive of efficiency and reliability in terms of the systematic application of technique; a move which helped to produce and continued to reinforce a mechanistic, deterministic conception of designing.

This understanding of designing as comprised of parts or stages bound by an identifiable and widely applicable 'law' is reflected in the various models and methods produced in the 1950s and 1960s. A de-compositional method for establishing the requirements of a design situation was among those produced for architecture. The method proposed by Alexander (1964) (a mathematician and architect) reflects the Cartesian process of breaking down a problem until the 'truth', or solution in this case, becomes self-evident. Specifically, for Alexander, this involved mathematically analyzing and explicitly representing the problem in terms of a hierarchy of subsets of requirements. Identification of these subsets and their pattern of interaction provided the logic for the recombination of the subsets in physical form. The basis of this approach is the belief that design is concerned with the 'invention of physical things', and that designing begins with an effort to achieve fitness between two entities: the form in question; and, the problem situation.

1.6. Technical research: a computational focus

In the 1980s, the systematic frame-of-reference which had informed research such as Alexander's developed more conclusively into a computational frame-of-reference. Researchers working from this platform regarded designing as a process amenable to symbolical (numerical) representation, interpretation and management by a computer. The emergence of this view can be attributed to early research involving information processing and cognition (Eastman 1979) , and to more research in cognitive science and artificial intelligence (Mitchell, 1990).

In architecture, as in other design disciplines such as engineering and industrial design, research with a computational focus has moved in two main directions: computer-aided design (CAD); and, knowledge-based design. As by the 1980s, CAD had proved to be beneficial in many areas of design process and practice including information storing, retrieving, processing and printing.

The book, *Computer-Aided Architectural Design,* by Mitchell (1977) is significant in summarizing the developments in computer-aided design up to the beginning of the 1980s. In addition, it also supports a computational model for understanding and improving the architectural design process. According to Mitchell, each project can be viewed as proceeding by the performance of various functions, each marking the achievement of some identifiable goal. Performance of each function requires the execution of some design procedure, which requires certain data as input, produces certain data as output, and consumes certain resources. As a design project progresses, the output from procedures accumulate, and an extensive, complex, project data base is built up. The project is complete when this data base contains a sufficiently complete, consistent, and detailed description of the proposed building to form a basis for a contract and for actual construction work.

With this conception of designing, Mitchell saw the computer as having considerable potential for architectural design. In his later work *Logic of Architecture* (1990), he draws extensively upon advances in artificial intelligence, cognitive science and the theory of computation in an attempt to demonstrate that the structure of architectural design reasoning can be understood by analyzing logically (through the notation of first-order predicate calculus) how architects conceptualize form and function. Here the distinguishing feature of Mitchell's thesis is the belief that the construction world, and subsequently, the design process, is for the most part, controlled by a formal language. Specifically, this language comprises a vocabulary and rules of usage (a typology) which have evolved over time for various parts of a building and, in some cases, for the building as a whole.

While CAD proved to be effective in handling well-defined problems, in managing ill-defined problems it was severely limited. In general, ill-defined or ill-structured problems (Simon 1973) do not possess any definite criterion for testing a proposed solution nor a mechanical process for applying the criterion. As a result, the designer is forced into an iterative mode of proposing tentative solutions which are then tested by stimulating the situation through drawings and models. Responding to this conception of designing as heuristic search involving closure of a goal state (Wade, 1979), a new field, which is described generally as knowledge engineering, was established. Concerned with improving designers' knowledge of the relationship between potential solutions and desired performance characteristics, knowledge research has concentrated on producing systems that contain the problem solving 'facts' and rules associated with specific types of design problems; rules involving simulation, generation and optimization.

Predictions for future research operating within this rationalist paradigm include the improvement of networking capabilities, the development of automated criticism systems that behave increasingly like human critics drawing on different knowledge bases, and the development of 'professional' memories containing collections of shape rules for access by designers.

1.7. Technical research: a management focus

Research in CAD and knowledge engineering has focused on specific design problems involving building form and its realization. Attempts, however, to address the complex array of professional practice issues have been insignificant by comparison. Reviewing the state-of-the-art in architectural management research, Akin (1990) identifies only a limited number of studies undertaken in architectural management in the last few decades. Among those identified are socio-historical accounts of office practice by Gutman (1988) and Cuff (1991), research by Mackinder and Marvin (1982) concerned with design information and its management, and studies by Haviland (1981) which found attempts by practitioners to formalize management restricted almost entirely to organizational structure and its generalist, studio, departmental or matrix model.

In response to the demand for more extensive architectural management research, studies aimed at confronting the newly emerging forces of architectural practice are currently under way.

In summary, design researchers who are 'technically oriented' define their role with respect to the efficient and effective production of objects. As previously mentioned, the tendency to understand efficiency and effectiveness as the systematic, mechanical matching of form with requirement dominated methodological research in the 1950s and 1960s leading to the development of various 'rigid state models' including the de-compositional method by Alexander. It was not long before the inadequacies of these methods in coping will the ill-definition and uncertainty of design practice, became apparent, motivating researchers ' to look behind the methods at the conceptual processes which were generating them (Evans et al., 1982).

1.8. Research methodologies' conclusion

As the review shows, methodological research in architecture has occupied, for the most part, a *'technological fix'* role in society. An investigation of the context of methodological research reveals several factors contributing to the consolidation of this situation. These include: consumerism and its emphasis on production efficiency and effectiveness; technical, social and environmental problems caused, in many cases, by industrialization itself; and, scientific and technological development with its underlying atomistic and deterministic consciousness. Influenced by these factors, researchers have been preoccupied with developing methods that could improve the efficiency and reliability of the design and production process. As noted, this is evident to a large extent in technical research where researchers have adopted a systematic, computational, or management-focus.

Despite the deficiencies of these methods and a transition to conceptually oriented inquiry with its associated psychological and man-environment focus, researchers have persisted in adopting a *mechanistic*, *deterministic* approach. This has occurred even though a considerable amount of environment-behavior research has sought to move away from a dualist understanding of man-world interaction towards a more dialectic understanding. Ultimately, most researchers regard environmental factors such as culture as the primary origin or cause of behavior and its concrete manifestations.

2. A PROPOSED MODEL FOR ARCHITECTURAL RESEARCH

Following a critical framework for research will require certain fundamental changes. Ontologically, it will demand a change from a dualist understanding of people and the world to one that is dialectically oriented. Epistemologically, it will require that explicit attention be given to the interpretative and context-bound nature of knowledge. Such changes will have various implications for how design, designing, learning to design and research are conceptualized.

Alternative to an understanding of design in purely physical and formal terms will be the understanding of it in qualitative terms. While the role of design can be described with respect to its technical involvement in meeting basic functional and commodity demands, it can also be viewed as something which, via the medium of form and its quality, is an integral part of experience and, as such, is instrumental in how people relate to the world. From this viewpoint, it is the role of the designer to inquire into the nature of this relationship.

To characterize how something is apprehended, thought about or perceived is by definition a qualitative question. In this qualitative context, designing is critically reflective rather than systematically mechanical. In this qualitative context, initial consideration is given to experience as the source and mediator of knowledge rather than to the world as it is physically removed from its context of meaning. In this qualitative context, learning does not happen passively through the transmission of knowledge from expert to novice but as a *reflective dialogue* with the materials of the situation. Experientially, the materials of the situation include the factors that influence how those involved in learning, conceptualize, perceive and understand various aspects of, and various phenomena in, the world around them.

Teaching designing, like designing, requires insight into how understandings of particular phenomena are constructed. Not only is this seen to be instrumental in the development of technical knowledge and skills but when approached explicitly and contextually, it also equips students with new ways of seeing things; ways which help them, personally and professionally, to make sense of a changing and uncertain world.

In view of these alternative conceptions of design, designing, and learning to design, research will be required to shift its initial emphasis from prescriptions to description. As well as changing the focus of inquiry, researchers should also be prepared to adopt a second-order perspective. They must be willing to accept, as a worthwhile starting point, the designers and students' experiences rather than attempting to describe designing and learning as concepts independent of their context (a first-order perspective). On the whole, for research to be more relevant to educators and practitioners, it must operate within a framework where there is a commitment by researchers to explore critically, rigorously and ethically the *ontological* and *epistemological* issues associated with architectural practice, education and research.

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Searching for a new paradigm in architectural education

Irina Solovyova[1], Upali Nanda[2], and Frances Downing[3]

[1]UTSA, San Antonio, Texas
[2]American Art Resources, Houston, Texas
[3]Texas A&M University, College Station, Texas

ABSTRACT: This paper is a position paper that will provide an extensive literature review on design education and raise questions regarding the current goal and a possible direction for architectural education. The paper will examine several critical issues such as education vs. training, the increasing disconnection of architectural education from the "real world" of design practice, and the role of research and theory in academia and the practice of architecture. This paper will address the challenges inherent in defining clear goals and directions for the field, given the current state of the architectural profession and academia. It will further argue that research can drive the development of a common language for use in a dialogue between the academic and the practitioner, a dialogue that is mediated by educational institutions, and which can also help shape architectural education and the profession as a whole.

We are currently in a networking boom where global, intricate, and complex collaborations are constantly taking place, and the world seems to be shrinking to create a new and more localized globe. Architectural education, however, continues to utilize models established almost 400 years ago. In order to keep up with this fast-changing world, the growing demands of the profession, and accreditation and institutional expectations, initiatives like the promotion of research into built environments, extensive coverage of new technologies, and an increase in the number of subjects covered during the formal education process, have all been undertaken by academic institutions. However, a clear directive for architectural education has yet to emerge. With major world changes including climatic change, population change, technological advances, and now a struggling economy, the architectural profession is scrambling to keep up. This paper posits that it is up to educators, to initiate a dialogue between the profession and academia, the studio and the lecture hall, the media and the material, design and theory, in order to have a forward-thinking educational process that not only readies students for the profession, but further helps focus the profession towards a common vision, shared between academics and professionals alike. We further posit that research is key to the development of this common vision that will help shape the educational system and, consequently, architectural practice.

Conference theme: Innovative approaches to architectural education
Keywords: architectural education, research, paradigm shift

INTRODUCTION

This paper is a position paper that undertakes an overview of several key challenges in architectural education today. As such, it falls into the category of architectural criticism. According to Somol (2009:33) "criticism is not objective, it is motivated." The motivation for this paper is to seek a direction for architectural education where practice and academia are not at odds with one another.

"Architecture is a distinct epistemological category, a Practical Art, occupying its own cultural territory" (Cunningham 2005:433). Architecture has always been a complex discipline and has increasingly become moreso with a technologically, ecologically, and culturally evolving world. As educators, we can become so caught up in attempting to keep up with these changes that we often lose sight of the big picture. In this paper we argue for the proverbial "step back" to look at the forest we can no longer see for the trees. There is a need to revisit the seemingly all-encompassing questions: What is the goal of architectural education today? Is it the same as it was fifty, twenty, ten years ago? Is this the same goal that will guide architectural education tomorrow? With growing demands for research from academia and the profession, what is the role of research in architectural education and its impact on the practice? The issue of refocusing key objectives in university education has been raised before (Fisher 1995, Bermudez 1999, Frank 2005, Habraken 2003, Salama and Wilkinson 2007), but has never been satisfactorily resolved.

An examination of the past 3 years of ACSA and ARCC proceedings (Hejduk and Van Oudenallen 2005, Heng and Tripeny 2006, Bing and Veikos 2007, ARCC proceedings 2007, 2006 and 2005,), as well as multiple issues of the *Journal of Architectural Education* have shown that although discussions regarding individual issues of architectural education and research are ongoing, the broader goals of architectural education have not been central to these discussions.

1. A CHANGING WORLD

In the past 60 years, our world and the profession of architecture have both changed dramatically: from the adopted design and communication processes, the shapes of spaces created, the construction methods employed, the materials developed and the machinery used, to the safety and quality standards adhered to and the incorporation of evidence-based design. Construction Facility management and Interior Design have both emerged as lucrative professions that acknowledge the complex system within which an architecture project operates. As a profession, in the last decades, architecture has continuously evolved and struggled (Fisher 1995, letters 1993). Despite this growing and glorious complexity, architectural education continues to utilize models established almost 400 years ago. While some change can be seen in the increasing emphasis on research, this change has not been homogenous across all schools; nor has it been construed to constitute a paradigm shift. Even at leading programs like that of Cornell University, where there is an emphasis on research and evidence-based design, the curriculum does not allow for a seamless integration of research and learning/teaching (Becker 2005).

Architectural education, within the university context, has a mandate not unlike that of other disciplines, with the

> considerable diversity of opinion about the ideals that should characterise universities, or the specifics of their roles…there is general agreement that universities are institutions which deal with the production of new knowledge, the conservation, critical testing and refinement of existing knowledge and the development of knowledgeable understanding in students (Coaldrake and Stedman 1999:17).

The emphasis on research is growing; however the role of research in academia and the relationship between academic research and its application in practice has not yet been satisfactorily established.

2. CAN THE PROFESSION GUIDE EDUCATION?

According to Gutman (2000), the architectural profession is in a state of turmoil due to contradictions within the profession that are a result of specialized and fragmented production systems, constantly increasing demands from society, the escalating complexity of the demands on the profession, and increasing competition with non-architectural professions that share the same market (Scalabre 2005, Seidel 1992, Bradley 2000). He (Gutman 2000:232) states it simply: “professionals are increasingly confused about their task,” especially now due to recess. In its current condition, the profession can provide little if any guidance to architectural education (Moore 2001). Within this context, the struggle to fulfil its immediate needs can result in senseless and dead-end strategies. Architectural education should prepare students for the profession in a critical rather than conforming manner. The architectural profession is not the client of architectural education. Education does not cater to the profession - it forms the profession. If education is inadequate to the task, then the educational system is at fault. But success or failure cannot be judged solely on the basis of training graduates who meet the immediate desires of a firm, but not the sustained needs of a profession. Unlike the profession, which is governed by the market, architectural education has the luxury, and indeed the responsibility, in both design and research, to maintain a critical position between the profession and the society it servers (Gislason 2005). As Necdet Teymur (1992:189) notices, unlike practice:

> educational design can be imaginative even when it is not imaginary, and profoundly realistic without being expedient, subservient or mundane.

Architectural education also has the ability to experiment and theorize freely. “Education is the profession’s lever over its own future” (Milliner 2000:227). Can architectural education lead the profession, rather than be continuously led, validated and examined by it? Or can it join forces with the profession to create an architectural practice embodying a broadly informed, culturally rich, linguistically conversant, technologically advanced, socially responsible and formally creative art that can continue to sing distinct tunes while being enjoyed by different audiences? (Milliner 2000).

3. CROSSROADS: EDUCATION VS. TRAINING, ACADEMIA VS. THE PROFESSION

In the field of healthcare, evidence-based design is becoming the norm. Evidence-based design is defined by the Center for Health Design (http://www.healthdesign.org/aboutus/mission/EBD_definition.php) as:

> the process of basing decisions about the built environment on credible research to achieve the best possible outcomes.

Healthcare firms now often hire full time research personnel. Practice-based environmental design research is defined as “systematic inquiry that both creates knowledge and solves specific design problems" (Geboy and Keller 2006). According to this definition it is highly specialized and need-based, understandably so since research in firms relies on billable hours. One of the most compelling arguments in support of evidence-based design is the "making the business" case, which demonstrates that the use of design based on the best available evidence can improve health, the quality of care, and have an impact the financial bottom line (Center for Health Design 2009). Being able to establish a chain of logic between design, outcome and financial return is key to the success of evidence-based design. Unfortunately, a search for a similar chain of logic is missing in the profession of architecture as a whole, and in design education.

Professional trends, challenges and priorities, are important indicators of the future of a profession, and its system of education. It remains to be seen what impact evidence-based design has on architectural education, beyond what has been seen in the very specialized arena of healthcare design.

It is also important to realise that in academia the objective of research is, or should be, higher than "problem solving" or meeting the immediate needs of a particular project or even of an industry. As Boyer (1990:23) wrote, academic scholarship:

> that both applies and contributes to human knowledge is particularly needed in a world in which huge, almost intractable problems call for the skills and insights only [the] academy can provide.

Not bounded by the constraints of a client or the demands of a market, academic research can be more "pure," seeking knowledge for the sake of knowledge, and answering questions not in the service of a single project or organization, but for the entire knowledge community.

Academic Institutions possess incredible capabilities and freedoms with regards to initiating, processing, storing and putting in perspective great masses of knowledge that can be both immediately applied and/or stored until the time for its intelligent use arrives. Unfortunately, the disconnection between the educational system and the profession that prevails in architecture puts research in an awkward position – one of struggling to find its place.

4. LACK OF A UNIQUE "DELIVERABLE" IN ARCHITECTURAL EDUCATION

Robert Campbell, architecture critic for *The Boston Globe* (as quoted in The Chronicle for Higher Education, October 22, 2004) wrote:

> Most people dislike the buildings that architects love most, and part of the problem is that architecture is taught within the culture of academe. University professors tend to believe, falsely, that architecture is primarily an intellectual activity, just like, say, philosophy. They dream up totally unreadable theories that can lead architects to "build for their peer group, and the hell with the rest of the world".

Campbell's point of view might be a little brutal in its expression, but is not unrealistic. The "God-complex" often seen in architecture students has become the element of the culture of the architecture school most responsible for encouraging the attitude of "starchitects" responsible for, at best 5%, of the building market (Letters 1993). Students graduate ready to change the world, with only a very fuzzy idea of what that world is really all about. Years in the profession tend to generate a healthy contempt for the very system from which we have all emerged. Jean-Paul Scalabre (2005:28) expresses this well and claims that:

> …the profession has the temptation to criticize a lack of realism in the school's curricula and a non-suitability of education to what is supposed to be the needs of the profession. On the other hand, schools seem to be destabilized by the frenetic movement of society; they loose their references and do not know what kind of future has to be proposed to the students.

The discussion during the 2005 meeting of the Heads of European Schools of Architecture in Hania (Spiridonidis and Voyatzaki 2005) reiterated the historically uneasy relationship between the architectural profession and architectural education that continues to this day. This relationship is just as challenging to architects and students in other parts of the world - not only in Europe (Salama et al. 2002, Menon 2004, Makarova and Chuntonov 2002). According to Bradley, (2000:181) the profession and educational system each are responsible for forms of practical and theoretical work, respectively:

> …each is able to maintain control over and develop its respective territory, unchallenged by the 'other side.' The territory of architectural discourse and production is partitioned between the two sectors, reducing the ability of either constructively to inform the other.

A common sentiment in the academic circle is that we should concentrate more on an understanding of and ability to "create Architecture" rather than simply to "build structures." This is an interesting turn of phrase; architecture is allied with creativity, whereas construction is linked with mechanical skill. In the age-old guild system when the lines between art and craft, architect and builder, were blurred, skill *was* creativity, building *was* architecture, and practice *was* education. Today, with an increasingly virtual world, firms exist in one location, build in another, for clients based in yet another locality, while outsourcing drawings from, perhaps, a completely different country. The profession has been completely redefined. It would be overly simplistic to advocate the previous structure without some accommodation for the way the world is organized today. Globalization gives us the "cultural general entropy" (Scalabre 2005) that offers unity to the seeming diversity that comprises today's society, profession and education. It is important to acknowledge that in fragmenting the whole, and in creating an extremely specialized and simultaneous world, a certain lack of equilibrium concerning a new, revamped “rightful place in the world” is only to be expected. If we can answer what the architect is uniquely qualified to do when (s)he steps out of school - and whether or not the unique qualifications (s)he now possesses represent a worthy goal - then education can find its essential direction. It has already become clear that an “architect as generalist,” who is a “member of [an] exclusive aesthetic culture” (Letters 1993:77) is not a reasonable qualification on its own.

3. TRADING SOUL FOR SKILL

The detachment of the design studio from the real world, and the encouragement to work with media in a virtual rather than material world has made architectural education passive and, to a large extent, superficial. This passivity carries into the profession (Thomas, in letters 1993) and contributes to the widening gap between the architect’s real world challenges and idealistic expectations. The academy has replaced the real with the mediated, mostly visual, significations, the rearrangement of denotations into new representations. As we have argued in our previous paper (Nanda and Solovyova 2005), architectural education today, with its overemphasizing of ‘special language,’ has led to the disembodiment of our experiences through visual manipulations and amalgamations, and has lost a practical focus. Intentionally or not, the whole aim of education has shifted from gaining an understanding of “how it works,” and learning to develop and maintain minimum required skills, to acquiring as much information (with the assumption that understanding will evolve from such accumulation) and skill in technology as possible. The prevalence of ‘soft’ sources (design magazines and product catalogues) rather than ‘hard’ sources (like scholarly periodicals and hard data) has become a bad habit of instructors and students that has carried over into professional careers (Dickson and White 1993). Deep reflective thought towards a stable, material product of design has somehow been trampled by a frenzy to collect new tools, and showcase innovative skills developed from these tools. Worst of all, the information and skills so carefully collected during the course of education do not even equip students with a basic knowledge necessary for actual architectural practice (Crasbie 1995). In a sense, what the graduates gain in skill, they lose in soul.

Something similar happens in research. The research performed in practice and the research conducted in academia follow two separate lines, perhaps crossing each other here and there, but currently existing mostly independently of one another. AIA, Soloso (http://www.aia.org/akr/index.htm) and similar knowledge-sharing communities allow for collaboration regarding research findings. ARCC conferences consistently feed Soloso, making academic research readily available to the professional community. The profession helps to shape academic research through grant programs and collaborations. However, to a large extent research from the profession is usually need-based and independently conducted by research offices in firms; alternatively, the research generated at architecture schools is to a large extent theoretical, and led by faculty composed mostly of pure academicians). By requiring an advanced degree and promoting faculty on the basis of academic publications (at the cost of creative practice), the academy may continue to sustain and possibly increase the gap between the profession and the system of education. Professionals see academic researchers as living on an island of abstract thought; this is, in part, due to the lack of a common language shared by the two branches of the discipline. Academic scholars don’t always conform to a “narrow interpretation of professional conduct” (Dickson and White 1993:4). If the practitioner’s definition of research focuses on the end use of knowledge rather than on the generation of new knowledge”[where does this quote begin?] with an emphasis on obtaining immediate answers for pressing specific design issues (Dickens and White 1993:9), then the gap will continue to grow.

Part of the problem is that not enough pressure has been put on architectural research to determine its own unique paradigm. Thus, while we know that architectural research is both pragmatic and philosophical, both scientific and artistic, researchers are left to choose their own external framework within which they fit their work. Groat and Wang’s (2001) overview of architectural research provides a synopsis of the various disciplines from which research may draw. Unless research, rather than rhetoric, is emphasized by the academy, it will never be able to bridge the gap that currently exists between it and the profession.

Currently, academia continues to possess the important luxury of engaging in intellectual discovery, the value of which often may not be recognizable until some time in the future. The philosophical aspect of research, not immediately applicable to the needs of practice, allows for the bridging of knowledge across time and different domains, offering new perspectives that assist in the development of design as a discipline, and society at large.

4. RESEARCH: PILOTING ARCHITECTURAL EDUCATION

We have to be honest with ourselves – the accumulation of information is not a substitute for knowledge and the creative process, but information accumulated through research can enhance and contribute to knowledge and the creative process in architecture. “Research can present new information that designers apply creatively in their design solutions,” and

> research provides substantial evidence of effectiveness (and alternatively, the weaknesses) of design decisions as they relate to the human experience of the environment (Geboy and Keller 2006:2).

Research is the backbone of most scientific disciplines, but in architecture it sits uncomfortably between the practical and the theoretical. Practice and pedagogy are both respected - but research that forms the foundation of both has yet to find a single solid ground upon which to locate itself. Paradigms and methodologies are borrowed from other fields; square pegs are forced to fill round holes. Philosophical architectural "theory" is omnipresent, but practical architectural research is, ironically, still only a distant relative. Part of the problem lies in the overall structure imposed by the university that sets the same standards for very different fields – research should benefit the industry (the reliance of different disciplines on grants), and research should somehow relate to teaching. In the case of evidence-based design, at least, a standard is beginning to be established for what constitutes a benefit to the industry (as exampled by healthcare). According to Becker (2005:4):

> If the goal is the production of research that is of publishable quality that contributes to the body of evidence-based knowledge, the trained and qualified researchers are required. Such research can be done as part of practice or academia. The key issue is not the location of research, but qualifications of those doing it (Becker 2005:4).

A similar attitude must be inculcated into mainstream architectural education as well - one that focuses on the quality of research, rather than on the profession vs. education debate. Direct links between design and industry benefits can be seen in the context of workplace design, retail, and the entertainment industry - all of which rely heavily on research before design.

Yet objects of design analysis can't always be directly linked to profits in the market. Benefits of the industry must be considered to exist beyond the financial returns established in cases like that of the healthcare industry. A large chunk of architectural education that deals with the intangible lacks patrons willing to support the more abstract objects of investigation. While

> without the competence to develop the unmeasured quality of space, we have very little to offer that belongs specifically to the core of our discipline (Olaf Fjeld 2005:93),

research that addresses this unmeasured quality is considered to be "too esoteric" (Anderson 2001) and therefore receives little funding, support or appreciation. There needs to be a greater emphasis placed on developing a research paradigm that is appropriate for the unique issues in architecture and design that can help to translate the esoteric into the tangible, enable communication between the professional and the academic, and still maintain the integrity of the profession.

Linda Groat and David Wang (2001) make a significant contribution to the complexity of architectural research with their work on Architectural Research Methodologies. This is one of the few attempts that addresses the uniqueness of architectural research, and the interdisciplinarity that it encompasses. They make the following argument for the imperative nature of architectural research (p.8):

> an ever increasing proportion of architectural practice involves unfamiliar circumstances beyond the expertise of individual practitioners, and beyond the conventional wisdom of the profession as a whole....great uncertainty is also likely if unconventional aesthetic principles are being used in a setting involving conflicting aesthetic values.

This need forms one of the key imperatives of architectural research. By being grounded in the needs of the profession, yet staying visionary about the future of the discipline, research can help draft the goal of what future educational qualifications should be.

According to Dickens and White (1993:10, original emphasis),

> the educator's *primary* role is to advance the profession through the generation of research that adds to the body of knowledge, to place this research into a contextual framework that can be used by the design profession, and to convey the existing body of knowledge to students. To advance the profession, the practitioner's *primary* role is to keep abreast of current research and to apply it in design solutions rather than frequently using past experience as the primary source.

The above quote describes a symbiotic role of education, profession and research, one that can establish a system of communication between the profession and academia. This interaction could solve the fundamental problem of the chasm between the two, which is the key challenge facing architectural education. By using research as the common language between these two architectural worlds, the field of architecture can advance towards a common vision, even when immediate goals and objectives vary.

5. CLOSING

As Boyer (1990:16) said, "the time has come to move beyond the tired old 'teaching versus research' debate" and move to a discussion of scholarship. Scholarship, in Boyer's understanding, has a much broader meaning and encompasses original research that builds bridges between theory and practice, and communicates real and useful knowledge to others. We believe that research has become such an important and inseparable part of both academia and design as a profession that not long from now it will be academic scholarship that shapes both architectural education and practice.

A university setting creates a unique situation where highly educated thinkers and specialists from various disciplines, and practitioners of architecture with decades of real world experience, can come together to form a strong collaboration focused on accomplishing the same goal (Dudestadt 2003). It is

> the complexity, diversity, and perhaps the

> contradictions within the university environment that make it so valuable, stimulate creativity and lead to new approaches and thinking as we strive to reconcile and solve the problems the structure imposes on us as academics (Frank 2005:2).

And as Constantin Spiridonidls (2005) claims, change is a fundamental dimension of architecture, and reform is a necessary condition of architectural education. In academia, research and teaching should and can be integrated (Brew 2003, Coaldrake and Stedman 1999, Boyer Commission 1998, Trigwell and Shale 2004). We are already witnessing research becoming a critical player in both education and design. Such changes will soon bring the paradigm shift to architectural education that it desperately needs.

In 1995, Fisher proposed three possible directions for the development of architecture, following examples of other professions that had already successfully overcame intellectual recessions: medicine, engineering and the law. Either one, or a combination of any of the directions taken by those other disciplines seem plausible, and two out of three strongly rely on a research component. If architecture is to follow the medical model, some architects will eventually serve as general practitioners, mainly responsible for diagnosing problems and analyzing needs, putting together a team of specialists - from architecture and from other fields – to offer in-depth knowledge in all areas affecting a particular project. In this case, specialists would be closely connected to the most current research, bringing the latest knowledge developments to the design practice. If architecture is to follow the engineering model, evidence-based design would become mainstream. Careful assessment of consequences decision making founded on evidence-based guidelines would allow for predicting effects and for proving the value of a project. In both cases, the market for architecture as a profession would grow from 5% to the entire building industry.

Most architects currently perceive evidence-based design guidelines as destroying 'the art of architecture.' Such a fear comes mainly from a lack of familiarity with the nature of research-based design. In reality, the guidelines established from research can only add strength, validity and marketability to creative endeavours. That said, both academia and the profession need to invest in understanding what research really means in the unique context of architecture, and discover new currency for "evidence" that addresses core architectural issues, including the traditionally intangible.

Architectural academia has all the tools to allow research to change the profession of architecture. Academia is brimming with great minds that are actively engaged in research; it has an opportunity for interdisciplinary collaboration; it has connections to forums that allow academicians to share their research and to provide a direct feed into professional practice; and most importantly, it has the ability to change the mentality and habits of [future] professionals through the preparation of graduates who can be taught to conduct and apply research as a practice of design.

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Innovations in Architectural Education

Building Systems Integration for Enhanced Environmental Performance

Kenneth S. MacKay

Integrating Environmental Performance Criteria in Architectural Design Studios

Hazem Rashed-Ali

Materially Driven Approach to Design

Vera Parlac

Building systems integration for enhanced environmental performance

Kenneth S. MacKay, AIA

University at Buffalo, Buffalo, New York

ABSTRACT: This paper will provide a summary of ongoing research funded by the US Department of Education's Fund for the Improvement of Post-secondary Education (FIPSE). This research has two significant aspects. The first is the development of interactive digital media through which to teach sustainable design. The primary focus of this paper will be on the second aspect of this research which is the analysis of specific building system integration strategies and how these strategies are related to environmental performance. This is done by the development of a series of examples presented as three dimensional models of well integrated building systems. Each model is composed of two paired integrated systems analyzed with full graphical display, text, analytical drawings, graphs, and tabulated values, to demonstrate the models' performance in a particular environment. A performance metrics provided for each model serves as a basis to evaluate the sustainability of the system based on its performance in the thermal environment, luminous environment, acoustic environment and its ability to address life safety issues. This research intends to serve as a manual for assessing the performance of integrated systems in the conceptual building design stage. The particular focus on the interaction of two paired main building systems aims to filter out the extraneous information and bring coherence to the environmental performance aspect of the systems. This is achieved through explicit presentations of six paired building systems. The pairing is based on four primary systems of structure, envelope, mechanical and interior systems which were identified as sufficient to completely describe a building in the Building Systems Integration Handbook. This book, published by the American Institute of Architects more than two decades ago, pointed out that although there are clearly many more than four systems in the contemporary building, these four are sufficient to completely describe a building and provide a concise starting point for the analysis of combinations.

Conference theme: Innovative approaches to architectural education
Keywords: building systems integration, environmental performance

INTRODUCTION

Figure 1. Screen shot from an animation depicting sunlight shading devices (morning)

In the practice of architecture an overlap exists in the system aspects of building design, where both architects and engineers develop solutions.

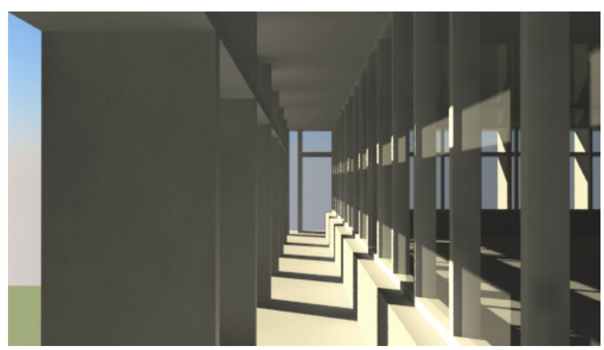

Figure 2. Screen shot from an animation depicting sunlight shading devices (mid-day)

Architecture and engineering have been characterized as two dissimilar disciplines, which must work together due to the vast array of aesthetic and technical needs of a complex modern building [Belcher 1996]. Several writers have emphasized the difference in approach that engineers and architects take to problem solving. Architects often start with a broad design concept with many different requirements, both functional and aesthetic, while engineers are provided with very focused tasks that may or may not include the broader design scope [Schlaich 1991]. Engineers make decisions regarding sub-system efficiencies most often by focusing on the efficiency of a particular sub-system. However, each of the sub-systems of a building are more malleable than often acknowledged. Each sub-system has its discipline-specific performance criteria and therefore, with regards to design, its own ordering principles. In the building sub-systems are more often than not in conflict, each sub-system using contradictory distribution systems which compete for the same space. Integration of building systems requires the resolution of these conflicts. This conflict raises fundamental questions about the role of architectural design in the process of integrating buildings' systems. If each system in a building has its own ordering principles, and integration inherently requires a compromise among individual systems for a larger whole, what is the basis for making design decisions?

Current guidelines for gauging the environmental performance of buildings are primarily *checklists* and may provide little direction regarding specific design solutions for individual systems. The US Department of Energy's *Smart Schools* program, for example, provides a number of directives for the design of schools which are based on discipline-specific research. *The Advanced Energy Design Guide for K-12 School Buildings* published by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) is one of these references. This document provides *Design Tips* for the school designer such as "provide daylighting to classrooms", "provide lighting systems with energy efficient lamps, etc." The foundation for these suggestions for daylighting is based on an extensive study of the impact of daylighting on student performance [Heschong, 2002]. This analysis included data on over 21,000 students and found better tests scores in daylight classrooms, suggesting an important relationship between daylight availability in buildings and student performance. This study provides a powerful justification for the incorporation of daylight into the design of buildings. However, on closer inspection, this study provides few specific metrics by which to judge the quality of a specific design. Conclusions were based on assigning existing classrooms into one of six categories of a *daylight code* which ranged from *daylight* to *no daylight*. Although this study provides some basis for judging which attributes of a daylight classroom contribute to a daylight effect (enhanced student performance) these attributes are not quantified.

1. ARCHITECTURAL SYSTEMS, BUILDING SYSTEMS, AND INTEGRATED BUILDINGS

1.1. *Building Literacy: The Integration of Building Technology and Design in Architectural Education*

As the environmental impact of buildings becomes increasingly scrutinized, the role of building designers in the initial decision making process and the impact of these decisions upon energy use become more critical. An informed design process merging environmentally responsible practices with advanced technologies can significantly reduce the adverse impact of buildings on the environment. A critical component of an informed design process is a clear understanding of building systems operation, interaction, and the synergetic benefits realized through their proper selection. A consideration of suitable building systems, gauging their interaction, and proposing well integrated systems can lead to producing efficient models of sustainable buildings with minimal adverse impact on the environment. This paper will provide a summary of on-going research entitled *Building Literacy: The Integration of Building Technology and Design in Architectural Education* funded by the US Department of Education's Fund for the Improvement of Post-secondary Education (FIPSE). This research has two significant aspects. The first is the development of interactive digital media to create a *gaming* environment through which to teach sustainable design. The audience or potential *player* is intended to be as broad as possible. Building *Literacy* is not intended to be developed as a substitute for high resolution analysis tools such as *DAYSIM* or a comprehensive analysis and visualization tool such as *ECOTECT*. Both of these examples require substantial input from the building designer to obtain feedback regarding building performance. Since both are meant to seamlessly integrate into the building design process, each require exterior wall types and building plans (and resultant geometry) generated by the user. *Building Literacy* will allow the user to select from a variety of *pre-constructed* virtual building elements. These will be comprised of element sets as diverse as exterior wall panels (refer to Fig. 1 and Fig. 2 for an example of an *eggcrate* shading device applied to a building envelope), interior room arrangements, floor templates, etc. Admittedly, the assembling of a virtual *kit of parts* can provide only a limited number of possible combinations as compared to the *infinite* possibilities supposedly open to the designer who designs a building from *scratch*. However, the virtual kit of parts provides a platform upon which an entire building can be rapidly assembles, analyzed for environmental performance, re-assembled and re-analyzed. It is believed that this iterative process will accelerate the learning of both the design variables involved in environmental building performance and the potential magnitude of each variable. The *Building Literacy* project does not involve the development of a new tool to evaluate a specific environmental performance (such as the distribution of light in perimeter spaces or the thermal performance of the building envelope) rather; it attempts to teach the performative interaction between different systems incorporated into a building. The desire to compare the performative interaction of various systems has provided an interesting vantage point from which to assess the various programs that measure specific metrics of environmental performance for individual systems. Two interesting points emerge out of this research. The first is a body of emerging research which seeks to *quantify* what to this point has been discussed in a *qualitative*, largely unquantifiable way. The quantifiable data currently being generated is not precise enough, nor easily tied to performance criteria to be able to make comparison across the systems. The second point is that there are very few metrics for measuring the impact of the integration of building systems upon environmental performance. In fact, this may have always been a relatively little analyzed aspect of building systems integration.

