Reflective knowledge and potential architecture

Jean-Pierre CHUPIN, Ph.D., professeur agrégé
Denis BILODEAU, professeur agrégé
Georges ADAMCZYK, professeur titulaire, directeur.

École d'architecture de l'Université de Montréal.
jean-pierre.chupin@umontreal.ca
denis.bilodeau@umontreal.ca
georges.adamczyk@umontreal.ca

Abstract:
This paper outlines an epistemological approach to "architectural project" with respect to the notion of *potential architecture*. We know, for example, that Rem Koolhaas and OMA's project for the *Parc de la Villette* probably had as much impact on architectural education and knowledge transfers, as Bernard Tschumi's prize-winning and built project. To explain this phenomenon in relation to the potential, and literally speaking, "virtual" nature of edification processes, we elaborate an analogy between the potential architecture of projects conceived in educational contexts, and the potential architecture of professional competition projects. A competition project clearly belongs to these activities of architectural thinking located exactly at the crossroads of discipline and profession. But there is another form of potential architecture that shares the same intermediate status, the same "in-between". These are projects conceived in educational situations by architecture students. Yet, the understanding of these projects suffers some very recurrent contradictions in most European and North American schools. Indeed, depending on studios and professors, students are often brought to consider their projects as results (as objects), or as representations of a result (as images), and rarely as process of thought (as intellectual journeys). Architecture students often have many difficulties understanding why their projects are, for some, just weak simulations of professional activities, while for other academic disciplines, hardly more than forms of creative activities without real epistemological status: In other words, without real value in the production of knowledge. In most so-called "research universities", Architecture is far from shining as a valid discipline of "thinking". It is as if student's thesis neither had a real professional, nor a real disciplinary value: a bad study sketch as it were!

Building on some of D.A. Schön's most durable hypotheses, particularly those stating that architectural knowledge lies at the core of reflective transfers between action and cognition, we investigate a model consisting in three fundamental aims of *edification* : construction, instruction and translation. These three aims are understood as complementary reflective sources of architectural knowledge that can be analyzed, in particular, on various corpuses of architectural competition projects whether or not these projects were prize winners or constructed.
Schools of architecture share the burden of responsibility in a phenomenon of growing indifference towards disciplinary research specifically devoted to the architectural project, to the advantage of an over-investment towards technological instrumentation. Students, far from the (sometimes hasty) socio-political commitments of their elders, feel at present a certain anxiety concerning, not the future of Architecture itself, but the acquisition of peripheral knowledge and know-how in order to participate, as responsible individuals, in the blooming of society. For most

of them, it is unclear whether the architectural project can be a vehicle of social changes and cultural mutations, given the contradictory messages (from professional as well as from academic circles) they are fed regarding both the pragmatic and epistemological value of their own projects.

Reflective knowledge and potential architecture

This paper outlines an epistemological approach to “architectural project” with respect to the notion of *potential architecture*. Building on some of D.A. Schön’s most durable hypotheses, particularly those stating that architectural knowledge lies at the core of reflective transfers between action and cognition, we investigate a model consisting in three fundamental aims of *edification* : construction, instruction and translation. These three aims are understood as complementary reflective sources of architectural knowledge that can be analyzed, in particular, on various corpuses of architectural competition projects whether or not these projects were prize winners or constructed. We know, for example, that Rem Koolhaas and OMA’s project for the *Parc de la Villette* probably had as much impact on architectural education and knowledge transfers, as Bernard Tschumi’s prize-winning and built project. To explain this phenomenon in relation to the potential, and literally speaking, "virtual" nature of edification processes, we elaborate an analogy between the potential architecture of projects conceived in educational contexts, and the potential architecture of professional competition projects.

Schools of architecture share the burden of responsibility in a phenomenon of growing indifference towards disciplinary research specifically devoted to the architectural project, to the advantage of an over-investment towards technological instrumentation. Students, far from the (sometimes hasty) socio-political commitments of their elders, feel at present a certain anxiety concerning, not the future of Architecture itself, but the acquisition of peripheral knowledge and know-how in order to participate, as responsible individuals, in the blooming of society. For most of them, it is unclear whether the architectural project can be a vehicle of social changes and cultural mutations, given the contradictory messages (from professional as well as from academic circles) they are fed regarding both the pragmatic and epistemological value of their own projects [Chupin, 2001-b].

Architecture as discipline and as profession

It is perhaps easy to forget that architectural thought is reflected, not at a single level of construction, but at two levels: one usually said to be *practical* – the legitimacy of which is usually recognized – and a level said to be *theoretical*. This second level appears all the more marginal as it reveals itself in a much less visible and operating way. In architecture, there are indeed two directions for action and cognition, but it is more fruitful to distinguish between the *disciplinary* and *professional* horizons while underlining that both contain a practical and a theoretical dimension [Piotrowsky and Robinson, 2001] [Chupin, 2001-a]. These horizons are often considered as foreign one to another because they refer to very different aims and temporalities. However, without looking in the margins of architectural discipline, if we consider once again the case of competition project, we shall agree that it can be considered neither as the result of an either purely theoretical activity, or an ordinary professional activity. We can say that an architectural project in competition situation is neither fundamental research nor basic service. A competition project, for example, can be a prize winner, but unimplemented. It is then within the decision of a community – either professionals or scholars – to participate in its archiving or in its publication integrating it into a long term cultural debate. Or, on the other hand, the unchosen project can be transferred to another situation should the design team considers all or part of it relevant "to recycle". Nevertheless, this project has originated in a competition process!

A competition project clearly belongs to these activities of architectural thinking located exactly at the crossroads of discipline and profession. As Stanford Anderson pointed out, it is indispensable not to stack these two directions of architecture on top of each other, to avoid confusing the two aims [Anderson, 2001]. But there is another form of potential architecture that shares the same intermediate status, the same "in-between". These are projects conceived in educational situations by architecture students. Yet, the understanding of these projects suffer some very recurrent contradictions in most European and North American schools. Indeed, depending on studios and professors, students are often brought to consider their projects as results (as objects), or as representations of a result (as images), and rarely as process of thought (as intellectual journeys). Architecture students often have many difficulties understanding why their projects are, for some, just weak simulations of professional activities, while for other academic disciplines, hardly more than forms of creative activities without real epistemological status: In other words, without real value in the production of knowledge. In most so-called "research universities", Architecture is far from shining as a valid discipline of "thinking". It is as if student's thesis neither had a real professional, nor a real disciplinary value: a bad study sketch as it were!

Between building and educating, between action and cognition

We can never emphasize enough that among all our life Projects, be they existential, technical or organizational, architectural projects have the distinguishing characteristic of combining an ambition to build and an ambition to educate. In this sense, they reflect a profound desire for "edification". Edification has perhaps become an unusual formula – certainly an ambiguous one – for, in fact, it refers not to two but to at least three aims, most of the time perceived as contradictory rather than complementary:

1 - Edification occurs every time we try to give shape to a major project. What we generally call design (*conception du projet* in French) refers in general to the sum of intentional steps stemming from first sketches toward contractual negotiations and up to the final built result. In this sense, edification is a fairly long maturing process, partaking of multiple interactions.

2 - Edification also exists when we try to contribute to the development of intellectual and manual abilities of an individual or a group of persons. This occurs by educating through a process of design and a production of a specific work ; contrasting product and process. Project corresponding here to an educational process summoning the individual's potential and motivations) [Boutinet,1990].

In the first case, edification refers to the intention of building. In the second case, it is the intention to educate (or even to instruct) that is mainly summoned. This first distinction, as clear as it seems, nonetheless is an unsatisfactory one. The bonds between building and educating are closer than it would appear in the oppositions between, for example, the builder and the educator, between the professional and the professor. Things are not as clear-cut. If necessary, we need to refer to Latin etymology in order to notice that whereas *instruere* and *construere* both mean "to build", *instructio* means… "to construct"! Edification becomes a complex notion when we recognize the existence of an intermediate relation, of a third level of motivation, one which refers to the necessary unity of any project:

3 - We shall refer to “project edification” to denote this sometimes unacknowledged intention, this urge – lying at the very heart of architectural design – this impulse to reach a coherent and almost organic whole [Hersey, 1999]. In his *De Re Aedificatoria* Alberti went as far as calling this impulse a *libido ædificandi*. Edification here means “making hold together unstable or heterogeneous parts into a formation” (in the same way as we speak of musical formation, battle formation, geological formation or even research formation). In this third sense, speaking of an intention to build, or a sole intention to educate, is not fully adequate for both are necessary mobilized at the same time. We shall then speak of an “intention to edify”. In the Latin *aedificare*, referring to the constitution of a house by its prefix *aedes*, means at the same time building, bringing up something considerable; as well as educating, bringing to virtue by examples or by words.

Let us come back to our analogy between the potential architecture of professional competition projects and the potential architecture of projects conceived in educational contexts. If it corresponds, on the one hand, to a series of acts and ways of educating aiming at designing a project in order to build, and, on the other hand, if it relates to a series of acts and ways of thinking aiming at designing a project in order to educate: can not we say than these acts and ways of thinking are properly speaking analogous? Indeed, the initial difficulty of the architectural project edification lies in an ambition to concentrate and “converge” a knowledge of objects to be built and a knowledge of beings to be educated [Chupin, 2001-b]. In order to go beyond some contemporary disjunctions which reduce projects designed in educational situations to "immature" (or even irresponsible) simulations of professional projects, and analogous disjunctions which reduce competition projects to "failed" or worse “aborted” propositions, we must first make a clear distinction between disciplinary and professional aims of architecture – even if an in-between situation is to be acknowledged later. How are we to consider the type of knowledge carried out in students’ projects (i.e. their potential architecture), along with the potential architecture of competition projects? In a literal sense, how can we acknowledge their "virtual edification"?

The virtual architecture of competition projects

Let us consider, for example, the amount of competitions organized in Canada between the beginning of the 1980s (Edmonton City Hall competition, Mississauga City Hall and Civic public garden competition, Calgary Municipal Building competition) and the year 2000 (Competition for the Grande Bibliothèque du Québec in Montreal). This period is not an innocent choice for it allows us to relate, on the one hand, a progressive practice of public competitions in Canada and, on the other hand, an intensified phenomenon of "reflective practices" (in the meaning coined by D.A. Schön [see 1983 and 1987]). Indeed, Schön’s own studies on the epistemology of professional activities have largely contributed to the recognition of the reflective paradigm in architecture; design processes being inadequately represented through the sole model of technical rationality [Schön,1984]. Architectural design is a complex process of breaks, returns and reorientations, which is closer to a cyclical process of iteration than to a rational (or even less linear) process of problem solving [Rowe,1982 and 1987]. Be it external or internal criticism and judgment, be it inter-disciplinary advice or expertise, collaborative design, or cultural mediation, for example, reflective practices have become an essential part of most architectural projects that summon various levels of collaboration. In professional situations, the designer rarely works alone and the sharing of spatial models, technical data and cultural references usually comes along with a sharing of interdisciplinary knowledge. This knowledge is sometimes explicit, but most of the time, implicit (*knowledge in action*). Today, cases of remote collaboration increase proportionally to the development of communication technologies, even when architectural projects call for the gathering of teams located in the same city. This phenomenon extends, in its turn, the demand for reflective strategies.

The history of architecture is rich of practices based on conscious methods of distancing, questioning and exploration regarding the disciplinary and cultural standards which tend to govern the production of the built environment. However, this phenomenon has witnessed particularly rich developments in the last quarter of the twentieth century, a period characterized at the same time by an intense critical activity and by an outbreak of architecture competitions [Bilodeau,1997]. Contemporary strategies appear to be "reflected", in particular, through the use of specialized publications, films, exhibitions and other multiple forms of mediations. But, in such a view, it is clear that, for example, the progressive establishment of public architecture competitions in Canada from the beginning of the 1980s, constitutes an important phenomenon that has not yet been studied rigorously. Yet the corpus for scientific studies is rich and comprehensive. Between the competition for *Mississauga City Hall* (won by Jones and Kirkland, Toronto architects and prize-winners among 246 participants from all Canadian provinces) and that of the *Grande Bibliothèque du Québec* (won by the Patkau firm, with architects Croft-Pelletier and Gilles Guité), not less than fifty competitions gave place to more than 250 projects of buildings and public organizations, and this, without considering idea competitions organized by specialized journals or by the Canadian Center for Architecture. For these two major symbolic buildings, *National Gallery of Canada* and the *National Museum of Man*, both built after 1982 by the Canada Museums Construction Corporation, not less than 12 Canadian teams (5 for the first building and 7 for the second) were appointed to design projects.

From 1975, we also note a specifically strong intensification of critical practices in the province of Quebec. Architect Melvin Charney's *Corridart* installation, conceived in 1976 as a protest against the gradual destruction of Montreal historic urban fabric, constitutes a striking example, if not a founding event, in the emergence of a new reflective paradigm in contemporary architecture in Quebec. Since, the works of Pierre Thibault, of Atelier Big City, of In Situ, of Bosses Design, of Schème inc., or the archetypal reflections on city and culture of the built production by architect Jacques Rousseau, amongst many others, have been clearly acknowledged [Adamczyk, 1994]. But in Quebec, as everywhere else, the "reflective turn" does not appear only through marginal practices as is attested by the "critical regionalism" wave identified both by Alexander Tzonis and Kenneth Frampton. We now witness a gradual displacement of reflective activities from alternative exploration to regular professional practice, as it is in many other fields [Schön, 1991]..

Are architects sufficiently aware of this phenomenon that goes beyond the case of architectural competition? Are we reflective enough on our own reflective practices? Such a paradox has already been pointed out by Schön himself.

The process of reflection-in-action, Schön writes, - and especially, the particular version of it that I call reflective conversation with the materials of the situation - is an essential part of the artistry with which some practitioners sometimes cope with uncertainty, uniqueness, and value-conflict in all domains of professional practice. But architecture with it special tradition of practice and education, is one of the few occupations in which the process is manifest, honored, and maintained. Even there, I think, the process is still largely implicit. Architects appear to reflect very little on their own practice of reflection-in-action. Yet their practice, redescribed through reflection, might serve as a powerful exemplar for other professions. [Schön, 1984].

Indeed, such a phenomenon, defined by French philosopher Michel Serres as a "*métissage*", an interbreeding of knowledge, is still very poorly known in the field of architecture. It nevertheless coincides with a transformation of cultural and technological conditions of constitutive cognitive practices of architectural thinking in which analogical thinking plays a crucial role [Chupin,2000]. The networking of teams and the computerization of design mediums intensify and diversify the sharing of decision-making and knowledge transfers. Although architectural competitions have already been recognized by some architecture historians as propitious situations for professional research and experimentation [Jong,1994; Lipstadt,1989 and 1991], a lot of work still needs to be done for a full grasp of the phenomenon. In our research we go as far as to formulate the hypothesis that competition procedures contribute, as a whole, to the building of a public space of exploration and debate on the values and orientations of a society and, in this sense, it contributes to an intensification of practices allowing social inquiry and cultural mediation at the very core of projects of architecture.

However, is it not paradoxical that explorations and transfers of knowledge seem to be more active in professional contexts than in academic contexts where architectural project should be at the leading edge of cultural and intellectual transformations? This paradox may be explained by the surprising reluctance of architecture scholars regarding the study of local transformations in contemporary practice of architecture. As a matter of fact, a great number of studies already deal with building conservation (either of traditional and modern heritages), while other studies focus on the reconstruction of monographic and biographic trajectories of these works: We must nonetheless recognize that little research specifically studies contemporary strategies of design and reflective practices in architecture, all the more in specific cultural contexts. This void can partly be explained by an over-investment of financing – and thus of efforts – dedicated to the adjusting of computer-aided design systems, to the paradoxical detriment of research studies on the most fundamental cognitive and disciplinary aspects. [Chupin,2000 and 2001-a]

Edification and translation

During the last edition of "Entretiens du Centre Jacques-Cartier" - an international and trans-disciplinary symposium we organized in Lyon in December 2001 – we were given the opportunity to formulate some of the most lively questions regarding contemporary edification. Entitled "Building, Educating, Translating", this scientific meeting on " mediations, transfers and knowledge in project edification " was the opportunity to assemble interlocutors originating from three groups of disciplines that increasingly resort to the notion of *project*. The discipline are architecture, urban engineering and educational sciences (for detailed information see the *CIT 2001* web site at http://www.lyon.archi.fr/CIT2001). This international meeting was aimed at evaluating the paradigmatic potential of architectural project edification for an understanding of various other forms of projects. As a matter of fact, at the crossroads between cognitive and cultural perspectives, architecture reveals itself as swayed by the double ambition of building and educating (a duality which, as we stressed earlier, is at the heart of the etymologic root *aedificare*). Confronted with operations of transfer where knowledge is not only displaced but most of the time transformed – or, better even, "translated" – we were interested in investigating in particular a twofold phenomena of alteration : alteration of knowledge and alteration of efficiency.

In all three disciplinary fields researchers and professionals acknowledged that knowledge-transfer divides up according to at least three essential vectors in any true project, each of these vectors carrying its own problematic : the operational vector, the educational vector and the trans-disciplinary vector.

1 - the operational vector: (building)

The constructive practice of project can be addressed as the application of knowledge, expertise and assimilated skills. However, considering that a project may be the opportunity for a production of knowledge, how is this knowledge built in a project?

2 - the educational vector: (educating)

The educational practice of project may be examined from the point of view of learning (or self-learning) and, in particular, as a process of assimilation of necessary skills for a collective participation to a project. In what way is a project a reversible space for a sharing of these skills: what do we teach and learn in a situation of project design?

3 - the trans-disciplinary vector: (translating)

Finally, it seems necessary to confront these two dimensions and the figure of architectural project as a paradigmatic form of *action / cognition* in contemporary edification. In which conditions does a project reveals itself as a decisive phenomenon in the transfer of knowledge: what do we translate in a project?

Yet, the verbal overbid around the notion of project – particularly in French and Italian contexts - sometimes masks a real absence of project, including in architecture. Some projects are very little constructive and some other are even less instructive. On the other hand, there are educational projects, or projects of engineering, in which these two dimensions are not underlined enough, whereas numerous educational projects appear most of the time obviously too "edifying". It is certainly not within the limits of this paper, that we can report what about twenty European and North American speakers handled in this symposium. We shall only hint at what Canadian architects Claude Provencher and Éric Gauthier discussed in particular with professors Bernard Rey and Jacques Tardif, and we shall end mentioning some element of a synthesis given by professor Philippe Meirieu, main adviser of former French Minister of Education, Claude Allègre.

Among the most revealing moments of this symposium, there was an argument between practicing architects and scholars in education sciences over edification as building and edification as educating. During a presentation on the new wave of " fast track " in architectural project, Montreal architect Claude Provencher questioned some of the most immediate consequences of the management trend on the fundamental nature of architectural project. For Claude Provencher, temporal and economical constraints created accelerated methods for the production of architectural project which have a direct impact on the methods of design and building, and consequently, on the result itself. Recognizing that projects conceived and executed according to these organizational criteria actually compress time schedules, he also admits that this procedure raises a great wave of controversies on behalf of professionals and even on behalf of judicial authorities. This tendency for fast track, demands in return new educational efforts and researches to assist future architects in their attempts to counterbalance its prejudices on architectural quality. According to Claude Provencher, f*ast-track* calls for new competences. [see Provencher in CIT 2001].

It is precisely on the issue of competences associated to project design and management, that professor Bernard Rey, Head of the Faculty of Education Sciences at "Université Libre de Bruxelles", insisted on the fact that a competence can not be reduced to the use or the invention of procedures. For professor Rey, "To enumerate competences to be acquired is a reminder that to enter the universe of knowledge means adopting a posture for intellectual activity: it is to put on this knowledge, to re-make choices and inferences which were of use for its construction, it is to practice procedures, it is also to raise problems and try to solve them thanks to the procedures that we know or to those that we invent… To be competent, thus means to build a situation, that is to say to cut a segment of the spatio temporal continuum and to track down to it various characters. Now, what competence requires, in the deep sense of the term, it is a *project*, understood as an act of freedom by which we decide on what deserves to be taken into account and by which the world takes meaning and qualities. And even if making it, the person gives to this reality a meaning that others already gave prior to him or her, it is for him or her every time an act of novelty. " [see Rey in CIT 2001, see also Rey, 1998].

Project edification thus appears to be the place for a particularly complex interbreeding of knowledge, innovation and learning. There are not only various transfers of knowledge, but also various transfers of ways of learning, as explained by professor Jacques Tardif from the “Faculté de l’Éducation” at Sherbrooke University. However, according to Jacques Tardif, the degree of transferability of learning is very different whether these are realized in a formal or less formal educational environment. In fact transfers of ways of learning appear easier to seize through a study of causes explaining a difficulty, if not an impossibility, to transfer what has been learnt in school, than through still badly defined theoretical models. Considering that learners’ dispositions to transfer (as well as their relationship to knowledge) seem more determining than any educational strategies, professor Jacques Tardif therefore suggests privileging the axis of competences rather than that of knowledge, whether it is in training programs or in educational program. [Tardif in CIT, 2001, see also Tardif, 1999].

In most North American contexts of architectural education, this problem of a balance between competence and knowledge is a well known issue. It requires a delicate equilibrium, the measure of which determines the “penalty” given to schools of architecture by accreditation boards. Now, among the amount of competences indispensable to become an architect, there is one which transverses all others and which is not on the accreditation list. This complex competence, which crosses throughout project design and generally speaking design thinking, we shall refer to as a competence to “translate”. Éric Gauthier, another Montreal architect invited to reflect on project edification, gave a perfect illustration to this very question of translation, taking the case of the reorganization of Buckminster Fuller’s masterpiece into the “Biosphere project”. In fall 1991, the City of Montreal and the Canadian Ministry of the Environment launched a competition of architecture about the transformation of the United States Pavilion built for the 1967 World Fair. The new program was to fit out a center of interpretation dedicated to “water” and more particularly to the Saint Laurent river. The following extract summarizes some elements of Eric Gauthier’s argument given at the colloquium in Lyon.

"The competition, said architect Éric Gauthier, presented three different and relatively new stakes which occupy an important place in the reflection that accompanies the production of contemporary architecture. First of all, it is necessary to approach the problem of what we qualify as modern patrimony today. The geodesic dome conceived by Buckminster Fuller belongs to the category of twentieth century icons…Then, it is necessary to evoke the issue of multi-disciplinarity. Here the statement of needs consisted of a brief text describing the mission of the institution in very general terms and competitors were required to constitute interdisciplinary teams of museologists, councilors scientists, architects and engineers to formulate satisfying propositions. Finally, the project also had to be exemplary on environmental issues and it had to implements means and techniques properly suited to produce what we qualify as “green architecture” today. The architectural process underlines a tension which can be generated by the desire to follow a rigorous method inspired by applied research in project design, while architectural gesture depends rather on poetic shortcut and on a rhetoric of seduction. Fuller’s dome illustrates in a tragicomic way this tension between his expressed will to contribute to the survival of a world threatened by the depletion of natural resources, and his desire to create a strong and singular work inscribed in a utopian scheme carrying to its paroxysm the simplifying mechanics of the architectural concept. " [see Gauthier in CIT 2001].

“Inhabiting and growing”

Finally, as French professor Philippe Meirieu magnificently laid out in a synthesis conference given at the end of the colloquium, " we cannot rid ourselves of invention because, as for most human projects, architecture is never once and for all a grounded discipline. There is a gap between what is of the order of analysis and what is of the order of individual or collective inventiveness". For Philippe Meirieu, we cannot work on a theory of project without assuming at first the contradictory character of human activity. Resuming those three transdisciplinary axes of the Lyon colloquium (building, educating and translating), he proposed an understanding of project edification aiming, on one hand, at building acceptable human actions, potential roads; and, on the other hand, at educating while sharing founding contradictions; and, finally (referring to Michel Foucault's famous work, Surveiller et punir), projects aiming at translating for better ways of "inhabiting and growing". [see Meirieu in CIT 2001, see also Meirieu,1995].

Since 1998, this on going research has already been a unique opportunity to exchange experiences on various technical, pedagogical or organizational projects. The relevance of such an epistemological forum increases proportionally to the development of new technologies and particularly within the implementation of " virtual universities ", "Virtual Design Studios" and in a general way in the context of new forms of collaborative practices. This originally franco-canadian research is now initiating the setting of an international, pluridisciplinary and pluriprofessionnal network devoted to the epistemological complexity of architectural edification and to the study of *potential architecture*.

list of main quotations

- Adamczyk, Georges, 1994, « Le petit Vitruve infatiguable », Possibles, vol.18, n°1.
- Anderson, Stanford, « The Profession and Discipline of Architecture : Practice and Education », in Piotrowsky, Andrei and Robinson, Julia, Editors, 2001, The Discipline of Architecture, Minneapolis : University of Minnesota Press. Pp 292 - 305
- Boutinet, Jean-Pierre, 1990, Anthropologie du projet. Paris ; Presses Universitaires de France.
- Bilodeau, Denis, 1997, Precedents and Design Thinking in an Age of Relativization. Delft : Delft Bouwkunde Press.
- Chupin, Jean-Pierre, 2001-a, « L’architecture comme discipline de la réciprocité analogique », Discipline et visée disciplinaire, (Philippe Louguet et Frank Vermandel éditeurs), Lille; Éditions de l’École d’architecture de Lille. pp. 26-42.
- Chupin, Jean-Pierre, 2001- b, « Pour une analogique du projet en situation pédagogique », Trames, Montréal, août. pp. 91 - 110
- Chupin, Jean-Pierre, 2000, « L’analogie ou les écarts de genèse du projet d’architecture », Genesis, n° 14, numéro spécial (Édité par Pierre-Marc de Biasi et Réjean Legault). Paris, septembre. pp 67-91
- CIT 2001, « Construire, instruire, traduire : médiations, transferts et connaissances à propos du projet d’édification » (14e Entretiens du Centre Jacques Cartier, Lyon 2001. http://www.lyon.archi.fr/CIT2001)
- Hersey, Georges, 1999, The Monumental Impulse (Architecture’s biological roots), Cambridge : The MIT Press.

- Jong, Cees de et Erik Mattie. 1994, Architectural competitions = Architektur Wettbewerbe = Concours d'architecture. Köln: Benedikt Taschen..
- Lipstadt, Hélène, et al., 1989, The Experimental Tradition (Essays on Architectural Competitions), Princeton : Princeton Architectural Press.
- Meirieu, Philippe, 1995, La pédagogie entre le dire et le faire, Lyon : ESF éditeur.
- Piotrowsky, Andrei and Robinson, Julia, Editors, 2001, The Discipline of Architecture, Minneapolis : University of Minnesota Press.
- Rey, Bernard, (1998), "Compétences et connaissances", in Deux points, ouvrez les guillemets, Lausanne, n°4, oct. 98, pp. 2-5.
- Rowe, Peter G., 1982, «A priori knowledge and heuristic reasoning in architectural design.» The Journal of Architectural Education 36 (1 - Fall 1982): 18 - 23.
- Rowe, Peter G., 1987, Design Thinking, Cambridge : MIT press.
- Schön, Donald, 1983, The Reflective Practitioner: how professionals think in action. New York: Basic Books.
- Schön, Donald, 1984, « The Architectural Studio as an Examplar for Reflection-in-Action. » Journal of Architectural Education, 38 [1 1984]: 2-9.
- Schön, Donald, 1987, Educating the reflective practitioner: toward a new design for teaching and learning in the professions, San Francisco.
- Schön, Donald, 1991, The Reflective Turn (Case Studies In and On Educational Practice), New York : Teachers College Press.
- Tardif, Jacques, 1999, Le transfert des apprentissages, Montréal : Les Éditions Logiques.

Signs, Images and Life: Researching the Mimetical Mode of Architecture

Hilde HEYNEN
André LOECKX
Department of Architecture, Urban and Regional Planning (ASRO)
Katholieke Universiteit Leuven (K.U.Leuven)
Andre.Loeckx@asro.kuleuven.ac.be

Abstract
The paper gives a theoretical argument as to the specificity of architecture as a field that touches upon very different modes of signification or modalities of knowledge: scientific knowledge (signs), artistic inputs (images) and interactive processes (life). It will argue that these different aspects are inextricably entwined in any phenomenon of architecture that is studied in its full width and depth. Most research strategies in architecture legitimately focus on certain aspects – e.g. historical analysis, or technical investigations, or inquiries into design methodology. It is our intention, however, to reflect upon the possibility of an encompassing research strategy, which aims at coming to terms with the specificity of architecture. This means that we intend to develop a strategy which deals with architecture's different modalities of knowledge or modes of signification. Examples are given of themes and issues that have been studied following the proposed strategy.

1. Architecture as the object of investigation and reflection

Architecture - it has been known for quite some time - is neither a real science nor a real art. Architecture is not simply a theory but it is neither to be reduced to a purely practical knowledge about how to build buildings. There exists a very long tradition of reflexivity and critique in architecture. The history of architectural writing is - from Vitruvius to Tzonis one could say - full with claims of scientificity. Nevertheless this claim has never been granted completely. Architecture has proven to be too slippery a thing to fit without problems in the rigid systems of science. And even within the humanities it is not quite clear where the study of architecture belongs.

The reason for architecture's resistance to categorization might be that the object of architecture, its 'essence' so to say, is not easily identifiable. One can indeed discuss endlessly about the exact meaning of the word, whether, e.g., we understand architecture to refer to the whole of the built environment or just to a very specific part of it that is informed by some reflexive theory. And even if it would be possible to agree on this topic, then the fact remains that the study of architecture requires an initiation in so many different fields and disciplines that the exact focus on an autonomous reality called 'architecture' anyhow becomes blurred. Nevertheless there is much to say on behalf of the hypothesis that architecture constitutes a very rich semantic and scientific field, and that disciplinary thought and epistemological debate as well in science as in the humanities can gain enormously from an intensive confrontation with architecture, especially with the ways architecture manages to intertwine different modalities of knowledge or modes of signification.

As one argument in favour of this hypothesis, we want to refer to a book by Max Horkheimer and Theodor Adorno, on the *Dialectics of Enlightenment*. In a passage which is severely indebted to Walter Benjamin, Adorno and Horkheimer explain how during the course of history the character of language underwent radical change. Originally, they claim, sign and image formed a unity in language, as can be seen from Egyptian hieroglyphs in which signification is the result of the merging of abstract reference in a sign and imitation in an image. This original unity dissolved and both modes of signification/modalities of knowledge, sign and image, developed separately. The sign became decisive for the development of language as denotation - in science and scholarship that is - whereas the realm of the image has been reduced to that of art and literature:

> *"For science the word is a sign: as sound, image, and word proper it is distributed among the different arts, and is not permitted to reconstitute itself by their addition, by synesthesia, or in the composition of the Gesamtkunstwerk. As a system of signs, language is required to resign itself to calculation in order to know nature, and must discard the claim to be like her. As image, it is required to resign itself to mirror-imagery in order to be nature entire, and must discard the claim to know her."*[i]

Horkheimer and Adorno do see the divorce between sign and image as a disastrous development, because reason in the fullest meaning of the word cannot be reduced to pure calculation: in that case it degenerates into a purely instrumental rationality, with the irrational consequences that follow. The same goes for the image: when the image becomes pure depiction and is no longer governed by a rational impulse, it is also inadequate and cannot bring about any genuine knowledge of reality.

> *"The separation of sign and image is irremediable. Should unconscious self-satisfaction cause it once again to become hypostatized, then each of the two isolated principles tends toward the destruction of truth."*[ii]

Nevertheless, according to Horkheimer and Adorno, it is possible and necessary both in art and in philosophy to confront this fissure between sign and image, and to attempt to bridge the gap. Philosophy operates at a conceptual level, the level of the sign, whereas art works at the level of aesthetic appearances, that of the image. Inasmuch as art and philosophy both aspire to provide knowledge of truth however, they may not hypostatize their own form of knowledge as absolute: philosophy cannot only operate with concepts, while art is obliged to be something more than pure depiction, more than just a reproduction of what exists.

What Adorno and Horkheimer state here about the relationship between sign and image in philosophy and art, should be understood as instructive for the relationship between scientific thinking and architecture as well. Architecture is, more than any art, the place where an artistic input is controlled by all sorts of rationalities. At the same time it is a discipline where rationality alone can never completely explain the results of the design process, nor the way people actually use their buildings and relate to them, unless it denies the artistic and poetic dimensions involved. In fact, the process character of design and of the interaction between people and buildings create a relationship between sign and image in which another modality of knowledge or mode of signification is at stake – we can call this the modality of mimesis.

Mimesis is a term that is not yet active in *Dialectic of Enlightenment*, but that is given prominence in Adorno's later work, especially in his *Aesthetic Theory*. In this book he refers to 'mimesis' as a kind of affinity between things and persons, which is not based on rational knowledge and which exceeds the mere antithesis between subject and object. According to Adorno, art characteristically endeavours to create a dialectical relation between both moments of cognition (modalities of knowledge, modes of signification), 'mimesis' and 'ratio': a work of art comes into being not only on the basis of a mimetic impulse, but requires also a lot of rationality and thought on behalf of the artist. Ratio and mimesis however, are in an antithetical and paradoxical relation opposed to each other: the two moments of cognition cannot simply complementarily or easily be reconciled with each other.

What is important in this idea about mimesis can be resumed under two headings. First of all mimesis has to do with a process of translation, a process of mediation. Mimesis is what is responsible for the very possibility to recognize similarities and to transfer meanings from one language to another. Characteristic for this process of translation that we call mimesis is that it is never completely transparent. There is always something happening, a shift appears, there is some gain or loss of meaning, something that is being twisted. Secondly it might be stated that mimesis can fulfil a critical role. Adorno more specifically relates the critical character of art to its mimetical aspect. Adorno is convinced that works of art on the basis of a combination of ratio and mimesis yield a kind of knowledge of reality, and that this knowledge is critical by nature: art, by its mimetical relation to reality, highlights something about the real nature of that reality, thus criticizing it at the same time. For not the beautiful, the harmonious, the charming will lighten up, but on the contrary, art through mimesis will reveal what is repressed, what is dissonant, chaotic or inhuman. Art in this way visualizes the torn nature of our reality. In as much as the shifting that is the result of mimesis reveals something which hitherto had been repressed or concealed, it is a shifting that acts in a critical way towards the existing situation.

Returning to Horkheimer's and Adorno's diagnosis regarding sign and image in the *Dialectic of Enlightenment*, it is clear that they see both as reductions of the correlative capacities of rationality and mimesis: sign refers to an instrumental rationality that has lost its capacity of critique; image refers to an impoverished mode of mimesis, which is reduced to the most literal level of imitation. The concept of mimesis also includes a performative aspect: mimesis has to do with a process of translation, a transfer of meaning, in which something happens that is never completely transparent.

Three registers and three tracks

Reflecting upon this diagnosis of Horkheimer and Adorno, we developed a working hypothesis that generates a certain research strategy and that is at the same time tested by that strategy. The working hypothesis is that in order to understand architecture in its full width and depth, one doesn't need just two terms or registers, but rather three. The word register comprises here what earlier in the text has been called modalities of knowledge or modes of signification. If, in the terminology of Horkheimer and Adorno, **sign** stands for instrumental rationality, for systematic analysis, for calculation, for denotation and coding (to borrow terms from semiology); if **image** stands for pure depiction, for reproduction of what exists, for representation without presentation, for mirror imagery, both words imply a certain immobility, a frozen state, where concepts and meanings are fixed and do not change anymore. In order to grasp the possibility of change and transformation, one has to take into account a process term, referring to interactive practices that forge an ongoing process of signification that is mobile, shifting and generative. It is thanks to this third term that the other two can be brought in interaction with one another.

For lack of any better word, we provisionally use the word **life** as the third term or register: life refers here to vital forces which ensure that the bleak realities of sign and image are sometimes forced into a condition where they need to interact with one another, thus giving rise to new and critical meanings. If these forces are taken into account, the possibility emerges that, in the interplay of the three registers of sign, image and life, sign is no longer necessarily reduced to instrumental rationality, but lives up to its vocation of critical rationality, whereas image is no longer confined to the literal realm of mirror imagery, but becomes mimesis and can play out its critical intent too. The processes and practices we refer to have to do with the emergence of something new and unexpected, with formation, with performance (acting out), with coincidences, sometimes with a system of self-regulation. It seems to us that they are provoked by a condition of lack: if something is missing, if there is a semantic void, if there is a condition of displacement, if a strong desire wakes up, the forces of life begin to claim prominence because the normally prevailing modes of signification/modalities of knowledge – signs and images - fall short.[iii] In a nutshell its sounds like this: life, process, practice fuelled by conditions of semantic void, displacement, desire manages to bring sign and image into a dialectic tension whereby possibilities of critical ration and critical mimesis originate.

In order to address the complexities that follow from architecture's involvement with these different modes of signification/modalities of knowledge, we have identified three tracks along which research can be organized each corresponding to different media of architectural expression or experience. (Not every research project necessarily comprises investigations along these three tracks and into these three media. The theoretical model we formulate here can support different actualisations of the model which can have a fairly different outlook when put into practice.)

One can indeed not simply subdivide architectural phenomena into their constitutive aspects of signs, images and life. A more subtle approach is needed, one in which different research tracks concentrate on different media that each comprise a different embodiment of the three modes/modalities of sign, image and life. By differentiating between the media in which architectural knowledge plays out, one can work with the three tracks of 'built forms, texts and actions'. These three different media embody the register of signs, images and life in different doses, and can be studied according to different methodologies.

Built form refers to spatial constellations with a specific history and an underlying (morpho-typological) logic. This underlying logic tends to be more mimetical than rational: it is a logic that has to do with transformations, similarities and correspondences. It is based upon processes of analogy and metaphorical transposition. As such it relies more upon the register of images than upon those of signs or life. The preferred methods to study this medium are morpho-typological analysis, historical analysis, iconography, and the like. Of course built forms correspond also to different registers of sign and rationality. They comprise the facts and figures content of each building.

The second medium is that of **texts.** Built form usually does not emerge out of the blue, but is immersed in the architectural and urban discourses that were imminent at the time of its conception. Studying the **formal texts** (prevalent theories and ongoing discussions) that concern a specific building or an urban neighbourhood, is therefore part of the second track in the research strategy. Here the analysis is mainly focusing on rational elements as they are spelled out in theoretical texts or argumentative discourses. The register of signs is most prominently present in this medium, whereas image and life tend to take second and third place. Under the heading of texts we also study **informal speech**, as for instance when we interview inhabitants or users. In this informal speech life is very actively present, with all the inconsistencies it implies. Such a speech often has image-like qualities, whereas the purely rational level of signs takes on a less prominent role. Discourse analysis is the method that is mostly applied within this track.

The third track comprises the level of **actions**, which is the heading under which we assemble design and implementation processes but also different modes of social interaction with buildings and spaces. One can discern a formal level of action (as e.g. in case a building is designed, realized or used in complete accordance with its official programme and requirements). In such a case, action is mostly based upon the register of signs, whereas life and images take on secondary roles. Sometimes, however, one can perceive another, more dynamic kind of action, which consists of a sort of 'bricolage' (Lévi-Strauss) whereby new concepts and solutions originate out of an unexpected interplay of available concepts and solutions or whereby improvisation of use leads to a reinterpretation of what is usable. This applies e.g. in those cases where buildings and spaces provoke uses and interactions which are not consistent with their official functions or intentions (e.g. when spontaneous demonstrations take place on streets normally forbidden for pedestrians). In such cases the mimetical register of the image is often at play, life taking on a secondary role and signs being of minor importance. The analytical skills required to work on this track are not always obvious. Sometimes it requires the input of fieldwork skills that come more naturally to anthropologists or sociologists than to architects.

The idea that we want to put forward is that a research that is organized along these three tracks, can come up with an understanding of its object that grasps something of the specificity of its qualities as architecture – namely the interplay between different modes of signification/modalities of knowledge. This aim can be reached by confronting the results of different analytical methods – addressing different combinations of signs, images and life – with one another. If it works out well, one can develop out of such a confrontation an understanding which goes beyond the results obtained through the separate analytical methods. To show the potentials of such an approach, we will briefly discuss two cases that work according to these principles.

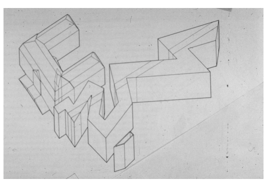
The first – an analysis of Daniel Libeskind's Jewish museum – investigates how signs and images fold into one another in a design process that is regulated by a condition of a semantic void (the absence of the Jewish culture). In this case, 'life' can be seen as the catalyst of the design process, provoked by this condition of void. 'Life' is also present in the case because the tactile experience of going through the building takes a prominent place in the analysis. The outcome of this interplay of signs, images and life (process, experience) is an architecture where an outspoken critical mimetical dimension is at stake.

The second case is part of an extensive study of three environments in Kabylia, Algeria – a traditional village, a colonial town and a new spatial constellation consisting of seven conglomerating villages along a road. Here signs and images of modernity and tradition, of the urban and the rural are being fold into one another by everyday practices. Something new – another village, another town – emerges because of a condition of displacement (returning migrant workers who no longer can live within the traditional village and who bring along the signs of Western consumption practices) that provokes a continuous 'bricolage' with an uncertain outcome in an environment that resists to all planning attempts.

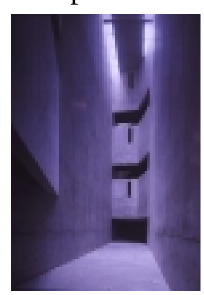
An example of mimesis as critique: Daniel Libeskind's Jewish Museum[iv]

This analysis is part of the line of argumentation developed in Hilde Heynen's book *Architecture and Modernity. A Critique*. The intention of this book is to come to terms with the question of architecture and modernity. Architectural historians and cultural philosophers have formulated many different positions with respect to the question what architecture is supposed to be and how it should relate to societal conditions brought about by modernity. The book aims to clarify the most important of these positions, by focusing on texts and arguments of authors such as Sigfried Giedion or Walter Benjamin. The book moreover develops a critical position of its own by confronting the theoretical arguments of these authors with architectural case studies that are analyzed according to a mimetical logic.

A project in which mimesis is clearly at work is Libeskind's design for the extension of the Berlin Museum with the Jewish Museum.[v] The aim of the design is to give form to the broken relation between German and Jewish culture. This relation is anything but unambiguous and it is therefore not simple to represent it in a building. Libeskind's project succeeds in expressing the different aspects of this relation: the mutual ties that persist and proliferate underground, the ineluctable catastrophe of the Holocaust, the cautious hope that a new openness can develop. It is the result of a mimetic process that uses various themes as raw material in order to bring about a work in which the tension between the different parts is increased to the point of climax.



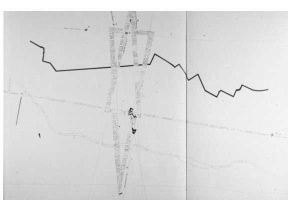
The architect calls this project 'Between the lines'. He is referring to two structural lines that are also two lines of thinking: one is a straight line but broken into many fragments, the other is tortuous but continues indefinitely. Both lines engage in a dialogue with each other only to separate again. Their mutual relationship delineates the basic structure of the building. This consists of a zigzag volume transected by a number of voids. These voids are five stories high and they form an interrupted straight line. As he follows the zigzag pattern through the museum as dictated by the layout of the building, the visitor is repeatedly confronted by these voids, that are nowhere accessible and which seem to be senseless. The flowing movement of the routing breaks down as a result. The character of the space changes at the places where the voids are spanned: the high spacious galleries turn here into narrow low-ceilinged bridges from which one can glimpse the cold gloomy depths of the voids.



The zigzag-shaped building has no entrance on the outside. It has the appearance of an enigmatic and impenetrable volume. Visitors to the building have to enter it through the old entrance in the main building, which provides a link to the new complex through the basements. To this end an incision has been cut in the main building that is a mirror image of one of the voids in the new complex. This mirror relationship, while it cannot be seen by the unsuspecting visitor, nevertheless forms an active presence, evoking the fatal mutual involvement of German and Jewish culture.

The underground level of the new building contains the areas reserved for the museum's own Jewish collection. The whole is organized on three axes. One axis forms the link with the main stair that leads to the exhibition rooms on the upper stories. A second axis is oriented on a free-standing tower-shaped object that, like the incision in the main building, is a `voided void' - echoes as it were of the voids that form the straight line that intersects the zigzag-shaped building. While the first void refers to the absence of Jews in Berlin, an absence that is decisive for the identity of the city, this voided void that is white and open to the sky, refers to the streams of energy and creative potential that was nipped in the bud with the annihilation of so many people. Finally there is a third axis in the basement that leads to the `garden of E.T.A. Hoffmann'. This consists of a wood of concrete columns at right angles to the sloping ground. A ramp that winds round this square-shaped garden gives access to street level.

Despite the fact that its lay-out is far from self-evident, the new museum is a very effective response to the existing urban situation. The slightly protruding facade on the Lindenstrasse accentuates the curve in the street at this point. The front facade of the new extension is extremely narrow here, but it is still clearly present. This suggests that the building is subordinate to the old Berlin Museum, a suggestion that is straightway contradicted once one gets the chance to size up the full scope of the new extension. Between the old building and the zigzag shape of the new one a narrow alley leading to a courtyard, the Paul Celan Hof, is created that fits in with the Berlin tradition of *Gassen* and *Hinterhöfer*. More towards the rear of the building the high broad volumes forming the last sections of the zigzag are arranged as spatially defining elements for the public gardens situated on both sides of the entire complex. The volumes have an effect that fits in excellently with the rich contrast of architectures in the neighborhood.[vi]



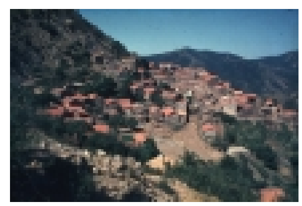
The David's star that Libeskind states as his starting point for the design is a revealing drawing. It is not only of the addresses of the people named in it that give the matrix its form, but also the contours of the *Landwehrkanal* and the trajectory of the Wall. The latter figures comprise as it were the horizontal supports of the drawing, while the outline of the star is formed by a section cut out of the map of Berlin. By combining this selection of graphic elements a pattern is created that makes the lay-out of the new building if not totally clear at least plausible. One recognizes that important components of the history of Berlin are crystallized in the zigzag form of the new extension: the classical pattern of the Friedrichstadt with its rectangular pattern of streets and geometrical squares, the flowing lines of the canal, the broken and shameless line of the Wall, all this is echoed in compressed fashion in the discontinuous shape of the new museum. Unlike a classical site layout plan, what is involved here is not any rational explanation based on the morpho-typological qualities of the new building. Instead the aim is rather to show how different aspects of Berlin as it exists today - both visible and invisible - mimetically converge in a new cutting that is grafted onto this organism. This drawing expresses the inner relationship - the *Wahlverwandtschaft* or elective affinity, if you like - between a constellation of existing structural elements and the additional urban figure.

In his text ‘Between the lines’ Libeskind suggests that the Moses and Aaron theme has to do with the intertwining of the two lines that gives the building its shape. Schönberg's opera is incomplete: the second act ends with Moses alone on the stage, expressing his dismay at the breakdown of his relationship with Aaron and consequently with the people of Israel as a whole. Aaron wants to communicate with the people and to lead them to the promised land, whereas Moses is unable to convey what God revealed to him with an image through which he could reach the people. "Oh word, thou word, that I lack!" - these are the final words of the opera. Moses knows the truth, God has revealed it to him but he is unable to convey the contents of this revelation. His truth does exist, it is unequivocal and consistent, but it cannot be translated, it is incommunicable. The only way he can deal with this truth is through silence, an absence of words, through the void. By contrast his brother Aaron is associated with the tortuous line of history. Aaron cuts a path for himself around the truth, seeing himself confronted repeatedly with an abyss that he does not dare to enter. The musical content of this unfinished opera has thus to do with the eternal and insoluble conflict between words and music, law (in this case the unspeakable sign) and image, revelation and communication. This content is translated mimetically in the architectural form of the building through the interplay of the lines, a translation that acquires shape and content in the design process itself. The mimetical dimension opened by the process and the architectural result is a critical one in the sense that it enacts an unspeakable and often repressed truth.

Another theme refers to a list of names, names in which history is petrified. They are no abstract numbers but signs of individuals who can be traced through their names and their place and date of birth. The paradoxical presence of those who are absent that underlies the Gedenkbuch is taken up in the complex interplay of voids and galleries in the building. Here too what is involved is to make visible what is invisible, to make one feel that which has been repressed. The Holocaust is a black hole in history, a hole that swallows up all rhetoric of progress, but which is invisible to the naked eye. This invisibility is transformed here into an experience that is incomprehensible and yet ineluctable. The visitor will be subjected physically to the confrontation through a series of spatial experiences that can leave few people unmoved: the entrance via the old building and the underground passages; the sloping basement with its complex axes; the endless stair to the upper floors; the sense of disorientation induced by the zigzag shape; the repeated crossing of the voids. These insistent experiences are reminiscent of the unthinkable events that are interwoven into the identity of our present culture.

This is how Libeskind's design for the extension of the Berlin Museum can be understood. There is a quality of endless resonance inherent to the mimetic operations on which both the design process and the experience of the building are based. Mimesis raises the question of repressed aspects - those aspects that cannot be contained either in a clear-cut logic or in an all encompassing image and which do not lend themselves to a definite meaning. The mimetical operations of design and experience create transgressions between different registers of knowledge and signification: speakable signs (the rational organisation of an urban plot, the museum programme, the collection …) and unspeakable ones (the register of names, the historical facts, the real object of display …) interact with suggestive images and more distant imaginative analogies (the Berlin addresses, the David’s star, the Wall, built voids and mirroring voids, the straight and zigzag lines, Mozes and Aaron …). The transitions and interactions are rarely unambiguous. To the degree that mimesis 'works', a signifying process is generated that has no end. According to Adorno the mimetic impulse is rooted in a gesture of negativity that does not have any positive ultimate goal: a final salvation, a full recover, in the case of Libeskind's museum an harmonious "Wiedergutmachung". It is this negativity, this ever vacant semantic void, that is responsible for the never-ending of the chain of signifying. Mimesis does not render any positive image of reality, let alone a positive image of what a utopian, ideal reality might be. The broken lines of the design testify to a broken reality. They do not succeed in achieving a synthesis, because reality does not lend itself to be conceived as healed and complete. Mimesis rather produces negative images and art is then par excellence the appropriate means to mimetically expose the negative qualities of reality. The term quality however distinguishes negativity from a complete absence of meaning, a profound nihilism, total despair. No direct image of utopia is offered us here, but the idea of utopia is preserved because we see clearly how great a distance separates our present reality from a utopian condition of reconciliation. The awareness of this distance outlines a never fulfilled desire that fuels the creative process of design and experience.

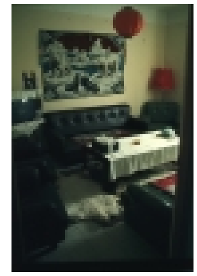
Every day environments and the mimetical enactment of another modernity[vii]



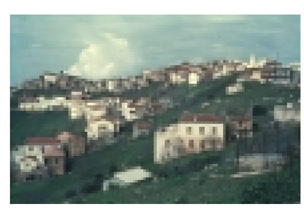
This case summarizes the main findings of an extended research programme carried out by the Post Graduate Centre Human Settlements of our Department in cooperation with the Algerian "Centre National d'Etudes et de Recherches Intégrées du Bâtiment". The aim of the research was to elaborate an insight in the often disruptive processes that are mutilating many urban and rural environments in North Algeria. Three kinds of environments have been studied: traditional villages affected by the exodus of their inhabitants, modern urban housing estates resulting from massive planning and housing programmes by the Algerian government and finally growing and conglomerating villages reconstructed in an haphazard way by the returning migrants. The ethnographical work by Pierre Bourdieu offered a conceptual frame to start with. In each case the research studied forms, texts and actions using different methods such as interviews, participatory observation, morpho-typological analysis and design simulation.

Life in the traditional Kabylian villages is not anymore what it used to be. The present appearance of many traditional houses in Kabylian villages testifies to the ongoing exodus. The image is still there, with all its appeal described by Bourdieu and others. It is an image formed by the "demon of analogy", full of semantic coherence and correspondence: between the human biography and the life cycle of nature, between the social and the built environment, between sexuality and inhabitation. One semantic field offers images to signify another one. The inhabited environment acts as a structure of reversal mediating between the outside, urban, masculine world ruled by signs and the inside, rural, feminine world dominated by images and analogies.

Migrants' departures and their annual comeback for holidays, however, disrupt the traditional coherence. The imprint of this disruption is legible in the built fabric. A stable transforms into a kitchen, cupboards and suitcases replace earthenware jars, a weaving loom becomes just a decorative object, new rooms are built in modern materials, furnished and locked, waiting for a visitor. In certain Kabylian villages the never ending process of modernizing the house apparently announces the return of migrants which in fact turns out to become at best a holiday stay. Confusing traces allow us to decipher an ambivalent desire for urban *and* village life, that leaves no other solution than a final exodus softened by rituals of yearly return and rebuilding. The lost traces of modernization and the migrant's leave are both signs of a displacement that, instead of acting as a catalyst of a regenerative process, further disrupts the coherence of images and analogies.

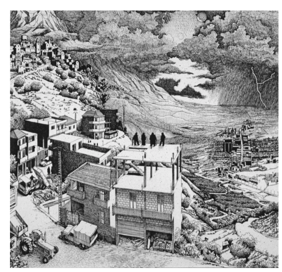


The introduction in the seventies and early eighties of modern town planning and modern architectural forms, as implemented in the regional capital city of Tizi Ouzou, often can be understood as the vehicle used by the socialist government for a far-reaching pursuit of modernization and emancipation. The massive building of modern apartment blocks at the outskirts of formerly colonial towns came forth from the young and independent Algeria's quest for a way out of the encumbrances of old traditions and backwards habits. By offering people leaving the villages ruined by the war of independence new dwellings with high standards of modern comfort, it was thought that they would, along with the adoption of new ways of living encoded in the built forms, also embrace new, modern values and attitudes. This, however, was not what happened in reality. Instead of wholeheartedly accepting this "political economy of signs" (Baudrillard), the programmatic modernism with its new way of life and its promises of emancipation, people went along only halfway. They came to stay in the city, in order to be near opportunities of work, education and modern amenities, but they did not really 'dwell' there. Their point of reference remained the traditional village, the realm of image and analogy, to which they returned for all matters of importance such as social interaction, annual festivities or funerals. The modern town, functioning according to the mode of 'signs', thus accommodated only part of their lives. The never ending displacement between town and village takes the form of a split in people's daily life. It seems to limit at the same time the full inhabitation process of the urban environment and the necessary modernization of the villages.