1.2. Building systems and environmental performance

The second aspect of research being conducted for the *Building Literacy* grant is the development of digital learning environments to teach specific lessons about building systems and environmental performance. As opposed to the stochastic environment of the *gaming* environment described above, these lessons will provide an analysis of specific building system integration strategies and how these strategies are related to environmental performance. This is done by the development of a series of examples presented as three dimensional models of well integrated building systems. Each model is composed of two paired integrated systems analyzed with full graphical display, text, analytical drawings, graphs, and tabulated values, to demonstrate the models' performance in a particular environment. A performance metrics provided for each model will serve as a basis to evaluate the sustainability of the system based on its performance in the thermal environment, luminous environment, acoustic environment and its ability to address life safety issues. This research intends to serve as a manual for assessing the performance of integrated systems in the conceptual building design stage. The particular focus on the interaction of two paired main building systems aims to filter out the extraneous information encumbered in the use of the broad term integrated building and bring focus to the environmental performance aspect of the interaction of various systems. This is achieved not through representations of entire buildings but rather by explicit presentations of isolated paired building systems. The pairing is based on four primary systems of structure, envelope, mechanical and interior systems which were identified as sufficient to completely describe a building in the Building Systems Integration Handbook [Rush, 1986]. This book, published by the American Institute of Architects more than two decades ago, pointed out that although there are clearly many more than four systems in the contemporary building, these four are sufficient to completely describe a building and provide a concise starting point for the analysis of combinations.

In the past several decades, the terms "architectural systems", "building systems integration" and "integrated buildings" have moved in and out of the lexicon of architectural discourse. The topic itself and the various approaches are so wide-ranging as to defy an exact definition. One of the most recent texts on building systems integration claimed that the building section of most construction in this country segregates individual sub-systems into horizontal layers to avoid interference [Bachman 2003]. By contrast is the efficiency of the integrated building which by eliminating redundant services will supposedly address issues of sustainability. Bachman's study of integration was a significant step forward from the *Building Systems Handbook* since it provided specific climatic data. It is suggested here that a further development would be the actual analysis of the environmental performance of specific examples to study the contribution of each system.

1.3. An example of *integration*

Figure 3. Screen shots of double envelope of the Occidental Chemical Building

Perhaps the potential of studying the relationship between environmental performance and building systems integration can be clarified by referring to a specific historical example. The Occidental Chemical Company Corporate Office Building by Cannon Design was included in the original *Building Systems Integration Handbook (BSIH)* [Rush, 1986]. The double envelope of the exterior of the Occidental Chemical Building was intended to act as a *thermal blanket* in the heating season and as an *exhaust vent* during the cooling season with operable louvers which actively respond to climate. The review of this building in the *Building Systems Integration* Handbook praised it as a *meshed* level (the highest level) of integration. However, as with almost all of the examples in this book, there is little quantifiable information as to the environmental performance (refer to Fig. 3 screen shots of double envelope of the Occidental Chemical Building). Ironically, the building was also published the same year in William Lam's *Sunlighting as Formgiver for Architecture* [Lam, 1986]; in Lam's book the building is referred to as the *Hooker Chemical Building*. While Lam acknowledged the success of the double envelope as a solution able to "defy any environmental influence on their form by a technological tour de force" (pg. 201), Lam criticized the louvers relative to views to the exterior as visually confining and distracting. Lam also commented on, but was not able to quantify the potential of the louvers on the distribution of daylight in the perimeter offices. Presumably, this is because of the limitations of *the daylight factor* as a performance metric at the time these books were written (refer to Fig. 4 screen shots of interior of Occidental Chemical Building).

Figure 4. Screen shots of interior of Occidental Chemical Building

The daylight factor has been in use for more than a half century and is defined as the ratio of the internal illuminance at a point in a building compared to the unshaded, external horizontal illuminance under a CIE overcast sky [Moon, P. and Spencer, D.E., 1942]. The daylight factor is the most widely used quantitative measure of daylight [Nabil, A. and Mardaljevic, J., 2005]. A number of different methods have been developed to calculate the daylight factor based on the overcast sky. An underlying assumption is that the overcast sky is a worse case condition and other sky conditions will provide more daylight. The daylight factor does not consider season, building orientation, building location, or direct sunlight. In the absence of these considerations the daylight factor provides little input regarding glare prevention strategies such as vertical and horizontal louvers. To overcome this shortcoming, most designers have historically used direct sunlight studies using simulations or scale models. The goal of these studies is to design facades that prevent direct sunlight on glazing and therefore minimize direct solar gain. The buildings that result from a consideration of both the daylight factor and the blocking of unwanted solar gain exhibit a considerably improved energy balance than a building designed using only the daylight factor. A limitation of this *combined approach* is that only static shading devices and different glazing types can be compared. This limitation has led to recent research which promotes the use of dynamic daylighting performance measured as a way to achieve sustainable design [Reinhart, C.F.; Mardaljevic, J.; Rogers, Z., 2006]. The argument for dynamic performance measures is based upon three shortcomings of the above mentioned *combined approach*; the difficulty of comparing shading devices with manually operated venetian blinds, the lack of consideration for varying daylighting requirements for different building types and occupants and the fact that although the combined approach accounts for building orientation and latitude, the actual climate of a site is not considered. The Occidental Chemical Building is a historical example of an integrated solution in which the contribution of each system was at the time the building was reviewed, somewhat unclear. The use of dynamic daylighting metrics allows an investigation into whether the operable louvers provided a solution to the limitation of static sunshades or simply compromised the distribution of daylight in the interior spaces.

1.4. Conclusion

What is proposed here is the proposition that architectural constructions involve a delicate balance between various systems, each of which has its own logic, indifferent to the other. It is left up to the architect to make sense of these contradictory conditions. The ability to read the inherent order (and disorder) of each system and to make conscious decisions which recognize the potential conflict and/or coincidence is one of the primary skills required of the contemporary architect. As the ability to measure the actual environmental performance of buildings becomes more refined, it is likely that we will be able to quantify both the specific contribution of each system *and* the interaction of systems upon each other.

ACKNOWLEDGEMENT

Research for this document was funded through the grant entitled *Building Literacy: The Integration of Building Technology and Design in Architectural Education* as part of the US Department of Education's Fund for the Improvement of Post Secondary Education (FIPSE).

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Integrating Environmental Performance Criteria in Architectural Design Studios

Hazem Rashed-Ali, Ph.D.

The University of Texas at San Antonio, San Antonio, Texas

ABSTRACT: In recent years, the need to increase the environmental sustainability of the built environment has been clearly established, and an increasing number of built environment professionals are now aiming to design high-performance buildings. However, numerous studies have clearly indicated that achieving high-performance buildings, not to mention zero-energy or carbon-neutral ones, necessitates the integration of environmental performance criteria in the early stages of the design process, where they can be most effective. While a couple of decades ago such integration was difficult to achieve beyond the general design guidelines or rules-of-thumb level, both of which are inadequate to address the specific circumstances of each project, recent advances in building performance simulation tools now allow architects to effectively include building performance criteria in the early stages of their form-making processes. In the case of architectural education, an even more urgent need exists to introduce new generations of architects to the principle of integrating environmental performance criteria in the design process, and to train them to utilize the latest available tools to achieve this. This, however, requires a change from the traditional studio format in which projects are evaluated solely or primarily based on their form/image into one in which projects are evaluated comprehensively based on multiple criteria that include environmental performance as well as other relevant design objectives. The time limitations and wide range of issues typically covered in studios, however, make it difficult to also teach students the skills needed to effectively utilize performance simulation tools. This paper aims to provide a review of previous efforts to integrate environmental performance criteria in the design process in general and in design studios in particular, and presents a proposed collaborative seminar/studio model, which utilizes a seminar to introduce students to the different topics and building performance simulation tools necessary to understand and integrate issues of environmental performance in their designs. These performance considerations are then integrated into design projects in a studio, which runs concurrently with the seminar. In addition to describing the proposed model, the paper will also present results and conclusions from its first year of implementation in the University of Texas at San Antonio.

Conference theme: Building performance studies, zero energy, and carbon-neutral buildings
Keywords: sustainability, environmental performance, architectural education

INTRODUCTION

In recent years, the need to increase the environmental sustainability of the built environment has been early established. This growing interest in achieving more environmentally conscious buildings and communities necessitates an increase in efforts to more effectively integrate environmental performance criteria in all stages of the design process. This is made more significant by the fact that an increasing number of architects and other built environment professionals are now striving to design high-performance, zero-energy, and carbon-neutral buildings, and that achieving these high-performance objectives is not possible without such integration. Integrating environmental performance criteria into the design process is achieved through various methods which differ according to the stage of the design process they are intended for. All methods, however, aim to inform design decisions by an assessment of the expected environmental performance of the community, building, or building components, based on measurable criteria (e.g. energy consumption, harmful emissions, or other environmental impacts).

While performance criteria can and should be considered in all stages of the design process, numerous studies have clearly indicated that achieving high-performance buildings, not to mention zero-energy or carbon-neutral ones, necessitates the integration of these criteria beginning from the early design stages, where they can be most effective. This is particularly important because of the high impact that design decisions taken in these stages have over the environmental performance of buildings and communities. The ASHRAE Green Guide (Grumman, 2003) contends that "*it is much easier to have a major impact on the potential energy savings in a building … at the very early stages of the design process*" and that "*the available impacts diminish [in later] design and construction phases*". On the other hand, integrating environmental considerations in the design process faces several obstacles that frequently cause them to be overlooked. Mazouz & Zerouala (2001) identify some of these obstacles as the influence of iconic models, conceptual modes and pictorial movements that tend to transcend other design variables. Additionally, reliance on technical solutions to solve any building thermal or environmental problems adds to this tendency to overlook environmental performance considerations in design.

Integrating performance criteria into early design stages in particular is made more difficult by the wide range of issues and limited time available in these early stages. Therefore, integration of performance criteria in these stages has typically been limited to expert rules of thumbs and design guidelines that indicate to designers the optimum alternatives and/or acceptable ranges for relevant design parameters under certain conditions. Both of these methods, however, are based on average regional conditions, do not address the circumstances of a specific project, and do not offer the possibility of predicting the performance of that project (Morbitzer 2003). This makes them inadequate to achieve the desired goals of high-performance. However, recent advances in building performance simulation tools now allow architects to effectively include building performance criteria in the early stages of their form-making processes. These tools take into consideration the relationships between different design variables and allow for a more accurate assessment of the impact of specific design decision on environmental performance, thus increasing the validity of design solutions and reducing the cases in which detailed environmental assessments, in later design stages, indicate the need for major design changes, which are typically difficult to achieve at that time.

In the case of architectural education, an even more urgent need exists to introduce new generations of architects to the principle of integrating environmental performance criteria in the design process, and to train them to utilize the latest available tools to achieve this. This, however, requires a change from the traditional studio format in which projects are evaluated solely or primarily based on their form/image into one in which projects are evaluated comprehensively based on multiple criteria that include environmental performance as well as other relevant design objectives. While several models exist for integrating environmental considerations in general, and simulation tools in particular, in design studios, the time limitations and wide range of issues typically covered in studios generally make it difficult to also teach students the skills needed to effectively utilize simulation tools.

Based on this, this paper aims to provide a review of previous efforts to integrate environmental performance considerations in the design process and in design studios. A proposed collaborative seminar/studio model is then presented and described. In this model, a seminar in utilized to introduce students to the different topics and building performance simulation tools necessary to understand and integrate issues of environmental performance in their designs. Students then integrate these performance considerations into design studio projects, which run concurrently with the seminar. In addition to describing the proposed model, the paper will also present results from its first year of implementation in the Department of Architecture, University of Texas at San Antonio.

1. Performance Simulation and design of high-performance buildings

It is now commonly accepted that the design of high-performance buildings requires the integration of performance criteria in all stages of the design process. This appreciation of the significance of performance evaluation within the design process is not new. Markus (1969) argues that measurement and appraisal of performance is central to the design process. More recently, Preiser and Vischer (2005) argue for a Building Performance Evaluation (BPE) framework for the planning, design, construction and occupancy of buildings in which quantitative and qualitative building performance criteria are used to inform all stages of the process and contend that this framework will allow decision makers to make more informed design decisions. With regard to environmental performance, Augenbroe (2005) proposes a set of environmental performance indicators (PIs), as unbiased measures of performance, which can lead to more rational decision-making and better dialogue between stakeholders in the building delivery process.

A variety of methods and tools currently exist for integrating performance criteria in the design process. Shaviv et al (1996), Garde-Bentaleb et al (2002), and Morbitzer (2003) all offer similar classifications of these tools including: 1) design guidelines and expert rules of thumb; 2) simplified calculation methods and simplified computer programs; 3) small scale modelling; and 4) comprehensive simulation programs. All of them, however, agree on the inadequacy of guidelines and rules of thumb and that computer simulation offers the best potential for effective design support. Clark (2001) further argues that simulation permits an evaluation of building performance that corresponds to reality and enables integrated performance assessment, while Malkawi (2005) contends that the use of performance simulation in architectural design is on the rise, and that the building industry is aware of the need for better integration of these tools into the design process. This increase in the use of performance simulation tools by architects and the relationship between their use and the design of high performance buildings is best illustrated by the numerous examples of high performance buildings in which such tools have been used. For example, Lerum (2008) analyses 8 case studies of high performance buildings, all of which utilize performance simulation in a variety of forms.

2. Performance criteria and Arcvhitectural design studios

The recognition of the need for better integration of environmental performance criteria in architectural design studios and the search for means of effectively achieving this is far from being a new concept. Recent increased concern for the environment, however, has given this area of research a renewed sense of urgency. Meunier (1980) argues for the necessity of introducing performance, measured in non visual ways, into the design studios through the application of simple scientific principles and the use of all kinds of testable models, both physical and mathematical. Brown (1980) makes an even stronger argument for this integration by contending that:

> *"The teaching of mechanical and electrical systems in isolation (distinct from design studio) reinforces the notion that technical courses are narrow, equipment oriented and independent. Broader environmental questions should be addressed relating to social and political. To accomplish this, mechanical electrical building design must be integrated with a synthetic building design process so as to combine programmatic elements in a way that is responsive to physical, social and political context."*

Throughout the years, several approaches can be identified for strengthening the integration of performance considerations in architectural design studios. Several prominent text books have been developed specifically to assist design studio students in taking environmental performance criteria into consideration within their design process. Brown and Reynolds' "*Inside Out*" (1982) aimed to provide students with exercises which require the design of a building and its site, evaluation of that design, and a redesign on the bases of that evaluation. Brown (1980) argues that the intent of "*Inside Out*" is to point out that all design decision, by intention or not, affect the thermal, luminous, sonic, and water environments in buildings, which in turn affect the natural environment. "*Sun, Wind, and Light*" (Brown and Dekay, 2000) was designed to be used by students in the schematic design phase and included various simplified analysis techniques that aimed to help architectural designers to understand the energy consequences of their most basic design decisions and to give them information so that they can use energy issues to generate form. More recently, the Green Studio Handbook (Kwok and Grondzik, 2007) aimed to inform students' designs through providing them with information about the what, how, and how big of various green design strategies to permit a go or nogo decision regarding the appropriateness and viability of a given strategy to be made during schematic design.

In another approach, several large scale collaborative projects have been implemented in the last two decades to develop curricular material that would enhance the integration of building systems' issues and more recently, environmental performance ones, in the design process. The Vital Signs Project (Vital Signs, 2002; Boak, 1999) aimed to achieve this by encouraging architecture students to examine architectural, lighting, and mechanical systems in existing buildings with attention to energy use, occupant well-being, and architectural space-making. Studies performed within the project resulted in 12 resource packages that address physical building performance issues such as energy use, the experiential quality of buildings and occupant well being. The Agents of Change Project (2005) provided training sessions for faculty and teaching assistants to train in methodologies of investigating actual buildings, conducting post-occupancy surveys, and developing exercises to implement at their home institutions. The Carbon Neutral Design (CND) Project (SBSE, 2009) is the most recent of these efforts. The project aimed to address the increasing sense of urgency of today's ecological challenges. The project was initiated by the Society of Building Science Educators (SBSE) in a joint effort with the American Institute of Architects (AIA) and its Committee on The Environment (COTE) to create and disseminate the resources and tools needed to integrate carbon neutral and zero-energy design into professional architecture programs and practice. As part of this project, SBSE implemented the Carbon Neutral Studio initiative in Fall 2007 to develop carbon-neutral teaching resources and tools; to pilot those resources and tools; and to develop a means to share educational resources and the studio outcomes for carbon-neutral design education. The initiative included the implementation of 31 carbon-neutral studios in universities across the US and Canada. One of these studios was the first implementation of the seminar/studio model described in this paper.

With regard to integrating performance considerations in design studios, Brown (1980) categorizes these approaches into: 1) general studio courses with clearly identified ECS content, 2) completely ECS oriented project studios; and 3) lecture courses strongly related to design studio processes. Similarly, Levy (1980) criticizes the traditional approach of separating studio and non-studio components of the curriculum and identifies two alternative model for overcoming its deficiencies: the total studio, in integration of design and all other areas of content happen in the studio, and the independent lab/studio, in which lecture courses aim to expand student motivation through experiential learning and problem solving, and employing and emphasizing creative design aspects, lab techniques, and studio methods.

Recent advances in building performance simulation tools, including their improved and more accessible user interfaces, enhanced application quality control, and better interoperability, more attempts at integrating performance criteria and simulation tools into design studios have been emerging. A survey of sustainability curricula in North American Schools of Architecture in the mid-nineties (Boak, 1995) identifies several software simulation tools, which were used in design studios at the time (some of which are still being used today). These include: G. Z. Brown's Energy Scheming, Murray Milne's Climate Consultant and Solar 5, Larry Degelman's ENER-WIN, Douglas Balcomb's ENERGY-10, and Leonard Bachman's Spreadsheets for Architects. Dekay (1999) describes an experiment in using Energy Scheming involving diverse approaches at different schools. The approaches included developing a Web-based "instructorless seminar", integration into lecture courses, and integration in studio. Dekay concludes that computer simulation offers a possibility for increasing students' ability to deal with greater complexity in a shorter time frame, especially with thermal and lighting issues.

Since that time, however, several new software tools with more capabilities have been developed, many of which have been used by faculty in different settings. Similar to the categorization of approaches discussed earlier, two approaches to integrating performance criteria in design education, and to the use of software simulation tools, can be identified in recent literature. The first approach involves teaching the technical content in a seminar setting with a strong design focus, while the second involves integrating the technical content directly into the studio. Dangel (2008) offers an example of the first approach, in which a graduate seminar was used to teach building envelop design in a design project-based learning method. The seminar included a semester-long design project which formed the core of the coursework, and which allowed students to investigate concepts and principles and then test their feasibility and practical application in a design problem. The project consisted of a sequence of strongly-related design exercises. Dangel concludes that this model allowed students to experience that the presence of physical and technical constraints in the design process did not have to be a creativity-limiting factor, but could in fact constitute a liberating yet challenging aspect. The second approach is exemplified by Faoro and Means (2009), who collaborated in a performance-based integrated-design sustainability studio. The studio was divided into four sequential phases, each utilizing one or more software tools to inform the design process. The instructors concluded that sustainable design studios can provide an opportunity for performance-based design measures to be integrated into academic coursework, and that the metrics used to assess sustainable characteristics employ physical and ecologically based scientific facts in evaluating and promoting ecological literacy in the design of carbon neutral buildings.

While both approaches represent successful models that clearly have a lot of merits, they also both have some draw backs. The first approach, while allowing for in-depth study of the technical topics combined with the obvious benefits of direct application in a design setting, has the drawback of the limited time typically available for seminars especially if student are concurrently enrolled in a demanding design studios. This may not allow students the time needed to fully develop, and benefit from, the design project included in the seminar. The second approach, on the other hand, avoids this issue and achieves the direct integration of the technical content into the studio setting, yet again, the many topics/issues that need to be covered in design studios may limit the time available for covering the technical topics, especially the time needed to acquire the necessary software skills for students exposed to them for the first time. This may subsequently result in not achieving the desired level of utilization of the full capabilities of these tools.

To address these issues, the following sections describe a proposed collaborative seminar/studio model for the integration of environmental performance criteria into design studios, which attempts to combine the strengths of the two models described above while reducing their limitations.

3. A Collaborative Seminar/Studio model

Integrating environmental performance criteria in the design studio process and teaching students the design of high-performance, zero-energy, and carbon-neutral buildings requires addressing a wide range of topics, strategies, systems, and technologies typically associated with various aspects of environmentally sustainable design. In addition, students should be introduced to state-of-the-art design decision support and environmental performance simulation tools, many of which have been designed specifically for architects and architectural students and are currently used by practitioners and researchers, as a means of informing their design decisions. To take full advantage of the potential these tools offer, however, students should be provided with hands-on experiences in using the tools, which they can then utilize both in their current studios as well as in their future academic and professional design activities. These experiences should also be used to demonstrate how sustainable design practices can significantly reduce the negative environmental impact of the built environment, while providing more comfortable, healthy and economic buildings and communities. Using these tools, studio projects can be evaluated not based on claims of performance, design guidelines, or rules of thumb but based on actual evidence that specific performance goals have been achieved. Architectural students should also be shown that the design of high-performance buildings does not preclude designers from addressing any other relevant design consideration and does not, as is sometimes claimed, necessarily result in low-quality architecture.

Covering the needed wide range of topics while in the same time training students to utilize the latest performance simulation tools in the studio is made difficult by the time limitations of studios which do not allow students the necessary time to address all of these topics and, in the same time, acquire the skills needed to take full advantage of the simulation tools especially if they are exposed to them for the first time. The seminar/studio model presented in this paper represents an attempt to address this issue by introducing students to these important topics and tools in a separate seminar yet allowing them to directly apply the knowledge and skills they acquire in a studio setting. To achieve this, collaborative teams are formed

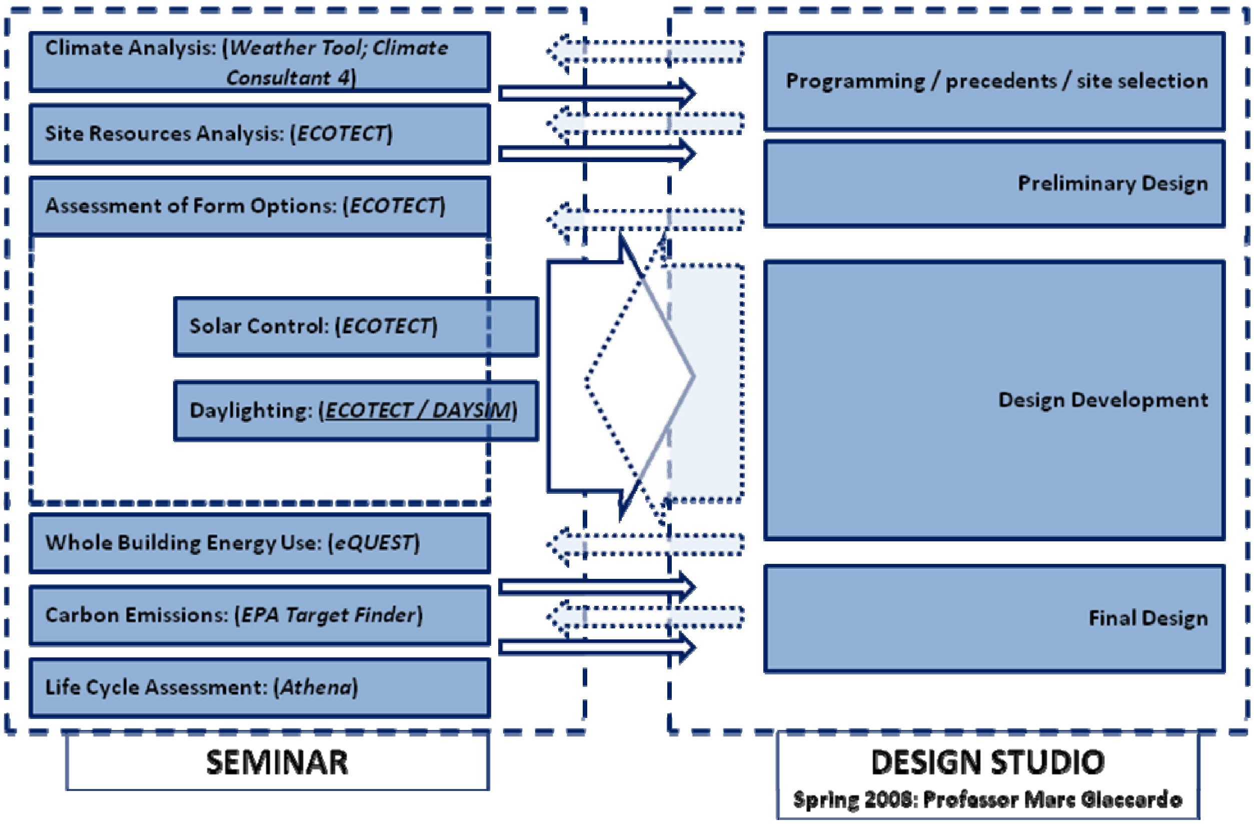

Figure 1: The proposed collaborative seminar/studio model.

between students in the seminar and in the studio, in which seminar student play the role of the environmental consultants within the design team. The goal of the consultants is to utilize the knowledge they gain in the seminar to provide the design studio students with the guidance, analysis, and support they need to inform their design decisions.

The proposed model was implemented for the first time in the spring 2008 semester in the College of Architecture, the University of Texas at San Antonio. The seminar was taught as an elective titled: "*applications in Sustainable Design*", which was cross listed for both graduate and undergraduate students. The seminar was conducted in collaboration with a concurrent undergraduate design studio taught by Professor Marc Giaccardo. The seminar included 18 students (11 undergraduate and 7 graduate), while the studio included an additional 18 undergraduate students. Design teams were formed between students in the design studio and in the seminar. Seminar students played the role of environmental performance consultants, while studio students were asked to utilize the results of the performance analysis in informing their design decisions. A schematic diagram of this collaborative model is shown in figure 1.

The seminar consisted of a sequence of topics and related exercises and assignments, which were coordinated with the sequence of the design studio project. The structure of the topics and assignments in the seminar aimed to capture synergetic relationships between the different systems in the building and to gradually build up from the individual components to the overall building performance. For example: relations between site resources, building form and orientation, and occupant comfort; shading and daylighting; daylighting, HVAC, electric lighting; etc. The topics covered in the seminar included:

1- Climate analysis.
2- Analysis of site resources.
3- Performance assessment of form options.
4- Solar control and shading.
5- Daylight analysis and design.
6- Whole building energy use.
7- Building carbon footprints..
8- Design of photovoltaic systems.
9- Life cycle assessment of building materials.

As part of covering each topic, seminar students were introduced to one or more software simulations tools relevant for that topic. Students first applied these tools to a simplified design exercise to gain some experience with its use, then they used the same tools to perform a series of analysis tasks to the design projects of the studio students and provide performance-based feedback. In each of phase, students were required to meet specific performance targets, while at the same time aiming to achieve the overall performance target of carbon neutrality for the whole project.

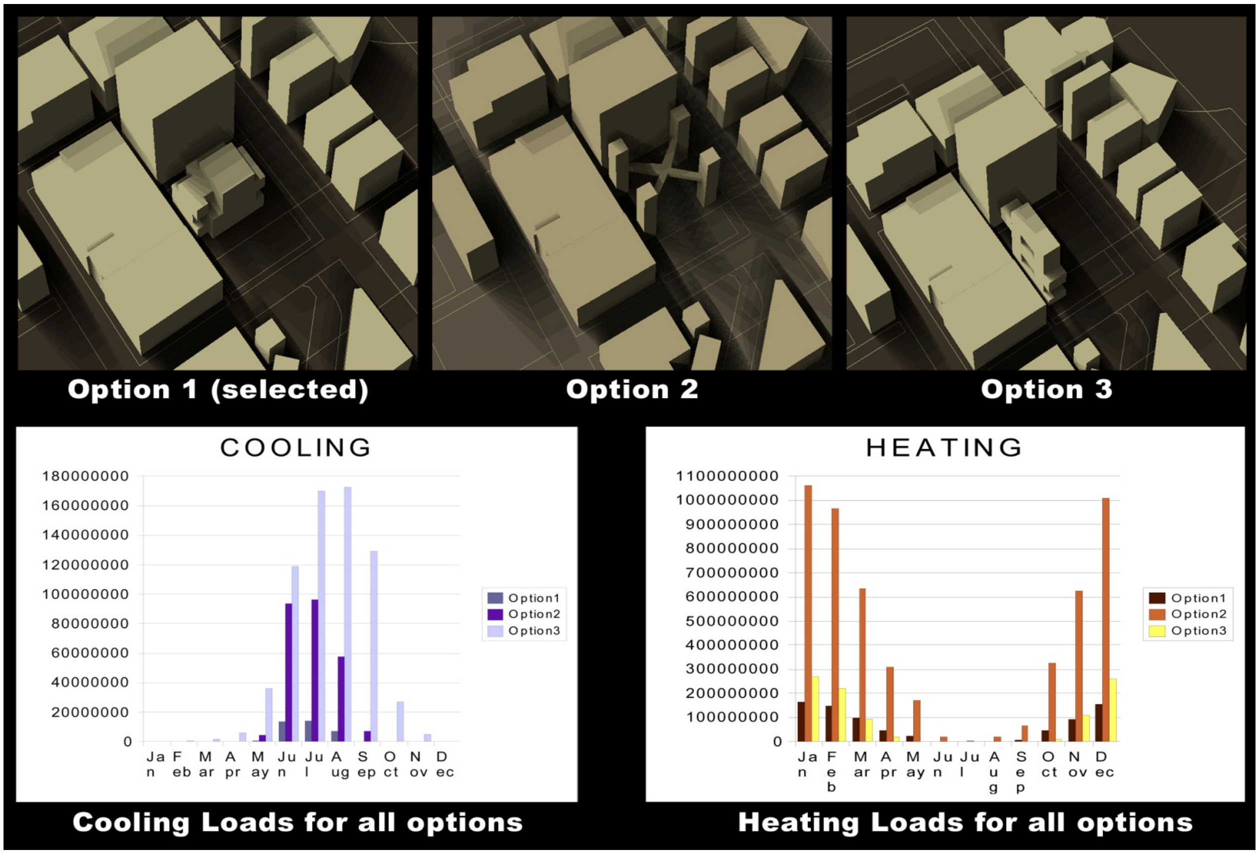

Figure 2: Using ECOTECT to compare the performance of project form alternatives.

Most of the performance analysis tasks conducted within the seminar/studio utilized the simulation tool ECOTECT. ECOTECT is a complete building design and environmental analysis tool that covers the full range of simulation and analysis functions required to truly understand how a building design will operate and perform through allowing designers to work easily in 3D and apply all the tools necessary for an energy efficient and sustainable future (Autodesk, 2009). During the seminar, ECOTECT was used to analyze the resources of the projects' sites, by conducting solar access and shadow range studies, to compare form alternatives, by simulating the cooling/heating loads of each option, to design shading devices, and to perform daylighting analysis. ECOTECT's Weather Tool was also used to perform climate analysis. Other software tools and databases used within the seminar/studio include Climate Consultant 4 (Milne, 2008), used in climate analysis; Radiance and DAYSIM (NRC, 2004), used to simulate daylighting performance, eQUEST (Hirsch, 2003), used to perform whole building energy use simulations; EPA's Target Finder (EPA, 2008), used to estimate the building's carbon footprint; and the life cycle assessment tools BEES (NIST, 2007) and EcoCalculator (Athena Institute, 2008). Figures 2, 3, and 4 show examples of student work in some of the analysis tasks performed. Figure 2 shows an example of using ECOTECT to compare different form alternatives for a design project based on the resulting cooling and heating loads, figure 3 shows an example of a daylighting simulation modelled using ECOTECT and then rendered in Radiance, while figure 4 shows an example of a whole building energy use analysis performed using eQUEST.

4. Evaluation of first IMPLEMENTATION

In general, the first implementation of the proposed model proved to be successful. Both the design projects and the performance assessment reports produced by the seminar students exhibited a good level of understanding of the principles, strategies, and systems involved in the design of high performance buildings. While some of the design projects did not manage to achieve the goal of carbon neutrality, mainly because the needed photovoltaic system was too large to be integrated in the buildings as required, they still resulted in high-performance buildings with carbon footprints 20 – 40 % lower than their conventional counterparts (according to the Target Finder tool).
Student feedback was also generally very positive especially form the seminar students. While students commented on the large amount of work involved in the seminar, compared to other electives in the program, they all seemed to appreciate the unique skills and experiences they gained from the seminar. Many also commented positively on the team-working experience they went through during the semester.

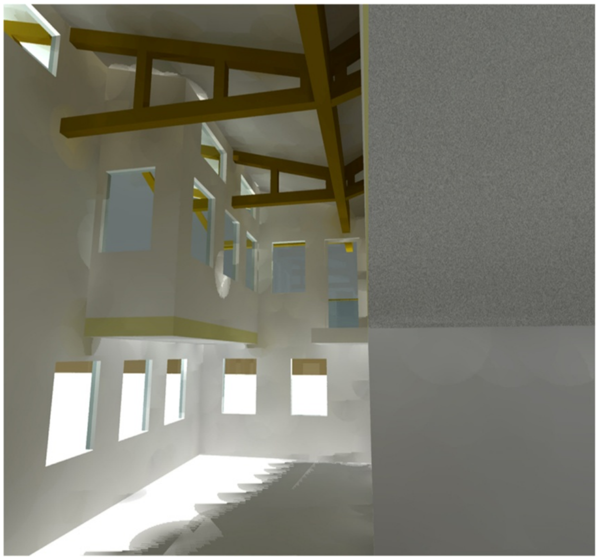

Figure 3: Daylighting simulation using ECOTECT and Radiance

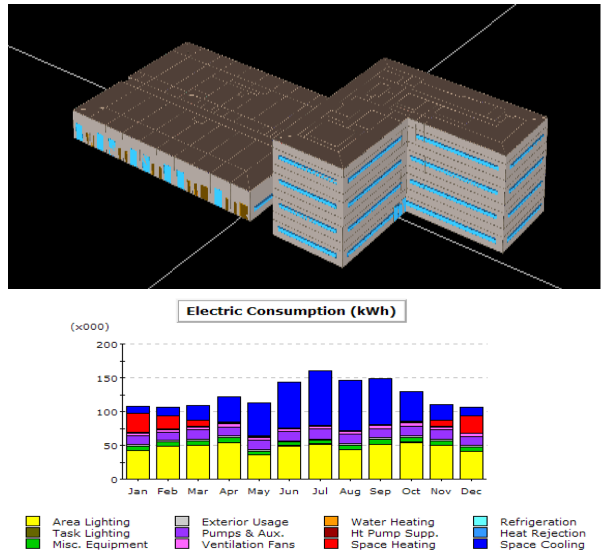

Figure 4: Whole building energy use simulation using eQUEST

On the other hand, several issues have been identified which require improvement in future implementations of the model. Most of these involve organizational and scheduling issues which resulted from the different day/times in which the two courses involved were offered. In this respect, several students commented on the need for more organized meeting times between the two groups of students. In addition, some of the groups also faced difficulties in communicating and exchanging the required work during the semester. Most of these however resulted from personal and group-dynamics issues in these groups. Finally, the issue of how to evaluate the design studio students with respect to the success of their design in meeting the performance targets also needs to be further explored and examined.

Based on all of this, we can conclude that the model implementation experiment was successful in general and resulted in effectively introducing a much larger number of students to the issues and tools needed to achieve high-performance and carbon-neutral designs and to the tools needed to achieve this goal than would have been possible using only the studio format. Future implementations of the model should prove more successful by building on the positive experiences of the first implementation and avoiding or minimizing any negative aspects.

Conclusions: MOdel effectiveness

Based on the experiences of the first year of implementation, the following can be concluded with regard to the effectiveness of the proposed model in assisting students in designing high-performance and carbon-neutral buildings in architectural design studios:

On the one hand, the use of simulation tools clearly allows for far exceeding the accepted objective of minimizing loads, through the use of passive design guidelines and rules of thumb, and providing PVs with no verification of achieved performance. On the other hand, it is difficult for studio projects to credibly claim/achieve zero energy and/or carbon neutrality both because of the limitations of the schematic design stage (lack of time, details, etc.) and the difficulty of accounting for the potential savings of advanced mechanical and electrical systems, or any potential integrative solutions to optimize the performance of both envelop loads and systems. While the simulation tools we have available now do allow for accounting for such savings, this requires a level of experience beyond that of architecture students.

However, the proposed format does allow measurable performance improvements targets for whole building energy use in the studio projects to be set and verified. As the simulation will be based on average mechanical and electrical systems performance, performance improvement targets should be limited to potential improvements resulting from building form, orientation, envelop improvement etc. (in the range of 20 – 30% from average usage), which still represents a significant improvement. Similarly, aggressive performance targets can be set for each of the element systems (shading, daylighting, etc.). These goals can be derived from existing or proposed building performance standards and initiatives (ASHRAE 189, 2030 Challenge, LEED®, etc.). For example, one of these goals could be to achieve the LEED® target with regard to space daylighting. These targets will probably also fall short being of zero-energy for the same reasons discussed above.

ACKNOWLEDGEMENT

The author would like to acknowledge the valuable contributions of Professor Marc Giaccardo, the instructor of the studio in the first implementation of the seminar/studio model described in the paper. The author would also like to thank Professor Jim Wesley and other participants in the Carbon Neutral Teaching Initiatives for their valuable comments and feedback on the teaching material developed for the seminar.

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Materially driven approach to design

Vera Parlac

University of Calgary, Calgary, Canada

ABSTRACT: This paper describes and assesses an approach to teaching an architectural design studio grounded in exploration of materials, their inherent properties and behaviors, and the performative capacities of material constructs. The goal of the studio was twofold: to blur the boundary between form generation and materialization of an architectural construct, and to examine the capacity of a materially driven approach to redefine traditional notions of function, context, and design methodology. The underlying ambition was to engage making as intrinsic to the design process. The resulting products of the material- and making-driven processes were then tested by projecting and engaging them in the public realm. In conclusion, this paper discusses possibilities brought forward by the emergence of an “intelligent” material – possibilities that relate not only to a change of a design methodology and process, but to the change in architect’s attitude that may arise from better understanding of material possibilities and how to work with them.

Conference theme: Innovative approaches to architectural education
Keywords: materials, technology, design process, materially driven approaches to design.

INTRODUCTION

Recent research and advances in material science have opened previously unimagined possibilities for architects and designers. However, it isn’t only the new properties and performative capacities of materials that trigger imagination. Like material scientists, architects and designers are increasingly interested in biological models and the way organisms use (i.e. make) materials and create structures. A possibility to tap into the growing knowledge base of how nature builds is truly fascinating. But it is not necessarily the beauty and elegance of the forms in nature that is most fascinating; it is a grasp of underlining processes which bring these forms into being that truly opens new possibilities into how we could design.

Fascination with biology is not new. Throughout the history of architecture this interest has taken various forms, but it is only in the past century that the understanding of underlining natural and biological processes (as opposed to figurative interpretation) has started to infiltrate architectural thinking. It is perhaps only in the past decade that this thinking has found its performative manifestation in architectural research.

At the beginning of 20th century chemists and physicists become interested in biology. Discovery such as double-helix structure of DNA provided an insight into a molecular structure and enabled manipulation of biological structure and function at the scale of the molecule. Alongside this and similar discoveries, building upon D’Arcy Thompson’s seminal text “On Growth and Form” showed that physical forces of the environment influence the form of an organism over long periods of time (Thompson 1917). The natural form and function of the organism were linked to the adaptation to the environment. The idea that form is not given or predetermined, but is the result of the process, influenced the technologically inclined architects, artists, and thinkers of the early 20th century. This influence is found in the works of Lissitzky, Moholy-Nagy, Kiesler, as well as Le Ricolais, Buckminster Fuller and others. The new understanding of indeterminacy of form opened the door to the question of what kind of processes or means are involved in the making of form (Mertins 2007).

Today, advances in science and technology continue to open new horizons for architects and designers, triggering their imagination and informing their thinking. Capacity to design materials with specific properties, design material behavior, along with tools and techniques to visualize and fabricate infinitely small and to simulate emergent behaviors are opening previously unimagined possibilities. Architects such as Lars Spuybroek, and engineers such as Cecil Balmond and others, are demonstrating that this is a very important area of architectural research that potentially can change the way architects think and design buildings.

It is important to mention that architecture as a profession is slow to embrace new horizons and a change in thinking. Historically, the capacity of material (matter) to inform the form (by means of its adaptation to the environment) has rarely been employed. Materialization and formation of an imagined construct have rarely followed each other. Form, as a representation of meaning, has been prioritized over material (matter). This has led to the subjugation of material to form, and subsequently to viewing material as an inert matter that has to be organized through various kinds of assembly. Assembling materials to achieve a form became a way of materializing layered and complicated representations. But the logic of collage and montage is quite different from the "logic" of a biological model; the seamlessness of execution, the evolving adaptability, the inherent responsiveness to the internal and external influences, awareness of the interconnectivity to the surroundings is an aspiration that would require the change of (collage) logic and sensibility. What would the focus on material, its operational capacity, its behavior, and its innate properties bring to a designer? Are we ready to begin to unmask, redirect, and reframe the concept of representation, shortcut the mediation of an image, and engage making more directly, seeking fluid alliances between conception and realization?

In the past, architects have occasionally used the inherent "intelligence" of material as an active design tool. For example, Frei Otto worked with form finding experiments using soap film and stretched fabric to develop minimal surface geometries that later served as a basis for the Munich Olympic Stadium. Heinz Isler, a Swiss engineer built doubly-curved concrete shell based on suspension method where the forms for shells are found by hanging and fixating cloth. Antonio Gaudi, a Spanish architect worked with upside down wire models that traced the flow of forces within a complex structure to expose the week structural condition. These materially driven experiments were simultaneously material, structural, and geometric (Spuybroek 2004). They drew upon the material's capacity for self-organization under the influence of the external and internal forces. However, in these experiments material's behavior was used only to visualize complex structures and the way forces interact to produce stable and optimized organizations.

In the studio described in this paper, we used material behavior not only as a model for exploring materials' organizational potential, but also as a way to explore formal and structural qualities emerging from those organizations. We were intrigued by their variability and complexity but also by a discovery. The intention of the material studies in the studio was to extend the inquiry into the materially-based process and recognize the capacity of the organizational logic of material distribution, so that this information can be perpetuated in the quest for form, structure, and space that emerge from the inner logic and workings of the material system itself. Also, the intention was to pose a question whether form can emerge from an engagement of the material and whether such an engagement can bring forward new possibilities in architecture where architectonic imagination relates more fluidly with the urban and cultural one (imagination). This link was further explored through the agency of the body and its capacity to experience, inhabit, and appropriate.

1. LEARNING FROM MATERIAL ORGANIZATION

> Increasingly, I think of a project as a distribution of material in space, not as the assemblage of preformed elements. We are moving from collage to morphology, looking to deploy material as material for its spatial and surface effects … (Goulthorpe M. 2005)

The studio began by studying forming processes in nature and biology, and then focused on material experimentation. Students were encouraged to use wide range of materials that have properties of distribution and deformation under stress (plaster, glue, sugar, rice paper, wood, paper, metal). Material experiments were conducted to focus on the properties of deformation / distribution / behavior in order to explore the materials' organizational potential. In these experiments materialization and formation were viewed as intrinsically and inseparably related. In other words, an attempt was made to preserve an intimate relationship between matter and form (Hensel and Menges 2007).

Generally, there were two groups of projects. One explored the emergence of a construct through the processes of accumulation and organization of the individual elements. The other group of projects explored the emergence of a construct through the manipulation of material properties.

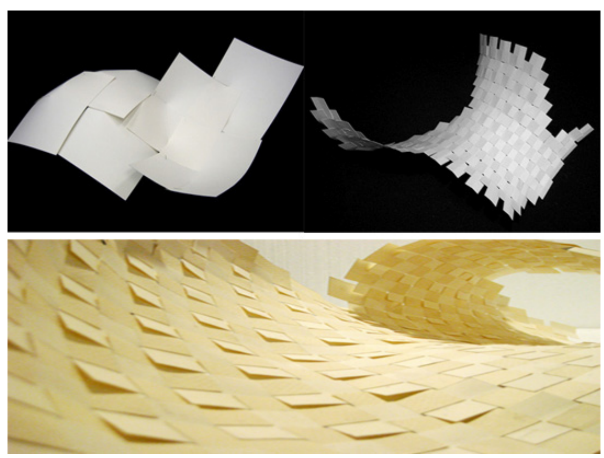

Figure 1: Experiments: Structuring Through Cut and Aggregation (Ji-Young Soulliere 2008).

Structuring through Cut and Aggregation experiment started by examining a capacity of an individual element to generate a spatial construct by modulating its local geometry. Local geometry of a sheet material (in this case paper) can be altered by cutting and gathering a material. The length and direction of the cut controlled the geometry of the sheet, making it more or less curved. Combination of elements with the slight variation in the curvature enabled an emergence of the construct that was capable of finding its own spatial distribution and structure (Fig. 1). In other words, the emerging form could be directed into particular spatial or structural configuration by choosing elements with the particular local geometry. Through the choice of these local geometries the global geometry of the construct could be choreographed. This simple technique generated variable and complex material system (made up of simple uniform elements) that exhibited a degree of adaptability to various external and internal conditions. Design of a material system with embodied behavior (and a built in technique to direct that behavior) raised a question whether this approach could be used to seek and to design alternative ways of spatial or urban occupation. Could these adaptabilities be further explored by examining the behavior of the system under the restrictions of physical context, scale, materiality, programmatic requirements, occupation of space, its relationship to a human body, and variety of other issues that are involved in thinking architecture?

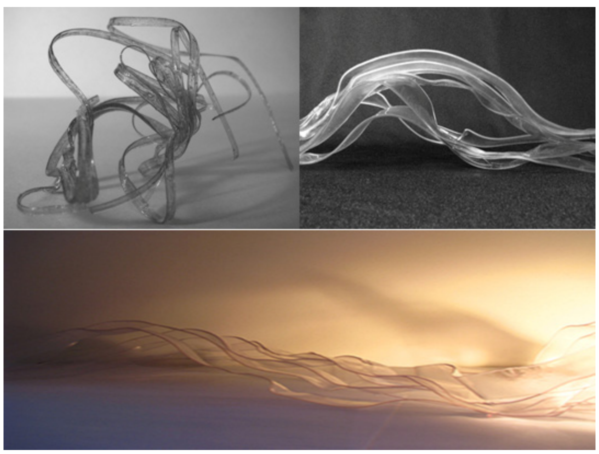

Figure 2: Experiments: From Sugar to Plastics (Gabriel Garcia 2008).

From Caramelized Sugar to Heating Plastics experiment started by studying the emergence of form and structure by manipulating a material property – in this case by the hardening of caramelized sugar. The process of extruding shapes by slowly pouring the hot sugar mass was suggestive of “drawing in space” and indicated the significance of movement in the emergence and structuring of the construct. The fragility of the material required the regions of strength that could serve as main supporting areas from which the construct could expand. The movement allowed an immediate attendance to the regions of structural weakness, enabling the construct to grow quite organically. The second part of the experiment looked into ways of structuring a plastic ribbon by heating it. The process demonstrated a capacity of a construct to renegotiate and adjust its form, balance, configuration, and structure under the influence of constantly changing conditions of the growth of the structure and heating process. Both experiments exposed movement of a “tool” as an important aspect of the formation process (Fig. 2). Taking this idea further into the full scale project would open a question of a role of the body’s movement as a direct “tool” in making the construct. Could this way of making blur the boundary between the tool and the craftsman? Could this be a way to engage making more directly and blur the boundary between conception and realization? When craft depends on the fluidity of movement of the entire body can we “dance” our buildings into existence? In this model, the physical work of the act of making embodies its own dynamic and constraints. The intuitive and gestural economies and limits of the body movement meet the limits, economies, optimization, and efficiencies of the material itself. The product of this process would certainly not be a representation of a form imagined in advance. The product would be a result of the interplay between the strength and resilience. It would emerge from the new sensibility that acknowledges and works with several strengths simultaneously.

2. DEPLOYING THE MATERIAL BASED APPROACH

In the first part of the studio the students were involved in designing a “material system” that embodied behavior and had a capacity to adapt under external influences. In the second part of the studio they were asked to project this material system into the public realm and use it to seek and to design alternative ways of urban occupation. Students were expected to design an urban interface that mediates between the body and the city. They were expected to engage through this materially driven approach a body and a city in order to establish distinct and productive interface between the two.

The initial material systems that students produced could “grow;” they could renegotiate and adjust their form, structure, balance, and configuration. The rigorous studies of the material and material systems laid out a logic by which the system works, but it is always a challenge to extend the discipline of the initial technique throughout the design process. It is difficult not to lose open-endedness and experimental quality of those techniques and at the same time integrate many dimensions that make architecture work. Architecture is experienced through its occupation, performance, and perception. Architectonic imagination has to be extended through the urban and cultural one. The challenge is to think and develop habits of design and making that are inclusive of many dimensions that make architecture work.

One of the first steps in an attempt to appropriate the material system was to project the ways in which it can be inhabited or engaged by the body (Fig. 3). The material system was also projected across the scales and through the variety of spatial occupations. Nevertheless the question of engaging the behavior of a material system through design and extending the influence of such behavior into the more defined articulation of the future construct remained a challenge. The organizational logic of material distribution speaks about form, structure, and space more easily than of the ways of occupying the space.

But the question whether the way of occupying the space could emerge from the inner logic and workings of the material system itself was readily engaged by the students. Could the nature of the urban interface be informed by that logic? Can programming of the space emerge from the crossbreeding of the material construct, appropriation of the construct by the body and the context? Could entirely new ways of inhabiting an urban space emerge?

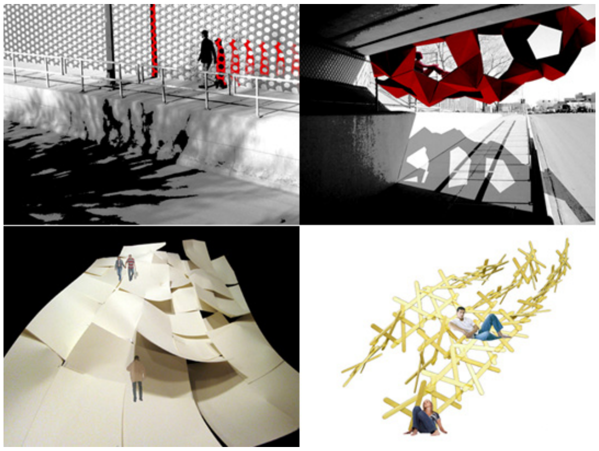

Figure 3: Inhabiting the material system (Dion Lassu, Ji-Young Soulliere, Roy Kuo 2008).

What follows is the description of two proposals for the urban interface that fully engage in its design the agency of the human body, embrace a dynamic quality inherent to the material system, and bring closer cultural and urban imagination to the architectonic one.
The context for the project is a Calgary neighborhood of Inglewood and its mixed-use medium-scale main street. This is one of the Calgary's oldest communities with the number of historic buildings undergoing a restoration. It is among Calgary's most trendy shopping and arts districts. It is also home to the Inglewood Bird Sanctuary, an urban wildlife refuge. It has the city's largest collection of antique and home decorating shops. The main street is surrounded by a thick belt of family homes and is one of the major roads leading to downtown Calgary, frequented by both the residents of Inglewood and the wider Calgary population. Even though there are number of conditions that could make this street a vibrant urban area it is not so. The students saw an opportunity to provide a catalyst for a public occupation of space by designing an urban interface that would activate public realm of the street. In this project there was an opportunity to work and think in two scales: the scale of a body and the scale of a city, and to establish distinct and productive interfaces between the two scales. The inhabitable urban interface was meant to mediate between the body and the city, and have capacity to position a wandering body and initiate spatial or temporal processes (urban activators) that can give rise to alternative ways of urban occupation.
The initial material study opened a possibility of facilitating form creation as opposed to creating a form. This possibility initiated an attitude that allowed a designer, at least partially, a role of a facilitator of a design process. In other words a designer had an opportunity to design conditions that would give rise to an intervention, and not an intervention alone. This initiated a process of working that was constantly modified, negotiated, and adjusted unlike any prescribed set of standardized procedures. This attitude, in addition to a focus on the agency of human body, significantly altered the relationship between a designer and a construct, and affected positions towards function and context. Form creation slipped away and the sense of space and occupation – and most importantly desire to activate the space through occupation and use – took a primary role. This process was a process of discovery and not a premeditated manipulation; it fostered intimacy with the material, site, function, and processes of making. This intimacy translated into a search that enabled a designer to incorporate materiality and form into a construct, and engage the construct with the context in a very direct way.

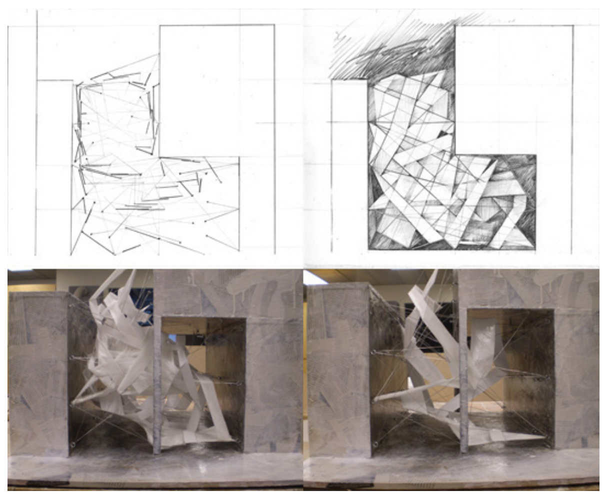

Figure 4: The Cocoon (Kate Anderson 2008).

The Cocoon (Fig. 4 and 5) is an urban interface that changes with use can be built in-between the adjacent buildings. It is highly adaptive, formally and programmatically, and therefore can accommodate variety of sites and uses. Initially it was conceived as an extension of a domestic space. This was motivated by a desire to reveal existing qualities of the street and the neighborhood that stayed hidden from the public eye. But its main use evolved to be an artists' place of work, as well as an exhibition space and a public gathering space. As such, the place could accommodate a group of artists or a single artist; it can be rented or public. The very structure consists of a tensile wire, enclosed and enveloped by hard and soft surfaces that would allow movement through and at the same time be the surfaces for work. Through use, the structure would change and gradually disappear as artists take away the surfaces on which the work has been created, eventually leaving only hard surfaces to walk on; afterwards, the structure would be wrapped again. This structure cannot be finished; its components are brought together but begin to change through occupation and weathering. This urban interface is a story, not a thing. It is a living system, a narrative that is always in process and incomplete.

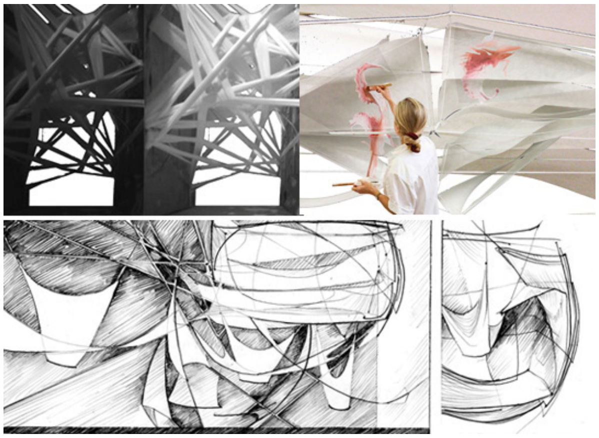

Figure 5: The Cocoon (Kate Anderson 2008).

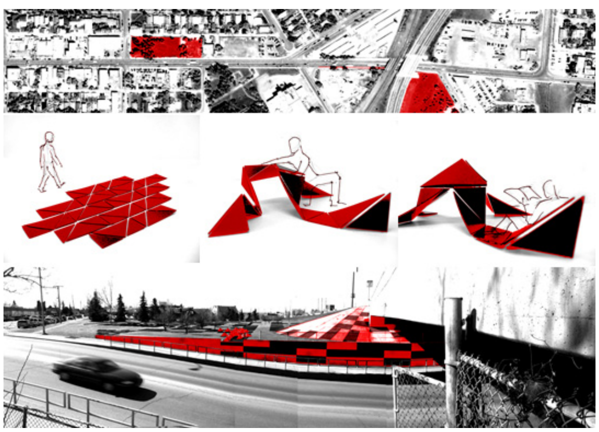

Figure 6: Migrating Folding Plane (Dion Lassu 2008).

Migrating Folding Plane (Fig 6) is an urban interface conceived to connect two neighborhood parks divided by some distance and the highway overpass. The connection was achieved by the proliferation and concentration of folding planes along the site. This was another highly adaptive proposal. Formally and programmatically, combination of the folding planes could accommodate variety of uses.

The element (folding plane) was made out of galvanized steel and coated with rubber. Powerful magnets at every fold of the plane made attaching possible, so that many planes could be clustered together in variety of formations. Through use, the rearranging planes would constantly change the landscape of the park. Each reiteration would hold a memory of the previous occupation.

CONCLUSION

The projects in their final articulation occupied perhaps the threshold between architecture and installation. The scale of the intervention was purposefully chosen to allow the intimacy between the body and its immediate environment. In this way the body, as the medium of experiencing and making, could more directly inform the process of design as well as the process of making. Perhaps the only way for us to explore the possibility of dissolving a traditional approach to making architecture is to dissolve its traditional placement. This potentially translates into alternative ways of occupying space of the building or a city and opens a way to alternative ways of living that might not necessarily require permanency, stability, or defined occupation, yet could productively participate in the cultural and anthropological unfolding of life.

In the initial studies of the material, the material behavior was a model for exploring materials' organizational potential. Understanding this behavior enabled students to manipulate the material by changing internal and external influences. The realization that form and structure could emerge from such process was very important. This possibility, that an architect could set up and facilitate a process of an emergence of the form as opposed to willfully participating in a production of objects, held an intriguing promise. In this context, the architectonic imagination began to reflect inclusiveness and interactivity characteristic of other, more complex systems. This enabled students to engage the questions of context and program more fluidly.

In an interview, titled "Where Architecture Meets Biology," Detlef Mertins comments that architecture requires an anthropological and cultural imagination as much as architectonic one (Mertins 2007). These imaginations occupy very different territories; the willfulness of the architectonic one stands apart from the anthropological and cultural ones which emerge through working of highly complex forces. Could they share the territory where form and space have to be inhabited and appropriated? Could one perpetuate the notion of emergence (imbued by the materially driven process and thinking) and allow it to inform and influence programmatic and urban participation of the architectural intervention?

It is also suggested in the student work that followed material experiments that a certain change in attitude is possible. Once we understand aspects and inner workings of matter we might be better equipped to intervene in the environment and redefine our zone of influence by being more keenly aware of the cross-influences that any intervention triggers. A more direct work with the material brings forward a new awareness of the material's capacity to behave and perform beyond the visible surface modulation. This "intelligence" offers an opportunity to conceive of material and construction systems from the system's intrinsic logics and constraints of making. This is a very exciting opportunity. But perhaps even more exiting is to speculate to what extent this awareness can refocus a "depth" of making. Creativity that can emerge from this awareness can potentially transform the act of making. If material's "intelligence" is fully deployed aren't we obliged then to make and think about our environments differently?

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Place Making in Urban Design

Sense of place in everyday spaces: lessons for urban design

Vikas Mehta

University of South Florida, Tampa, Florida

Many philosophers and thinkers have lamented the loss of *place* in terms of the loss of contact of the body with the environment in post-industrialized societies. With the diminishing cache of places it becomes even more important to study spaces in the city that posses this character and genius loci. This paper investigates the qualities of a seemingly ordinary everyday space that imbue it with character and elevate it to become a *place*. The paper explores the significance of this space in everyday life and how it is transformed from an ordinary space of consumption to a meaningful place for meeting, interaction and human-human contacts, and a place for haptic experiences and body-object contacts in the community.

An extensive study of a neighborhood commercial street in Cambridge, Massachusetts revealed a handful of spaces that were extensively used for social interactions. Observations and interviews suggested that one of these spaces supported the majority of social interactions and was a concrete human space with a unique sense of place. The patterns of interactions at this location were documented and analyzed using sketches, drawings, notes, interviews, photographs and videos and by actively participating in the *phenomena* of this space. Observations show that this location on the street has a distinct hereness, a sense of being in it and enclosure, a sense of ease and safety that is at the core of the experience of place. By analyzing the various phenomena of this place this study suggests essential qualities for the design of public spaces to become places that will retain a sense of nearness, a connection between people and places, and will strengthen our sense of tactile reality.

Conference theme: Urban design studies
Keywords: experience of place, phenomenology, social interaction, street, urban design

INTRODUCTION

Urban design is concerned with the creation of places of distinct identity; with both, special places in the city and also with everyday places. This paper focuses on ordinary everyday spaces that are typically in the neighborhood close to home. It employs a mixed-methods approach of environment-behavior research by using methods from behavioral geography as well as phenomenology to study the phenomena of everyday spaces as experienced by the people who use them. The study analyzes the phenomena to determine the qualities of the everyday space that imbue it with character and transform it into a place of significant meaning for its users.

1. PLACE

Place, it is suggested, is a central ontological structure of the human experience (Casey, 1993). According to Relph places are “fusions of human and natural order and are the significant centers of our immediate experiences of the world” (Relph 1976:141). Of the many definitions of place, the one put forth by Harrison and Dourish (1996) captures the notion of place succinctly. They suggest that place is the result of space that is overlaid with meaning by humans. Continued contact and association with a space is critical to its becoming a place. Emphasizing this temporal dimension, Tuan suggests, “What begins as undifferentiated space becomes place as we get to know it better and endow it with value” (Tuan 1977:6). Similarly, in discussing the essential experiential structure of place, Seamon (1979:70) argues that regularity of place use results in emotional attachment to place that he calls *at-homeness*. We develop an attachment to the spaces that we regularly associate with and ones that hold special meanings for us. The repeated use of such spaces of meaning in the landscape provides us with a sense of place that is essential to our experience of the world we live in.

1.1. Location of place-experience

Because most of us are inextricably linked to our place of residence, the home is at the core of the idea of place (Cooper-Marcus 1995). However, other settings at various scales in the neighborhood and the city are as much felt and identified by people as places (Relph

1976; Norberg-Schulz 1980; Oldenberg 1981, among others). In fact, while the home is the physical center of place, other familiar places where the person feels comfortable outside the home make complete the experience (Seamon 1979). “Places occur at all levels of identity, my place, your place, street, community, town, county, region, country and continent, …” (Donat 1967:9 cited in Relph 1976:29). Hence, place-experience at home and at other settings outside the home is essential to our experience of the world and to our existence and well-being.

1.2. Loss of place

The increasing mobility of current society has challenged the notion of place. Many philosophers and thinkers have lamented the loss of place in post-industrial societies. This loss is articulated, for example, as a “loss of nearness” (Heidegger 1962), a “schism between people and places” (Arendt 1958), and “weakening the sense of tactile reality” (Sennett 1994). The current pattern, Relph suggests, “is towards an environment of few significant places – towards a placeless geography, a flatscape, a meaningless pattern of buildings” (Relph 1976:117). Existence in such a placeless landscape deprives us of meaningful associations and contact with people and the world in which we exist.

However, there are everyday spaces in our landscape that, if designed and managed with place in mind, have the potential to provide a connection between people and place and between people and people. In urban areas, public spaces such as streets still provide the opportunity to be designed to accommodate places of meaning near the home.

2. THE STREET

Historically, streets in cities and towns were used as spaces to serve basic survival, communication and entertainment needs and to perform several political, religious, commercial, civic and social functions. Even in current times, streets are an important part of public open space in the city. For urban areas, streets are both literally and metaphorically the most fitting symbol of the public realm (Jacobs 1961; Rudofsky 1969; Jacobs 1993; Chekki 1994; Lofland 1998).

> Streets and their sidewalks, the main public spaces of the city, are its most vital organs. Sidewalks, their bordering uses, and their users, are active participants in the drama of civilization… (Jacobs 1961:29-30).

People depend on streets for functional, social, and leisure activities; for travel, shopping, play, meeting, and interaction with other people; and even for relaxation. Hence, even in the present times the street has a legitimate role as a public space to cater to multiple needs of its users.

2.1. The street as place

Scholars in various fields related to urban studies suggest thinking of the street as a social space rather than just a channel for movement. Streets that support stationary human behaviors and activities provide opportunities for short-term, low-intensity contacts that constitute easy interactions with other people in a relaxed and relatively undemanding way (Jacobs 1961; Gehl 1987). It is suggested that these short-term, low-intensity contacts or weak ties are possible beginnings of deeper and more long-term social interactions and engagements between people (Jacobs 1961; Granovetter 1973; Greenbaum 1982; Gehl 1987). The daily comings and goings permit renewed and repetitive activities on the street that help in making the street a legible place for the users. Such streets become places “where we experience the meaningful events of our existence” (Norberg-Schultz 1971:19).

2.2. The neighborhood commercial street

The neighborhood commercial street or Main Street, due to its location in or near the residential neighborhood, possesses the ability to make it possible for local people to see and meet one another as a part of their daily routine. And because it is the location of various businesses it has the ability to house numerous types of places that may have collective community meanings resulting from repeated interactions and shared experiences of daily life. This paper examines the neighborhood commercial street as a public space with the potential to accommodate everyday places of meaning.

2.3. Places on the street

Around the world streets are a dynamic space of activity. But certain streets have a vitality that is so powerful that it is easily legible and identifiable. These are streets that Jacobs (1993) calls “great streets.” In most cases, however, there are only specific locations on the street that anchor the vitality of the street. These are spaces that are easily recognizable and memorable and often define and reflect the vibrant character of the street. Such spaces of gathering usually achieve the quality of place on the street. Hester suggests that such places possess a sense of “collective-symbolic ownership” and are ones that people in the neighborhood hold “sacred” (Hester 1984:13). Although in these spaces people are seen engaging in ordinary activities of daily life, these places provide a comfort and at-easeness that is invaluable to our well-being.

3. THE STUDY OF PLACE

As stated in the introduction, the primary objective for this study was to investigate the qualities of a seemingly ordinary everyday space that imbue it with character and elevate it to become a place. As a part of the mixed-method strategy, the inquiry employed a variety of techniques, including structured and semi-structured observations (visual surveys), extensive field notes, diagrams, maps, sketches, photography, and face-to-face interviews with the users, and the author’s first-person experience of the street. These methods provided information on people’s behavior, attitudes and perceptions and on the ambience, characteristics and qualities of the special places on the street. Hence, both qualitative and quantitative data were collected, analyzed, and presented in the study. It is suggested that a "survey design is useful when investigators want to find out in detail about a phenomenon, …" (Zeisel 1981:67). The first-person phenomenological inquiry provided experiences of specific individuals and the author involved in actual real-life places.

Additionally, although it is difficult to base generalizations on a few cases, case studies provide useful knowledge to suggest possible relationships between various factors (Yin 2003; Zeisel 1981). Miles and Huberman reiterate this view by stating that "… qualitative research lives and breathes through seeing the context; it is the particularities that produce the generalities, not the reverse" (1994:34).

4. THE STUDY

Figure 1: A view of Massachusetts Avenue at Central Square, Cambridge, MA.

4.1. The study area

Massachusetts Avenue at Central Square is the main neighborhood commercial street of Central Square neighborhood in Cambridge, MA (Figure 1). It provides for the day-to-day amenities of the neighborhood and serves as a destination for shopping, eating, entertainment and culture. Massachusetts Avenue is a historic street with mostly older building stock and only a few new buildings constructed in the last 40 years in the stretch of the street at Central Square. Almost all buildings are built to the sidewalk leaving no setbacks. Aside from a few newer buildings with commercial office space, all buildings range from one to four stories in height and accommodate a combination of small independently owned local businesses and national chain stores. A five-block stretch of Massachusetts Avenue at Central Square has been upgraded in the last decade to make it more pedestrian-friendly. These improvements include widening and resurfacing of sidewalks, creating curbside parking, planting of trees, and providing benches, bicycle racks, trash cans, and pedestrian oriented street lighting, and so on.

4.2. Methods

The upgraded five-block stretch of Massachusetts Avenue at Central Square was extensively studied from April to October in 2005. Behavior mapping, including structured and semi-structured observations, was conducted every hour from 7:00 AM to 10:00 PM on weekdays and 8:00 AM to 11:00 PM on weekends to understand the relationship between the temporal and spatial patterns of the people's behaviors and the physical setting – to examine how people used the streets. Hence, there were 30 behavior maps – 15 for the weekdays and 15 for the weekends – for the study area.

Behavior maps provided information on when and what people did on the streets and where they sat, stood,

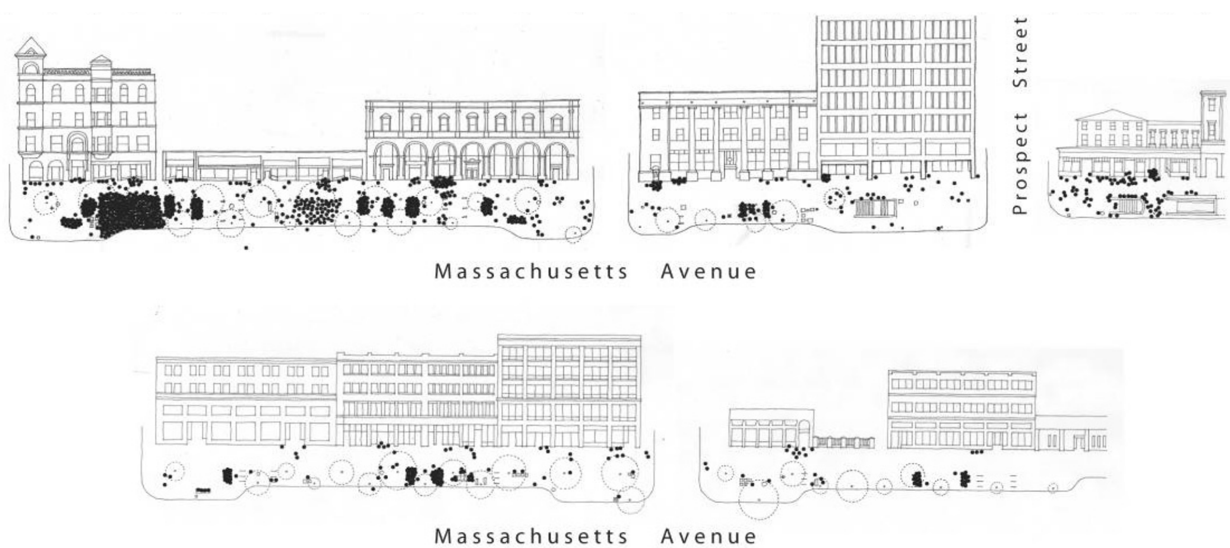

Figure 2: Behavioral map of people engaged in some stationary activity on weekdays and weekends on five blocks on Massachusetts Avenue at Central Square, Cambridge, Massachusetts. Data from thirty observations on each block spread throughout the day and evening. Each black dot represents a person.

gathered and socialized, and what facilities they used, either as a part of their daily functional activities or for recreational purposes.

Simultaneously, people who frequently used the street, were interviewed to understand their experiences of the street environment – the street, the buildings, the businesses, the people who used the streets and the ones that managed the businesses; and to find out what particular feelings did the places on the street evoke for them.

Next, using sketches, drawings, maps, field notes, photographs and videos and by actively participating in the *phenomena* of the space, the author documented and analysed the patterns of activities and interactions on the five-block stretch of street.

4.3. Results of behavior mapping

Behavior mapping provided a snapshot of human behavior and activities on the street and revealed that a handful of spaces on the street were extensively used for stationary activities and social interactions. But it specifically suggested that one of these spaces, the street space at 1369 Coffeehouse, supported the majority of stationary activities and social interactions (Figure 2). Similarly, interviews indicated that people attached special meaning to a handful of locations on the street. Among these, 1369 Coffeehouse held multiple meanings and evoked feelings of attachment and sense of place beyond just a space for consumption.

4.4. The coffeehouse as place

On their website the owners of 1369 Coffeehouse state their goal of making a meaningful place for the community:

> We strive to create a comfortable, inviting atmosphere and to be an integral part of the community. Many friendships, including several marriages, have developed at 1369. Several books and many theses have been written at our tables. We take pride in being a good neighbor and local gathering place. We are dedicated to maintaining this feeling.… (1369 Coffeehouse website).

The people using the street unanimously agreed on the unique *place* quality of 1369 Coffeehouse and especially the street space it extended onto.

> I like the fact that people can hang around here and socialize and not just be a customer. It [1369 Coffeehouse] is a meeting area, a destination. Everybody comes here. It attracts [people from] all walks of life, all races, working class, families, … it has it's own unique aura about it. (R 39.1).

1369 Coffeehouse was one of the numerous businesses on the street to serve goods that could be consumed outdoors, which encouraged people to stay at the street. Like many other businesses on the street, 1369 Coffeehouse used the street space outside the store to put out furniture and furnishings. However, unlike the rest of the street, walking into the territory just outside 1369 was like walking onto a terrace. The experience of movement, as on the street before and beyond the 1369 space, was transformed into an experience of rest – a pause. The street was transformed into a place of stay rather than just a space of movement. At the street space outside 1369, one was in a place of its own distinct identity unlike the other parts of the street (Figure 3). Without using any physical barriers, 1369 was able to claim a physical territory on the street that was inviting to the passer by to stay.