In studying the building practices of returning Berber migrants in the Beni Yenni in Kabylia, one notices that they introduce certain urban activities and building types from their migration career in Paris - shops, garages, apartment buildings. These new types are grafted in a haphazard way onto the asphalt road that links different neighbouring villages of the clan territory. This gradual process results in the development of a spine connecting seven old villages into a kind of new urban agglomeration. However, since the villages are situated on ridges and hilltops and the spine road runs slightly below each village, the compact village form keeps its identifiable shape. By introducing these alien elements through countless building and dwelling practices that are often contradictory to each other and to the village context proper, returning migrants construct in a rural environment something that performs like a modern town without actually being one. Out of a contradictory condition of displacement emerges an ambivalent environment that seems to correspond to an equally ambivalent desire for a modern urban life, full of performative signs of modernization, that does not oblige them to lose the cherished village tradition and its collective memory of images and analysis. It is as if the transferred signs of modernity loose their pure instrumental logic and acquire imaginative power in their new context. At the same time images and analogies of a worn out tradition acquire new imported signifiers to reconstruct an enlarged coherence.

The transformation of the road connecting seven clan villages into a proto-urban spine that acts as the main generator of spatial and cultural changes, is not due to the implementation of a coherent planning purpose. It can be seen as a collective staging of individual actions and trials, allowed by the topographical situation of the seven villages and initiated by occasional initiatives of modernization undertaken by the government (monument of war, post office, school, bus stop). A multitude of ad hoc 'bricolages' by the villagers add up with the remarkable interventions by returning migrants, who introduce along the road building types and functions displaced from their migration journey. Although the resulting conglomerate is most of all confusing, the road and the buildings, the physical space, the economies and the uses it conveys, seem to converge in one way or another, as if an implicit staging turns ad hocism into coherence. The play generated by the staging achieves much more than the countless individual actions that compose it. The emergence of the spine is profoundly urban and theatrical and so are the uses it induces: the seemingly pragmatic reconnoitering of (male) public space by the women, the show-off walks by young males, the demonstration march for the recognition of Berber cultural identity (an early sign of the forthcoming national crisis).



The formal and functional capacity of the road – referent of a clan territory, landscape feature, morphological backbone, functional support, scene of urban behavior - plays a prime role in a process of mimetic identity formation that seems to succeed in transforming contradiction into ambivalence. The resulting mimesis is a critical one since it aims at correcting both an alien mode of modernization and a tradition that lost its development potential. Concluding their journeys of migration and removal, the Beni Yenni villages outlined the possibility of another urbanity and rurality, an 'otherness' that would enable them to realize their ambivalent desire for both tradition and modernity. Such ambivalence and otherness are however far from stable conditions. They constitute a kind of provisional synthesis or suspended dialectics that does not outline another utopia but offers a cue for a critical rationality of development.

[i]. *Dialectic of Enlightenment*, p. 17-18; German version: "Als Zeichen kommt das Wort an die Wissenschaft; als Ton, als Bild, als eigentliches Wort wird es unter die verschiedenen Künste aufgeteilt, ohne dass es sich durch deren Addition, durch Synästhesie oder Gesamtkunst je wiederherstellen liesse. Als Zeichen soll Sprache zur Kalkulation resignieren, um Natur zu erkennen, den Anspruch ablegen, ihr ähnlich zu sein. Als Bild soll sie zum Abbild resignieren, um ganz Natur zu sein, den Anspruch ablegen, sie zu erkennen.", *Dialektik der Aufklärung*, p. 40.

[ii]. *Dialectic of Enlightenment*, p. 18; German version: "Die Trennung von Zeichen und Bild ist unabwendbar. Wird sie jedoch ahnungslos selbstzufrieden nochmals hypostasiert, so treibt jedes der beiden isolierten Prinzipien zur Zerstörung der Wahrheit hin.", *Dialektik der Aufklärung*, p. 40.

[iii] Hilde Heynen, André Loeckx, "Scenes of Ambivalence. Concluding Remarks on Architectural Patterns of Displacement", in *Journal of Architectural Education,* 52-2, Nov. 1998, pp. 100-108.

[iv] This analysis is published in Hilde Heynen, *Architecture and Modernity. A Critique*, MIT Press, Cambridge (Mass.), 1999, pp. 200-208.

[v]. Kristin Feireiss (ed.). Daniel Libeskind. *Erweiterung des Berlin Museums met Abteilung Jüdisches Museum / Extension to the Berlin Museum with Jewish Museum Department*, Ernst & Sohn, Berlin, 1992.

[vi]. Bernhard Schneider, `Daniel Libeskinds Architektur im Stadtraum', in Alois Martin Müller (Hrsg), *Daniel Libeskind. Radix - Matrix*, Prestel, Munich, 1994, pp. 128-135.

[vii] A more complete version of this case study is published in André Loeckx, "Kabylia, the House and the Road: Games of Reversal and Displacement", in *Journal of Architectural Education*, 52-2, Nov. 1998, pp. 87-99.

Nurture and nature of research in architecture
The research foundation of architecture as a discipline

Herman NEUCKERMANS
Katholieke Universiteit Leuven, Belgium
Herman.Neuckermans@asro.kuleuven.ac.be

Abstract:
Architecture is lacking theoretical foundation, because its mechanisms to create and accumulate knowledge and experience are non existent or not well developed. Research and especially Ph.D. can contribute to overcome this weakness.
This paper focuses on 2 topics: the need for research and the nature of research in architecture. It deliberately articulates some polemic positions in order to stimulate discussion.

THE NEED FOR RESEARCH
If engineers behaved like architects, they would still be reinventing Thomas Edison's light bulb. However through years of cumulative research and invention we are now in the era of electronics and IT.
If we look at architecture we see architects ignoring or undoing what other architects have done, we see more and more specialists eating parts of the architect's cake (programmers, quantity surveyors, consultants, engineers…).
Of course nobody dies from architecture and therefore architects are less vital to society than their intellectual brothers from medicine. However more and more architects risk to die from architecture because of un- or underemployment. How does it come that after 5 years of study architects do not earn more than an unskilled labourer?

Why all these - deliberately exaggerated - statements? Why all this pessimism? Don't we still see impressive numbers of students choosing for architecture? Of course we do: they like architecture, they feel architecture is fantastic and fascinating. And indeed it is, as recognised by other disciplines, especially when they 'borrow' from architecture: systems architecture, information architecture and even systems 'architecting'[1]
There is a manifest dichotomy in the perception of architecture within and outside the discipline. And education plays only part of the game, but within its part, education has to consolidate architecture as a discipline. Architecture as a discipline needs more foundation, needs a stronger basis.
Therefore education in architecture needs to emphasise more on theory, needs to stress more on cumulative knowledge[2], on competences that have been lost or neglected in the last decades. Education in Architecture also needs a rigorous transfer of knowledge in a domain that is wide enough to employ the vast numbers of students in architecture. That means that education in architecture has to broaden and to deepen its scope towards other fields of the spatial system than the sole profession of the architect-designer. Architecture needs to think inclusively, because partly by being exclusive in the competences we are training for, we are loosing parts of our jobs

---

[1] confer Zwegers,A., 1998, On systems architecting, Ph.D. thesis, T.U.Eindhoven, 1998
Rechtin, E., 1991, Systems architecting: creating and building complex systems , Prentice-Hall, Englewoods Cliffs (NJ)
[2] Architecture has to extract and accumulate the 'reflective knowledge'(Schon, Chupin) embedded in experienced architects, in built architecture, in competitions through case studies.

but more important, we are missing opportunities where architects can make a meaningful contribution. How did we lose the skill of construction, of correct detailing, of pricing our designs accurately...?
But primarily we need a healthier basis, more strength and evidence in our argumentation towards society and towards the client, we need more ‘serieux’: not by producing post-modern architecture or by building jokes. Whereas the production of post-modern dance or post-modern art is original and refreshing, the same cannot be said of the meaningless reuse of empty shapes from the past in post-modern architecture. It is a matter of intellectual level and competence, which is symptomatic for the loose way in which theoretical concepts are borrowed from other disciplines and handled in architecture. Take as an example architectural theory. A lot of people do not even know what it means. Some say this lack of definition characterises precisely the richness of architecture, there is nothing to worry about: it is a typical characteristic of a discipline in transition, or better of a discipline that escapes rules. This may be true, but we have been hearing this credo for 30 years and we still see the situation of architects becoming more and more precarious. Architecture is simply lagging behind. Every engineer knows what are the major ingredients in a course on physics - just buy the book by Ohanian [1989] or Serway [2000]- no architect knows the content of architectural theory, the foundation course of the discipline. Neither do we know what, in general, is the compulsory literature for students in architecture. Frame 1 shows a (possible) definition of architectural theory [Bekaert, 1996].
Recently several readers in architecture and urban design have been published. These can be considered significant contributions to the constitution of the body of knowledge of architecture, provided they appear in the education of architecture. [LeGates, 2000], [Hays,2000], [Leach,1997], [Heynen, 2001]

Architectural Theory

Definition: study of the role and meaning of architecture for man and society, including the (study of) the processes of change induced by architecture

We distinguish 3 levels of generality / scope in this discourse:

1. cultural-philosophical level: is architecture an art? How does it relate to science? to economy? to philosophy? etcetera…
2. the level of the relationship between theory and practice: how does architecture come about? What is an architect? How does (s)he (have to) function in society?
3. the level of relationship between insight and action: given an assignment, a site and a programme, what to do? This level accommodates for what traditionally is called ‘Architectural composition’.

Frame 1.

We deliberately stress the weakness of architectural theory. But even towards theory in the well-established disciplines like structural mechanics and building physics or building technology or computation in general, interest is modest, not to say nonexistent. Many architects consider urban design as the making of architecture on the larger scale and they forget about traffic, because that needs computation. The major commercial developments of software for

architecture are made by non-architects. Others eat our cake, because we resign. If we want to aim at a broader profile, we definitely need more theoretical background.
Emphasis on theory, on refreshing and renewing theory, and progress in theory goes hand in hand with research. We simply need research to underpin our theoretical courses.
We ultimately need research to survive.

Structurally theory and research go hand in hand within universities or within pedagogical structures that have the size for and the diversity of many disciplines resourcing itself permanently through research. The isolated school is not capable of nurturing the discipline as a discipline. Historically, the university is the centre of production of knowledge. The university has the research tradition. Architecture on the other hand has the design tradition as its stronghold. Architectural education fully emphasises design; design teachers are the best of practitioners; they come and bring into the school what they experienced live in practice. Nothing less, nothing more. Structurally there is in this habit no built in mechanism that guarantees cumulative knowledge. After years this becomes visible and that is where architecture as a discipline is today.
At the same time architecture deserves a place at the university, more than ever before, because of its societal relevance.
The Cartesian thinking university, however, is not really tailored to the needs of architecture, neither in the appointment regulations and criteria (Frame 2), nor in the publication culture with citation indices and impact factors (Frame 3)[3].

Appointment / promotion criteria

Age
Teaching
Ph.D. promotership
Publications
Projects
Pedagogical evaluation
Scientific consultancy
Seniority in previous rank

Frame 2

Publications (last 5 years)

In international and refereed magazines
In other scientific magazines
Papers presented in international conferences and symposia
- published in proceedings
- only available as an abstract or not published

Presentations at national conferences, symposia, workshops…
- published in proceedings
- only available as an abstract or not published

Internal reports
Theses
Books
- author of the entire book
- contributor
- editor

Frame 3

[3] These criteria are used within the University of Leuven.

European universities have difficulties in coping with a discipline that is partly artistic. It is still difficult to obtain academic credits for publications by others concerning your buildings. These should be considered as a kind of citation.
Each school doing research has its own tradition determined by the actual staff. Within the academic freedom staff members choose their research projects tailored to their capabilities and interest, the opportunities for granting, which normally accounts for its societal relevance.
Being embedded within the university is a double-edged sword: it gives freedom but at the same time imposes restrictions. If indeed the university is not the paradise for architecture, it is nevertheless still the place to be. Subsequently, architecture has to take actions from within the university, in order to transform and to enrich the ruling system with the best of architecture.
Although science cannot grasp architecture as a whole, major parts of it can be caught in a scientific debate. There is a lack of cumulative and incremental scientific writing in architecture and Ph.D. theses are a means to contribute in filling that gap. The Ph.D. is by definition a proof of scientific writing pushing forward the edge of knowledge. Nothing, however, limits the incorporation of seminal project work into scientific writing.

THE NATURE OF RESEARCH

Research and design are fundamentally different.
The *research* activity has a well-defined methodology. Research is based upon hypothesis formulation, model-making and empirical or logical proofing. It appeals to analytic and rational thinkers with a critical mind. In general, research is teamwork today.
In architecture we can identify two major research methodologies: historical investigation and the structural(istic) approach. The first one is traditionally diachronic and sequential, for example a monograph on “Le Corbusier” [Von Moos,1980] , the latter is synchronic and layered, for example the semantic reading of “the Kabylian house” [Bourdieu, 1980].
The output of research is insight, knowledge, discovery… Research is communicated through publications, among which doctorates deserve a special place, as has been explored at the EAAE meeting in Delft 1996.
Scientific writing has to comply with several criteria:

- being testable by verification, confirmation or falsification;
- relying on empirical or experimental evidence;
- being logically consistent;
- being economic in its formulation. [De Groot, 1994]

Citation follows strict rules.

Looking at these characteristics, it becomes clear that architecture cannot be caught in this straitjacket. This explains partly the difficulty in establishing the scientific foundation of architecture. However, it is not because the phenomenon as a whole cannot be grasped in a scientific discourse, that major parts of that discipline do not need scientific foundation. Even if the result of such an investigation primarily proves the limitations of that investigation.

Design is completely different, it is creative, wide, speculative, oriented towards synthesis. According to N. Cross [1982] , there is a ‘designerly way of thinking’: working and reasoning with and within images. Designers have a broad interest, they show lateral, simultaneous, wandering, jumping thinking, they are proficient in mixing things that apparently have nothing to do with each other, in metaphorical thinking, i.e. in seeing something as something else. Citations are most of the time tacit or implicit.

In the early hours of apprenticeship, architects, or better students in architecture, design through trial and error; the more they get experienced the more they use heuristics.
Originality in the solution prevails. Maybe due to this 'innate' passion towards originality, meticulous, incremental and cumulative knowledge has not been fully developed within the discipline of architecture. Architects are trained in rethinking the world; scientists are trying to understand the world.

Design as a method of research?
From within architecture several attempts have been made to include design in research, to qualify design as a type of research, not always without political ambitions. And indeed, some design projects, especially those in competitions meant to explore / unveil the capabilities of a given site in a given context without a given programme, come close to what can be called research in a traditional way. Answering this kind of questions by design is probably the most appropriate way to go. Also it has been shown that the design activity itself develops new design knowledge. [Heylighen & Neuckermans, 2000]. In current architectural pedagogical practice this new knowledge and experience resides within the experienced architects and disappears mainly with them. The accumulation of all these personal knowledge and experiences is only transferred to some students in the projects tutored and is not fed systematically into the discipline of architecture as such.
A design project at the one hand and research at the other hand have different meanings, denominating different realities, different products, different rules and constraints. Design does not traverse the hypothesis phase of research, because only in using the building can the hypothesis be tested and verified.
Traditional research and traditional design thus are fundamentally different. They are different activities, they need different attitudes and different minds, they prove different aptitudes and attitudes. As a manner of speaking: the researcher has a paper sent in time for a conference and is not paid for, the architect usually has no paper or delivers it too late and must be paid for the artistic performance in public.

THEORY IN EDUCATION of ARCHITECTURE

More emphasis on theory implies less time for other activities, i.e. design. This has to be compensated by a more efficient pedagogy in the design studio, in other words a didactic framework for the design studio, that clearly shows what will be the benefit of each assignment for the student; indeed just being confronted with another tutor is not a sufficient legitimisation for yet another design. It also means a better preparation of the assignments (not the last-minute jump into the studio in a hurry between two appointments with the mayor and a contractor).
More efficiency can also be obtained by eliminating all pure manual tasks that could be done by a draftsman. Take as an example model-making for presentations: students tend to loose themselves into astonishing miniature making, but at the same time – and they are not aware of it - they lose their time and their intellectual assertiveness.
Another strategy for improving the theoretical basis of our pedagogy, is working with mixed teams of practitioners and theoreticians in the design studio. The practitioner will learn about the latest developments in theory, the theoretician will find inspiration for research topics while discussing a project and the student will profit from both.
Doing so theory will entangle more with practice, and hence so will research.
Research is thus by no means a substitute for design.

All of this does not mean that research cannot benefit from 'the designerly way of thinking' as well as inversely design can learn a lot from the research tradition.
The intricate and lively relationship between research and design induces shifts in the definitions of research and design, just as - related to that - the definition and demarcation of science is a permanent subject of debate and adjustments among scientists and philosophers of science. [Popper, 1963], [Kuhn, 1962], [Feyerabend, 1975]

RESEARCH **TOPICS and EAAE ACTIONS**
Some people have doubts about the possibility of research in architecture, because most of the research done so far pertains the periphery of architecture. According to them the core of architecture does not lent itself to scientific investigation.
The contrary is true, just look at a few topics (and the list is endless), which we think to be (of common interest and) relevant to most of us:
- quality in architecture, including cost / quality assessment
- evaluation of architectural design, a topic which is related to the previous topic
- post-occupancy evaluation in order to obtain the necessary feed-back
- low-cost housing
- density and quality
- safety in the environment
- understanding and coping with old and new, with tradition and modernity
- CAAD during the early stages of design
- …..

EAAE has the structure and the capacity for collective actions in architectural research. These could be manifold.
We suggest but a few:
- the publication of the list of ongoing research projects in the different schools
- a list of publications of each school
- a list of ongoing and finished Ph.D. theses
- a list of tenure staff with research area
- a reader on history, a reader on architectural theory
- a list of priority in research topics
- identification of common research topics
- a thematic network amongst EAAE schools of architecture
- in-depth course content development
- a case-based library

Most of these can be organised through the Internet.

References
Zwegers, A., 1998, On systems architecting – a study in shop floor control to determine architecting concepts and principles, Ph.D. thesis, TUEindhoven, Eindhoven.
Rechtin, E., 1991, Systems architecting: creating and building complex systems , Prentice-Hall, Englewoods Cliffs (NJ)
Ohanian, H.C., 1989, Physics, W.W. Norton & Co, London
Serway, R.A., 2000, Physics for scientists and engineers with modern physics, Saunders Philadelphia (Pa)
LeGates, R.T., & Stout, F., (Eds.), 2000, The City Reader, Routledge, London, second edition.
Hays, M.,(Ed.), 2000, Architecture Theory since 1968, The MIT Press, London.
Leach, N., Rethinking Architecture: a Reader in Cultural Theory, Routledge, London

Heynen, H., Loeckx, A., De Cauter, L., Van Herck, K., (Eds.), 2001, ‘Dat is Architectuur’, Uitgeverij 010, Amsterdam
Bekaert, G., 1986, personal communication, Leuven.
Von Moos, S., 1980, Le Corbusier Elements of a Synthesis, The MIT Press, London.
Bourdieu, P., 1980, ‘La maison ou le monde renversé’, pp. 441-461 in : Le sens pratique, Minuit, Paris
De Groot, A.D.,1994, Methodologi, grondslagen van onderzoek en denken in de gedragswetenschappen, Van Gorcum, Assen (Ndl), 12th print
Cross, N.,1982, ‘Designerly ways of knowing’ in Design Studies, Vol.3, No.4, pp. 221-227
Heylighen, A., Neuckermans, H., 2000, ‘Design(ing) knowledge in architecture’, in Hanrot, S. (Ed.) Recherche et Architecture/Research and Architecture, EAAE/ARCC Conference Proceedings, EAAE, Leuven, pp.231-241.
Popper, K.R., 1972, Conjectures and Refutations, Routledge and Kegan, London.
Feyerabend, P.,1975, Against method Outline of an anarchistic theory of knowledge, New Left Books, London
Kuhn, Th., S., 1970, The Structure of Scientific revolutions, The University of Chicago.

researchpapermontreal2002.doc

Learning to search

Florinel RADU
Ecole d'architecture / PARC / EPF Lausanne
florinel.radu@epfl.ch

> "People always ask how do we get some results, rarely why. The first question belongs to those who want to do the same, to imitate; the second to those who search for understanding of the reason for the act, the desire that motivated it."
>
> Man Ray

Two questions lie at the origin of this paper and of the experience it describes: is it possible to efficiently perform an education that aims at developing a research attitude and at acquiring research abilities for second year students in architecture? How can we describe thoroughly, but concisely, such an educational (learning and teaching) experience?

The paper consists of the description of the process and students' and professor's critical comments. At the same time we will outline a possible framework for comparing different pedagogies in architectural design.

We have considered this experience as:
- an opportunity to raise and amplify students' interest in studying architecture and design;
- an intermediary phase in educating architects, an edification of a platform allowing and asking (only delineated) future developments;
- a panoramic opening to the contents of architecture and design, as well as to the learning paths.

Architecturally, we wanted to make students aware of the complex reality and of the ways to approach it, focusing on the "opening the eyes", not only in a perceptive sense but in a wider one, conceptual, operational and emotional. Pedagogically, referring to the educational vision of John Dewey, we were trying to meddle in learning, thinking and researching[1].

We will comment here only on those aspects that deal directly with the development of a research attitude. Obviously, applying a didactic strategy asks permanent actions of re-evaluation and re-orientation, immediate decisions and actions, revisions and changes of routes, all conditioned by the specific aspects of the actual educational process.

The point of departure was the previous enquiry of students' capacities and motivation through a series of interviews[2] and by an overview of the content of their first year of studies. On the one hand, most of the students were strongly motivated for the study of architecture and exhibited a remarkable and diverse general intellectual development. On the other hand, their first year design education was directed toward basic design operations, especially focused on formal and graphical exercises[3]. At the same time, the interviews unveiled their lack of architectural orientation and of a personal educational project: they were just waiting to see what the school offered them.

[1] Fundamentally, Dewey states that we learn by thinking our experiences and that we think by searching the real problems we meet. Finally, we can imagine ways of solving them through the brought about reflection. See more in John Dewey – Democracy and Education. An Introduction to the Philosophy of Education, The Free Press, New York, 1916.
[2] Occasioned by the selection procedure of 30 students from the 60 demands.
[3] A replica of Bauhaus education philosophy.

The didactic programme included four exercises, the didactic subjects of the second and third exercises being a part of the general programme of the school.

a. Architecture and building (the extension to an existing building)

Through the first exercise we wanted to confront them with the complexity of architectural reality (in contrast to the abstract character of the first year studies) and to take advantage of their acquired knowledge and abilities. We saw it as a further step in the already initiated "knowing each other" process.

The objective of the exercise (50 hours in 5 weeks) was to experiment design process (acknowledge and experiment basic aspects of design) by proposing a small scale operation, concentrating on construction (structural and material conception). They were asked to design the extension to an existing building (the British Council residence in Bucharest), occasioned by the need to accommodate more educational facilities (classrooms, multimedia, exhibition spaces, cafeteria, etc.).

The educational process consisted of common and research activities. The common ones were: site visit and critical comments on the existing situation, meeting the British architect of the previous intervention, several lectures (reasons of building actions, structural principles, interpretation of structural types and critical presentations of examples), preliminary and final reviews. The research activities aimed at developing a new understanding of the reality: questioning the existing situation from different standpoints, questioning students' knowledge and actions.

The students designs resulted from the adaptation / imposition on the site of the compositional schemes experimented and acquired during the first year and from the use of new means of representation - model, CAAD, sketches, verbal. We encouraged them to develop personal intentions and we stimulated them to question their choices; a great diversity of attitudes emerged, ranging from understanding the pertinent significance of an extension to the incapacity to conceive more than a "solitary" object. Consequently, several themes were approached: main building versus extension, inner versus courtyard space, local operation versus neighbourhood, structural form versus materials, function versus meaning, etc. Some of them succeeded in formulating and developing an operational concept, others had difficulties in controlling elementary design aspects. The studio was the scene of meeting between different pedagogic approaches – the doctrinaire ones the students had faced during the first year of studies and a referential one consisting of the attempt to connect the reflection with action and learning with communication. The main problem was to challenge their already formed *habitus* of considering the architectural image as determinant in the design process. As a consequence, the intended reflection on building actions and on their architectural meaning had a weak development. Actually, they didn't go very far beyond the "given" compositional schemes used previously, but this exercise showed quite clearly their level of motivation, their potential and limitations.

b. Architecture and form (a house on an imaginary site)

Through the second exercise we wanted them to correlate architectural intentions and means, a first tentative sketch of a design.

The initial objective of the exercise (70 hours in 7 weeks) was the exploration of the relation between the architectural space and its dweller. The students were instructed to focus on the spatial experiences (sensations, perceptions and emotions) in a private ambient, trying to express a design vision reflected in several levels of the design. They were asked to design an individual dwelling on an imaginary site. During the initial phase of the exercise the students couldn't control at the same time the formal aspects and the implications of specific spatial experiences, difficulty amplified by the abstract context (generic site and user) they should have worked within. So we decided to re-orient the work toward another objective – to conceptualise design process through the experimentation of some formal architectural means (inner space, building, parts, light, order, etc.). We took this decision knowing that during the second semester the students would again approach the individual dwelling in a real context.

The educational process consisted of the exploration of an architectural object: looking for relevant references, interpreting data, establishing the state of the art and designing with references. It included surveys of individual dwelling problems and of their design within a one week seminar[4], lectures on historical understanding of use and on examples of thematic use, spatial appropriation and experienced space, work at different design levels (from conceptual drawing to preliminary sketch and scale representations). The students performed design and learning procedures – schematisation, comparative analysis, conceptual design sequences, data collection and group presentation. They also discovered several sources of architectural knowledge. Through these actions the problem of individual dwelling was resituated in a historical and cultural perspective, the insight into the modernist tradition filled partly the students' lack of information and also it was revealed and questioned an automatism persistent in school (the relations between fashionable conveyed through professors' preferences and students' projects in the recent past).

The students responses had been developed around personal architectural references[5], a personal cultural background, an imagined user profile or they had consisted of more vague searches (compositional schemes, structural order, etc.). It was actually their first "architectural design" including several constraints at the same time. As a consequence, even if it was accompanied by a more structured pedagogy, the studio work proved to be a painful, hard and risky experience (in this case, experimenting the manipulation of spatial determinants - form, proportion, hierarchy, light - and understanding the inner coherence of a "language"). It was probably the part of the year with most tension as their main previous convictions had been challenged (provoking informal debates) – the attraction of celebrity, the confidence in the value of graphic representation[6]. The partial freedom they had in choosing references proved to be a rewarding but responsible option. This experience showed that some students were able to chose their way of working themselves and to go beyond a "regular" dwelling design experience.

c. Architecture and context (a house on a real site)

The third exercise was an experimentation of design as a research tool and a test and an adaptation of the design thinking schemes used previously.

The objective of the exercise (80 hours in 8 weeks) was to contextualize design process: the identification of relations between the architectural intervention and its context (physical, social, cultural, etc.) The context was seen as an essential part of architectural design, which,

---

[4] Group presentations on the following subjects: inhabitant - dwelling relationship, dwelling types, modern and contemporary examples - object analysis, the individual dwelling in Bucharest between the two world wars, individual dwellings in student designs of the last 30 years, dwellings in context, architectural space in modern dwelling.

[5] From the examples studied in the first year, Le Corbusier, Adolf Loos, Tadao Ando, Luigi Snozzi, etc.

[6] I intentionally exaggerated: "drawing doesn't mean anything!".

in turn, was understood as a means of transforming a given situation. The subject was an individual dwelling located in the historical centre of Bucharest, a territory in current mutation (social, physical and cultural).

The educational process consisted of an exploration of an environment - urban references: questioning a problematic urban and architectural environment, acknowledging the emphasized importance of historical and social values. The students educated their eyes to perceive and interpret the urban complexity, discovered the identity of the area and its critical and unstable configurations that require an intervention and they tested different hypothesis of transformation (also in order to know its potential). Within the studio several specific investigative tools were used in order to have a first understanding of an urban phenomenon: a preliminary elementary analysis (sensitive, historical, morphological, typological and social), unfinished and prolonged, embedded into the design process, working at different scales (physical and meaning) and with various types of representation, lectures and field debates on the history of Bucharest (main periods and typical urban elements), on how to understand a place, on the relation between architecture and town.

Most of the students questioned the validity of their knowledge on an individual dwelling design, taking now into consideration a real context, real inhabitants and existing types of siting. The studio work had a more open structure: the students were the ones to chose the area to be studied and the precise locations of their interventions, as well as the dwelling types and programmes in respect to site potential. They had several opportunities to internalise the problems, to look for and to discover local rules, to experiment different attitudes towards these "rules" and to test them through their design, to imagine a diversity of dwelling types responding to the specificity of the studied area. We had observed a qualitative change in some students' responses compared to the previous exercise: some of them dealt with more ease the abstract situation, focusing on formal aspects (as they possessed the capacity to formalise) and others the contextual one, focusing on actual constraints and experiences (as they possessed the capacity to intuitively understand reality). The main difficulty was making students more responsible as they had to structure their own work.

d. Architecture and use (re-conversion of an existing building)

The fourth exercise was an experimentation of the potential of *design as a brief making instrument*, a reflection on the interactions between architecture and user in terms of wider concerns like accessibility and sustainability, an initiation in teamwork and in communicating with professionals from other disciplines.

The objective of the exercise (40 hours in 4 weeks) was to link concepts and experience: to question the way how social use makes a building significant and to understand a temporary use as just a moment in a series of past and future destinations. The subject was the functional conversion of an existing building into a day nursery or into an educational centre for emotionally and socially affected children or into an educational centre for disabled children. There were only general requirements (minimal and maximal programme configurations), so the task included the definition of programme, at the same time with the problem of transforming the existing building.

The educational process consisted of the exploration of an environment - psycho – social references: questioning the nature of various requirements and their "contextual" validity. The students tried to understand the existing building, to identify its valuable characteristics, to define its potential use, to explore the adjustment of the functional requirements to the building and to re-adapt the building to a specific use. Working within small groups, the students confronted the given programmatic requirements with the field observations – visits of the considered building and of existing children educational centres, interviews with experts. A lecture on concepts like destination, programme (specific requirements), ineffable needs, distributive schemata, actions versus activities, behaviour, outlined a theoretical background.

On the one hand, the students looked for the values of the existing building, not even listed as a monument - what to preserve, what to exploit, which occupation and what suitable transformation strategy? On the other hand, they identified "stronger" and "softer" requirements (not as quantitative but as qualitative demands) - what lies behind a number of square meters? why does these requirements exist? These requirements had been related to various behaviour of children (similar or different in the three instances), at the same time with the operation of accommodating them into the existing building. They realised that there are never univocal or literal transfers but contextual connections at every level. During the process, several types of representation were used (at their choice) according to their relevance, the dialogue between students had become more important and, at the same time, there was more tension[7], as they had to explicit their approach and strategy. This helped them to attempt to create ambiances appropriated to each destination (how to satisfy a quantitative demand through an ambient quality).

The main difficulty was to make students aware of the co-operative side of design process, though a few of them extended their questioning meeting specialists from other fields (health, psychology, sociology).

e. Perceptions and evaluation
Students' comments
The students' perception on this educational sequence was expressed through answers to questionnaires at the end of every semester. There was a diversity of opinions (some aspects being judged positively by some students and negatively by others), approving ones being followed by critiques and suggestions[8]. But here we will confine ourselves to comment on those related to the subject of this paper. The students expressed their opinions mainly on the architectural and pedagogical content and secondly on wider aspects such as attitudes and behaviour.

On the one hand, they appreciated the efforts to form and develop architectural thinking, a reflexive and questioning attitude, but they found professor's attitude too critical and not encouraging enough during the process; also they had considered the pedagogical discourse too theorizing[9], not always meeting their need to receive precise indications for immediate actions (they were expecting professors to make more decisions). They valued the thematic diversity and the progressive approach to architectural complexity, but they considered more attention should have been granted to the architectural detailing. They welcomed the sometimes tense but open way of communication, the personalized support and informal education (suggestion of readings, lines of reflection, comments on each student's evolution), but they needed more help to develop their work ethic. Most of them thought they didn't have enough time for fulfilling the studio tasks within such a time consuming pedagogy. But the

[7] I identified various types - hierarchical, complementary and disputing teams.
[8] "I don't agree with the differentiated treatment of students – some had better and constructive critiques of their design schemes."
[9] Of course, their observations should be interpreted in school context, beside their peculiar understanding of the situation.

most encouraging answer belonged to a great majority, expressing the significant increase of their interest for architectural design and for the complementary fields (building, theory, history).

On the other hand they have realized significant changes in their behaviour and attitudes: they looked differently at the surrounding reality (architectural or not), they developed a stronger sense of responsibility, they learned to question their actions, to argue and to criticise and then to make a decision.

Our comments

During the learning process the students have experienced several actions:

- including disparate criteria and requirements into their reflection and in decision making (beside the exclusive compositional ones considered at the beginning of the year);
- selecting appropriate precedents and working with them;
- questioning an existing situation and discovering problems;
- testing alternative hypotheses.

To a certain degree they succeeded in controlling the link between intentions and design actions and the relation between an architectural action and its context (in a wide sense). We think the greatest difficulty was that of reshaping the students' high-school beliefs, looking for one solution to every problem in a naive "right or wrong" vision. A small number of students enhanced group dynamic throughout the year so, at the end, most of them proved to have a more structured perspective, and even clear interests for their near educational future - they wanted to learn more and within more defined areas. Of course, all these new developed capacities have to be deepened and enforced by other future similar experiences (a common pedagogical "rule"). Dealing with a wide range of architectural and pedagogical issues led to an acknowledged degree of superficiality. It was a choice that can be understood in the peculiar context of the school – imposed timetable and partly imposed subjects, a narrow profile of the second cycle architectural design education. In another school the program would have been differently structured.

In general, we think this experience argues that architectural education can aim not only at transmitting design techniques and subsequent knowledge, but also at developing attitudes and capacities such as: the desire to explore the possible, the sensibility to observe peculiar phenomenon, the global vision, independent thinking, creativity, etc., and even the capacity to look for, to find and interpret various types of data and finally to establish the state of the art of a peculiar field. Learning to search, as "research" in general, seems to be a risky and controversial enterprise developed in uncertainty, asking a strong psycho-emotional involvement.

f. Conclusions

This experience could be synthetically described according to the following criteria: pedagogical intentions, objectives, subject, educational process (learning to search), students' actions, students' results (during the process), psycho-pedagogical problems. The following table (see table A) allows two main types of lecture, horizontally - corresponding to an educational sequence - and vertically – corresponding to the succession of each criteria. For example, first, on each row we can appreciate the pedagogic coherence between an objective and the educational process or between intentions and results. Second, on a column we can detect the evolution of each aspect, as the column of objectives shows a certain progression from experimentation to conceptualisation and then to contextualisation of design process, finishing with the link between concepts and experience.

This experiment and its description framework (that enriches the “regular” presentation of the didactic programs) could be interesting from several points of view:

- it brings into attention student’s learning problems;
- it unveils what actually happened in the studio;
- it emphasizes the ways used to adapt the initial strategy to a responsive context;
- it offers to other successive professors the opportunity to know more about their students knowledge, capacities and attitudes.

It also opens future, more systematic and interdisciplinary lines of research: describing different pedagogical experiments with a similar set of criteria and thus having the possibility of their comparison; looking for similar learning difficulties faced by students in architectural design (how to start a design process, how to design and how to learn at the same time, how to communicate architecturally with the others, how to connect studio and courses pedagogies, etc.)

References

Boudon, Phillippe (et al.) - *Enseigner la conception architecturale*, cours d’architecturologie, Les Editions de La Villette, Paris, 1994.

Chupin, Jean-Pierre - *The Analogical Phases of Architectural Design in Studio Teaching*, in Research In Design Education, proceedings of the ARCC/EAAE conference, NC State University, Herberger Center for Design Excellence, 1998, pp.93-101.

Dewey, John – *Democracy and Education. An Introduction to the Philosophy of Education*, The Free Press, New York, 1916.

Gagné, Robert - *The Conditions of Learning*, New York, Holt, Rinehart and Winston, 1965.

Gelernter, Mark - *How Can We Teach the Results of Design Research?*, in Architecture and Teaching. Epistemological Foundations, transactions of the 31st EAAE workshop, Monte Verità, vol.2, 1998, pp.165-174.

Graaff, Erik De, & Cowdroy, Rob - *Models of problem-based learning*, in Design and Pedagogy, transactions of the EAAE Summer University in Urbino n.1, Louvain-la-Neuve, 1996, pp.27-38.

Habraken, N. John - *Around the Black Hole*, in STOA Annual revue of EAAE, no.1, L’Exote Editions, Levallois, France, 1996, pp.6-15.

Kurfiss, Joanne and Landau, Royston - *Critical Thinking*, ASHE, Washington, 1988.

Mabardi, J-François - *L’enseignement du projet d’architecture*, Propos recueillis par Jean-François Mabardi, Ministère de l’Aménagement du Territoire, de l’Equipement et des Transports, Paris, 1995.

McKinnon, Hunt - *Learning Style / Thinking Style: Is There a Design Type?*, in Research In Design Education, proceedings of the ARCC/EAAE conference, NC State University, Herberger Center for Design Excellence, 1998, pp.220-223.

von Meiss, Pierre - *De la forme au lieu*, PPR, Lausanne, 1986.

Monteil, Jean-Marc - *Eduquer et former; Perspective psychosociale*, Presses Universitaires de Grenoble, 1989.

Rowe, Peter - *Design thinking*, The MIT Press, Cambridge, Massachusetts,1987.

Spiridonidis, C-tin - *L'enseignement des architectures*, in STOA Annual revue of EAAE, no.1, L'Exote Editions, Levallois, France, 1996, pp.16-29.

Till, Jeremy - *Contingent Theory*, in STOA Annual revue of EAAE, no.1, L'Exote Editions, Levallois, France, 1996, pp.66-79.

Whiteman, John and Kipniss, Jeffrey - *Strategies in Architectural Thinking*, Chicago Institute for Architecture and Burdett, Richard Urbanism, 1992

	Pedagogical intentions	Objectives	Subject	Educational process	Students' actions	Students' results	Psycho-pedagogical problem
0	preliminary knowledge of students' capacities and motivation	initiate the dialogue	Interviews and overview of the content of their first year of studies		express their motivation and interests in architecture	strongly motivated for the study of architecture and a remarkable and diverse general intellectual development; control of basic design operations	lack of architectural orientation and of a personal educational project
Ex.1 (50h)	confront them with the complexity of architectural reality take advantage of their acquired knowledge and abilities	experiment design process (acknowledge and experiment basic aspects of design)	design the extension to an existing edifice	observing reality (questioning the existing situation from different standpoints, questioning students' knowledge and actions)	adaptation / imposition to the site of the compositional schemes previously acquired working with new means of representation	from understanding the pertinent meaning of an extension to the incapacity to conceive more than a "solitary" object; some of them succeeded to formulate and develop an operational concept, others had difficulties in controlling elementary design aspects	challenge their already formed *habitus* of considering the architectural image as determinant in the design process
Ex.2 (70h)	correlate architectural intentions and means (first tentative sketch of a design)	conceptualise design process (experimentation of some formal arch. means - inner space, building, parts, light, order, etc.)	design a house on an imaginary site	exploring an architectural object (looking for relevant references, interpreting data, establishing the state of the art and designing with references)	designing and learning procedures (schematisation, comparative analysis, conceptual design sequences, data collection and group presentation); discover sources of architectural knowledge	developed around personal architectural references, a personal cultural background, an imagined user profile or consisting of more vague searches (compositional schemes, structural order, etc.)	challenge students' attraction of celebrated architecture and their confidence in the value of graphic representation
Ex.3 (80h)	experimentation of design as a research instrument testing and tuning the design thinking schemes used previously	contextualize design process (the identification of relations between the architectural intervention and its context - physical, social, cultural, etc.)	design a house in a historical centre	exploring an environment - urban references (questioning a problematic urban and architectural environment, acknowledging the emphasized importance of historical and social values)	educating the eye to perceive and interpret the urban complexity; discovering the identity of the area and its critical and unstable configurations that require an intervention; testing different hypothesis of transformation	a qualitative change in some students' responses: some of them dealt with more ease the abstract situation, focusing on formal aspects and others the contextual one, focusing on actual constraints and experiences	making students more responsible by asking them to structure their work
Ex.4 (40h)	experimentation of the potential of design as a brief making instrument; reflection on the interactions between architecture and user; initiation in teamwork	link concepts and experience (question the way how social use makes a building significant and understand a temporary use as just a moment in a series of past and future destinations	re-conversion of an existing building	exploration of an environment - psycho – social references (questioning the nature of various requirements and their "contextual" validity)	understanding the existing building; identifying its valuable characteristics; defining its potential use exploring the adjustment of the functional requirements to the building and re-adapting the building to a specific use	they realised that there are never univocal or literal transfers but contextual connections at every level	making students aware of the co-operative side of design process

Temporality, flexibility, durability:
A new attitude for architectural education?

Sabine CHARDONNET- DARMAILLACQ
Architecte DPLG, Docteur en Urbanisme
École d'Architecture Paris-Malaquais
Paris, France
sabine.chardonnet@wanadoo.fr

At the time of modernity, the perfect adequacy of the architectural object to its use was enough to meet its legitimacy. In the perspective of sustainable development, the architectural object becomes "*environmental*". Building product cannot be considered anymore, as regards form, as finite and determined or established. It has to integrate open thought in terms of resources management as well as usage or social practice mutations.

Rapid mutations in various domains of urban and domestic life lead us into considering *temporality* related questions. Immutability and perpetuity of built space are firmly fixed notions strongly related to a representation of building as an object of transmission of property or political power (public buildings seen as monuments). A technical consequence of this conception of buildings being the durability, long life span and rigidity of pieces of work that compose them. Yet by the time, these notions are being discussed and rapid evolution of our societies lead to a demand for frequent changes of functions, destinations and picture of built space, considered internally and externally.

1.
<u>Universal flexibility : Accountability or pursuit of contradiction ?</u>

These considerations should not keep us away from the notion of accountable project in the perspective of collective liability.
Developing the concept of "*movism*", the french philosopher Terguieff *(1)* denounces an imperative which nothing seems to escape: neither man who is always required more flexibility and adaptation, nor institutions that are subject to perpetual reform. The term "modernization" has come to designate the repeated attempt to "*make up for the real always behind an ideal present*[i]".*(2)* Thus modernization is permanently urgent.
Rapidity, efficiency, flexibility, profitability,…facing human universality then made abstract, we remain with insular individual, mobile and deprived of memory.. the globalization process legitimates the "technical/technological".

The danger of "*movism*" lays in universal flexibility: rapidity, efficiency, flexibility, profitability… may fire social links for the benefit of free trading interactions. In this blind pursuit, the world landscape our students face offers a contradictory progress towards uniformization and fragmentation, endowing the new kind of unidimensional man with two faces : that of "de luxe planetary nomad" and that of "sedentary imprisoned within its roots". Seduction of utopian explorations of nomad architecture or fragmented space must not let us forget about the principal of accountability.

Opposite attractors

Koolhas' naturalization of the real versus sustainable realities

Our students are seduced by contradictory discourses all of them pretending to be the concern of the real and the new. In view of the conformism resulting from regularization and normalization of urban policies and the attractive position of the "meteorologist of global urbanity" *(Didelon)* that is Rem Koolhas, students do not resist seduction at first. Between difficult objectives of Agenda 21 and positions of architects and urban designers, as Koolhas, praising the "*real*" and blindly backing to its causes, we can yet find a place for a scholarly and critical position about architecture.
If remaining far from its critical role, beyond provocation, architecture supposed to be experimental may become a "simple form of registration and intensification of urban transformations that operate exclusive of it" *(3).*

The urban world scene and the new real

In 2000, the famous exhibition "Mutations" in Bordeaux layed out the big show of a deliberately assumed urban apocalypse, hurling the spectator towards "junkspace" and the generalized ordinary run of "shopping" as a substitution to former social nature. According to Koolhas, the certainty of patent failure of urbanism justifies his radical position to mould a world favouring the space of flow to the detriment of the space of place. This drastic tabula rasa reminds us of that of Le Corbusier who came to the same conclusion but whose argument was grounded on the opposite premise and belief that he had found *the* solution. *(4)* This proclaimed irresponsibility based on ideological position pretends that determined action against the current of strong trends induced by global market and its corollary "the generalized urbanity"*(Le Dantec)* or "metapolisation" *(Ascher)* would be illusion and source of errors.

Koolhas' position tends to naturalize urban phenomena. He presents a generic city as a sum of chaotic and inexplicable transformations that would escape any aim. The city he describes seems to be moved by organic laws, with the repeated use of the term "mutation" ignoring that these are generally provoked or instrumentalized. It is not the result of a cultural construction, but an irrefutable fact where the real is given for natural. *(5)*

How many students in architecture are fascinated by this *up to date* position made dogma. If mobility, hybridization and juxtaposition of different scales are topical questions, is it necessary that we oppose city and architecture this way? And yet, experience shows that the more telepresent we are, the more we need spatiality and real presence, let us say places. The growing strength of flood logic is far from canceling space logic.*(6)*

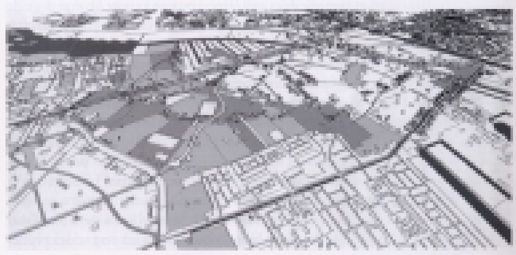
The heralds of a new generation enthusiasts of urban smartness or neo-colonial solutions promote peripheries shopping-attached without asking any of the questions such as:

- the difference between nomadism of the rich (associated with capital free flow) and nomadism of the poor,
- citizen participation,
- consuming of goods, territory and non renewable resources which are un-sustainable on a planet scale…

One can legitimately think that the growing strength of flows is far from voiding the logic of place and suppose that the idea of inhabiting by establishing relations with oneself, the other and the world, is still the future of humanity. But still we have to avoid politicians and urban planners to lose control of urbanization and globalization as they follow rationalities that transcend them.

From the apology of the "real" to the "*negociated project*" as an object in process

For Crimson Architectural Historians (Rotterdam) also on the Dutch stage, the generic city with an authorless form is not a fatality but on the contrary a construction that is economical, political, cultural and needs to be amended in transforming the external constraints into internal opportunities. Crimson and Max 1 (for ex. in Leidsche Rijn project) work to reveal the cultural component of our environment. They present their approach as "*negociated planning and design*". Of course, such a position of a planner or designer does not directly lead to a status of world-star.



The multiplication of actors implemented into urban or architectural projects and the confrontation of variable problematics do not accept pyramidal and deterministic development and planning practice. The certitude of universal programmes durable on the long term and susceptible to establish planning continuities disappear for non-functionalist programming.

In order to analyze the production of urban projects, and the role of its various actors, it is worth noting the importance of differentiating between two types of design concepts, the *hierarchic* and the *negotiated model* : linear production versus iterative production, compartmentalization versus opening of skills, rigidity versus inventiveness, information control versus joint elaboration.

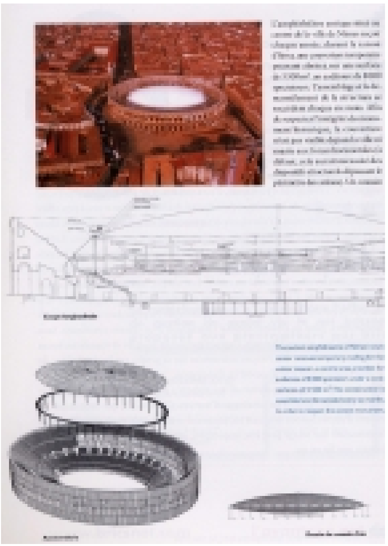
A new denotation and sense of flexibility happens to show up here.

<u>From flexibility to adaptation : Lab-fac "bottom-up model"</u>

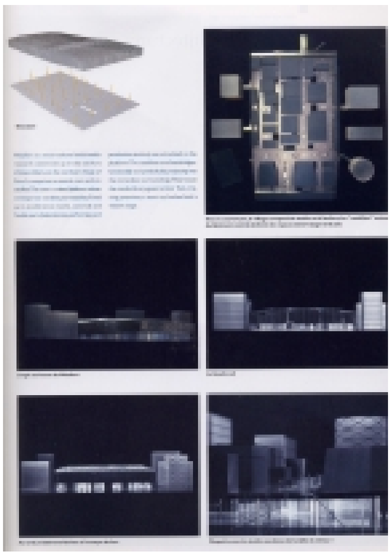
The temporality of spatial structures is also in the heart of Labfac work (Geipel & Michelin) where the "*bottom-up model*" is at work rather than the *negotiated model*. Labfac grounds its projects on a detailed analysis of content conditions (and not the content itself) on which they will found their decisions. They establish a new generic type of building adaptable to change, growth or uncertainty that could result from social, technological or cultural developments as well as new institutional limits.

Geipel and Michelin tend to privilege the organization of movement during the elaboration of the plan, withdrawing from formal configuration to the benefit of a minimalist programming of physical control, aiming at maximal organizational openness towards future uses and interpretations. They overstep traditional distribution principal in which the programme is given datum not to be modified in time.

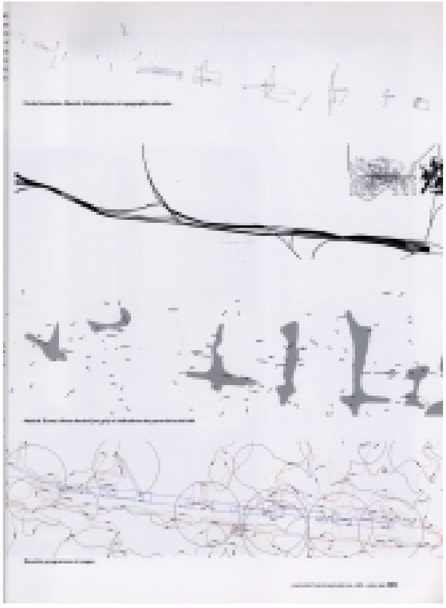
According to A. Tzonis, the search for temporal flexibility leads to the development of a clear repartition that reminds us of the concept of distribution, more than areas dedicated to circulation as in the servant and served sense of Kahn. "Those are microzones that can channel a variety of movements, provide a variety of micro environmental or micro climatic controls, offering a variety of socio-ecological niches". *(7)*



Arena of Nimes: tent pneumatic structure,
Frei Otto inspired.



Aubervilliers Metafort: multimedia research center, clad in a perforated metal sheath + presence of layers of different grid patterns.
A central core and six satellites with variable permeability.



Munich rail wasteland : urban density, nodes, vegetation / long term occupation strategy and changing balance.

For Labfac, architecture is not a response to hierarchical layout systems, but a conception that is plural, differential as opposite to preconceived scheme organizations. Frontal strategies of progressive development usually followed in industrial processes are abandoned for an organization of the project in "*microcycles*" independent and free in their development. Their interconnections operate a certain flexibility of the system in a network (web) architecture endowed with evolvability. Despite strong preoccupations with process and information, Labfac projects do not lead to dematerialization of buildings, keeping a physical body, wary of inaction or intolerance.

2.
Flexibility, innovation, adaptation

The answers to the demand of temporal adaptation, whether programmatic or conceptual, form a subject of research and experimentation. They are fundamentally linked with the questions of sustainability. Appoaches oscillate between sustainable or re-usable (evolvable) constructions and disposable, ephemeral or knockdown constructions. They challenge functionnal programming and consider at the various stages of their definition the temporality of buildings.

Conception choices, building adaptation to change, prevention towards ageing factors and damage or erosion have strong and often irreversible incidences on cost and quality of service. If the analysis of life cycles is relevant for the study and design of a building, considered as a product with an end, it is not the case for urban space which never dies but changes and grows.

Considering technical research the traditional occidental approach of innovation is still a linear technical progression. If we view a capacity of adaptation to uncertainity, we have to consider innovation at different levels of concern : social, cultural and environmental. Evolution or retraining of buildings, adaptability to variable needs need to consider:
- making the relation subject/object explicit : not thinking the object in irreversible perpetuity, but as capable of satisfying to a destination in a determined duration
- redefining space contours and zones,

- reconsidering the immovable character of buildings, introducing the notion of mobility applied to the sheath or cover, to space partitions modelling the opposition inside-outside,
- rethinking contructive options : regarding their resulting rigidity (and especially environmental and economical criteria), considering dismantling versus flexible distribution,
- deepening the question of architectural integration of services and urban integration of buildings (networks, connections, individual elements, given and designed scales,…)

The notion of sustainability

Even if the contours of this notion are still difficult to outline, we can propose 4 major componants of a definition :

- Economical development in long term viability, calling for a reasonnabble use of resources that need to be preserved for future generations,
- Lasting social development and notion of resouces sharing, whether spacial, environmental or economical; notion of sense;
- Control of technological development concerning notably matter and materials (production, life span, life cycle analysis) and calling for maintenance looked at from a preventive and not curative point of view,
- Built territory not reduced to its strict geographical sense, but looked at from the angle of appropriation and practice, allowing new actors into the design process; a built space where the notion of quality stands far from the logic of subjectivity expression and questions legibility of space with its structural role and a sense of cultural values of community.

In this light, comes a question about the place of programmation between demand and order, between quality process and sustainable development. The resulting notion of quality is different from the normative approach of a "professional" client traditionally concerned with return on investment, management rationality and performance objectives. Of course the idea is not to deny the notion of performance, but on the contrary to enlarge the notion of performance to future situations and to find new definitions of quality in long life span. This notion of *quality* carry on with the resarch concern and calls for a renewed definition.

3.
Temporality, flexibility, durability : a new attitude for architectural education?

This field of investigation is still under construction in architecture schools or faculties even if a great number of curricula claim to develop it. It is possible to explore it in different thematic courses, but it is mainly project design education and training that will offer answers to these questions.

In the first phase of the creation of the latest school of architecture in Paris - Paris-Malaquais - I worked with Finn Geipel and Patrice Mottini, to define the objectives of one of its five departments(8) named at that time "strategies, methods and techniques". Each department produces research, dissemination of architecture culture and contributes in the definition of the curriculum and modules.

Considering the methods of *negotiated project* and *bottom-up model*, we tend to develop into design project teaching principals as : iterative production, opening of skills, inventiveness, joint elaboration, open and evolvable expertise, etc.
We proposed to experiment in the project modules:

- focus on different methods and strategies, import knowledge into design : discussed lectures;
- redefinition of the notion of design project : iterative approach of an objective within a choice of problematics : *projet spécifique* (one department specific project)
- work in "integrated project" module: a project task and method being defined and followed by several departments and when possible with external partners who share a question and a territory : *projet commun* (two or three departments shared project).