> 1369 [Coffeehouse] is very personal. There is great outdoor seating. The music outdoors attracts people. It is a great place to sit and enjoy your day and people-watch. It is interesting to see all kinds of people. I frequently run into people without planning. (R 37.1).

There were distinct qualities that gave 1369 such a sense of place. These were both physical qualities as well as attributes of the way the owners and workers operated the coffeehouse.

Figure 3: The “room”-like quality of the street space outside 1369 Coffeehouse provided a sense of enclosure that was distinctly inviting.

5. QUALITIES OF PLACE

The open-ended interviews, the author's analyses and first-hand personal experience of the study area pointed to six essential qualities that transformed the everyday public space on the street to an identifiable place – flexibility, fluidity, multidimensionality, personalization, long-term constancy and short-term changeability. These qualities can be summed up in three themes that encapsulate the experiential character of place on the street – *continuity, adaptability and personalization.* These three themes that help the owners achieve this unique quality and make 1369 Coffeehouse a place in the community are discussed below.

5.1. Continuity

Continuity is the quality of permanence of a place. Much of it is manifest through the mere ability to exist over time. It offers the capability for regularity of use that provides an at-homeness (Seamon 1979), which is essential to creating a sense of place (Relph 1976). Continuity supports routine and provides familiarity that leads to a sense of security and comfort in knowing what to expect, not only in terms of goods and services, but also with respect to continued contacts with the same people – both friends and acquaintances – as noted by this regular user of the street:

> I'm here two-three times a day. I walk here daily. It's exercise. It takes me out of my house. I come here to read. It's very relaxing for me. My friends know where to find me.
> (R 10.3).

Familiarity is particularly significant on neighborhood commercial streets since most of the users are people who live or work nearby, and who therefore are likely to come back to visit the street and stores frequently. Many people expressed a preference for stores that had been present for a long time, because they were familiar with the goods and services, and owners and workers.

> [It] is one of my favorites because it's been there for many years. I'm glad that it's still there. They have friendly service. And I'm welcome there. (R.19.1).

This continuity in tenure of 1369 Coffeehouse translated into a familiarity with the goods and services and a friendliness with the workers of the coffeehouse as suggested by this user:

> I like the atmosphere there. It is very personal. People are very friendly and I know the people who work there. (R 14.1).

People of the neighborhood came to the coffeehouse to share significant events with their friends and this added meaning to this ordinary space on the street (Figure 4). The continued existence of the coffeehouse was significant even to people who had moved from the neighborhood. A regular of the coffeehouse who had moved still returned and narrated that many others did too:

> People have changed due to the rents. It used to be neighborhood people earlier. It has changed from neighborhood people to a destination with more new people. But people who lived here [in the neighborhood] still come back here. (R 35.4).

Hence, continuity fostered the notion of stability that is at the core of attachment to place.

5.2. Adaptability

Adaptability deals with the ability of a space to change on an ongoing basis as a response to the changing needs of the people and the environment. Although continuity is essential in the long-term, change in the form of flexibility is crucial in the short-term. Adaptability is also the ability for a space to be multidimensional; to be open to the needs of diverse groups or individuals. 1369 Coffeehouse was a place that was suitable to people of various backgrounds, age, race, and class (Figure 5) as reinforced by comments from the users:

> Different kinds of people hang out here. On this section [of the street] attached to 1369 [Coffeehouse]. The business owners are making some efforts to make it inviting.
> (R 26.3).

The street space at 1369 transformed during the day, the week, several times in a month and seasonally. This was a result of modifications that the owners and workers of the coffeehouse made to accommodate the needs of people, whether it was bringing out more chairs for patrons and others when street musicians set up to play on the sidewalk or setting up more umbrellas to provide shade on a hot summer afternoon. The street space at 1369 often changed to accommodate the activities and life of the street.

But adaptability is also the ability for the users to be able to modify their setting to claim territory or to make

Figure 4: People shared significant events with friends at street space outside 1369 Coffeehouse.

Figure 5: 1369 Coffeehouse was a place for people of various backgrounds, age, race and class.

it more comfortable, or both. This meant that the business owners had to forego some control of the space. People were able to move the furniture and furnishings to nearby locations, often outside the immediate domain of the coffeehouse, to suit their needs and to freely move in and out of the coffeehouse as needed (Figure 6 and 7). They were able to use the coffeehouse space and furniture to gather, meet, play music or a board game, and so on, even if they were not purchasing goods from the coffeehouse. This seemingly insignificant flexibility translated into the usefulness of the coffeehouse for multiple purposes for many people of different backgrounds and income groups. The comfort and ease created by this quality of adaptability led to place attachment that was reflected when people talked about the coffeehouse:

> 1369 [Coffeehouse is my favorite]. It is affordable and I meet my friends there. It has a good in-out flow. The tables on the sidewalk and the benches are great. It is a magnet for street culture. (R 32.2).
> I love the coffeehouse. You can sit there for hours. Sit there, read, [and] look at people. I do some of my work here. It's an atmosphere not as serious as a library. (R 26.2).

Figure 6: A street musician moves the coffeehouse furniture to suit his needs.

Figure 7: The coffeehouse territory expands with the needs of street musicians.

5.3. Personalization

Figure 8: An employee of 1369 Coffeehouse personalizes the street-front by changing seasonal plants and flowers.

Additionally, this ability to modify and control private goods in an otherwise public territory involved a certain degree of negotiation, compromise, and accommodation of the needs of other people present at the street. People were obliged to interact with other people to move furniture or to ask for a chair. All of this resulted in opportunities for social interaction adding to the meaningfulness of the space.

Personalization is the act of modifying the physical environment and an expression of claiming territory; of caring for and nurturing the claimed territory. Many businesses on the street had personalized their street-frontage with signs, displays and decorations, and by bringing out their wares, goods and services to the street. But 1369 Coffeehouse was the most personalized businesses on the street (Figure 8). By personalizing a space, people change the environment to meet their needs and specific activity patterns. This provides psychological security, a symbolic aesthetic, and the marking of territory (Lang 1987:148). By marking territories through personalization individuals or groups are also able to make the territory "distinctive and identifiable" (Edney 1976). One user of the street described it succinctly:

> Signs out on the street [in front of the coffeehouse] change every few days. They tell you the special brews or flavors 1369 [Coffeehouse] is serving that day. And the flowers and planters – they change every few weeks. It's very personal and neighborly. Not like a corporate. (R 41.1).

Personalization creates change in an otherwise familiar setting that provided stimulation and interest, and a reason to stop and look. Personalization added uniqueness to the setting that created an ambience that provided the much-needed layer of identity to the physical environment. Increased opportunities for personalization add those elements in the environment that are of prime interest to people (Gehl 1987) as corroborated by comments such as the following:

> I like 1369 [Coffeehouse] for the music they play, the artwork on the walls, the ambience. They serve you in a regular [glass] cup.
> (R 23.3).

Observations showed that 1369 personalized its street-front by spending considerable effort in altering and updating its interface with the street by frequently changing their show window décor, displays, planters, signs, often displaying their goods and wares on the sidewalk and thus adding a personal touch to their appearance. Such small gestures meant a lot to the users of the street:

> We need planters, awnings – things that give off that people are around. Something that makes the stores communicate with you.
> (R 42.9).

The personalized street space at 1369 Coffeehouse was like a "room" with a sense of enclosure distinct from the rest of the street (Figure 3). Upon entering that part of the street one experienced a sense of being "inside." Gestures and objects, as manifestations of personalization, suggest the presence of people and activity, and therefore of occupancy, adding a human touch to the environment.

> Signs associated with occupancy can do more than announce the existence of territorial claims; they can also be seen as visible evidence of caring. They can represent a feeling of attachment between the occupant and the physical setting, and as such they will be felt to add "warmth" or "intimacy" to a setting, which, in the absence of such signs, would be too "monumental" or "sterile" or "inhuman" (Brower 1980:189).

Personalization through the change of signs and displays also provided current information about schedules and events, and goods and services in the store, right at the street.

The articulated building façade with its permeable edge was particularly suitable for personalization efforts. The setbacks, alcoves, niches, nooks, and articulations of the façade created spaces for plants, signs, items for sale, and so on.

CONCLUSION

Continuity, adaptability and personalization provided a sense of security, comfort, a sense of community, visual stimulation and interest for the users of 1369 Coffeehouse. But most importantly, continuity, adaptability and personalization helped create an identity for 1369 Coffeehouse in the minds of the people who used the street. This offered a sense of place on the street for the people of the neighborhood.

Current urban design literature suggests that mixed-use neighborhoods with their own neighborhood commercial streets are a desired pattern of physical development to achieve a more vital, vibrant, attractive, safe, viable and sustainable pattern of urban lifestyle. Presently, there is considerable interest in revitalizing city centers by promoting mixed-use neighborhoods with neighborhood commercial streets to cater to the daily needs of shopping, eating out, and entertainment. But at a time when there is increasing competition from big-box retailers, it takes more than proximity to attract people to the neighborhood commercial street. The biggest competitive advantage of the neighborhood commercial street is its ability to be an easy meeting place for the local people. Neighborhood commercial streets will be successful if they are managed to support community-gathering places and if they integrate places of social meaning.

The findings of this study suggest that the private business owners as well as the public authorities play an important role in making neighborhood commercial streets a location for meaningful spaces close to home. Public authorities should help to preserve any community places, regardless of their use or appearance, and encourage supporting small, independent businesses that in turn have the ability to become places of meaning. Architecturally, private owners and public authorities need to demand buildings that are designed with more articulated street façades, especially at the first- and second-floor levels. Public authorities need to provide incentives for businesses to be able to appropriate spaces on the street for occupancy wherever suitable, to personalize their street fronts, and to encourage the private businesses to control and occupy the street territory with movable and semi-fixed objects and artifacts. Public authorities also need to provide physical street improvements such as wide sidewalks, trees, comfortable seating, and other physical artifacts that could help make the street a comfortable and pedestrian-friendly neighborhood space.

The findings of this study show that when an appropriate combination of characteristics is present, an everyday space on the street can attain a sense of place by becoming a place of meaning and attachment.

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The urban square: from space to place

Nadia Charalambous, Christos Hadjichristos

University of Cyprus, Nicosia, Cyprus

ABSTRACT: This paper explores the potential of fostering an integrated research culture between academia and the profession through a case study in the city of Nicosia, Cyprus. By focusing on the nature of the urban square as a socioeconomic and spatial phenomenon and the notion of a sense of "place" as its most important characteristic, the paper aspires to a) expand knowledge base in relation to architectural projects undertaken by the profession and academic research, b) address through the use of research methods, the challenges of designing an urban square while at the same time responding to local culture and community aspirations. The walled city of Nicosia is connected with the city outside the walls through three gates, two on the south and one on the north. Still, the main connection between the old and the new city which evolved through historical time, is Eleftheria Square. Although the spatial characteristics of the space are geometrically more those of a bridge rather than a square, it is symbolically the centre of the south section of the city. This is where major events such as political rallies, soccer celebrations and New Year's festivities take place. Following an international competition, Zaha Hadid's office was awarded the first prize and the commission for the renovation of the existing square. When the design was presented to the public, there were protests against it, partly because according to the protestors, the proposal does not fulfil the spatial requirements of a "square"; the square as it is familiar to the city-dwellers. This forms, according to this paper, an important challenge for scientific research: to explore the potential of a methodology which takes into consideration both spatial analysis and people's intuitive explanations. The present study suggests the development of such a method which combines both quantitative, spatial analysis of the structure and morphology of the urban "square" and qualitative investigation of individual perceptions and aspirations, of people's sense and awareness of their environment.

Conference theme: New methodology in architectural research
Keywords: "sense of place", "configured" space, urban square

INTRODUCTION

The production of "place" has been a central concern for architects and urban planners during the past years. Increased mobility and relocation of people to new cities and countries has formed a major challenge for recognizable "places" that will form distinctive, socially and economically sustainable urban environments. Architects and urban designers are called in to either create new sustainable and distinctive "places" or to redesign the old ones reinforcing existing dynamics. The need for a new positive dynamic to reinforce the existing social and economic forces within the old part of the city of Nicosia, prompted the Municipality to hold a competition for redesigning the area around the city's central urban square.

Named Eleftheria Square, the space has been the focus of high profile activities such as advertising promotions, political rallies and celebrations of sporting events and is described by locals as "the most important link between the historic centre and the contemporary city". (Stefanos Evripidou, London, for Cyprus Mail, 2008).

The competition for the redesign of the area was held in 2005 and the first prize was awarded to the study of Zaha Hadid, Christos Passas and Saffet Bekiroglu.

The report of the jury committee for the first prize noted that the proposal stands out for its originality, its contemporary style as well as for the successful creation of an uninterrupted flow between the areas within and outside the old city. The solution was described as an exquisite architectural composition, which is functional, while it also pays its respect to the Ancient Monument in its whole. The design of the square itself is mentioned as a sculpture in the area, which creates a central point of reference in the city.

When the design was presented to the public, there were protests against it, partly because according to the protestors, the proposal does not fulfill the spatial requirements of a "square"; the square as it is familiar to the city-dwellers. Some claim that the specific site was never a proper square nor could or should it be converted into one, due to its peculiar relationship with the moat and the historic walls. The argument put forward is based on the way in which what the city dwellers perceive as primarily a bridge (and has been a familiar, distinctive place for them) is, with the proposed design, forced to behave more like a square.

Drawing on the above, this paper reviews the context of the urban square and the study of possible urban factors that construct a "place". What is proposed is the development of a method which combines both a quantitative, spatial analysis of the physical structure and morphology of the urban "square" and a qualitative investigation of individual perceptions and aspirations, of people's sense and awareness of their environment. Analytical approaches of spatial characteristics are thus set in a phenomenological-experiential perspective.

1. BRIEF HISTORICAL BACKGROUND

1.1 The Urban Square

A square is considered to be an open place or area usually formed at the meeting of two or more streets. It tends to be a flat, convex space which allows for the gathering of people. It is a communal public space. Still, it usually implies the presence of movement, pedestrian or other. It could even be claimed that the life of a square depends as much on events that take place in the square itself as it does on through traffic which may or may not participate in those events. In other words, a square may not necessarily or primarily be a major destination since it may acquire its character by being a crossroad.

Mark Childs's book titled 'Squares' starts with the following paragraph:

> As places of joyful celebration, heartbroken communion, civic discussion, and as places to exercise the rights of assembly and free speech, civic places are essential to participatory democracy and the good life. Vital civic places-squares, the post-office steps, farmers' markets-are the great advantages of life in town. The architecture of civic places can support or frustrate these convivial uses….conviviality may be used to speak of the enjoyment of festive society, as a means of living together. Conviviality, in this meaning, is the vibrant sense of belonging to a settlement. (2004)

In other words, for a space to be a public square, its geometry and other spatial characteristics need to be supplemented with its use by the community.

Another element of the built environment which may or may not have an urban character is the bridge, a structure that is, which carries a pathway or roadway over a depression or obstacle. This tends to primarily be a transitional space, allowing that is, for the passage of its users from one side to the other. Still, as in the case of the square, its use is not pure; while passing through may be the main activity taking place on it, this frequently takes place along some form of social interaction.

Childs argues that 'it is the job of the designers of a civic place to uncover, foster, and give place to a sustained and evolving dialog between a community and its landscape' (ibid). What then are the tools which the designer can use in order to achieve that? Inevitably, some form of abstraction or representation regarding a selected number of parameters is involved. This process, according to Lefebvre, is dangerous:

> Knowledge falls into a trap when it makes representations of space the basis for the study of 'life', for in doing so it reduces lived experience. The *object* of knowledge is, precisely, the fragmented and uncertain connection between elaborated representations of space on the one hand and representational spaces (along with their underpinnings) on the other; and this 'object' implies (and explains) a *subject* – that subject in whom lived, perceived and conceived (known) come together within a spatial practice. (1991: 230).

Lefebvre describes a flattening out process which shatters space into images, into signs, into connected-yet-disconnected data that reduces the subject into a lived abstraction (1991: 313).

This seems to be the fear of the people who are against the proposal of the Zaha Hadid team for Eleftheria Square. One of the points they keep stressing is that the designer herself never actually visited the island. A second criticism is the way the design addresses, or does not address the climatic conditions of Cyprus. A third point which is put forward as we have noted above, is the way in which what they see as primarily a bridge is, with the proposed design, forced to behave more like a square. This paper focuses more on this last criticism.

1.2 Eleftheria's Square

The city walls of Nicosia may be considered, if not its strongest, but certainly its most visible feature. These walls were designed by Julio Savorgano and built by the Venetian rulers of the island in the 16thC. They are one of UNESCO's World Heritage monuments due to their cultural value and their unique architectural character.

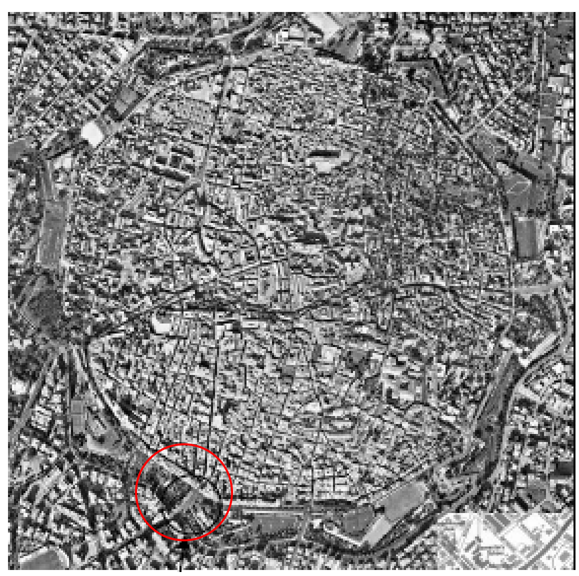

Figure 1: The Square

During the Ottoman Occupation of the island (1570-1878) the three gates of the Walls, the Kyrenia Gate, the Paphos Gate and the Famagusta gate were the only points connecting the walled city with the surrounding region and the other cities. The gates would close at sunset and could only open with a special order. The closing of the gates also continued for some time during the British Rule. It was eventually decided that the city should open to the outside for the convenient transportation of people and goods. In 1950 the British did not demolish the wall but built a version which accommodated the needs for a bridge, resulting to what we have today. A wooden bridge over the moat was initially constructed, joining the old city with the first houses built outside the walls. This was later widened, and was renamed Metaxas Square. It was named Eleftheria Square (Freedom Square) in 1975 after a public vote.A point to note is that British administrators had early on in their rule placed their offices, as well as some residences, south and south-west of the walled city (presumably for health reasons, as this area was slightly higher up and away from malarial swamps, but possibly also in order to separate themselves out from the natives). By the 1930's some wealthy Greeks had followed the example of the British, moving southwards, out of the walled city. This process was accentuated after the post World War II economic growth and the increasing use of the walled city for commercial purposes. This meant that many residences in the inner city were converted into shops and commercial offices (Attalides, 1981). Gradually this development expanded out of the walled city and a new commercial area grew, in a south and south - east direction. Effectively there are now two main commercial areas: the older one, within the walled city and the newer one, starting outwards from the walls.
These developments have brought new uses in the walled city. Firstly, because of the increasing congestion, most wealthy and middle class families moved to new areas of Nicosia, leaving behind the poorer families and the elderly. Second, increasing numbers of immigrants and other foreign nationals (such as unskilled manual workers, housemaids and students in local colleges) are moving to the area, since the rent for these, mostly old flats and houses is much lower than elsewhere in Nicosia. Thirdly, some parts of the walled city have acquired a new importance as cultural centres or as parts of the city's heritage. In most cases this latter use involved restoration work by the Nicosia municipality or the state – and this has brought about a fourth trend, relating to commercial restoration of old houses, restaurants, pubs, galleries, and so on, aiming at exploiting the higher values bestowed on the return of culture and tradition in the area. During its recent history, the walled city gradually became for many people an "urban ghetto", accommodating ethnic minority and lower social and occupational class groups. However, Eleftheria Square still remains the city's center, with the inhabitants often expressing a strong attachment to this specific "place".

2. A SENSE OF "PLACE" IN CONTEMPORARY CITIES

According to Hall (1997) post-industrial cities are polycentric systems with multiple centers of residences, employment and other social activities. Musterd argues even further, that the majority of social activity takes place in a spatially "local" context due to several constraints that people experience in space and time (2001). City-dwellers, as in the case of Nicosia, often express sentimental bonds with certain geographical spaces or "places" such as their neighborhood or the city's squares. They even suggest that these distinctive "places" are a way of defining their urban identity.
The perception of "place" and locality has been the object of discourse since the 60s. Lynch (1981:131) has suggested that the "sense of place" is related to the ease with which its elements can be linked to other places or events as a mental representation of time and space which includes non-spatial elements as well.
Hillier (1996), through the theory of Space Syntax, introduced the concept of "intelligibility" defined as the degree that we can be informed about our position within the urban system as a whole, from every location that we potentially occupy.
However, he argues that there is not sufficient evidence to support a corresponding relation between space and social identity. Hillier and Hanson (1987) support the argument that the urban environment is heterogeneous and space plays a role in controlling and generating this heterogeneity; a point also suggested by Jacobs (1961) and Appleyard (1981). They argue even further that empirical evidence does not support a correspondence model between space and society as suggested by Alexander (1977), Newman (1980) and Lynch (1981); furthermore, it does not support self-contained spaces and neighborhoods at the local scale. Hillier argues that cities have a dual nature, operating both at the local scale of the neighborhood, the square or other node, and the global scale; hence, although we experience the city in fragments each time, we are aware of the whole. He criticizes research focusing only on place-making since, according to him, it deals mostly with the "local and apparently tractable at the expense of the global and intractable in cities"; "places" he argues, are not local things but "moments in large-scale things, the large-scale things we call cities" (1996:151).
Recent architectural and urban theory has in many cases proposed the social benefits of local groups, enclosures and identification. Space Syntax empirical studies have shown however, that the effects have been rather negative, resulting in the fragmentation of the urban structure into over localized zones; natural movement is consequently prohibited since there is lack of integration with the global structure of the city and signs of both social and physical degeneration may appear (Hillier, 1996).
Hillier suggests through a number of analyzed examples that "places are not local things" and do not make the city; but rather it is cities that make places.

our analytical studies of the structure and functioning of urban space suggest that it is the global scale that is critical, whether to the structuring of co-presence through movement, the sense of safety, the development of social networks, or the distribution of crime. The local sense of place arises not from the existence of segregated local zones, but from the different types of deformity in the local grid. The same applies to social networks. Good urban networks are not self-contained groups but distributions of probabilities within a larger, continuous system. The key to "urbanity"….lies in the way the local and global scales of space and networks relate to each other." (Hillier, 1996 p.256).

The most important global mechanism of cities, is what we know as the **urban or deformed grid;** a mechanism which is found in all settlements. Cities and more specifically the urban grid, can be described as a "mechanism for generating contact"; contact between the city's inhabitants and between the inhabitants and visitors, basically generated through movement. The grid itself and the good relation between local areas and the global structure of the city is what make a city function well by allowing the user to experience it in an effortless and pleasant way.
he deformed grid is also the mechanism which gives the city its individual characteristics; characteristics related to culture and social processes.

The urban grid is an imprint of the history of the city, containing traces of different growing, planning and social processes. Each grid tells us a particular history, that might include the accelerated growing of Latin American cities or the deep medieval roots of some European cities (Figueiredo and Amorim, 2007)1.

What emerges so far, is the need to seek the difference between space and "place" as conceived by both experiential and analytical theories like space syntax. The latter as we have seen above, suggests the concept of "configured" space, that is, the inhabited or experienced space, not only in relation with a bounded local setting but with its global dimensions.

3. SPACE SYNTAX METHODOLOGY – AN EXPERIMENTAL PERSPECTIVE

3.1. Space Syntax Methodology

Morphological studies presented through the Social Logic of *Space* (Hillier and Hanson, 1984) and subsequent research during the last decades, try to clarify the configurational properties of space described in the previous section and their meanings, by mathematical and graphical analysis rather than intuitive explanations, through Space Syntax methodology. A set of non discursive techniques are utilised to discover how far it is possible to bring to light and subject to rigorous comparative analysis the configurational[2] aspects of space and form in settlements, cities and buildings, through which culture is transmitted.
Space syntax research sees settlements as specialized forms of spatial engineering which permit a large number of people to live in concentrations. Seen as systems of organized space, settlements seem to have deep structures or genotypes, which vary with culture. Studies of cities and traditional settlements all over the world, reveal such differences in spatial organization which seem to be expressions of what might be called "spatial culture" (Hillier and Hanson 1984; Hillier 1996; Space Syntax Conference Proceedings 1999, 2003, 2005, 2007). Furthermore, spatial properties which define cities and settlements as cultural types seem to be associated with the social systems of their corresponding societies[3].
Space Syntax research attempts to shed light on the aforementioned issues by treating built environments as systems of space, analyzing them "configurationally" and trying to reveal their underlying patterns and structures (Hillier and Hanson, 1984).
Two levels of analysis describe the organization of public space: the "convex" analysis or "two-dimensional" organization of the system, and the "one-dimensional" or axial organization (Hillier and Hanson, 1984).

The essence of urban form is that it is spatially structured and functionally driven. Between structure and function is the notion of intelligibility, defined as the degree to which what can be seen and experienced locally in the system allows the large scale system to be learned without conscious effort. Structure, intelligibility and function permit us to see the town as social process, and the fundamental element in all three is the linear spatial element, or axis." (Hillier, 1996).

[1] Two factors need to be taken into account at this point: that cities are unique since the forms they take are influenced by factors quite specific to the time and place in which they grow (and indeed in a unique way we experience each city); secondly, the spatial and physical development of a city is believed to be a reflection of the social and economic processes responsible for their existence. Differences for example, in the physical and spatial forms of cities to the north and south of the Mediterranean, have been shown through thorough analysis to be connected to the cultural and social idiosyncrasies of the European and the Islamic traditions.

[2]What does the term "configuration" tell us? According to Hanson (1998), spatial relations exist where there is any type of link between two spaces. Configuration exists when the relations that exist between two spaces are changed according to how we relate each to a third. Configurational descriptions, therefore, deal with the way in which a system of spaces is related together to form a pattern, rather than the more localized properties of any particular space.

[3] For example, in cities in the Arab world, the spectrum between public and private spaces is often quite different from that in European cities .In historic European cities, local areas are for the most part easily accessible to strangers whereas in many Arab cities strangers tend to be guided to certain public areas in the town and access to local areas is much more forbidding.

In this way, the “axial” map[4] of the city has a structure - the distribution of local and global “integration”; the latter is considered by several researchers as the most powerful functional mechanism driving the pattern of movement, the distribution of land uses, building densities and large-scale spatial and physical elements such as landmarks and open areas. Well-functioning cities according to Hillier can be considered as “movement economies”. In other words, the effects of space and movement on each other, and the number of effects on both that arise from patterns of land use and building densities (themselves influenced by space-movement relation), give cities their characteristic structures.

3.2. Space Syntax and Phenomenology

At this point, we could possibly argue that Space Syntax offers a fairly accurate picture of how the physical world contributes to place experience and place making, through what Hillier calls the “deformed grid”; the physical core of this grid is the most integrated system of pathways, that is, those routes that have many other pathways leading into them and are therefore, potentially more alive with public life. This deformed grid as Seamon suggests (2007) is the underlying foundation for a web of connections among people and among people and places. This web, according to Vaughan, affords and is afforded by a particular district character and sense of place (2006).
It has been claimed during the past years that space syntax descriptions are by their nature experiential entities (Seamon, 1994, 2007). According to Perdikogianni (2007) it is exactly this experiential aspect of the Space Syntax analytical tools, along with the correlated observed patterns of usage of the “configured” space considering the global properties of the urban system, that could lead us to the definition of “place” as the “inhabited” space, the “lived” space. She argues even further that a problematic needs to be established upon which empirical data about how people understand and define “place” could be incorporated as other concrete values in the syntactical model of the city. She claims that there are other implicit interactions between the individual and space which are related with his/her awareness of the surrounding environment.
Seamon (2007) defining phenomenology as the careful description and interpretation of human experience, suggests that the space syntax tools potentially relate to a particular kind of phenomenological place structure, what he calls the place ballet. In the latter, the spatio-temporal regularity of individuals potentially coalesces into some larger environmental dynamic that both sustains and is sustained by an attachment to and a “sense of place”.
Many of the analytical concepts and procedures of space syntax, as Seamon suggests (2007) is that they “appear to arise from and accurately point towards real-world aspects of environmental and place experience... In this sense, axial and convex spaces are an accurate analytical rendition of the movement/rest dialectic”. These tools help us understand how spatial and physical qualities might contribute to lived aspects of movement and rest; as Seamon points out, the two-dimensional quality of convex space is possibly associated to rest and allows for “local places”. On the other hand, axial spaces relate to the one-dimensional, “moving” quality of open space and to a global relationship. Experientially, Seamon suggests, the kind of place ballet arising out of axial-space structure is different in its spatial and temporal dynamics than the kind of place ballet associated with convex spaces.
Seamon’s aforementioned suggestions can be observed in the analysis of the existing Eleftheria’s square and the proposed scheme, utilizing Space Syntax methodology.

4. ANALYSIS OF ELEFTHERIA SQUARE

As seen in the plan of the existing square, we currently have an axial space structure (in the form of a bridge) which relates to the one-dimensional, “moving” quality of open space and to a more global relationship. Not surprisingly, a striking observation when we study the axial map of Nicosia (fig.6) is that Eleftheria Square is

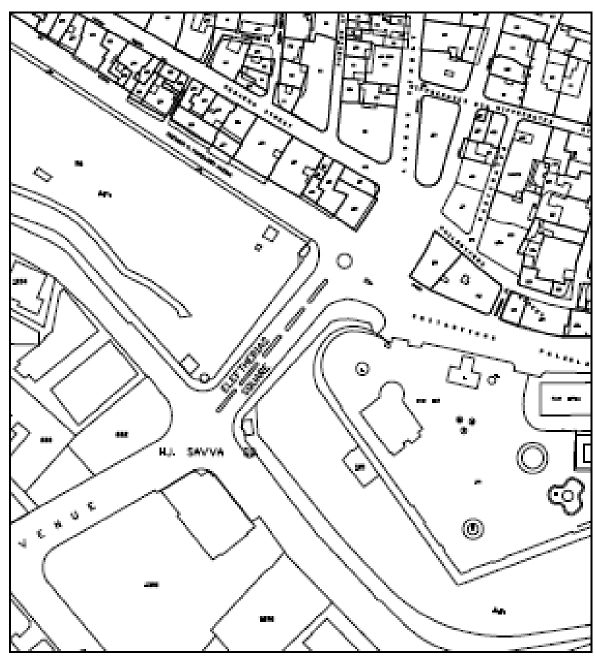

Figure 2. Plan of the existing square

[4] The analytic tool used to describe the organisation of public space in this paper, is the "one-dimensional" or axial organisation: this refers to the global organisation of the system from the point of view of those who move in to and through the system; that is, in terms of its lines of access and sight. It can be described by drawing the fewest and longest straight lines which pass through all the convex spaces of the settlement. Because visitors in a settlement, or in part of a settlement, are likely to be moving through the space, the axial extension of the public space accesses strangers to the system, whereas inhabitants have more static relations to the various parts of the local system (Hillier 1996).

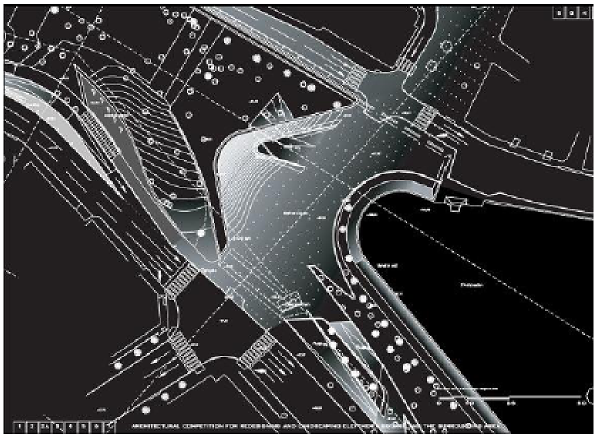

Figure 3. Plan of the proposed square

"integrated core"[5] of Nicosia. The integration core remains the same with the new proposal. Although the city of Nicosia within the walls becomes strongly isolated from the newly expanded city outside of the walls, the square remains strongly integrated in its axial dimension.
The basic difference however, of the winning scheme is the widening of the platform and smooth connections to the moat level, with the area below the platform accommodating a variety of uses (Figs 3, 4,5).

Figure 4. The existing square

The old wall is restored and a palm tree lined pedestrian walk alongside it is created. The presently underused moat, seen as a green 'necklace' in case the city is reunified, becomes the main public park of the city. The moat will also be altered topographically to make it more accessible from the surrounding streets. A smooth downhill continuation of the square will lead

Figure 5. The proposed square

[5] The integration core of a city includes the most integrated areas at a local level.

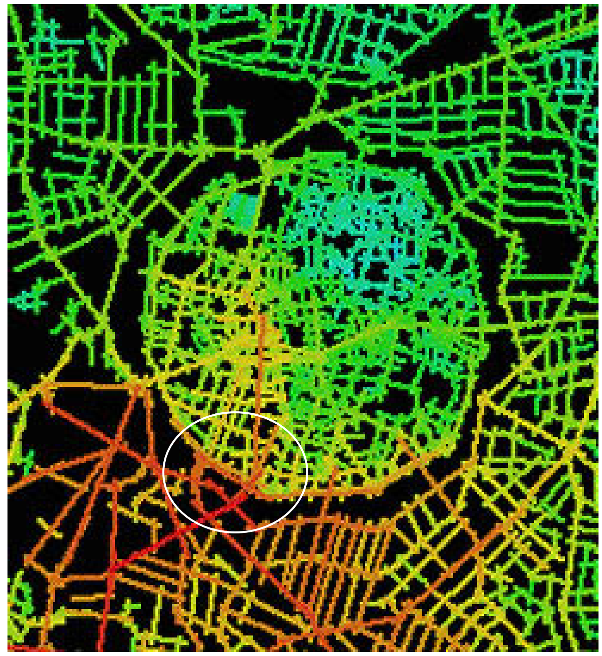

Figure 6. Axial analysis of the city within the walls

to the moat, where pedestrians can descend to the garden level and actively use the area. Coffee shops, snack bars and newsagents are placed on this level, while a range of recreational facilities including bicycle routes and walkways are proposed in an effort to enhance the quality of the residents. Retractable bollards will cut off the traffic at night, so that the square can be used for social events and gatherings.
In other words, the new scheme remains strongly integrated in the axial, moving quality of space and introduces the creation of convex spaces. The two-dimensional quality of the convex spaces proposed is associated, based on our observations in the previous section, to rest and potentially allows for the creation of local places. Taking the aforementioned ideas into consideration, design might be tailored to approach local communities and encourage acceptance of proposed developments and even behavioral change.

6. FROM SPACE TO PLACE

A major challenge faced by architects and urban designers is that of creating distinctive places which people enjoy using, by taking into consideration the physical and spatial characteristics of the space proposed. This paper deals with the nature of such a space, namely the urban square, and brings to the fore the "sense of place" and people's awareness of it, as its most important characteristic.
It is acknowledged that the perception of "place" and locality has been the object of discourse since the 60s. Research has so far focused either on local design features of urban design or on individual's perception of spaces with a lack of methods that deal with the physical and the experiential at the same time. What emerges through the current study is the need to trace

the difference between space and place and explore how this can be conceived in both analytical and experiential theories, a challenge that seems to be met by the Space Syntax methodology. This forms an important challenge for research: to explore the potential of a methodology which takes into consideration both spatial analysis of our physical environment and people's perceptions of it.
Space Syntax's analytical approach set in its phenomenological/experiential perspective, could lead us to the definition of "place" as the "inhabited" space, the "lived" space (Perdikogianni, 2007). Empirical data about how people understand and define "place" could be incorporated as other values in the syntactical model of the city (convex and axial structures) mentioned in the previous sections. Such a methodology might foster a more integrated research culture between academia and the profession and expand knowledge base in relation to architectural projects undertaken by the profession and academic research.

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The law of Indies as a foundation of urban design in the Americas

Roberto B. Rodriguez

University of Texas at San Antonio. San Antonio, Texas
Simon Bolivar University, Caracas, Venezuela

ABSTRACT: This study analyzes the establishment and functional structure of the population centres during the colonization process of the new provinces in the Americas. It is therefore a valuable attempt at recollecting and understanding information on the phenomena which marked the beginning of these settlements. When the Spanish Empire enacted a series of norms to guide the process of the founding of future populations in the discovered territories, thereby establishing the first territorial codes carried out that could be considered the first record of urban design and planning in the Americas. This paper analyses the criteria used by the Law of Indies in the settlements of frontier towns in Latin America using as a case study the city of Barcelona (Venezuela). This research relies on urban historiography of early cities in Venezuela and the morphology structure of the historic centre of Barcelona (Venezuela) from its foundation in the XVII century (circa 1671) to the turn of the XX century. Barcelona constitutes one of the clearest examples of the implementation of the regulations to direct the foundational process of the new settlements in the Americas. These regulations were based on a number of urban planning and sanitary principles that in turn, fostered order and organization over the colonization process in Hispanic America. On the other hand, the morphological principles derived from the Law of the Indies were already used in the layout of the Pre-Columbian American cities (Cuzco, Peru; Tenochtitlan, Mexico) as timeless 'Universal' principles in city design. These principles, conceived more than 400 years ago, are still prevalent as ordering concepts in modern urban planning. The relevance of this work lies in the fact that for the first time the city of Barcelona has gone under scholarly scrutiny of its physical structure and urban form.