Four kinds of investigations should characterize the design process in variable density with the passing years :

- Tools for learning : observation, fundamental knowledge, specializations
- Methods: transposition, implementation, self-governing development
- Experimentation: manipulation, 1:1, building scale
- Theory : references and development of concepts, theorization of practice

Quality assessment is necessary to allow a recognition of the effects of our general preoccupations and teaching orientations. But yet we consider that the spinned notions of *Temporality, Flexibility, Adaptation, Sustainability* are grounding an attitude which can be observed as:

- not a moral code but a collective consciousness, confronting the power of ideas and the economical power,
- not restraining but learning to reverse constraints,
- not adapting architectural production to new regulations , but rethinking architecture,
- not immediately attractive but in the end rather subversive in education policies.

---

[1] Pierre-AndréTaguieff, *Résister au bougisme*, Paris, Mille et une nuits, 2001
[2] Luc Borot, « Modernisation », *Cités*, n°5, 2001, pp.185-186
[3]/ [5] Valéry Didelon, « La conspiration du réel », *Le Visiteur* n°7, SFA, Paris, automne 2001
[4] Jean-Pierre Le Dantec, « Rem Koolhaas et la mondialisation », *Urbanisme* n° 318 mai-juin 2001, pp.24-26
[6] Manuel Castells, *La société en réseau*, Fayard, Paris 1998
[7] Liane Lefaivre, Alexander Tzonis, « Architecture en réseau et minimalisme cartésien », *L'architecture d'aujourd'hui* n° 327 avril 2000, pp. 54-58
[8] the school is organized in five thematic departments grounded not on disciplines but on questions : *Domestic architecture + art in general + matter, media, strategies + theory and history of project + city, territory, architecture*.

Teaching How to Learn:
Reconsidering Architectural Design in Undergraduate Education

Ali HESHMATI
Virajita SINGH
University of Minnesota
heshm001@umn.edu
singh023@umn.edu

Abstract:
This paper examines an architectural design studio, which puts a strong emphasis on the role of research in design process. The co-authors taught collaborative parallel architectural design studios consecutively in spring, fall semesters of 2001, and spring semester of 2002. An ongoing research tests the effectiveness of efforts made by the authors to re-examine the priorities for the undergraduate curriculum through the second level studio in architectural design offered to students of the Bachelor of Arts (BA) and Bachelor of Science (BS) degree programs. The efforts to refine and redefine priorities within the studio education were based on the following eight premises:

1. The main role of the studio teacher is to teach students how to learn.
2. Research is a crucial tool for design.
3. Learning about the environment and sustainability, in an elemental and direct way, is critical to design education.
4. Design is integrally related to and influenced by materials and methods out of which emerges a particular aesthetic.
5. Exposure to a diversity of ideas and viewpoints through guest speakers, reading assignments and other resources is invaluable to student development.
6. Creating opportunities for students to teach their peers and teachers accelerates their rate of development.
7. Learning through collaboration is a means of constructively harnessing student's energy and conveys an often-neglected reality of the architectural profession.
8. Building, documentation, and exhibition of student's work, both process and product, have the potential to positively engage the larger community

The methods employed to test the effectiveness of the teaching efforts are observation, documentation, and analysis of student presentations and projects by the authors. Informal interviews of students and of guest speakers invited to the course also contributed to the research. The main results will be illustrated through specific student projects and more generally in the paper. Research is ongoing through the current semester.

Teaching How to Learn: Reconsidering Architectural Design in Undergraduate Education

Introduction

"All the time my ideal of teaching has been to argue with people on behalf of the idea that they are responsible for their own activities, that they are really, in a sense, the question, that ultimately they *are* what it is they have to contribute. The most critical part of that is for them to begin developing the ability to assign their own tasks and make their own criticism in direct relation to their own needs and not in light of some abstract criteria. Because once you learn how to make your own assignment instead of relying on someone else, then you have learned the only thing you really need to get out of school, that is, you've learned how to learn." ***Robert Irwin***

The studio course was developed collaboratively by Ali Heshmati, Virajita Singh, and Jennifer Yoos, for second semester undergraduate architecture design students. The backgrounds of the authors were crucial in the development of the course materials. Ali and Jennifer are both practicing architect faculty with interests in the process of design and the role research can play in that process. As a research fellow, Virajita's focus has been on architecture and sustainability.
Design process, as a creative endeavor, is rooted in consideration of major forces in any given context: material, historic, cultural, environmental, physical, and psychological. We are all preoccupied with the potential effects of structure, construction, materials, environment, and human factors on architectural design response.
Our common goal is to educate undergraduate students to become self-reliant learners with ability to think, make, and criticize. This we believe will prepare them to engage the contemporary world in any field in a relevant manner.

Course Basics

The second semester curriculum in undergraduate design studio calls for examination of the concepts of materials, technologies, and details in the context of architectural design. Along with these concepts, the authors wanted to bring in a sharp focus on environmental forces and sustainable practices throughout the course.

In this studio, the students explore materials and methods of construction (**Textile-Tensile, Cast & Molded, Frame & Skin, and Modular Units**) in combination with the four elements of **Earth, Water, Wind,** and **Fire**. The material constructions provide inspirations for form, space, and use. This formal understanding of a building through varied procedures of construction is attributed to a theory of architectural production first articulated by Gottfried Semper in the 19th century. In his book, *Der Stil*, Semper identifies four procedures or *"building arts"* and types of material productions that are the basis of all architectural form. His four methods were related to the technical arts and included the textile (fabric), ceramic (plastic), tectonic (carpentry), and stereotomic (stonecutting). This analysis of building methods moved the focus from supremacy of structure towards enclosure and surface of the space. It also allowed the study of portable buildings (textile or fabric) to be included within architecture.

Parallel to the exploration of materials and methods there is the introduction of nature and environmental forces to which architecture must respond. We express the major forces of nature through the four ancient elements of Earth, Water, Wind, and Fire. The current state of the world demands a deliberate inclusion of issues of our livable environment and sustainability in the education of architects. Yet, these ideas are often expressed purely in technical context of energy conservation, embodied energy of materials, and alternative energy as the focus. A more inclusive approach was selected to use the four elements of Earth, Water, Wind & Fire as a means to examine architecture's relationship to nature on the spectrum of possibilities between the natural and the artificial. A clear response to the elements is often already present in successful design and design thinking. This translates into issues such as economy in the use of material and labor, the understanding of natural processes, flexibility, and adaptability to fluid contexts.

There are eight projects assigned through the semester. Four of these are the **Body Prop** projects. A Body Prop is defined as a tool or device to mediate between the frail human body and the natural environment. Each of the Body Prop projects takes on one material procedure and set of appropriate building materials from the four procedures to be considered (textile-tensile, cast & molded, frame & skin and modular units). Students are asked to develop a thesis and design a prop that mediates between their body and one isolated natural element (Earth, Water, Wind, and Fire). After doing a preliminary research into the materials and method of construction at hand, they are asked to experiment with the set of materials belonging to the chosen method. Then they must explore and articulate their design concepts through sketches, diagrams, models, and full-scale well-crafted objects. Two projects one at midterm and the other before the end of the semester are full-scale objects. One is an **Icehouse** using water and ice, as the primary building material and the second is a **Sukkah,** a temporary shelter for the annual Jewish festival of Sukkot. Parallel to these projects we examine some significant contemporary and vernacular architectural works that are preoccupied with similar architectural issues. In this, project students select a project out of pre-selected list of examples. They work in groups of three or four to do an extensive research and in collaboration present their findings to the class in a multimedia format. The last project is the Reduce, Reuse, Recycle project in which all the work from the entire semester is reviewed, edited and re-presented in a CD format. This is accompanied with a hard copy "album cover" portfolio in a jewel case.

The main role of teacher is to teach students how to learn.

"…With every lesson you teach, you take a learning opportunity away…"

Magda Gerber

Teaching in effect is teaching students how to learn. Through a process of discovery, in which the teacher plays the role of a resourceful guide, the students can become independent and self-confident individuals. Emphasis is placed throughout the studio on the students own take, read, and pursuit of a line of thought based on their particular interest within the framework of the assignment. Students are recognized and respected as individuals in different stages of their academic development, with strengths as well as weaknesses that need close attention through observation, guidance, and criticism from their teacher. Our role as teachers is not to shape our students in our image, but to help them to discover their own voices. At this early stage in their education, many students want to be told what to do. Some arrive with well-formed preconceptions about architecture that need to be questioned and reevaluated. Although somewhat resistant to it at the beginning, soon students learn a systematic questioning process, which helps them to arrive at a reasonable depth.

Research as a design tool

As in the professional projects, research plays a critical role in the design process within our studio. Time and space is allocated for this endeavor. A third of the time scheduled for each studio project is spent on research of relevant topics. The ***research wall*** is a physical space dedicated to all collected materials, which become public property. Sharing of information across the studio helps the learning environment and accelerates the rate of interpretation and abstraction processes. Through each of the projects, the students discover inherent properties of building materials and appropriate methods of construction. They are asked to consider the mediation between their bodies and the natural environment as the major program for all of their projects. They are also asked to articulate a clear and concise conceptual **Narrative** or **Thesis** based on their research findings. This assures that students get into the habit of finding resources, pursuing related ideas and referencing them in a rigorous way.

The **Precedent Analysis** project in particular motivates the students to find reference material and research issues connected to the particular architectural project addressing similar issues. Some of the subject projects for their analysis are not widely published and finding material on them becomes a challenge. This encourages the students to look further and explore other sources of information including the Internet and even the architectural offices responsible for the project. Students in turn present their findings along with series of conclusions and questions to the class in a seminar format. This instills a sense of responsibility and thoroughness towards the process of research since questions are raised during the presentation that the students have to address.

Environment and sustainability are critical to design education.

“The shape of a tree is the history of the forces which were acting on it while it grew.” ***Julian Vincent***

Sustainability is a relevant and critical issue in architectural education given the extent of environmental degradation that is the direct result of building activities. The word sustainability can mean many things. A deliberate attempt is made to keep the concepts related to sustainability within the studio very elemental, simple, and direct. In the design studio sustainability becomes a way of thinking rather than a series of readymade techniques that can be applied to any building as an additive. The relationship of the architectural object to the natural environment is explored through the four ancient basic elements of ***Earth*, *Water*, *Wind*,** and ***Fire***. The examination of these four elements as major environmental factors and their profound effects on the build environment becomes a way to compare, contrast and learn from a great variety of architecture objects from vernacular to contemporary. Throughout the course, the built object is considered as prosthesis.

The architectural object is a mediating technology that relates the frail human body to the natural and the artificial environments. The simple underlying program for all of the studio design projects is a sustainable relation to the natural environment. Before the advent of electricity and air-conditioning technologies and the development of climate rejecting buildings, all architecture had to relate to its natural environment in a meaningful way or cease to exist. Since then, many architects have simply forgotten how to integrate these effective forces in architectural design. Our hope is that the familiarity with these forces and their potential rational and emotional effects on formation of innovative architectural design, will become second nature to our students, as designers and users of architectural objects

Sustainable principles of lightness, temporality, reusability, assembly and disassembly, mobility, adaptability, and flexibility are explored throughout the course

Tectonics, material, and methods

Design is integrally related to and influenced by materials and methods out of which emerges a particular aesthetic. The idea that materials and methods are the inevitable components of any architectural project is strongly emphasized throughout the semester. This studio considers the impact of building materials and methods in the formation of designed object. The *Architecture as procedure* (course title) alludes to a theory of architectural production first articulated by Gottfried Semper in 1863. Semper identifies four ***procedures*** or ***building arts*** and associates four *material types* with these procedures that form the basis of all architecture. Experimentation with new materials is required. Students soon learn from the material behavior, what are the possibilities and challenges inherent in any given material. Many of the students have never worked with materials and methods of construction introduced in the course. Approaching architectural design from this perspective allows them to get over many preconceptions they bring to the class and learn through direct experimentation with building and modeling materials.

Multi-disciplines and the design studio

Exposure to a diversity of ideas and viewpoints through guest speakers is invaluable to student development. Unlike our traditional studio structure, we started the integration of a seminar day into the schedule. The seminar format exposes the students to a variety of viewpoints through a guest speaker or video presentations, which follows with a class discussion. This happens every other Wednesdays and is complemented with our student analysis project presentations and few workshops on digital and shop skills, which follow the same format in alternating Wednesdays. These seminars provide a necessary structure for exchange of ideas and different viewpoints between students, their teachers, and the guest lecturers. So far speaker presentations have included the following: presentation on weaving textile by a weaver, on sustainable practices by a senior research fellow, on textile-tensile architecture by an architect and editor of a Fabric Architecture magazine, on the theoretical aspects of sustainability by architecture faculty, on the tectonics of frame and skin in small scale and ephemeral architecture by a technology professor, on architectural design in the context of the 1932 Chicago Tribune competition by an architectural historian, and finally on tensile architecture by a structural engineer. We have found that the students are energized by these discussions and usually raise intelligent, provocative questions that stimulate great discussion and learning environment for the students, presenters, as well as the teachers. A series of reading assignments and few video presentations provoke stimulating discussion amongst the class. While the reading assignments generally are directly related to contemporary architectural theory, the video presentations are from divers genres.

Students as teachers

Creating opportunities for students to teach their peers and act as teachers accelerates their development. In collaborative teams of three, the students are asked to conduct an analytical research of an architectural project to produce a lecture presentation in a seminar format. In this project they are required to

research and find all the material they are going to use in presenting their analysis and synthesis to the group. For all the group projects, students are encouraged to team with students from the other participating studios. Like our other collaborative projects, this produces group dynamic problems that are naturally present in similar situations. However, the outcome more often is very impressive. They have produced great lectures of sophisticated content, which take a full advantage of our wired classrooms. This not only validates their own points of view and supports their academic development, but also gives them a better perspective in questioning the authority of the authors they study.
The fact that students are responsible for producing and conducting a seminar gives them a great sense of direction and management of this research project. This in time becomes an automatic part of their design process.
Another important aspect of this exercise is the notion of public speaking, which we all need in our education. Theatricality of classroom presentation is not a mystery to anyone, but production of a good theater does take practice.

Balancing the individual and group dynamics

Learning through collaboration is means of constructively harnessing student energy and conveys an often-neglected reality of the architectural profession.
The myths of the lone ranger and the hero architect like that of Frank Lloyd Wright, F.O.G., and other contemporary gods of architecture needs great reconsideration. Although anyone of these individuals would probably admit that none of their major projects had been possible in an insular manner, it appears that these supermen are all very singular in there ability to change the world and save the day. Outside architectural *comic* books, no building project in any stage is done by the might of an individual. Therefore collaboration is the norm not the exception. Although in an early stage when one needs to develop, his or her own vision of the world, isolation can be of value, we must emphasize the importance of collaboration in our profession.
In addition to the analysis project, we undertake two full-scale design-build projects in-groups of three students. These small-scale prototypical projects attempt to mediate between their bodies and the environment. Depending on the season and the region, these design projects engage climate, culture, scale, material, construction, and structure as they relate to the four major elements. In winter, the **Icehouse**, explores the possibilities of various states of water in combination with cold climate construction. Using the transformation of water into ice as building material and the experimental work of the engineer *Heinz Isler* as inspiration, we continue to elaborate on earlier studies of textile/tensile and cast/molded construction methods. The program for the **Icehouse** is for a portable and prototypical ice fishing structure to be used by one person. As such, it is inwardly directed and deals with basic issues of enclosure and light. Students are asked to incorporate textile/tensile with cast and molded structures using ice/snow as the primary material of construction. In Fall, they design and build a **Sukkah** in celebration of Sukkot, a Jewish holiday. Marking the harvest

time and in commemoration of wandering of Israelites from Egypt to the Israel this ephemeral structure must follow certain guidelines. This has been a valuable project for our students because of its simple but loaded program with and a wealth of spiritual and cultural issues.

Process and Product

Building, documentation and exhibition of student's work, both process and product have the potential to positively engage the community. A major portion of the studio time is spent on documentation of the ongoing design process and exhibition of this process in conjunction with outcome in public realm. This plays two roles; one it gives a clear picture to the students of their own design process through material documentation of the work, two it provides a key into their thinking and making for a well informed and critical dialogue. They are asked to digitally document the process and the work and distill this documentation in a compact disk format as their final project. Titled, "***Reduce, Reuse, Recycle***", this electronic portfolio becomes their base portfolio for application to graduate programs.

Conclusions

As an experiment in progress, we are constantly measuring the value and effectiveness of this course as an undergraduate design studio. We are also interested to know about our own effectiveness as teachers. Informal interview of students, guest lecturers who are invited back for review days, and other guests in addition to more formal student evaluations are all important tools for us. We have shaped and reshaped this course and its content each time we have taught. Like any design project, we see no end to this continual evolution, only deadlines and due dates.

Selected Bibliography:

- Lawrence Weschler, *Seeing is Forgetting, The Name of The Thing One Sees, Robert Irwin* University of California Press, 1982
- Gottfried Semper, *Der Stil In Den Technischen und Tektonischen Kunsten,* Two vol. 1860-1863
- Magda Gerber, Allison Johnson, *Your self-confident Baby: How to Encourage Your Child's Natural Abilities From The Very Start,* 1997
- Julian Vincent, *"Smart by Nature", Lightness, The inevitable renaissance of minimum energy structures,* 010 Publishers, 2001

Teaching Distributed Work Practices: the Liquid Campus

Peter RUSSELL
Aachen University of Technology (RWTH)
Aachen, Germany
russell@caad.arch.rwth-aachen.de
Dietrich ELGER
University of Karlsruhe, Germany
dietrich.elger@ifib.uni-karlsruhe.de

Abstract:
The paper describes an educational project using methods similar to those described as virtual design studios. This term, however, is avoided by the authors as it is used by other educators in projects ranging from relatively simple CAAD courses to those who share files over the internet between separated groups of students. The design studio spanned six universities over an entire semester using both physical and virtual environments. It is named: The Liquid Campus. The focus of the Liquid Campus was to teach distributed work practices to a collection of upper level architecture students using Internet based communication methods. Indeed, the authors contend that these work practices are better trained than taught. In the summer of 2001, forty-three students from six different universities took part in the 3 1/2-month project. The students worked as teams of three (with one group of four) with each member of the team coming from a different university. Furthermore, each student team was assigned a tutor coming from a fourth university. By setting these strict ground rules, the authors were able to truly test the ability of the students to work over the Internet with one another to achieve a design solution. The physical separation of all partners was essential in precluding other communication methods such a face to face meeting. The semester began with a three-day workshop in which all students and tutors took part. This served to introduce the design problem, but more importantly, to allow social interaction between the potential partners. Short research assignments and social time allowed the students and tutors to get to know one another before the groups were set on the last day of the workshop. The entire group met again 15 weeks later for a final review, although individual teams met with their respective tutors halfway through the project. The participants used a co-operation platform developed at one of the partner institutes as a common information and co-ordination centre. Indeed, the platform became the "place" to meet to discuss ideas generated from the design problem. The platform served as a directory of web-based student work, schedules, tutorial sessions as well as a repository of contact and research information for the participants. The individual teams established their own rhythms for meeting and working on their design solution. The design theme itself was somewhat self-referential in nature. The students were to design a place for members of a virtual university (such as the WINDS project currently being funded by the European Commission in the 5th Framework program). Thus, the students worked in, on and within the same set of design parameters. While this overlay of design method and design problem was taxing for the students, it also lead to a wide band of design solutions ranging from completely virtual to mostly physical "places". All 14 teams successfully completed the project. Questionnaires following the final review show an overwhelmingly positive resonance from the students. The paper discusses the results of the project as well as an assessment of the value of the project in relation to its relatively high organisational costs.

Keywords: CSCW, Virtual Design Studio, Distributed Practice

Teaching Distributed Work Practices: the Liquid Campus

The Liquid Campus is a design studio that was run in the summer of 2001 using techniques that are often referred to as a "virtual design studio" [Donat et al, 1999] The authors would like to initially clarify the ontological aspects of the "virtual" aspect. The Liquid Campus is one of many design studio assignments that have run under the banner of the "Netzentwurf" [Elger, Russell 2000]. The Netzentwurf concept does not in any way imply the use of any digital or computer based application (such as 2D Drawing Programs and 3D - Modellers). It simply calls for the use of the Internet in order to foster the type of informal discussions that occur within a typical design project studio as is common in most architectural schools from the first Beaux Art schools to today. Indeed, the term Virtual Design Studio has been used by those swapping CAD files across borders and time zones using the internet [Wojtowicz 1995] or simply having the students produce their work with three dimensional modelling programs [Sellés 1999]. The authors content that what differentiates an architectural education from other university faculties (as opposed to say the education of an engineer or an accountant) is the design studio. The design studio is the place where communication, co-operation (or not) and collaboration take place in order to arrive at a design solution. The Netzentwurf concept seeks to virtualise the interpersonal processes of the design studio as opposed to the production and reproduction processes. Indeed, many of the successful design solutions produced in the Netzentwurf setting were created with cardboard models and hand drawn plans. These were simply digitised and then made accessible through HTML web pages. [Russell et al 1999]

That said, it is not easy to truly test the effectiveness of Internet based collaboration when the participants are living in relatively close proximity to one another. Since 1997, the Institute for Industrial Building Production has undertaken Netzentwurf design studios employing various aspects of the netzentwurf concept. In the summer of 2000, it was possible to offer studio placement to three universities in three different cities. This allowed the first tests where students were then required to use net-based media to convey their ideas. The results published thereafter [Elger, Russell 2001] showed promise, but owing to the varying constellations of students, the results were somewhat watered down and inconclusive. The summer 2000 groupings included groups of four students with two in each city or groups of three with two at one university and a third at the second university. In each case where the students had the chance to communicate with face to face meetings, the net-based communication suffered. This meant that in the three person groups, the third person was rather cut off from the discussions. In the four person groups, the teams tended to split into two smaller teams at each university.

The summer 2000 project was not without some success however. The groups of two, where one student was located at each university (as well as one group of three from three universities) showed a relatively high rate of communication with the Internet and in most cases were able to come to a fruitful and meaningful discussion. The absence of any other method required the students to optimally use the Internet to collaboratively arrive at a common design solution. The results of the summer 2000 Netzentwurf laid the groundwork as well as helped establish the framework for the Liquid Campus experiment.

Response from the round table discussions at eCAADe 2000 Conference in Weimar, Germany describing an electronic atelier [Russell, Forgber 2000] generated some international and substantial domestic interest in pursuing a joint net-based design studio. Owing to incompatibilities with various semester schedules as well as financial issues, the international partners in eastern europe were not able to contribute. Nonetheless, members from six German universities met together in the fall of 2000 to map out and plan the summer semester 2001. It must be made clear that this lead-time was necessary for the success of the project. Certain aspects needed adequate time to be organised, however the majority of the planning involved negotiating the terms and rules for the design studio. In this respect, the tutors from all six universities were well versed in the problems and methods needed to come to an agreeable solution and based on this experience, qualified to provide consultation to the students. The Liquid Campus members consisted of the University of Karlsruhe, the Brandenburg Technical University in Cottbus, the Bauhaus University in Weimar, the University of Siegen, the Aachen University of Technology and the University of Kaiserslautern.

The results of the summer 2000 netzentwurf pointed towards completely dispersed student groups. The relatively high number of schools also allowed the groups to be distributed among the schools. A team size of three members was chosen. Additionally, the main tutor for each group was located at a fourth university so as not to favour one of the team members with direct communication. This arrangement allowed the members to truly test the viability of the netzentwurf concept in extending the design studio setting to the Internet.

Another aspect of the netzentwurf concept that has proven necessary is a kick-off workshop. Attempts to initiate group work across the Internet have met with almost no success whatsoever without initial personal contact among the team members being established. Previous semesters where no initial workshop took place (the students "met" only through email, chats and video conferences) showed low levels of communication and little collaborative work. With this experience, the Liquid Campus also started with a three-day workshop where all students and tutors were present.

The workshop involved short group exercises to collectively analyse the design task. In the case of the liquid campus, the 43 students were initially divided into 6 groups for a one-day brainstorming session about various contextual issues of the design assignment. The analysis was then presented to the whole group at the end of the day. A second day involved touring the site of the project and holding group discussion sessions. The third day was effectively oriented around creating the three person groups (one of the groups consisted of four persons). The rules of group building were made known (3 students from different universities with a tutor from a fourth) and the students were left to make their own groupings and then to find a tutor. The differences in student populations among the schools (between 3 and 9 students came from each university) precluded certain combinations and also led to imbalances in the teaching loads. Nonetheless, within 90 minutes, the groups were set. These groups then met for half a day with their tutors in order to work out logistical issues such as on which day of the week they would meet. This half-day also allowed the students and tutors to develop a feel for one other. The workshop introduced the students to the design problem, but really served to mitigate the social engineering aspects of the entire group.

The members all dispersed to their respective universities where the real work began. The tutors agreed that each local tutor was to provide technical and if need be moral support. The design criticism, however, was to be carried out only over the Internet. The groups all used the netzentwurf platform as a collective "place" to meet. [Russell 2001]

Figure 1: The Netzentwurf-Platform / Competencies

The netzentwurf platform provides a place for informal discussions as well as information regarding competencies, timetables and links to the student work itself; the students must document their work and present it using HTML. The platform served as a central meeting place where further discussion could be then directed. Aspects of the platform such as a logbook went unused whereas others such as an informal chat function were essential to the success of the semester's work. The platform also serves as central repository of the student's work. In the four years the netzentwurf, over 700 students have taken part in over 20 projects. The platform is open and free so as to allow a wide public audience.

The students used most every type of communication available including normal telephones and occasionally meeting together for a day. Highway restaurants tend to available at "half-way" points and thus were used my some of the teams as an ideal meeting point. Each group tended to develop their own way of working and communication. Word files, scans, CAD files and the like were traded between discussions on chat forums, videoconferences and instant messenger systems. The tutors regularly used the iVisit videoconference software as a communication medium and although it lacks a whiteboard feature, its price (free) and multi-platform capability (Macintosh + MS-Windows) were convincing. The authors often simply turned their camera towards a blackboard when the need arose to draw.

Figure 2: Communication Difficulties with internet-based conferences

The iVisit sessions proved effective as long as the network had good throughput. Disturbances in network traffic or simple problems like volume settings undermined even the most courageous attempt to generate critical discussion. This must be emphasised as the discussions often got going well and then, after 10 minutes of 3 to 5 people discussing a design, the speaker would suddenly drop out of the conversation or disappear from the screen. The students are certainly to be commended for their perseverance in continuing the experiment. The first four weeks of the project were fraught with technical problems and as a result, the momentum of many projects was negligible by the mid-term review. The technical infrastructure was not even across the six universities which also led to tensions within the groups.

The mid-term review took place as a series of smaller reviews where the student teams travelled to their tutor or to a central location. This allowed more flexibility in scheduling the reviews as well as fostered a more intimate atmosphere. The mid-term reviews were also important for the teams. The chance to have a day of intensive discussions unencumbered by technology was essential to the success of their designs.

The students then returned to their individual universities for the remainder of the semester. A final review took place in an independent city so that each member of the project was relatively equally distant. The Museum for Communication in Frankfurt am Main provided the venue for the two-day final review. This too was considered an essential part of the virtual design studio in that it provided a strong focus and deadline where the students had to present their work in front of all the tutors and fellow students.

The theme the students worked on was a "place" for a virtual university such as the WINDS Project currently being funded as part of the European Commission's Fifth Framework Program. The WINDS project is attempting to create a Virtual European School of Architecture and Construction Engineering using case based courses placed on a web platform. (See the Links List) The hypothesis was put to the students that a virtual university needs a real place for the participants to meet, if only for a short period. The obvious self-referential nature of the assignment, the working methods and the entire Liquid Campus project allowed the students additional insight into the problems of creating a virtual university through their own experiences. At the same time, the multi-layered aspect of the theme allowed many to personalise the problem and thus take a more philosophical approach to the problem. Indeed, questions as to the nature of the virtual university led to questions about the university itself and its role in the society in general. While these questions proved in the end entirely fruitful, it was hard for some students to leave the realm of the general and to start to provide possible design solutions. It is interesting to note that although a site for a potential building for the virtual university was provided, all 12 groups chose solve the problem in other ways and in other places.

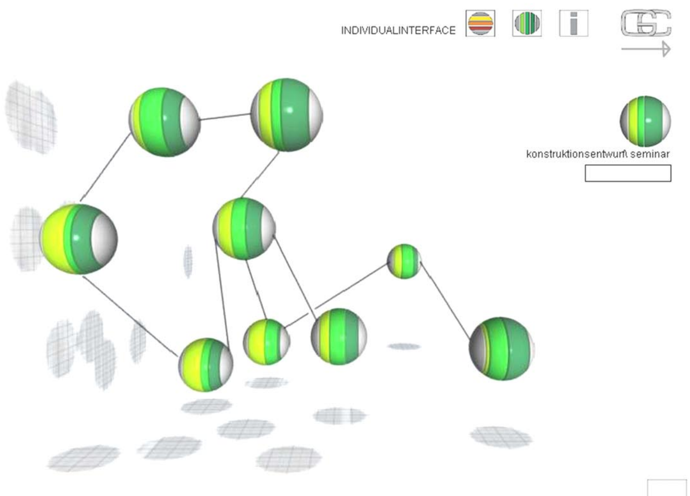


Figure 3: #SCZ / Doerr, Ebert, Ribaudo

The design solutions ranged from the purely virtual where no "architecture" was needed to those that relied heavily on built space to create the virtual university campus. The student's solutions reflected the original hypothesis and their own experiences in terms of creating interpersonal relationships. The chance to meet physically played a dominant role in almost all of the solutions.

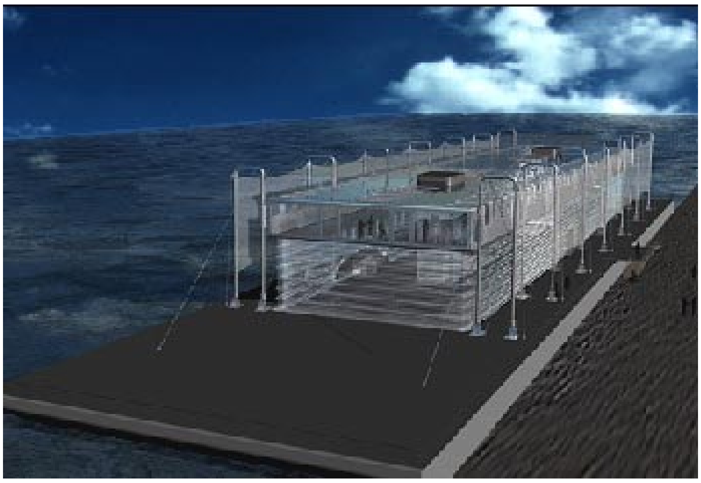


Figure 4: Net-Base.org / Karnott, Meger, Pahle, Walter

All 12 groups remained together for the entire semester in contrast to the experiences of the previous year. Difficulties encountered in some groups were mostly personal in nature, however none of these hindered the critical discussions. To be sure, not all solutions were spectacular, but it must be noted and credited that all of the groups worked with higher than normal levels of effort to complete their solutions in addition to the weight of communicating over the Internet. A larger problem lay with the tutors. It became apparent relatively early in the semester that not all of the tutors were well prepared to criticise work about a "virtual" building. This lead to some frustration on the part of the students. The open nature of the netzentwurf concept allowed the students who wanted to, to seek criticism elsewhere. This did not absolve them of their responsibility to discuss their work with the designated tutor, but allowed them to broaden the scope of responses to their work. While this is obvious to any practitioner, it was helpful to the students to have this formalised as part of the netzentwurf platform.

In conclusion and retrospect, the project can be considered a success. Post-project questionnaires showed an overwhelming positive response from the students. The importance of the physical meetings was verified as was the suspicion that for all members, the amount of effort and time needed for the project exceeded any local design studios carried out to date. Furthermore, the costs of travelling and communicating were not trivial, especially for the students. Nonetheless, over two thirds indicated they would repeat the studio, which speaks for the quality of the students as much as for the value of the project.

References:

[Donat et al, 1999] Donat, D. Kruiff, E. Regenbrecht, H. Hirschberg, U. Johnson, B. Kolarevic, B. Wojtowicz, J., "Virtual Design Studio 1998: A Place to Wait" in: Proceedings of the 17th Annual eCAADe Conference, Liverpool UK, 1999

[Elger, Russell 2000] Elger, D. Russell, P., "Using the World Wide Web as a Communication and Presentation Forum for Students of Architecture" in: Proceedings of the 18th Annual eCAADe Conference, Weimar, 2000

[Wojtowicz 1995] Wojtowicz, J. "Virtual Design Studio", Hong Kong University Press, Hong Kong, 1995

[Sellés 1999] Sellés, P. "RGB Winds are Blowing in the Design Studio" in: Proceedings of the 17th Annual eCAADe Conference, Liverpool UK, 1999

[Russell et al, 1999] Russell, P. Kohler, N. Forgber, U. Koch, V. Rügemer, J. Interactive representation of Architectural Design: The Virtual Design Studio as an architectural Graphics Laboratory" in: Proceedings of the 17th Annual eCAADe Conference, Liverpool UK, 1999

[Elger, Russell 2001] Elger, D. Russell, P. " Net-based Architectural Design: The Difficult Path from the Presentation of Architectural Design in the World Wide Web to Teamwork in Virtual Planning Offices: A Field Report" in Proceedings of the 19th Annual eCAADe Conference, Helsinki, 2001

[Russell, Forgber 2000] Russell, P. Forgber, U. "The E-Talier: Inter-university networked Design Studios" in: Proceedings of the 18th Annual eCAADe Conference, Weimar, 2000

[Russell 2001] Russell, P. "Creating Place in the Virtual Design Studio" in: Proceedings of the CAAD Futures 2001 Conference, Eindhoven, 2001

Links:

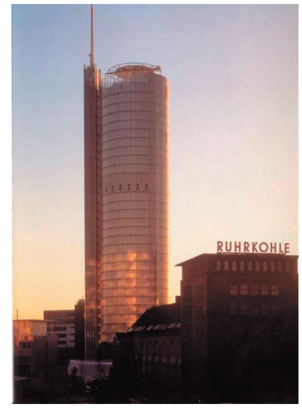
Netzentwurf	http://www.netzentwurf.de
WINDS	http://www.winds-university.org
iVisit	http://www.ivisit.com
CAAD, Aachen	http://caad.arch.rwth-aachen.de
ifib, Karlsruhe	http://www.ifib.uni-karlsruhe.de

The Tectonics of the Double Skin:
Green Building or Just more Hi-Tech Hi-Jinx?

WHAT ARE DOUBLE SKIN FAÇADES AND HOW DO THEY WORK?

Terri Meyer Boake, Associate Professor
School of Architecture, University of Waterloo

B.Arch. and M.Arch. Co-authors/Research Assistants:
Kate Harrison[1] 4A
David Collins[2] 4A
Taymoore Balbaa[3] 4B
Andrew Chatham[4] M1
Richard Lee[5] M1
Andre Bohren[6] M1



Double skin façade systems are employed increasingly in high profile buildings, designed by famous Architects, using acclaimed engineering consultants, and being touted as an exemplary "green" building strategy. It is a new technology that is more often found in high-end European and Pacific Rim architecture, and far less often in North American building. For the majority of mainstream architects, double skin technology remains elusive. From perspectives of both knowledge and budget, double skin systems are often beyond the scope of most commercially driven, North American projects. The question arises as to whether or not double skin buildings truly are more environmentally responsible and sustainable. Is North American commercial architecture missing out on potential energy and environmental savings?

The Double Skin Façade is based on the notion of exterior walls that respond dynamically to varying ambient conditions, and that can incorporate a range of integrated sun-shading, natural ventilation, and thermal insulation devices or strategies. Early modern architects such as Le Corbusier, with his "mur-neutralisant"[7], and Alvar Aalto, in the window design of the Paimio Sanitorium, explored this new building technology. Early solar passive design exemplified in the "trombe" wall, is also viewed as a precursor to modern double skin systems.[8] Only recently has double skin technology become analogous with explorations in transparent and glass architecture, and moreover, acclaimed as environmentally "responsible" design.

This paper represents the findings of a team of upper level B.Arch. and Masters students who have conducted an initial investigation into double skin cladding systems. The study has allowed us to begin to ascertain whether or not these systems represent a valid approach to energy efficient and environmentally responsible design or are, as they might appear, just another "cool" high-tech style. Does this type of skin system represent environmentally "responsible' versus "responsive" design? The end result of the research will be posted on the School website so that it can be shared with others interested in the findings.[9]

Classification of Double Skin Façade Systems by Type:

The gathering of data on double skin façade systems revealed that according to both texts and web browsers, these types of systems go by many names. These include: Double-Leaf Façade, Double-Skin Façade, Double Façade, Double Envelope, Dual-Layered Glass Façade, Wall-Filter Façade, Environmental Second Skin Systems, and Ventilated Façade.

The double skin façade is essentially a pair of glass "skins" separated by an air corridor. The main layer of glass is usually insulating. The air space between the layers of glass acts as insulation against temperature extremes, winds, and sound. Sun-shading devices are often located between the two skins. All elements can be arranged differently into numbers of permutations and combinations of both solid and diaphanous membranes.[10]

As there are numerous variations in the construction types for double skin facades, it is necessary to create a classification system in order to assess and compare the merits of the various systems as well as the "environmental success" of one building's skin versus another. Two classification systems seem to exist – one British, one North American.

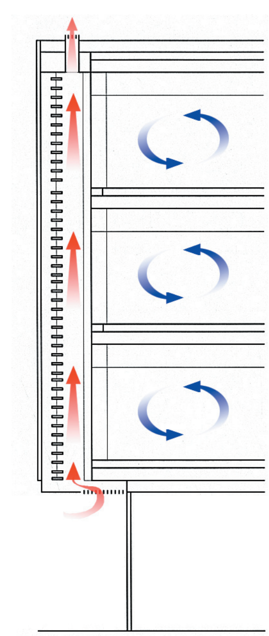
The Environmental Engineering firm of Battle McCarthy in Great Britain created a categorization of five primary types (plus sub-classifications) based on commonalities of façade configuration and the manner of operation.[11] These are:

Category A: Sealed Inner Skin: subdivided into mechanically ventilated cavity with controlled flue intake versus a ventilated and serviced thermal flue.
Category B: Openable Inner and Outer Skins: subdivided into single story cavity height versus full building cavity height.
Category C: Openable Inner Skin with mechanically ventilated cavity with controlled flue intake
Category D: Sealed Cavity, either zoned floor by floor or with a full height cavity.
Category E: Acoustic Barrier with either a massive exterior envelope or a lightweight exterior envelope.

In the American typology only three types of general systems are recognized[12]. These refer to the method of classification contained in the Architectural Record Continuing Education article titled, "Using Multiple Glass Skins to Clad Buildings", by Werner Lang and Thomas Herzog. Lang and Herzog cite three basic system types: Buffer System, Extract Air System and Twin Face System. The three systems vary significantly with respect to ventilation method and their ability to reduce overall energy consumption.

a) *Buffer System:*

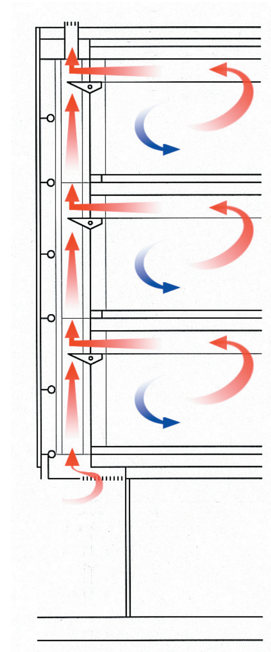
These façades date back some 100 years and are still used. They predate insulating glass and were invented to maintain daylight into buildings while increasing insulating and sound properties of the wall system. They use two layers of single glazing spaced 250 to 900 mm apart, sealed and allowing fresh air into the building through additional controlled means – either a separate HVAC system or box type windows which cut through the overall double skin. Shading devices can be included in the cavity. A modern example of this type is the Occidental Chemical/Hooker Building in Niagara Falls, New York. This building allows fresh air intake at the base of the cavity and exhausts air at the top.



Buffer Façade

b) *Extract Air system:*

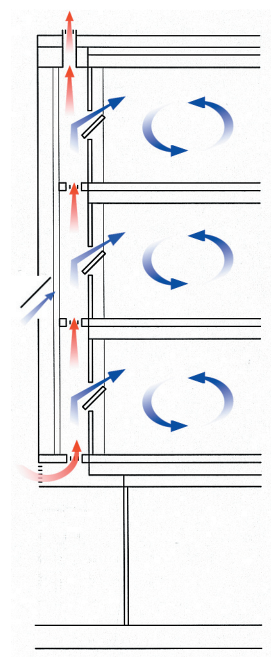
These are comprised of a second single layer of glazing placed on the interior of a main façade of double-glazing (thermopane units). The air space between the two layers of glazing becomes part of the HVAC system. The heated "used" air between the glazing layers is extracted through the cavity with the use of fans and thereby tempers the inner layer of glazing while the outer layer of insulating glass minimizes heat-transmission loss. Fresh air is supplied by HVAC and precludes natural ventilation. The air contained within the system is used by the HVAC system. These systems tend not to reduce energy requirements as fresh air changes must be supplied mechanically. Occupants are prevented from adjusting the temperature of their individual spaces. Shading devices are often mounted in the cavity. Again the space between the layers of glass ranges from around 150 mm to 900 mm and is a function of the space needed to access the cavity for cleaning as well as the dimension of the shading devices. This system is used where natural ventilation is not possible (for example in locations with high noise, wind or fumes).



Extract Air Façade

c) *Twin Face system:*

This system consists of a conventional curtain wall or thermal mass wall system inside a single glazed building skin. This outer glazing may be safety or laminated glass or insulating glass. Shading devices may be included. These systems must have an interior space of at least 500 to 600 mm to permit cleaning. These systems may be distinguished from both Buffer and Extract Air systems by their inclusion of openings in the skin to allow for natural ventilation. The single-glazed outer skin is used primarily for protection of the air cavity contents (shading devices) from weather. With this system, the internal skin offers the insulating properties to minimize heat loss. The outer glass skin is used to block/slow the wind in high-rise situations and allow interior openings and access to fresh air without the associated noise or turbulence. Windows on the interior façade can be opened, while ventilation openings in the outer skin moderate temperature extremes within the façade. The use of windows can allow for night-time cooling of the interior thereby lessening cooling loads of the building's HVAC system. For sound control, the openings in the outer skin can be staggered or placed remotely from the windows on the interior façade. The RWE Tower in Germany would typify a classic Twin-Face building.



Twin Face Façade

The above classification system presumes a façade comprised principally of glass layers. The students investigated “other” methods of using double skin systems, that included more opaque elements, and screen elements that are used to control the amount of heat, solar gain, and ventilation in buildings. It was recognized that these buildings did not conform to the three primary categories.

A discussion on double skin façade systems held on the Society of Building Science Educators listserve in August 2001 inferred that the preferred classification system was that proposed by Lang and Herzog. The members also highlighted the need for an additional category, Hybrid System[13], to address variations on the three main systems that do not neatly fall into any category.

d) *Hybrid System:*

The hybrid system combines various aspects of the above systems and is used to classify building systems that do not “fit” into a precise category. Such buildings may use a layer of screens or non-glazed materials on either the inside or outside of the primary environmental barrier. The Tjibaou Center in New Caledonia by Renzo Piano may be used to characterize this type of Hybrid system.

The student researchers preferred the Lang and Herzog system of classification over the one proposed by Battle McCarthy as it seemed less encumbered by sub-classifications. It also seemed more self-explanatory in the clarity of its terminology (i.e. easier to remember names than letters). In general it was found that the actual category term “buffer system” was somewhat confusing as all wall types are attempting to affect a buffering of the exterior to interior environments that exceeds that provided by typical full glazing systems.

The Air Space:

Appropriate design of the air space is crucial to the double façade. Variations allow for improved airflow, sound control and other benefits. The air cavity can be continuous vertically (undivided) across the entire facade to draw air upward using natural physics principals (hot air rises), divided by floor (best for fire protection, heat and sound transmission), or be divided vertically into bays to the optimize the stack effect.

The Undivided Air Space:

The undivided façade benefits from the stack effect. On warm days hot air collects at the top of the air space. Openings at the top of the cavity siphon out warm air and cooler replacement air is drawn in from the outside. However, without openings at the top of the cavity, offices on the top floors can suffer from overheating due to the accumulation of hot air in the cavity adjacent to their space. The undivided air space can be transformed into atria, allowing people to occupy this “environmentally variable interstitial space”[14] The atria/air cavity can be used programmatically for spaces with low occupancy (meeting rooms or cafeterias). Plants are used in these spaces to filter and moisten the air as well as act as shading devices.

The Divided Air Space:

The divided air space can reduce over-heating on upper floors as well as noise, fire and smoke transmission. Floor-by-floor divisions add construction simplicity of a repeating unit and in turn can produce economic savings. Corridor façades (commonly used in twin-face façades) have fresh air and exhaust intakes on every floor allowing for maximum natural ventilation. Shaft facades (divided into vertical bays across the wall), draw air across the façade through openings allowing better natural ventilation. However, the shaft façade becomes problematic for fire-protection, sound transmission and the mixing of fresh and foul air.[15]

Cleaning the Air Space:

The design of the air space also impacts cleaning. The continuous cavity, as can be seen in both the Hooker and Telus buildings, uses either a bosun's chair or platform, similar to a window-washing rig, to access the interior of the space for cleaning. Any louvers that are located within the cavity must be able to be moved to facilitate access. In some air spaces designers put open grates at each floor level. These still permit airflow through the space but provide a platform upon which to stand when cleaning the cavity floor by floor. In some instances, where the cavity is more divided, the interior windows, whether operable for ventilation or not, will function as access panels for cleaning crews to enter the space for maintenance. Where there has to be occupation of the air space for cleaning, the interior clear dimension is usually in the 600 to 900 mm range. Where the dimensions are small, cleaning is done from within the office space and requires that interior window panels open fully to provide adequate access for cleaning.

If the aesthetic drive behind the use of the fully glazed double façade is key, maintenance is critical. Research would indicate that full cleaning is carried out anywhere from 2 to 4 times a year and is a function of the cleanliness of the air that is passing through the space. Where the early design of the Hooker building (1983) provided a continuous cavity and fully open grilles at the base for continuous intake air, the Telus Building (2001), includes timed dampers to close off the air intakes at the base during times of peak traffic.

The Components Of Double Skins Façades And Passive Design:[16]

The double skin façade incorporates the passive design strategies of natural ventilation, daylighting and solar heat gain into the fabric of the high-rise building. These are the key components of the double skin façade in respect to energy efficiency and comfort that are controlled by the occupants of certain types of double skin façades.

Natural Ventilation:

Natural ventilation allows the inhabitant access to air flow that can be used to cool and ventilate the space. This passive use of air currents over mechanical means of air-conditioning reduces the energy consumption of the building and in turn reduces the CO_2 output of the building in the operational phase of the building. The exterior glazing of the double skin creates a layer of air next to the exterior wall of the building that is not affected by high velocity wind. This buffer zone, a key component to the double skin façade, is typically the region accessible by the inhabitants for natural ventilation. In some instances the use of operable windows in the exterior glazing skin is also used for natural ventilation. These operable windows would be subject to the high velocity winds prevalent at the higher altitudes of multistory buildings.

“*The reduction of wind pressure by the addition of the extra pane of glass means that the windows can be opened even in the uppermost floors of a high-rise building. Natural ventilation of offices by fresh air is much more acceptable to the building’s users and it has the additional benefits of reducing investment in air handling systems and also reducing energy consumption.”*[17]

A typical strategy of the double skin façade is to compartmentalize the buffer zone into separate regions with air supplied by grilles or vents at each level or individual zone, as in the Stadttor building in Duddeldorfer by Petzinka, Pink and Partners. This compartmentalization eliminates the impact of noise, sound, smoke and heat transfer from one section, level or room to the next area. The use of vents or grilles allows for the control of the incoming air by reducing air velocity, protecting from rain and reducing noise transmission from the exterior. It is this control that allows occupant access to natural ventilation in high-rise constructions.

“*most effective ways to reduce building services energy consumption is to “exploit natural means and depend less on mechanical techniques”*[18]

Solar Heat Gain:

The control of solar heat gain with the double skin façade is obtained through the use of shading devices contained in the air cavity, typically horizontal blinds, as well as the ability of the cavity itself to absorb some of the incoming solar radiation. Various configurations for these horizontal blind shading devices exist; they can either be fixed elements or, typically, operable units that are either controlled by the occupant or by sensors within the building. On multistory building unprotected external devices are expensive because of installation costs and safety concerns. They are typically fixed and not usually effective for all sun angle conditions especially with low sun angles in the morning or late afternoon. The double skin is important because it offers protection from the elements for the shading devices. The most effective manner to keep incoming solar radiation from heating a room above comfort levels is to prevent the heat from initially entering the space. External shading devices are the most efficient means of reducing solar heat gain in a highly glazed building. The horizontal blind allows for continued use of daylighting and maintains some of the view to the exterior.

The air space itself has the ability to draw off some of the initial solar radiation captured in this zone. Convection currents carry the heated air upwards and would then be extracted to the exterior through the venting arrangement at the top of the cavity.

“*A double-skin façade also reduces heat losses because the reduced speed of the air flow and the increased temperature of the air in the cavity lowers the rate of heat transfer on the surface of the glass. This has the effect of maintaining higher surface temperatures on the inside of the glass, which in turn means that the space close to the window can be better utilized as a result of increased thermal comfort conditions”*[19]

This aspect of the buffer zone allows for the increased use of the perimeter zone of the space that typically requires heating or cooling mechanisms against the exposed glazing. Also, with the use of improved solar heat transmission values for glazing the absorption and reflection of heat can be manipulated to minimize solar heat gain. This can be accomplished through the use of what is referred to as ‘spectrally selective glazing’;

"Spectral Selectivity refers to the ability of a glazing material to respond differently to different wavelengths of solar energy – in other words, to admit visible light while rejecting unwanted invisible infrared heat. Newer products on the market have achieved this characteristic, permitting much clearer glass than previously available for solar control glazing. A glazing with a relatively high visible transmittance and a low solar heat gain coefficient indicates that a glazing is selective. Spectrally selective glazing use special absorbing tints or coatings, and are typically either neutral in color or have a blue or blue/green appearance. An ideal spectrally selective glazing admits only the part of the sun's energy that is useful for daylighting."[20]

The air space and integrated solar shading devices control the solar heat gains that would typically require the use of mechanical means of air conditioning and air extraction.

Daylighting:

Daylighting is important in two ways; first it reduces the amount of electrical lighting required and second is that the quality of light from daylight is preferential to electrical lighting. The double skin façade with its increased glazing coverage improves the access to daylighting in the space. Also important to daylight penetration is floor to ceiling height and floor plan depth.

"Good lighting of the workplace is one of the main factors of indoor comfort that can positively influence health and productivity of office personnel. Natural light, its variations and its spectral composition are of great importance for well-being and mental health. Natural light is a fundamental component of our life, helping our body to produce vitamin "D", an important anticancer element."[21]

The increased daylighting component of the completely glazed façade introduces excessive glare and heat at certain times of the day. These increases require further measures in design to combat their negative effects. Solar shading devices are designed into the air space to decrease solar heat gain through the glazing and reduce the amount of glare caused by the increased access to daylighting.

Environmental Claims: An Ongoing Dispute

Investigation into double skin systems finds that researchers and practitioners are clearly divided into two opposing camps. The camp in the middle is fairly skeptical and seems to be waiting to be firmly convinced before making a commitment.

The "Pro" camp finds the systems to be environmentally "responsible", netting overall energy savings. The high profile buildings that have used double skin systems for their facades have been pronounced to be "green". The environmental engineers that have been involved in the design and construction of these buildings claim to have test data to substantiate their statements. Some "numbers" have been published that would indicate that significant energy savings are possible. In these articles, energy savings include both mechanical plant (hard costs) and energy to be expended (ongoing operating costs). These savings alone seem to be used to justify the approach.

“It is well understood that the double skin façade presents the many advantages over the conventional (single skin) façade. This research, performed by Franklin Andrews, Professor Michael Wigginton of the University of Plymouth and Battle McCarthy, on behalf of the United Kingdom Department of Environment, Transport and Regions has shown that double skin buildings are able to reduce energy consumption by 65%, running costs by 65% and cut CO^2 emissions by 50%, in the cold temperate climate prevalent in the United Kingdom when compared to advanced single skin building. Cost exercises have shown that buildings employing a double skin may cost as little as 2.5% based on Gross internal floor area.”[22] Battle McCarthy, Environmental Engineers.

Battle McCarthy, author of the above statement, was in the process of publishing a book on their findings at the time of the writing of this article but it was not yet available.

The “Con” camp is skeptical about the “gross” environmental benefits of the double skin system. For some, a significant aspect of the problem emanates from using the glass tower building type as the flagship for this supposedly “green” or environmental building technology.

Responding to the concerns of ecologically responsible design, Foster, Kaplicky and Rogers, among others, have incorporated innovative cladding techniques to improve energy efficiency, natural ventilation and natural lighting in their recent architectural projects . These projects have been acclaimed by the architectural press as the leading edge of a new ‘green’ architecture (Chevin, 1994; Foster, 1993; Russell, 1992a; Welsh, 1993). Most remarkable however, is that these ‘green’ projects are introduced in the guise of the glass-tower, a form often interpreted as an enemy of ecological sustainability (Vale, 1991, p170; Szokolay 1989).[23]

There is also concern that whereas significant improvements in tower type building performance may have been achieved in some of the more renowned case studies (such as RWE, Helicon, ING), not all developers that might like to adopt the double skin façade will have either the budget or the engineering assistance to detail and construct the building to achieve the same performance levels.

Green-glass-tower as a design concept is flawed both mythologically and technically. Moreover green-glass-towers provide dangerous exemplars to lesser designers, or developers with budgets of more modest proportions. The possibility of uncritical replication of this aesthetic following iconic design procedures (Broadbent, 1973), without sufficient consideration of the complex environmental problems inherent to the glass- tower, render an alliance of ecologically responsible design and glass-tower a risky proposition.[24]

The opponents additionally site a wide range of quantities that must be accounted for in determining a final savings value, including, embodied energy, maintenance, life-cycle/durability of the system, mechanical savings (operating cost as well as physical plant), and additional floor area. The bottom line seems to be in the basis of comparison of the insulating value of the double skin system to what sort of wall. Some of the statistics that have been published by the “pro” side compare the double skin system (which is often comprised of a high level Thermopane curtain wall system with an additional glass layer) to a mid level curtain wall system. Comparing a double façade system to a high level curtain wall that uses spectrally selective daylighting would result in a fairer point of of departure. Some of the more firmly entrenched in this camp would suggest that the provision of a space to house extensive sun shading devices safely away from the elements would not be an issue at all if such excessive glazing were completely avoided. This is particularly sited as an issue when looking at east and west facing façades.

> *"Reducing cooling load can best be achieved, in approximate order of effectiveness, by using opaque wall elements, shading, and/or solar-control coatings. Many analyses of DF's begin with the assumption that 100% of the vertical enclosure must be transparent. This eliminates the possibility of the most effective means of reducing cooling load."*[25]

The "pro" camp seems to have access to more statistics than does the "con" camp. Indeed, one of the most difficult aspects the students have found in their research has been in finding reliable (independent) statistics upon which to base *any* comparisons. The problem of the availability of relevant, reliable statistics stems from: the lack of published test data; the pro camp is comprised largely of engineering companies that have been retained to design these buildings (i.e. their livelihood has a vested interest in the increase in this market and much of the data seems to be guarded); and, the absence of an agreed base case from which to compare results.

Economic Considerations:[26]

In the end, there are many different factors that must be weighed when considering the double-skin façade. The particular financial, ecological and social framework of each building must all be taken into account when examining each case study.

Hard Economy: Capital Investment

In Europe double skin façades are twice as expensive as regular cladding systems. In the U.S. they can be four or five times the cost[27]. Cost increases in North America are due to engineering costs (mechanical and structural), the amount of special glass required, and the unfamiliarity of tradespeople with these systems, leading to higher installation costs. In Europe energy (utility) costs are much higher and therefore offset the original investment with a faster return. If the design process fully integrates mechanical and architectural concerns from the beginning, these systems often require less mechanical (HVAC) systems and this also can compensate for the cost of the second façade.

Significant studies in sustainable architectural design have shown that statistically, operating costs (which are largely based on heating, cooling), far exceed the monetary and environmental capital cost of buildings.[28] If double skin buildings can indeed reduce overall long-term operating/energy costs by a reasonable amount, then perhaps the increased initial capital costs can be justified.

Again, whether or not the double skin façade is the "best" choice of system for decreasing energy costs depends upon a complex set of comparative choices. A building comprised of solid, highly insulated walls, will obviously result in much lower energy and maintenance costs, but do little to achieve daylighting and raise workplace design standards.

Social Costs:

The goal of these systems is not only to be environmentally "responsible" but also to greatly improve working conditions for the occupants of these buildings through access to day lighting, natural ventilation and greater control over the workplace atmosphere. Social costs such as employee satisfaction and productivity become factors in calculating cost because content, healthy employees produce and accomplish more. Depending on labor costs, the investment might be worthwhile[29] Studies of the positive economic benefits of daylighting have already been conducted. Much data has been gathered on the Lockheed Building in California indicating a significant reduction in employee absenteeism which translates quite directly into economic benefits for the employer.[30]

This social ideal is exemplified in the German concept of "Grünkultur" (green culture). This concept is so fundamental to their architectural expression that it has become synonymous with their cultural environmental consciousness and consequently translated into legislation for quality of life. For example, German law mandates that every workstation in new commercial buildings be in direct sunlight.[31] The typical distance from the window to the core is limited, ensuring that all workers are within a maximum distance to a window. The design of office buildings has changed then to preclude the typical ring of perimeter closed offices and the interior windowless open office plan. North America seems to lag behind Europe in mandating the same standards for quality of workspace. Perhaps this is another reason why there are very few double façades in North America.

Other Cost Considerations

When entering the discussion regarding environmental "costing" there are many different factors that require consideration. The extra materials used in constructing the façade (essentially the addition of a whole second building envelope) can be seen as being too excessive to balance the energy cost savings. The embodied energy contained in the double skin system is significantly higher than in an advanced standard curtain wall system -- in some cases double the materials.

Operational costs associated with these systems are lower, however there are much higher maintenance costs. The air cavity must be cleaned because of the air movement within the space circulates dust particles more quickly. A recent visit to the Hooker Building in Niagara Falls, New York, allowed us to take a close-up look at the cavity of this close to 20 year old building. The construction of the new "Aquarium Attraction" that will directly connect to this building resulted in the unplanned for intake of much construction dust into the cavity. The sun shading louvers were obviously excessively dirty. As a result, the intake grilles at the base of this continuous height cavity have been closed off, causing the HVAC system to malfunction. An interview with security people at the building revealed that the building was always either too hot or too cold.

Life cycle costing must also be taken into account. Many buildings with double skin façades incorporate high-tech mechanics that tend to have a higher failure rate and repair cost. These same mechanics also necessitate higher replacement costs (for example wiring must be replaced after a certain number of years. The more wiring, the higher the costs). Our interview with people at the Hooker Building revealed that the electronic devices controlling the automatic function of the shading louvers failed approximately four years ago. It has not been fixed. Consequently, the majority of the louvers on all four facades have been fixed in a horizontal position, which is most appropriate only for south facing elevations. Tenants have added vertical blinds behind the primary building louvers to continue to have control over shading.

Retrofitting and recyclability are also important factors. The majority of these buildings are corporate in nature. If a company expands they may be required to add additional office space. Are these buildings suitable for expansion? Where retrofitting and recyclability has proven to be the driving force behind the success of the project is in the case of the Telus Building in Vancouver, B.C. The existing building owned by Telus, which was of solid masonry exterior wall construction with “punched” double hung wood windows was cleaned, retained, and clad with a new exterior fully glazed skin. The use of the double skin allowed for the salvaging of the existing structure and the upgrading of the quality of the interior environment. Lower operational costs are also expected.

The location of these buildings is also important in relation to the proximity of their occupants' homes. If these buildings are located too remotely, the environmental savings associated with the design and construction of the building itself may not balance the transportation energy costs of their users. The net environmental benefits of two buildings that use precisely the same double skin construction method, may be grossly different if one is located in the city center, on a transit line and the other replaces farmland, is surrounded by a sea of asphalt parking and is inaccessible by public transit. Such complex environmental assessments are best carried out with comprehensive tools such as LEED or BREAM.

Double Skin Façades as a Sustainable Strategy for High-Rise Buildings: [32]

Double skin façades technology is a starting point to develop a strategy to integrate high-rise commercial buildings into the realm of sustainable architecture. Not as a comprehensive solution but as a component of an integrated system of building design. Accepting the premise that the fully glazed office tower is not an effective design in terms of energy efficiency in the first place, the introduction of adaptive management strategies and passive energy design with the double skin façade, increases the potential of this building design to come more in line with sustainable architecture.

Double skin façades do offer a potential solution to the glazed office tower in terms of climatic control. The advantages of this system are; improved occupant control over local environment with operable windows for natural ventilation behind the exterior glazing, the ability to control the shading device allows the occupant to modify the incoming solar radiation for either heating or lighting requirements. Both of these strategies introduce the idea of passive design strategies into the modern office tower. Typically the office tower is a major consumer of energy in its' operational phase. These design interventions reduce the overall energy consumption by including passive design concepts and energy efficient strategies. The issue at hand is whether or not they are appropriate or complete solutions for energy efficiency or whether they are tactics to compensate for the lack of sustainability of the design of modern office towers. The design of the façade still seems to lack the idea of climatic response in the design of “elevationally undifferentiated” façades. Climatic design considerations would entail considering the regional and microclimatic conditions of building design. Each individual building sits in a climatic region: cold, temperate, hot-humid or hot-arid. The modernist response to design negates regional considerations through technological sophistication or compensation.

In terms of sustainable design the twin-face façade offers strategies for use and control of solar heat gain, increased daylight and moderation of temperature differences. It is the only system at present that offers a range of natural ventilation strategies to the occupants. The ability to engage and control these environmental aspects inevitably leads to increased energy efficiency. The argument is that numerous and less intensive strategies are also available to serve the same purpose. Then why use the double skin façade? No other system maximizes daylighting with integral solar heat gain control, blinds and buffer zone. Potential green house effect in the buffer zone can be used for heat production and exchange. Natural ventilation for high-rise conditions reduces air-conditioning loads.

The concept of regional response in building design offers more benign solutions that would further enhance concepts of sustainability by promoting climatic responses such as solar availability, weather patterns, urban design considerations, and other issues that deal with specific regional differences versus a technological solution that operates on universal conventions.

Looking to the Future:

When looking for/at case studies, it was found that the most common type of true double façade was the Twin-Face system. The buffer façade seemed to represent a type of system that is to be found in older, more historic models and that has been subsequently modified. From the point of view of construction, it remains the least "technical" and is used in instances where simple environmental buffering is desired. The Extract Air system is not commonly used. From a mechanical viewpoint the Extract Air system is more complex than the buffer system and is less favored as it excludes natural ventilation. The Twin-Face system, in its variety of configurations and being the only base system that actively make use of natural ventilation strategies and includes some sort of operable windows, is currently preferred.

Although in its preliminary stages, early results would indicate that double skin façade systems do not win when evaluated on a totally "hard", economics/statistics based, scoring system. Some of the systems fair better when judged on certain "softer" environmental criteria that are more difficult to measure. These would include: daylighting, solar control, access to and control of natural ventilation, and resultant employee satisfaction and productivity.

The depth of this initial investigation was limited by timeframe, access to proprietary information, access to actual dollar costs for both the capital and maintenance aspects of the systems, and actual performance data for the systems in use. To continue this investigation in a more scientific vein it would be necessary to set a firm "base case" building/wall type upon which to create a comprehensive set of statistical comparisons.

Endnotes:

1 Kate Harrison was responsible for significant contributions to the introductory and explanatory text in the paper and also for the case studies on Occidental Chemical Center (Hooker Building), Niagara Falls, NY, USA, Cannon Design Inc., and Log ID.
2 David Collins was responsible for case study research on: the “Mur-Neutralisant” by le Corbusier, RWE Corporate Headquarters AG, Essen, Germany by Ingenhoven Overdiek und Partner, and the Helicon Building, and in creating the UWSA web document..
3 Taymoore Balbaa was responsible for case study research on: S. Giacomo Church, Foligno, Italy by Massimilano Fuksas, Police Station, Beerseban, Cujik, Netherlands by Wiel Arets, 1997, and Piazza Center, Eindhoven, Netherlands by Massimilano Fuksas.
4 Andrew Chatham was responsible for text input on sustainable aspects of high rise design using double skins as well as case study research on: Das Dusseldorfer Stadttor, Germany by Petsinka, Pink und Partner, ING Headquarters, Amsterdam by Meyer en Van Schooten, and, The Telus Headquarters (William Farrell Building), Vancouver, British Columbia by Peter Busby and Associates.
5 Richard Lee was responsible for case study research on: Paimo Sanitorium by Alvar Aalto, Debis Headquarters Building, Germany by Renzo Piano, and, The Tjibaou Cultural Center in New Caledonia by Renzo Piano.
6 Andre Bohren was responsible for case study research on: Children’s Museum of Rome by Abbate e Vigevano Architects, Print Media Academy, Germany by Schroder Architekten, and, Laboratori RACOTEK srl in Teramo, Italy by Giovani Veccarini
7 Bryan, Harvey. “Le Corbusier and the ‘Mur Neutralisant: An Early Experiment in Double Envelope Construction”, Proceedings of the Ninth International PLEA Conference. 1991, pp. 257-262.
8 http://www.battlemccarthy.demon.co.uk/
9 UWSA Link. http://www.uwaterloo.ca/architecture
10 Diprose, P. R. & Robertson, G., Towards A Fourth Skin? Sustainability And Double-Envelope Buildings, Department of Architecture, University of Auckland, Auckland, New Zealand. 1999
11 Battle McCarthy website. http://www.battlemccarthy.demon.co.uk/research/doubleskin/doubleskinhomepage.htm
12 Architectural Record. July 2000. <http://www.archrecord.com/CONTEDUC/ARTICLES/7_00_2.asp>
13 Vorapat Inkarojirit, working on a Ph.D. thesis on Double Skin Façade systems at UC Berkeley.
14 Diprose and Robertson, 1999.
15 Lang and Herzog.
16 This section written by Andrew Chatham, edited by Terri Boake
17 Compagno, Andrea, Intelligent Glass Facades; Material, Practice, Design, Birkhauser, Basel, Switzerland 1995, p. 94
18 Farmer, Graham and Guy, Simon, Visions of Ventilation: Pathways to Sustainable Architecture, Department of Architecture, University of Newcastle upon Tyne, Newcastle upon Tyne, (UK)
19 Compagno, p. 94
20 O’Connor, Jennifer with: Lee, E., Rubinstein,F., Selkowitz,S. Tips for Daylighting with Windows; the Integrated Approach, Ernest Orlando Lawrence Berkeley National Laboratory
21 http://www.buildingenvelopes.org Harvard University & Massachusetts Institution of Technology
22 Michael Wigginton and Battle McCarthy. June 2000. http://www.battlemccarthy.demon.co.uk/research/doubleskin/doubleskinhomepage.htm
23 Peter Diprose and Graeme Robertson. “Ecologically Responsible Design, Solar Architecture and the Mythology of the Glass Tower.” http://archpropplan.auckland.ac.nz/people/peter/Solar_94/solar94.html
24 Diprose and Robertson.
25 John Straube. “Analysis of Double Facades for Cool Humid Climates.” Department of Civil Engineering. University of Waterloo. 2001
26 This section was written by Kate Harrison, edited by Terri Boake
27 Lang and Herzog.
28 Sustainable Design of Buildings. RAIC Conference. November 2001. Ray Cole, Professor, University of British Columbia.
29 Lang and Herzog.
30 Solar Today.
31 Slessor, 1997.
32 This section was written by Andrew Chatham, edited by Terri Boake.

Additional Information Sources:

Baker,N. & Steemers, K., Energy and Environment in Architecture; a Technical Design Guide, Routledge, New York 2000

Melet, Ed, Sustainable Architecture; Towards a Diverse Built Environment, NAI Publishers, Rotterdam, The Netherlands, 1999

Neubert, Steffi, Double Skin Facades - A Contribution To Sustainability ? masters thesis,
European postgraduate studies of Architecture and Sustainability, Louvain-la-Neuve, London, Lausanne, Freiburg, steffineubert@yahoo.com

The Tectonics of the Double Skin:
Green Building or Just more Hi-Tech Hi-Jinx?

NORTH AMERICAN CASE STUDIES:
Occidental Chemical Center (Hooker Building), Niagara Falls, NY, USA, Cannon Design Inc.
The Telus Headquarters (William Farrell Building), Vancouver, British Columbia by Peter Busby and Associates

Terri Meyer Boake, Associate Professor
School of Architecture, University of Waterloo

B.Arch. and M.Arch. Co-authors/Research Assistants:
Kate Harrison[1]
Andrew Chatham[2]

North American Double Façade Buildings: 1980 to 2001

Where over the past ten years, Europe and the Pacific Rim have seen the construction of a number of vanguard double skin façade buildings, very few have been either proposed or constructed in North America. The first to be constructed was the Occidental Chemical Center (also known as the Hooker Building) in Niagara Falls, New York. It was designed by Cannon Design Inc. and completed in 1980. Occidental Chemical has achieved historic status in texts on building systems as the first of its kind to be constructed in North America. In spite of much press and notoriety, its skin system was not widely adopted in commercial building types to follow. SOM designed a double skin envelope for the Prudential Life Insurance Company in Princeton, N.J. in the late 1980's.[3]

Following few built examples in the 1980's, it would appear that the double skin façade system continued without influence in North America during the 1990's. The next building of note is the double skin façade for the Seattle Justice Center designed by Arup Associates in 2000/2001.[4] The European offices of Arup Associates have been responsible for many of the double façade buildings constructed to date in Europe and Asia.

A double skin, referred to in this case as "une façade intelligente", is being used on the "Caisse de Depots et de Placements du Quebec" in Montreal. Façade erection commenced during Winter 2002. They chose to use the system for its thermal, visual and acoustical properties. The double skin used, is a Twin-Face type and integrates an operable window. In designing for the severity of the Quebec climate they used double glazing on the outside and single glazing on the inside skin. Standard recommendations for Twin-Face systems would provide single glazing on the outside buffering skin and double glazing on the interior layer. This approach might work in more temperate climates, but is not suitable to a cold climate installation. Ongoing construction information on the CDP may be found at
http://www2.destinationcdp.com/index.asp?version=3

The Telus Building in Vancouver, British Columbia, designed by Busby and Associates has been recently completed. This building varies from most other examples in that it uses the second skin to encapsulate an existing concrete masonry building, to prevent its destruction, extend its life and create an improved interior work environment.

Occidental Chemical Center (Hooker Building), Niagara Falls, NY, USA., Cannon Design, Inc., 1980[5]

Design Intentions:

View of Occidental in December from Customs Buildings

The construction of the Occidental Chemical Center dates back to the early 1980's. It is important as it is the first North American example of a double skin façade building.[6] It represented a development in the recent history of glass in architecture that is cited to be of fundamental importance.[7] The building is situated immediately on the American side of the Rainbow Bridge that connects Niagara Falls, Canada to Niagara Falls, New York. Its appearance has been likened to a conventional glass curtain wall box. It was constructed with a straightforward square plan with a central core and suspended ceilings. At all four sides a 4-foot (1.2m) cavity allows for maintenance of the movable daylight controlling louvers and window washing, as well as ventilation of the cavity by stack effect. In modern terms, this type of double façade is known as the Buffer Façade.

The architects of the Occidental Chemical building were trying to design a building that was at once both highly energy efficient and also highly transparent. They were trying to capitalize on the location of the building and the wonderful views of Niagara Falls that were afforded by the site.

> *"The result, after comparative analysis of various buildings skins, was (for its time) perhaps the largest passive solar collector in the world, and possibly the most energy efficient office building in its climate zone (a latitude of about 43 degrees, the same as Marseilles in Europe, but with the climatic characteristics of the American continental land mass and very cold in winter."*[8]

The skin system used by Occidental is sometimes termed "dynamic" owing to its ability to change as a function of the time of year and time of day. A full scale mock-up of one module was erected in Tempe Arizona at the College of Architecture at Arizona State University. The design was tested and apparently validated.[9] The louver system was designed to automatically rotate to control daylight entering the building. There were solar cells at the back of each bank of the aerofoil louvers. If sunlight fell on the cell the louver would rotate, tilting the bank and blocking out the sun. In this way direct sunlight would be intercepted and directed to the ceiling. The louver itself would pick up the solar heat gain, which could be exhausted by the stack effect of the cavity if desired (summer conditions). For insulation purposes the louvers would rotate to a closed position and provide additional R-value at night.

The ceiling acted as a diffuse reflector. The louvers are shaped much like an airplane wing rather than flat. This will permit diffuse reflectance of incoming sunlight as it hits either the top or bottom side of the louver. The louvers were originally coated with a bright reflective surface. As a result of blinding glare into the eyes of motorists crossing the Rainbow Bridge, these were refinished with a white colored coating soon after the building was completed. Initial sketches of the louver system indicated that a specular reflective coating was desired on the louvers to maximize the depth of sunlight penetration into the building.

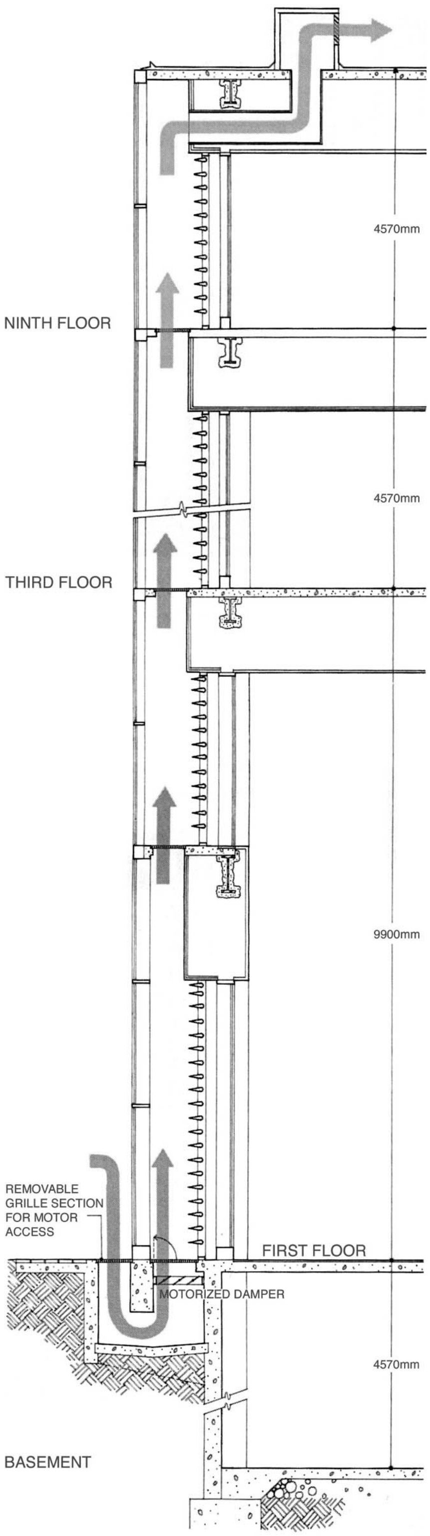
The outer skin was double glazed. The outer pane was a blue-green glass and the inner pane was clear. For the time the choice of a simple iron oxide glass was the result of a selection to use glass chemistry that would maximize light penetration while simultaneously limiting solar gain. Mullions are at 1.5 m on center and transoms at 1.8 m. The inner skin is floor to ceiling single glazing.

The cavity was fitted with motorized dampers at the base and top to assist in controlling the flow of air through the cavity. Reports vary as to the use of the hot air generated in the cavity. Most sources indicate that the air is entirely vented and never reused, although cite the possibility of reuse of this heated air.[10] Other sources agree that this air is vented during the summer/cooling months but indicate that it is directed to the north side of the building to supply heat during the winter months.[11]

A view of the front of the building at the excavation where the Aquarium addition is proposed.

Detail of corner of building

A view inside the cavity showing its clear width to allow for maintenance; the plywood sheets that close off the grille at the base preventing air intake.



Performance as of 2001:

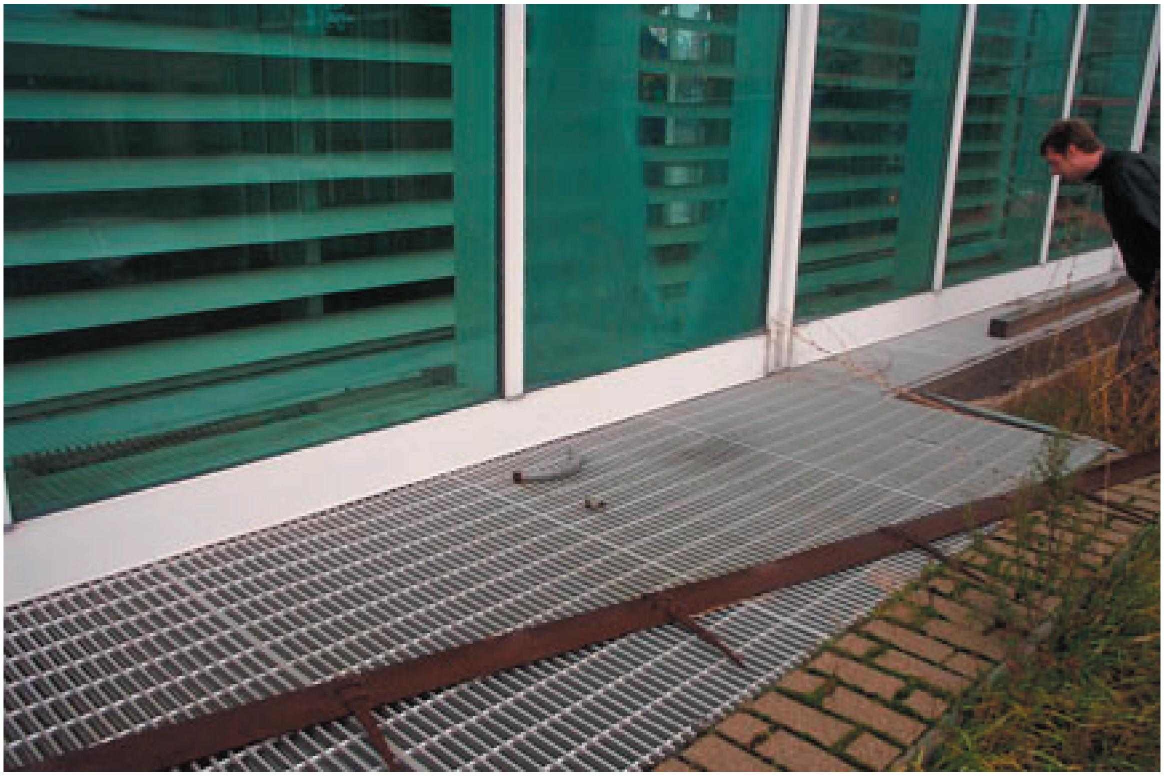
Part of the research group working on double skin façade buildings had the opportunity to visit the Occidental Chemical Building in December 2001. As part of our investigation, an interview was conducted with security and maintenance people who now work at the building.

The building is presently only 30% occupied – the balance of the floor space is looking for tenants. The large plaza that used to exist at the front entrance of the building has been replaced by a large construction site/excavation. A large attraction – "Aquarium" – is being constructed in the space at the front of the building and will connect to the lower floor of the building only, being largely held underground. The Aquarium is advertised to open later in 2002.

Approaching the building, it looks to be in pristine condition. Closer examination would reveal otherwise. Many of the original design intentions and systems of the buffer façade system are no longer functioning – either in whole or in part. A significant percentage of the glazing appeared to be clouded. We initially assumed these panels to be the result of a broken seal on a double glazed unit. This proved incorrect. The coating on the interior surface of the exterior glazed skin was disintegrating or delaminating. Proper maintenance and cleaning of the louvers has not taken place. The air space and associated louvers were "filthy". This could be credited to lack of cleaning, or, site conditions as a result of the recent excavation. The grilles at the base of the cavity are presently closed off with large plywood planks. Although the cavity was originally outfitted with motorized dampers, the presence of the plywood would indicate that these are no longer functioning.

According to security and maintenance, the brightly finished louvers were painted white early on in the life of the building due to the glare issue. This would have had an appreciable change on the diffusion of sunlight into the building. The computer controls for the louvers ceased to function approximately 4 years ago. They have not been repaired. They are now fixed in a horizontal position – inferring that they will provide only partial shading (particularly on the east and west elevations). It was apparent that tenants had decided to supplement the building shading with their own "personally controllable" louvers in the form of vertical blinds.

The interview revealed that the tenants are NOT comfortable, complaining that the building is either too hot or too cold. If the louvers and dampers are not functioning the heat accumulated in the summer months will build up rather than be expelled. Proper shading will also not take place. During the winter, although heat may be generated in the air space, the louvers that were intended to rotate into a closed, insulating position, will fail to provide heat retention at night.



View of air intake grille at base of building. Note clouding on center glazed unit.

It can be seen that the louvers are fixed in a horizontal position, painted white and are very dirty.

It would be hoped that as a result of the capital investment into the attached Aquarium, that the building and location may become attractive enough to prospective tenants to spur on the renovation and repair of the original facility. According to most architectural sources, this building is considered to be "historic", in a modern sense of the word!

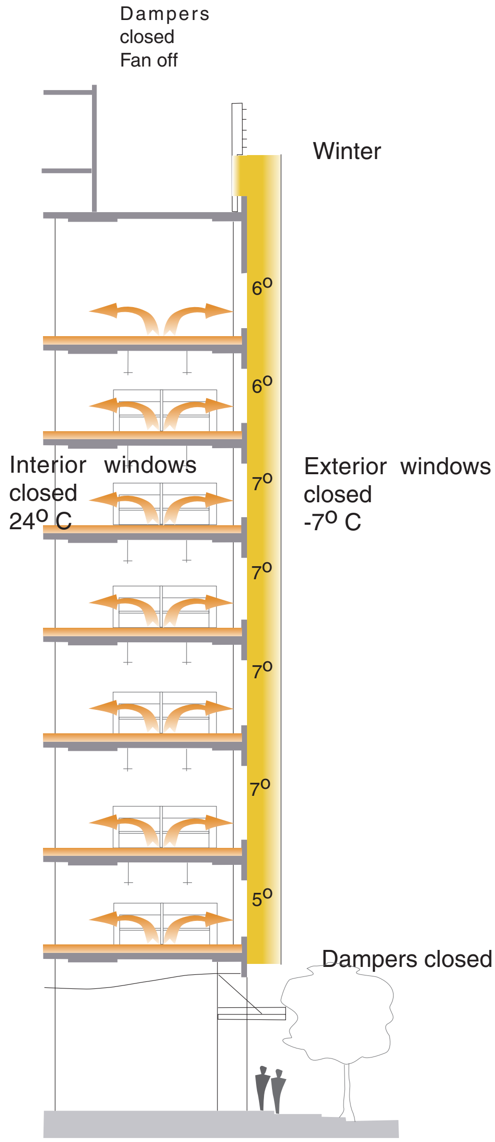
The Telus Headquarters (William Farrell Building), Vancouver, British Columbia by Peter Busby and Associates, 2001[12]

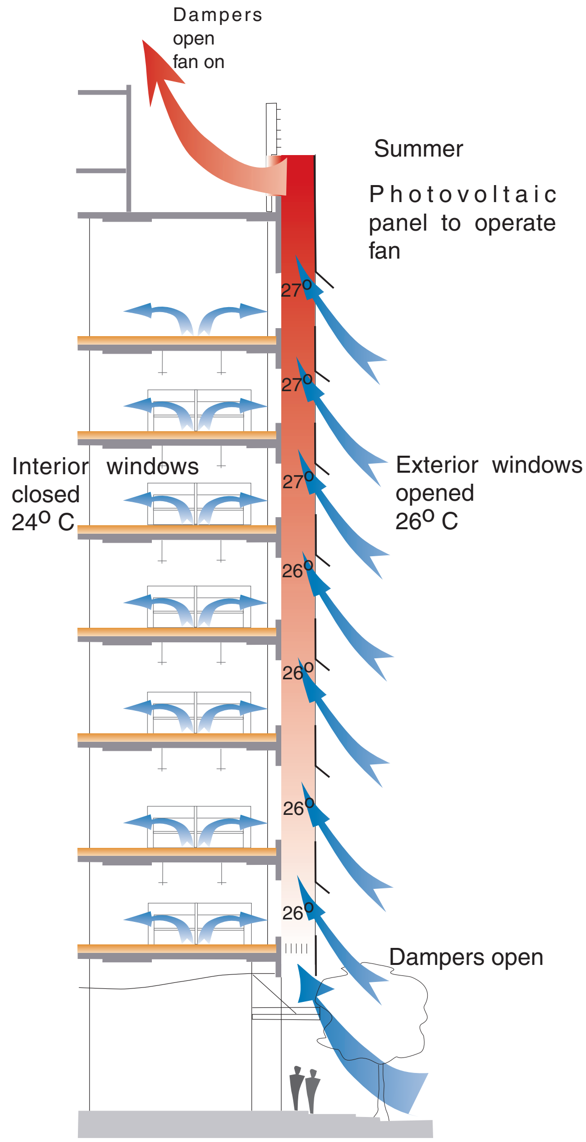
A view of the front facade after the renovation.

The Telus Headquarters was opened for occupancy during the Fall of 2001. It is one of the few double skin façades to be completed in North America, being primarily predated by the Occidental Chemical Building. It employs a double skin façade strategy commonly referred to as Twin-Face. This system provides natural ventilation through operable windows in both the exterior and interior façades. In the Telus Building the cavity extends for the full height of the building, the air space acting as a buffer zone between the busy downtown Vancouver site and the interior office environment. Daylighting seems to have been a motivating factor in the design of the façade.
Differentiating the Telus Building from other current and European double skin projects is its unique position as a renovated concrete and masonry structure. Ordinarily such technologically and environmentally outdated structures would be demolished and replaced by a completely new building. The existing structure and skin of the William Farrell Building was able to be retained, effecting significant environmental savings in accordance with the LEEDS Environmental Assessment system.

The interior of the building was gutted. Existing suspended acoustic ceilings and HVAC runs were removed. This effected as well a cleaning of the interior environment and improved air quality. The exposed concrete ceilings were painted white to assist with daylighting and succeeded in exposing thermal mass. The new outer skin is comprised of a differentially glazed, curtain wall frame, with operable windows, set out from the building to facilitate access to the buffer air space for cleaning.

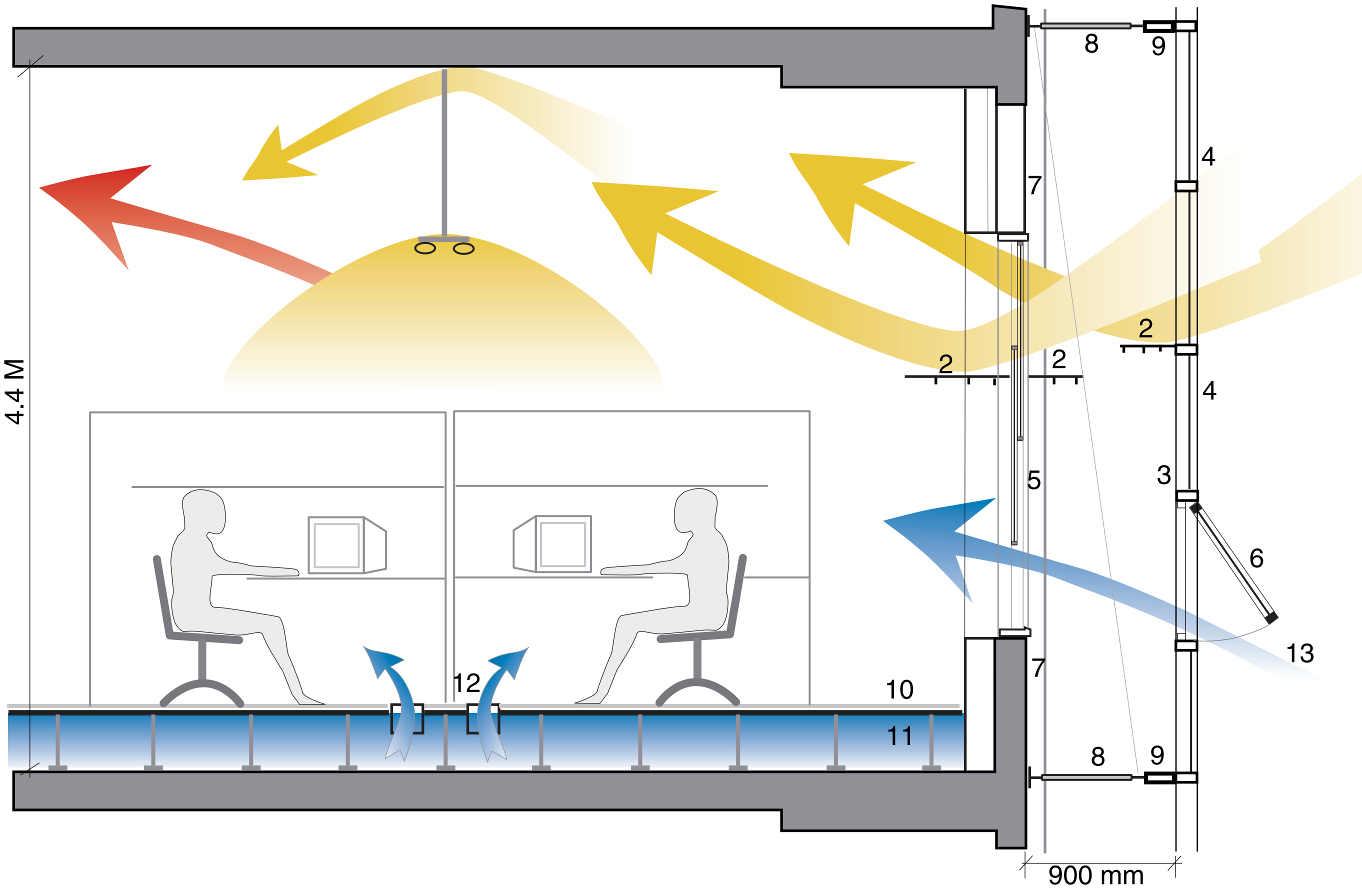
The William Farrell Building is an eight story brick faced concrete structure. It was originally made to house the company's analog telephone switching gear. With the introduction of digital operating equipment, much of the space in the building became redundant for its intended use. Instead of demolishing the building, Busby and Associates Architects proposed retrofitting the structure. For energy conservation purposes the building was covered with a double glazed aluminum framed curtain wall. This wall acts to reduce ventilation and heating requirements. The cavity between the existing building and the new building is essentially a greenhouse. The interstitial space stores heat in the winter and provides shade and diverts heat from the building in the summer. The cavity is controlled by louvers at the base of the cavity and dampers at the top, to flush the air as required. Photovoltaic cells are linked to the ventilation fans and dampers on the roof.





Winter Wall Section:
Dampers Closed

Summer Wall Section:
Dampers Open



Detail of Wall to Room Function:

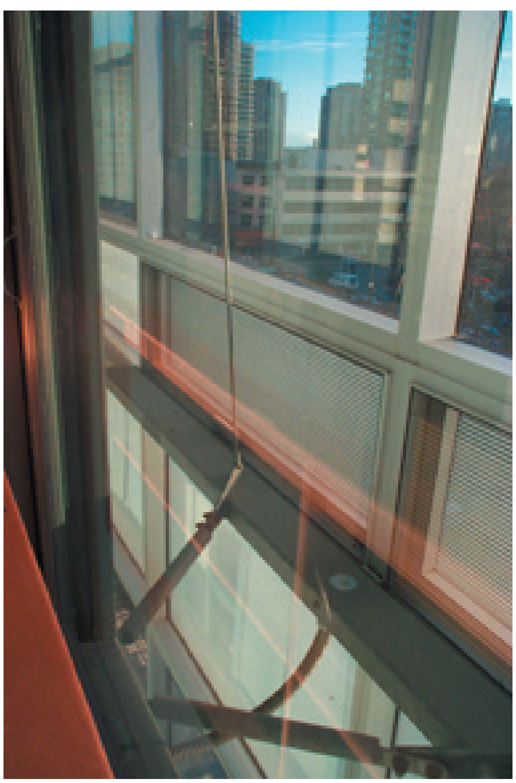
1 Interstitial space - seasonal climate buffer zone
2 Daylight reflector and sunshade
3 Aluminum framed glazing curtain wall
4 Solar shade glass panel - ceramic frit glass panel reduces solar heat gain
5 Operable windows - existing restored
6 Operable windows - new mechanized
7 Existing exterior wall - exposed concrete
8 Curtain wall hangers
9 Steel reinforcing for curtain wall frame
10 Raised office floor
11 Air plenum in raised floor
12 Air diffusers
13 Natural ventilation possible in moderate temperatures

The existing windows were restored to operating condition. This provided both a cost and an environmental savings. To supply fresh air, mechanized operable windows were fitted on the new glazed wall. The existing brick veneer was removed. The exposed concrete acts as a heat sink. The curtain wall is hung off of the existing building with steel brackets and supports. The new glazing wall extends beyond the property line of the site, but as it only starts below the second floor level, does not impinge on the sidewalk space.

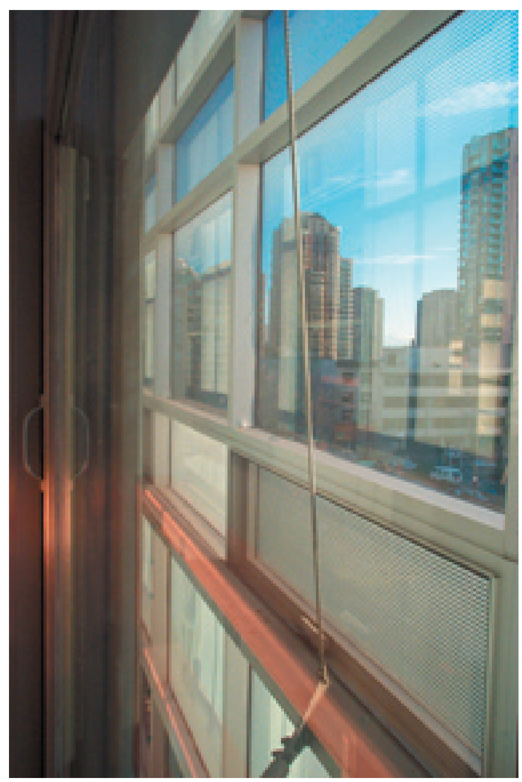
"The double skin acts as a ventilation chimney in warm weather and as an insulation jacket in cool periods. In winter months louvers at the top of the double skin remain closed, trapping a layer of air, allowing the building mass to retain available solar energy, which is then reradiated into the building. The exposed concrete structure acts as a heat sink, helping to reduce temperature fluctuations. In warm weather, with the louvers open, heat building within the double façade causes convection air movement. Assisted by fans, warm air is drawn up and out of the top of the air space, creating negative pressure within the interior, which in turn draws warm air away from the occupied areas." John McMinn, 2001

View of interior, façade faces south-west, 4 p.m., November

This image was taken prior to occupation. The white painted interior was very brightly lit. The low sun angle provided penetration to the back corners of the office space. Much shading is provided by the existing concrete wall. In fact, were it not for the ratio of wall to window area, the glare in the space would make the working condition impossible.

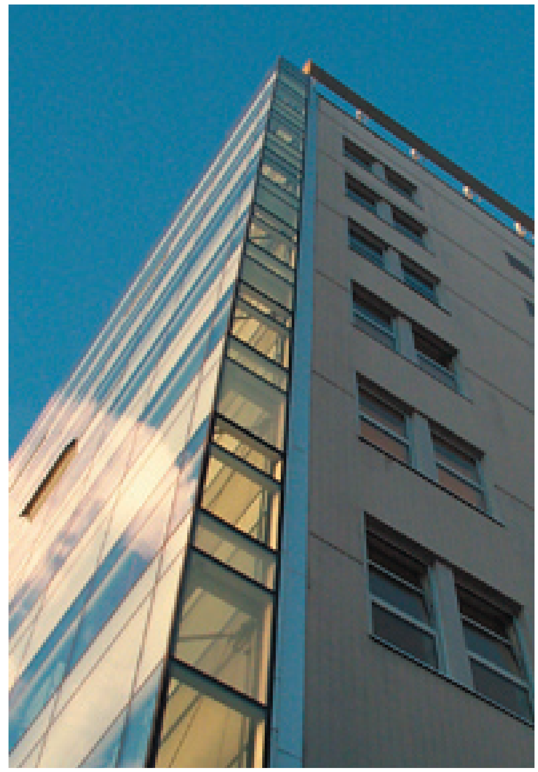


Views looking into the cavity. Note the differentiated glazing materials: clear and fritted, as well as the operable window.



The envelope helps to modulate internal temperatures. Motorized windows on the new curtain wall, as well as operable existing units, enable the occupant to obtain natural ventilation when possible. The window glass on the curtain wall is fritted at different densities for temperature modulation. Photovoltaic panels are fitted in the new curtain wall and are linked to ventilation fans and dampers on the roof that ventilate the interstitial space. Each workstation is equipped with individually controlled diffusers to allow the flow of fresh air through a forced air plenum under the raised floor. The daylight reflectors allow light to penetrate deep into the building.

A view of the shading device attached to the interior of the windows. It also serves as a daylight reflector/light shelf to bounce light up to the white painted concrete ceilings.



A view of the north east end of the double skin addition clearly showing the depth of the new system.

Here we can see the differentiated glazing: clear versus fritted glass, and two of the operable windows in an open position.

The Telus Building will only be fully occupied during the Winter of 2002. It will be interesting to follow the performance of this building to see whether or not the design intentions of Busby and Associates are realized in the function of the double skin of the building and whether the occupants find the work environment invigorating.

Comparing the Occidental Chemical and Telus Buildings:

The Occidental Chemical Building, constructed in 1980, and the Telus Building, constructed in 2001 may exhibit similarities in the aesthetics of their façades, but they employ two quite different strategies in their selection and detailing of the double façade skin systems for each. Whereas Occidental Chemical uses a Buffer System (no natural ventilation), Telus has adopted the Twin-Face system and has made significant use of natural ventilation and its occupant control. Trends in the construction of double façades on an international scale would indicate that Twin-Face is the current preferred method of construction, in part due to its ability to provide access to natural ventilation.

Occidental Chemical was a new building and Telus is a renovation. Both, however have adopted the double skin system to achieve environmental goals. In the case of Occidental Chemical, the buffer system was adopted to reduce cooling loads in the summer and reduce heat loss in the winter. Telus has employed the second skin for similar heating and cooling purposes and to allow the retention of the existing concrete masonry structure and single glazed windows. This scored the designers points in their LEED Environmental Assessment. The exterior concrete wall provides significant thermal mass in the cavity that will enhance the thermal properties in the winter and slow heat transfer in the summer by making the wall work in a fashion similar to the adobe walls common in hot-arid climates. Occidental does not provide thermal mass in the cavity.

Both Occidental Chemical and the Telus Building are of similar height, 9 stories versus 8 stories. This makes their full height cavities quite similar in proportion – particularly when considering the free space dimension from the face of the louver to glass in Occidental to the free interior space in Telus. The buildings as well have similar face dimensions, although Occidental is completely wrapped with its second skin and Telus only uses this on its two street facing façades (south and west) – the east side is on an urban lot line and is basically a blank wall and its north face is buried against an adjacent building. Both air spaces run the full height of the building and are not compartmentalized, and are able to be closed at the bottom and top by control dampers as well as fan assisted to exhaust the warm air more quickly when the stack effect is insufficient. The full height cavity in the Twin-Face system is somewhat unusual. Most of the European examples of Twin Face buildings use highly compartmentalized systems with input and output louvers at each floor level (RWE, Debis and Helicon).

A chief difference in the function of the Buffer Façade of Occidental and the Twin-Face Façade of Telus lies in the exclusion or inclusion of natural ventilation and user operable windows. It must be said, that the general building style that was prevalent in the 1980's when Occidental was designed was the sealed glass box. Natural ventilation was not a part of mid to high-rise office design. Telus is responding, with its ventilated skin, to current pressures towards natural ventilation and user control as a means to improve air quality, worker comfort and worker performance.

Whereas the glass on Occidental Chemical is uniform over the entire building envelope, the Telus Building has used differentiated glazing: clear vision glass in a band on the exterior skin that aligns with the interior windows, and fritted glass in the "spandrel" sections to cut out unnecessary heat transfer.

The overall width of the double skin including cavity is 1200 mm in the Occidental Chemical Building and 900 mm in the Telus Building. It must be recognized that North American architecture, particularly with the office building type, is commercially driven. The 300 mm savings around the perimeter of the building may result in an increase in net leasable area that will assist in offsetting some of the initial capital cost required to construct this type of wall system .

Name Location Date Completed Architect	**Occidental Chemical** Niagara Falls, New York 1980 Cannon Design Inc .	**Telus Head quarters** Vancouver, B.C. September 2001 Busby & Associates Architects
Climate	Cold	Temperate
Facade construction	Buffer system – no natural ventilation. Full building height cavity. Air cavity -buffer zone.	Twin-face - natural ventilation through operable windows in both faces. Full building height cavity. Air cavity -buffer zone.
Daylighting	Yes -maximum exposure, floor to ceiling glazing, but dropped acoustic ceilings.	Yes-Tall windows and light shelves.
Shading	Yes-Operable louvers in air space with photocell control and manual override.	Yes-Sun shades / light shelves. Glazing of different densities.
Adaptability to various orientations	Undifferentiated façade, but louvers have ability to alter position according to orientation and sun angle.	No
User control	Only on supplementary interior vertical blinds.	Yes-operable windows, interior and exterior . individual air diffusers w/control
Ventilation	HVAC – cavity air is not used by central system but expelled.	Natural- operable windows. High ceilings HVAC -Forced air plenum in floor
Aesthetics	Square plan office tower with central core, 1.2m double skin around entire exterior	Curtain wall frame applied to existing brick faced building, renovation
Cavity Dimension	1.2 m	900 mm

What has the Telus Building achieved that the Occidental Chemical Building may not have? I believe that the environmental success of the double façade system as constructed for the Telus Building is far more believable than the Occidental Chemical Building. Key differences must include the "points" scored for the retention of the William Farrell Building Structure and the added benefit of this existing exterior mass structure in assisting with normalizing the temperatures in the building. Whereas the complete failure of the computer control systems over the function of the louvers in the Occidental Chemical Building has rendered the interior environment extremely uncomfortable, the ventilation strategies employed in the Telus Building would appear to be less likely to fail, and the primary means of shading (fritted glass and solid wall) are not building elements that are subject to failure by mechanical aging. Each building does rely on computer assisted mechanical systems to control cavity ventilation, dampers, fans, windows and louvers. Standard curtain wall construction does not. Such systems are subject to failure over time – as Occidental Chemical illustrates. Hopefully a visit to the Telus Building in 20 years will prove increased longevity in these all important control systems.

The Twin-Face system used by Telus, with its continuous versus segmented cavity, has created a second skin system that from indications is less capital intensive than the segmented systems used in many of the European examples. This type of skin may perhaps tip the economic scales in favor of double skin buildings in the competitive, commercially driven, North American market.

Looking to the Future:

The depth of this initial investigation was limited by timeframe, access to proprietary information, availability of actual dollar costs for both the capital and maintenance aspects of the systems, and actual performance data for the systems in use. There is little published data to be found on the Occidental Chemical Building. Most text references speak distantly/historically of the building and do not include current occupancy information. The Telus Building has just been completed, and although early reviews are favorable, it remains to be seen how the building will in fact perform. We anticipate undertaking additional research to both substantiate the more subjective means of comparison used in the current case studies, as well as in creating a larger database of both North American and off shore examples.

Endnotes:

1 Kate Harrison was responsible for significant contributions to the case study on Occidental Chemical Center (Hooker Building), Niagara Falls, NY, USA, Cannon Design Inc.

2 Andrew Chatham was responsible for case study research on: The Telus Headquarters (William Farrell Building), Vancouver, British Columbia by Peter Busby and Associates.

3 Rick Diamond. Progressive Architecture. March 1989. p. 117

4 Maurya McLintock. Arup Associates. ACSA Technology Conference 2001. Proceedings (in press).

5 Research conducted by Kate Harrison, line drawings by Kate Harrison, photography, Terri Boake

6 Lechner, Norbert. Heating, Cooling, Lighting. Wiley. p. 382

7 Michael Wiggonton. Glass in Architecture. Phaidon. p. 156

8 Michael Wiggonton. p. 156

9 Michael Wiggonton. p. 156

10 John S. Reynolds and Benjamin Stein. Mechanical and Electrical Equipment for Buildings. Wiley. p. 350

11 Nobert Lechner. p. 382

12 Research conducted by Andrew Chatham, line drawings by Andrew Chatham, photography, Terri Boake

Thermal Comfort in a Naturally Ventilated and Air Conditioned Urban Arcade

Nicholas B. RAJKOVICH,
Graduate Research Fellow

Alison G. KWOK, PhD

Department of Architecture
School of Architecture and Allied Arts
University of Oregon
nrajkovi@darkwing.uoregon.edu
akwok@aaa.uoregon.edu

ABSTRACT

Thermal comfort research in office buildings has led to developments in new thermal comfort standards. Yet a review of thermal comfort research reveals a lack of information on human response to conditions in *transitional spaces*: courts, atria, and arcades; spaces influenced by the outdoors, but bounded by a building or conditioned space. This study focuses on one type of transitional space, the urban arcade.

Adapting methods from past field research of indoor thermal comfort, we collected data using two techniques: survey questionnaires and physical measurement. Subjects walked through two arcades and completed a thermal comfort survey. To quantify the thermal conditions of the arcade, we designed a measurement cart, containing equipment and sensors that took measurements of the physical environment as subjects completed surveys.

The arcades of Cleveland, Ohio served as a case study in which 25 occupants completed questionnaires in two arcades, one naturally ventilated, the other air-conditioned. In general, the thermal environmental conditions of the arcades met the specifications of current thermal comfort standards. A wide range of votes and large deviation between votes characterized thermal sensation voting of occupants.

INTRODUCTION

An urban arcade is a glass-covered passageway that connects two or more city streets, lined on both sides by shops. Arcades host a multitude of activities such as retail establishments, serve as passageways for pedestrians between streets, and provide protection from inclement weather. At the scale of the city, arcades play a major role in the energy use of parent buildings. Understanding the environmental conditions that produce human thermal comfort in arcades is critical to design an optimized, energy efficient arcade, but has greater implications in the design of buildings of similar type, and the construction of the urban fabric.

Past research of urban arcades has documented the thermal environment of arcades, and attempted to predict the subjective response, or vote, of occupants through mathematical modeling. (Potvin 1999, 2000) This study adds to the current body of knowledge of thermal comfort, transitional spaces, and arcades via a field study that characterizes the thermal environment of arcades, and documents actual subject response through surveys. The primary questions of this study ask:

1. *What are the ranges of thermal environmental conditions found in urban arcades?*
2. *What are the characteristics of thermal sensation voting in arcades?*

The results of this field study provide thermal comfort data for the study of arcades and transitional spaces, and quantify thermal sensation voting in arcades, potentially shaping the way we craft future thermal comfort standards and design urban form.

CONTEXT

The Climate of Cleveland, Ohio

Cleveland, Ohio is in a temperate zone of the United States at 42ºN, 82ºW. Cleveland's climate has two distinct seasons: a hot-humid summer, and a cold-dry winter. The shift in temperature between the high of summer and low of winter is extreme, averaging 52ºC.

The summer design dry bulb temperature of Cleveland is 32ºC, with a wet bulb of 22ºC. (ASHRAE, 1997) Summer design temperatures generally reach their highs in mid to late August. Field surveys of the arcades took place during Cleveland's hot season. After reviewing climate summaries and coordinating schedules with arcade management, the first survey took place on September 7, 2001. A second survey took place the following day. Temperatures on both test days reached 30ºC, 2º short of the summer design dry bulb temperature. (NOAA Climate Summary) Tests were coordinated to coincide with the warmest part of the day, early to mid-afternoon.

Arcades Surveyed

Several criteria provided the basis for selection of arcades in this study. These criteria included the selection of an air-conditioned and naturally ventilated arcade, close proximity of one arcade to the next such that subjects could walk between spaces, permission and accessibility granted by arcade owners, availability of subjects, budget, logistics, and time. Preparation for the study included researching past field studies of arcades and transitional spaces, finding and compiling a list of extant arcades, recruiting a subject group, documenting the history and original design of the arcades, and documenting changes to the ventilation and conditioning systems of the buildings. Two arcades volunteered to participate in the study, one mixed mode and the other fully conditioned.

The first of the two arcades, the Euclid Arcade, is a one-story passage connecting two 5-story office structures. The arcade is a straight corridor 400 feet long, 15 feet wide. Constructed in the beginning of the 20th Century, around 1910, it features a double shell glass roof along its full length. Currently, the arcade operates as a mixed mode space, using air-conditioning in shops, and in the main arcade space only on days in which the temperature or humidity are excessively high. (Marcus, 2001) For the purpose of the study, the HVAC system in the mixed mode arcade was disabled throughout testing with subjects, simulating the original, naturally ventilated nature of the space.