Conference theme: Urban design studies
Keywords: urban design, planning history, urban morphology.

INTRODUCTION

The colonization of the new territories may not at first, have counted on a pre-established plan. Nonetheless, the dimensions of the discovery acquired prime interest to the Spanish Crown as an important source of wealth that required the design of a carefully crafted strategy that would bring coherence and continuity to the colonization process. As a result, the Spanish Empire enacted a series of norms to guide the settlement process of the newly found territories thereby establishing the first territorial codes to be carried out at that time. This could be considered the first record of urban design and planning in the Americas.

The model of the semi-lattice city plan used by the Spanish had great operational advantages which favoured the division of the lots of land among the inhabitants as well as allowing an easy pattern and division into streets and blocks, thanks to its geometric properties. Such ease, no doubt stimulated the rapid expansion of the urban Spanish network of towns in America and the division of land among the inhabitants ensured a growing sense of identity to the new land.

The morphological background of the semi-lattice model in the Law of the Indies has its roots in the Greek colonies which were later adopted by the Romans in the conquered territories. On the other hand, the layout of some Pre-Columbian American cities (Tenochtitlan, Mexico; Cuzco, Peru) were already designed with a semi-lattice pattern as an additional feature that positively influenced the colonization process in the New World. The grid pattern is a constant component in the founding of Hispano-American cities applied to different topographic land and environments. This vision created a uniformed urban design pattern of cities in the Americas where a number of principles are considered 'Universal' in city urban planning worldwide.

The application of this model has shown a great structural flexibility and a multiplicity of morphological variations as opposed to the geometric rigidity that the reticular grid could entail. The reticular pattern of the checker box offered possibilities for controlled expansion, as it has been showed in cities founded in

North America, such as San Antonio in Texas.

Research objectives

This paper analyses the criteria used by the Law of Indies in the settlements of frontier towns in Latin America using as a case study the city of Barcelona (Venezuela). This research relies on urban historiography of early cities in Venezuela and the morphology structure of the historic centre of Barcelona (Venezuela) from its foundation in the XVII century (circa 1671).

Barcelona in Venezuela (current population: 350,000) has evolved in one of the major cities in Eastern Venezuela and is the third city founded in Eastern Venezuela, preceded by Nueva Cadiz (a town island no longer in place) and Cumaná. The relevance of this work lies in the fact that the historical evolution of a colonial city has been analysed with a focus in its physical structure and for the first time the city of Barcelona has gone under scholarly scrutiny of its urban form.

1. BACKGROUND

1.1 The Law of the Indies (enacted in 1573)

The process of the founding, building and later development of the urban areas in America started by the Spanish crown and which continued for approximately three hundred years was, no doubt, the greatest effort at the creation of cities and urban planning in an extension of continental magnitude without comparable precedent till the present day.

The conquerors of the New World considered the city to be an important element in the colonisation of America as it was the site at which political, military and religious power was to be found, as well as being the basic infrastructure which would allow commerce with the Metropolis through a network of population centres for the control of resources and its administration in the provinces.

The urban centres, which the Spanish found on their arrival to America, were the first centres for settlement. These frequently served as support centres for territorial expansion which resulted in new urban settlements which, in turn, became advanced religious and military population centres which would permit new conquests and greater penetration of the territories which would gradually be incorporated into the empire.

The characteristics of the land, unknown to them, and its enormous distances led to a dispersed occupation of the land in diverse geographic locations. In spite of this, relative uniformity in the founding of the new settlements was achieved (Vegas, et al. 1984).

The conquest and colonization began in Santo Domingo and then progressively extended to the rest of the Greater Antilles and later on to the continent in Mexico and Panama, from where expeditions for the occupation of South America would depart. By 1580, Spain had practically concluded its colonial conquest and occupation, initiating the consolidation of its urban network (De Mendoza 1887).

At that time, the colonizers had made a valid attempt at urban planning through the development of a model applicable to the new settlements considering that the founding and later expansion of the centres would be determined by the rigorous application of a previously elaborated plan.

The growth of the planned cities was based on a layout or regular pattern in which the exact form of the settlement was defined, the alignment of the roads, the arrangement of the blocks and the pattern for the division of the parcels among the founding members. These cities were subject to modifications in their form, both at later stages in their development as well as at the start, due to topographical adaptations or the territorial interests of its inhabitants.

The variations of the reticular pattern could be produced by the alignment of the roads or through the disparity of the arrangement and the dimensions of the blocks, with which the orthogonal pattern whose regularity in the urban structure is not precise would be called semi-reticular (semi-lattice). Generally, these modifications were the result of geographical accidents but in certain cases they were the result of the interests of the owners which wielded power over the use and occupation of the urban space.

The gridiron used in the Law of the Indies is a milestone precedent of the concept of 'partially ordered sets' (posets) of relationships also known as the semi-lattice system. This system helped the Spanish Crown to organize the new found land settlements throughout the Americas in such a way that all its components have to be determined by an open ordering system that has a central core as the departing place/space from where all functions and activities depart.

Although the grid looks rigid at first sight, it poses high flexibility as an open system that has one of the highest levels of connectivity as opposed to the existing towns of the times throughout Europe (laissez faire built up during the medieval period).

The eventful experiences of the first settlements established the need for regulating the foundational process of new cities in America (except for special cases such as Tenochtitlan, whose reticular layout of its channels were used as a base for the founding of the city of Mexico). As a result, a number of arrangements to this end were established by the Spanish metropolis during the reign of Charles I (1517-1556) who enacted the "General Cedula for the Founding of Cities in the Indies" (1521), the "Instructions to Cortez" (1523) the "Imperial Provision" (1526), the "Instructions and Rules for Populating" (1529), all of which permitted the elaboration of the "New Laws" (1542) during this period.

During the reign of Philip II (1556-1598) a number of norms and regulations with greater weight were drawn up (>70%) with regard to the new settlements and which were to be the instruments for the codes of the settlement centres for the colonial period in Hispanic America. This group of norms was called "Ordinances of Discovery, New Settlements and Pacification" and were decreed by Philip II in Segovia Wood on July 13th, 1573.

The ordinances were really a compendium of norms which would be considered a law on territorial and urban codes. Due to the general nature of its terms the text includes several decrees and documents which made possible to enact the settlements' organization.
At the time in which the Ordinances were decreed, the main urban centres had already been founded in the colony and in general a large number of smaller cities, among which of greater importance were Santo Domingo, Bogotá, Quito, Mexico, La Asunción, Cartagena, Veracruz, Panama, Potosi, Lima and La Havana. The majority of these cities would not lose their importance as political and commercial centres and many would even become the capitals of the future Latin American nations from the XIX century onward.
The Ordinances are kept in the General Archives of the Indies in Seville, in the General Indifference Section, dossier 427, book XXIX. The text that is analysed in this report is taken from the facsimile edition edited by the Ministry of Housing of Spain, under the auspices of the Hispanic Cultural Institute. The ordinances were included in the fourth volume of the Cedulario by Diego de Encinas, under titles I to VII in his Colección de Incuables Americanos. Torres de Mendoza also published them in 1887 in the unedited collection of documents on the Indies related to "Discovery, Conquest and Organisation of the Old Spanish Possessions in America and Oceania".
The content of the Ordinances comprise a number of normative principles and procedures for action which are described in the 148 chapters or articles subdivided, in turn, in three large groups in the following manner: a) The Discovery (32), b) The New Settlements (105) and c) The Pacification (11).

1.2. The Spanish conquest in East Venezuela

Two stages can be identified in the foundational process of the Spanish settlements' consolidation in the coastal sub-region in the east of Venezuela. The first occurs from the first insular settlement until the final founding of the city of Cumaná in 1569, the capitol city of de province of Nueva Andalucía (Ramos, 1980). From this moment the second stage of the conquest began which encompassed the entire functional development of the lands in Cumanagotos and culminated with the founding of Barcelona, one century later in 1671.
The territorial occupation during the first stage began in 1510 with the founding of Cubagua, uninhabited at that time. The first settlement was due to the presence of large pearl resources on the island. The exploitation of the pearls led to the spontaneous appearance of a newly founded centre, without a pre established urban plan, from 1517 on, which was called Nueva Cadiz and which from its start was dependent on water, food and labour from the less rugged territory.
In 1528, the settlement was firmly established and was granted the title of city by Carlos V although the population might not have surpassed one thousand inhabitants at that time. However, from 1539 on there was clear decline of the population as a centre for commerce and emigration of the majority of its inhabitants to newer sources of wealth in the continent began as a result of the premature *exhaustion of* the oysters.
In 1543, Nueva Cadiz was completely abandoned and its inhabitants transferred to the neighbouring island of Margarita where a permanent settlement was made although initially due to the same reasons of economic exploitation.
Nevertheless, the island is the only stable territorial reference during the first years of the conquest and was a point of departure and operations base for the new expeditions to the nearby continent and the following territorial occupation of the east of Venezuela which would culminate with the founding of the city of Cumaná in 1569 (Martinez, 1989) and Barcelona in 1671.

1.3. The foundation of Barcelona in Venezuela

The historical development of the functional structure of the city of Barcelona is based on three basic premises. In the first place, the city was formed as a new urban centre the result of the merging of two previous settlements; San Cristóbal de Los Cumanagotos and Santa Eulalia or New Barcelona. This created a differentiation and spatial segregation of its inhabitants which was evident from the moment of the founding of the city. The former inhabitants of Santa Eulalia, who were greater in number, inhabited the central plots and were located in the vicinity of the buildings and spaces, which represented the public and religious powers (Zawisza 1989). On the other hand, the former inhabitants of Cumanagotos were located in the peripheral area on the west border of the Neverí River based on their lesser political weight.
The spatial separation referred to caused from the start, the informal coexistence of two ecclesial parishes, although this figure would not be definitely installed until the end of the XIX century. Paradoxically, both newly founded parishes were given the name of the patron saint which corresponded to the settlement. Therefore, the parish of the present cathedral was consecrated to St Christopher although its inhabitants were from New Barcelona and the peripheral parish, presently devoted to Our Lady of Carmen, was consecrated to Santa Eulalia, although the majority of its patrons came from the old settlement of Cumanagotos.
This segregation (and therein its importance) was reflected in the difference in the spatial and functional elements based upon the in nature of two different groups of inhabitants that generated a distinct urban dynamics from the start as two types of growth tendencies in the process of the city expansion: Consolidating of the original central area, density and expansion toward the river. The latter, was made in an attempt to stimulate port activities *pushed by* the inhabitants of Cumanagotos, whose settlement was older than that of Santa Eulalia, with an important commercial and maritime calling.
At this point, it may be relevant to begin the discussion of the second premise under analysis; the implementation of the Ordinances of Phillip II. As a

matter of fact, the initial *forming* and future expansion of the city was carried out formally by the construction of a perfectly reticular and orthogonal plan whose epicentre of activity was the Main Square, rectangular in form and looking toward the west, in accordance with the urban concept found in the Law of the Indies (IPC Reports 2000).
The morphology of the Main Square from where all the streets spread out at a right angle, in an east-west direction showing the inclination of the river to the city, bore the names of the religious patron saints and showed the typical arrangement of the Spanish square, even more so when the dimensions of the Square are seen to be the equivalent of two blocks and these were divided into four square plots of similar dimensions.
The reticular urban pattern of Barcelona is found in the expansion which the city underwent form 1671 to 1884 at which time the urban structure suffered considerable modifications and the process of spatial occupation of the historical centre and its nearby areas were completed. However, this process cannot be understood unless the third premise, which deals with the geographical space over which the settlement would be founded, is not analysed.
The city of Barcelona was initially located on the west border of the Neverí River the natural limit or border which was relatively isolated until 1793, the year in which the construction of the first bridge was completed. Similarly, to the south of the city the Arroyo River which today has been channelled but which at that time of the founding of the city was an important barrier to spatial growth, particularly due to the presence of large marshy areas. However, even though the Arroyo River was a barrier for urban growth, the Neverí on the contrary represented an attraction due to the possibilities which it offered as a means of commercial communication.
Based on these three previously explained premises, and the elements that modified the city in time and space, it has been considered appropriate that the functional analysis of the city be divided into four chronological periods. The first began in the year of the founding of Barcelona in 1671 and extends toward the beginning of the XVIII century. The second period covers the first half of the eighteenth century while the third continues to the year 1800. Finally, a fourth historic period has been included which covers the XIX century. It should be pointed out that from this moment, the physical expansion of the historic centre of the city had been completed and the changes that were observed were mainly with regard to the use of the soil and not its urban function. Nevertheless, at the end of the present chapter a brief description of the more important morphological modifications shall be made.

2. ANALYSIS OF URBAN STRUCTURE

2.1 First Period (1671 – 1700)

During the first period mentioned, development of the city was slow and evolved around two main east-west focal points, a third to the north and five transversal (cross) streets which made up a total of fifteen blocks arranged form around the Main square, with a total development of ten of these while the rest showed an incipient growth, at the same time that shows the tendencies toward urban expansion (Fajardo 1992) and the limits of its growth (Fig. 1).

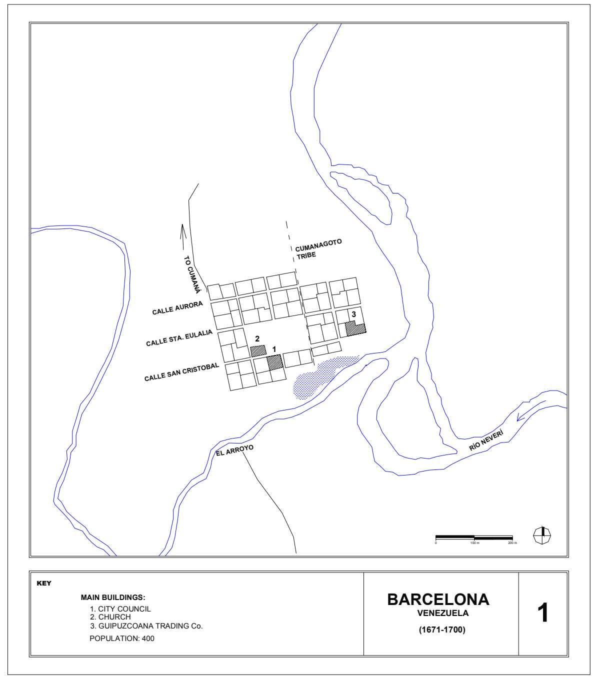

Figure 1: Reconstructed plan of Barcelona, first period.

In particular, during these twenty five years of urban existence, the city solidified the presence of fifty lots of houses which housed a population of four hundred inhabitants considering thirty families that came from the city of Santa Eulalia, while the other twenty were originally from the town of Cumanagotos.
As described in the previous paragraphs, the original urban structure during this period has been modified by the inclusion of three important buildings: the church, the Town Hall and the house of the Guipuzcoana Company. Thus, the three main powers of the colonial government, political, religious and especially the economic – commercial, were present at the beginning of Barcelona. Although these buildings were notably incipient at the beginning, their original locations would remain throughout time.
In its usual manner and as stated in the norms found in the ordinances, the church was located in the Main Square with access from the east. This first building was of a provisional nature and served the two old towns traditional parishes. This situation was maintained until 1720 when the differences between the two parishes were eliminated.
The Town Hall, for its part, was located in one of the first four houses built and particularly in one that had a balcony and doorway which is still conserved today. It is particularly interesting to note that this building was a

replica of another on the opposite side and both buildings flanked the larger church. This morphological accuracy shows without doubt, the representative nature of the municipal and religious functions, *maximized in both cases as they are found in the vicinity of the Main Square in accordance to that established in the Law of the Indies.*

Finally, it should be pointed out that during the first period Barcelona reached a population of one thousand inhabitants which, in conjunction with its geographical conditions, those of defence and communications, led to the installation of a representative of the Guipuzcoana Company in the city. This doubtlessly had a notable effect on the growth of the same and marked from its initiation the growth and importance of this commercial venture.

The Guipuzcoana house was located, for obviously commercial reasons, in the proximity of the Neverí River and was the nearest lot to this fluvial and the newly founded port area of Barcelona. The location of the Guipuzcoana House in conjunction with the commercial experience of the former inhabitants of Cumanagotos, undoubtedly led to the main line of initial expansion of the city coinciding with the extension of the San Cristóbal and Santa Eulalia streets which bordered the Square to the south and the north respectively.

This process of expansion in an east-west direction was reduced from the second period due to the irregular course of the Neverí River and the start of the construction of the Hospice or Hospital - Convent in the north of the city which was a functional element of greatest importance for the following years.

2.2. Second Period (1700 – 1750)

During the second period, which reached the year 1750, Barcelona experienced a rapid demographic growth and an intense development in its urban activities which were spatially reflected in the doubling of the occupied surface area. As a matter of fact, the city was now comprised of twenty three blocks of which seventeen were completely built up (see Fig. 2).

During this period, it is important to note the construction of the Hospice (Hospital – Convent) of the Franciscans on the outskirts of the city on the way to Cumaná.

The convent in Barcelona in honour of Saint Francis of Asis began with a slow construction in 1739 and in 1744 the chapel, the vestry and two annexes were built enabling its formal use by members of the order.

In this same period, during the year 1748, the San Cristóbal church was permanently built on the southwest corner of the Main Square on the same spot as the first chapel of the city.

Parallel to the consolidation of the religious power, there was a strengthening of commercial activity with the implementation of the ports of Barcelona and La Galera on the banks of the Neverí River which led to the installation of the Royal company of Catalan Commerce which, in conjunction with the Guipuzcoana, held a monopoly of the productive and commercial activities in the city for the first years.

These changes produced significant modifications in the urban pattern and the dynamic of the activities in Barcelona. There was an increase in the commercial importance of the axis of the Camino Real Street formerly known as calle San Cristóbal as well as the road to Cumaná and the areas near to the fluvial ports along La Galera Street. Therefore, the occupation and urban expansion trends and the productive activities toward the north and toward the river continued thereby increasing the demand for new residential areas.

It is interesting to note that during the second period, the city did not extend toward the El Arroyo sector. This was due to the marshy ground and previously mentioned factors which together led to the city's growth in other areas.

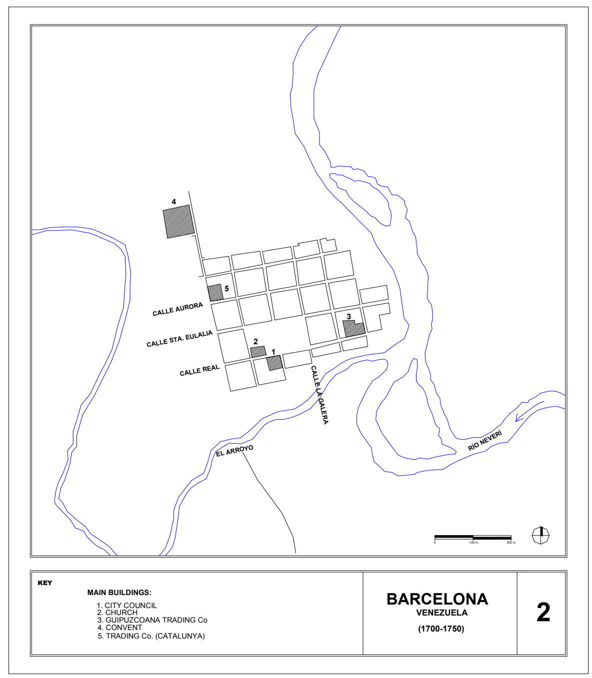

Figure 2: Reconstructed plan of Barcelona, second period.

2.3. Third Period (1750 – 1800)

In 1761, the city reached a population of three thousand inhabitants, six times larger than its original population ninety years earlier at its founding. By the beginning of the 19th century approximately forty years later still the city had quintupled its population, surpassing fifteen thousand inhabitants in the independence period.

Certainly during the third period from 1750 to 1800, the city underwent accelerated growth. During this time the occupation of the present historical centre was practically completed (see Fig. 3).

By 1777, the fourth cloister of the Franciscan hospice had been inaugurated. In 1783, the building of the upper floors was completed with the termination of the missionary work.

About the same time (1774) the construction of the San

Cristóbal church, which had been temporarily halted between 1766 and 1768 as a result of a strong earthquake which had destroyed its sidewalls, was completed. During this period, commerce in Barcelona continued to maintain a certain amount of importance both on a local as well as regional level. This was evidenced by the construction of huge mansions by the Creole oligarchy that would later play an important role in the historic events of the independence period. Among these buildings, the residences of the Cajigal, Freites, Urbaneja, Anzoategui, Arquidegui, Dominici and Salavarría families should be noted.

With regard to the functional structure of the city, the construction of the bridge over the Neverí, the Portugal Bridge in 1795, stands out. This generated intense urban growth on the right bank of the river over the port quarter of Barceloneta or Portugal. In said sector, the public city jail--which had been partially destroyed by the building of the bridge--was sited. It served as a government house for a brief period.

Due to the construction of this bridge, the commercial activities on Santa Eulalia Street were developed in a parallel fashion to the dynamic of the High street. Both, long with La Paz Street, the old route to Cumaná, represented the main corridors of urban activity during this period, maintaining its importance in the structure of the city to the present day.

In the same vein, the expansion of residential activity led to the creation of the El Resbaladero quarter in the north of the city in the vicinity of the Franciscan hospice. Parallel to this, the bank of the Neverí was occupied while the El Arroyo River continued being the southern limit of the city. At that time Barcelona was made up of 44 squares or blocks divided following the colonial reticular pattern. It should be pointed out that the size of the Main Square continued being reduced in favour of religious and commercial activities at the same time as a slight distortion in the square pattern in the El Resbaladero quarter began.

2.4. Fourth Period (1800 – 1900)

In the fourth and final period identified, that reaching 1900, the expansion of the city spans the era of the War of Independence and the first half of the Republican Regime (See Fig. 4).

In the first twenty years of this period, war wrought huge destruction on the structure and morphology of the city. Most important was the Battle of Barcelona in which the patriots used the Franciscan convent as a fort for defence. As a result, this building, today in ruins, would later be christened Casa Fuerte in 1817.

Among other important elements in the urban landscape of the time, the enlarged San Cristóbal church and the building of the Municipality over the old Main Mayor, called Plaza Principal in the first Republican Period, should be pointed out. As a result, said space was substantially reduced and ended up in the form of a square. The other square which remained in the city is known as Libertad (Freedom). It is the former Hospice Square considering that the present Rolando Square was not built until the demolition of the block which it presently occupies at the beginning of the present century.

On the edge of Rolando Square the National Theatre, today known as Cajigal, and the Church of El Carmen the new parish in Barcelona -an ambition which as we

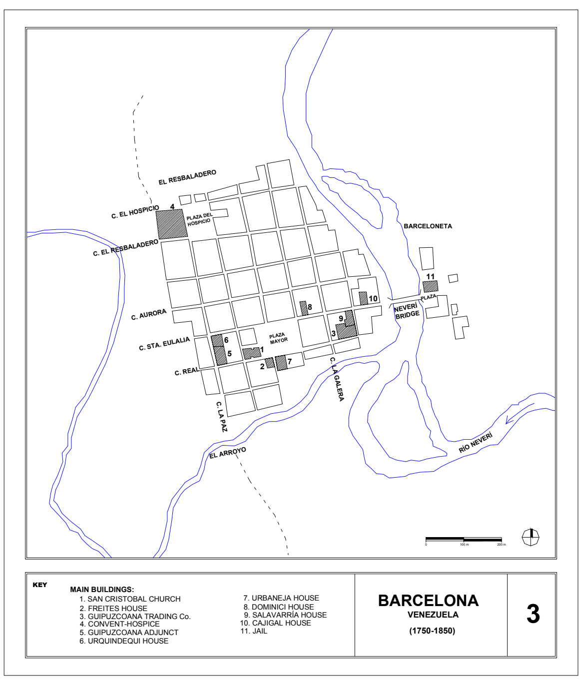

Figure 3: Reconstructed plan of Barcelona, third period.

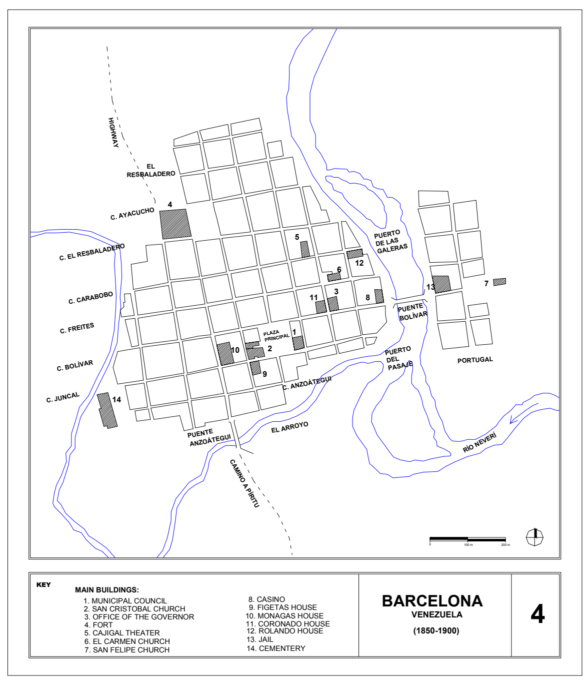

Figure 4: Reconstructed plan of Barcelona, fourth period.

have seen- stems from the first years of the founding of the city.

During the fourth period the final solidification of the historic centre was completed as well as that of the first peripheral quarters such as El Resbaladero in the north; Cayaurima, Dos Caminos and San Pedrito or Buenos Aires in the west; La Aduana and El Arroyo in the south; and Guamachito, Portugal and la Barceloneta on the right side of the river. The emergence and consolidation of the quarters on the other bank of the Neverí prompted the building of the San Felipe Church in the vicinity of the public jail.

In the same fashion, the access roads to the city at the end of the century were improved by the construction of the Guzman Blanco Road connecting Cumaná, the Anzoategui Bridge on the road to Píritu and the Pozuelos Road on what is today Cajigal Avenue. These improvements in the access routes were accompanied by maintenance work on the infrastructure of the fluvial ports of El Pasaje and La Galera and by the remodelling of the bridge over the Neverí, rechristened Bolivar, after the War of Independence.

The economic surge of the city in the second half of the nineteenth century, in conjunction with its standing in government in the new republic as well as with the improvements in the city's communication infrastructure, substantially changed the structure and dynamics of its urban activities. This is evidenced by the erection of a casino in the city, the inauguration of the cemetery in 1892, the running of a university college between 1885 and 1893, and the construction of public buildings such as the Municipality and the government building.

The subsequent developments of the city in general and the historic centre in particular have been conditioned by the changes undergone during the latter part of the nineteenth century. It was then that the pattern for locating activities was defined. The function of the centre as a mixed commercial and residential area was also defined then, although commerce tended to progressively displace residential homes as a historic trend.

3. RESEARCH OUTCOME

The analysis of the urban structure of the city of Barcelona should be undertaken both from the perspective of its physical and spatial structure and from the typology pattern of the buildings and the layout of the roads. These are compatible with the conditions established in the Ordinances for the New Settlements. This means that the location of Barcelona in an extensive fluvial plain where the only immediate border is the eastern bank of the Neverí River rendered the possibilities for the continuing of the semi-lattice pattern.

These geographical characteristics permitted the formal implementation of the stipulations contained in the Ordinances of Philip II without any notable resistance posed by the physical terrain. This is evidenced by the fact that the reticular pattern remained unaltered in Barcelona until the end of the nineteenth century. The first result of this analysis is therefore the implementation of the urban norm established by the Law of the Indies. The norm was conditioned by the geographical factors that determined the possible physical expansion and the dynamics of the newly founded urban structure in the initial years.

It is especially important to mention that toward the end of the eighteenth century the population of Barcelona managed to overcome the physical obstacle of the Neverí River by constructing its first bridge. This permitted permanent and vital communication with the other side of the river and constituted the first important structural modification of Barcelona. This new communication link was the first step in spurring on the development of other peripheral areas and led to stabilizing diverse activities for the storage, exchange and distribution of products coming to the interior of the country via the port area.

Thus a trend of urban growth was revealed, first in the traditional city centre of Barcelona and from there towards the outskirts. It can therefore be stated that the peripheral quarters on the outskirts of Barcelona comprised, until the beginning of the 20th century, an extension of the central area. The morphological traits of said outskirts are very similar to those which are present today in the central area.

Geographical location is not the only element which determines spatial growth. Cultural patterns unique to the region, patterns which impart special characteristics to the city, should also be kept in mind.

From the beginning, Barcelona was an important point in linking the east of Venezuela with the Captaincy General of Caracas. This role was reinforced by Barcelona's proximity to the port of Cruz (today known as Puerto La Cruz) which, like other ports in America such as la Verdadera Cruz (today Veracruz in Mexico) to name but one, comprised access and exit ports for indigenous products. This strategic position as a link between the governments of New Andalucía and Venezuela made Barcelona the main commercial centre of the East of Venezuela.

Cumaná arose similarly. It was the first populated settlement for advance military and religious entities on the continent. Its position as the first city and its early consolidation quickly made it the leading military and political centre of that provincial area. This led to the construction of permanent forts and castles which gave it an important cultural legacy. However, the distance from the Captaincy General and the discovery of a nearer, alternative port gave Barcelona the edge as an important location in the region.

4. SEMI LATTICE ANALYSIS

The term semi lattice is referred as a mathematical concept with two definitions, one as a type of ordered set, the other as an algebraic structure. Both definitions have order theory as the basis for relationships that capture the notion of extended ordering of sets. The semi lattice definition adopted in early adaptations to urban sets analysis is that of the partially ordered sets

(posets). Semi lattice analysis was first applied to understand urban systems by Christopher Alexander in the milestone article, “The City is not a Tree.”
In this case, semi lattice theory serves first to expose the ordering principles of the Law of the Indies, and secondly to demonstrate the partially ordered subsets that define Barcelona growth in a 200 hundred years span of time. While growth in history has been defined as a linear phenomena the various events that affect growth are not. To understand this, the analysis of Barcelona will be revealing for an understanding of the systems that operate in the city.

4.1. First Period

The establishment of the city began with the basic urban elements such as the grid that accommodated 30 families the main Plaza, the Church and Guipuzcuana Company which acted as trading company by appointment of the King of Spain.
Urban life was along the Calle Real and I found to main subsets of urban activity; one around the main Plaza, and the other where the Guipuzcuana Company was located. In Fig. 5 it can be seen the relationship among activities (see key on Fig. 1).

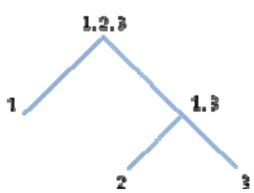

Figure 5: Semi Lattice Analysis, first period.

4.2. Second Period

The second period is characterized by the expansion to north due to the creation of the hospital on Calle de La Paz where it also was located a second trading company managed by the Catalunyan Province with permission from the King of Spain. In this case the creation of the Hospital and the Catalunyan Company partially offset the location of the Guipuzcuana Company, strengthening the western side of Barcelona in the first half of the XVIII century (see Fig. 6)

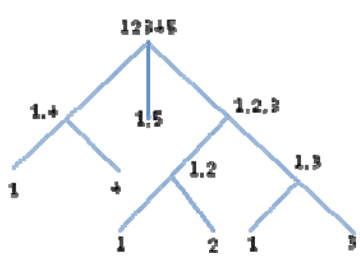

Figure 6: Semi Lattice Analysis, second period.

4.3. Third Period

With a time span of 100 years the city grew at steady pace where the major features are the jail on the other side of the Neveri River and the bridge that connect it to the city. These additions to the urban fabric brought new meaning to Sta. Eulalia Street transforming it into the new main street that opened Barcelona growth from its confinement beyond the river (Fig. 7).

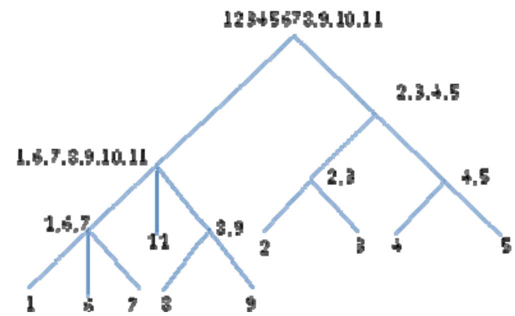

Figure 7: Semi Lattice Analysis, third period.

As a result, two subsets of activities become more balanced than in the second period. On one hand the subset marked through the Calle Real and Calle de La Paz and on the other, the subset of Sta. Eulalia Street. The former is mainly characterized by religious activities (Church and Hospice) and the Catalan district and the latter, with governmental and trading activities.
This period was also characterized by the Independence war from Spain.

4.3. Fourth Period

This period is marked by the different Governments of president Guzman Blanco who was in office much of this last half XIX century (1870-77; 1979-84; 18886-87) 13 years in all. This period was signed by transformation and the passageway from a colonial province to an independent country with all obstacles that this might mean in the path to become a modern State.
During this period Sta. Eulalia Street became Bolivar Av., the Cajigal Theatre (following the French tradition of the times) was built, and Barcelona became the Capitol city of the newly created Anzoategui state.
The subset of activities marked by the Church and the Hospice were strengthened with a new City council building and a new cemetery on the western side skirts. Although, the La Paz – Calle Real subset was consolidated, the Bolivar Av became more prominent throughout this time since all governmental and commercial activities settled in and around this subset. This trend paved the path for the foremost and future development of Barcelona and the early XX century highway 9 that would connect the city with Caracas and with its natural seaport; Puerto La Cruz (6 miles away).
In Fig. 8 it can be seen (on the right) where most activities are located
The magnitude of activities that took place along the riverside informs again the importance of water courses to establish human settlements. It also tells that the development took place where city dynamics were higher and closer to ways of connectivity with the ‘out of the town’ roads to other centers.

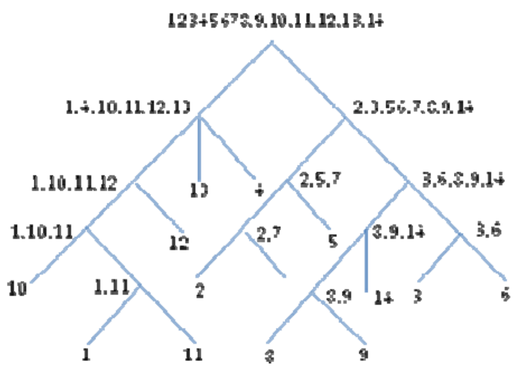

Figure 8: Semi Lattice analysis, fourth period.

Although the growth in Barcelona and all cities in Latin America took place around the main Plaza following a sort of concentric development where all the above mentioned activities determined the organizational structure of the city, giving its identity and sense of place. In the case of Barcelona, the linkage across its own borders with other settlements was crucial to create a distinctive urban fabric pattern and an identifiable urban morphology

CONCLUSIONS

Barcelona still evinces the conditions set out in the Ordinances of the Law of the Indies for New Settlements. The Ordinances constituted a model for development adaptable to local topographical conditions. Barcelona's strategic location within the region was fundamental to enact the political functions that facilitated to carry out the territorial occupation and colonization of Eastern Venezuela.

It should also be pointed out that Barcelona's proximity to the Captaincy General of Caracas made it complementary with regard to the latter. On the other hand, Cumaná played a role as a link with respect to the East of the country. For that reason, the urban development of Barcelona would flourish within the parameters of commerce and a unique geopolitical position.

Therefore, it is important to highlight the validity of the 1573 Ordinances of Philip II, the influence of which is found in the present urban structure of Hispanic American cities. Barcelona constitutes one of the clearest examples of the implementation of the regulations to direct the foundational process of the new settlements in the Americas.

These regulations were based on a number of urban planning and sanitary principles. These principles in turn fostered order and organization over the colonization process in Latin America and that blended the Old World cultural traditions in the New World population centres.

On the other hand, the semi lattice analysis give us new insights about the underlying principles embedded in the Law of the Indies such as the creation of magnet components that are dynamic agents that foster further development. These components sustain a wide array of activities as the "wide variety of ensembles" (Alexander 1964) represented in the natural organisms and its linkage with the physical environment.

The dynamics generated around these unique places determine the centralities around which the city functional structure develops and if balanced, create sustainable environs.

Semi lattice analysis helps us out to determine the existing subsets within the city system thus, revealing the operational structure about how the city functions.

The principles, conceived more than 400 years ago, are still prevalent as ordering concepts in modern city planning and urban design. The most notorious is the centrality principle, which allows flexibility in the reticular plan consistently based on a cellular configuration that is open ended and highly adaptable to further development that in turn, drives into a more cohesive and balanced sets of land use patterns.