The Cleveland Arcade is a three building complex that joins two 9-story office buildings with a 5-story arcade. The arcade was completed in 1891, the collaboration of an architect and structural engineer. (Schofield, 1966) Within the last year, a private development corporation has purchased the Cleveland Arcade, investing over 50 million dollars to restore its interior. Installation of an air conditioning system was part of the renovation to the arcade's interior. The air-conditioning functioned as designed throughout testing, at set points normally used in summer. (Goeden, 2001)

METHODS

Thermal Comfort Cart

An indoor thermal comfort cart, designed for compactness to facilitate easy air travel from Oregon to Ohio, as well as mobility on site, took measurements at 1.1 meters above the floor while subjects filled out the comfort surveys. The thermal comfort cart automatically measured ambient air temperature, relative humidity, and globe temperature. Ground surface temperature, solar radiation, and air velocity were measured with hand held equipment, also at the 1.1m height. The instrument cart rolled from location to location in the arcade, and subjects filled out specific survey pages at locations in the arcade while standing in close proximity to the cart.

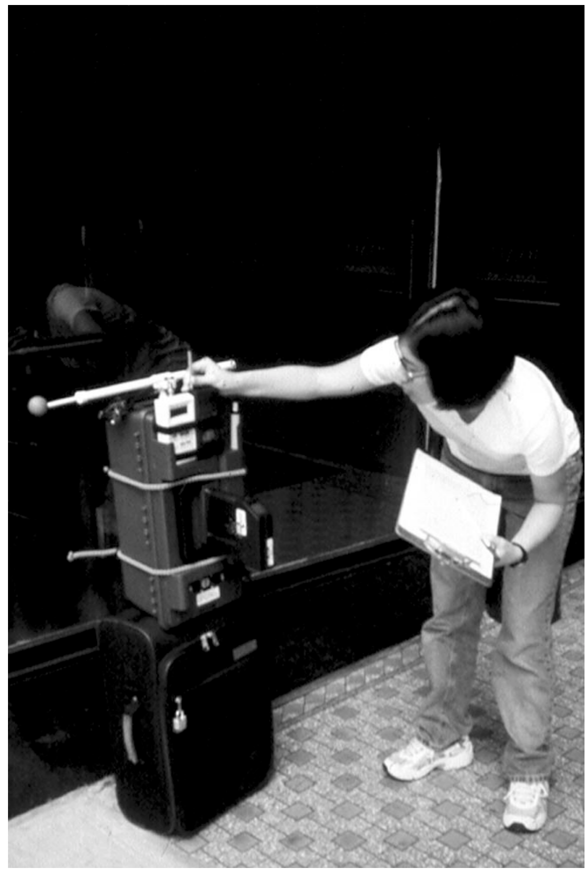


Figure 1: The Thermal Comfort Cart

The ambient air temperature probe was constructed with a Type-T thermocouple, and was accurate to 0.2ºC. The relative humidity sensor, constructed by Vaisala, was rated to be better than 5% accurate. The globe thermometer was constructed from a 38mm ping-pong ball, painted gray, with a Type-T thermocouple at the center. Measurements were recorded and stored in a Campbell 21X data logger, which was downloaded post survey to a computer for analysis.

Ground surface temperatures were measured with a Raytek Raynger infrared pyranometer, at accuracy better than 0.5ºC. Solar radiation was recorded with a Li-Cor hand held pyranometer, at an approximate accuracy of 5%, and air velocity was measured with a Vaisala hot wire anemometer, with high accuracy. These measurements were taken by hand, and entered onto preformatted data record sheets on-site.

From this data, and data from the surveys, indoor climate indices such as mean radiant temperature, operative temperature (Top) and new effective temperature (ET*) were calculated. These indices were calculated by inputting thermal environmental data from the thermal comfort cart, and data from the subjective surveys into the UC Berkeley Thermal Comfort Program, version 1.03.

Arcade Comfort Survey

The comfort survey covered four main sections, 1) demographic information 2) current status of thermal comfort, 3) thermal expectation, and 4) thermal memory. Demographic questions recorded information such as age, sex, and length of time lived in Cleveland, clothing levels, and level of activity before the survey. Current status of thermal comfort questions used standard comfort scales common to field studies of thermal comfort such as the ASHRAE 7pt. Thermal Sensation Scale, the McIntyre 3pt. Preference Scale, a 6pt. General Comfort Scale, and questions about direct acceptability in which subjects were asked to reply "acceptable" or "unacceptable" about their current thermal conditions. Questions about humidity, air movement, and direct sunlight also used preference and acceptability scales. Thermal expectation questions asked the subject to anticipate their thermal sensation before entering or exiting the arcade by recording a vote on an ASHRAE 7pt. Thermal Sensation Scale. Thermal memory questions asked the same questions as the "current" thermal comfort questions, but asked the subject to reflect on the conditions they had experienced after they had left the space.

For analysis, metabolic heat production was assumed equal in all subjects, and equivalent to walking at a steady 2km/h, which corresponds to 1.9 met or 110 W/m^2.

Table 1: Summary of Subject Samples

Arcade, Date	All	Cleveland Arcade, 9/7/01	Euclid & Cleveland Arcades, 9/8/01
Conditioning	NV & AC	AC	NV & AC
Sample Size	25	9	16
Gender (% of sample)			
Male	60.0	77.7	50.0
Female	40.0	22.3	50.0
Age (years)			
Mean	51.2	41.9	56.5
Std Dev	14.2	13.2	12.1
Maximum	80.0	59.0	80.0
Minimum	28.0	28.0	45.0
Height (cm)			
Mean	172.5	175.4	170.8
Std Dev	9.9	9.3	10.1
Maximum	190.5	189.2	190.5
Minimum	157.5	157.5	157.5
Weight (kg)			
Mean	78.0	75.3	79.7
Std Dev	18.6	21.1	17.5
Maximum	123.6	118.2	123.6
Minimum	50.0	50.0	56.8
Number of years in Cleveland			
Mean	34.9	21.7	42.4
Std Dev	16.9	12.6	14.5
Maximum	80.0	40.0	80.0
Minimum	7.0	7.0	24.0
Clothing Levels (clo)			
Mean	0.44	0.50	0.40
Std Dev	0.11	0.10	0.11
Maximum	0.73	0.73	0.62
Minimum	0.28	0.41	0.28

Subjects

Table 1 presents a statistical summary of the respondents to the arcade survey. This table describes the 9 occupants who took the survey in the fully conditioned Cleveland Arcade on September 7, 2001, as well as the 16 occupants who took the survey in the naturally ventilated Euclid Arcade and fully conditioned Cleveland Arcade on September 8, 2001. The total sample size was 25 people; none of the survey respondents took the survey more than once, and none took the survey on both days.

The majority of the survey respondents have lived in Cleveland for more than ten years. None of the respondents lived in Cleveland for less than 7 years. These results indicate that the survey respondents are familiar with Cleveland's climate, and are therefore acclimatized to Cleveland's climate.

MEASURED THERMAL CONDITIONS

Table 2 presents a statistical summary of the thermal environmental and comfort indices by arcade and date tested. These indices include operative temperature t_{op} (average of t_a and t_r), and new effective temperature (ET*).

Table 2 indicates that, the average ET* in the naturally ventilated arcade was 26.2ºC, 0.2ºC higher than the 26ºC ET* upper boundary of the *Standard 55* comfort zone. (ASHRAE, 1992)

Table 2: Summary of Indoor Climate Indices

Arcade Name	All (AC+ NV)	Cleveland Arcade (AC)		Euclid Arcade (NV)
Date of Visit		9/7/01	9/8/01	9/8/01
Number of Visits		1	1	1
Sample Size (Top)	15	5	5	5
Sample Size (ET*)	205	45	80	80
Operative Temperature (ºC)				
Mean	25.1	24.7	24.7	26.0
Std Dev	0.7	0.2	0.2	0.1
Maximum	26.2	25.0	25.0	26.2
Minimum	24.5	24.5	24.5	25.9
New Effective Temperature (ET*)				
Mean	25.3	24.8	24.8	26.2
Std Dev	0.7	0.2	0.2	0.2
Maximum	26.4	25.2	25.2	26.4
Minimum	24.6	24.6	24.6	25.9

Comparison to The Comfort Zone

Figure 2 presents operative temperature and humidity data for each arcade plotted on a psychometric chart and compared to the criteria specified by *ASHRAE Standard 55-1992* for summer conditions. Each series represents one pass through each arcade, from street, to inside the arcade, and back to the street.

After completing the surveys and thermal sweeps through all of the arcades, it was determined that the response time of the globe thermometer on the thermal comfort cart was unacceptably slow in situations of large step changes (>2ºC), and therefore could not be considered accurate at the first point of entry into each arcade. These measurement points (3 in total) are included as outliers in all figures in this paper.

Nearly all of the indoor climate measurements (92%, or 11/12 points) fell within the boundaries of the *Standard 55* comfort zone. No data points fell below the cool boundary prescribed by *Standard 55* (<23ºC ET*), or exceeded the upper humidity limit of 20ºC wet bulb. Nearly all of the outdoor climate measurements (83%, or 5/6 points) fell outside the boundaries of the *Standard 55* comfort zone. No points fell below the cool boundary prescribed by *Standard 55*, but nearly all points exceeded both the upper humidity limit of 20ºC wet bulb, and upper temperature limit of 26ºC ET*. As expected, the thermal environmental conditions in the naturally ventilated Euclid Arcade were markedly warmer than those of the conditioned Cleveland Arcade, hovering at the 26ºC ET* upper boundary of the summer comfort zone.

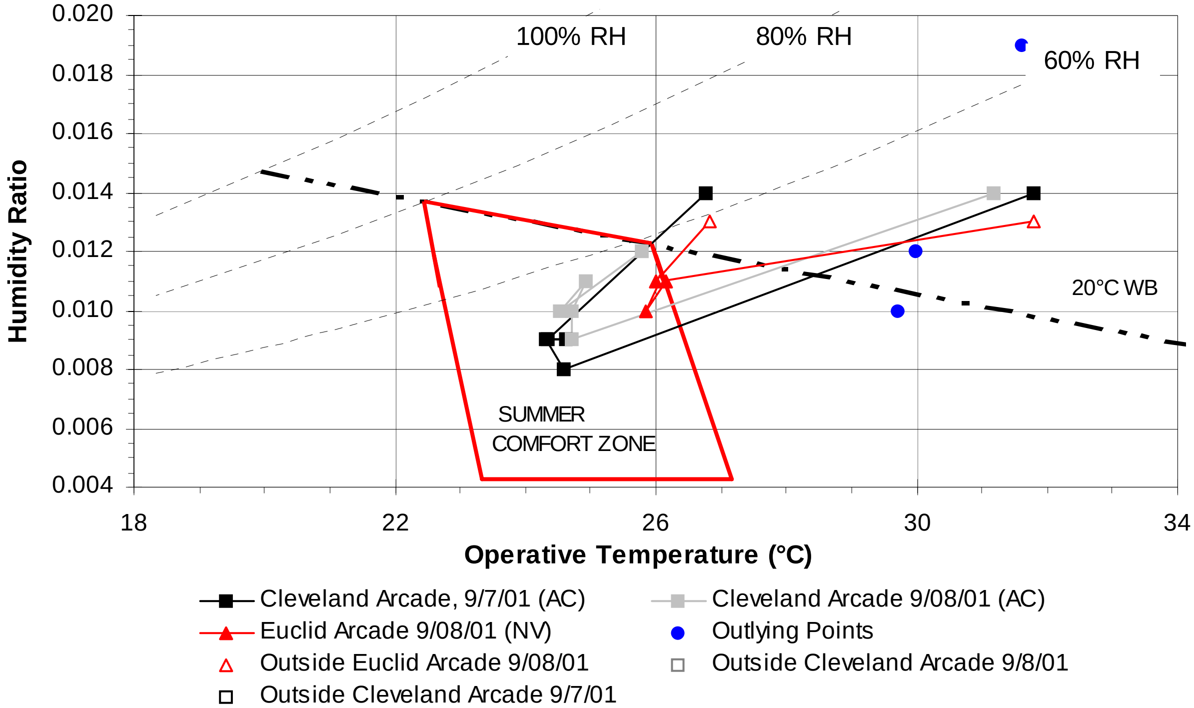


Figure 2: Comparison to the *Standard 55* Comfort Zone

THERMAL SENSATION VOTING

The mean thermal sensation vote for the subjects in the air-conditioned Cleveland Arcade was close to neutral (0.2), while subjects in the naturally ventilated Euclid Arcade had a mean thermal sensation vote close to slightly warm (1.3). The range of votes in the conditioned Cleveland Arcade was wide, from cool (-2) to hot (3). The range of votes in the naturally ventilated Euclid Arcade was slightly smaller, from slightly cool (-1) to between warm and hot (2.5).

Figure 3 is a frequency distribution of thermal sensation voting for both arcades. The top of the distribution curve for air-conditioned arcades centers on neutral (0), while the top of the curve for naturally ventilated arcades centers between slightly warm (1) and warm (2). This is consistent with the plot of thermal environment conditions on the psychometric chart of Figure 1, where the conditioned Cleveland Arcade data is centered in the

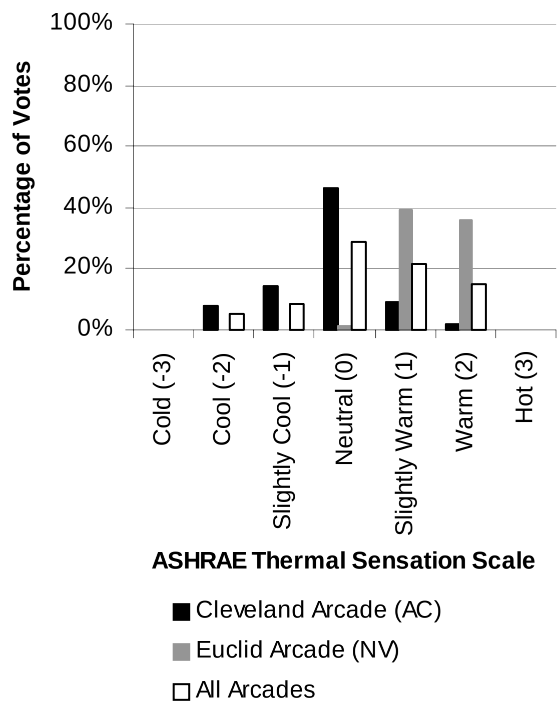


Figure 3: Frequency Distribution of Thermal Sensation Votes

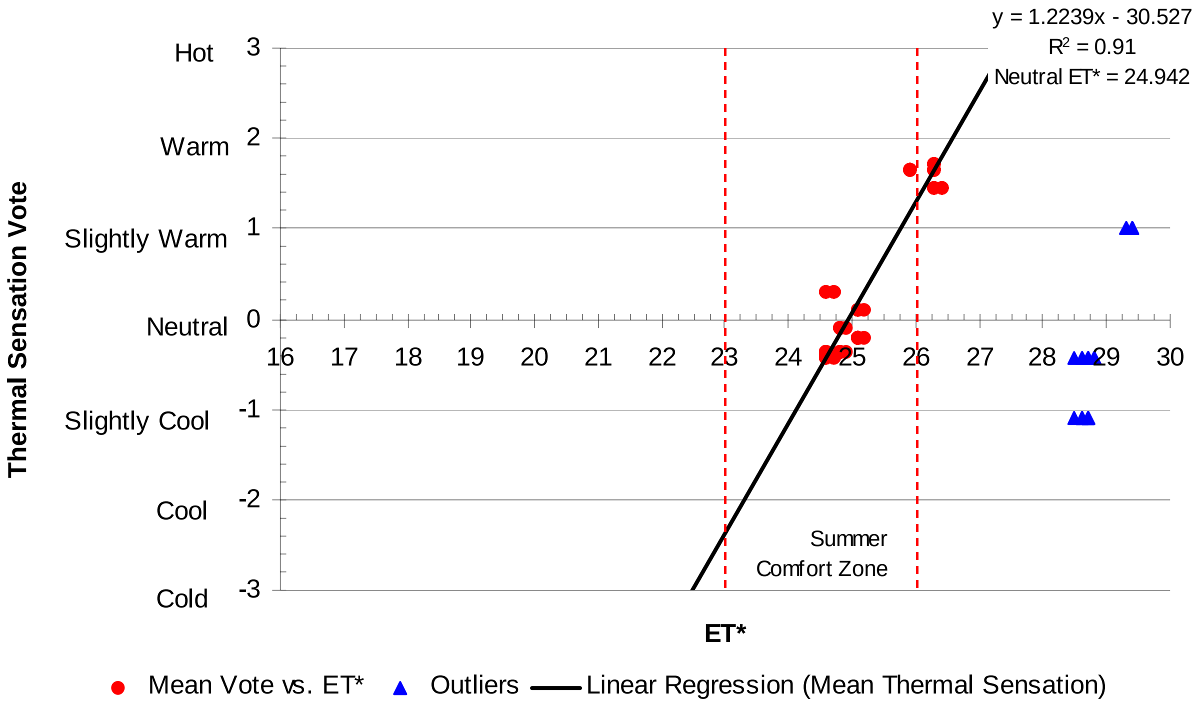


Figure 4: Linear Regression of Thermal Sensation Voting

comfort zone, and the naturally ventilated Euclid Arcade thermal environment edges towards the top of the thermal comfort zone, at 26ºC ET*.

The strength of association and sensitivity of thermal sensation votes to an indoor climate index can be quantified by using a linear regression technique. This type of analysis is common to field studies of thermal comfort. The analysis of arcade thermal sensation vote data proceeded by taking mean votes at each point in the arcade as a dependent variable, and comparing it to an independent variable, new effective temperature (ET*).

Figure 4 presents the results of this comparison, for all arcades. (Because of the small size of the subject sample, not enough data was available to create a statistically significant linear regression model for the two ventilation modes.) The regression line fitted to the data was statistically significant; the R^2 coefficient was 0.91. The subjects in all arcades had a gradient coefficient of 1.22 thermal sensation units per ºC ET*. Therefore, the subjects will experience a one-unit change in their thermal state for every 0.8ºC change in ET*. The neutral temperature of the subject sample was 24.9ºC ET*.

CONCLUSIONS

The ASHRAE 55-1992 Standard uses 23 and 26ºC ET* lines to delineate the temperature boundaries of the comfort zone on the psychometric chart. Compliance to the standard given these sets of conditions was good. Over 90% of the points measured inside the arcade complied with the standard, even though outdoor temperatures were at or exceeding the summer design dry bulb temperature.

The average ET* in the naturally ventilated arcade was 26.2ºC, 0.2ºC higher than the 26ºC ET* upper boundary of the *Standard 55* comfort zone. The average ET* in the air conditioned arcade was 24.8ºC, with a range of 24.6 to 25.2ºC.

The mean thermal sensation vote for the subjects in the air-conditioned Cleveland Arcade was close to neutral (0.2), while subjects in the naturally ventilated Euclid Arcade had a mean thermal sensation vote close to slightly warm (1.3). A regression line fitted to mean thermal sensation vote data was statistically significant; neutral temperature of the subject sample was 24.9ºC ET*, and the subjects in all arcades had a gradient coefficient of 1.22 thermal sensation units per ºC ET*.

ACKNOWLEDGEMENTS

We would like to thank John Marcus, manager of the Euclid Arcade, and Mark Goeden, manager of the Cleveland Arcade, for granting us full access to the arcades for testing. We would also like to thank Wendy Fujinaka for her help in designing and building the test equipment, as well as assisting on both days of testing.

REFERENCES

American Society of Heating, Refrigeration and Air Conditioning Engineers, 1992. ASHRAE 55-1992: Thermal Environmental Conditions for Human Occupancy. Atlanta: ASHRAE.

American Society of Heating, Refrigeration and Air Conditioning Engineers, 1997. ASHRAE 55-1992: Thermal Environmental Conditions for Human Occupancy. Atlanta: ASHRAE.

Goeden, Mark, 2001. Interview regarding the Cleveland Arcade, June, 2001.

Marcus, John, 2001. Interview regarding the Euclid Arcade, June, 2001.

National Oceanic and Atmospheric Administration. *Local Climatological Data, Monthly Summaries*, September 2001.

Potvin, Andre. 1999. The Thermal Environment of 19th Century Arcades. Paper read at edra 30/1999, at Orlando, Florida.

Potvin, Andre. 2000. Assessing the microclimate of urban transitional spaces. Paper read at PLEA 2000, July 2000, at Cambridge, UK.

Schofield, Mary-Peale. 1966. The Cleveland Arcade. *Journal of the Society of Architectural Historians* 25 (4): 281-291.

UC Berkeley Thermal Comfort Program 1.03 . UC Berkeley, Berkeley.

Design and Experimental Analysis of Ventilated Walls and "Ice House" Roofs Applications in Warm Climates

Jason C. SHIH, Ph.D.*
Philip W. FAIREY, M. Arch.**
Jeffrey A. SHIH, B.S. ***
Louisiana State University
jshih2@lsu.edu

.

ABSTRACT

This paper contains the findings of experimental research conducted to determine the effectiveness of ventilated walls and "ice house" roof applications in hot-humid climates. Ventilated wall and "ice house" roof is the type of construction which consists of interposing an additional wall or roof skin between the standard building envelope and the exterior environment. The new skin is separated from the building envelope by an air space, which is usually vented to the ambient environment. The primary objective of such construction is to eliminate or drastically reduce the effects of solar loading on the building envelope. The information presented in this paper can enable the designer to have a better understanding of how buildings might function at various times of the day and the season. Recommendations on applications of new buildings and retrofit of existing structures are presented here as well.

* Professor, School of Architecture and Director, Office of Building Research
Louisiana State University, Baton Rouge, LA, USA
** Principal Research Scientist and Deputy Director, Florida Solar Energy Center, Cape Canaveral, FL, USA
***Research Associate, College of Engineering, LSU
Now-Medical Student at the School of Medicine, Emory University

---

INTRODUCTION

To understand what measures can be taken to conserve energy through passive solar building design, the underlying causes of heat gain and loss must be examined. In warm climates, the primary problem in designing the building shell is how to reduce summer heat gain. Further north the primary problem is how to reduce winter heat loss.

The way heat transfers is distinctly different during the winter and summer seasons. For this reason the insulation strategy must be fine-tuned to take advantage of the correct mix of summer/winter severity. What works in the north to reduce energy costs does not necessarily work well in hot humid climates.

Heat flow in buildings is a complex subject that is best described with three physical laws of heat transfer from a warm to a cool area: conduction, convection and radiation. A basic group of these three principles helps in the understanding of requirements to reduce energy consumption.

Conduction and convection occur only through such mediums as air, glass, foam, etc. Radiation, however, can transfer without medium. Bodies need only 'see' each other for thermal transfer by radiation.

Typically, insulation design strategies attach the problem of summer heat gain by reducing convection and conduction. Walls, ceilings and windows only are traditionally protected from conduction and convection, ignoring radiant heat flow, which contributes most significantly to heat gain. Part of the reason radiation has been ignored until now is that only a small research base was available and because of the complexity of the calculations to adequately model a structure.

The Office of Building Research at LSU and Florida Solar Energy Center under a contract conducted a series of tests to determine the effectiveness of radiant barriers in reducing heat gain in typical roof and wall configurations.

METHODS OF TESTING

The basic experimental tool employed for this project was Passive Cooling Laboratory (PCL) of Florida Solar Energy Center (FSEC), which provides for controlled side-by-side building component experiments. Results were additionally compared with field monitoring results from three lived in residences in Orlando, Florida. Side-by-side testing is designed to indicate the relative performance of a particular alternative with respect to a given base case. The base case or control strategy is held constant throughout the experimental process and is used as the "yardstick" for the performance of alternative strategies. Both roof strategies and wall strategies were tested. For roofs, a standard frame roof with 6 in of fiberglass batt insulation was used as the base case. For wall system experiments, standard 2 x 4 in. frame wall construction with R-11 (thermal resistance value is 11 hr. sq. ft. °F/BTU) batt insulation functioned as the standard against which other wall types were compared.

FIELD TESTS

Three residences in Orlando, Florida have been retrofitted using foil radiation barrier techniques. One residence (Alas house) has employed a multiple layer foil radiation barrier product in the attic. It is manufactured in various widths to be installed between normal building framing members. This product was installed between the top chords of the roof trusses of the Alas house and stapled in placed. A continuous ridge vent was added to the roof peak of the residence to increase ventilation between the roof decking and the foil radiation barrier.

A second residence (Schoonmaker house) was retrofitted using a concept known as the vent-skin or "ice-house" roof. This technique consists of adding an additional roof above an existing roof plane. The two roof planes are separated by an air space, which is vented at the soffit and at the roof peak. As part of the retrofit project the Schoonmakers added additional space to their existing house. The new roof framing was sheathed with dennyboard. On top of the dennyboard, 2 x 2 in. vertical battens were applied to act as spacers between the dennyboard and a standard 1/2 in. plywood and shingle roof. A continuous ridge vent was employed at the roof peak.

The third residence (Castles house) was retrofitted with a similar roof. The old shingles were stripped off and a single layer of builder's foil was laid on top of the existing plywood roof deck. After application of the builder's foil, 2 x 2 in. vertical battens and a 1/2 in. plywood and shingle roof were applied as in the Schoonmaker house. Again a continuous ridge vent was used to ventilate the air space.

In addition to the roof of the Castles house, a radiation barrier vent-skin was employed in the retrofit of the west-facing wall of the residence. In a similar manner as in PCL tests, the uninsulated concrete block wall was covered on the exterior with a single layer of double-sided builder's foil.

Two 2x 2 in. vertical batten strips were then attached through the foil to the block wall. A reinforced 5/8 in. stucco finish backed with 30 lb. felt was then applied to the battens as the exterior finish. The wall was vented at the top and bottom with continuous vents.

TESTING RESULTS AND CONCLUSIONS

The results of the analytical studies performed with computer simulations sometimes showed a significant divergence form the experimental data. The most notable example of this occurred in the modeling of radiation barriers. Temperature distributions resulting from TNODE ventilated-skin radiant barrier roof systems often diverged from experimental data by a factor of two. The computer simulations showed temperature depressions on the order of 25 °F for these roof systems while monitoring results often indicated depressions of up to 60 °F.

No attempt was made to adjust the model to the measured data for two reasons:

1. It is still somewhat unclear exactly how the radiative heat transfer process is affected by the convective heat transfer process and vice versa, and

2. The model does not currently allow for the non-linear modelling of temperature dependent heat transfer coefficients.

The second constraint is especially critical to roof/attic modelling where temperature differences can be quite high and can have extensive diurnal swing patterns 100 °F. Modeling of radiant and convective fields in attics is even further complicated by the fact that convective transfer in such spaces is not only temperature dependent, but also directionally dependent (i.e., there are different non-linear functions for heat transfer upward and heat transfer downward).

WALL CONFIGURATIONS

The four wall configurations, which were studied include:

1. An uninsulated concrete block wall (R-2.5)*.
2. A concrete block wall with exterior insulation (R.8)*.
3. An uninsulated vent-skin concrete block wall with radiant barrier (R.5)*.
4. A reference frame wall (R-ll)*.

For convenience, these walls are referred to as concrete block wall, exterior insulated wall, vent-skin wall, and frame wall, respectively.

Representative test data in Table I for the wall configurations under summer sunlit conditions are shown. The following preliminary conclusions were reached.

1. The uninsulated concrete block wall was significantly less effective than the other configurations including the frame wall.

2. The vent-skin and exterior insulated concrete wall performed equally well under free-float test conditions (i.e., with unconditioned interior spaces).

3. The effectiveness of the vent-skin wall is primarily due to the radiant due to the radiant barrier, rather than airflow through the vent. Consequently, the use of a dead airspace with a radiant barrier is only slightly less effective than the vented configuration.

4. No clear alternative (between the frame, vent-skin and exterior insulated block walls) stands out yet as the best wall configuration for year round energy savings.

ROOF/ATTIC CONFIGURATIONS

The three roof configurations, which were studied, included:

1. An unventilated reference standard (R-19) roof with 6" fiberglass ceiling insulation.
2. The same roof with the addition of single-sided builders foil as a radiant barrier, and
3. A ventilated-skin (double) roof with a radiant barrier and ridge vent.

For convenience they will be referred to in the following discussions as:
Standard roof, radiant barrier roof, and vent-skin roof, respectively.

Resulting test data for the three roof configurations under summer sunlight conditions are shown. In addition, a much more detailed description of radiant barrier performance is presented in Reference 3. Preliminary conclusions are as follows:

1. Normal ceiling insulation products (e.g., fiberglass, mineral fiber, etc.) absorb significant amounts of radiant energy emitted by the underside of roof decks.

2. Attic heat transfer down is driven primarily by radiant heat transfer. Less than 10% convection is involved.

3. One single-sided aluminum foil radiant barrier can reduce the heat gain into an unconditioned building by over 40% under bright sunlight conditions compared to the standard roof.

4. Both the radiant barrier roof and vent-skin roof significantly reduce heat gain to the building compared to the standard roof.

5. Single foil radiant barriers will theoretically work almost as well as double or triple foil barriers in roofs. However, the winter season performance of these barriers has not been experimentally examined.

6. The use of aluminum foil radiant barriers appears to be one of the most simplest and cheapest energy improvements to a home.

The results of full-scale experiments are very well supported by the hotbox test results. Table 2 indicates the relative effectiveness of various attic/roof insulation strategies based on hotbox tests. The table is expressed in terms of relative effectiveness. Each ratio is expressed in terms of the effectiveness of R-19 plain fiberglass batt. In other words, the measured heat flux through the plain fiberglass batt is divided by the measured heat flux through each alternative giving a relative effectiveness for each. If the true resistance of the plain fiberglass batt (with foiled vapor barrier facing down toward ceiling) is known the other resistances can be determined by multiplying that resistance by the given effectiveness ratio.

DESIGN/CONSTRUCTION CONSIDERATIONS IN WARM CLIMATES

It is now well accepted that good building design is climate dependent. Designers and builders of structures must keep this fact uppermost in their minds. It is important that the information contained in this paper not be taken out of context climatically.

Armed with a knowledge of the climate, many of the "trends" indicated by the data presented here can enable the designer to have a better understanding of how his building might function at various times of the day and the season.

Applications of radiant barriers do not require any radical change in existing design practices. They are simply installed between the roofing and interior of any residential or commercial structure. This gives the designer a wide latitude in deciding where to place the product. The best location in most buildings will be either on the top or the bottom of the rafters with at least a 3/4 in. air space adjacent to the highly reflective (low emissivity) surface, which can face either, up or down with the same effect. Radiant barriers offer simple and cost effective solutions to existing energy problems in hot-humid climates.

TABLE 1 Effective Resistances of Walls

WALL TYPE	MEASUREMENTS FROM	TO	MEAN TEMP. °F	MEAN TEMP. DIFF. °F	TOTAL HRS. OF DATA COLLECTED	LAG TIME Hr.	EFFECTIVE RESISTANCE Hr.Sq.Ft.°F/BTU
Uninsulated Block	Exterior Surface	Interior Surface	83.5	5.2	55	4	5.0
Insulated Block	Exterior Surface	Interior Surface	83.2	9.1	44	4	12.7
Vent-skin Block	Exterior Surface	Interior Surface	82.9	6.9	67	4	13.5
Frame Wall	Exterior Surface	Interior Surface	87.9	16.0	44	2	*5.7

* Resistance values for this frame wall are quite low. We are unsure of the cause of this but believe that moisture levels in the exterior environment may be a contributing factor since the vapor barrier is on the interior. Calculated steady-resistance values around 10. Little confidence should be placed on this value unit its origin is determined.

TABLE 2 Effectiveness Ratios of Three Attic/Roof Insulation Strategies

Strategy	Effectiveness Ratio
Plain fiberglass batt (R-19)* (raw fiberglass facing radiating surface)	1.00
Single foil layer (double sided foil with air space on both sides of foil)[Ice house roof]	1.42
Foil faced fiberglass batt (R-19)* (with foil and air space facing radiating surfaces)	1.82

*R-19 means the thermal resistance value is 19 hr.sq.ft. F/BTU

REFERENCES

SHIH, Jason C.: Louisiana Solar Design Notes, Published by Louisiana Department of Natural Resources, Baton Rouge, LA. Revision 2000

FAIREY, W. P. and SHIH, Jason C.: Final Report on Ventilated Walls and Ice House Roofs Testing under contract No.FSEC-CR-65 between the Office of Building Research, LSU and the Florida Solar Energy Center.

SHIH, Jason C. and FAIREY, W.P. : Analysis of Ventilated Walls and Ice House Roofs, Architectural Science Review, Volume 30.3, pp73-76, University of Sidney, Australia

VENTRE, G. G., et. al.: Establishing a Design and Data Base for Passive/Hybrid Solar Cooling in Warm, Humid Climates. Proceedings of 1982 ASME Solar Division Conference, Albuquerque, NM 1982.

FULLER, E. F. and MCFARLAND, R. D.: Passive Solar Test Modules. Los Alamos National Laboratory Report No.LA-9421-MS, Los Alamos NM 1982.

FAIREY, P. W. and KALGHCHY, S., Evaluation of Thermocouple Insulation and Mounting Techniques for Surface Temperature Measurement in Dynamic Environments. Proc. of Seventh National Passive Solar Conference, Knoxville TN,1982.

HOUSTON, M. M., FAIREY, P. W., and GONZALES, E.: Computer Simulations of East/West Wall Design Options for Warm, Humid Climate. Proceedings Seventh National Passive Solar Conference, Knoxville TN.

FAIREY, P. W., "Effects of Infrared Radiation Barriers on the Effective Thermal Resistance of Building Envelopes". Proc. ASHRAE/DOE Thermal Performance of- Exterior Envelopes of Buildings II Conference, Las Vegas 1982.

BROWN, W. C. and SCHUYLER G. D.: In Situ Measurements of Frame Wall Thermal Resistance, ASHRAE Transactions, Vol. 1, pp. 667-676.

Many of the concepts incorporated in vent-skin walls are covered by U.S. Patent #4,286,420 held by Panayiotis D. Pharmakidis, 7623 Bonniebrook, Sylvania, Ohio 43560.

ACKNOWLEDGEMENTS

The work was accomplished by the Florida Solar Energy Center and the Office of Building Research, School of Architecture at Louisiana State University under a contract funded by the U.S. Department of Energy, and the Louisiana Department of Natural Resources. The authors wish to thank the funding agencies, which made the results possible.

Six Modes for Digital Media in Design

Wanda DYE
Georgia Institute of Technology Architecture Program
Wanda.dye@arch.gatech.edu

As a point of departure, through the use of Italo Calvino's *Six Memos for the Next Millenium*, I would like to establish a framework for my own research, teaching, and practice in terms of digital media and its role in design processes and productions. Calvino's six memos are ***Lightness, Quickness, Exactitude, Visibility, Multiplicity,*** and ***Consistency***.[1] It is through these *memos*, [which I would like to term *modes*], that I propose to investigate digital media and design within a critical framework for research, teaching, and practice. Through this rigorous yet potentially unbounded framework I will attempt to provide for a continuous reworking and redefining of the understanding of the role of digital media in design. Hopefully this strategy will develop a multiplicity of potential lines of inquiry in terms of increasing creative and agile use of digital media in design. For this particular presentation I will refer to examples of digital media in design teaching and practice that I feel exemplify these modes explicitly as well as implicitly and help to further this particular investigation, although not to propose a particular teleological condition.

It is through these modes, ***Lightness, Quickness, Exactitude, Visibility, Multiplicity,*** and ***Consistency*** that I intend to develop a poetics of digital media and design. Below I have formulated a working definition of the term ***mode*** in terms of quality and operation which I use instead of ***memo***. This formulation is intended to locate 'mode' more specifically within the context of this particular investigation, as well as enable the investigation to move back and forth between all three terms.

Quality - *"An attribute, a property, a special feature or characteristic. A manner, a style."*[2]

Operation - *"An action. Exertion of force or influence; working, activity."*[3]

Mode - *"A way or manner in which something is done or takes place; a method of procedure; a means."*[4]

Quality + Operation = Mode

---

[1] Italo Calvino, Six Memos for the Next Millennium.
[2] The New Shorter Oxford English Dictionary, vol. 2, p. 2438
[3] Ibid., p. 2005
[4] The New Shorter Oxford English Dictionary, vol. 1, p. 1802.

Lightness

"Whenever humanity seems condemned to heaviness, I think I should fly like Perseus into a different space. I don't mean escaping into dreams, or into the irrational. I mean that I have to change my approach, look at the world from a different perspective, with a different logic and with fresh methods of cognition and verification. The images of lightness that I seek should not fade away like dreams dissolved by the realities of present and future…"[5]

Lightness – "The quality or fact of having little weight; agility, nimbleness, quickness; ease, facility, readiness, esp. of belief; grace, elegance, delicacy."[6]

Lightness, in terms of quality is digital media's ability to explore light with all of its ephemeralities and permutations. Through digital 3-D modeling, one can experiment with an infinite variety of light qualities. Also through the many degrees of transparencies and reflections one can experiment with different materialities in tandem with specific light qualities with an agility and ease that may not be possible through large scale physical models, many of which gain a certain personal attachment merely through the time and labor that inevitably taints one's experimental attitudes toward lightness and poetics. Even less sophisticated software, such as Photoshop, has the ability to create an infinite variety of creative images through varying degrees of transparencies, opacities, brightnesses, contrasts, colors, etc., and through various light processes and filters. In addition, video and digital editing software capture light and shadow with an accuracy and an immediacy less attainable through physical drawing.

Lightness, in terms of operating with digital media and design, comes with a paradoxical balance of experience and naiveté. As a teacher and practitioner of design I personally do not have a vested interest in learning all the technical language of the computer or the thousands of commands that it performs. But through experimentation over time I have been able to develop a familiarity with many of these commands and a menu of operations that I am able to continually expand upon. For example, when one sits in front of the computer with a sketch and says, 'this is what I want to draw, build etc…,' one automatically falls into a weighty attitude of operating that has nothing to do with the reciprocity of digital media and the design; only with what that designer wants to do a priori with little room for learning, growth, or experimentation. Can we use digital media with the lightness of a gestural sketch, and yet with the precision of the constructed drawing? How can digital media afford us that "different perspective, with a different logic and with fresh methods of cognition and verification?"

---

[5] Calvino, <u>Six Memos for the Next Millennium</u>, p. 7.
[6] <u>The New Shorter Oxford English Dictionary, vol. 1</u>, p. 1587.

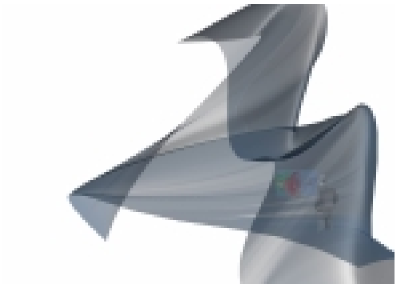


Fig. 1

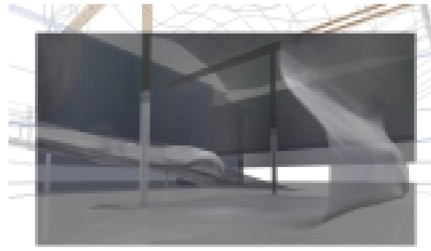


Fig.2

Quickness

"Speed and conciseness of style please us because they present the mind with a rush of ideas that are simultaneous, or that follow each other so quickly they seem simultaneous, and set the mind afloat on such an abundance of thoughts or images or spiritual feelings that either it cannot embrace them all, each one fully, or it has no time to be idle and empty of feelings. The power of the poetic style, which is largely the same thing as rapidity, is pleasing for these effects alone and consists in nothing else. The excitement of simultaneous ideas may arise either from each isolated word, whether literal or metaphorical, from their arrangement, from the turn of a phrase, or even from the suppression of other words and phrases."[7]

Quickness – *"The quality of being quick, rapidity."*[8]

What could be a better mode to discuss in terms of digital media and design than quickness? The computer's quickness, its ability to render, construct, and visualize with the click of a mouse, affords a more fluid and less cumbersome attachment to a particular design. The deftness of moving back and forth through different views, colors, reflections, etc. affords an array of design options quickly. This 'simultaneousness' of images initiates a quickness of ideas and evocations of space and material with a fluidity that keeps the designer from being bogged down within an overarching a priori static position. Through the quickness of digital media, one encounters an apparatus that extends and opens up other visions and perceptions. This is not to say that quickness is always better, however, there is something about an image emerging so quickly and effortlessly that it may precipitate a eureka moment within the process and production of design ideas.

Video and video editing software also have tremendous potential when using quickness as a mode of representation. Through accelerating video with the aid of digital editing software, unforeseen patterns may emerge that may not have otherwise been noticed by the human eye or ear. It is through the quickness of digital media's apparatus and modes of representation that the possibilities and potentials open up other lines of design inquiry that may not have been obtained through the slowness of more physical, static modes of representation.

Fig. 1, 2 – Flexible "skin" design for an art gallery interior by author's student, Catalina Victoria. Through the use of digital 3D modeling and Photoshop the student was able to experiment with "light" and "gestural" non-normative geometries, as well as the effects of "light" on different translucent materials.

[7] Calvino, Six Memos for the Next Millennium, p. 42.

[8] The New Shorter Oxford English Dictionary, vol. 2, p. 2448.

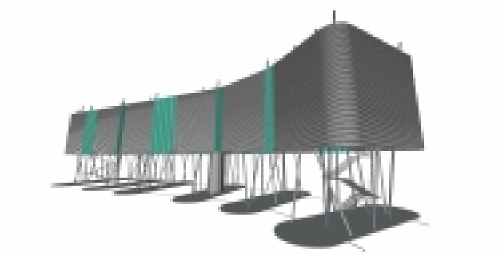


Fig. 3

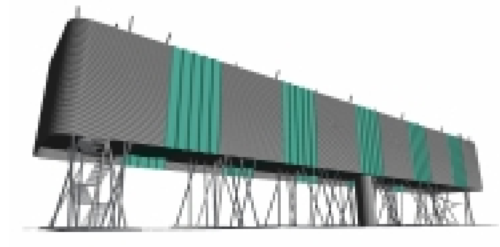


Fig. 4

Exactitude

"From the moment I wrote that page it became clear to me that my search for exactitude was branching out in two directions: on the one side, the reduction of secondary events to abstract patterns according to which one carry out operations and demonstrate theorems; on the other, the effort made by words to present the tangible aspect of things as precisely as possible."[9]

"For example, Giacomo Leopardi maintained that the more vague and imprecise language is, the more poetic it becomes. I might mention in passing that as far as I know, Italian is the only language in which the word vago (vague) also means 'lovely, attractive.' Starting out from the original meaning of 'wandering,' the word vago still carries an idea of movement and mutability, which in Italian is associated both with uncertainty and indefiniteness and with gracefulness and pleasure." [10]

Exactitude - "Accuracy; attention to small details." [11]

What is interesting about this particular mode is its multivalent definition. In terms of exactitude, digital media has tremendous capabilities of moving back and forth between abstraction and detail instantaneously. For example, through the operation of the zoom in many computer aided design programs one can understand the design as an abstract diagram or as a precise detail. Micro worlds are embedded within macro worlds in the space of digital media. It is this ability to move back and forth between these two worlds precisely without losing information along the way that facilitates design from conceptualization, to the final detail; from initial generative seeds to full fruition of a design. It is precisely the movement and mutability between these worlds that allows a poetics to emerge, through an 'indefiniteness' *and* 'tangibility'.

Fig. 3, 4 – Fast food prototype design by author's student, James Fullton. Through the use of digital 3D modeling the student was able to "quickly" manipulate the prototype into many different configurations.

[9] Calvino, Six Memos for the Next Millennium, p. 74.

[10] Ibid. , p. 57.

[11] The New Shorter Oxford English Dictionary, vol. 1., p. 869.

Video and video editing software also afford exactitude through operating back and forth between haptic worlds of abstraction and hyper-realization. Both of these are very different perspectives, but nevertheless no less ‘exact’ than the other in terms of use. Again, it is digital media’s intrinsic potential to be both vague *and* precise simultaneously and instantaneously that gives it an exactitude.

Fig. 5

Fig. 6

Visibility

“In devising a story, therefore, the first thing that comes to my mind is an image that for some reason strikes me as charged with meaning, even if I cannot formulate this meaning in discursive or conceptual terms. As soon as the image has become sufficiently clear in my mind, I set about developing it into a story; or better yet, it is the images themselves that develop their own implicit potentialities, the story they carry within them.”[12]

Visibility – “The condition, state, or fact of being visible; visible quality; ability to be seen; sight; the exercise of visual perception.”[13]

Visibility is probably one of the most important modes within design. I am not just referring to final visualizations through photorealistic renderings of a design. I am particularly interested the creative processes and potentials through imaging and visualization as “eidetic operations.” James Corner in his article “Eidetic Operations and New Landscapes” states: “Imaging has a metaphoric agency in that the [mostly arbitrary] bringing together of two or more elements fosters a host of associative possibilities… Such eidetic images are fundamental stimuli to creativity and invention;”[14] What is particularly interesting is how these operations act as catalysts, initiating and enabling one to think about how an image may translate and transform into a physical

---

Fig. 5,6 – Bus stop prototype design by author’s student, J. C. Elder. Through the use of digital 3D modeling the student was able to show detail with “exactitude”, as well as the overall design within the same model/drawing. Digital modeling also enabled him to experiment with “exactitude” the different reflectivities and transparencies of materials in order to “visualize” many different design possibilities.

[12] Calvino, Six Memos for the Next Millennium, p. 89.

[13] The New Shorter Oxford English Dictionary, vol. 2., p. 3588.

[14] James Corner, “Eidetic Operations and New Landscapes”, Recovering Landscape, ed. James Corner, p. 163.

construction. Digital media's ability to render many different atmospheres through light and material simultaneously and instantaneously enables the designer to visualize more accurately the repercussions of such design choices. This fluidity and agility again facilitates the design process as well as opens up other potentials and possibilities that may not have been as easily acquired through physical drawing and modeling.

Fig. 7

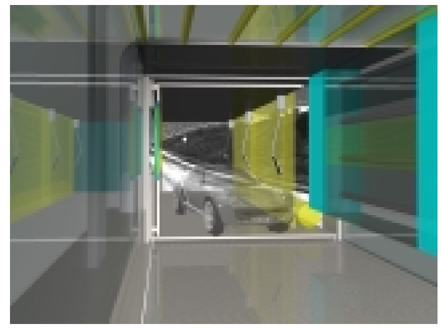


Fig. 8

Multiplicity

"What tends to emerge from the great novels of the twentieth century is the idea of an open encyclopedia, an adjective that certainly contradicts the noun encyclopedia, which etymologically implies an attempt to exhaust knowledge of the world by enclosing it in a circle. But today we can no longer think in terms of a totality that is not potential, conjectural, and manifold."[15]

Multiplicity – "The quality or condition of being multiplex or manifold; manifold variety." [16]

Digital media's intrinsic quality to produce many different variations of a design affords a more open ended process. These many variations enable one to think in terms of an 'open encyclopedia,' or a series of ideas versus an over arching 'totality,' or an end all solution. Through the operations of iteration, permutation, and reproducibility that digital media affords, multiplicity as a mode for digital media makes perfect sense. Multiple views, multiple colors, multiple materials, multiple sites, etc. are produced and reproduced through the aid of digital media more quickly than physical drawing and modeling.

Fig 7, 8 – Fast food prototype design by author's student, Dara Douraghi. Through the use of digital 3D modeling and Photoshop the student was able to "quickly" "visualize" different scenarios and perspectives during the entire design process of the drive thru prototype.

[15] Calvino, Six Memos for the Next Millennium, p. 116.

[16] The New Shorter Oxford English Dictionary, vol. 1, p. 1857.

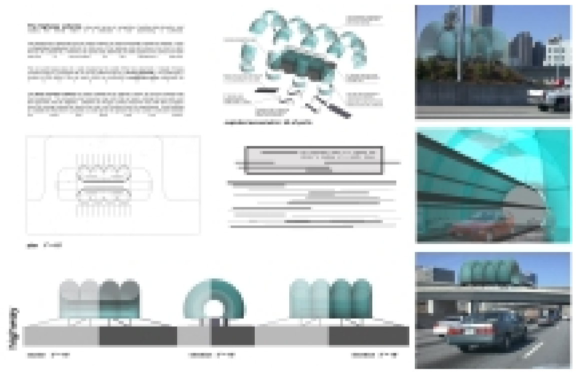


Fig. 9

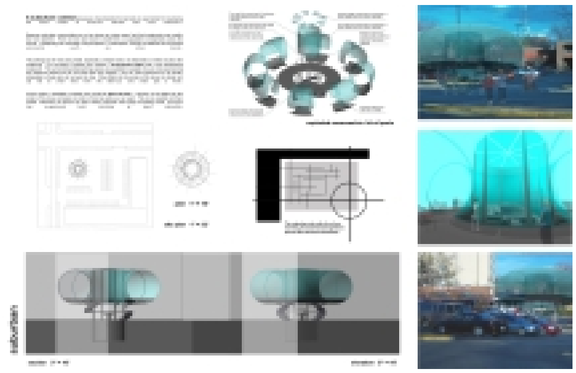


Fig. 10

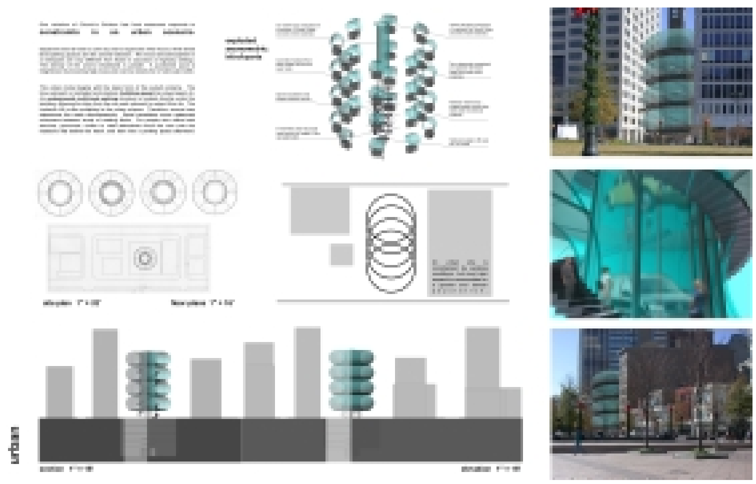


Fig. 11

Video and video editing software are also modes of multiplicity. For example, Diana Agrest in “Representation as Articulation: Between Theory and Practice” states: “Given the nature and the characteristics of the contemporary city, and urban culture, the mode of its representation needs to be rethought. There need to be different modes of representation in order to account for the multiplicity of the contemporary city, the complex and fragmentary quality of the urban realm. Some aspects can be represented by a drawing, or even a model or a particular notation; other aspects require transcending the exclusivity of the visual, so that other media, like film and video, become necessary.”[17] Video and video editing software have tremendous potential and possibilities of “representation as articulation,” as Agrest states, precisely through capturing light, sound, time, and movement, all of which are tremendous contributors to our experiences of space. Thus these qualities should be intrinsic to the design process and production of space.

Fig. 9, 10, 11 – Fast food prototype by author’s student, Christina Luu. Through the use of digital 3D modeling and Photoshop the student was able to design “multiple” prototypes “quickly” because of digital media’s innate quality of “multiplicity” through reproduction.

[17] Diana Agrest, “Representation as Articulation”, Practice: Architecture, Technique and Representation, ed. Stan Allen, p. 174.

Fig. 12

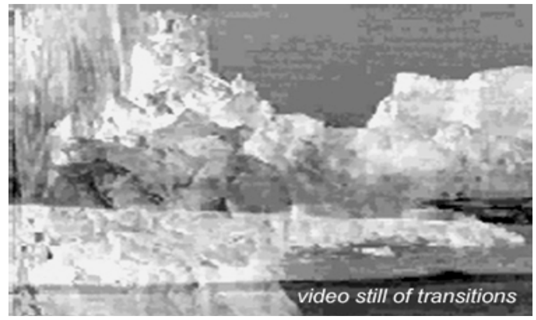


Fig. 13

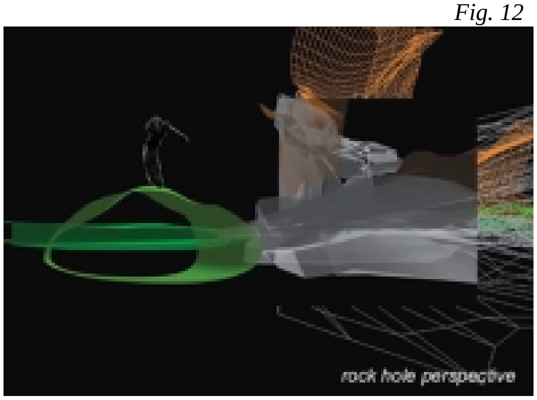


Fig. 14

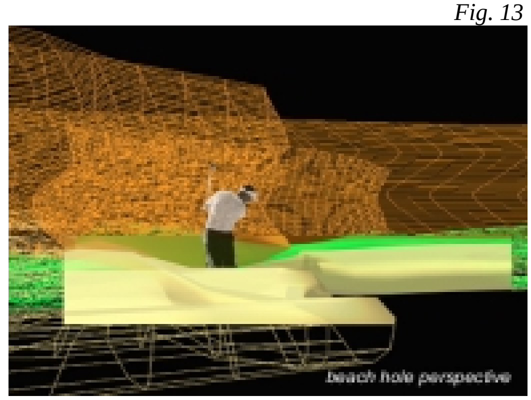


Fig. 15

Consistency = Conclusion

Consistency – "The agreement of parts or elements with each other, esp. as a personal attribute in life or conduct; constancy of principle."[18]

Calvino did not write on the sixth memo ***Consistency*** before his death, but…this ongoing investigation can be described as an attempt to develop a ***consistency*** of poetic practice in the use of digital media as a designer and a teacher. I believe that the modes I have outlined will continue to provide a critical framework within which I may continue to operate. These new media are alternatives for a designer and a teacher in the conceptualization and construction of space within the complexities and multiplicities of the design process and production; especially within our contemporary built landscapes.

The use of these new modes of "representation" is intended to transcend, not dismiss, nor merely extend, more conventional modes of representation such as physical modeling, sketching, drawing, etc. It is also intended to move beyond "representation" in that it acts as a catalyst within the design process rather than simply as "representations" of a final product, and, may perhaps be valid as a project and/or a production of space in and of itself; not necessarily just a "representation" of something else.