All in all, the Ordinances of Phillip II along with existing native human settlements most definitely marked the foundation of city design principles that led to modern urban planning and design development in the Americas.

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Placemaking as a sustainable planning strategy: Serenbe Community

Phillip Tabb, Ph.D., AIA

Texas A&M University, College Station, Texas

ABSTRACT: Placemaking offers a wholistic approach to the application of sustainable planning and design measures that cross the varying scales of residential development. A place can be described in terms of certain archetypal planning principles and specific sets of ectypal patterns that when taken together form the basis for this sustainable planning strategy. Using this set of place-making patterns, sustainability is explored in terms of the inherent geometry of a place, the spatial structure and characteristics for form, the opportunities affording the creation and support of community, the positive health affects of active living and social activities, and the grounding nature of a site contributing to the quality and spirit of place. The results are a coherent settlement form, diversity through densification and transect design, integration of necessary functions and essential mixes of use, generous preservation of land, and provision for organic agriculture. The ectypal patterns and their archetypal effects are analyzed for a small experimental community located southwest of Atlanta, Georgia. This paper addresses both an explanation of the evolving community and presentation of the in-progress research. Serenbe Community is a model residential development, which is a 900-acre constellation of interconnected hamlets designed around traditional values and environmental sustainability. This paper describes twenty place-making patterns and the ways in which they have informed the design, the realization, and the sustainability of this unique community.

Conference Theme: Urban design studies
Keywords: placemaking, sustainability, community, planning, patterns

INTRODUCTION

Sustainability, as related to the built environment, has typically focused on the relationship between transportation and building energy utilization and resource conservation relative to design and use. At the single building scale the focus has emphasized climate-responsive form, use of on-site resources, energy efficient building materials, equipment and construction practices. At the planning scale the focus has been on density, diversity of landuse mixes, transportation modes and configurations, and the support of pedestrian environments. According to geographer Dr. Susan Owens (1985), substantial savings can be achieved through these spatial strategies reducing both building and transport energy needs. The implementation of the design and planning strategies required to achieve these savings has recently been achieved through aggregate planning guides or through green building rating systems such as LEED certification (Farr 2008). It is the assertion of this paper that placemaking can contribute to sustainability in significant ways and that certain ectypal patterns contribute to the placemaking process. Serenbe Community is an experimental community that can be used as a model for sustainable planning and urban design as observed through the incorporation of the proposed placemaking patterns.

1. PLACEMAKING PATTERNS

There can be a powerful and inextricable relationship between a settlement's form and its ability to create place; which correspondingly affects its function, use, dwelling and patterns of behavior. Unfortunately, many residential development projects have not used sound planning principles and placemaking patterns, thereby rendering them vapid, placeless, and over-consuming environments. This paper posits, that as a settlement becomes more place-oriented, its potential for livability, health, community and sustainability increases.

1.1. Pattern origins

In a series of works by the architect and architectural educator Michael Brill (1985) and his architectural students at State University of New York at Buffalo, a set of patterns were identified as being present with sacred sites. They believed that a "charged" site might contain a common set of fundamental characteristics by which placemaking can be supported and its special nature may be revealed. These patterns followed a sequence creating a center, to it's containment, and finally to its consecration and use. It is important to realize the presence, the quality of expression and the impact of each of the patterns, as they constitute the properties and attributes of a charged place. In subsequent research by Tabb (1990), these patterns were expanded and applied to small settlements.

1.2. Archetypal placemaking principles

Archetypes describe the energetic qualities of a principle. Through the action of the First Principles, certain ectypal patterns emerge and support sustainability. The *Unity Principle* describes two actions – the emergence of harmonic parts and the dissolving of parts into a comprehensible whole. The *Generative Principle* describes growth within a place and proliferation. The *Formative Principle* describes varying ordering systems of a form. The *Corporeal Principle* is a grounding into the pragmatic realms. And the *Re-generative Principle* describes the transformative qualities of a place (Lawlor 1982).

1. Unity Principle
2. Generative Principle
3. Formative Principle
4. Corporeal Principle
5. Re-generative Principle

1.3. Ectypal placemaking patterns

An ectypal placemaking pattern is a model and a guide that embodies both an idea and a physical means by which to express that idea (Alexander 1977). A design pattern is an element of a larger collection of patterns, which constitute a whole place (Joseph 2006). The patterns follow a certain sequence through the First Principles. Ectypal patterns that were synthesized and used to evaluate Serenbe Community are the following (Alexander 1977, Brill 1985, Tabb 1990):

1. Making location, centering
2. Connections and transects
3. Bounding with Differentiation
4. Whole place
5. Orientation and direction
6. Descent, grounding
7. Reaching upward, levity
8. Multiplication, proliferation
9. Scaler order, anthropomorphism
10. Geometric order
11. Natural order
12. Celestial order
13. Economical order
14. Functional order
15. Spatial structure
16. Physical materiality
17. Elemental materiality
18. Passage and thresholds
19. Light
20. Consecration and ceremonial order

1.4. Pattern sets

It is through the lens of these ectypal patterns that both the quantitative and qualitative nature attributed to placemaking, sustainability, and community may be understood. Of course, they do not function in isolation, but combine into a single phenomenon. The first eight patterns are part of the volumetric creation of a place, the second eight patterns contribute to differing mechanisms of order, while the last set of five patterns give a particular quality to that creation. The twenty patterns are also organized into the five sets of four patterns corresponding to the unity, generative, formative, corporeal and re-generative principles.

2. COMMUNITY-SCALE SUSTAINABILITY

2.1. Community-scale measures

Sustainability at the community scale spans from measures that create a more energy efficient individual building to the spatial patterns of the whole community to the landuse for an entire site. Architect and Urban Designer Douglas Farr (2008) states that the LEED for Neighborhood Development emphasizes three divisions; which constitute a comprehensive approach to community sustainability. These include the larger context and location of the place, the nature of the internal design of the place, and the construction and operation of the place. From an energy point of view, transportation modes and configurations, building density, typologies and corresponding loads, on-site energy and resources, and water and waste management are all affected by the designs of a community plan. According to Dr. Susan Owens (1985), these factors can vary by as much as 200% as a function of the settlement design.

1. Size, configuration and infrastructure
2. Density and building typologies
3. Interspersion of non-residential uses
4. Integrated organic agriculture
5. Climate-oriented form, site design
6. Energy efficient construction

2.2. Environmental and social issues

Community-scale sustainability goes beyond measures that affect form and technology, and address broader environmental and social issues that address land preservation, diversity of use, affordable housing, creation of community, stewardship of local resources, and the spirit of place (Norberg-Schultz 1984). Therefore, place sustainability encompasses a broad range of concerns that address quantitatively as well as qualitatively measures, including the following:

1. Spirit of place
2. Creation of community
3. Diversity
4. Health through active living
5. Interaction with nature
6. Land stewardship

3. SERENBE COMMUNITY

3.1. Background of Serenbe Community

An analysis of the sustainability and placemaking can be clearly seen in Serenbe Community, which is a new residential development located southwest of Atlanta, Georgia. Most of the surrounding land encircling Atlanta has now been developed, except for a southwestern strip, which includes most of South Fulton County. This area of land covers approximately 125,000 acres (50,000 hectares) and is about the size of the Napa Valley, and is bounded by Interstate Highway 85 and the Chattahoochee River. Competitive land costs, the completion of the South

Fulton Parkway, and its proximity to the Hartsfield-Jackson Atlanta International Airport have now rendered this location prime for development. The fate of this remaining area of land rests in the nature and quality of future development and the planning principles that possibly will guide it, particularly for the relatively undeveloped Chattahoochee Hill Country.

3.2. Serenbe community plan

The Serenbe Community plan is composed of a network of *omega* and *crossroad* hamlets derived from curvilinear and T-junction spatial organizations. The four omega hamlets (Arts Hamlet, Farm Hamlet, Health and Wellness Hamlet, and Hill Village) are located around intimate forested valleys. The road circulation typically occurred on a common contour partially encircling the small valley. Each of these omega hamlets accommodates differing housing typologies and non-residential activities, public space for light recreation, community gardens, vegetated wetlands and re-circulating sand filters. Settlements incorporate density gradients, which provide a climax at the center of the serpentine road where there is a concentration of higher density housing, commercial, and other non-residential mixes of activities.

3.3. Settlement patterns

Serenbe is made of hamlets that combine two of the village spatial characteristics common to most of the English villages. That of the linear spatial form and the nucleated form is common according to Thomas Sharp (1946). In addition Serenbe has *crossroads clusters* of twenty-five dwellings each that are placed at the intersection of internal roads (T-junctions) and they have a central green around which are placed townhouses and a multi-use community building. The Serenbe Community plan accommodates several estate farms or farmsteads that include between five and ten acres of land and a small housing cluster with house, barn and storage sheds. The natural landscape is coupled to the developed land is several ways creating a complementary and beneficial interaction serving both functional and aesthetic objectives. Over 80% of Serenbe is preserved land with 20% urbanized by the hamlets. When viewing the masterplan, the shapes and geometry suggest an arrangement of small settlements that are connected into an angelic constellation. Refer to Figure 1.

3.4. The hamlet functions

The hamlet sizes vary from 120 to around 240 dwelling units. When complete, Serenbe Community will comprise approximately 850 homes and a population of several thousand residents. These diverse land uses will contribute to generating an individual settlement function and an evolving unique character. The first hamlet has a focus on residential living and the arts, particularly the culinary arts. In the second hamlet, the focus is on residential living associated with the equestrian center and Serenbe Farms. The third phase is planned for health and wellness and the fourth phase, which is larger than the other hamlets, is

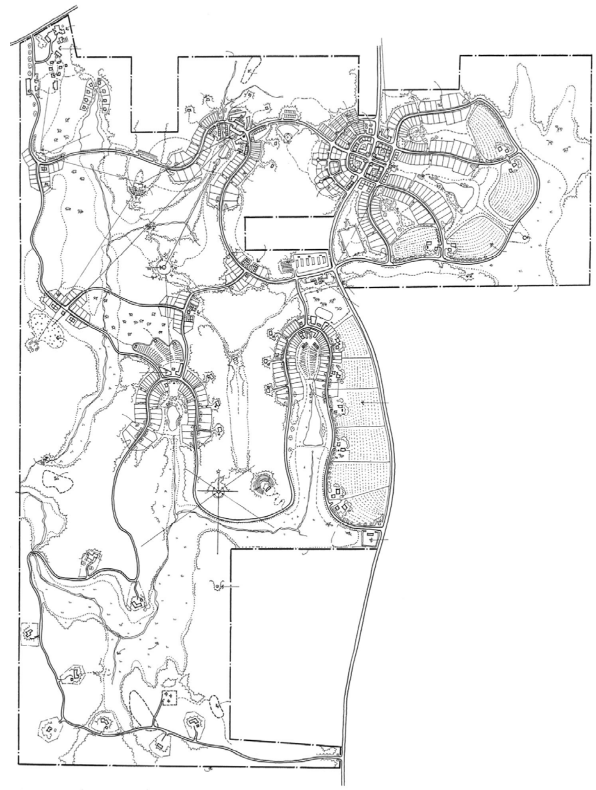

Figure 1: Serenbe Community Masterplan Phases 1-4 (Tabb 2002)

planned for education, commerce and mixed of use appropriate to the scale of this entire development.

3.5. Omega form

The *omega* form derives from a double-loaded linear spatial organization, utilizing serpentine characteristics that provide inherent qualities that contribute to both a sense of community and support certain sustainable functions. The omega-cluster form allows for a natural interface to occur between the urbanized zones of the village and the natural occurring landscape. This has two positive effects. First is in creating greater adjacencies to useful open spaces for recreation, organic farming and scenic beauty. Second is in providing a functional context for the implementing of the natural water-waste systems including water retention, and storm water management.

The curvilinear form creates and protects a central portion of a natural landscape, usually fed by a stream, pond or wetlands. At the ends of the omega form lots are larger and density is lower. At the zenith of the shape, there is a more urban intensity and higher density of built form and where there is a focus for pubic activities. This space is designed to provide for recreation as well as being planned to incorporate a "*living machine*" water-waste and purification systems developed by Dr. John Todd and implemented at Serenbe by engineer Michael Ogdon (Todd 1994). The system utilizes treated effluent water that is reused for irrigation and future water supply for toilets. Serenbe storm water runoff is directed into vegetated filter strips of land and shallow channels.

3.6. Settlement transect

Densities in the hamlets vary from one half unit per acre to twenty units per acre. The circulation systems through the hamlet are open ended. In an attempt to preserve the rural character of the site and at the same time create a critical mass of activity, the scheme accommodates an increasing density gradient from the hamlet perimeter to the center. At the outer edge of each hamlet, dwellings are set back from the road with ample landscaping providing a buffer, sun shading and stand-alone energy systems. This transitional effect, first observed by Thorburn (1971), transects density of built form, placement of landscape elements and the location of certain building materials. Buildings of a more rustic aesthetic are located at the ends of the transect while buildings near the center are typically attached and using masonry construction. Buildings closer to the hamlet center are more densely placed and are closer to the road thereby creating a pedestrian public space, and landscaping occurs in the rear yard with walled-in-gardens or natural openspace. The aerial photograph shows the omega form embedded into the forested landscape (Figure 2).

Figure 2: Aerial Photograph of Phase 1 - Selborne Hamlet (Serenbe Website 2008)

3.7. Hamlet non-residential uses

Unlike the form of a "gated community," where it is totally enclosed with strict control at the gate, the omega has three formal geometric properties. First is the basic shape, which is like a container. Second is the apex of the curvature or the bottom of the container. And third is the outward curving lips of the form, which create an openness and full connection to nature, which fills this container. Each hamlet of the four hamlets is planned with a particular specialty, which is reinforced through its non-residential facilities and land uses. For example, the first hamlet constructed was, Selborne Hamlet, which focuses on the arts, particularly the culinary arts. At present there are two fine restaurants, a bakery with cafe, a small specialty grocery store, an art gallery, and other retail shops. Grange, the second hamlet, which is now under construction, is related to the adjacent horse stables, equestrian arena and farms that supply vegetables to the local restaurants and residents. There will be a tack shop, small hardware store, vegetable market, and barbeque restaurant. The third Hamlet is Mado and is oriented toward health and wellness. The fourth hamlet is the Hill Hamlet and is intended to be a little larger and to house a greater variety of non-residential uses.

3.8. Health and wellness hamlet

In Phase III of the Serenbe development a third hamlet is planned. It is designed to accommodate a variety of small-scaled facilities woven into the residential fabric of the community. This hamlet is named Mado and is within easy walking to the other hamlets. "Mado," according to the Creek Native Americans, means "things in balance," and this is both the name and intention for this latest hamlet. In a charrette conducted in July of 2006 and later is a series of consultant meetings, the mission statement generated for this hamlet stated that it's purpose was "to create a residential community that is in harmony with nature, that has an inherent design that encourages healthy living, that supports the commercial development of health and wellness services which are fully integrated into the very fabric of the hamlet, and that combine the best of east and west healing practices," (Figure 3).

3.9. Architecturalizing Serenbe

The architecture at Serenbe derives from two general development methods: first is through speculative builders who develop several adjacent building sites with an in-house architect, and second is through individual plot owners who work with their own architect and contractor. All buildings are constructed to EarthCraft standards for energy efficiency, air quality, water conservation, and resource efficient building materials. Some of the sustainable planning measures can be seen in Figure 4, which is a live/work cluster constructed near the center of Selborne Hamlet. The first floor is dedicated to small businesses while the upper floors are for residential use. In addition the live/work units are attached, thereby reducing individual heating and cooling loads.

3.10. Serenbe placemaking

Functionally zoned suburban subdivisions have rarely displayed any redeeming planning principles. Gated communities are closed common interest developments offering little in the way of community. As observed by Blakely and Snyder (1998), these communities simply promote "privacy within privacy. Models such as the New Urbanism, according to Ruth Durack (2001), are by necessity fully planned and regulated environments, fiercely resistant to change and any deviation from the rigid rules that govern their form and function. The New Ruralism is an exurban strategy for creating new communities in the country solely built on traditions of the agrarian past. Serenbe is not suburban, gated, New Urbanism nor is it New

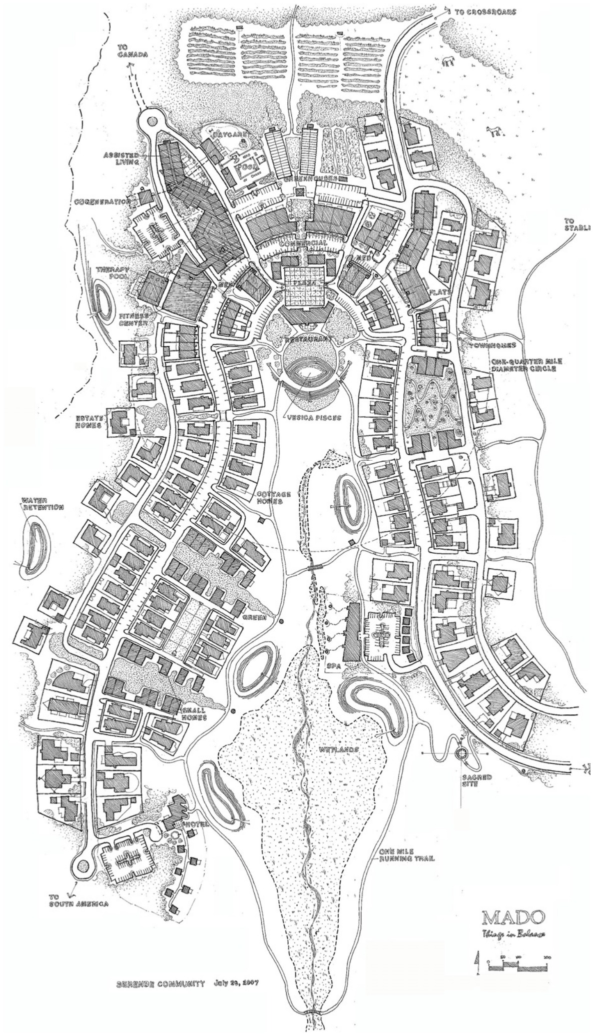

Figure 3: Mado Hamlet Phase 3 (Tabb 2007)

Figure 4: Serenbe Live/work (Tabb 2008)

Figure 5: Serenbe Farms adjacent to Grange Hamlet (New York Times 2009)

Ruralism, rather it is a self-initiated sustainable community that cannot really be named or classified. Serenbe is an amenity-driven community seeking authenticity, flexibility, individuality, and a respect for modernity. Figure 5 is an image of Serenbe Farms with the chef Nick Melvin of the Inn at Serenbe and Paige Witherington, farm manager.

4. SERENBE PATTERN ANALYSIS

4.1. Serenbe pattern analysis

The twenty-placemaking patterns are organized according to the five categories or principle sets and were applied to the plan and realization at Serenbe Community. Using an inferential analysis, certain preliminary conclusions are presented. This is part of on-going research.

4.2. Research methodology

These placemaking patterns were initially developed in 1990 and applied to the masterplan design by the author in 2002. A literature search and analysis of published place patterns was conducted by MS and PhD in Architecture students at Texas A&M University and a comprehensive sets of placemaking patterns were re-generated forming the a basis for current twenty patterns (Joseph 2006 & Rodregues 2008). In subsequent visits to the project site, a photographic record, field notes and behavioral maps were created forming the basis of this initial matrix, which indicates the listing of the patterns, the principle under which the patterns function, a numerical rating for both the presence and quality of expression of the pattern, and finally a brief description of the physical examples of each pattern as related to Serenbe Community.

It must be noted here that occupation of the first hamlet occurred in 2005 and the development has been slowly increasing over the past four years. Presently there is an approximate population of 150 residents. This summer (2009), the research will be furthered using more mapping and questionnaires. Caution is needed

Table 1: Serenbe Place Pattern Matrix (Tabb 2008)

# PATTERN (as ectype)	PRINCIPLE (as archetype)	PRESENCE (quantitative)	EXPRESSION (qualitative)	IMPACT (as type)
1. Centering		4.5	4.0	Omega centers, special natural areas and concentration of commercial
2. Connecting	Unity Principle	5.0	4.25	Roads, trails, bridle paths and greenways
3. Bounding		4.75	4.0	Hills, natural contours, the open omega road and built form
4. Wholeness		4.75	5.0	Omega organization and masterplan constellation
Average		*4.75*	*4.1875*	
5. Direction		4.5	4.0	Omegas oriented to south and to natural centers
6. Grounding	Generative Principle	4.5	4.25	Terraced sites, agriculture, unique natural features of the land
7. Reaching Up		3.0	3.0	Hamlet centers, hills surrounding hamlets, trees
8. Multiplying		5.0	5.0	Hamlet replication in naturally formed valleys, housing duplication
Average		*4.25*	*4.0625*	
9. Scale		4.5	4.0	Pedestrian scale, narrow country roads, walkable community
10. Geometric Order	Formative Principle	5.0	3.5	Strong serpentine geometry (omega), Aligned along parallel contours
11. Natural Within		5.0	5.0	Nature within and surrounding, 100 farm animals, Serenbe Farms
12. Celestial Order		2.5	2.0	Solar orientation, celestial site
Average		*4.25*	*3.625*	
13. Functional Order		4.5	4.5	Residential with diverse mixes of use and building type
14. Economic Order	Corporeal Principle	3.0	3.0	Smaller variable plot sizes, higher densities
15. Spatial Structure		4.5	4.25	Double-loaded serpentine structure, open ended
16. Materiality		4.0	3.0	Sustainable residential construction
Average		*4*	*3.6875*	
17. Elemental		4.0	4.0	Hills, valleys, water features, bonfire
18. Passage	Re-generative Principle	5.0	4.25	Intentional transect rural-to-urban, many paths leading into the hamlet
19. Light		3.0	3.0	Filtered, natural
20. Ceremonial Order		5.0	5.0	Sense of community, labyrinth, market
Average		*4.25*	*3.8125*	
Total Average		**4.3**	**3.9**	

because there is not a large resident sample to provide conclusive results. Refer to Table 1 on the following page, which is a preliminary listing of the twenty-ectypal patterns according to the five-archetypal principle sets. Each pattern is assigned a numerical value on the Likert Scale of 1 (lowest) to 5 (highest) assessing both the presence (quantitative) and the quality of expression (qualitative). At the *typal* level each pattern is described in specific ways.

5. RESULTS OF THE ANALYSIS

5.1. Pattern summary

The matrix in Table 1. Indicates an analysis of the twenty-placemaking patterns organized according for five principle categories. By obtaining data from Table 1, the pattern rating system was placed within a spider diagram articulating twenty points around the perimeter of the circles. Starting at the top of the diagram is pattern number one - *Centering* and the rest of the patterns follow in a clockwise direction until pattern 20 again near the top. As the inner area of the diagram fills and approaches the perimeter of the circle, there occurs a greater impact of the various patterns (Rodregues 2008). The star-like shapes indicate the variable values assigned to the various patterns. There is a summarizing value for each of the Principle sets. In the case of Serenbe, the Principle with the highest value is the Unity Principle with 4.75. The Principle with the lowest value is the Corporeal Principle with 4.0. And the Generative, Formative and Regenerative Principles all receive the same rating of 4.25. Serenbe tended to be higher for the pattern presence with 4.3 over the pattern quality of expression with 3.9. Refer to Figures 5 and 6 on the following page.

5.2. Pattern presence

While the overall rating of 4.3 for the presence is quite high, it can clearly be seen that many of the patterns score high. These include: Connections (2), Bounding (3), Whole Form (4), Direction (5), Scale (9), Geometric Order (10), Nature Within (11), Function Order (13), Spatial Structure (15), Passage (18), and Ceremonial Order (20). Those patterns that seemed to score low include: Reaching Upward (7), Celestial Order (12), Economic Order (14), and Light (19).

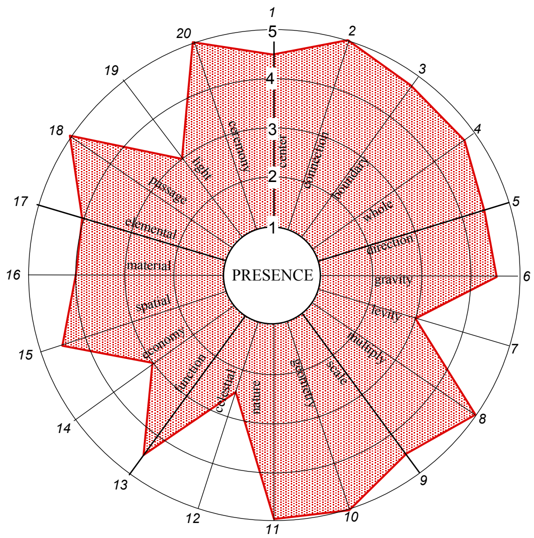

Figure 5: Spiderweb Likert Scale Pattern Presence (Tabb 2008)

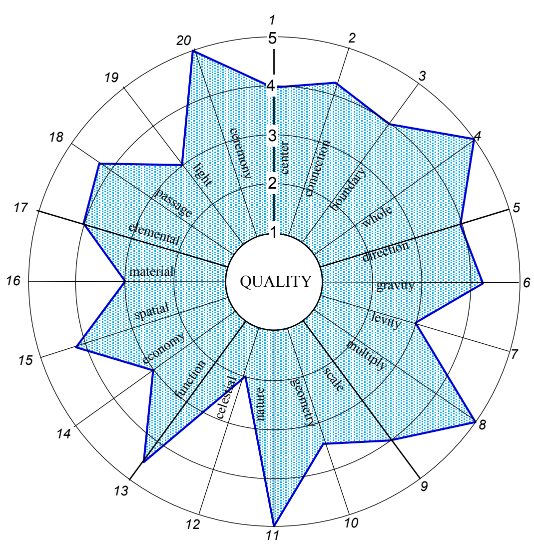

Figure 6: Spiderweb Likert Scale Pattern Quality (Tabb 2008)

5.3. Pattern quality of expression

The analysis of the quality of expression of the patterns is similar, but combines to a slightly lower total – 3.9. Many of the higher scoring patterns are the same as the presence patterns with the exceptions of the pattern for Multiplication (8) with a score of 5.0. The patterns that scored high include: Whole Form (4), Grounding (6), Multiplication (8), Nature Within (11), Functional Order (13), Spatial Structure (15), Passage (18), and Ceremonial Order (20).

6. CONCLUSIONS

6.1. Observations of the principles

To summarize the influence of the principles on the Serenbe design, the range of averages is between 4.75 and 4.0 for pattern present and between 4.2 and 3.6 for pattern quality. The Unity Principle is the strongest while the Corporeal Principle is the weakest. This most likely is contributing to a strong sense of community and is supporting common activities. This contributes to a “place-boundedness” that can contribute to greater presence, commerce and pedestrian activity. Since Whole Form (4) scored high, there is coherence to the place and potentially greater identity. The patterns that most contribute through the Presence and Unity Principle are: Connecting (2), Bounding (3), Whole Form (4); and through Quality is: Whole Form (4).
The strongest pattern in Presence and Quality with the Generative Principle is: *Multiplication (8).* The weakest pattern is under this principle is *Reaching Upward (7)*. The Formative Principle has *Scale (9) Geometry (10)* and *Nature Within (11)* as the strongest Presence and Quality. Under the Corporeal Principle only *Functional Order* (13) scores high for both Presence and Quality. *Passage (18)* and *Ceremonial Order (20)* score high under the Re-generative Principle. This suggests that the scale, replication of hamlets, geometry of the omega, functional diversity and pervasive connections to nature are all contributing to the sense of place.

6.2. Observations of the patterns

As can be observed from both the spider diagrams, all but a few of the place patterns are present at Serenbe and the quality of the expression of these patterns is nearly as high. Only *Celestial (12)* and *Light (19)* patterns scored low. Residents not only share the central natural space in the center of the omega, but also form a place in defining the geometry. While in a material sense, community can be expressed as large gathering, such as the Saturday Farmer’s Market at Serenbe, but it can also be experienced in an immaterial way as a felt sense of belonging or in the dissolving solitude found in nature. In these regards community members see themselves as sharing a similar style of living and as part of the larger group of residents. The patterns that contribute the most to community and placemaking in this regard include: Centering (1), Bounding (3), Whole Form (4), Geometry (10), Nature Within (11), Functional Order (13), and Ceremonial Order (20). Only Whole Form (4) scores higher in quality than presence.

6.3. Placemaking and sustainability

Place sustainability involves measures that are supported by a placebound environment – one in which the residents are present, involved and engaged. Sustainability at this level has a correspondence between the physical characteristics of the place and the resulting behaviors and lifestyles. This means more time, creativity and resources are infused into the everyday experience of a place. Residents rely on more in-place mixes of use and pedestrian movement rather than between-place reliance on the automobile. Critical to this measure is the inclusion of facilities, such as grocery stores, medical facilities and schools. With increase densities and improved building materials energy efficiency is increased. Serenbe recently received the Urban Land Institute Inaugural Sustainability Award for its demonstration of land preservation, interface with nature, pedestrian orientation, diversity and mixes of use, innovative wastewater treatment system, integrated agriculture and energy conserving construction.

6.4. Conclusions

The work reported in this paper represents the on-going development of an experimental model community. The small hamlet-focused masterplan affords an incremental approach to deepening into greater levels of sustainability over time. The research in placemaking is shadowing this process of physical construction along with increased occupation by its growing residents. Further analysis will be focused on user preferences, patterns of use, and the relationship between settlement spatial structure and form with sustainability. It is anticipated that the placemaking patterns will provide planning guides not only for greater levels of sustainability, but also for healthier and more livable places in which to live. Serenbe Community offers a wonderful laboratory in which to test these assumptions and designs. It is hoped that there is a transfer of knowledge that might inform future development, particularly at the urban edge of metropolitan areas of the United State.

Serenbe Community is a place that has physical presence and encourages a quality of life supported by a strong sense of community and sustainable lifestyle. Figure 7 illustrates the Farmers Market held on Saturday mornings where residents mingle and shop for local produce and goods. Woven together are the placemaking patterns, the participating community residents and the wonderful spirit of Serenbe. According to Serenbe resident John Graham (2008):

> *Serenbe is marked by an extraordinary sense of community. What has contributed to this remains something of a mystery: The founder's vision, the inculcation to the sacred, and the commitment to the principles of sacred geometry in physical design, have resulted in a strong sense of place that attracts residents sharing a commitment to the land, the environment, and to each other. The formula may not be simple, but the results are obvious to all.*

Figure 7: Farmers Market Along the Omega Road Phase 1 (Serenbe Website 2008)

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International Perspectives on Urban Design

Reaching out and reining in: Four proposals for planning community

Alexandra Staub

Penn State University, University Park, Pennsylvania

ABSTRACT: This paper compares two sets of planning paradigms in the Soviet Union and the United States. The projects analyzed are Mikhail Barshch and Moisei Ginzburg's *Zelenyi Gorod* ("Green City") of 1930, Frank Lloyd Wright's Broadacre City of 1935, the anonymously planned Soviet *mikrorayon*, and William Drummond's competition entry for a neighborhood unit in Chicago, completed in 1913. The first two projects both propose dissolving the large city and dispersing the population across the land, while the second two envision cities composed of hierarchically structured communities with shared facilities. The paper highlights both the striking similarities and differences between the projects created in two very different national contexts.

Conference theme: Urban design studies
Keywords: urban design, Soviet Union, Broadacre City, neighborhood unit, William Drummond

INTRODUCTION

Worlds apart in both ideology and space, two parallel sets of planning ideas developed within only a few years of each other. The first set included Mikhail Barshch and Moisei Ginzburg's *Zelenyi Gorod* ("Green City") of 1930, which proposed distributing Moscow's population into the countryside and letting the big city fall to ruin, and Frank Lloyd Wright's Broadacre City of 1935, which envisioned the dissolution of major urban centers and the redistribution of the U.S. population across the land. Set two contained the anonymously planned *mikrorayon*, a neighborhood unit that first appeared in the Soviet Union in the 1930s, and William Drummond's encompassing vision for a similar neighborhood unit, proposed for Chicago in 1913. This article examines how the social aims of the projects – freedom from societal constraints in the first two cases and the creation of an ordered community in the second – are expressed by their physical configurations. Projected for countries that defined themselves as diametrically opposed, the two sets of ideas nevertheless point to similarly focused visions: the first, reaching out to let space loose with wild abandon; the second, reining space in to create hierarchy and a shared order.

1. REACHING OUT: BROADACRE CITY AND *ZELENYI GOROD*

In 1930, Mikhail Barshch and Moisei Ginzburg's won a competition for a new resort town to be built outside Moscow. Called *Zelenyi Gorod,* or "Green City" it radically proposed distributing Moscow's population into the countryside and letting the big city fall to ruin. Garden city ideas were certainly known in the Soviet Union – Ebenezer Howard's texts had been quickly translated into Russian – yet *Zelenyi Gorod* went far beyond the idea of a self-contained green-town satellite for the big city. Five years after the publication of *Zelenyi Gorod*, Frank Lloyd Wright's *Broadacre City* envisioned the dissolution of major urban centers and the redistribution of the population across the United States.[6] While Wright's *Broadacre City* has been compared to Le Corbusier's urban plans of the 1920s, which glorified and concentrated the large city (Alofsin, 1989), to date no comparison has been made between Wright's disurbanist ideas and those of Barshch and Ginsburg.

Both Broadacre City and *Zelenyi Gorod* were created in the 1930s, yet the social and economic context for them could not have been more different. The U.S was in the midst of the Great Depression, with many unemployed and homeless. Under these circumstances, the thought of "returning to the land" and a more basic economic existence must have seemed comforting to many. The Soviet Union, on the other hand, was trying to overcome a backwards, rural legacy. Economically, it was a time of optimism, as Stalin began forcefully industrializing the country and creating

[6] The analysis of Zelenyi Gorod presented here is based on the project's 1930 presentation by its authors in the journal Sovremennaiya Arkhitektura (Contemporary Architecture). Wright refined his Broadacre City concepts over the course of many years and the project has been extensively discussed; the version taken here is that of 1935, when the well-known model of the scheme was built.

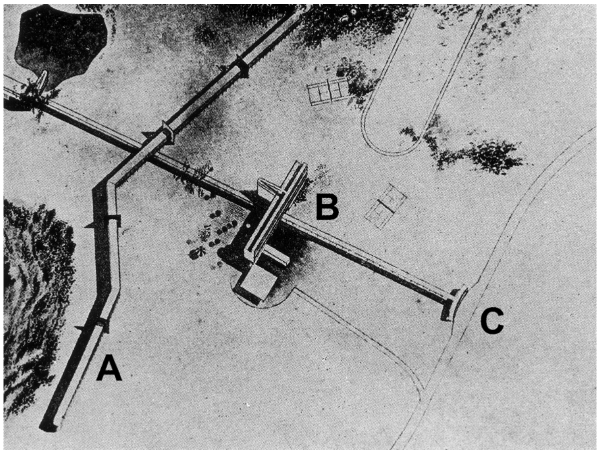

Figure 1: Zelenyi Gorod, detail. A) string of housing units, B) community center with canteen, C) bus stop. Source: (Barshch and Ginzburg 1930)

new factory centers in remote areas of the empire. Soviet architects had not yet been compelled into membership in the conformist Union of Soviet Architects (this happened in 1932), and idealistic planners were still looking for ways to build a new, socialist world.

Physical expression of this order proved difficult to realize. In the writings of Marx and Engels – the foundation for socialist thought – no guidance was given on how a socialist city would actually be organized,

With the only theoretical guide for architecture and urban planning being Friedrich Engel's *The Origins of the Family, Private Property and the State* (published in German in 1884 and translated into Russian ten years later). Hugh Hudson makes the point that throughout the 1920s, the new architecture forced into the public arena issues that had received scant attention within Marxism-Leninism: the emancipation of women, the nature of the socialist family, the form of housing most conducive to socialist consciousness, the interaction between town and country, and the relationship between the individual and the collective (Hudson 1994). In *Zelenyi Gorod*, we see Barshch and Ginzburg struggling with these very issues.[7]

The economic philosophy that Broadacre City and *Zelenyi Gorod* express may be closer than one initially suspects. Wright's scheme was repeatedly called "socialist" for its abolition of rents and speculative income (Grabow 1977). Although he vehemently denied this charge, he did not offer conclusive arguments as to why his concept was particularly capitalist. Land would be "given" to those who used it and resided on it. Individual growth through science and communications, industrial co-ownership and nationalization, social credit, public ownership of utilities and transportation, free education and health care – these were some of the aspects of the Broadacre plan, and although they reflect the thinking of progressive economists and sociologists of the time, they were not that far from what was being discussed in the Soviet Union. Physically, most of the inhabitants in Broadacre City lived in smaller single-family houses or in apartment towers, with little room for economic extremes. This physical expression is similar to the one in Barshch and Ginzburg's scheme, which was clearly non-capitalist and part of a program to restructure the Soviet Union along a new, socialist order. In their system, everyone lived in the same type of unit, with both class and gender differences having been decidedly abolished.

In Wright's scheme, each family would be given an acre of land to farm, while in Barshch and Ginzburg's version, individual workers lived in little housing units – one-room "living cells" – that snaked in 250-meter-wide swaths through the countryside. Both projects were basically linear, and organized along a major thoroughfare – a superhighway in the Broadacre scheme, and a country road and railway lines in *Zelenyi Gorod*. While Broadacre City was orthogonally laid out, *Zelenyi Gorod* ambled over the topography.

Transportation in the two schemes was quite different and expressed the economic realities of the two countries involved. Broadacre City assumed that each adult would have a car, a vehicle that could turn into a little helicopter for larger distances. *Zelenyi Gorod* relied on public transportation. While workers could walk from their one-room "living cells" to the collective canteens and cultural facilities located nearby, they rode the bus or a train to their farming or factory jobs. As in many Soviet projects of the time, this one spatially presented the idea that the individual was free but would be subjugated to the community, since individual spaces were so minimal. In Broadacre City, families lived together and the parents worked at home. Schools and cultural facilities were located in each four-mile square. In *Zelenyi Gorod*, cultural facilities were located by the bus stations and thus close to the housing units, but children of all ages were removed from their parents to be collectively taken care of in central boarding schools.

Both Broadacre City and *Zelenyi Gorod* stressed the idea of "freedom", albeit in different ways. Barshch and Ginzburg saw the dissolution of the traditional family structure, which in Russian culture of the time usually consisted of three generations, as an expression of socialist freedom. In this, they followed ideas very prevalent among the Soviet avant-garde: the patriarchal family unit would be dissolved, and each man and woman would live in an individual space just large enough for sleep or individual study. Study and bettering oneself was seen as important because socialism needed educated workers. Adults would use cultural and recreational facilities such as clubs, movie theaters and sports facilities collectively; these and the

[7] Planning in the Soviet Union was centralized, with ideas for socialist spatial order to be universally applicable to all of the Soviet republics. The Soviet Union, however, was both multinational and multicultural. When this article refers to concepts predominant in the Russian culture (as opposed to cultures in other Soviet republics), I refer to "Russian" as opposed to "Soviet".

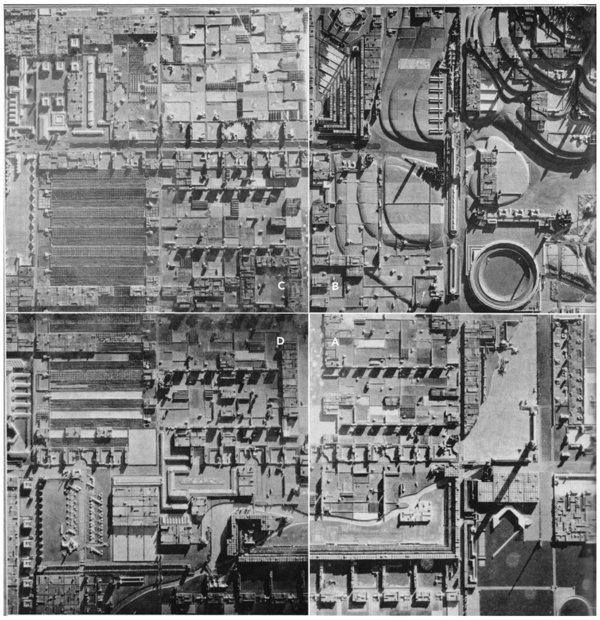

Figure 2: Broadacre City, model
Source: (Zygas 1994)

workplace would provide one's social life in lieu of family life. The avant-garde generally stressed that all relationships were to be on a voluntary basis. Nothing was to prevent couples or groups of friends from living near one another; one could even have a door between housing units, yet one could just as easily dismantle one's house and move it elsewhere. This was usually presented as a key to ending the subjugation of women, who would be free to lead their own lives, unsaddled by having to care for their husbands, parents or children.

Women perceived this new freedom quite differently from how it was presented by male planners. Women still did "women's work" in the new economy since typical "female" chores, such as childcare and social welfare, were generally transposed to the macro-level (Voronina 1989). Freedom from relationship constraints took a similar turn. Liberalization of the divorce laws had led women to bitterly complain that men were now exploiting women more thoroughly than ever through the acquisition of one wife after another and through a reluctance to shoulder any responsibilities for their children. Single women complained of being called "petty bourgeois" if they didn't go to bed with any man who wanted to (Evans 1981). Despite their best efforts, the concept of freedom expressed in socialist lore remained written by and for males.

Although socialist writings usually saw children cared for under the expert guidance of professionals, Barshch and Ginzburg went one step further. Children were removed from *Zelenyi Gorod'*s adult world. Infants up to the age of three were to be cared for in "infant homes", where "mothers could visit them". Preschool children lived in groups of 15-20 children and were employed as help on the farms, to teach them self-sufficiency and movement skills, and introduce them to production processes. Older children were to be housed in a type of boarding school. Each school was specialized in an area of practical training in agriculture, forestry, construction industry, or home economics, with a central education board deciding which school a child would attend based on the child's aptitude. Essentially, this meant that children began practical training from preschool on, with children and adults later working side by side in production industries. Although Barshch and Ginzburg described the children's facilities in a 1930 article on their project in the Soviet journal *Sovremennaiya Arkhitektura* (Contemporary Architecture), it is telling that there are no illustrations of these spaces.

Clearly, the social parameters of Broadacre City and *Zelenyi Gorod* were at opposite ends of the spectrum: Wright's plan emphasized the family as a basic social unit, while Barshch and Ginzburg's plan saw the family's dissolution, with childhood no more than a short phase of training and socialization. This did not mean that family was not important in Soviet culture of the time – on the contrary, socialist strivings can be read as an attempt to break down the strong family unit in an effort to replace its cultural domination through that of the state.

Wright's Broadacre City has been called prescient for its portrayal of an auto-centered lifestyle. Although Wright saw people as working from home, thus avoiding a daily commute, the sheer distances between everything in an era before mass electronic communication mandated some form of transportation system. Wright's answer was one of individual mobility, while goods would be moved by truck. His plan included areas that strongly resemble today's shopping malls, although strangely enough without the sea of parking that as come to characterize such structures. The backbone of his Broadacre Scheme was a series of superhighways that would allow unimpeded traffic flow, while gas stations received prominence through a loving attention to their situation and design detail.

Barshch and Ginzburg were more realistic about what the Soviet Union could offer in terms of transportation. Their plan saw light-rail and busses as providing transportation for workers between their homes, work, and cultural institutions. In this scheme, no one would have more than a ten-minute walk to a bus stop. In this, they foresaw what would become an identifying aspect of the Soviet Union: a widely meshed and well-used public transportation system that included light rail, metros, and electrically and diesel powered busses to move the population.

Both Broadacre City and *Zelenyi Gorod* show a national preoccupation with the concept of "freedom" as expressed through spatial expanse. In Wright's version, a man living on his family's own acre had the feeling of looking out of the window of a modest home and being the lord of all he could see. In Barshch and Ginzburg's version, the careful placement of the housing cells away from the road, and the floor-to-ceiling folding glass doors – a perplexing idea for the Russian climate – show the preoccupation with taking in the visual expanse of virgin lands.

Historians have frequently compared Russian spatial perceptions and ideals with those found in the West and especially the United States. The openness of land in Russia and some of the neighboring republics is certainly comparable to the mythos of the American West. Elena Hellberg-Hirn describes the "ever-moving open frontier" (Hellberg-Hirn 1999: 52) while Jeremy Smith has noted that, "the desire to expand and control physical space has become an integral part of Russia's character" (Smith 1999: 9). Both attitudes characterize the American experience as well. Blair Rubel has analyzed that the Soviet debate of the 1920s boiled down a demand for the urbanization of rural areas into nodal points (concepts broached by the theorist Leonid Sabsovich and others) against proposals to disperse cities along continuous linear communities adjacent to transportation and power corridors (concepts that include *Zelenyi Gorod*, but also other proposals by Nikolai Miliutin, Ivan Leonidov, and others). The former group decried the latter as offering "automobile socialism," with services and employment extending along efficient road systems linked by fast, flexible, and individually operated transportation, a concept that Rubel calls, "the Californization of the Soviet hinterlands." (Rubel 1990: 112).

Despite these far-flung ideas of occupying virgin lands – or building on greenfield sites – urban sprawl in the Soviet Union never materialized. Although Barshch and Ginzburg provided an extreme method of overcoming the urban-rural divide, in the end, it ran counter to a cultural view of both family and space. Hellberg-Hirn has compared the Russian idea of homeland to the *matrioshka* doll, a set of concentric circles that forms, "a play with identity, boundaries, and the contraction or expansion of space." (Hellberg-Hirn 1999: 64). The national centricity, as represented by the Kremlin, is overlaid by a private identification with the home - one's family house, home city, district, and landscape. Dismantling this cultural idea would prove to be difficult. Both Broadacre City and *Zelenyi Gorod* present a markedly non-hierarchical use of space that erases differences between rural and urban life (in itself usually perceived as a value hierarchy). In this idealized world, large social inequalities were erased, with only a distant government regulating whatever processes needed oversight. While this social leveling was certainly an aim of the socialist revolution in the Soviet Union, such thinking was regarded as utopian in the United States, where ideas of economic competition and the "self-made man" were so determining. Central to both Broadacre City and *Zelenyi Gorod* was the idolization of an unspoiled type of "back to nature" existence that nevertheless made ready use of modern-day technologies. Thus, we see transportation as well as mechanized and efficient production processes central to *Zelenyi Gorod*, while cars, telephones, and high-speed freeways determine Broadacre City. Technology and the machine, commonly associated with the ascent of large urban centers in the nineteenth century, were now to find a new home far from the big city. While this may be seen as expressing the Soviet belief of diminishing the urban-rural divide, in 1930s America this idea must have seemed quite radical. Ironically enough, it is in the United States that the city's edge has so obviously blurred, folding into suburbs and now exurbs, while in today's Russia urban and rural landscapes have remained more distinct.

2. REINING IN: THE "NEIGHBORHOOD UNIT" AND THE *MIKRORAYON*

Both the Soviet Union and the United States have a rich history of thinking on urban theory; more than can be covered in a short article. What ultimately came to dominate the Soviet landscape over the course of sixty years of building was not disurbanism or even the Garden City, but rather the *mikrorayon*, an anonymously planned administrative and spatial neighborhood unit that in one form or another rippled across the peripheries of existing cities and determined the fabric of new ones. The culture of centralized planning in the Soviet Union allowed for such standardized solutions, yet the concept is far from being uniquely Soviet. On the contrary, the idea of neighborhood units in one form or another continues to surface in projects proposed for the United States, with one of the earliest examples – a 1913 project to restructure Chicago – reading like a blueprint for what would be built in the Soviet Union several decades hence.

The Soviet city was a hierarchically organized administrative structure based on a neighborhood unit. "Superblocks" accommodated 1000-1500 people. Kindergartens, playgrounds, and schools were embedded within this unit so that they were within easy walking distance. Several blocks together comprised a *mikrorayon* of 8000-12,000 inhabitants, the next step in the hierarchy. Facilities such as a service center (containing shops), and recreational and cultural facilities such as libraries, movie theaters, and a "cultural palace" with an auditorium and space for clubs and other recreation, provided infrastructure at this level. Several *mikrorayons* made up a *rayon*, which comprised anywhere from 30,000-50,000 inhabitants. A *rayon* was a fairly autonomous unit, providing a polyclinic and government services as well as recreational facilities, such as district parks. Finally, planning regions, of which Moscow (in a 1971 plan) had eight with a projected population of one million each, and Leningrad (in a 1966 plan) proposed 14, with a population of 200,000-300,000, were the largest planning unit under the Soviet system. This size was considered to be an ideal population size for newly planned cities as well (Shaw 1978, Bater 1980, White 1980, Ruble 1993).

While rural housing in the Soviet Union centered around small, single-family structures, urban housing consisted of apartments. From the 1930s through the 1950s, these were located in quite grand buildings built conventionally brick-on-brick and with richly decorated facades, and, when that became to costly to sustain, in apartment houses made of prefabricated concrete panels hoisted into place in assembly-line fashion by large rolling cranes. While individual units were small by Western standards, they were now "regular" apartments designed for a nuclear family, with a kitchen and bath per unit. Gone were the experiments with individual living cells for adults and collective boarding homes for their offspring. In their stead, the traditional family of parents, children, and often grandparents had returned.

The quality of building was usually marginal, especially after 1959, the year that Nikita Khrushchev initiated the enormous Soviet prefabricated housing programs, yet that is not the issue here. After the bout of experimental housing that tried to eradicate the hold of the Russian (peasant) family on everyday life, the arrangement of the superblock and *mikrorayon* shows how Soviet society settled into a compromise between collectivism on the one hand, and a familiar family culture on the other. The nuclear family, now urbanized, sent its children to local daycares and schools, rode public transportation to work, shopped at the nearby groceries on the way home in the evening, and relaxed in parks, cinemas, and "cultural palaces" on the weekends. All of these facilities were located in close proximity to the apartments they served, while a network of streets and

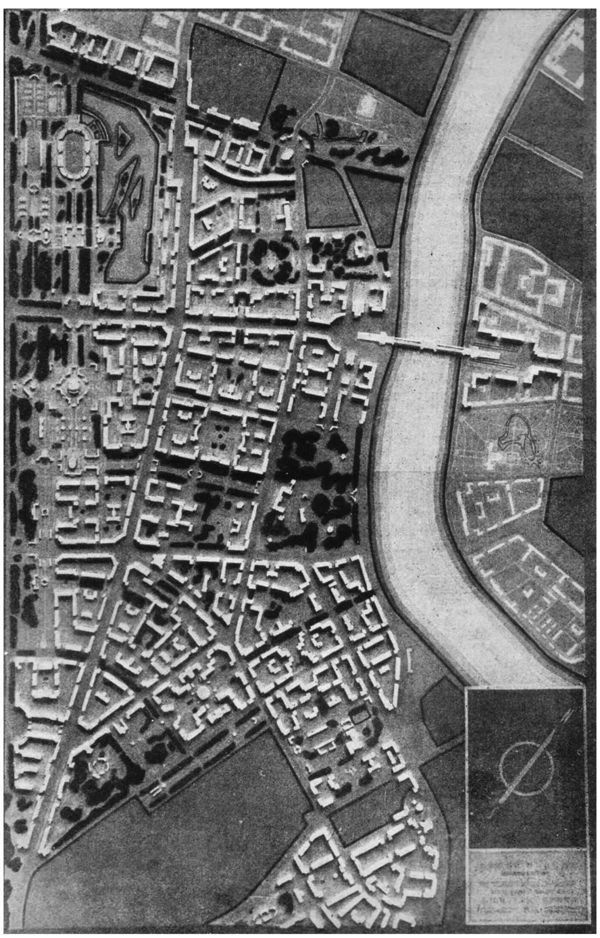

Figure 3: Plan of a *mikrorayon* near Volodarski Bridge in St. Petersburg, Russia Source: (*Arkhitektura SSSR* 1938)

the placement of the buildings provided a spatial hierarchy that defined the framework of the neighborhood itself. The spatial idea was most purely expressed in the early projects from the 1930s through the 1950s, when the apartment buildings were set on the perimeter of a large block with a large verdant courtyard within. This courtyard contained everyday facilities such as daycares and schools, playgrounds, as well as services such as laundries. The *mikrorayon's* shared facilities, such as a small shopping center, movie theater, cultural center, and sports facilities were located on the wider streets at the edge of the blocks. The *mikrorayon* as a whole was usually defined by wide arterials that wrapped it into a tidy package and provided a fast-paced exterior to contrast the pedestrian interior.

For many Russians, the *mikrorayon* is uniquely Soviet, although Western Europe certainly had its share of similar, but smaller, programs, such as the series of 1920s social housing estates in Vienna, Austria. Yet the United States has also had its transit-oriented planned communities with a focus on walkable neighborhoods, even if the status of such projects in a car-centered culture remains fraught with discord. Well before the automobile took over (but during the same era that Henry Ford was building his assembly-line factories in Dearborn, Michigan), William Drummond's 1913 competition entry to restructure Chicago presented an encompassing vision that was close to would be built by the Soviets only decades later.

"Can the suburban extensions to the great city of to-day be made to bring about the realization of a more ideal residential neighborhood than we now have?" asked Drummond in an article describing his plan for reorganizing the outskirts of Chicago in 1916.[8] The ideas he proposed as part of a competition and housing exhibition held by the City Club of Chicago in 1913 were comprehensive and developed at several scales. Drummond's plan, the basis of which he

called the "neighborhood unit" saw the city divided into six or seven boroughs, each of which would be subdivided into neighborhoods roughly ½ mile by ½ mile in area (a "quarter section"). Each unit was to have at its heart an "institute" to provide intellectual, recreational and civic services, as well as "local business requirements" at its corners. This would create an alternate series of centers, either cultural or commercial. The space between these was mostly residential in the form of both apartment buildings ("always the most economical habitation") and the low-

[8] The competition held by the City Club of Chicago in 1913 was drawn up by the Illinois Chapter of the American Institute of Architects in order to provide a planning framework for areas of Chicago that were then being haphazardly developed. The site was assumed, so that results could be generalized. Submissions had to include street forms, public open spaces, spaces for business and social requirements, and housing, including lot sizes, dwelling and garden types.
Although Garden City principles were not a requirement, the City Club included a list of books and pamphlets with the guidelines that described Garden Cities and the garden suburb movement in both Great Britain and Germany.

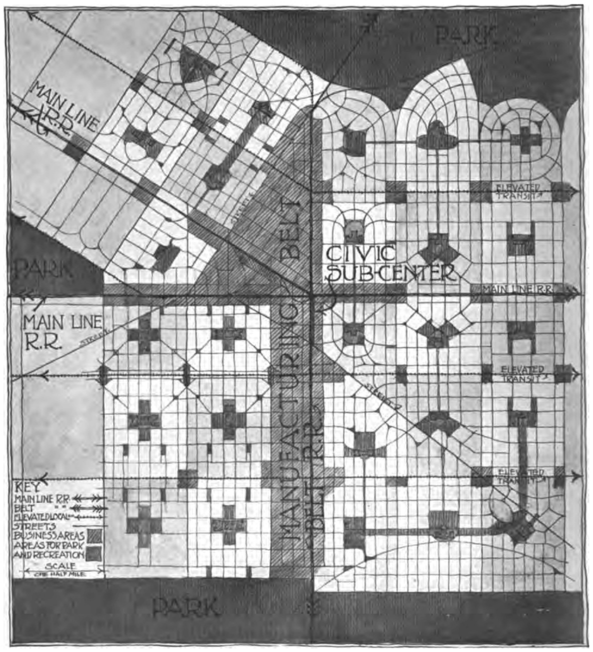

Figure 4: William Drummond's "neighborhood unit" plan for Chicago, 1913
Source: (Drummond 1916)

cost single dwelling ("always in the greatest demand"). The neighborhood unit was thus linked both to neighboring units and to a larger system of hierarchical administrative and spatial organization. Major transit lines were located on the same one-half mile grid, with the larger railway station integrated into the commercial sub-center. This method, creating boundary lines out of certain streets having transit facilities, resulted in marking off the unit neighborhood areas (Drummond 1916: 38).

Drummond recognized that a project such as he envisioned required administrative restructuring, and he proposed local community ownership and control instead of individual ownership, citing the successes of the English garden city in this regard. He saw the large sweeping measure of an uncompromised master plan as essential to the success of his scheme, assessing that, "if half-way or superficial measures only are to be tried, no general improvement need be looked for" (Drummond 1916: 39) The neighborhood plan was thus to be comprehensive, and Drummond envisioned all of Chicago realigned to fit it.

Drummond's concept was not merely organizational, he also took great care in the aesthetic properties of his project. While the competition itself did not seek entries following City Beautiful ideals, Drummond's combination of art and science gave his project close kinship to what has been called the City Efficient movement.9 In a flow of what was designed to be civic art, pedestrian-level perspectives emphasized "broad and interesting vistas," with the buildings symmetrically arranged and with a classical pediment and cornice (Drummond 1916: 40). If the streets bordering the neighborhood unit were designed to accommodate a heavier traffic flow, interior streets were designed to be narrower, and for local access. Alleyways were banished, instead the block interior was designed to be a garden or lawn for common use. Most interestingly, Drummond also saw these spaces as harboring, "common dining-rooms, children's play space, garden space, etc.," in short, spaces that were similar to the collective spaces so central to much Soviet thinking (Drummond 1916, 41). The "institute" that was at the heart of each neighborhood was analogous to the Soviet "cultural palace", and served to coalesce the neighborhood unit. Located roughly at its physical center, it contained, "schoolrooms, workshops … a large assembly hall … smaller halls for rotated use by classes, clubs and societies, for reading, music, drama, dancing, and lectures …. [while sports facilities assured that] wide and varied popular recreation would be available" (Drummond 1916: 43). Drummond saw the institute as fostering participation in civic life, and while the Soviets used their clubs as a forum for disseminating cultural propaganda, Drummond envisioned his institute as encouraging voluntary participation in the community spirit.

While the Soviet mikrorayon did not include single-family housing or much opportunity for shopping – the Soviet Union could afford neither – the concept of a tapestry of administrative units that could be knit into a larger urban area remained similar to both schemes, as did the idea of strong central planning required to put the pieces together. Both the neighborhood unit and the mikrorayon were highly ordered, greenfield-site ideas. The unquestioned authority of the Soviet state made implementation much easier in that context, of course, and thus from its inception, the mikrorayon quickly advanced to being the ubiquitous Soviet planning paradigm. The American idea of the neighborhood unit had a more limited application; even considering the long history of U.S. attempts to foster such middle-class versions of community (see Silver 1985). Drummond's plan was not realized, but a series of later new-town projects, including Clarence Perry's famous Radburn, N.J. plan, incorporated very similar ideas of the "neighborhood unit" as a social and administrative basis of urban or suburban life.10 In both Soviet and American versions, such plans stirred up a concentric ripple effect in which one's home was the center of a world that expanded into a neighborhood, a city, a region, and ultimately a nation.

[9] Emily Talin (2006) describes the City Efficient movement as an offshoot of the City Beautiful movement of the late nineteenth century. City Efficient saw use and serviceability as important as esthetic beauty, with a civic center of grouped public buildings central to the plans.

[10] The concept of the neighborhood unit is often attributed to Clarence Perry for his Radburn, N. J. plan of 1929. Donald Johnson (2002) traces the idea of the neighborhood unit back to William Drummond. Because Drummond's plan was never realized, Perry's work remains a crucial early example of the concept.

CONCLUSION

The two sets of urban ideas outlined above were formulated in the early part of the twentieth century and in their respective contexts have encountered vastly different fates. Expressing a yearning for an individualistic existence free from societal constraints, both Broadacre City and Zelenyi Gorod may be seen as struggles against the cultural system in which they were born. Wright's urban ideas were often ridiculed in his lifetime, which did not hinder him from extensively championing them through articles, exhibits, and lectures. Barshch and Ginzburg's scheme saw a different fate: with the mood ripe for social engineering – and despite the lunacy of building such exposed housing in a cold-climate zone – construction began soon after their entry won the "Green City" competition, yet the project was abandoned as the political mood shifted (Bliznakov 1993). Their concepts fell into disfavor soon after, with the major theoretician of the disurbanist movement, Mikhail Okhitovich, murdered by Stalin in 1937.

If Broadacre City and Zelenyi Gorod expressed a longing for virgin lands and the pursuit of liberty, then the mikrorayon and the neighborhood unit expressed the inverse of that far-flung dream. It was the concentric matroyshka doll slipping back together to roost, the road trip interrupted to rediscover a sense of local kinship. For the Soviet Union, it was most certainly a pragmatic end for a country whose economic reality meant a reliance on public transportation and a dearth of private resources; the mikrorayon was a way to organize the city that struck a balance between private life in one's family space and the public sharing of services and recreational opportunities. For the Unites States, the neighborhood unit remained one option among many. The greater availability of private transportation, and the powerful images connected with the freedom of individualized travel helped unravel the ideal of community as quickly as it could be built. The neighborhood unit thus remained a niche apparition amidst the suburbs that circled the core city.

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A ‘*vernacular approach*' to re-shaping the built environment in arid-zones

Hanaa Mahmoud Shokry

Higher Technological Institute, 10th of Ramadan, Egypt

ABSTRACT: Essentially this paper advocates the adoption and use of the traditional fabric resulting from dynamic generative processes vs. the use of static blueprints of 'proto-type houses' that produce fabricated built environments. The paper also discusses the components of the vernacular houses in the Egyptian Oasis and how they are utilized for re-shaping the new settlements. The study tries to set some design criteria to ensure that the changes that will occur would maintain the character and sense of place of each new desert settlement. The methodology of the study uses the analytical approach as well as a field survey of a certain place, 'Al- Wahat' Egyptian Oasis, to identify the traditional built form to show how the impact of social life and physical conditions generated the sense of place .There are some challenges that we must face if we are to escape from dilemmas of our present model of development and turn towards a new – traditional paradigm which shows greater respect for the harmony with nature. This paper is also valid for other countries of the arid zone.

Conference theme: Urban design studies
Keywords: traditional fabric, vernacular houses, Egyptian Oasis, desert settlement, social life

INTRODUCTION

Viewing the city as a process and a product is an effective analytical, evaluation and planning tool. The specific field of research is traditional mud brick architecture in the New Valley Region (el-wadi el-jaded as called in Arabic), in the Egyptian Western Desert, which includes many ancient human settlements in the form of towns, villages and oasis. Recently, the most significant shift in thinking is to consider the building as a whole. From this perspective we should examine how the site, form, and materials can be used to reduce energy consumption but also to maintain comfort. There are traditions that go back to the beginning of human society and yet they are still alive and will exist perhaps as long as human society does; Steele (1988)

Objectives of the study

The study aims to develop systematic research on traditional indigenous highly ecologically sustainable building technologies. Concerned with the failure of contemporary environments, architects have turned to the traditional environments for answers even to modern problems, to observe their forms and use, analyze their rules and patterns to study their physical and social structure.

1. VERNACULAR ARCHITECTURE

1.1. What is the vernacular approach?

The goal of this paper is to clarify what the vernacular approach is, and by doing so shed light on how it is different from the common processes on development currently used in many parts of the world. Vernacular architecture tends to evolve over time to reflect the environmental, cultural and historical context in which it exists. Although the study addresses the context of settlements in the Egyptian Oasis, the insight gained is applicable to new development projects as well as it is valuable for formulating policies for housing projects.
The norm in most cultures is that each has its processes that were shaped by the morphology. This is what we currently refer to as ‘vernacular architecture'. Modern processes applied at many parts of the world are completely different.
The specific area considered within that region is the Baharia Oasis (290 km SSE of Cairo, 180 km W of Al-Menia)), and its village of Al-Qasr. This settlement is characterized by a compact structure of mud-walled alleyways, narrowly separating houses with elaborately –carved wooden support beams and contains a wealth of vernacular architectural examples that eloquently represent ingenious methods and techniques to cope with the harsh environment prevailing in the region.
The traditional vernacular form of buildings and settlements embodies the folk experience of many countries. The adaptation to the climate and culture requirement of a particular community has taken place subconsciously over such a long period of time that a building procedure is eventually taken for granted as the appropriate solution to the community's immediate

needs. Close study of the vernacular building form in the Egyptian Oasis, therefore reveals much wisdom which has only recently been ignored under pressure from the internationally accepted high technology and the politically and economically attractive image of modernism

1.2. Why choose the vernacular approach?
The dialogue between architecture and nature is as old as architecture itself. Many modern architects have studied vernacular buildings and claimed to draw inspiration from them; including aspects of the vernacular in their designs. In 1946, the Egyptian architect Hassan Fathy was appointed to design the town of NEW Gourna near Luxor. Having studied traditional Nubian settlements and technologies, he incorporated the traditional mud brick vaults of the Nubian settlements in his designs. (Steele 1990) It was the first recorded attempt by an architect to address the social and environmental requirements of building users by adopting the methods and forms of the vernacular. Almost twenty years after the Gourna, Fathy participated in the planning of the Bariz Village, sixty kilometres south of the Khargah Oasis (Fig. 1). He used the traditional village typology itself with its winding streets and introverted forms as a guide, with the reassurance that in villages like Old Khargah nearby, these tactics worked to offset the harsh climate.

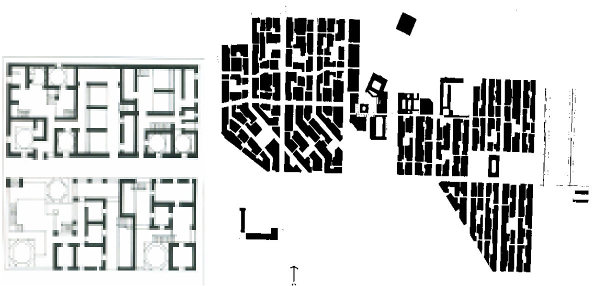

Figure 1: Lay out of Bariz Village and a group of houses designed by Fathy at the Khargah Oasis, 1963. (Steele 1990)

1.3. The Baharia Oasis
The Western Desert is characterized by hyper arid climatic conditions with rare rainfall and extremely high temperatures. Golany1982,, defines such arid zones as those areas where the average rate of evaporation is higher than the average annual rate of precipitation, where temperatures between day and night vary greatly, and where high degrees of solar energy radiation are experienced, especially during the summer (Rimsha1982). The Baharia Oasis (28^0 30 N $31^0$5 E) is one of the five principal oases(Siwa , Baharia Farafra, Dakhla and Khargah), the nearest one out of Cairo, a large depression covering an area of flat, clay plain, bounded to the north by a steep limestone escapement (Fig. 2). The southern, western and eastern boundaries of the oasis are less distinct, as the gradually rising floor of the depression disappears beneath the shifting sand dunes of the surrounding desert. The Baharia Oasis is some 95km west to east and 42 km maximum wide with oval shape. The population is about 31,482 (2006), settled in 14 ancient villages (al-Qasr, and Baweti, are the largest).

Figure 2: Location of the oasis on map of Egypt. (GOPP 2006)

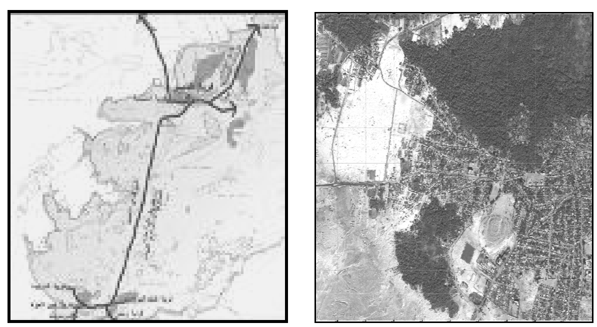

Figure 3: Maps of Al-Qasr Village 2007. (GOPP 2006)

The local economy is based in agriculture and there are no known mineral or other viable resources. The capital is Al-Qasr, which has been the main town since at least the eighteenth dynasty, about 1.500 BCE. The Baharia Oasis has had a continuity of settlement for about the last 8,000 years but only since 2,500BCE has it been politically tied to the Nile Valley (De Fillippi 2006) (Fig. 3 and 4).

Figure 4: The entrances of the Al- Qasr.

2. URBAN FORM

The traditional Arab town represents a level of sophistication in urban form; the original settlements have a clear-cut organization which defines the use of space and determines the distinction between public, semi public, and private areas, varying in degree of accessibility and enclosure. Narrow streets together with the high-density buildings of two or three stories create a situation where, for most of the day, the buildings shade each other as well as the streets.
The house surrounded an open space forming cool, pleasant microenvironment and a blank face and entrance door to the narrow public streets. The domination of pedestrian have resulted in a close network composed of these streets, occasionally punctuated by larger spaces used for social and religious purposes. The social system requires both segregation of domestic life of and participation in the economic and religious life of the community.
The ancient villages of the Western Valley were developed according to the typical features of the Islamic desert defensive architecture. That design was made of a compact fortress with concentric and radial connecting streets. This allows internal communication within the village. Mud brick walls surrounding the village, closely packed buildings and houses connected one to another by narrow alleys. The entrance of the village was allowed by more than one gate.
The harsh conditions of the hyper arid desert environment imposed to adapt life to these conditions; narrow, often covered and shaded streets, avoid the heat of the sun and extreme brightness and provide a ventilation shaft, buildings are internally ventilated by a vertical and cross stream of fresh air thanks to a system of apertures (as shown in Fig. 5 the use of the topography of the oasis). Houses are divided into separate living spaces for summer or winter, and for day or night to accommodate the different temperatures.

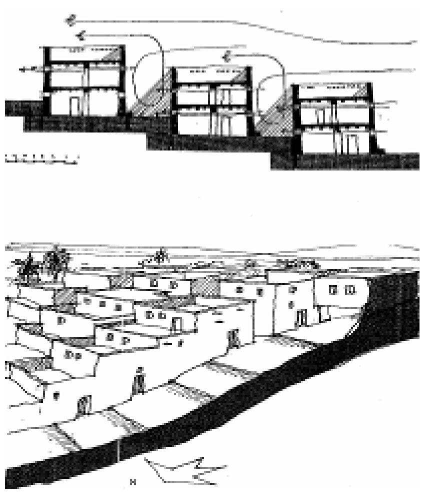

Figure 5: The traditional village typology of the Baharia Oasis. (Hamad 1996)

2.1. How buildings work

Because the buildings look inwards and the majority of rooms face the courtyard, they are closely packed and share common boundary walls (often on three sides) thus reducing the amount if wall surface exposed to solar radiation.

2.2.1. Strategies

In hot weather, when the external temperature is high, too much heat may enter the space. If this heat can be absorbed by the fabric of the building, the peak air temperature during the day will be less. If night time ventilation is possible, the heat absorbed by the fabric of the building can be lost at night when the temperatures are lower (Thomas 1999). In hot regions, evaporative cooling is induced by accelerating airflow through and across spaces; temperatures are reduced by ensuring that direct sunshine cannot penetrate the building, and the thermal capacity of massive structure is used to insulate and take up heat during the day and release it at night when it is cooler. Control at the building envelope is necessary because solar gain, temperature and wind speed vary so much

2.2.2. *The building envelope*

One of the most significant influences on vernacular architecture is the micro climate of the oasis. The building must be able to cope with the variations in temperature (Fig. 6) and be altered by their occupants according to the seasons. On a very hot day in the desert the air and sand are both likely to be hotter than a parson's body; the body is therefore heated by the sand on which one stands, by the air and the sun. Depending on the exact air and body temperature, the only cooling mechanism may be evaporation through respiration and sweating these basic physical processes apply both to humans and buildings (Thomas 1999).

2.2.3. *The building "body”*

The building body is highly affected by heat (internal and external). This is related to the thermal conductivity of its materials. Dense constructions have higher admittance; these absorb more energy for a given change in temperature as shown in Table 1. Normally, the heat flow into a building from the outside is approximately cyclical. Architecturally, the key requirement is to incorporate high-admittance materials in the building and expose them in an appropriate manner.

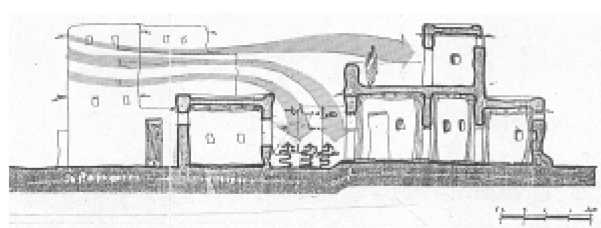

Figure 6: Air ventilation at the two stories of a traditional house for summer and winter days. (Hamad 1996)

3. URBAN FORM RULES

Examining the oasis built-form as a product clarifies how a complex and sophisticated built form is achievable with a simple set of physical organizational components (Fig. 7 and 8) and a related mechanism of the essential urban elements found in most cities of the Islamic world are:

a- The courtyard building: The basic module used for housing and public buildings", the ratio of building area to its plot is 1:1 (Hakim 2007).

b- *The street system*: street systems are primarily of two types; the through, open-ended street, which was considered a public right of way and had to be at least wide enough for two packed camels or mules to pass; and the cul-de-sac which, according to Islamic law is considered to be the private property of the people having access from it to their front doors. An important feature in streets and cul-de-sacs is the exterior finaa, (a width of about one meter adjoining the edge of a building and extending vertically along surface of the façade to which the inhabitant has certain rights for using it) (Shokry 1987).

*c- The elements above the street***.** The elements usually found above the street were a *sabat*, a room bridging the street, and the buttressing arches spanning between walls on either side of the street to provide structural strength and support for the opposite wall (Shokry 1987). An important attribute of this built – a form element was that it integrated physical components of form and function into its elements. Other elements like *skifa,* (entrance lobby with entry doors placed so that no one can see directly into the courtyard from the outside), with two *mastabas*, (built-in benches provided in the skifa, traditionally used by the male to receive visitors), and open courtyard located usually in the centre of the house.