Fig. 12, 13 – Video stills by author, Wanda Dye. The video titled "cityscape/landscape" documented from the car, the landscape of the highway juxtaposed and superimposed with the cityscape of the city.
Fig. 14, 15 – Digital 3D models by author, Wanda Dye. The golf course program and design ideas emerged from the video "cityscape/landscape" aforementioned. Through the use of digital modeling I was able to more easily construct topological/landscape forms and spaces, as well as visualize and move through them through the unlimited generation of perspectives and animation.

[18] The New Shorter Oxford English Dictionary, vol. 1, p. 486.

Bibliography

Agrest, Diana, “Representation as Articulation: Between Theory and Practice”, in Practice: Architecture, Technique and Representation, ed. Stan Allen, G+B Arts International, 2000.

Calvino, Italo, Six Memos for the Next Millennium, New York, Vintage Books 1988.

Corner, James, “Eidetic Operations and New Landscapes”, in Recovering Landscape: Essays in Contemporary Landscape Architecture, ed. James Corner, New York, Princeton Architectural Press 1999.

The New Shorter Oxford English Dictionary vol. 1 & 2, ed. Lesley Brown, Oxford, Clarendon Press 1993.

An architectural Shift+F7
Supporting Concept Development Through Design Cases

Ann HEYLIGHEN
Katholieke Universiteit Leuven, Dept. of Architecture
Ann.Heylighen@asro.kuleuven.ac.be
Nicole SEGERS
Technische Universiteit Eindhoven, Design Systems Group

Abstract

This paper describes the linking of Idea Space/E3dAD, a system that captures and interprets the architect's ideas with DY*N*AMO, a dynamic memory of design cases, to support concept development in architectural design. So far, a major obstacle for the breakthrough of digital case bases like DY*N*AMO has been the separateness of these tools from the architect's working environment. Having to leave this environment to consult a case base inconveniently interrupts the design process. The remedy proposed in this paper was inspired by the Shift+F7 shortcut in Ms Word®. Just like this shortcut allows authors to look up synonyms in a thesaurus without having to leave the text, linking Idea Space to DY*N*AMO enables architects to trigger case retrieval 'en passant', that is during the very act of designing.

1 Intro – supporting concept development in architectural design

Implicitly or otherwise, every tool that aims at supporting architects' design process implies a value judgement of architecture. There are different viewpoints to assess the value of architecture, and along with the viewpoint the judgement may vary. At one time in history considerations of form determined architectural quality, later functional ones. Today we assume that what makes an architectural design valuable is its underlying idea. As Bryan Lawson contends, "Good designs often seem to have only a very few major dominating ideas which structure the scheme and around which other relatively minor considerations are organized" (Lawson, 1994). There is nothing wrong with taking this view, provided we are clear about it being *our* view at *this* moment.

The ideas underlying an architectural design are known to architects by many names, ranging from 'image' (Alexander, 1979) over 'primary generator' (Darke, 1978) to 'organising principle' (Rowe, 1987), but most often are called the 'parti' (Leupen e.a., 1997) or 'concept' (Lawson, 1994). They do not necessarily require the addition of an extra ingredient. In fact, every aspect already present in the design situation, e.g. a special feature of the site or programme, or a curious trait of the client, may qualify for this role. Moreover, underlying ideas are rarely found in the singular. In the Institut du Monde Arabe in Paris, for instance, Jean Nouvel combined the need for sun shading with a 'Moucharabieh' pattern and the idea of a light-controlling diaphragm in a camera lens (Sharp, 1990).

The use of these underlying ideas of the design, is constructive in nature and similar to a dialogue (Schön, 1983). Tom Witt compares this process with telling oneself stories (2000). In order to tell a story, that is to explore and communicate their ideas, architects/designers combine different kinds of information and representation. Whereas other research has concentrated on sketches and diagrams (Deering 1996; Gross e.a., 1994, 1996; Igarashi, 1999), this paper focuses on everything the architect/designer jots down: from loose keywords, annotations to images and sketches, labels in schemes, descriptions of ideas, etc.

Coming up with a concept is one thing, translating this concept consequentially into a built artefact is yet something different. Indeed, what makes designing good architecture extremely difficult – and at the same time extremely fascinating – is that this translation is far from straightforward a procedure. Unless there is consistency and continuity from the earliest conceptual phases right through design development to detailed design, those important underlying ideas will get lost. Apparently, this 'hanging onto the big idea like grim death' is something architects/designers tend to struggle with (Lawson, 1994). Speculating about digital media in architectural design, the question rises: Can computer technology improve the consistent development of design ideas?

In this paper, we propose to combine two tools as a way of supporting concept development in architectural design (see Figure 1):

1. a design idea recorder/interpreter/associator
2. a case base of architectural designs

E3dAD / Idea Space is a prototype for capturing and interpreting the architect's design ideas (Segers et al., 2001). All design ideas captured are put into a gigantic network, where nodes are words, sketches and images, and where links are relations in meaning of the words and relations made by the user (i.e. time, place and gestures). The interpretation of the design ideas is used then for associative suggestions by the system. The case base is DY*N*AMO, a growing online collection of design cases (Heylighen and Neuckermans, 2000). Each case is represented by a mix of media and characterised by various features, including the underlying concept(s) of the design.

Whereas Idea Space provides architects with an overview of their own, personal ideas, DY*N*AMO can provide examples – both successes and failures – of how related ideas have been developed into built artefacts by other architects. To some extent, the connection between both is analogous to the Shift+F7 shortcut in Ms Word®. Just like this shortcut allows authors to look up synonyms in a thesaurus without having to leave the text they are writing, linking Idea Space to DY*N*AMO enables architects to retrieve relevant cases 'en passant', that is during the very act of designing. The architectural Shift+F7 has the advantage of combining a personalised design space – where architects can feel free to jot down just anything – with a collective space – where they can find and share with others interesting insights and ideas.

In the following sections (2 and 3) we describe these two main components of our architectural Shift+F7, after which section 4 switches attention to the connection between both. We conclude by briefly mentioning topics for future research.

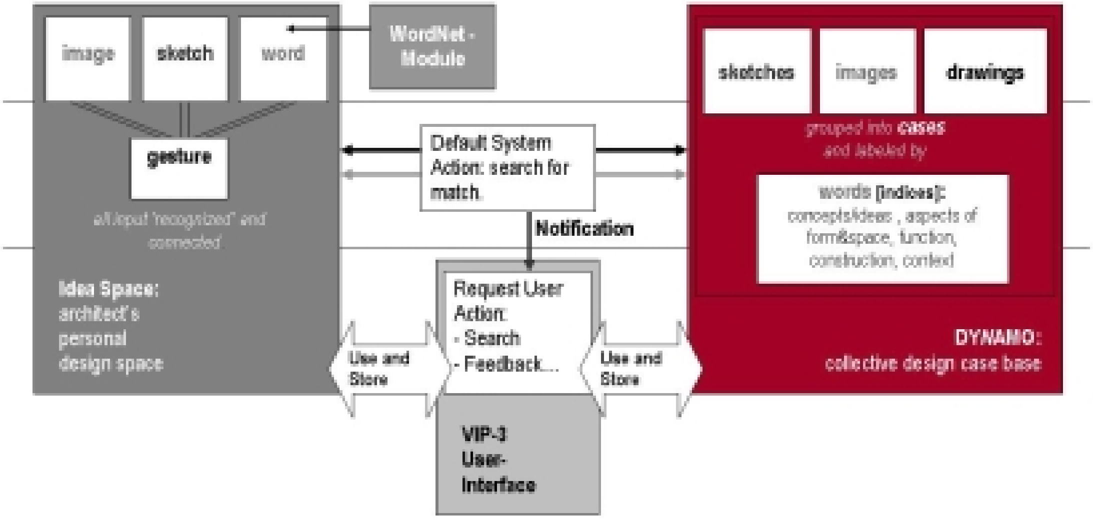


Figure 1: Scheme of the architectural Shift+F7

2 Idea Space

Architects, we have mentioned, do not only sketch during design. They combine different kinds of information and representations. We contend that all design information represented should be seen as small parts of ideas and contextual information, which are used to construct the design, to dialogue, or to tell stories. All these elements are captured and constitute a network, as if part of the frame of reference is being made explicit. This network of information is called the Idea Space. The Idea Space is part of the E3dAD system, and focuses particularly on everything the architect writes down. We can think of descriptions of ideas, the annotations to writing, images and sketches, further more loose keywords and the writing in schemes or schemas.

The combination of text, image, sketch and/or draft can provoke new associations, which keep the design process going. An overview of all representations supports the architect in combining the different kinds of information. Finke et al. (1992) have defined cognitive structures used in creative cognition, and of particular importance amongst these are so-called *pre-inventive structures*. Pre-inventive structures are internal representations like novel visual patterns, object forms, mental blends (conceptual combinations, metaphors and blended mental images), category exemplars, mental models, and verbal combinations. These are made explicit in sketches and writing. In doing so architects provide themselves with an external memory, visual cues for association and a physical setting in which thoughts are constructed. Suwa et al. (1998) have stated this for sketches, but in fact it holds for every representation that architects use.

In Idea Space all representations can be used and are placed next to each other, so they can interact in influencing the architect's development of ideas. Creative cognitive processes serve to generate and explore the pre-inventive structures. The ideas that are made explicit (sketches, text) can be altered or related to other ideas.

Ways of doing so are making changes in attributes or contexts of ideas, or making combinations with other parts of the network. In all cases new relations and ideas are formed.

While designing and putting ideas on paper, all information that is made explicit by the architect/user is captured by the system. The system deals with words, sketches and images as being nodes of a huge network of information (the Idea Space). To begin with, relations between nodes are made by the user: what ideas are put down in a particular brief space of time, what ideas are written next to each other, and what ideas are connected by marks like arrows, frames or encircling. Additional links are made by the system. In trying to 'understand' what the architect has written, the system analyses all written information by checking words in pairs in Wordnet (Fellbaum, 1998). Wordnet is a lexical reference system the design of which is inspired by current psycholinguistic theories of human lexical memory. English nouns, verbs, adjectives and adverbs are organised into synonym sets, each representing one underlying lexical concept. Different relations, like antonyms, hyponyms and meronyms, link the synonym sets. The relations or links in the Idea Space are then named.

With this information, the system is able to identify regularities, structures or patterns in the Idea Space in two ways. It searches for keywords that the architect uses often and compares to what words or sketches these were related earlier in the design session, or in former design sessions. In addition, it searches for returning combinations of types of links. We can think of structures consisting of 'synonyms' versus 'antonyms'. These regularities or structures are used to provide the user/architect with feedback during design.

Feedback from the system is twofold: an overview of ideas (the idea space) with the possibility to represent them in multiple ways (restructured or not), and suggestions for continuing development of ideas (associations). The overview of ideas is related to a certain period or (combination of) word(s). The user can retrieve the ideas that s/he came up with in a certain period and see them as put on ‘paper’. Since such an overview helps reflecting on these design ideas, the system acts as an advanced diary. Optionally the relations made by the system can be displayed too, which is especially interesting when words are related indirectly. For by showing the intermediary word(s) as well, the system might make the user aware of certain relations or give new ideas: suggestions for continuation. The user can also retrieve the ideas related to a specific word or combination of words. In time one might have thought differently about an idea or issue while designing. When looking back at words, sketches or images previously associated, one may be remembered of something important or perhaps even see a development and proceed to the next step. In this case the system can be considered a sort of design partner. The regularities in the network do not only provide the system with the most suitable structure to present the Idea Space to the user; they also serve as input for the system to suggest associations. In this way the system aids the architect in associative reasoning. It may discover gaps in the structures and then make a suggestion to user. Furthermore, if the user requests a certain type of association, the system can provide different items related to a word, which can be useful in brainstorm sessions.

3 DY*N*AMO – A Dynamic Architectural Memory On-line

The second component of our architectural Shift+F7 is DY*N*AMO, which stands for Dynamic Architectural Memory Online. DY*N*AMO is a collective Web-based design assistant that tries to kill two birds with one stone.

At short notice, it provides architects with a rich source of inspiration, ideas and design knowledge, as it is filled with a permanently growing collection of design cases by and from different architects. Especially in the early, conceptual stage of the design process, previous design cases provide grist for a number of decisions to be made (Domeshek and Kolodner, 1992). Being themselves end results of initial concepts, cases are cut out to illustrate how a particular idea can be pursued through all aspects of an architectural design.

DY*N*AMO's long-term objective is to initiate and nurture the life-long process of learning from (design) experience as suggested by the cognitive model underlying Case-Based Design (CBD). Being rooted in the Theory of Dynamic Memory, this model claims that human memory is dynamically changing with every new experience (Schank, 1982): it acquires new cases by storing fresh experiences in memory; re-indexes cases that are not immediately stored in the right place; and generalises individual cases that belong under the same heading. Inspired by this model DY*N*AMO is conceived as an (inter-)active workhouse rather than a passive warehouse: it is interactively developed by and actively develops its users' design knowledge. Its most important feature is not merely that it presents cases, but that those cases trigger in-depth explorations, stimulate reflection and prime discussions between architects/designers in different contexts and at different levels of expertise. Physically, DY*N*AMO consists of:

1. a growing collection of cases – the actual memory content: Cases are entire building designs, both built and unrealised projects, and are represented by a mix of text, photos, graphics, 3D models, facts and figures, video and sound.
2. a database that structures this memory: In this database, each case is characterised by various features, so-called indices, which serve as filter criteria during retrieval and as links to other cases having common characteristics. These features include the underlying concept(s) of the design as well as aspects of form and space, function, construction and context. If we consider cases encapsulations of design knowledge, this web of indices further enhances each case's value. It allows users to approach a project from different perspectives and to situate it in relation to other projects.
3. a user interface to consult and modify memory: The interface allows users not only to consult and navigate between cases in memory, they can also change and improve memory as suggested by CBD's cognitive model, i.e. by adding new projects (possibly self-designed), making links between them or creating extra indices.

The case collection and database are stored at the server side; the interface can be viewed with a standard Web browser at the client side (Figure 2).

Confrontations between DY*N*AMO and potential users have been surprisingly successful (Heylighen and Neuckermans, 2001a, 2001b). Despite the tool's prototype nature, both student and professional architects have reacted favourably to using it during design and would like to use it again for future design tasks. A major drawback, however, seems to be the tool's separateness from the architect's actual design environment. As already mentioned, DY*N*AMO can be accessed through a standard Web browser. User friendly as such browsers may be, they are not particularly compatible with an architect's designerly way of working, especially not during concept development.

In a pilot study with professional architects, for example, videotapes clearly illustrated the gap between DY*N*AMO on the one hand and the designer's paper and pencil on the other hand. The architect must first realise that previous cases may provide useful information, try to find relevant cases in DY*N*AMO (which is the convenient shortcut for: switch to the browser, type in the URL, specify one or more selection criteria, screen the cases that meet these criteria and pick out the relevant information), and finally carry the information back to the paper and pencil environment. Each step of this process – realising that cases may be useful, finding relevant ones, and transferring the corresponding knowledge to the design – interrupts the design process considerably.

In order to fully integrate the process of consulting cases with the very act of designing, users must be able to go swiftly back and forth between their design environment on the one hand and a case base on the other hand. In this respect, the ideal would be if DY*N*AMO could be accessed from within the design environment itself instead of through a Web browser, as is currently the case. Therefore we propose a scenario for case retrieval that is interwoven with the architect's activities during concept development.

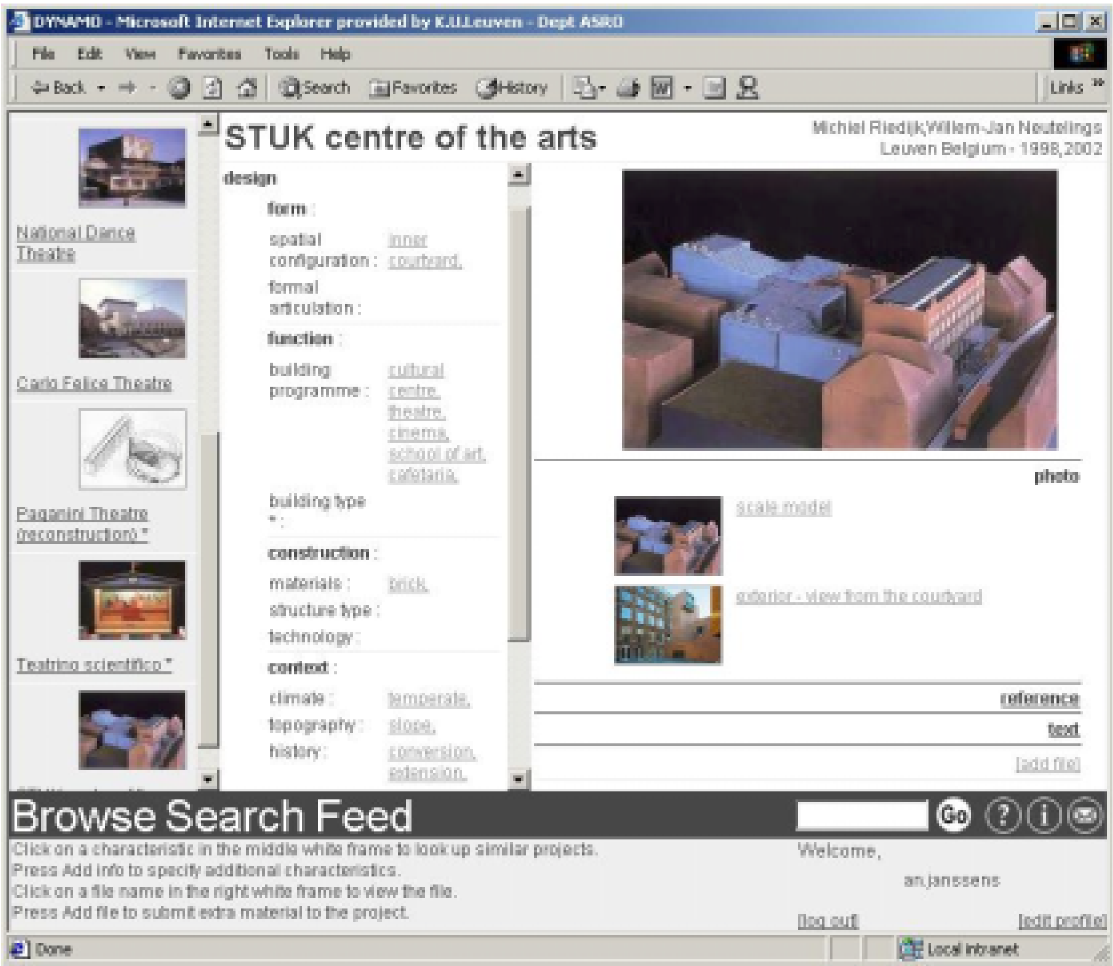


Figure 2: Screen shot of DY*N*AMO

4 Triggering case retrieval by design ideas

The scenario we propose makes use of the Visual Interaction Platform (VIP), developed at IPO/ Center for User-System Interaction (Aliakseyeu et al., 2001). VIP's major advantages are that action and perception spaces coincide, two-handed interaction is possible, and multiple users can collectively interact at the same time, using separate interaction elements. Using VIP feels like working on real paper, be it that this paper is augmented with a projection of a virtual paper. In case of the architectural Shift+F7, the latter contains both Idea Space and DY*N*AMO. Since action and perception spaces coincide, there is no interruption of the design process. The architect/user writes things down, makes sketches, and can consult Idea Space and/or DY*N*AMO whenever s/he likes. By adding all information on the real paper (captured by the system and made virtual as well) and the 'virtual' paper, the Idea Space of nodes and links is being constructed on the fly.

How then does this architectural Shift+F7, i.e. the connection between Idea Space and DY*N*AMO work? Idea Space recognises the different representations used by the architect, whereby words are treated in a special way: the Wordnet-module searches for word-pairs, having a semantic or lexical relation. DY*N*AMO for its part uses these words or word-sets as input to continuously search the case base. If a word(-set) coincides with the content of a case's index (i.e. with its underlying concept or an aspect of its form and space, function, construction or context), a notification pops up in the perception space. If interested, the architect can study the case in more detail and/or browse to related cases. Moreover, the architectural Shift+F7 allows inserting images, sketches, or text from DY*N*AMO into the Idea Space, either by making a reference or by simply dragging the material into the network. The advantage is that, at all times, the architect can trace back which information from other designs/cases was used as hint, source of inspiration or solution. This also works the other way around: starting from material (i.e. an image, sketch or text) from DY*N*AMO one can detect when and where in the design process this information was used, since this is all stored in Idea Space.

DY*N*AMO offers access to cases through various issues that are at stake during design. Suppose, for instance, that the architect is thinking of using windows that provide a wide view for the user of the building to be. If this quality, of windows providing a wide view, is not explicitly mentioned in the case base, the architect can browse through the cases and label and link the relevant ones by this new issue. While DY*N*AMO is meant for collective use – all architects can add to the case base and have access to the corresponding ideas – Idea Space is personal like a diary. Nobody but the architect using the system can access the ideas in his/her Idea Space, even if they are connected or related to cases in DY*N*AMO. Just like Mase et al. (1998) deal with creativity in conversation, the architectural Shift+F7 has the advantage of combining a personalised design space – where architects can feel free to jot down just anything – and a collective space – where they can find and share with others interesting insights and ideas.

Summary and future work

Consistently developing design ideas into a built artefact has been identified as one of the most fascinating difficulties facing architects during design. In order to support this development, we have proposed an architectural Shift+F7, which links a personal idea capturer/interpreter/associator with a collective dynamic memory of design cases. This should allow architects to consult relevant cases from the early conceptual stages of the design process on without having to leave their working environment. Through the explicit link between early ideas and concrete cases, we believe that this tool will act as a permanent source of inspiration, in providing all sorts of design information related to the current issue they are working on. Moreover, it will draw architects' attention to all aspects of the ideas they conceive, thus stimulating the awareness of the downstream implications of their concepts.

We are the first to admit that further evidence is needed for the value of our architectural Shift+F7 idea. Therefore, we are planning first of all to build a prototype interface between Idea Space and DY*N*AMO. A further step is to use the prototype in a pilot study with architects in different contexts and at different levels of expertise. Although this scenario still lies largely in the future, we are already aware of some important problems to be dealt with, such as the ambiguousness of the information the architects will provide the system with – architects can interpret words, ideas or sketches in multiple ways – and the identification of relevant information to provide the user with. Indeed, finding or tracing the 'right' information in a structure as large as Idea Space plus DY*N*AMO is far from trivial a task. We do not want the system to find exactly the same as the architects have in mind, but to provide them with relevant ideas that can help advance their design process. The key challenge here will be to find material that is both sufficiently like *and* unlike the architects' design ideas.

Acknowledgements

The 1st author is a postdoc fellow of the Fund for Scientific Research Flanders; the 2nd author is a PhD-student at the Technische Universiteit Eindhoven. Special thanks go to Prof. Bauke de Vries and Prof. Herman Neuckermans for their comments on earlier versions of this paper.

References

Alexander, Christopher (1979) *The Timeless Way of Building*, Oxford University Press, New York (NY).

Aliakseyeu D., Martens, J.-B., Subramanian, S., Vroubel, M. and Wesselink, W. (2001) 'Visual Interaction Platform', in *Proc. of Interact 2001*, July 2001, Tokyo, Japan (in press.)

Darke, Jane (1978) 'The primary generator and the design process', in Rogers, W. E. and Ittelson, W. H. (eds.) *New Directions in Environmental Design Research*, Proceedings of EDRA 9, EDRA, Washington D.C., pp.325-337 (referred to in Lawson, 1990).

Deering, M. F (1996) The HoloSketch VR Sketching system, *Communications of the ACM*, 39, no 5, pp. 54-61.

Domeshek, E.A. and Kolodner, J.L. (1992) 'A case-based design aid for architecture', in Gero, J.S. (ed.) *Artificial Intelligence in Design '92*, Kluwer Academic, Dordrecht (The Netherlands), pp.497-516.

Fellbaum, C. (1998) *WordNet, an electronic lexical database*, The MIT Press, Cambridge (Mass.).

Finke, R.A., Ward, T.B. and Smith, S.M. (1992) *Creative Cognition*, MIT Press, Cambridge (MA).

Goel, V. (1999) 'Cognitive Role of Ill-Structured Representations in Preliminary Design', in Gero, J.S. and B. Tversky , B. (eds.), *Visual and Spatial Reasoning in Design*, Key Centre of Design Computing and Cognition, University of Sydney, Sydney.

Gross, M., Zimring, C. and Do, E. (1994) 'Using Diagrams to access a case base of architectural designs', *Proc. Artificial Intelligence in Design '94*, Kluwer Academic, Dordrecht, pp.129-144

Gross, M. D. and E. Yi-Luen Do (1996) Ambiguous Intentions: a Paper-like Interface for Creative Design, *Proceedings UIST '96 Seattle Washington*, 1996, pp. 183-192.

Heylighen, A. and Neuckermans, H. (2000) 'DY*N*AMO – Dynamic Architectural Memory On-line', in *Journal of Educational Technology and Society,* Vol.3, No.2, April 2000, pp.86-95.

Heylighen, A. and Neuckermans, H. (2001a) 'Baptism of fire of a Web-based design assistant', in de Vries, B., van Leeuwen, J. and Achten, H. (eds.), *Computer Aided Architectural Design Futures 2001*, Proceedings of the 9th International Conference, Eindhoven University of Technology, Eindhoven, The Netherlands, July 8-11, 2001, Kluwer Academic, Dordrecht (The Netherlands), pp. 111-124

Heylighen, A. and Neuckermans, H. (2001b) 'Destination: practice. Towards a maintenance contract for the architect's degree', Jabi, W. (ed.), *Reinventing the Discourse*, Proceedings of the 21st Annual ACADIA Conference, University at Buffalo, New York, October 11-14, 2001, ACADIA, Buffalo (NY), pp. 90-99.

Igarashi, T., S. Matsuoka and H. Tanaka (1999) Teddy: A Sketching Interface for 3D Freeform Design, ACM SIGGRAPH 1999.

Lawson, Bryan (1994) *Design in mind*, Butterworth Architecture, London (UK).

Leupen, B., Grafe, C., Körnig, N., Lampe, M. and De Zeeuw, P. (1997) *Design and Analysis*, Van Nostrand Reinhold, New York (NY).

Mase, K., Sumi, Y., and Nishimoto, K. (1998) 'Informal conversation environment for collaborative concept formation', Toru Ishida (eds.), *Community Computing: Collaboration over Global Information Networks*, John Wiley & Sons, 1998.

Rowe, P. G. (1987) *Design Thinking*, The MIT Press, Cambridge (Mass).

Schon, D. (1983) *The Reflective Practitioner*, Basic Books, New York.

Segers, N.M., De Vries, B., Achten, H.H. and Timmermans, H.J.P. (2001) 'Towards Computer-Aided Support of Associative Reasoning in the Early Phase of Architectural Design', in *Proceedings of The Sixth Conference on Computer Aided Architectural Design Research in Asia*, pp. 359-368.

Simoff, S.J. and Maher, M. (1998) 'Ontology-based Multimedia Data Mining for Design Information Retrieval', *Proceedings of ACSE Computing Congress*, Cambridge.

Sharp, Dennis (1990) *Twentieth century architecture: A visual history*, Facts on File, New York (NY).

Suwa, M., Gero, J. S. and Purcell, T. (1998) 'The roles of sketches in early conceptual design processes', *Proceedings of Twentieth Annual Meeting of the Cognitive Science Society*, Lawrence Erlbaum, Hillsdale (NJ), pp. 1043-1048.

Witt, T. (2000) 'Indecision in quest of design', *Proceedings of the 5th International Conference on Design and Decision Support Systems in Architecture and Urban Planning*, Eindhoven University of Technology, pp. 423-431.

Intermedia: speculations about tactility in the digital design environment

John Maze
Assistant Professor
University of Florida

Abstract

In the digital age, what is the role of tactility in the digital design process as it is taught in schools of architecture today? Very often, students are never taught to appeal to any other sense other than sight, particularly now as digital media is embraced as a valuable design tool. Yet, is there some essential characteristic of architecture and the phenomenology of place-making that is being cast aside due to the nature of the tools being used? However true or enigmatic this may be, there is a way of working and teaching that exists somewhere between the digital and the tactile. Often there is discussion on final reviews about the flatness and glossiness of purely digital presentations, and contrapuntal criticism about the lack of accurate perspectival representations illustrating the inhabitation of students' projects without the benefit of computer renderings. Imagine if there was a methodology that by its nature simultaneously forces students to work digitally and yet with the depth and tactility of analog media?

This paper postulates a hybrid working environment in the design studio that not only takes advantage of the strengths of various design media but also focuses on reinterpreting its limits and drawbacks. The role of digital media in the realm of paper based design media will be explored and shown to potentially be as tactile and interactive as trace and chipboard. A curricular sequence of instruction will be proposed that exploits the limits of digital media and reinterprets their usefulness in a productive manner. The ultimate outcome will be a new digital media (intermedia) pedagogy that can revolutionize the way that we teach architecture and moreover computer "aided" design.

Introduction

One of the primary problems with CAD as it is taught in many schools of architecture is that it is taught at the very end of the undergraduate studio sequence as a tool to be used in internships. Quite often, CAD is relegated to a semester of two-dimensional drafting followed by a semester of rendering (and maybe animation). The timing and sequence of this sort of computer instruction restricts digital media to pure production rather than design (conceptualization). The resulting drawings are usually banal, uninspired, and flat (little layering and depth).

Fig. 1 Overly textured brick form z rendering by fundamental design student Derek Drish.

The opposite problem exists at other institutions that introduce younger students to basic modeling programs that seldom encourage students to continue developing their ideas once they are entranced by the digital visualization before them. Student work of this variety is fraught with overly textured image-mapped surfaces devoid of subtlety, no connection to the land (site), lack of subtlety and detail development, little to no understanding of the realities of construction or structure, and little concern in resulting animations for the accurate portrayal of human sequence. Only a carefully constructed curriculum closely keyed into the studio sequence can avoid these pitfalls, and can foster a new engagement of the senses (as appropriate in the multi-sensual environment of architecture) beyond the purely visual.

What is the Problem?

Is there something lost from the design process caused by the use of digital media? Does "CAD" produce lifeless, desensitizing components of the design process when compared to traditional paper (and wood) based media? If so, does the value added by CAD as a design tool outweigh the lack of what I will simply refer to as "tactility?" As such, is there a way by which this limitation of tactility can be overcome or reinterpreted in such a manner that instills a multi-sensory component into the digital process that is more indicative of or even surpasses other "traditional" (analog) methods of working?

The nature of digital media in architecture is that it requires a conduit of conveyance, a carrier media if you would, in order to be viewed. One cannot perceive an AutoCAD drawing or Form Z model without either a monitor or a printer. One cannot simply reach inside the CPU and *touch* a model, or run one's hand across a plan and feel the space of the drawing. We must rely heavily on our sense of sight to create and read digital work (as it is typically used), which limits a truly holistic perception of the architecture. Even when music or sounds of inhabitation are incorporated (a dramatic improvement, which will be discussed later) we are still referencing only two modes of perception, thus limiting our holistic understanding.

Redefining tactility and the role of intuition

Tactility is of course defined as a quality "of or connected with the sense of touch."[1] The author has expanded the definition of tactility to encompass the perception of touch-related sensations (as in the photograph of a texture) and the ability to derive perceptual realizations through direct physical touch. This refers to an understanding of one's environment through actual touch, or the perception of what a touch would be like as well discoveries found through the touching, manipulating, and assessing of materials.

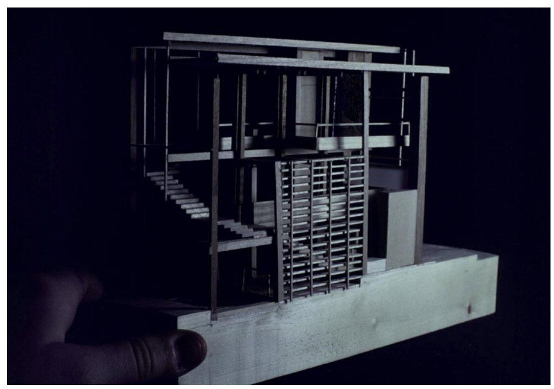


Fig. 2 Fundamental design student Meri Tepper holding physical model.

Clearly the direct role of touch in the architectural design process is somewhat limited, given the fact that we see drawings and see physical models, and draw conclusions from what we are looking at. Architects tend to design cerebrally through reason, but do, to a certain degree, utilize intuition in the design process. Intuition in general absorbs knowledge and awareness through the senses, and is a more direct method of understanding than conscious reasoning which requires the mental processing of gained data before understanding can be reached. Thus many intuitive realizations result from the physical handling of design media, and from the perceived sensation of touching forms, surfaces and textures contained in images.[2]

The sense of touch, even the visual extension of the sense of touch, responds to tactile cues contained in media, and through comparison with remembered sensations, draws conclusions about the corporeality and palpability of it and what it may represent (design media). Directly or indirectly, tactility and in general a synthesis of the senses plays a strong part in how we perceive the world around us, and in particular to architecture, how we perceive and conceive the built environment. Thus, when working with architectural digital media, a media which is by nature visually based, one must be careful to engage more than just the sense of sight by virtue of how one represents the subject matter (i.e. proposed projects, existing building sites, etc.). This is of paramount importance in the rendering visible of architectural space.

Digital perception

Inarguably, the human brain receives information via neurological pathways beginning at sensory organs (eyes, ears, skin, nose, and tongue (not including other hypothesized sensory types)). Through a combined processing of this data, the brain constructs a mental approximation (or re-creation) of its surroundings and any event that has just occurred, informing a reactions to this situ. Except for cases involving various sensory impairments (i.e. blindness, deafness, etc.) at least four of our five senses are simultaneously engaged at any given time, though at different levels of primacy. Human beings have generally evolved as primarily visual operants, depending secondly on our sense of hearing, then touch. The sense of smell (and taste), while arguably the sense most able to trigger the most powerful primal memory responses, [3] has devolved largely when compared to even our closest evolutionary primate relatives, chimpanzees. Though our initial conscious awareness of our surroundings is not on the surface dependant on our sense of smell, it is (though perhaps subconsciously) shaped and affect by our sense of smell. All of our senses work in concert to inform our perception of our world around us and guide our actions and reactions within it.

Relying solely on one sense to formulate a complete approximation of one's surroundings will not provide an accurate and holistic understanding. A view of a seemingly conducive room for sleeping or contemplation may not reveal the fact that a major freeway lay five meters outside the walls of the room, causing it to endlessly pulsate in a cacophony of passing trucks and commuters. Equally, a recording of a similar environment seemingly appropriate for such an activity due to its silence and aural tranquility would not reveal the fluorescent-orange and lime-green wall surfaces, or would it reveal the all-pervasive smell of rot and decay caused by the dead rat lying in the corner under a chair. We depend on combinations of senses constantly, often when we are not even aware of it.

Similarly, when working to create something (i.e. architecture), each of our senses is going to afford us a different interrelated perception of what we are doing. To be more accurate, we work to create different, individual components of the design process that each in and of itself reveals or explores something different within our architecture that the other components could not. Physical models provide one kind of interactive perception of an abstract architectural physicality, while rendered perspectives provide set views with material and temporal approximations of inhabitation. Plans and sections allow for cerebral understanding of relationships within an architectural project utilizing our abstract reasoning abilities, while material samples evoke a tactile understanding of the intended architectural results. However thorough an understanding of an architectural problem or solution this myriad of techniques and tools for working can provide, not one of them is singularly capable of evoking at least four of our sense at once.[4]

Drawing upon the musical world for the sake of comparison, there has for decades been a debate about the merits of electronic synthesizers and samplers that replicate the sounds produced by other instruments. When computers were first used as instruments, the electronic sound produced by early synthesizers was not yet developed enough for mimicry, and was treated in a more genuine fashion with its own sound characteristics. When they were developed enough to replicate other instruments, the authenticity of the synthesizer as an instrument in its own right was lost to some. Yet as prolific a presence the synthesizer has had in music over the past thirty plus years, it is still unable to completely capture the idiosyncratic essence of many acoustic instruments.

What makes many instruments unique is the irregularities between tones, and the particular ornamentation that the instruments allow or demand. Take the Irish uilleann pipes for example, where the timbre and color of each note is very different, and much of the sometimes guttural ornamentation that is unique to them such as crans, rolls, slurs, and popping could never be replicated to perfection by any other instrument including the synthesizer. The same argument could be said about the violin, the flute and many other instruments as easily as it could be said for non-musical artistic acts such as sculpture and painting.

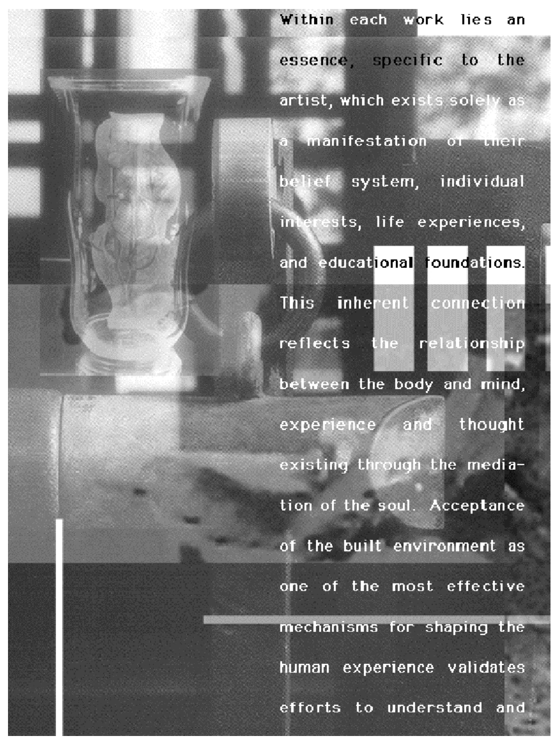


Fig. 3 Conceptual collage by graduate student Linda Chervenak. A series of these collages were sequentially placed onto a timeline in Premiere to create a narrative of the project.

Collage

As a fundamental design studio instructor and digital media instructor, I am continually aware of the pitfalls of introducing students to digital media without an adherence to the world of the corporeal. Projects begin to completely divorce themselves from the actualities of *Place* and *Time*, grow sterile in their digitalness, [5] and lose any sense of spatiality beyond the superficial. This is partially due to the students' inability to perceive the spaces that they are creating digitally in any greater depth than what is immediately shown to them on the seventeen inch monitor (no peripheral perception, no spatial awareness or memory of what is behind them). Experiments with virtual reality visors and gloves have not yet produced a practical, workable model to use in the design studio realm. Even if one does become practical, it is questionable whether the spatial engagement of the student during the design process will improve.

In the process of redesigning a computer curriculum, the problem of non-tactile computer work is being addressed in three major categories: input of design data, digital processing of design data, and output of design data. Prior to a reevaluation and subsequent reinvention of the computer curriculum, the only available architectural computing courses were one drafting course, and one rendering course. Stand alone courses such as these seldom require students to explore issues of media and representation beyond basic literacy, and often produced results that fail to transcend banal, generic drawings and renderings.[6] The new sequence of digital media immersion begins earlier in the undergraduate curriculum, and introduces students to imaging software, modeling software, page layout techniques, web design, animation, and rendering in addition to drafting. Students are taught to switch between program types (imaging to modeling, and visa versa for example) and between analog and digital methods routinely in the course of the curriculum, using their current design studio projects in the process.

Using the notion of collage as a starting point, new design pedagogy can be authored that encourages the seamless integration of digital and analog design media. As we gradually introduce to students the tenants of design from semester to semester, beginning with basic formal manipulation and analysis and leading up to more complex design issues, a similar sequence can be created to introduce digital media. Instead of being taught in separate, stand alone drafting and modeling courses, students begin a truly multi-media design curriculum in a way that requires them to switch from one way of thinking/working to another automatically and back again, resulting in work that is always layered, tactile, evocative, and precise.

The problems I believe are at least threefold first, and a careful examination and reworking of the use of digital media in any curriculum can yield drastic improvements. First, the process by which design data is currently entered into the computer is not conducive to a holistic, multi-sensual method of designing within a physical environ. Can we intuit awareness of existing design determinants and even our own design intentions by simply moving a mouse around and tapping on a keyboard? We do indeed use our hands and touch the input devices, but do we *feel* anything more than plastic?

Second, the way in which design data is currently manipulated in the digital environment is not consistent with how we experience space and the world around us. Do students typically amalgamate virtual and real images, textures, or models during the design process, or do they work in a linear fashion and use one mode of exploration at a time?

Thirdly, the way that design data is currently output is not entrancing to the senses, does not reflect an inherent understanding of how the media is produced (i.e. brushstrokes), nor is truly and intuitively representational of the physicality of surfaces, textures, and forms indicative of the proposed architecture. Is there a way that computer prints and plots can become more tactile, or is there another means of output that is more conducive to tactility?

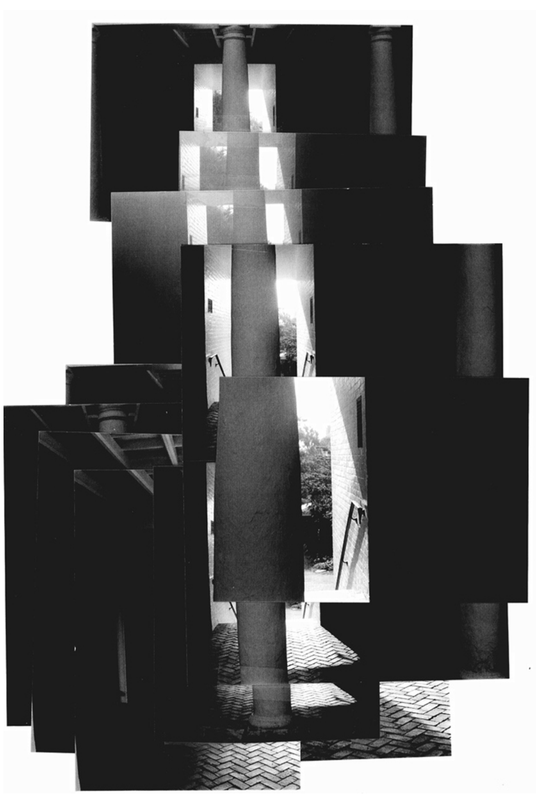


Fig. 4 Photomontage by fundamental design student Melissa Tronquet.

Inputting design data

There are research groups such as the Design Machine Group at the University of Washington who endeavor to create new digital interfaces that are more natural to the way designers tend to work. Digital pens, styluses, marker boards, and scanning wands are being developed and beta tested that allow for a more tactile, analog method of inputting data into the computer.[7] Perhaps in the near future, faculty and students can mark up their design drawings with a hand held stylus that scans the corrections directly into the model or drawing file. In this manner, the lines generated by hand as sketches can remain as vector graphics, which would allow for parametric changes to be made to them directly rather than through a series of operations that detracts from the immediacy and tactility of the sketch.

Markup boards are becoming common elements in corporate boardrooms, and in some computer classrooms. Being able to create a sketch using not a mouse, but a pen or marker and input that data directly into a vector format is a new paradigmatic shift in how we draw digitally. Students could project their drawing onto the board, and their studio critic could then mark it up similar to using trace, except that the redlines would be stored as a separate layer in the data file rather than necessitating the separate scanning of the trace paper. Hand drawn lines could remain a part of the finished drawing, and textures could be rendered by hand and directly integrated into the digital image. Designers that tend to work in sketch perspectives to study space could sketch out their ideas without the cumbersome process of using a mouse, and digitally "paint" their sketches with scans of real materials (stone, wood, etc.). Tactile approximations of a space or building could remain visually speculative and sketchy and yet with "real" materiality and substance.

Imagine for a moment the auspicious invention of digital clay. This synthetic clay-like material would be made up of miniscule sensors and metallic power held together by a silicon-based gel. It would resemble the malleability of Plastisine (or other types of synthetic clay) and could be worked into any sort of form that would remain somewhat stable without drying like clay. As wonderful a modeling compound as this sounds, its real power is in how it relays its form via the sensors to a neighboring computer. The sensors would be able to determine their proximal location in relation to one another, and to the mass of metallic powder held by the silicon. Utilizing electromagnetic pulses through the mass, the exact shape, size, and location of each sculpted piece of digital clay would be replicated digitally in virtual space. One would be able to watch the transformations occur in the virtual version in real time as the clay is worked. Instead of simply working with a mouse or keyboard to input data to create virtual forms, or use a scanner to replicate physical objects in virtual space, one would directly create virtual form with their hands.

As with clay, physical objects could be pressed into the clay leaving a textural inverse of their surface. Stone, skin, hair, wood, engraving plates, basically anything could have its particular relief digitized in such a fashion. Similar to the childhood toys made up of a cluster of pins that would push forward when a face or hand was set into it, one could observe in real time the transformation of form in virtual space and could record such change in animation form. The possibilities of such an invention will be monumental to how designers and students of design will be able to work digitally.

The application in which the virtual model is created would have tools that automatically regularize the surfaces and edges in any modules or to any tolerances input by the user. In this way, the designer can work with the clay as quickly and freely, or as methodically and carefully as desired. One would be able to also use X-Y-Z grid snaps, directional snaps, and orthogonal snaps that when activated would force the virtual replication to lock into whatever level of control the user needs (likewise, snaps could also be used in conjunction with sketching on mark up boards as well). Perhaps the inverse could also be true as well, where the digital clay would respond to objects in virtual space. Electro-magnetically, the clay would conform to the exact shape, size, and location displayed on the screen in real time. In this manner, one could build in virtual space, pick up their creations instantly rather than wait for a laser cutter or extrusion device to finish. The designer could change the clay's controller setting to "input" instead of "output" and continue to manipulate their project by working the clay with their hands and have the virtual model conform to those changes. Interchangeability between analog and digital would be seamlessly possible.

Manipulating design data

Once data is input into a computer, it is typically held there by the student until the resulting drawing or model is completed. Students tend to be reluctant to output a digital construction in order to complete it by hand. The general view held by students is that digital media *replaces* analog media rather than augments it. The problem does not lie in the software or the hardware, but instead lies in the attitude towards using digital media. One can introduce students to the great benefit of utilizing multiple media simultaneously and interdependently. As with musical instruments in an orchestra, each design instrument will yield different results, different discoveries, intentional and unintentional, and will allow different understandings of a student's project that is unique to its essential nature and limitations. A combination of various representational and analytic modes will produce a *gestalt* composition that can make use of the limitations of each tool and create a much richer project than otherwise possible. This attitude is dependent upon how digital media as a design tool is introduced, the sequence of instruction, and the type of projects assigned and studied.

An appropriate introduction to digital media is one that encourages students to work with subject matter that is input from the corporeal realm rather than created solely in the digital realm. Imaging software (such as Adobe PhotoShop) and scanning should be the first lessons in working in digital media, and actually require the student to procure or produce analog media to input. Students can then be taught recombination techniques as well as photomontage and collage. If the introduction occurs within or aligned with a fundamental design studio where analysis is introduced prior to design, then analytic techniques can be introduced using the imaging software.

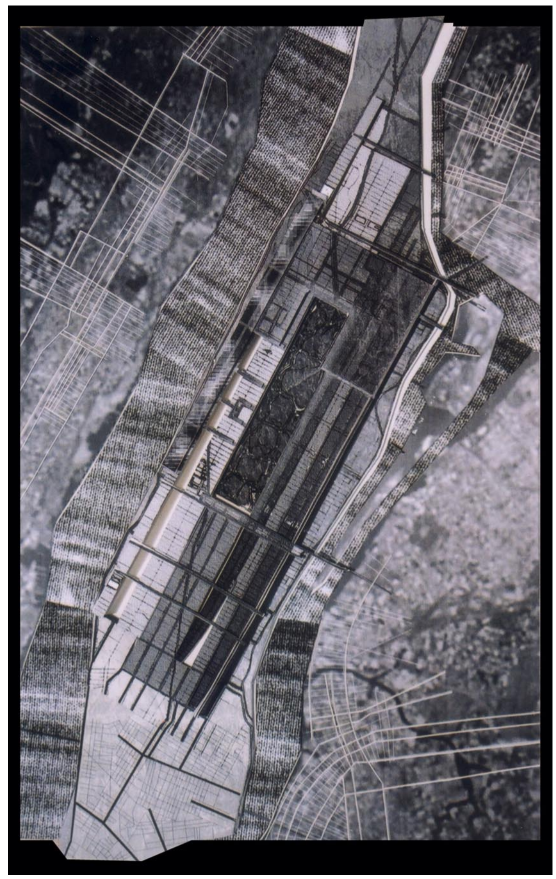


Fig. 5 Analytic collage by third year student Duy Ho.

In figure one, the student used PhotoShop to analyze the structure of Richmond, Virginia. Topography, urban infill patterns, blocks, and streets are all created using diagrams and patterns scanned into the computer. Working with "real" patterns and textures, the student cannot help but to create tactile work. Even when the textures are digitally manipulated and transformed, their original tactile quality can be authentically retained.

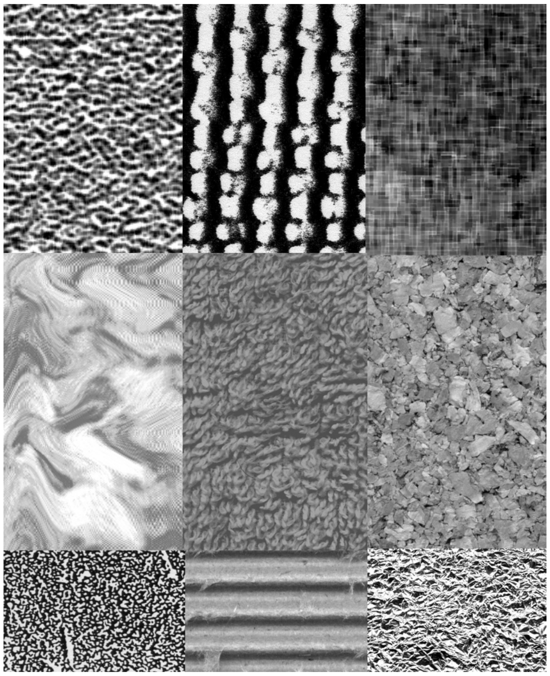


Fig. 6 Assortment of typical collage materials.

It is essential that students learn to output these first exercises soon after their completion in order to transform them manually. From the printed analytic collages, students can create multi-layered physical models of their cities (Richmond, Virginia in this case) and extrude in three dimensions what verticality they could only infer in the computer. If certain readings in their digital collages lacked coherence or clarity, it is at this time that students can manually create additional layers and edit their work. By demonstrating the interchangeability of digital and analog working methods in this manner, at an early stage in an architectural curriculum, students tend not to learn to separate the design tools. This latter problem is more indicative of stand-alone CAD courses and introductions to digital media occurring too late in the curriculum.

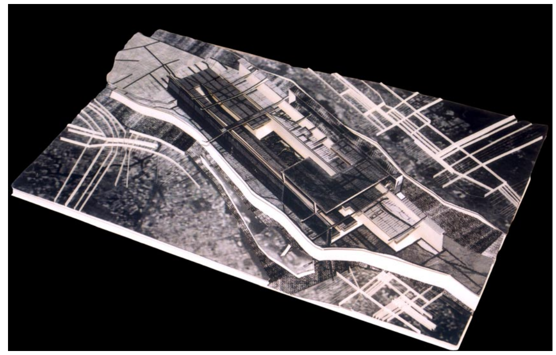


Fig. 7 Analytic collage model derived from analytic collage in fig. 5. Ideas of height and layering inferred in the two-dimensional collage are physically extruded.

The next level of interplay between digital and analog modes would require that the physical models be somehow scanned into the computer and further manipulated digitally. By use of a scanning wand, three-dimensional models can be input and translated into digital models. These digital models can then be developed further as architectural projects. When imported into a program like Form Z, 3D Studio Viz, or Lightscapes, irregularities in the model can be fixed, additional layers of details and design elements can be added, and a fully developed architectural digital model will emerge. One of the greatest assets that this phase of the project allows is the virtual inhabitation of the project so that it can be further resolved from the viewpoint of a user. Sequence of space can be studied by “moving” through the project, and materials can be applied (using scanned textures) to approximate the experience of actually inhabiting the intended spaces.

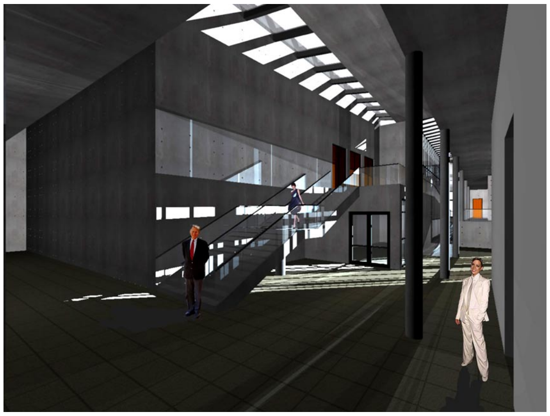


Fig. 8 Form Z rendering with montaged scale figures by Xavier Garcia. Note the concrete pattern used as a texture and image map.

At this point, if certain materials can not be convincingly manipulated or created digitally, the student can simply print the unfinished perspectival views of the project to be manually rendered. In this manner, the work retains a level of artistic sophistication that arguably might only be possible by working the image by hand. Architectural projects are by their very nature speculative up to a certain point of construction, and often a more speculative, sketchy representation technique of a designer's intentions will yield a warmer, more engaging conversation about the architecture. Clients as well as studio critics can misread fully rendered digital images as being absolute and final, rather than investigative and flexible. Students themselves can quickly become entranced by their digital creations and prematurely end their design process as a result. Encouraging students early in their educations to avoid this problem by combining media types can only prove beneficial.

Output

Imagine experiencing a digital representation of a building that allows one to smell the linseed oil on the floor, or the stone on the walls. How would one's intuitive engagement with the architectural design differ than when only vision was used? The same can be said for the sound of footsteps on different flooring materials, the warmth felt in a light filled space, or the smoothness of a polished wooden handrail. The intended experiential qualities of architecture can be conveyed and studied simply by working with media that does not only appeal to the sense of sight, but engages a combination of senses, promoting a multi-sensual gestalt understanding of a project.

When contemplating the need for conveying intentions, the vehicle for the transmission of ideas is critical. Without the proper manner of conveyance, or output, communication is impossible. Students need to be encouraged to think beyond typical print media and models to communicate their design intentions. Sonic recordings, material samples, full scale details, and other similar techniques of exploring the phenomenological characteristics of a project both deepen a student's understanding of their work as well as more thoroughly describes the essential quality of inhabitation being designed. It is perhaps the computer that in the near future can provide a truly multi-sensory understanding of a project through the use of smell synthesizers, sound samplers, photomontage animations, texture synthesizers, and thermal radiators, all technologies in existence today.