Table 1: Admittance and density of selected construction elements. Source: (Thomas 1999)

Items	Admittance (w-m2k)	Density (kg-m2)
220mm sold brickwork, unplastered	4.6	170
335mm sold brickwork, unplastrered	4.7	1700
220mm sold brickwork,+16mm light weight plaster	3.4	1700 for brickwork, 600 for plaster
200mm sold cast concrete	5.4	2100
75mm lightweight concrete block +15mm plaster on both sides	1.2	600 for concrete, 600 for plaster

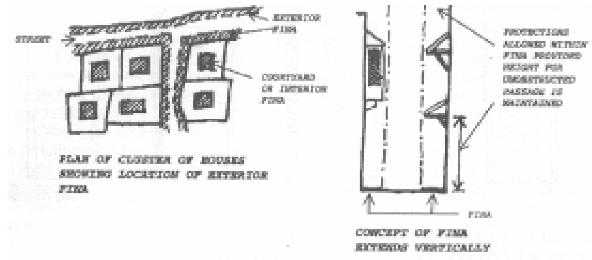

Figure 7: The *finaa* and the *sabat,* concept 1. (Hakim 2007)

Figure 8: Covered streets at Al-Qasr, *sabat.*

3.1 General Rules;

The physical factors that shaped the traditional Islamic City, particularly at the neighbourhood level, were the same at oasis built- form. Another important component of the built-form, that can shape the context and compatible with the ethical/ legal norms, the rights and responsibilities of the inhabitants,

*First, heights of buildings***,** tend to be uniform, the reasons of this are; 1- roof terraces are a potential location for people to overlook the private domains of adjacent neighbours, 2- owing to limitations of traditional construction methods and building materials, constructing a building higher than two or three stories was discouraged and in some cases was impractical.

Second, location of exterior doors and windows, it is difficult to determine now, accurately which buildings were built before others in the traditional fabric of the oasis, however, the general rule (doors and windows facing the public –right-of-way were traditionally viewed as either "old, or recent", as a result of the sequence of building events) is to respect the rights of older established building.

*Third, the structure of the village***,** consist of a system of neighbourhoods as relative independent units. Although the quarter is a closely knit group, providing consciousness of social identity and security, there is always a balance between the self – sufficiency and isolation and quarter's participation in the community and economic affairs of the village as a whole.

Fourth, a comprehensive fabric, single buildings are conceded as part of a comprehensive fabric, never as

isolated structures, and the repetition and variety of basic architectural typologies produce the lively of built form. If the fabric is disrupted or the sense of wholeness and consistency of life vanish, The buildings with the fabric, together were coherence with the physical environment.
Fifth, privacy gradient, houses within a unit can be accessed through semi- public alleys (*hara*) which lie behind a large gate with a wooden lintel with carved inscriptions and decorations, and which mark the transition from the private spaces (of the house) and the public street. Extended families are sharing a narrow alley (*zoqaq*) as an autonomous community.

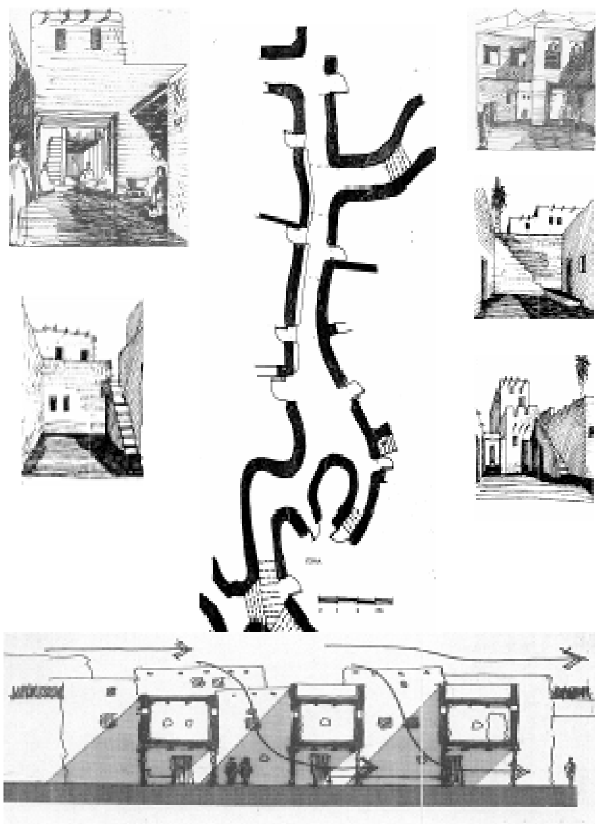

Figure 9: (Harat-Al-Sywiah) and its urban spaces, at Al- Qasr Village.

4. HOUSING TYPOLOGY

Houses are compact with a closed outer face. The layout is similar in most of the villages, except in Al-Qasr, where they are exceptionally tall and built in a more urban style. Plans are about 5-6 m width and the upper one is usually smaller, and sometimes, it extends over a street below creating the sabat, (which is a room spanning the street or occasionally the cul- de-sac) (Fig. 10); however it could be a succession of rooms creating continuous coverage and tunnel effect over the street. Secondarily, there is a pedestrian requirement for coverage and protection from the sun.
The first house investigated in Al-Qasr is of "Abdel-jawad Khalaf- Allah" and is located at the Mahdy Awad quarter (Fig. 11 and 12). The house has a ground floor, one story and a roof terrace connected by two staircases, also serving as a ventilation shaft through the construction of perforated wooden steps. The total area of the house about 200 m^2 and has a central court about $22m^2$, it contains the typical elements of local building tradition, not only in terms of their use of materials and techniques, but also from the standpoint of the interior layout and the distribution of the environments.
The size of the building indicates a social status and wealth above average compared to the rest of the local community. The first typical house element is the primary entrance passage. The skifa is a secondary entrance corridor or lobby with entry doors placed so that nobody can see into the house from outside (De Fillippi 2006). The family had lodgings for male and female, rooms for servants, storage spaces, a living room at the ground floor and upstairs. The terrace at the highest level gives peoples an opportunity to sleep outside during the hot summer nights. The major

Figure 10: Rooms extends over a street below created the sabat, covered streets at Al-Qasr Village.

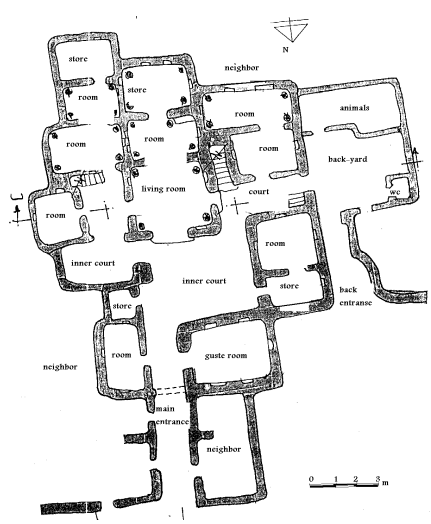

Figure 11: Abdel-jawad Khalaf- Allah"- house in Al-Qasr 'ground floor' plan. (Hamad 1996, and update by the author 2007)

percentage of ground floor use for services areas shows the necessity to store food, the requirements for cooking and washing facilities, and often to have space for a home bakery.
In general, the house contains three main parts according to the privacy gradient and function. The first part is the entrance sector, hostess and male, with private entrance. The second sector is for living and sleeping in winter days with privet entrance usually around the central court. The third sector is for services and utilities, around the back yard with minor entrance if it could be possible. The upper floor is using as a sleeping room in summer days.

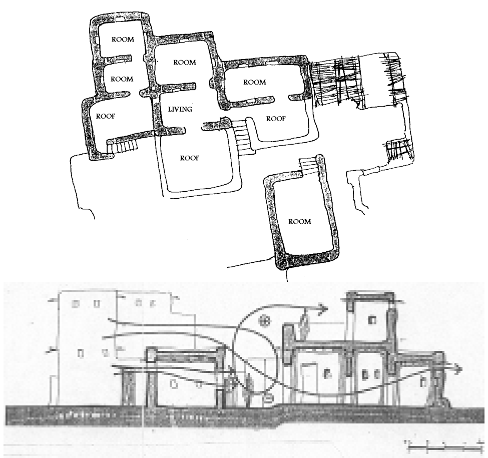

Figure 12: " Abdel-jawad Khalaf- Allah" upper floor and section. (Hamad 1996, and update by the author 2007)

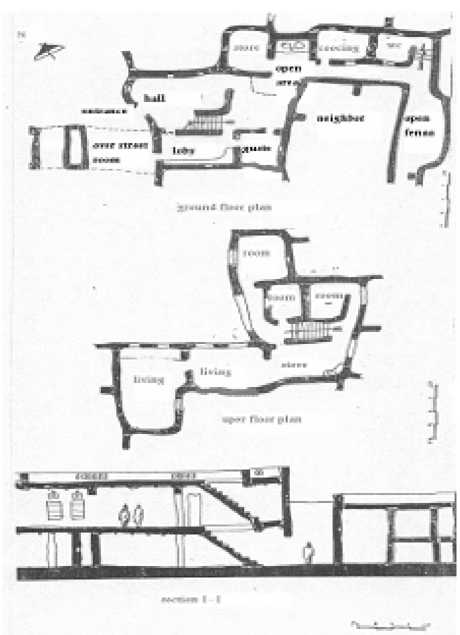

Figure 13: "Abdullah and his brother Abdulkader house in Al-Qasr (ground floor, upper floor and section) with a room spanning the street. (Hamad 1996)

The few secondary rooms surrounding the main areas provided valuable shade and insulated the walls from external heat.
The second house investigation in Al-Qasr is of "Abdullah and his brother Abdulkader" and it is also located in the Mahdy Awad quarter (Figure 13**).** The house has a ground floor, one story and a roof terrace connected by one staircase, rooms and all spaces, albeit of limited size, were used in different ways in relation to the climatic conditions. The open spaces used during the night in summer, while the areas under cover were the best place for spending the day, shielded against direct sunrays and are naturally ventilated.

4.1. Building techniques

Sun dried mud brick, sometimes mixed with straw was the building technique used most widely in this area. This best fits the local conditions, the need to reach appreciable heights over small surface areas and to reduce progressively the masonry wall thickness.
Brick, usually measuring 21x12x7 cm, masonry bears witness to builders' great mastery in using bricks and creating particularly sturdy structures. (De Fillippi 2006)
The outer walls are laid in double rows, reaching 50 cm of thickness, to improve structural and heat accumulation capacity. Upper stories and interior walls are laid in rows of one brick and a half. This material kept houses internally cool in summer and warm in winter. This technique is also used for roofs, cornices and internal partitions, to obtain lighter-weight structures and be able to create more complex elements, such as arches, bas-relieves and ornate decorations.
Mud and straw plastering were applied by hand on the wall surface. This material ensures perfect bond to the support, is elastic, and can absorb expansion and shrinkage phenomena. The outer coat of plaster protects the brickwork and can be renovated whenever necessary. Its colour endows these buildings with an appearance that blends in perfectly with the landscape.

5. TRANSITION FROM TRADITIONAL TO MODERN

In 1960 the Egyptian government started the New Valley Project at The Western Desert. New modern towns were built on the European planning models to support the increase in population and better use space in the name of efficiency and development.
The new towns, built of corrugated steel, cinder block, and reinforced concrete, now sit next to the older villages and are ordered on a grid pattern with wide streets and public squares. The public and private may be clearly marked in the plan of the new settlements, as is the intended function and ideological intent of space. But these designations tend to breakdown with traditional use of private/ public areas.
Al-Qasr today is a dilapidated village, housing in bad conditions. The prefabricated production methods have produced unacceptable solutions both in environmental and human terms (Fig. 14). These

reinforced concrete panel and box systems are being suggested as solutions, with the implicit assumptions that providing housing is predominantly a production problem ant that technology can produce the necessary units in a volume which will put the operation on an economic basis. The simple fact that 6in of reinforced concrete is the worst possible building skin to put between a human being and the external environment of the hot-dry regions is usually brushed aside. The economic assumption that building on a large scale is, by definition, bound to be cheaper per unit than smaller scale operations using traditional methods have also been found to be untrue when total coast are taken into consideration.

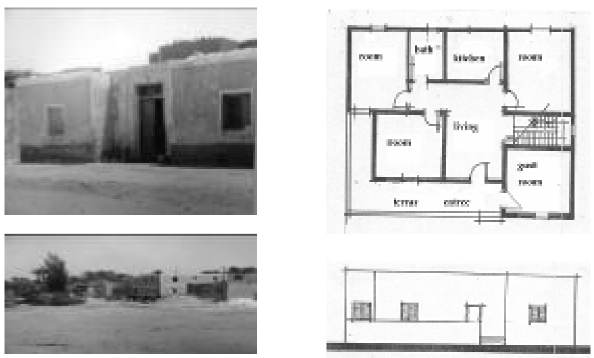

Figure 14: Example of a new house in Al-Qasr built by the owner (ground floor, and elevation) using concrete.

6. LESSONS FROM THE OASIS STUDIES

Viewing the city as a process and a product is an effective analytical design tool. It can best be appreciated by viewing the dynamics-of building as affecting the neighbourhood level:
1-The outside door must not be located opposite houses; a door must not be located adjacent to an existing neighbour's door.
2-The height of a window sill on the ground level facing a street is determined from the exterior, it should be approximately 1,75m from the surface of the street. This dimension is above eye level of an average man.
3-The exterior finaa; space on both sides of an existing door it extends vertically alongside the walls of the building.
4-The court, internal courtyard, or, and the back yard are basic element of a building is named finaa or *hoshe*.

6.1. Design principals

In the developing countries, most existing conditions and experiences are inherited from past generations and some may go back to ancient time. It is impossible to outline one or even a few forces without considering all comprehensively. The study of ancient civilizations in arid zones reveals a close relationship between the ecological equilibrium and the quality of social order, (Rimsha 1982) in the past, the survival of civilization in arid zones depended primarily on man's understanding the delicate environment and establishing equilibrium between society and that environment. The conditions result from socioeconomic, political and other forces rather than from climatic conditions**.**

6.2. Influences on the vernacular

Vernacular architecture is influenced by a great range of different aspects of human behaviour and environment, leading to differing building forms for almost every different context. Despite these variations, every building is subject to the same laws of physical, and hence will demonstrate significant similarities in structural forms.
Although Islam is not the predominant religion in every hot, dry area; its teachings serve to emphasize the reality of life in such place.

6.3. Was the holding of a balance between tradition and progress ever more difficult to achieve?

The inner suburbs of every urban centre in the developing countries, such as in Egypt, now contain square miles of boxes made from reinforced concrete and solid burnt brick, built solely for structural stability and outward appearance and designed by builders who never thought of the environmental consequences to the occupants. Close examination must be made of the way in which people live and work both inside and outside their houses. It is better to keep daily travel distances short so that motor transportation is needed only for less frequent, longer journeys. It is better to think of the environment in terms of people first, and their relationship to one another and to community. Equilibrium between the forces of tradition and progress must be sensibly maintained if respected human values are to survive.
Modern techniques developed in the world have been adopting without due consideration of their suitability rational analysis of the technical and thermal problems. However, rational thinking alone is not enough; for housing in common with all forms of architecture expresses cultural and emotional needs which cannot be totally satisfied by a technically and thermally correct solution.
The satisfaction of cultural and emotional needs is the most elusive and difficult task for the architect. An obsession with the image of international modernity or traditional techniques and motifs or the scientific analysis of environmental problems will not provide the solution. Awareness of the environment and of the economics and social history of the area in which he working, and love for the people who will use his buildings together with the qualities of modesty and sensitivity, would seen to be the essential attributes for a designer facing this seemingly impossible task.
What is needed now is a new pattern of urban development allowing for the controlled circulation or motor traffic, while maintaining the density of the traditional layout.

6.4. Climate and the ideal house

1-The ideal house for such conditions would be sited with its major axis running east-west, so that the

longest walls facing north and south would be shaded either by the overhang of the main roof, by a lean-to terrace roof, or by applied shading devices.
2-window openings, also shaded, would be small enough to give adequate capable of being firmly shuttered against dust storms and pilferers.
3- The roof would have a reflective top surface to minimize heat absorption and a construction incorporating some sort of insulation, most likely its intervening air spaces. (Thermal admittance is defined as the percentage of energy a material can radiate away after it is absorbed).
4. The surroundings would be laid out with as much surface vegetation and tree planting as feasible in order to lessen glare, encourage air movement, and break up the ground surface to reduce reradiated heat.

CONCLUSIONS

Vernacular built heritage can be seen as "the essence of sustainability", being constructed with local materials and the minimum waste of resources. The traditional system has a great deal to offer to learn for our contemporary period and for the future. Cultural heritage is a non – renewable resource, vernacular architecture is the fundamental expression of the culture of the community, at the local, regional territory and at the same time, the expression of the world's cultural diversity. Due to homogenisation of culture and global socio-economic transformations, vernacular architectural and urban forms all around the world are extremely vulnerable, generally, ascribed to an overwhelming attitude towards modernization and inadequate cultural changes.
Building envelops need to be durable, aesthetically pleasing, weather tight, structurally sound and secure. Psychologically, views out are very important. Environmentally, the questions that need to be addressed are; how they respond to solar radiation, how ventilation is made possible, how heat loss is minimized. The envelope will, to a large extent; determine how the internal environment is affected by the external one. Skin is a major component: external forces meet internal ideals at this point. The building and its site are a landscape of possibility, with the skin (or skins) the mediator between in-ness and out-ness.
This has to be one of the major commitments for who works on housing projects, and on heritage conservation.

ACKNOWLEDGEMENT

This paper presents the results of the survey carried on the Egyptian Oasis during April 2007, by the author with a group of architecture colleagues and students. This study is also based on an academic research (Msc Thesis edit by Mahmoud Tarek Hammad 1996). Photos and drawings are by the author.

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Practice and theory in Greek urban design

Despina Dimelli[1], Konstantinos Ioannidis[2]

[1] Technical University of Chania, Crete, Hellas
[2]University of Thessaly, Volos, Hellas

ABSTRACT: The phenomenon that has intensively been recorded in contemporary Greek urban reality is the observed deviation between built urban environment and the process of teaching urban planning in universities. The particularities of local architecture, products of the effort of adapting the peculiar urban landscape combined with the existing climatic conditions, are often ignored in order to create impressive elements (most times copies of international corresponding) aiming at superficial impressions than to function and duration. "*Impression of the moment* "often restricts urban formations to smoothly integrate within existing urban terrain and prohibits project to adequately adjust the existing environmental conditions. As soon as young students from architectural schools begin their profession as licensed architects, they realise the amount of legislative restrictions they have to face in order to adjust their practices to contemporary Greek urban status. Consequently, they are "trapped" between inspiration and reality. Our paper aims to reveal the way traditional urban design, as developed through years of adaptive function, operates in local urban tissues (Greek islands, town centres etc.) and how new projects have failed to adjust its qualities, neglecting to take into active consideration the existing reality. In light of the research, a few important conclusions have been reached as to propose ways of connecting theory with practice in Greek urban reality.

Conference theme: Urban design studies
Keywords: Greek traditional urban design, waterfront, legislation,

INTRODUCTION

This paper is written as a result of ongoing research on the relationship between ''education'' and ''practice'' in contemporary Greek urban design. Below we discuss the most recent large-scale urban redevelopment at the waterfront of Faleron (Athens) for the demands of the Olympic Games 2004 set against to a more exhaustive in terms of topos' attributes acknowledgment within design process example from Ermoupoli. In what follows, we will suggest that contemporary urban design practice is often governed as strongly by restrictions from the contemporary planning legislation as it is by impositions from market-driven forces in shake of projects' economic feasibility; and that the conceptual approach most often disseminated within planning schools usually restricts young urban designers to employ a self-legitimized, concrete and consistent to local attributes design practice. In the current paper, we critically evaluate the impact that recent approaches in teaching urban design and students' subjective position may have at the formulation of design attitudes and strategies when *topos-making* and *topos-shaping* actions are seen as supplementary dualities in the context of Greek urban terrain. The selected projects for the comparative study manifest the most recent practices and are employed to answer the question on the relationship between ''education'' and ''practice'' in the light of the major studio-courses for undergraduate student at the Architectural and Planning Faculty of the University of Thessaly, Greece. In light of the case studies, a few important conclusions have been reached as to the value and contribution of enhancing students' subjective position to actively acknowledge the particularities of Greek architecture, its needs and qualities to the ''topos-making'' and ''topos-shaping'' process by means of a more realistic design attitude.

It is possible to initially address the question of 'bridging theory with practice'' raised by the above thoughts through a systematic theoretical inquiry; but our understanding of the issues involved may not be comprehensive enough to make that a viable option. Instead, it is seemed safer to address the question through an exploratory, diagnostic comparative case study that outlines two real-setting situations of contemporary urban waterfronts which can help to identify the essential characteristics of the on-study phenomenon. This will keep matters concrete; help bring to light unsuspected issues; and, above all, use the empirical data of the investigation process (notes from discussions with students, remarks on published researches etc.) to formulate the main theoretical concepts in order to keep the structure of the general arguments expositive enough. This is a ''ground-up'' approach to theory building, defined by Strauss and

Corbin as ''qualitative research method that uses a systematic set of procedures to develop an inductively derived theory about a phenomenon'' (Strauss & Corbin, 1990:24)

1. THE URBAN WATERFRONT AS DISBOUNDED ''SHOWCASE'': AN URBAN DESIGN STUDY

1.1. Selecting the case study

Figure 1 shows the regenerated image of the urban terrain at the coastal space of Faleron as developed for the demands of Olympic Games in Athens 2004. The project was based on the urban study carried out by architects ''Th.Papayiannis and Associates'' dealing with the regeneration of 80 hectares on the waterfront of Athens. Since the traditional and natural opening of Athens to the sea at Faleron Bay was violently disrupted in recent decades by wrong political decisions and impacts of mass urbanization, the Olympic Games put pressure for its regeneration. In the case of the new coastal reality, effort was made for a dramatic shift: urban practices during 1970's and 1980's resulted in an extensive no-man's land and certainly an undefined relation between city and sea (both functionally and aesthetically) which was called to change into a new, more flexible and privileged metropolitan public area and an attraction pole of metropolitan significance, allowing the reopening of the city to the sea.

This prospect allows us some important insights into the final achievement of project's initial purposes mostly at the post-Olympic era. The paper takes as a premise the observation that ''Faleron waterside reality'' is rather epitomized by the word ''complexity'': a variety of components and interaction relations construct the study premises of this paper. These components include among others:

Figure 1: Faleron Bay and its urban context. Source: (Google maps)

- the technical dimension of Faleron urban waterfront (utilitarian features related to the waterside environment of the Olympic phase like athletic facilities or coastal promenades)
- the environmental dimension (the degree to which urban design acknowledges the adaptation of climatic and ecologic parameters as design guidelines or how natural and climatic changes influence the rest components)
- the social dimension (the ramifications of people's interaction with other groups at the location or with the environment as well)
- the symbolic dimension (urban Faleron Bay has always played the role of accommodating transcendental water-related beliefs with its utilitarian features)

Even within the ''New Waterfront'' era proper, starting with London Docklands during 1980's, there has been a tradition of recognizing the significance of complexity's aspects in designing the urban forehead upon water – a tradition that includes scholars as diverse as Ann Breen and Dick Rigby, authors of the inaugurative book ''The New Waterfront, A Worldwide Urban Success Story'' (1996) who brought a collective study from major built waterfront large-scale redevelopments to urban design process, and Kenneth Powell, who, inspired by contemporary pragmatism in building the Edge, argued for a ''City Transformed'' (2000) by market-driven processes relatively autonomous rather than as by-product of an applicable ''societal'' urban design theory.

Indeed, the ''field site'' of any waterfront-related research effort should acknowledge the complexity of the issue and include its constituted dimensions. However, this effort, adds to them another, even promising, premise that ''New Waterfront'' era seems to deliberately exclude: coastal formations can also employ micro-climatic aspects to their structure. That is, incorporation of ecologic elements that make up their form not as parts merely circumstantially brought together under the pressure of commercial urbanization, but as entities existing under reciprocal influences with their environmental settings.

In the current study, the premises of Faleron's forehead include both structure and location. The current site is selected on the basis of the richness of seaside environmental data, and/or site's unfamiliarity and suitability (Neuman, 2003:371). The Faleron coastal area, identified as the specific are of study, is located in the main waterfront area of Athen's forehead upon water. The particular site is characteristic, due to its significance to citizens' everyday life, as well as its plethora of sub-areas of athletic and recreational functions; and is, therefore, selected primarily on the bases of the richness of its data. The priority that government ascribed to the redevelopment of the area for the purposes of Olympic Games manifests the high degree of significance that city ascribes to this vital zone.

1.2. Contemporary practice and disregarding variables

The design attitude of incorporating local and environmental aspects as ‘’initial decisions’’ is often predicated on several issues vital to each project’s success as a quite thriving public space. The on-study waterfront redevelopment should have been conceptualized not just as an athletic district but as a community’s “living room” which could possibly support at least three basic types of socializing:

- people who approach the Faleron in groups for the purpose of, for example, recreation, eating or entertainment
- people who approach the area alone and hope to meet others which may belong to the same group and are expected to be found there
- and people who pass-by the area every day or several times per day and tend to develop routines relations with others of the same group.

However, the total disregard for a general waterfront spatial identity, smoothly applied and strongly interwoven with backstage urban reality brings to the fore the importance of transitional, interpenetrated areas between water and city and alerts us to the greater necessity of a kind of spatial mixture (in terms of environmental aspects first, and afterwards uses or functions) as determinant of re-defining image’s structural relation. In fact, we can say that for Faleron Bay, the sense of a transitional zone (or sub-places) between urban core and waterfront area was lost and been replaced by the concept of ‘’self-building”: structures unconnected to the city and alien to the sense of topos (figure 2).

Figure 2: Master plan of the post-Olympic phase. Source: (Faleron Bay Brochure, 2004)

If we try to categorize the above-mentioned parameters of local, social and ecologic variables which seem to intervene to such a large-scale redevelopment, we can sketch out the weak points that the project failed to acknowledge during its ‘’initial decisions’’ phase:

- It seems to disregard the creation of object(s) of high aesthetic quality specially designed to serve orientation purposes in order to challenge human behavior towards them. For this reason ‘’surprising’’ and ‘’meaningful activities’’ are not found inside or around Faleron (activity patterns addressed not only to athletes but for as much of social groups possible)
- There is a failure to incorporate a variety of design attitudes and spatial layouts for docks-like “extensions” which can afford different degrees of formality of interpersonal interaction: from intimate ones (cafes located on city/water edge that could facilitate warm conversations) to more formal (like social events- temporary expositions, concerts, festivals- held around the Faleron Bay area)
- It doesn’t connect the new reality with the existing urban fabric, restricting its fragmented zone by means of a high-speed motorway which cuts into two pieces the whole area
- Its buildings are designed without clear semantic and/or symbolic meaning to be communicated along user groups. Moreover, they are not consistent to human-scale design in order to assure their successful, meaningful and smooth operation. For this, desolation and abandoned, dead spaces along Faleron are to be found.
- It lacks the programming stage which pre-determines what short of “in-water extensions” will be needed and assure that these are located in meaningful points (well orientated, close to entrances of the area, near the liquid element that promotes poetic views, near important buildings, near natural qualities etc.) Therefore the area has been cut down by a linear monotonous track which makes the whole area to be avoided and neglected by passersby.

The prevailed prospect is that of an absolute commercialization at eh name of a ‘’new athletic complex’’ in the heart of Faleron and by the new enormous heights allowed by planning regulations on the coasts of city, aspects that promote the aesthetic, olfactory and microclimatic blocking of sea. The Faleron lost its forehead, and was transformed into a complicated hypertopic circulatory hub that excludes people - instead of welcoming the citizens. In the place of the old Athenian poetic forehead, enormous stadiums and buildings of offices were raised, following certain postmodern incoherent aesthetic writings, allowing the complete “exploitation’’ of Faleron area (picture 3).

Urban design has always had an ambivalent attitude towards theory and practice of designing city’s edge on water but never before had been so influenced by the commercial paraphernalia of our days. And this because the resulting design proposal with a circulation network which embraces and suffocates the sensitive area of the coastline usually leaves aside the question of human-centered design and adopts images of “cityness” to obscure the relation of the intellectual and practical parts; the juxtaposition of the architectural thought for expanding the city into the sea and the final built result is immediate and tragic. By that, we do not necessarily imply a deficiency of the first or that the current waterfront projects is spiritually bankrupt; but rather an “incompatibility” between these two, which prevents a well expressed result to be established. This

Figure 3: The redeveloped area cuts the city from its access to the sea. (Faleron Bay Brochure, 2004)

incompatibility has as starting point the policy of convenience which trivializes architectural totality in favor of – economical, most times – merits and produces gestures which do not justify their existence, while they fail to gain an understanding of the image of the place.

2. TRADITIONAL GREEK ISLAND WATERFRONT: A STORY OF SUCCESS

As case study we have chosen Ermoupoli the waterfront of Syros Island, a place that is close to Athens and has the same climate characteristics, and has initially been designed as Greece's capital in the early creation of Greece. Ermoupoli was built between 1821 and 1835 by Greek refuges with the traditional elements of Greek architecture adjusted in the particularities of the island (figure 4).

Ermoupoli's waterfront is an area designed for a country's capital where commercial, administrative and recreation land uses exist and is mainly used by its residents during winter added by many tourists during summer. It's main characteristic, is that its today status has been created by constant adding changes during the effort to adjust to social , climatic and many other parameters.

The land uses that exist are mixed as shops co-exist with hotels, small manufactures, boat facilities e.t.c. allocated in buildings that follow "the constant building system" (a system where buildings are next to each other creating a continuous front) which is applied in building squares that are close to the sea in order to avoid the "urban canyon" phenomenon that is faced with the combination of strong winds and small open spaces between high buildings.

The main orientation of the building squares is south north with a small rotation that adjusts the buildings main "sight" towards the sea. The buildings that initially were houses and administrative buildings had two floors, tile roofs and many symmetrical windows at both sides of the buildings (smaller at the south side) in order to renew the air inside the house. The widths of the roads were regarding to the buildings heights proper for the best city's airing.

Figure 4: Ermoupoli, the capital of Syros Island. Source: (Google maps)

Figure 5: Central square and rest open and green areas. Source: (Google maps)

As for urban planning, the base of city's design was the creation of the central square, where all central activities were allocated (figure 5). Road axes connected the central square with the rest, mainly residence areas that also had their own bigger squares covered with trees for the best possible shading. The environmental parameter, the climatic conditions (strong winds, intense sunlight, humidity, lack of rain) have resulted the creation of ecological urban design that could solve the problems that are created by the above mentioned conditions.

The exterior areas that face intense solar radiation are shaded by manufactures that

Figure 6: Spaces protected from the intense solar radiation with manufactures that are parts of the buildings. Source: (author, 2000)

- are parts of the buildings, (figure 6) . (The constructions position is according to the wind's direction, internal courtyards are created and shading constructions are built, etc.)
- cover and protect these areas (figure 7). (Mobile covers from timber or canes, vegetation, shutters, ledges above the windows, etc).

All these features are built with local "cheap" materials as stone, wood, marble that at the same time ensure the buildings best climatic adjustment (cool during summer, warm during winter).

The buildings are made of stone in order to maintain the internal building's temperature. Trees are helping to reduce the temperature of the air that comes in the houses during summer, and that is why they consisted (although they are reduced due to continuous touristic constructions) a major part of the city's total.

We must report at this point, that today's status is different from the initial, and planning principles have been ignored as market forces have led to the intensive land exploitation and that Architecture and urban design as today function in Greece have very few similarities with the corresponding traditional, as far as environmental factors are concerned.

Figure 7: Spaces protected from the intense solar radiation with external elements. Source: (author, 2000)

3. THEORY AND PRACTICE DESCREPANCY IN ARCHITECTURAL STUDIES: THE NEED FOR AN EDUCATIONAL RESTRUCTURING

3.1. Preliminary reflections on modeling project studios

The main characteristic of Greek architectural and spatial studies is that every project, as presented to students for further study, has no restrictions, neither legislative nor economic. This results from the initial intention of university teachers to often leave students unconstrained in the belief that such an attitude will foster their inspiration and imagination for the best possible experimental design outcome. This phenomenon is observed in most design courses: from industrial and architectural to spatial and urban design, producing impressive but unrealistic works.

The real problem initially appears when students finish their studies and become licensed professionals. From this moment, they have to deal with new, strict and unknown conditions. Unfortunately, and this is mainly observed with public constructions, the economic factor is often raised as the basic design "tool". Suddenly many restrictions -concerning for example material prices, existing legislation, salaries etc. - appear, limiting if not the initial idea of the final design product.

In fact, state's "General Building Regulation" is the core for any architectural and spatial development in Greece, defining several restrictions that all constructions should obey. All architects face similar restrictions during design process regarding aspects like the maximum allowed height, surface, distances from other buildings, and many other parameters. This set of hundreds of regulations must apply in every construction since 1985; and until today its punctual application is the necessary condition for every building creation and function. These restrictions remain unknown to young professionals due to their limited education; so many times they have to work with more experienced professionals in order to acquire methods

of adjusting their practice to the current conditions and learn all the “new” design parameters.
The paper proposes a shift in educational practice, though it does not take all the steps towards it itself. From kinds of merely thinking in interpreting topo’s needs and qualities during urban design courses to kinds of thinking that pursues how urban formations and relations are established, coordinated and maintained in contemporary Greek cities. From our experience in architecture profession and education at the same time, we believe that restrictions, both economic and legislative, must also be taught in architectural schools during the main studies. We believe that all new architects must be prepared to enter the construction market with adequate knowledge to prove their skills. So we propose ‘’on-situ’’ workshops: the entrance of “real time” conditions in all projects in order to prepare new professionals with the best way possible. We believe that every project should address a certain area *with* its building restrictions, with a certain budget, and students should encouraged to investigate ways of adjusting their work at current contemporary conditions, as if it is a real market project. Finally, we have observed that inspiration and imagination, not only are not under any threat, but instead are developed as more flexible under the framework of building restrictions, being a greater challenge to develop feasible designs than purely utopian.

3.2. Conclusions and course’s guidelines

The goal of this study, within the framework of applicability in urban design practice, is to generate adequate knowledge leading to the development of guidelines for the restructuring of urban design studios within architectural schools. Before prescribing the proposed framework, it is necessary to systematically analyze the above mentioned deficiencies and explain the conditions that contribute the necessity of their improvement. The systematic analysis and explanation of these ‘’educational gaps’’ guides us to a rather formulative model for organizing future design studios. The model should be realistic; able to grasp the essential characteristics of project’s on-study site within contemporary urban environment: its limitations, allowances and objective handling.
In the previous section of the comparative case study, the crucial questions necessary to investigate the development of such a course-framework in the context of real-given waterfront design are put forward. Here we outline the criteria that determine what will constitute satisfactory solutions to the gaps identified so far. These criteria can be considered as ‘’preliminary reflections’’ on the development of a formulative model for urban design studios addressed to third and fourth year students of architectural schools.
The preliminary reflections on a formulative model for course’s framework are:

- Given that students tend to handle the urban environment with an attitude of poetic realism, the model should identify the conditions that render a site prone to, on one hand, sense-creation and suitable to generate, on the other, design results that can actually be built. The model should investigate students’ attitudes to local conditions, both as a situation in relation to other locations without building restrictions, and in terms of its unique internal characteristics addressing minimally three scales: territory, legislation and logical form.
- Given that the project’s site is better to be selected for urban regeneration processes and is often called to accommodate essential urbanistic activities for its future users, the model should rigorously investigate both the spatial and market-driven processes related to the location. If a number of user groups are about to accommodate their everyday lives in this site, the model should define the experiential patterns to be investigated by the students and distinguish the different urban formations that result from the (even loose) application of the ‘’General Building Regulation’’. The model should distinguish between those spatial patterns that occur only on the specific site and those that can occur in various urban locations.
- Given that students are called to deal with the whole set of location’s spatial and environmental recourses, the model should register all restrictions categories for the specific site. The model should correlate building activity and nature’s adaptation and therefore identify how urban spaces and formations can beter be integrated within existing conditions in focus. The model should identify what makes urban spaces and formations experienced appropriate for prescribed spatial relationships by the ‘’General Building Regulation’’ to occur.
- Given that students participating in the courses have no prior experience of the complexity of the urban scale, the model should be dynamic and incorporate city’s real demands and needs, market’s tendencies and past successful spatial patterns as variables. It should identify both long-term and short-term changes for the site. Finally, course’s model should promote the evolution of a realistic design strategy for the location instead of messed experiential and utopian scenarios that result mostly to superficial ‘’*impressions of the moment*’’.

This first instant of a new framework for restructuring design studios in architectural schools was investigated in real setting situations employing field research techniques such as noted discussions and inquiries from both inside and outside academia. The preliminary observations have been presented as an ideographic course model and provided the grounds to read the failure of Faliron development in contrast with the adaptive traditional urban design practice of Ermoupoli. Finally, the questions that the ideographic model intends to answer leading to the definition of model’s preliminary reflections on ‘’bridging the gap’’ have been pronounced and can provide guidelines for structuring future cohesive urban design studios.

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ISBN: 978-1-935129-158