Strangely, the problem is not necessarily the inability to make the computer more *tactile*. Computers themselves are not tactile devices. They are processors of digital code that can be programmed to process input data; they not multi-sensory beings. It is frankly impossible for a computer itself to work in a tactile fashion without the sense of touch. What is problematic is how students view the relationship between digital output and completion. Once an output device has delivered a plot or print to a student's eager hands, the task is commonly viewed as 100% complete. Whatever the condition of the drawing at this point (in regards to line weight, trimmed corners, hatching and shading, etc.) it is what it is and will be presented as such. Very seldom will a student take the time to thoroughly review the drawing for printing (or drafting) errors, and make the appropriate corrections. Perhaps students put too much trust in the capabilities of the computer to "create' their presentation drawings for them, rather than regarding the computer as merely a tool representing only a part of the process. Instead, students should be encouraged to intervene in the evolution of the drawing, and render visible the textures and irregularities that exist in reality, and in doing so transforming otherwise purely digital creations into artistic endeavors.

This antipodal condition of utilizing the digital tool to create rendered views of architectural intentions in lieu of constructing and rendering perspectives by hand, but still having to further "work" the output by hand is not an easy sell to students. Students tend to be seduced by what they see on the monitor, perhaps partially due to growing up in the MTV generation of television viewers. What they know of performers is what they see in their music video, so a unique rapture with the delivered image pervades their mentality. Video games create a similar infatuation with the delivered image, and the immediacy of being engaged by this hyperactive, hyper-realistic environment.

Conclusions

One could discuss the sterile, generic conditions of suburbia that most architecture students grow up in today. One could continue to generalize about the type of superficial broadcast media in front of which students spent countless hours, or about the sensory-deadening effects that video games can produce in excess. Without questioning the changing values and priorities that are always in flux in the continuum of human civilization, one could instead speculate about how to overcome observed deficits in the use of the most prolific design tool ever to be embraced by the design profession.

So, the mental barrier that the process ends upon the print must be broken if digital medial is to have the tactile appeal to the senses that other sorts of media have. Printing to other sorts of media other than standard bond paper (i.e. watercolor paper, cloth, etc.) can gain a tooth to the print, but inherently the image upon the paper is still devoid of time. Time is readily perceived in projects that are worked and layered as part of a process of conception, and allows the work to transcend the canvas, becoming much more than paint (ink, pencil, etc.) on paper. The work instead becomes "real" and imperfect. The effect is similar to the sound of fingers sliding along the strings of an acoustic guitar, a sound that is not a note or ornament of the music per se, but is a side effect of the process of making the music. It is this sort of corporeal sound that reminds us that an imperfect human being is playing the guitar rather than an electronic synthesizer. As the music remains a human endeavor when it is allowed to retain its authentic essence and beauty, so can a "worked" piece of digital art once it has had the benefit of human intervention.

Architecture is inherently a human act. It is conceived of and created by a human being ultimately for other human beings. Architecture is experienced spatially by all of our human senses, not just one, and it is the combined collage of sensory input that constitutes our perception of it. If there is a lack of sensory input in the perception of a place (i.e. as in a photograph), the human mind cannot fully embrace an understanding of the place, whether natural or built. The result is an incomplete, superficial engagement.

Why then should the act of design be anything less than a truly multi-sensory experience when it is possible to work as a designer (or design student) in a tactile, holistic manner? Even though the computer itself is a lifeless, plastic and metal design tool capable of many splendorous feats, if used carefully can be capable of multi-sensory work. It is the manner in which the designer uses the tool that can be carefully shaped to produce work that is significantly holistic in its engagement of the senses. A careful sequence of study that maintains an emphasis on the physicality of the world and moves between analog and digital modes of working will take advantage of the limitations of digital media, and reinterpret them into tactile working methods.

Notes:

1 The Concise Oxford Dictionary of Current English, Claredon Press, Oxford, England, 1990, page 1241. Other similar definitions contain similar references to the sense of touch, of course. The Oxford Dictionary continues on to describe "tactility" as being "tangible" and "concerning the effect of three-dimensional solidity." Arguably, one can make the assertion that there is a visual extension of the sense of touch, similar to the "synesthesia" described by Diane Ackerman in A Natural History of the Senses, Vintage Books, New York, NY, 1991.

2 When the body and mind encounter an architectural (or other) image that contains surfaces and textures to which it cannot relate, a degree of intuitive understanding is inherently lost. The perception of the subject is more limited and superficial, the understanding of it lessened.

3 Nowhere is this better illustrated than by Diane Ackerman. In A Natural History of the Senses, she begins with a chapter on the sense of smell. The first association a human infant has with his mother is her scent and the sound of her heartbeat. Infact, not until the "mirror stage" of child development does the child visually separate itself from the mother.

4 By using synthesizer technology, digital media is perhaps the paradoxically one of the best media for engaging at least four senses at once. Smells, sounds, textures, and of course images can all be synthesized digitally. The most multi-sensual item in my possession is a wooden musical instrument (I of course have several). Imagine if digital media had such an evocative, essential tactility similar to an old wooden instrument, with the finger holes worn down from years of use.

5 How many of us have seen students grow fascinated with using the computer, and reveling in how digital, how slick and ephemeral their projects become? I remember hearing a student remark after a live performance that the musicians sound almost as good as they sounded on their CD. In the digital world of late capitalism, the simulacra of recorded media is preferred by many to the actual performance that the CD is trying to emulate.

6 After developing and teaching digital media courses at two universities, and being a graduate teaching assistant instrumental in developing one at another, I have seen that digital media courses that actively teach the tool as a design tool rather than just a representation tool yield a more seamless integration of the tool with the design studio. Moreover, students using the tool for projects they are designing for studio tend to bring the computer into the studio rather than just working in a separate lab. Because the projects being used are the students' designs, they tend to put more time and energy into their digital renderings and drawings.

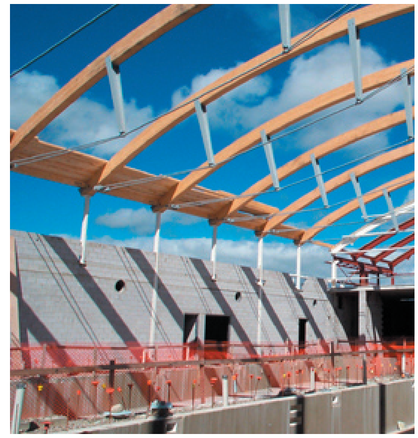
7 Ellen Yi-Luen Do, Mark D. Gross, and Brian R. Johnson at the University of Washington's Design Machine Group are working to reinvent the computer interface. "Spacepen" is one such invention as is their version of a freehand digital modeling interface they call "Digital Clay." Their version of the latter is dramatically different than my own.

8 Earlier inceptions of cinematic creations such as the "Star Wars" saga were filmed completely using analog technology. Sets and props were created physically, and characters were portrayed by human beings (even the non-human characters such as R2D2 and C3PO). Costumes that were not physically inhabitable by human actors were made as puppets and controlled by humans in hiding off screen. The results of film productions made in this manner were "funkier", shakier, and seemed more imperfect and flawed than those of their digitally generated counterparts. Even in the StarTrek series, the invention of the "Holodeck" allowed for imperfection to exist in cyberspace. Fairhave, the hologram of an Irish village was so full of "real" personalities and qualities of Earth, that some members of the starship's crew became addicted to the virtual experience.

9 Heidegger's *Place* vs. *CyberPlace*
"…the French philosopher Rene Descartes, using algebra and a coordinate system, developed an abstract geometry that also enabled the description of three-dimensional perspective on a two-dimensional plane. With Descarte's geometry, there was no need for tools or, in fact, for reference to the real world. His method defined abstract objects in an imaginary world of a selected coordinate space, and gave equations to calculate points of intersection, perspective, and depth algebraically." (Steven R. Holtzman, Digital Mantras: The Language of Abstract and Virtual Worlds, The MIT Press, Cambridge, Massachusetts 1994, pg. 194.)

10 Please note that this paper serves more as a discussion of possibilities than it does a research report. In inventing a computer curriculum at the University of Florida, reflecting back on my prior utilization of digital media and the architectural design process, and researching the curricula of other institutions, these thoughts have emerged. The question of appropriateness is always coupled with possibilities, as is the history of representation in architecture coupled with an understanding of perception. Please send any thoughts to my attention at maze@ufl.edu.

Teaching Technology: Skins vs. Structures



Terri Meyer Boake B.E.S. B.Arch. M.Arch.
Associate Professor
School of Architecture
University of Waterloo

Introduction:

Technological developments over the last hundred years have resulted in the compounding of materials issues as they relate to architectural design. Structural steel and concrete systems, as well as different varieties of load bearing masonry design have radically altered the structural design processes for buildings. The changeover from the predominant use of load bearing exterior walls to curtain walls and rainscreen elements, has also complicated issues related to the design of exterior wall systems. Environmental awareness has been introduced to the equation and has required significant changes to envelope design as relates to climate and energy issues.

WHY is Skins Teaching Different?

Numerous texts have been written which are used to teach building construction to students of architecture. Most of these texts[1] present a uniform approach to the instructional aspects of "structural systems"; i.e. excavation methods, foundation types, steel structures, sitecast concrete, precast concrete, load bearing masonry and wood frame/timber framing. Although calculation methods and units might vary from Canada to the United States and Europe, in practice, structural requirements and the techniques of constructing this portion of the building are relatively uniform. Also, the construction methods and practices for "structural systems" are quite typical in spite of regional differences, code variations and diverse climatic requirements. Basic structural systems (excluding seismic design innovations) are for the most part, logical. They are very accessible to students as they are highly visible components of both construction sites as well as finished buildings. Many are purposefully dramatically exposed, sculptural, tactile and thereby easier to comprehend.

Skins, on the other hand, are quite inaccessible to most students. In viewing completed buildings, the exterior and interior surfaces of the skins are visible, but the highly complex, multi-layered, interior is (forever) hidden from view. Understanding the building science, performance and code requirements of skins is difficult for many students to both comprehend and then apply in the form of good building construction practice. Because skin design must respond to diverse climatic conditions and considerations, teaching skins requires that the building construction courses address issues that are normally covered in environmental courses.

Although the same *general* building construction texts do cover information on cladding and roofing systems -- AKA skins -- the majority do NOT attempt to address the complex building science, environmental, code related and performance issues that vary as a result of climatic location and jurisdiction. More specific documents, often laboratory, manufacturer or government publications, must be relied upon to supplement and sometimes CORRECT what is presented in the general text.

For these reasons, the *teaching* of skins is an aspect of the field of building construction that presents itself as a very complex task. It demands a different teaching methodology than the teaching of basic “structural systems”. It exposes a unique set of problems related to regional differences. Teaching skins also challenges professors to find *reliable, up to date* teaching and reference materials.

WHAT Should We Teach?

Five Points Towards the Teaching of Skins:

There are five major issues that must be addressed when teaching building envelope design. This requires ***teaching*** on many levels, not simple delivery of the facts. Students need not only to be delivered “the facts”, but they need to be *taught how to think* about the information. This will help to assess the correctness of information, its applicability to specific design problems, and the possible interpolation/manipulation of examples.

Firstly, students must be **taught general principles**. It is more than fair to stress envelope design criteria for the “home zone”, but students should be familiar with the general environmental principles which determine detailed envelope design for the four major climate zones: cold, temperate, hot-arid and hot-humid. Although many students graduate and work close to home, a large number choose to travel. Many grads may decide to seek employment in a climatic zone very different than the one in which they received their schooling. If they have been properly educated to understand “general principles” then they will have an easier time applying the codes and building science practices that are appropriate to their new locale. Case in point, the vapor barrier should be placed on the warm side of the insulation. Footings need to extend down to the line of frost penetration. Cold climate and hot climate case studies can be used in opposition to illustrate comparative climate related variations such as vapor barrier placements. Teaching “climate” is often left to the “Environmental Control Systems” courses. It must become a key part of the introductory Building Construction course in order to give validity and reference to the teaching of the “general principles” that affect the design of skins.

Secondly, students must be **taught climate specific design solutions**. General principles are extended to include *detailed* case studies for all climate regions. This should include specific reference to regional building code and performance standards. These include thermal insulation values, climate data tables, air and vapor barrier requirements, and other relevant performance standards.

Thirdly, students must be **taught how to read/interpret periodicals and reference materials**. Most of the design ideas that enter the Studio do so through the latest issues of “Architectural Record”, “Architecture”, “Canadian Architect” or “Architectural Review”. There are five issues that must be addresses: *new* magazines, *old* magazines and books, *“local”* technical reference materials and *“foreign”* technical reference materials and the *publication dates* on technical data sheets.

Students need to be taught to look beyond the seductive glossy photographs in magazines and monographs. They need to look for the geographic location and understand how it has impacted the detailing and performance of the skin and appropriate use of all materials. They need to appreciate when the building was constructed. Early modern or International Style architecture has numerous technical problems associated with the performance of its skins. This kind of knowledge may require that the student discard the example if the solution is climatically or technically inappropriate, or is too difficult to modify to suit local conditions.

Technical publications are not without fault. Much information has become outdated over the last 10 to 30 years. There were numerous building science and energy performance documents commissioned after the oil embargo during the mid 1970's. Many of these have not been updated since their early 1980 publication dates as a result of the reluctance of governments to spend the funds. These documents may still be found in our libraries and are still being used (for lack of anything new or easily accessible).

Fourthly, students need to be **taught to understand the evolution of modern architectural design**. Heroes are not only found in current periodicals, they are found in the modern masters: Le Corbusier, Aalto, Mies, Wright. Teaching the historical technological development of the modern movement can highlight scientific deficiencies of these buildings in current terms. Most of the "Modern Masters" designed in a time when insulation was either token or non-existent, "thermal bridge" was not a known term[2], glazing was single, energy was cheap and "performance" not a consideration. Introducing such historical issues in the Building Construction course can help students to identify changes in construction/skin techniques and can help them to understand contemporary detailing.

Lastly, and most importantly, students must be **taught to develop a critical eye**. This will assist when they look at anything. Just as students grow to understand that not all Design is good Design, not all technical publications are entirely accurate. The accuracy of the content may be quite limited and specific to either the material or the topic. Students need to understand that the researchers who create technical publications expect that they will know to cross-reference their details with those of bordering disciplines.[3] Students, when working on a problem that involves detailing, are generally looking for details that can be directly incorporated into a design. When using technical publications that emanate from National testing agencies or research firms, assumptions are made that these details are correct, not only for the central material but also for conjoining materials. This is often far from the truth.

Regional Differences:

"Skins" are constituted by the *entire* building envelope, walls, roofs and glazing systems. The design of these elements varies greatly from climate region to climate region. Students need to be taught that different approaches are required based upon the general climate as well as on the basis of the relative number of "heating or cooling degree-days". Buildings in a heating dominated climate will require a different approach to fenestration, orientation, shading and insulation than buildings in a cooling dominated climate.

When examining some regional building methods, the term "skin" can be misleading. It is difficult to think of many building envelopes as "skins". With the exception of siding or stucco on frame, most walls are at least 300 mm (12 inches) thick. They are often assemblies comprised of many different layers of materials, each with a specific job to do: rain screen, pressure equalization space, air barrier, thermal barrier, vapor barrier, interior finish, and structure. Performance and building science must be important considerations when designing the building envelope. Skin systems must also account for earthquakes, wind, humidity and overheating. Designing systems that achieve a high standard, under such severe weather loads is very difficult and often demands a compromise of the aspirations of the design and the Designer. Rain, snow and deicing salt are also major enemies of the building skin. Inadequate design performance results in extremely expensive lawsuits.

Including Passive and Sustainable Design Practices:

In these days of climbing fuel costs and power blackouts, we need to teach students to rely less and less on non-renewable fuel sources to heat and cool our buildings. Passive heating and cooling principles, which are tightly tied to regional conditions, add another dimension to the detailed design of our building skins. The teaching of passive and sustainable design building practices is an aspect of architectural design that has historically arisen out of ECS courses and is seen incorporated less often in normal building construction courses.

Passive design principles have a ramification on envelope design as well as the structural design of buildings. Concentration of windows on south facing facades, incorporation of shading devices, increases in insulation, cross section shape and the addition/placement of thermal mass, changes the approach to detailing buildings and selecting materials. Even the selection of a thick adobe wall to make use of diurnal cycles brings the issue of passive design to the building envelope designer.

The Problems with Reference Texts and Publications:

Within the United States and Canada, minor code and standards differences, imperial versus SI units, and seismic zones aside, structural system requirements are quite consistent. The same steel skeleton structure can be erected in Toronto as is possible in Houston. This allows for an economical proliferation of very good texts, industry publications and building case studies that can be used across the breadth of schools that populate the various climatic regions of the continent. The same cannot be said for publications that detail “skin systems”. However excellent the Building Construction text, it does not normally discuss the design implications and detailing of skin systems in the full range of cold, temperate, hot-arid and hot-humid climate zones. *General* building construction texts must be supplemented by publications that explore and detail the building science and performance aspects of building envelopes for specific geographic, climatic and legal regions. These publications must account for regional differences; i.e. building codes and climate data, as well as up to date industry and building science input.

Herein lies the root of the problem. Each scientist or industry partner develops expertise pertaining to its own *discrete* sector of the building industry. Researchers study masonry OR wood OR roofing OR air barriers OR thermal insulation. They create publications about their specific concern. By and large what is published is correct inasmuch as it speaks about the field of expertise, but often, errors are published when information is included about periphery material – structural systems or materials that are included in diagrams simply to “complete the picture”. It is not intentional. These publications assume that the reader understands that they are reading about masonry and that the wood frame details attached are “framework” and not pertinent. A knowledgeable researcher or practitioner may be able to identify these inconsistencies or errors. Students don’t. They copy. They get confused. They don’t understand that the blind copying of details from government or industry publications can lead to problems in their building details. They are looking for answers. They are trying to find some reference book that covers the difficult part of detail design – i.e. what happens when two different materials or systems meet?? They cannot understand how their professor could have them refer to documents, often published by reputable agencies, that are erroneous.

HOW Do You Teach Skins?

Beyond the set of ingredients presented thus far, “The 5 Points Towards the Teaching of Skins”, Regional Differences, Passive/Sustainable Design and References Materials, lies the issue of teaching pedagogy or STYLE. Not WHAT but HOW do you TEACH skins. The majority of building construction or skins teaching takes place in a lecture style format course. This teaching is sometimes, but not consistently supported or reinforced, with detailed design exercises or drawing requirements in the parallel Design Studio. If WHAT we teach, is not presented in an inspired manner, students may retain very little. The majority of students find building construction information rather dry and uninspiring. The format of the course is key to engaging the students’ interest in the material given.

The materiality of both the structure and the envelope is intrinsically entwined with Design. Neither design nor building construction can be considered in purely abstract terms. Three types of lectures are necessary to properly develop skins material. The first type is historical in nature and traces the evolution of a material/system (like steel, concrete or veneer systems) from its introduction into modern architectural design to the present. The lecture takes a case study approach and looks at the impact of the material or system on the development of modern architecture. The material or system is looked at primarily as a form/style giver, and without much reference to detailed construction practices or technical problems.

The second type of lecture takes a very detailed approach to the system/material in light of modern construction technologies/requirements. Again case studies are used, but these quite contemporary and illustrating wherever possible images of actual construction sequencing. Overhead transparencies of details and periodical articles can be used to supplement slides. (I require that the students keep a sketchbook of the course. I use an overhead projector and continually draw details for their reference that they are required to copy. The details supplement their study notes and texts.)

The third type of lecture is unfortunately quite dry and very serious. It delves the deepest into the technical information pertaining to specific code, constructional, detailed requirements of systems. It often involves important rules and calculations. It is the type of lecture that must exist, and survives only because of the placement in the curricular flow that sees the three types as a sequence/pattern repeating itself throughout the term.

ASSESSING What Students Have Learned:

Beyond what we give the students as information and how we deliver that information, what do we ask that they *give us back* to show how much they have learned?? What assessment methods are both effective as *evaluation tools* as well as *learning tools*? What type of exercises are the best? Tests, projects, drawings, models? Although we may have inspired ideas of what we would like our students to do, how much time can we ask our students to spend on our course, will usually impact the type of assignment. The precise nature of “construction – design” exercises varies from topic to topic and from School to School as a result of local restrictions in time and budget.

Skins/Construction Projects at UWSA:

Hence, in addition to the numerous quizzes that students must write, mostly as an incentive to have them keep abreast of the readings and technical information, and the sketchbook that they must keep of details presented in class, they complete seven projects that are employed improve the level of absorption or understanding of the subject, and that reinforce various of the “5 Points”. Scales and techniques are used that highlight contrast to emphasize the various purposes of the projects.

a) The Oasis[4] Project:

In this project the students are divided into the 4 major bioclimatic regions. They must design a discrete architectural space for their specific climate region that focuses on experience and comfort. They present and share their projects. It involves first year students in the teaching of the class. It forces cold-climate thinking students to begin to understand the ramifications of designing in other climate zones. The project addresses general principles, regional differences and begins to bring in issues of detailed design and passive/vernacular influences.

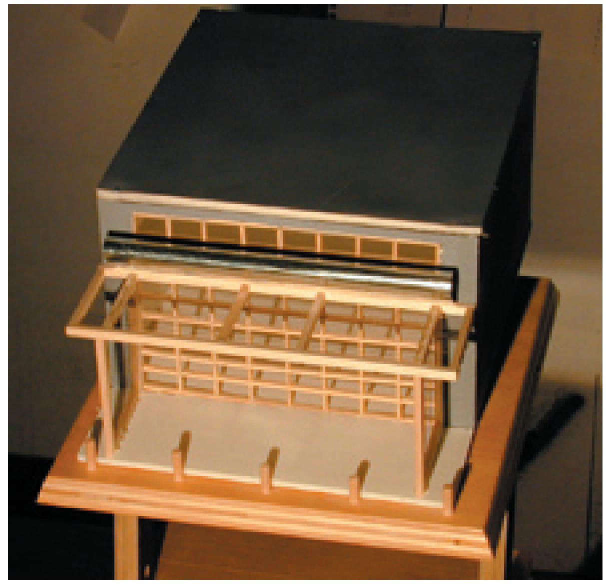
b) Masonry Wall Building:

The students participate in a hands-on session held at the regional masonry training headquarters. There they must construct a masonry veneer wall comprised of concrete block back-up, air barrier, rigid insulation and brick veneer. This project is intended to highlight the contrast between the act of drawing and the act of building. Precision versus roughness.

c) The Modernization Project:

This project refers to design in a cold climate. Ontario, Canada has very stringent building standards. In this project a list is assigned comprised of early modern buildings or contemporary buildings from warm climates. The students must redesign the key wall section and meet our building code and insulation standards. It is a tough project and in a few days work forces the students to think about detailing, materials, and how modification is necessary if you are borrowing ideas from areas or times that are not in agreement with their own. Students see the technical shortcomings of early modern design and the connection between design ideals and technical limitations/considerations.

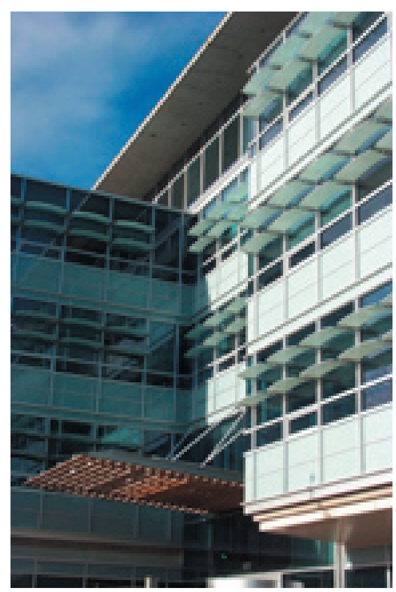
d) The Light Box [5]*:*



Purposeful holes in the building envelope are a major design issue. Students can begin to understand the technical and thermal considerations of this aspect of the skin through lecture material, but the "architectural" design and passive design aspects are also critical. The students must build a 1:10 metric foamcore model of a room and test their fenestration, glazing, and shading strategies on a heliodon. This project helps them to understand basic design of shading and to introduce principles of daylighting design into their vocabulary. The project can be used to highlight specific climate and latitude issues and is an excellent potential cross over into design studio.

e) The Design Project:

The final Design Project is the "pièce de resistance", the challenge that forces the students to "put it all together". It is given in lieu of an exam. It disallows rote memorization and demands research and ingenuity. It mimics a "real" design problem. It can be relied on each term to ask the student to extend the "D"esign exercise into one that must address specific materiality and detailing of both the structure and the skin of the building. At the end of each course the students are assigned the detailed design of a small building. Understanding that time (and available student energy) is limited, only 3 drawings are normally required: a plan at 1:50, a detailed/labeled wall section at 1:10, and a structural axonometric at either 1:25 or 1:50. They must use most of the materials that have been covered in the term as well as address major teaching issues. This a more reliable way to integrate the notion of Technology with Design than expecting the crossover to take place in the Design Studio. That can be hit and miss depending on the professors involved. Often relevant design competitions can be used as a subject, with the option open for the students to enter. Competition work seems to increase the amount of effort students are willing to put into a (time consuming) project for a course outside of Design Studio.



f) Detailed Building Case Studies: Looking at <u>Special</u> Skins:

To investigate more unusual skins systems requires that students engage in detailed case studies as a means to personally investigate the tectonics of architectural design. Research investigation and seminar presentations in small groups are excellent methods of both teaching and learning. Also presented at this conference, a paper on the Tectonics of the Double Skin, addresses a senior research elective that explored these more innovative environmental skin systems. The students have put together a web page with their results and pdf files for their case studies. In this way they learn and leave the information behind in a format that is available for other students.

g) The Vital Signs Case Study [6]:

The project is based on the Vital Signs Case Study model from UC Berkeley. It requires students to assess the "performance" aspects of an existing building. The project type is an excellent way to look at the impact of detailed technical design on the skin's performance. Depending on the design intentions of the building chosen to study, various aspects of performance can be studied. It relies on the availability of data collection equipment making it more appropriately available to a smaller number of students in an elective setting.

A student team won an Honorable Mention in the 1998 Vital Signs Student Case Study Competition for their research on "Green on the Grand", Waterloo, Ontario.

These exercises have been designed to reinforce and expand/extend the information and ideas taught in lectures. By engaging the students with design motivated problems it forces the connection between the technology of skins and its incorporation into or influence of architectural design. It is neither a finite nor complete list of potential projects. It represents a good variety of relevant problems that can be accommodated by curricular limitations. Visits to actual construction sites are well received, although problematic for large groups. Some schools are able to engage students in actual building and testing programs for skins. Real life, hands-on exercises are the best teachers and reinforcements of learning. We have recently mounted electives in which the students can participate in a Habitat for Humanity build. Although the subject buildings may be mundane, it does allow the students to engage in the "act of building" and to see a project from foundation to completion within a two-week period.

Suggestions:

Industry sponsored technical documents have shortcomings insofar as they may only be seen as reliable for "core" information as it pertains to the material in question. They are, however, available. Since the tragic events of September 11, 2001, much building case study material is no longer available. Drawings and documents that were previously found on the web, have disappeared. Municipal building departments are no longer releasing building plans for academic study and teaching. Most architectural offices, for reasons of liability, are not willing to share detailed building documents. It will become increasingly important for academia to engage in a proactive publication and sharing of developed building case studies.

It would be helpful if there were a "clearing house" for detailed technical material, construction documentation, and case study information that could be used as a teaching/learning resource. Much in the way that CREST has sponsored a website that provides key links to sources of environmental design, perhaps ARCC might host a central (web) index for (verified) sources of relevant technical information, academic papers and building case studies.

The reviewer's comments for this paper asked whether or not there was any way to assess the learning/teaching effectiveness of the various exercises. It was suggested that there might be a sampling of studio work before and after the teaching to show influences. Such assessment could be done for individuals or classes as a whole and also include interviews to understand what the retained message, principles and practices might be. This might also include a before and after survey assessment to evaluate what is learned. Such analysis would provide more concrete feedback and allow for refinement of both the teaching and project outlines.

Conclusion:

As a result of its unique position as the membrane that connects the teaching of "structures" and the teaching of "environmental systems", the teaching of "skins" requires, as outlined above, both carefully staged teaching and a varied approach to project selection and testing. As the technical curriculum continues to develop in its intensity and requirements, it may mean that designated courses, portions or lectures need to be developed to address specific issues related to skins – breaking away from either the structures or environmental systems courses. Skins issues might also need separate identification in the NACB criteria.

For the above outlined reasons, the *teaching* of skins is an aspect of the field of building construction that presents itself as a complicated task. It demands a different teaching pedagogy than instruction in basic "structural systems". Skins expose a unique set of problems that must address regional differences in order to properly respond to issues of climate and performance. Teaching skins also challenges us to find *reliable, up to date* teaching and reference materials for both ourselves and our students.

Because "skins" are different, their instruction demands that we approach teaching in an innovative and comprehensive manner – and that we reinforce our teaching by providing means of assessment that can continue to teach and stimulate our students to learn.

Notes:

[1] Allen, Edward. Fundamentals of Building Construction: Materials and Methods, is one of the most widely used texts in North America.

[2] The first official mention of thermal bridges in Canada was in Canadian Building Digest No. 44 titled "Thermal Bridges in Buildings", published in August 1963 by the National Research Council. It is still cited as a pertinent reference on the NRC website.

[3] Upon reviewing the recently published "Masonry Details That Work", 2000. Version 2.0, it was apparent that the details that were included presented not only a range of performance solutions but were also erroneous when drawing/detailing the non-masonry details adjacent. When the author/editor was queried they responded that this information was there as a reference only and not purported to be correct.

[4] The Oasis Project was developed at a Retreat sponsored by the Society of Building Science Educators and is still used by many members, in various forms.

[5] Thanks to Bruce Haglund, SBSE, at the University of Idaho for the basis of this project.

[6] More information on the Vital Signs Curriculum Materials project may be found at <http://www.arch.ced.berkeley.edu/vitalsigns/Default.htm>

Contemplating Architecture as an Instrument of Policy Implementation: Or Translating Rhetoric into Architectural Form

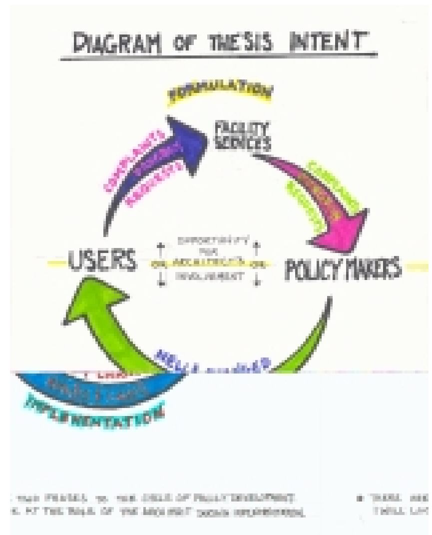
Andrea BOYLE
Boston Architectural Center
andreaboyle@charter.net

Abstract:
Just as means are to an end, public policies are to the documentation of the general will, administrative processes are to public policy implementation, and building regulations are to architecture. Consider then that architecture is an instrument of public policy implementation. The dictionary definition of instrument is, "3. that with or by which something is effected; means; agency." In the case of government, the implementation of public policy is the result of administrative procedures. In the realm of the built world, architecture is the effect.

Examined under a different light, both public policy and architecture can be considered the instrument by which something else is effected instead of being the result alone. If we recognize that public policy reflects the general will of the people, then in its rhetorical form, it is used to articulate the desires of a society. It is the agent of a democracy. Identifying architecture as a means instead of an end is more difficult since it is rarely considered as such consciously.
Architecture, unlike public policy, is often open to interpretation. For some the term architecture evokes images of well known buildings, for some it is simply the quotidian built environment, while for others, "Architecture is whatever in a building does not point to utility,". Once the term architecture is defined by designers and users (just as procedures for enforcing public policy are legislated) one can propose considering architecture among those methods by which something is effected.

The importance of the contemplative architect to society is clear when distinction is made between projects where architecture is an end and those where it is the means to an end as identified by the general will of a society.

Contemplating Architecture as an Instrument of Policy Implementation: Or Translating Rhetoric into Architectural Form



“What is the role of the professional architect in today’s society?” Aside from constructing sound structures that incorporate aesthetic sensibilities into the planning of the built environment, architects make a social impact through their projects. Typically rules and regulations, as much as the architect’s design skill, play a role in the development of a project which must ultimately address the needs of a client. It is important therefore that the architect recognize what a client wants and what society desires. Policies are an example of the articulation of these needs and desires and it is the contemplative architect who is able to translate that rhetoric into its tectonic form. It is through such action that architecture can itself become an instrument of policy implementation.

Thoughtful architects are subsequently in a position to mediate between the policies of the private client and society. To do this, they need a clear understanding of not only their clients’ and society’s agendas, but also their own. On one hand, it is assumed that architects will determine for themselves which policies they support and intend to promote through their design work since architecture that is the action born of a thought will necessarily reflect, tectonically, the intention of that original thought. [1] On the other hand, the notion presented here is that the architect’s role in the implementation of policy can produce intended private and public consequences when the design process is self-conscious, collaborative, and concentrated on the stated policies of all parties involved. Just as governmental processes must rely on legislatively stated intentions, the architectural process is entitled to have access to the same or similarly articulated agendas (i.e. corporate mission statements). These are herein referred to as “policies” and are typically understood to be documented in such a way so as to be referable.

The assumption for purposes of this proposal then is that the term “architecture” refers to the process of designing and constructing the built environment and that “policy” is synonymous with the private client’s mission statement or a society’s documented public policies. These are citable statements of these groups’ agreed to collectively formulated initiatives. In Western society, there are established ways of documenting a collective public thought: through representative government. The American democratic process is founded on this principle; political representatives to the legislative branch of government are charged with representing and documenting the general will or more specifically the “happiness” of society in the form of laws.[2] The Enlightenment presented us with the concept of “general will” [3] and the Benthamites adapted this term with an explanation of the motive behind democratic legislation as a community’s effort to address the happiness of a community as a whole or in other words, the interest of the community is, “The sum of the interests of the several members who compose it”.[4] The motivation to abide by or at least consider the reason behind legislated dictates (or laws) however, remains up to the individual member's interpretation of that law.

Practicing, "the art or science of planning and building structure"[5] in a manner that contemplates a process of public policy enforcement, would respond to the general consensus of a society's desires instead of producing unintended consequences if the policy's intentions were left unexplored. In the American judicial system, law enforcement officials following agreed upon procedures established under the executive branch on federal, state and local levels, as well as members of the judicial branch of our government are often required to interpret written public policy. Members of the judicial branch must decide what the intent of the legislation was when the policy (law) was created.[6] Antecedents of interpretations might play a role in their decision of intent, just as their understanding of the current-day general will of their society could. As members of a society, architects can understand the intent of its policies. And as members of the design profession, they can reference precedents within the realm of the built environment when they interpret both public will and private agendas as outlined in a policy.

As an integral part of the development of society, professional architects are often required to be aware of both the societal and professional expectations of the environment in which they are practicing. This is an intangible context. The perception that a company wants to project into society is often outlined in a mission statement (a type of policy). Whereas United States citizens are empirically familiar with the U.S. Code of Law, confusion often occurs in a corporate setting when a client's agenda is not articulated or conveyed to the architects or other professionals working with them. Design problems arise, "…when a designer does not understand a problem clearly enough to find the order it really calls for, he falls back on some arbitrarily chosen formal order. [Hannah Arendt's "complacent 'truths" for example.] The problem, because of its complexity, remains unsolved."[7] The challenge for architects then is not only to comprehend the policy agenda, but to translate rhetoric into architectonic form.

The translation of policy into tectonic terms is a collaborative process. If, "…,the function of the architect requires a training in all departments of learning,"[8], then architects need to work in conjunction with, and not independent of, the other people involved in the organization of society. Even if designers are consciously creating spaces that they believe address those intentions, ignoring the benefits of an interdisciplinary approach to design might create environments that are contrary to the intention (per the policies) of that community's social order.

Philosophies behind principles of design date back to Antiquity. Ancient Greece's Hippodamos of Miletus had a rationale for his gridiron urban plan just as Vitruvius documented his reasoning in his treatise *De architectura* in 46-30 BC Rome. These theorists/architects may have founded their design principals on the overall social intentions of their societies without explicitly taking a consensus since their societies were, by modern standards, insular. Their design efforts were successful apparently because they did not need to address a broad range of societal concerns. Over two thousand years later, Western societies encompass more diverse cultures. Society's collective motivation itself has become more complex and less readily translated into a singular design philosophy.

There are several aspects of complexity surrounding the modern notion of society's intentions that warrant exploration on their own accord. A few should at least be recognized as potential support for the proposition that a parallel can be drawn between the way that society implements its collectively legislated intentions and the creation of the built world:

1) While not able to create it, modern architecture should have been able to respond to its own rhetoric that promoted Utopia as Manfredo Tafuri describes.[9] In this case, a design initiative was developed primarily for the benefit of those who wanted to advance modern architecture's policies instead of the general will articulated by society (or per Bentham, instead of society's "happiness"). The International Congresses for Modern Architecture (CIAM) architects essentially took on a dual role of policy makers and enforcers. The ultimate directive of the CIAM policies was to promote their own view of Utopia through architecture and so they clearly recognized the direct parallel between society and the built environment that it inhabits.

2) Economic impetus exists for some members of society entirely outside the realm of utility. For example,
the Western policy of economic expansion in the early part of the twentieth century led to the development of the metropolis.[10] The design of one part of the city, even just one office building when multiplied, ultimately led to the creation of the whole. The architecture in this case was following an oligarchic, private policy agenda, not a public one; the creation of the metropolis was not in response to the happiness of the community as a whole. In both of these instances the architect's role as a mediator between the policies of society and the client was not established.

That architecture has been used as a vehicle of the articulation of an ideology appears to be an accepted concept in general. The nature of that ideology and the origin of its policies however are what critics fundamentally attack. However, anything connected to it is subject to scrutiny as well. Contention that arises over ideologies behind a policy might require the architect to defend it. Architects therefore should be educated in the policies of their client and recognize that they might be held accountable for their role in the promotion of that ideology. Even if they are not formally trained in other disciplines within a society, those creating the built environment, namely architects, must be conscious of this complexity if they intend to address the desires of the client or even the "happiness" or "will of all" for that matter. Tafuri claims that, "Paradoxically, the new tasks given to architecture are something besides or beyond architecture."[11] In the social context of a project, architects play a role in the creation of their client's image through the built environment that is created. Lebbeus Woods, contends that regardless of the architect's recognition of this responsibility, once they contract with a client, they agree to support the client's ideology. Even if the architect fails to reflect on this notion, he or she is still culpable in the dissemination of that ideology.[12]

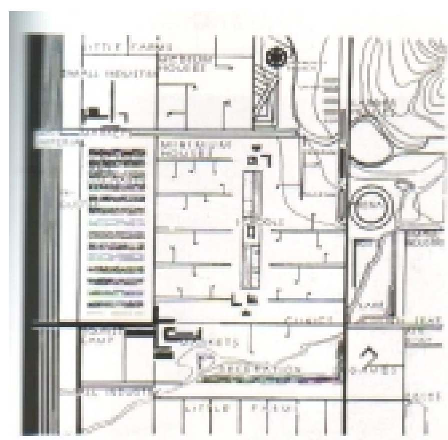
In certain cases, we can learn from an analysis of design philosophies. Five examples are explored here. While successfully so, some design processes only addressed the will of some but subsequently were considered failures when critiqued in terms of addressing the balance of the sum of a larger society's individual desires. Examples of such include gated communities and public housing. In other instances, such a critique reveals success precisely because the designers themselves were able to influence a community's legislation through their philosophies. Examples of these include work by Thomas Jefferson, Frank Lloyd Wright and the company towns of America.

There are two levels of exploration of these precedents. The first concerns the designers' methods of theoretical analysis of the intent of the project, then their interpretation of that intent in graphic terms, and finally the application of those conclusions to the built environment. The second level pertains to those designers' self-awareness of (or in some instances, the lack thereof) the aforementioned actions.

Thomas Jefferson

> "The spirit of the Revolution, which Jefferson articulated and embodied, was to create the framework of a new society reflecting in its constitution, statutes, buildings, furniture, songs and mottoes, the sober, republican, civic virtues drawn from the ancient examples of Greece and Rome."[13]

Just as Thomas Jefferson's political views were influenced by the classical principles of a republic, his architectural impulse was to rely on the models offered by Antiquity; he trusted these established concepts.[14] Today, Washington D.C.'s plan resembles the nation's triangular governmental structure (as outlined in articles I, II, and III of The Constitution of the United States: the separation of the Legislative, Executive, and Judicial branches of government.[15]). The capitol city's plan is anchored on two points. One is at the Capitol building and the other is at the White House. Triangulated, they point to the Potomac River (and today Jefferson's Memorial). Encompassed in this triangle's perimeter is the Mall (where many of this country's achievements are gathered and on display at the Smithsonian).[16] It has been observed that when the lines of axis of the Capitol and the White House converge, the letter "L" (e.g. Legislation) can be discerned. [17] Jefferson's rare position of both having articulated the general will in the form of the United States Declaration of Independence and later being presented with the opportunity to reiterate those same ideals architecturally, allows for the assumption that he was indeed self-consciously using architecture to implement public policy. (fig. 1)[18]

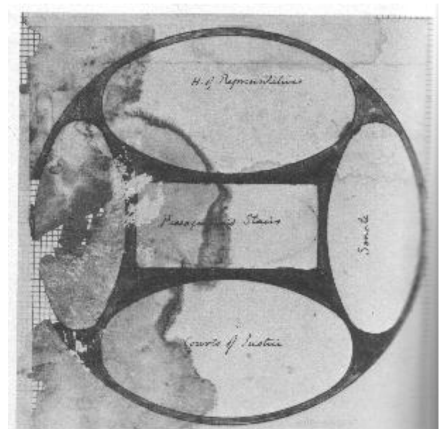


349. Broadacre City. 1934. Frank Lloyd Wright. Plan.

Figure 1: Evidence that Jefferson was not only contemplating a domed Capitol, but a separate chamber(s) dedicated to the Supreme Court within that same rotunda.

<u>Broadacre City</u> “Wright, however, wanted openness without dominance; his ideal was always an ‘architecture of democracy’.” [19]

The policy that Frank Lloyd Wright was responding to with the Broadacre design was based on an apparently democratic capitalist set of principles that included a respect for the mechanization of the world. The principles were based on a notion that harkens back to the founding principles of America, the right to independence and to own property. In the 1930s, this translated into owning an acre of land to live on or use as well as having an automobile.[20] In Wright’s Broadacre City, elements of the community were to be laid out in graduated concentric circles originating not from a central (pedestrian orientated) park, but components of the municipality.[21] Smaller scale homes were relegated to the denser town center while the larger homes were situated on the edge of the urban fabric. (fig. 2)[22] The Cartesian grid was borrowed from the Garden City plan as much as it was from Corbusier’s plan for Ville Radieuse.[23] Though still present in Wright’s Broadacre plan, agriculture is pushed further to the periphery alongside the spaces designated for use by industry. If Wright’s policy for urban planning was based on the aforementioned set of underlying conclusions born of an “architecture of democracy and capitalism” then in the case of the Broadacre City diagram, architecture was used to implement a policy.



434 Study for the capitol building, Washington
THOMAS JEFFERSON 1743–1826
Laid paper 1792
18.1 x 17.8 (7¼ x 7)
Lent by the Massachusetts Historical Society, Boston

Figure: 2 Broadacre City plan

<u>Scotia, California</u>

> "…to purchase timber land, to erect sawmills, to construct booms and piers, to construct team tugs and tow boats, or purchase the same, to cut and transport timber and lumber, to saw lumber and sell the same, to do all things that may be necessary to the production and sale of lumber…"[24]
>
> - The Pacific Lumber Company mission statement in 1883

This (America’s oldest) company town’s mission statement doesn’t directly relate to the development of a town understandably because it wasn’t in the town-making business. Ultimately, the motivation of the company was profit. But without a loyal skilled workforce, this goal would be impossible. The creation of the town of Scotia was the indirect result of the company’s goal of lumber production. The sawmill was built and lumber was processed and sold from the mill and factory in Scotia. The mission statement was adhered to thanks to the buildings that were constructed, and the employees living in Scotia benefited indirectly from this.

Windsor at Vero Beach, Florida

> "Windsor is a private, seaside village reminiscent of historical coastal towns like Charlestown and Nantucket. A typical enclave with elegant Anglo-Caribbean homes along intimate lanes, Windsor combines the ambience of village living with premier amenities including golf and croquet."[25]
>
> - policy as stated in a Windsor Brochure

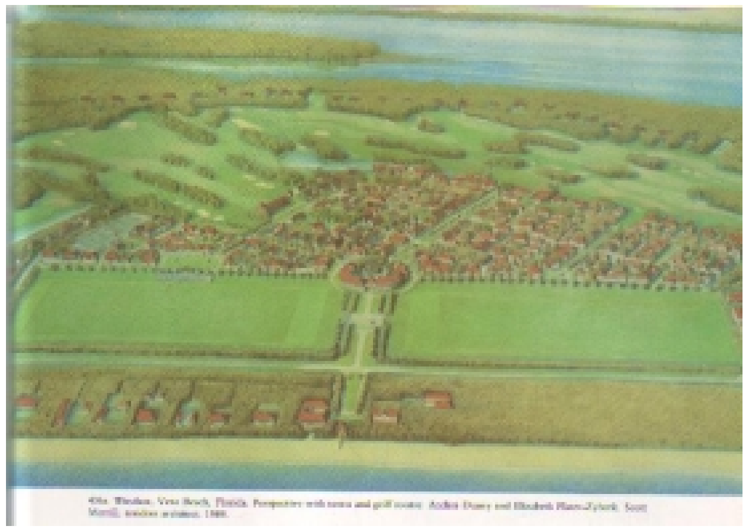


Figure 3: Rendering of Windsor, Vero Beach Florida

Gated communities such as the Windsor in Vero Beach, Florida (a neo-traditional sub-urban planned town), represent a white collar version of the company town. (fig. 3).[26] The initiative however comes instead from a commercial community developer who is in the town-making business. The Windsor Zoning regulations that dictate materials and design rules (i.e. "Steeply Pitched wood or metal roofs; open eaves that are deep and have exposed rafter tails..."[27]) ensure that the style of homes and atmosphere of the town do reflect what the developers advertise. There is one element of the mission statement that seems to be difficult to implement: ultimately this community is not a village. Due to its commercial or corporate origins, the town itself and its houses are larger in scale than the traditional villages cited. Additionally, the seasonal nature of the residents who are there precisely because they seek privacy when they are in town, does not promote the formation of a community. This results in a gathering of individuals instead of a community. The economic motivation of the developed gated community, (instead of a policy born of the general will of society for example) does not allow Windsor to create a built environment that reflects the rhetoric of its mission statement. Because the designers and developers were so closely affiliated however, their unarticulated policy was probably what they intended to address and did; the town exists and appears to be profitable.

Centennial Place, Atlanta, Georgia H.U.D. 2000 – Urban Revitalization

The United States Department of Housing and Urban Development (H.U.D.) under Secretary Andrew Cuomo released its State of the Cities report in June 2000. In it, H.U.D. outlined four factors that contributed to the results of its findings in that year: a new economy, a new demographic, new housing challenges, and new forces of decentralization.[28] The policy for improving conditions in America's cities and suburbs that was formulated was labeled "Building on Success."[29] The principles behind this policy agenda are that urban housing conditions can improve, without harming and with the help of, neighboring suburban communities. The Atlanta Housing Authority (A.H.A.) teamed up with private investors and developers to create a community that resembles the standardized private housing being built by developers throughout the nation. The country's oldest public housing project, Techwood Homes, was supplanted by Centennial Place with its contemporary mixed-use community of townhouses. [30] (fig. 4)[31] The location of the new housing complex offers the opportunity to literally connect to the existing community as the school will be on-line with Georgia Institute of Technology, the apartments are wired for internet connection, Atlanta's mass transit system (MARTA) is accessible to the residents and corporations in the area are expected to lease office suites located within the development. Additionally, the goal of inspiring self-sufficiency is addressed by the mixed-use element of the program since the social stigma that might be experienced by the low income resident is potentially eliminated because subsidized apartments are indistinguishable from the standard-rate units. The percentage of units designated for public housing residents is equal to that of those for standard-rate ones. It is anticipated that this will also encourage a sense of local pride among the community members and lead to care of the property. [32]

Figure 4: Image of Centennial Place Townhouses

The project however does not seem to address what appeared to be a key objective of the "Building on Success" policy: addressing the issue of decentralization. The urban core of Atlanta is still separated from its many suburban edges by a multi-lane beltway: The Perimeter. Aside from the imitation of the style of housing that can be found in the city's periphery, a connection to suburban communities is not evident. For example, some program (even housing) components could have been located off-site or some suburban communities could have been considered among the commercial leased space candidates. However on the larger scale of the urban plan, the potential for using architecture as a tool of policy implementation was overlooked.

Ironically, with the exception of the aforementioned H.U.D. example, the clearest examples of architecture used as an instrument of (public) policy implementation are those in the urban planning and programming realm. As the scale of the program recedes and the scope and articulation of the policy decreases, the matter of translating the general will or even utilitarian principles of the greatest good for the greatest number into architecture becomes difficult. In some instances, the mission statement or public policy isn't articulated at all. The small company, for example, might not have a formal mission statement to share with the architect. Or in the case of one of the most informal forms of society, the family, members would likely fail to recognize that they empirically adhere to any collective family policy, let alone be able to verbalize this (to use the socio-architectural theorist, Frederic Jameson's definitions) "particular"[33] side of politics to an architect. It is precisely in these most difficult instances that the thoughtful architect can encourage his or her client to state their company's, family's, etcetera "general or universal"[34] guiding principles and in so doing, he or she will exceed typical professional design expectations.

To carry this task out sincerely and successfully, architects are also required to develop and state his or her own personal mission statement. This process starts with defining what architecture means to the architect himself or herself. It might be "organic"[35], "… a stable structure, which gives form to permanent."[36], or "the art or science of planning and building structure."[37] In the realm of policy formulation, architects can also exchange and develop agendas right along with, not only the client, but with the whole of society since they contribute to that whole by creating its manmade context. The same is true in regard to policy implementation. It is true that in some cases, an architect might be satisfied to create a built environment that expresses their personal agenda (architecture as the *end*). Others, however, recognize that they can better serve their community by "thinking" (in the manner that Arendt describes)[38] and therefore anticipating the sociological consequences of their design actions. They recognize that they can adhere to their own mission statement while simultaneously addressing society's and the client's policy initiatives. As a result, the contemplative architect, in conjunction with his or her society, creates architecture that still reflects the architect's personal convictions without overshadowing the overall architectonic statement being made by the client (architecture as the *means to the end*).

Public and private policy can therefore be represented by the built environment. Observation of the social context of a design and construction project can lead to the conclusion that public policy does articulate the desires of society. Only architects who are prepared to anticipate the possible societal consequences of his or her actions are in a position to utilize architecture as an instrument of policy implementation. If the process is successful (if the architect's and client's mission statements and policy agendas are respected) then both professional architects and society benefit from the use of architecture as instrument of public and private policy implementation.

ENDNOTES

[1] Hannah Arendt discusses issues behind "thinking" in relation to "action" in her book *The Human Condition*. p. 5.
[2] Article I of "The Constitution of the United States. *Webster's Encyclopedic Unabridged Dictionary of the English Language* [includes a reprinting of "The Constitution of the United States"], (New York USA: Portland House, 1989),p. 1701.
3The reference here is to Rousseau's definition of general will, "…the general will studies only the common interest while the will of all [what all individuals want] studies private interest, and is indeed no more than the sum of individual desires. But if we take away from these same wills the pluses and minuses which, cancel each other out, the balance which remains is the general will." Rousseau, Jean-Jacques. The Social Contract. Trans. Maurice Cranston. Original Publication in 1762 and First Translation published 1968, (England: Penguin Group, Clay Ltd., 1968), p.73.
[4] Burtt, Edwin A. *ed. The English philosophers from Bacon to Mill.* (New York, New York: The Modern Library, 1939), p. 289 & 792.
[5] *The New Merriam Webster Dictionary*. Ed. Frederick C. Mish, (Springfield, Massachusetts, USA: Merriam-Webster Inc., 1989), p.54.
[6] Articles II & III of "The Constitution of the United States. *Webster's Encyclopedic Unabridged Dictionary of the English Language* [includes a reprinting of "The Constitution of the United States"], (New York USA: Portland House, 1989),p. 1702.
[7] Christopher Alexander, *Notes on the Synthesis of Form*, (Cambridge, MA: Harvard University Press, 1964), p.1.
[8] Vitruvius, *The Ten Books on Architecture*, Trans. Morris Hicky Morgan, PhD, LlD., (New York: Dover Publications, Inc., 1960), pp. 13&11-12.
[9] Tafuri, Manfredo. *Architecture and Utopia, Trans. Barbara Luigia La Penta*. (Cambridge Massachusetts: The MIT Press, 1976), pp.48-49.
[10] Mumford, Lewis. *The City in History: Its Origins, Its Transformations, and Its Prospects*. (New York, New York: Harcourt, Brace & World, 1961).
[11]Tafuri, Manfredo. *Architecture and Utopia, Trans. Barbara Luigia La Penta*. (Cambridge Massachusetts: The MIT Press, 1976), p.ix.
[12]Woods, Lebbeus. *Anarchitecture : Architecture is a Political Act*. **(**New York : St. Martin's Press, 1992), pp. 8-9.
[13] Adams, William Howard, ed. *The Eye of Thomas Jefferson*. (Charlottesville Virginia: University Press of Virginia, 1981). p. xxxiii.
[14] Ibid, p. 168.
[15] Articles II & III of "The Constitution of the United States. *Webster's Encyclopedic Unabridged Dictionary of the English Language* [includes a reprinting of "The Constitution of the United States"], (New York USA: Portland House, 1989),p. 1701-1702.
[16] Ibid, p. 7.
[17] Tafuri, Manfredo. *Architecture and Utopia, Trans. Barbara Luigia La Penta*. (Cambridge Massachusetts: The MIT Press, 1976), p.32.
[18] Adams, William Howard, ed. *The Eye of Thomas Jefferson*. (Charlottesville Virginia: University Press of Virginia, 1981). p. 256.
[19] Norberg-Schulz, Christian. *Meaning in Western Architecture.* (New York, New York: Praeger Publishers, Inc., 1975). p. 348.
[20]The All-Wright websitehttp://www.geocities.com/SoHo/1469/flw.html
[21] Scully, Vincent. Scully, Vincent. *American Architecture and Urbanism*. (New York, New York: Henry Holt and Company, 1988). p.171.
[22] Scully, Vincent. Scully, Vincent. *American Architecture and Urbanism*. (New York, New York: Henry Holt and Company, 1988). p.171.
[23]ibid. pp.161-171.
[24] The Pacific Lumber Company website: http://www.palco.com/roots.htm
[25] Windsor community promotional brochure, 1996. [see also the Duany, Plater Zyberk & Company website: http://www.dpz.com]
[26] Scully, Vincent. *Architecture: The Natural and the Manmade.* (New York, New York: St. Martin's Press, 1991),p.314
[27] ibid.
[28] Housing and Urban Development website archived report: http://www.hud.gov/pressrel/socrpt.pdf, pp. 1-2.
[29] ibid. p.79.
[30] Easley, Marie. *A Closer Look At Mixed Income Housing*. On the Federal Reserve Bank of Atlanta - Community Development website: http://www.frbatlanta.org/comm_affairs/partners/v7n2/v7n2_1.htm
[31] ibid.
[32] ibid
[33] Jameson, Frederic. *Is Space Political?* in *Rethinking Architecture: a Reader in Cultural Theory*. comp. Neil Leach, (USA: Routledge, 1997),p.256.
[34] Jameson, Frederic. *Is Space Political?* in *Rethinking Architecture: a Reader in Cultural Theory*. comp. Neil Leach, (USA: Routledge, 1997),p.256.
[35] Wright, Frank Lloyd. *The Living City.* (New York, New York: Horizon Press, 1958).
[36]Tafuri, Manfredo. *Architecture and Utopia, Trans. Barbara Luigia La Penta*. (Cambridge Massachusetts: The MIT Press, 1976), pp.42.
[37] *The New Merriam Webster Dictionary*. Ed. Frederick C. Mish, (Springfield, Massachusetts, USA: Merriam-Webster Inc., 1989), p.54.
[38] Arendt, Hannah, *The Human Condition*, (Chicago: The University of Chicago Press, 1998).p. 5.

BIBILIOGRAPHY

Adams, William Howard, ed. *The Eye of Thomas Jefferson*. (Charlottesville, Virginia: University Press of Virginia, 1981).

Alexander, Christopher. *Notes on the Synthesis of Form.* (Cambridge, Massachusetts: Harvard University Press, 1964).

Arendt, Hannah, *The Human Condition*, (Chicago: The University of Chicago Press, 1998).

Benjamin, Walter. *The Work of Art in the Epoch of Mechanical Reproduction.* Trans. H.H. Gerth and Don Martindale. in *Studies on the Left*, vol. 1 no. 2, 1960 [reprinted (New York, New York: AMS Press, Inc., 1968)].

Burtt, Edwin A. *ed. The English philosophers from Bacon to Mill.* (New York, New York: The Modern Library, 1939).

Crawford, Margaret. *Building the Workingman's Paradise: The Design of American Company Towns.* (Great Britain: the Bath Press, 1995).

Dickson, Harold E. *Arts of the Young Republic: The Age of William Dunlop.* (Chapel Hill, North Carolina: The University of North Carolina Press, 1968).

Ellis, Joseph J. *American Sphinx: The Character of Thomas Jefferson.*(New York, New York: Vintage Books,1998).

Giedion, S. *A Decade of New Architecture*. Jean-Paul Haymoz, trans. (Zurich, Switzerland: Girsberger., 1951)

Guiness, Desmond and Julius Trousdale Sadler, Jr. *Mr. Jefferson Architect.* (New York, New York: The Viking Press, Inc., 1973).

Harries, Karsten. *The Ethical Function of Architecture*. (Cambridge, Massachusetts: The MIT Press, 1997).

Heidegger, Martin. *The Question concerning Technology: and Other Essays.* Trans. William Lovitt. (New York, New York: Garland Publishing, Inc., 1977).

Jameson, Frederic. *Is Space Political?* in *Rethinking Architecture: a Reader in Cultural Theory*. comp. Neil Leach, (USA: Routledge, 1997).

John Fleming, Hugh Honour, and Nikolaus Pevsner. *The Penguin Dictionary of Architecture*. Fourth ed. (New York, New York: Penguin Books USA Inc., 1991).
Penguin Architecture Dictionary

Mumford, Eric. *The CIAM Discourse on Urbanism, 1928-1960*. (Cambridge, Massachusetts: The MIT Press, 2000).

Mumford, Lewis. *The City in History: Its Origins, Its Transformations, and Its Prospects*. (New York, New York: Harcourt, Brace & World, 1961).

The New Merriam Webster Dictionary. Ed. Frederick C. Mish, (Springfield, Massachusetts, USA: Merriam-Webster Inc., 1989).

Norberg-Schulz, Christian. *Meaning in Western Architecture.* (New York, New York: Praeger Publishers, Inc., 1975).

Pirages, Dennis. *Global Technopolitics: The International Politics of Technology and Resources.* (Pacific Grove, California: Brooks/Cole Publishing Company: 1989).

Rousseau, Jean-Jacques. *The Social Contract*. Trans. Maurice Cranston. Original Publication in 1762 and First Translation published 1968, (England: Penguin Group, Clay Ltd., 1968).

Rupert, Mark. *Producing Hegemony: The Politics of Mass Production and American Global Power.* (Cambridge, Great Britain: Cambridge University Press, 1995).

Rykwert, Joseph. *The Necessity of Artifice.* (New York, New York: Rizzoli International Publications, Inc., 1982).

Scully, Vincent. *Architecture: The Natural and the Manmade.* (New York, New York: St. Martin's Press, 1991).

Scully, Vincent. Scully, Vincent. *American Architecture and Urbanism.* (New York, New York: Henry Holt and Company, 1988).

Tschumi, Bernard, *Architecture and Transgression,* (MIT: Cambridge, 1996).

Tafuri, Manfredo. *Architecture and Utopia*. Trans. Barbara Luigia La Penta. (Cambridge, Massachusetts: The MIT Press, 1976).

Vitruvius Pollio, Marcus. *The Ten Books on Architecture.* Trans. Morris Hicky Morgan, PhD, LlD., (New York, New York: Dover Publications, Inc., 1960), pp. 13&11-12.

Webster's Encyclopedic Unabridged Dictionary of the English Language [includes a reprinting of "The Declaration of Independence" and "The Constitution of the United States"], (New York USA: Portland House, 1989).

Windsor Community promotional brochure. Obtained in 1996 from the Windsor management office at 3125 Windsor Boulevard, Vero Beach, Florida, 32963 / 1-800-233-7656.

Wright, Frank Lloyd. *The Living City.* (New York, New York: Horizon Press, 1958).

Woods, Lebbeus. *Anarchitecture : Architecture is a Political Act***. (**New York : St. Martin's Press, 1992).

Franck, Karen A. and Lynda H. Schneekloth eds. *Ordering Space : Types In Architecture And Design.* (New York, New York: Van Nostrand Reinhold, 1994).

WEB SITES REFERENCED

Airline companies customer service / Contract of Carriage information websites:
Delta- http://www.delta.com/care/service_plan/index.jsp;

United - http://www.ual.com/site/primary/0,10017,1505,00.html;
American - https://www.im.aa.com/American?BV_Operation=Dyn_AAPage&referer=index.html&form%25referrer_site=None

The All-Wright website: http://www.geocities.com/SoHo/1469/flw.html

The Pacific Lumber Company website: http://www.palco.com/roots.htm

Easley, Marie. *A Closer Look At Mixed Income Housing*. On the Federal Reserve Bank of Atlanta - Community Development website: http://www.frbatlanta.org/comm_affairs/partners/v7n2/v7n2_1.htm

Duany, Plater Zyberk & Company website: http://www.dpz.com

Housing and Urban Development website archived report: http://www.hud.gov/pressrel/socrpt.pdf,

Housing and Urban Development website archived report: http://www.hud.gov/library/bookshelf18/pressrel/pubhouse/phreport.pdf.

Key elements of teaching sustainable design and their integration in Russian architectural education.

Yelena CHENCHIK
University of Idaho
chen2731@yahoo.com

Abstract:
It is widely understood now, that we have to change the way we live on Earth in order to survive as a species. Architects as designers of the built environment can have significant effect in this process by creating an environment that provides for human needs while still preserving and even improving nature. This understanding has led to introduction of courses in sustainable architecture in many United States and European universities, but at present time there are no such courses offered in Russian universities.
The study presented in this paper is conducted as a part of a graduate research thesis on developing a curriculum that would allow issues of ecological design in general and sustainable/regenerative architecture in particular to be an integral part of architecture education in Russia. The paper defines key elements in teaching sustainable design and ways to integrate those elements into curriculum of a Russian university. It examines courses in the field of sustainable/regenerative architecture taught at United States universities, as well as textbooks and other resources used in these courses. The analysis shows that successful programs don't focus on architectural applications alone, but develop general ecological attitude; provide students with the information on the available resources, tools and methodologies and their appropriate applications; and promote multi-disciplinary and holistic approach to design process. The study also reveals that issues of sustainability could be efficiently integrated into different course formats that range from lectures (ECS) to seminars with opportunities for hands-on experience (Vital Signs) to integrated design studio projects.

The second part of the paper provides an overview of the Russian system of architecture education, current level of environmental issues involved in the architectural educational process and existing opportunities for interdisciplinary study. It suggests several ways to integrate issues of sustainability into the curriculum, such as a series of lectures within the History of Modern Architecture course, an elective course in sustainable architecture, or a design studio project. It also stipulates the ways the key elements defined in the first part could be integrated into such courses. The paper concludes that sustainable/regenerative design can be an integral part of architecture education in Russia creating a new generation of eco-logical, as opposed to techno-logical, architects.

Key elements of teaching sustainable design and their integration in Russian architectural education.

It is widely understood now, that we have to change the way we live on Earth in order to survive as a species. It seems that the only way we can do that is through sustainable development. The Brudtland Commission defines sustainable development as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (qtd. in Orr, 1992). I agree with David Orr in his opinion that the commission "hedged its bets between two versions of sustainability" – "technological" and "ecological," that are both "necessary parts of sustainable world." First, we have to stabilize "planetary vital signs" with the use of advanced technology, and then find the alternatives to our usual practices to prevent future problems (Orr, 1992). Architects as designers of the built environment can have a significant effect in this process by creating an environment that provides for human needs while still preserving and even improving nature. It is also well accepted that "higher education has the power to lead in this endeavor by exercising its role in training future leaders, teachers and other professionals and in producing the wisdom needed to face the challenges of an increasingly complex world" (Second Nature Home). This understanding has led to introduction of courses in sustainable architecture in many United States and European universities. In Russia the understanding of the importance of sustainable development is constantly growing. There are certain steps being made toward improving energy and resource effectiveness of the mechanical systems, but there is not yet much change in the area of architectural design. Specifically, there are no courses in sustainable architecture offered in Russian universities.

The study presented in this paper is being conducted as a part of a graduate research thesis. The goal of the thesis is to develop a curriculum that would allow issues of ecological design in general and sustainable/regenerative architecture in particular to be an integral part of architecture education in Russia. Throughout the study I have identified several key elements in teaching sustainable design and ways to integrate those elements into curriculum of a Russian university.

First, I have examined integration of issues of sustainability into architecture curriculums of the U.S. universities. I reviewed particular courses specifically concerned with sustainability, as well as textbooks and other resources used in these courses. The courses included environmental control systems lecture classes, as well as seminars on sustainable architecture, passive heating and cooling and daylighting. The preliminary studies show that successful programs don't focus on architectural applications alone, but develop general ecological attitude. It is important to not just provide students with the information on the available resources, tools and methodologies and their appropriate applications, but also to establish understanding of the philosophy and concepts behind the tools. Sustainable architecture is not just collection of "add-ons" – it is a whole different, integrated approach to architectural design. An important role in this design process is played by a multi-disciplinary and holistic design process: the architect is not just a "decorator" of buildings, he has to work with a diverse group of consultants and contractors and himself has to be proficient in many different areas, knowing the consequences of his actions. One way the integration of sustainability issues in architecture curriculum is achieved is through its omnipresence. It is never taught as a single course, students are introduced to the issues of sustainability early in their studies and continue acquiring the knowledge throughout their course of education. The study also reveals that issues of sustainability could be efficiently integrated into different course formats that range from lectures (ECS) to seminars with opportunities for hands-on experience (Vital Signs) to integrated design studio projects. The hands-on, open-end projects are other important elements of teaching sustainable design. The way these courses are taught is as important as what is taught. All of the above-described elements were incorporated into several curriculum models for teaching sustainability in universities in general and in architecture programs in particular that have been developed over the past years in the U.S. (Second Nature, EASE Project, Vital Signs). They define the ultimate curriculum that would integrate issues of sustainability into higher education and that are model for all the universities.

The Russian system of architecture education is quite different from the American both in the administrative structure and in the level of environmental issues involved in the architectural educational process. The major difference between the American education system and the Russian is that in Russia students don't choose the classes that they take, but just follow a curriculum that is set by the university for the specific major. This system has its pluses and minuses. The positive side is that the university has greater control of what students are studying, and is able to create the specific course sequence that would insure the most efficient progression through the courses. The negative sides of such system are that it is very difficult to introduce new courses into a set curriculum, and students are unable investigate more deeply the areas of their particular interest by taking additional courses in other departments. However, in recent years educational reforms have led to including several elective courses in the usual set curriculum. That change somewhat lessens the negative effect of the system by giving the students a chance to choose classes in areas that they are more interested in, and also by allowing for an easier introduction of new courses.

The architecture curriculum in Russian universities is defined by the State Standard of Education. The curriculum takes five and a half years to complete, where first five yeas the students take courses in the university and then from September through February of the sixth year they work on a big "diploma" project under the supervision of assigned faculty advisor. The classes taken during five years include several core courses, such as Russian, history, philosophy, calculus, foreign language, sociology. Then there are several engineering courses: geodesy, structural mechanics, metal, wood and masonry construction systems design, methods of construction, environmental control systems (focuses on conventional mechanical systems taught by engineering departments); as well as art courses: history of art, freehand drawing, watercolor painting, sculpture. The major part of the curriculum consists of architecture courses – history of architecture, theory of architecture courses (volumetric-spatial composition, theory of city planning), and design studios. The sequence of architecture design studios takes the student from learning how to create technical and presentation drawings through designing simple one-story commercial buildings to the design of multistory mixed-use complexes.

At present the only course dealing with environmental aspects is ecology. At the South-Ural State University, where I have received my first architectural degree, it is a short course (one and a half hours per week for one semester) that is taught to architecture students by

Department of Architecture faculty during the first semester of the fifth year. The course provides students with some background on general ecological issues and then focuses on reclaiming abandoned mining sites, which are quite common in the region, for use as recreational parks.

The opportunities for the multidisciplinary approach are limited to occasional cooperation with architectural engineering students in the design of the building structure, or using Design studio project for the ECS assignment, and consulting with the engineering departments in design of mechanical systems while working on the final "diploma" project. All such work is always done within the Architectural-Construction Faculty (administrative part of the university that includes the architecture department and several engineering departments related to construction industry).

Based on my understanding of Russian educational system, I propose to integrate issues of sustainability into the university curriculum in several stages. The first stage would consist of adding to the existing courses: guest presentations in the first- or second-year design studios, which introduce students to sustainability; integration of ecological issues into design studio projects; and a series of lectures within the History of Modern Architecture course. Some effort also should be made to integrate learning passive and active solar systems into ECS course. That could be achieved through series of guest lectures integrated into the class. Then, using current addition of elective courses, a specific lecture-seminar course on sustainable architecture can be introduced for the most interested students. Some students can also expand their knowledge in environmental design while working on their final project[1]. That way some of the key elements would be integrated into architecture curriculum: students are introduced to the issues early in their studies, the exploration of them continues throughout their education and they have an opportunity to get an in-depth knowledge of the applicable strategies and methods.

Of course, that would be only the first step on the way to "greening" the curriculum. Later on, the whole architecture curriculum and all the courses should be revised to integrate the issues of sustainability. That would require collaboration with interested trained faculty throughout Russia and possibly creating a Russian chapter of the Society of Building Science Educators. Same changes should be done in all the other departments of the university providing wide basis for truly multidisciplinary and holistic approach to understanding and preserving the complex environment we all live in.

Acknowledgements

Research for this article was supported in part by the Edmund S. Muskie and Freedom Support Act Graduate Fellowship Program, of the Bureau of Educational and Cultural

---

[1] As part of my Master's thesis, I am working on developing syllabus for the elective sustainable architecture course and guidelines for integrating sustainability into design studio project. The work will be completed by the start of the conference and I will be glad to share my findings.

Affairs, U.S. Department of State under authority of the Fulbright-Hays Act of 1961 as amended, and administered by the Open Society Institute (OSI). The opinions expressed herein are the author's own and do not necessary express the views of ether ECA or OSI.

I want to thank my major professor Bruce Haglund for his guidance and support.

References

Orr, David. Ecological Literacy: Education and the Transition to a Postmodern World. New York: State University of New York Press, 1992

Rosenman, Marv Educating Architects for Sustainable Environment. Feb. 1998. Ball State University. 28 Dec. 2001 <http://www.bsu.edu/cap/ease/>

Second Nature Home. 2001. Second Nature, Inc. 28 Dec. 2001 <http://www.secondnature.org/home.html>

Free-standing Chardaks of the Balkans and Anatolia

J. BROOKE HARRINGTON, Temple University
Judith BING, Drexel University
jharring@astro.ocis.temple.edu

Abstract:
Chardaks – tiny structures built for repose beside farmers' fields – abound throughout the Balkan and Anatolian countryside. Across many languages and cultures, this word and building form remain surprisingly consistent, adopted by peoples of differing religions and languages. The modest chardak invites us to speculate about broad cross-cultural themes that link diverse architectural cultures.

Over the past fifteen years we have collaborated in the study of vernacular wooden architecture of the Balkans. This study has covered not only artifacts of the Balkans but also those of the Venetian, Austro-Hungarian, Slavic, Ottoman and Greek neighbors who contributed both population and settlements to this diverse cultural region.

The goals of this research are a survey and comparative analysis of settlement types, building elements, and variations in form, construction and detail, to reveal patterns and similarities. Extensive fieldwork has yielded a multitude of data, but the task of analysis remains incomplete. The chardak is a pervasive building type that has emerged as a particularly provocative artifact for concentrated study.

Both the architectural idea and the word came from the East -- *čardak* is defined in Serbo-Croatian dictionaries as of Turkish origin, with Persian roots from the word *cartaq*, in which the root *car* means "four" and *taq* means "arch." Words from these roots with similar meanings exist today in Turkish, Greek, Albanian, Romanian, Bulgarian, and even farther east in Aramaic and Farsi. It is thought that the earliest chardak structure of the ancient middle east was made by farmers near their fields, by joining together four adjacent saplings in order to form a platform for sitting above the ground, exposed to breeze and shaded by foliage overhead. Over time, this temporary, agricultural structure (this "primitive hut") grew to be part of houses, first as an exterior arbor and then built into the body of the dwelling itself, always maintaining its essential qualities of elevation, repose, sociability, and connection with nature. Along the way, the concept of chardak entered folk culture and acquired its most vivid definition as "a place between heaven and earth."

What accounts for the temporal endurance and geographic spread of this tiny building type? How has its essential meaning survived? Perhaps we cannot answer these questions, but in recording and comparing the easily overlooked chardaks (everyday structures, outside the mainstream of cultural themes) we can make a convincing argument for the importance of such inquiry.

With the chardak as a focus for this presentation and paper, our objective is to define approaches of the larger project on Balkan vernacular architecture. Examples (photographs, drawings and analytic diagrams) will describe environmental settings, spatial characteristics and details of materials and assemblages that have been recorded across the landscapes of the Balkans and Anatolia.

Introduction

The chardak is an element in the architecture and lives of a large proportion of the people of the Balkans and adjacent Asian areas of the northeastern Mediterranean. This observation has come from extended research about the buildings of the Balkans and those countries whose empires have controlled the region in the past. Tracing the word and the original forms, as free-standing single space constructions, is a task which has occupied us over several years.[1]

The romantic definition of the chardak as "a place between heaven and earth" is haunting and has made it imperative to look for the ideal examples of this definition.[2] Is this a purgatory, a place of transition, or is it a place that provides a view to the best of what is beyond? A number of scholars who are very familiar with chardak structures and elements view them as utilitarian spaces that have simply functioned as places for work and relaxation that began as freestanding elements but also became integrated into the dwellings of the past.[3] But one can find even within the accepted integration of the chardak as an element, the remnants of more noble and honorific stature. It is this singular noble stature that is most compelling and ideal.

Goals and Objectives of Research

The goals of our research are a survey and comparative analysis of settlement types, building elements, and variations in form, construction and detail, to reveal patterns and similarities. To frame this study let us look at four examples taken from different parts of the Balkan and Anatolian worlds and consider the great variety of meaning and usefulness that have been assigned to the various chardaks (figures 1 - 4).

Taurus Mountains, Turkey
Fig.1 RURAL AGRARIAN

Macedonia, Formerly in YA
Fig.2 TOWER LIVING

Serbia in Yugoslavia
Fig. 3 WORKING PORCH

Serbia in Yugoslavia
Fig. 4 GUEST QUARTERS

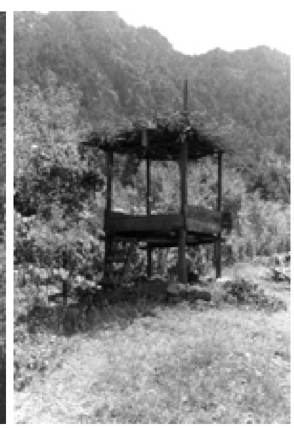
The Rural Agarian Chardak

One of the simplest forms of the chardak can still be found in the Taurus Mountains in the southeastern part of Turkey. These structures are crudely constructed and are set next to broad fields in level areas of the mountain range but also occur in steeply sloped areas where the land is terraced for planting.

The principal attributes of most of the chardaks that we studied include an elevated position, protection from the sun, access of breezes and orientation to distant views. Use of the spaces, even in their simplest forms, varies greatly. The chardak is a place to view and as such can serve as a platform to the land and the sky. This platform provides a place of repose for those who work in the field and a place to watch over the fields to protect them from birds or animals that might steal the fruits of the fields. The chardak also serves as a place for family members to work in view of the fields but protected from the sun; a perfect place for someone to shell peas or work on textiles while watching a sleeping infant. Roofs of early chardaks were believed by scholars to be made using boughs and as posts, the trunks of adjacent saplings.

Üzümdere, Turkey / Chardak near the top of a terraced field and view of the fields and valley from chardak
Figure 5 Figure 6

In examples we found two years ago, the raised platforms were constructed of planks but the vertical elements were constructed of stripped poles. Shade roofs were made using hewn branches interwoven or bound together with roping and then covered with boughs for shading and cover. The sides of the raised platforms were enclosed with low rails made of planking or with sticks organized in regular patterns. The chardaks were sited to command views of the fields and the landscape. The examples found today vary in size and proportion from those that accommodate two or three people comfortably to larger structures for four to six (figures 5 - 10).



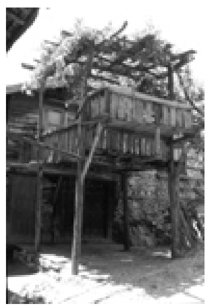
Akseki, Turkey Üzümdere, Turkey
Figure 7 Figures 8, 9 & 10

An open freestanding chardak serves well as a perfect outdoor room in the balmy climate of Anatolia and beyond. The columns of the chardaks are often of the size and scale of saplings and the roofs vary from framing and boughs or climbing vines to open planking to provide well-ventilated shading. Variations in the freestanding chardaks of Turkey today have yet to be fully explored but the building type does survive in agrarian settings as well as along roads as shelters for vendors and dining structures at restaurants. In the contemporary setting the need for additional living and working space for use during the extended mild seasons of the year and the simplicity of construction allow people to continue the use of chardaks.

Figs. 11 & 12 - Yakaçiftlik, Turkey / View of a chardak built beside a house, detail shows female within the chardak

In a number of small Anatolian villages we also found instances where the chardak abuts the dwelling of the owners (figs. 11 & 12). This is an important step as a precursor to the integration of the chardak into the fabric of the house, a condition more often found in the Balkans (Yugoslavia & its separate republics, Bulgaria and in Sub-Carpathian Romania).

Chardaks joined to dwellings / Ibradi, T
Figure 13



Akşahap köyü, T
Figure 14

Tarşağil, Turkey
Figure 15

In the Balkans, one chardak (figure 16) (after a drawing in "Seoska Arhitektura I Rurizam" by Branislav Kojić, Beograd 1973) illustrates an example of an open freestanding chardak found in the Sar Planina mountains that join Kosovo and the Former Yugoslav Republic of Macedonia. This chardak was supported on post and beam structure with woven boughs to stabilize the structure and form the enclosing walls of a granary (ambar) below the platform. Floor, seating and rails were made with planed timbers.

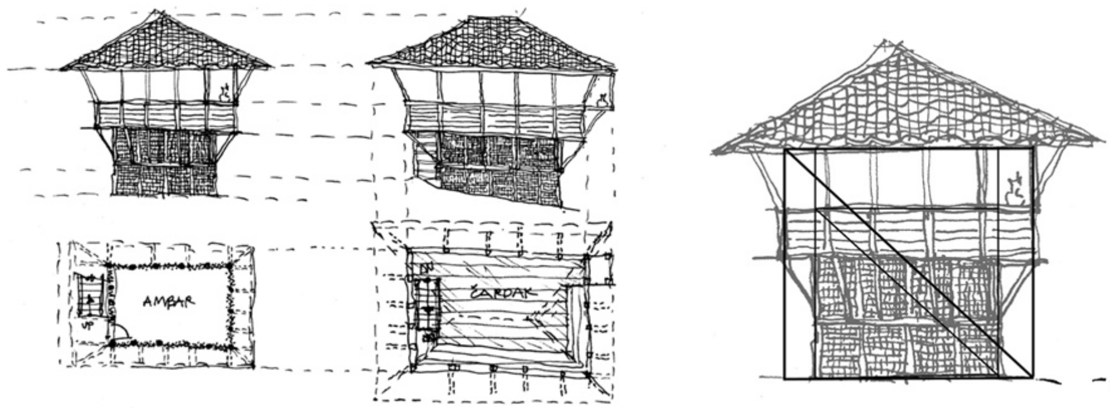


Figure 16 - Example of an open freestanding chardak structure found in southern Yugoslavia in 1960

Thresh and straw stables and barn structures, of the same construction type, still existed in the region near Bitola in the late 1980's. The characteristic extension of the upper structure beyond the base enclosure as well as the further extension of the roof to provide further protection from the sun are common formal expressions in many of the traditional buildings in both Turkey and the Balkans

The Chardak as a Tower for graceful living

The term "chardak" and "kula" are sometimes used interchangeably in Serbian folklore and elsewhere[4]. A *kula* is a tower structure that is found as a vernacular building type in Bosnia, Montenegro, the Serbian province of Kosovo, Macedonia and Romania. In many tower dwellings the viewing room at the top of the structure is referred to as the chardak. However, in most cases each level of the tower is a single room.[5] The most compelling example of a kula that serves as a chardak is the tower structure of the former Dervish monastery in the city of Tetevo, of the Former Yugoslav Republic of Macedonia (figs. 17-19). This monastery is an eighteenth century complex and the tower is set on the edge of the tekke (the Macedonian word for a dervish monastery). The tower was built, according to local historians, for the daughter of the leader of the tekke since women were not allowed within the tekke proper.

Figures 17, 18 & 19 - Tetevo, Former Yugoslav Republic of Macedonia

This building has all of the attributes of the chardak - height, light, views and breeze - but does not exhibit the four-posted structure. Wooden structure and paneling occur on three sides of the upper portion and are painted a deep blue color. A minor band of wall above this, appearing like a frieze, is plastered and contains small windows and detailed paintings. Seating lines the interior of the upper level. The paneling is designed with shutters that open up and down. Those that open up serve as shading devices, while the lower panel serves as a backrest and rail for the seating. A solid masonry wall to the north contains the fireplace. The mountains to the north are part of the Sar Planina range and the source of winter winds and cold weather. Views to the south, east and west overlook a wide valley.

The tower form presents a clear cubic base of stone with stone corners that extend upward to provide support for wooden corner columns. Its strong masonry base contains a storage room and its appearance is reminiscent of storage buildings of market town centers and fortress houses that line the Serbian-Albanian border to the northwest. Stone steps and platform provide a counterpoint to the offset storage door and the solid landing serves as a spring point for the light wooden steps that give a more open ascent to the tower itself. The location of the stairs beyond the confines of the tower itself also extends the entry to a central space; an external stair is typical in most freestanding cardaks. This tekke complex (Sersem Ali Baba monastery) has many interesting pavilions and includes another chardak element, a surveillance space that sits as a guard tower that spans over the principal gate of the tekke.

The Chardak as a Work Space

At Poganovo, in the Stara Planina mountains at the eastern edge of Serbia, less than ten kilometers from the Bulgarian border, is the monastery of Saint John (Sveti Jovan) built in the fourteenth century. The monastery is famous for its church, icons and the small chardak that sits within the walls (figure 20). In cultural literature the chardak is indicated as ‘an example of 14th-century artisan building’.[6] It sits within the compound with its back to the defining walls and steep mountains and faces the open green space, gardens and church to the east and south.

The chardak has served a number of uses including as a granary on the base level and a working and guest sleeping area on the upper level. The exterior area on the upper level provides a space to sit and work with shade from the summer sun and cover from autumn rain and winter winds. Views from this area give occupants visual access to the entire complex (the garden, church, river beyond and approach pathways).

Poganovo, Serbia / Chardak with interior stair
Figure 20

Initial study of building’s regulating lines
Figure 21

The most striking characteristics of the Poganovo chardak are its clarity of form and complexity of compositional elements. The mixture of various construction expressions and spatial intricacies makes it especially noteworthy, and its component forms and technologies reflect attention to the environmental needs and the aesthetic expression of the buildings of the times. The granary, indoor and outdoor spaces display characteristic expressions found today in the preserved vernacular architecture of the rural and urban buildings of the Balkans.

The building construction is a blend of wood plank and a construction technique named “bondruk”. Bondruk consists of a frame infilled with wattle and daub and covered with a white wash. The arches visible in the chardak are made by placing lath over the framing and plastering over this to generate the shapes shown. This false-work technique is found in the vernacular buildings in various parts of former Yugoslavia as well as in the revival national architecture found in Bulgaria. This combination of bondruk and plank construction responds to the various uses of the building. The wooden granary element provides well ventilated storage space protected from the dampness of the ground and condensation that might destroy the food stores of the monastery, and the bondruk construction provides a more appropriate seal from air infiltration in the occupied spaces of the chardak. The projection of the roof and upper level beyond the base serves to protect the lower bondruk surfaces from rain-wash.

As a whole the visual composition of the chardak’s exterior presents a clever interplay of exposed framing and interlocking formal elements that show a concern for ordering of the elevations with playful offsetting geometries that give the building its special character. Through the simple overlay of regulating lines, shown above, one begins to see the level of skill used in the subdivision of form (figure 21).

The Chardak as Guest Quarters and Place for Negotiations

One of the most interesting chardak forms is that of the chardak as “gostinica” or “konak” (guest house). This type of chardak came into use in the Sumadija district of Serbia during the Ottoman occupation after the Turks allowed trade among the ‘unbelievers’ to resume in the country. The chardaks served as guest quarters on farms for traders (most often pig traders) traveling to negotiate with the farmers and owners for produce and livestock. The structures typically contained a granary or storage space underneath the room to accommodate the guest travelers accessed by an exterior stair. A number of these chardaks still remain in the countryside of Serbia (figures 22 - 26).


Fig. 22 - Pranjana, Serbia


Fig. 23 - Dobrinja, Serbia


Fig. 24 - Brezna, Serbia

Savinac, Serbia / Chardak elevation toward dwelling Elevation to land and valley below
Figures 25 & 26

The chardak in Dobrinja was constructed by Prince Miloš Obrenović as a place to rest when he made visits to a church he had built in the village where he was born to honor his mother. The chardak sits as a monument and symbol of the opening of trade that was accomplished through his efforts. In the other, more typical examples, casks of plum brandy from the orchards of Sumadija were stored in the ground-level spaces of the chardaks, and served farmers well in helping to negotiate deals with the visiting merchants. Most of these chardaks are located near the farmer's dwelling but had their principal windows overlooking the fields and orchards of the farm. The winters in the mountains are cold so the chardaks are often enclosed with only small windows. Typically the farms were on the south-facing slopes of the mountains and the dwelling structures were located to catch the sun and view of the fields below.

Closing Observations

In our travels and studies we found numerous cultures and ethnic groups that adopted and adapted the chardak into their lives, building traditions and environments. The creation of this simple, elevated, covered place surrounded by nature appears to be an inescapable imperative that transcends cultural ownership. Furthermore the word chardak does not establish a fixed dominant form that must be replicated; instead it establishes an idea that allows all to build their vision. The examples included above give a sense of the range of uses and forms created in Anatolia and the Balkans over the past four hundred years but one is hard pressed to identify single elements that are carried by all. Instead each has developed to respond to the cultural, social and climatic setting. Although the chardak sadly has left the lexicon of building forms of our contemporary lives, in the mountains of the these places, one can still find that the value of a simple place for mankind to view and engage nature is still understood.

---

[1] See J. Bing with J. Brooke Harrington, "A Study of Words and Buildings: The Cardaks of Former Yugoslavia", - *Traditional Dwellings and Settlements Working Paper Series* (Volume 100 / IASTE 100-96), Center for Environmental Design Research, University of California at Berkeley, pp. 1-40.
- *Environmental Design*, Journal of the Islamic Environmental Research Centre, Como, Italy, no.1-2/1994-1995, pp. 174-200.

[2] First introduced to the authors in 1987 by Professor Zoran Petrović of the Architecture Faculty at the University of Belgrade in Yugoslavia

[3] Dr. Amir Pašić, architect and planner in Mostar, Bosnia & Hercegovina; Dr. Ayda Arel, former lecturer at Istanbul Technical University; and Dr. Rachelle Anguelova, professor of architecture at the University of Sofia in Bulgaria each have their own views on the chardak as principally highly useful elements and structures.

[4] In *Felt Tents and Pavilions , Volume I* by Peter Alford Andrews, Melisende, 1999, there is a reference on page 736 in a passage he translated of the records about an official event in Samarkand in 1404. His text indicates "Though in this case the booths should perhaps be regarded as elaborate market stalls, their use at this date in a camping ground is of some interest as four-posted pergolas called *chardaq* have come to be used extensively by the Turkish Yörök. There is a footnote that follows (173) that states within it "… Though Lurish nomads use them too, they call them *kula*."

[5] We have not included our studies the kulas of Bosnia, Montenegro, Kosovo or Romania since these structures typically contain more than two levels (a ground level, intermediate, and top level). In the examples of Kosovo and Romania the uppermost level normal has more than one habitable space.

[6] Rakić, Kosta, editor *Treasures of Yugoslavia* , Beograd 1986, page 385.

East Meets West: On Feng Shui and Western Environmental Models

Jun XU, Environmental Design and Planning Doctoral Program
James JONES, Phd, Professor, Department of Architecture
College of Architecture and Urban Studies, Virginia Tech
juxu@vt.edu

Abstract:
Environmental principles in architecture have drawn increasing awareness internationally. Conventional decision approaches such as those defined and analyzed by Olgyay, McHarg, and other researchers, emphasize western principles for basic aspects of the natural environment, including climate, physiography, hydrology, vegetation, and the life of the inhabitants. As both an alternative and complement to contemporary environmental design, feng shui is an ancient wisdom that examined the sites of cities and determines the desirable layouts of buildings. However, less focus is on the comparison of contemporary and traditional environmental principles and the possible incorporation of the two. In this paper, we will compare contemporary environmental principles and feng shui, and emphasize the integration of environmental issues into architectural design.

Our comparison will focus on several aspects, including philosophical background, analysis methods, and application fields. Traditionally, the Western view is based on the philosophical, religious, and cultural belief that man is the center of the universe. The environmental study is to seek the harmony of the human and nature by analyzing the climatic influences on human activities. However, in the view of feng-shui, human is part of the nature. It is argued that design with feng shui principles can follow the natural law and can help to accumulate a good energy field, and eventually improve the life cycle of nature. In addition, contemporary environmental principles are more practical with quantifiable figures and numbers. While feng shui methods focus on the observation and calculation of the primordial causes, including the movements of planets and stars, and the balance of subtle energy changes.

However, considering the design process as a whole, two approaches have similar systematic thinkings. In bio-climatic design, four major elements (temperature, radiation, air movement, and humidity) are “assembled” together after the studies have been done separately. In eastern culture everything in the universe is related. The climatic factors cannot be separated from the topology, vegetation, and psychology. When further applying rules in design, similarities can also be seen in several fields: certain restrictions in topographical study, emphasizing geological and hydrological factors, and analyzing the vegetation. Comparisons of other rules show some factors are emphasized in feng-shui, but might not be the major factors for the western rules; or vise versa.

Although feng shui can be used in buildings and human settlements, in this research, we only compare the principles more applicable to building designs, and intend to connect the "art" and the "science" with the focal point of environmental issues. Therefore, this research seeks to establish a combined analysis approach based on the comparison of contemporary environmental principles and feng shui. Case studies will also be conducted based on both theories. The

combination of two sets of principles will be helpful to enable students and professionals to learn and apply the knowledge in the design process.

EAST MEETS WEST: ON FENG SHUI AND WESTERN ENVIRONMENTAL MODELS

Feng shui is an ancient wisdom that examined the sites of cities and buildings, and determined desirable arrangement of interior space. It has been used by Chinese since the Western Zhou dynasty (1100 B.C. - 771 B.C.). Following the simple observation that environment influenced the decline or rise of civilizations, the ancient Chinese concluded that the energy or force of nature, feng shui (literally meaning wind and water) creates mountains and rivers, nurtures plants and animals, and is essential to human life. Therefore they argued that selection of land for a city or construction of a house should follow the principles of feng shui. Thus, feng shui was developed as a comprehensive environmental evaluation system that examined issues related to astronomy, climate, geology, topology, ecology, and landscape. This system was used when the ancient Chinese selected the sites of cities and determined the desirable layouts of buildings and tombs. It also incorporates various taboos and certain symbols that can be used to achieve a favorable environment in site selection, building construction, and interior design.

The potential benefits of feng shui have been recognized by westerners since the mid 19th century (Yates, 1868; Eitel, 1873; Dukes, 1914; Needham, 1962; Rossbach, 1983). Since the first Christian Missionary went to China, differences between western models and feng shui in dealing with the environment were noticeable. For example, in the late 19th century and early 20th century, architectural activities of Christian missionaries such as Gothic churches were rejected by the Chinese people, because these buildings where not in harmony with their surroundings and were not consistent with feng shui. Mining of metals and coal were prohibited in order to maintain the Qi vein (Yu, 1994).

After the industrial revolution, western approaches to environmental integration are in many ways similar to the eastern tradition of feng shui. Since the 1940s, industrial and chemical processes have caused irreversible damage to our natural resources, such as depletion of the ozone layer and global warming. With this awareness, effective environmental control and improvement methods become one of the most urgent tasks for scholars and professionals in every field. There have been several environmentally conscious approaches to architecture as demonstrated in various projects and publications. During the 1940s and 1950s, Buckminster Fuller invented *Dymaxion*, an object can perform at “the greatest possible efficiency with the most current technology.” The result was the Dymaxion house. In the 1960s, Paolo Soleri invented the term Arcology to integrate architecture and ecology. A prototype arcology for 5000 people named Arcosanti was constructed near Phoenix, Arizona. In its West and East Housing, passive solar strategies are used to make the indoor space comfortable; while the structure of foreground, named the Foundry, is designed to respond to changes in the sun angle and to control the amount of shade. After the oil crisis of 1973, many pioneers also began to design houses, such as the “integral urban house” of Ken Baer and Sim van der Ryn, using solar energy and other alternative sources. Meanwhile, books and publications, including Rachel Carson’s *Silent*

Spring (1962), E. R. Schumacher's *Small is Beautiful* (1976), and David Pearson's *The Natural House Book* (1989), have helped to raise awareness of environmental issues.

Recently, combinations of eastern and western approaches are more obvious. Contemporary architects of several projects in New York and Washington DC have considered input from feng shui experts on architectural and interior design projects (Rossbach, 1983). However, there is less focus on comparison and a possible incorporation of the two. In this paper, we will compare contemporary environmental principles and feng shui. Our comparison will focus on several aspects, including epistemological background, analysis methods, and evaluation criteria.

I. Western Environmental Models and Feng Shui

In the West, the environmental emphasis in architectural design has a long history. Early in the first treatise in architectural history, *Ten Books on Architecture*, Vitruvius emphasized the importance of climate in the sixth book, "[i]f our designs for private houses are to be correct, we must at the outset take note of the countries and climates in which they are built." From Rousseau's rural utopia to the latest Earth Day activities, every milestone in the history of modern architecture reminds us of the hard journey toward achieving a better understanding of the relation between man and nature. Systematic examination leads to new ecological movements and disciplines. Since the 1950s, researchers have proposed design approaches and methods focused on the relationships between architecture and the environment, including climate, physiography, hydrology, vegetation, and the lives of the inhabitants. Among them, two widely accepted models will be used for comparison with feng shui: Olgyay's bioclimatic model (1973) and the environmentally conscious model represented in McHarg's *Design with Nature* (1969).

Bioclimatic Model

Concentrating on the relationships between buildings and the environment, Victor Olgyay (1973) analyzed examples from around the world and documented his findings in *Design with Climate*. He noted that regional architectural characteristics could be found in response to certain climates, although in different geological locations and cultures. Olgyay investigated a series of steps to interpret climatic factors in relation to human comfort. Then the designers could focus on specific issues of the synthesis model (Fig. 1).

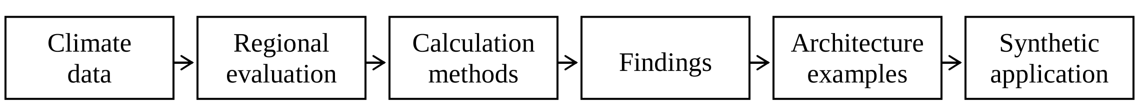


Figure 1 Bioclimatic design steps (Hyde, 2000)

Based on Olgyay's research, four most important climatic elements were identified – air temperature, radiation, air movement, and humidity. The following bioclimatic chart not only assembles individual factors, but also shows the correlations between the various climatic elements in the context of the comfort zone (Fig. 2). In addition, when the climatic conditions are not located within the comfort zone, several modification strategies are suggested. Olgyay also suggested that bioclimatic evaluation must be associated with regional climatic conditions.

For example, four regions are selected to represent major climatic zones within the United States: Minneapolis, Minnesota for cool climate, the New York – New Jersey area for temperate climate, Phoenix, Arizona for hot-arid climate, and Miami, Florida for hot-humid climate.

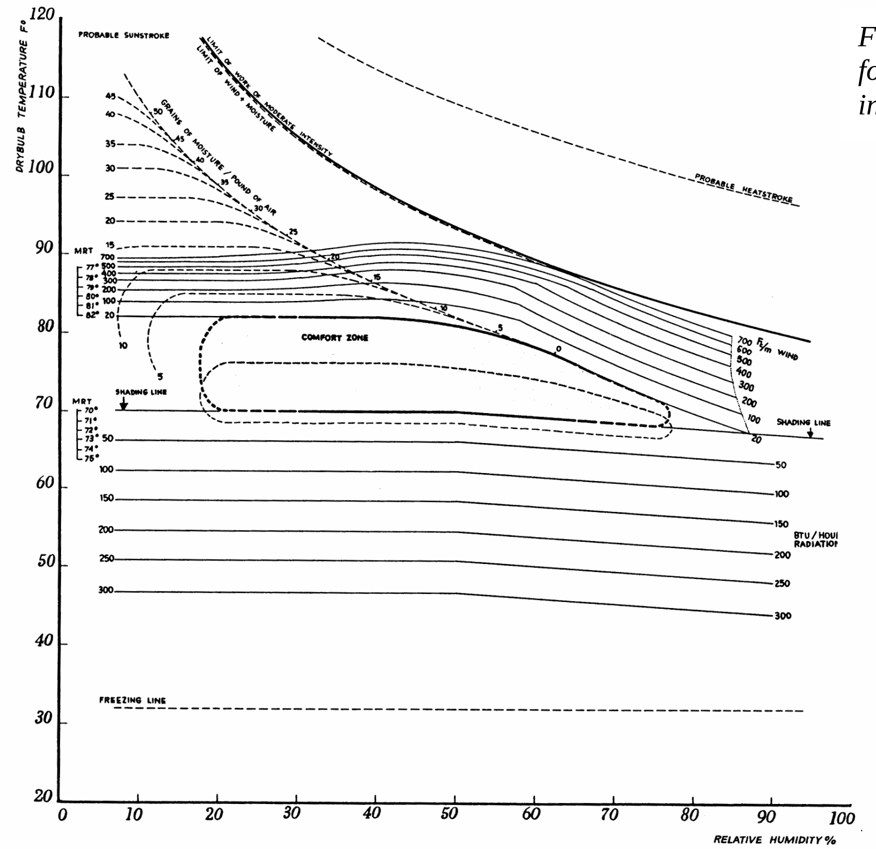


Figure 2 Bioclimatic chart, for U.S. moderate zone inhabitants (Olgyay, 1973)

Environmental Conscious Model

In addition to Olgyay, Ian McHarg proposed a model of design with nature related to architecture. In his book McHarg established guidelines for choosing sites for urban developments in various geographic locations, especially in metropolitan areas. By using mapping and measurement techniques, eight natural processes related to land use were identified. Further interpretation of the values can be seen in the following case study of Staten Island in New York City:

- Identify the major physical and biological processes. The basic information includes the data on climate, geology, physiography, hydrology, pedology, vegetation, wildlife habitats and land use.
- Establish a value system to interpret the data. The factors are ranked in importance using a gradient of five values, and also in a hierarchy using color and tonal intensity.
- Map the relevant factors to show the result of "the maximum concurrence of all the positive factors and the least restrictions."

In terms of the residential development, positive factors to consider include features such as good soil and bedrock foundation conditions as identified by the geology and pedology studies, riparian water features in the physiography study, and historical and scenic value in the land use category. Negative factors include excessive slopes, poor drainage, susceptibility to flooding or erosion area, and existing forest. More detailed criteria are also developed: “the land should have slopes of no greater than five per cent inclines; it must not be in the 50-year floodplain, nor in an important aquifer recharge area, nor in fog pockets or high and exposed elevations” (McHarg, 1969).

Feng Shui Model

Feng shui came from the observation that Qi, a Chinese term describes energy flow related to these forms, could be dispersed by the wind and be gathered by the water (Gu, 1995). Qi is the most important concept in feng shui as well as in other forms of traditional Chinese culture and science. It is a philosophical category of Chinese origin -- its full implications cannot be vividly translated into any single English word or even a phrase, such as “cosmic breath” (Wheatley, 1971), “matter-energy” (Needham, 1962), and the Greek term *genius loci* (Norberg-Schultz, 1980). In the human body, Qi is the energy that flows through the acupuncture points. On the earth, Qi is the energy carried by wind and water. In housing design, when Qi is abundant, the site will bring health and strength to those who live there. Qi can be influenced by orientation, land form, wind, water, and the surrounding environment of the site.

Table 1 Living Qi and dead Qi

	mountain	river	soil	vegetation	air
living Qi	smooth	clean, slow, meander	thick, rich	green, flourish	warm, clean, dry
dead Qi	steep	turbid, swift, straight	damp	barren	cold, stale, moist

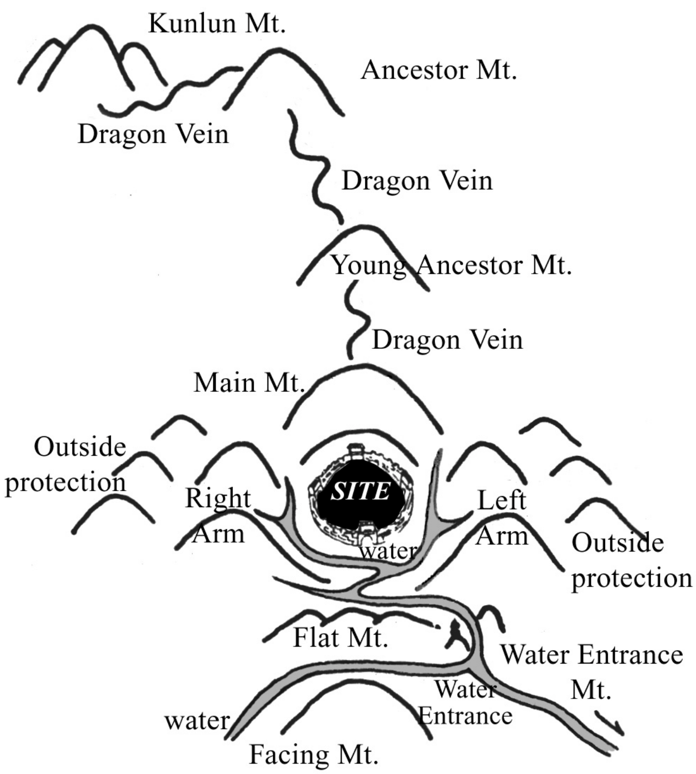


Figure 3 Ideal feng shui model (Yi, Yu, and Hong, 1996)

There are two types of Qi: living Qi and dead Qi. Summaries of separating live Qi and dead Qi into different natural elements is shown in Table 1-1 (Yi, Yu, and Hong, 1996). The simplest concept in feng shui is searching for a place where living Qi is abundant. Feng shui masters examine and arrange Qi by analyzing the land form (Fig. 3) and using a feng shui compass.

II. Comparison of Feng Shui and Western Models

Several aspects of feng shui and western models are compared and analyzed in detail. They are research subjects, analysis method and structure, and criteria. The following table shows the simplified comparison results.

Table 2 Brief comparisons of three models

	RESEARCH SUBJECTS	ANALYSIS METHODS		ANALYSIS STRUCTURE	ANALYSIS CRITERIA
Bioclimatic Model	Climatic factors: temperature, humidity, wind, radiation	Individual analysis and their correlation effects, psychometric chart, and comfort zone	tangible	Frame structure	Human comfort
Environmental Conscious Model	Nature process, including geology, physiography, hydrology, climate, vegetation, etc.	Identify values for different categories and select a better fit environment and adaptation		Layer structure	Fitting environment for development
Feng Shui	Qi and its relation with environment	Survey the mountain and water, find suitable area, and arrange Qi	in-tangible	From big system to small sub-system	Living Qi should be abundant and harmonious with the surrounding

Research Subjects

During the process of investigation, it gradually becomes clear that both western models share a common epistemological background. This explains the similarity in the two research subjects. Since the 17th century, the task of exploring the foundations of physical science, which is symbolized by Newton's physics, turned the philosophers to epistemology. As part of this trend, modern environmental study seeks the harmony of man and nature by analyzing the climatic and other natural influences on human activities.

Olgyay noticed that man in the same environment as other living species "must either adapt their physiology, through selection or mutation, or find other defenses against the impacts of environment." This is because it has been widely accepted that human physiology and cultural development have close relationships with climate and environment. With the identification of four major elements of climatic environment, Olgyay presents clear and profound analytical results of their correlated impacts on human comfort. In his research system, nature and human beings are different entities. The development of science and technology provides opportunities to investigate in depth each sub-system and their antagonistic relations.

McHarg's approach is similar to that of Olgyay, although his model of design with nature consists of eight major factors including climatic influences. He criticized traditional man-nature relationships. From his perspective, human beings are a part of nature. He believes that by understanding and considering the manifestation of the natural processes and interactions of these factors, plans can be developed based on intrinsic suitability and limitations of the land. In addition, McHarg noticed that time may also become a major factor. So the investigation of "surficial geology" or hydrology and soils can show geological and meteorological history.

In the view of feng shui, man is part of nature and is also a form of Qi like everything else in the universe. Qi is the holistic concept that encounters natural phenomenon and human experiences, which cannot be simplified by any individual scientific factor such as energy and/or material. It is an entity of the earth and the stars, the divinities and the mortals, and human being on the earth. In addition, the ancient Chinese believed that everything in the universe was produced by changes, the results of the balance between Yin and Yang. Yin (- -) symbolizes the moon, the female, the dark, and the stillness; while Yang (—) symbolizes the sun, the male, the brightness, and motion. The concept of Yin Qi and Yang Qi is the basic for feng shui to express the ideal that man and nature can be and should be in harmony. Thus, it is argued that design with feng shui principles follows the natural law and can help to accumulate a good energy field, and eventually improve the life cycle of nature.

The differences of epistemological background and research subjects also reflect their various criteria. Human comfort is one of the fundamental goals of the bioclimatic model. It becomes the major criteria. In McHarg's model, the basic criterion is fitness of environment for certain land development. The scientific understanding of the natural processes helps to select an appropriate plan. According to feng shui, living Qi should be harmonious with the surroundings. The important criteria thus become the balance between yin Qi and yang Qi, and abundant living Qi.

Analysis Methods and Structure

The method analysis and structure of the three approaches are different. Bioclimatic design emphasizes the major results of climatic changes, such as temperature and humidity, and focuses more on the correlations of these factors. Analytical results come from quantifiable figures and numbers. The analysis structure of the bioclimatic model is a frame structure, while each factor has liner connections with other factors.

In McHarg's model, both tangible and intangible methods are used. For example, the thresholds of five phenomena ranking slope are defined as 2%, 5%, 10%, and 25%; while the results only show high or low ranking for air pollution with no specific standard. The model of design with nature has a layer structure. Factors of different categories are analyzed on separated layers and projected together; while factors within a major category are considered simultaneously.

Feng shui focuses on the observation and calculation of primordial causes, including the movements of planets and stars, and the balance of Yin Qi and Yang Qi. It is hard to use modern equipment and technology to implement the concepts. In terms of the analysis structure, the feng shui model considers every object or phenomena as a unit within a hierarchical-order system. For example, the site as a unit needs to have living Qi. According to the feng shui literature, vegetation is considered as the hair of the earth, soil as the flesh, land form as the bones, and water as the blood. Using this metaphor, feng shui intends to protect the vegetation and soil, to enhance the land form, and to free and clean the circulation of the water.

III. Conclusion and Discussion

In summary, the differences among the three models show a change in the degree of tangibility from the bioclimatic model to feng shui other than conflicts between the western models and feng shui. It is also worth noticing the similar structure of the two western models. Both analysis processes follow a sequential order, although in the model of design with nature, the factors within a category also form a parallel structure – so the analysis sequences are from one unit to the other (Fig. 4a). On the contrary, feng shui has a different model with a hierarchical order. The unit can also be considered as a sub-system (Fig. 4b).

John Michell says “Feng-shui is the art of perceiving the subtle energies that animate nature and the landscape, and the science of reconciling the best interests of the living earth with those of all inhabitants” (Eitel, 1993). The above analysis shows it is possible to suggest an integrated approach (Fig. 4c) -- using a scientific research method and organic system, may lead to a better

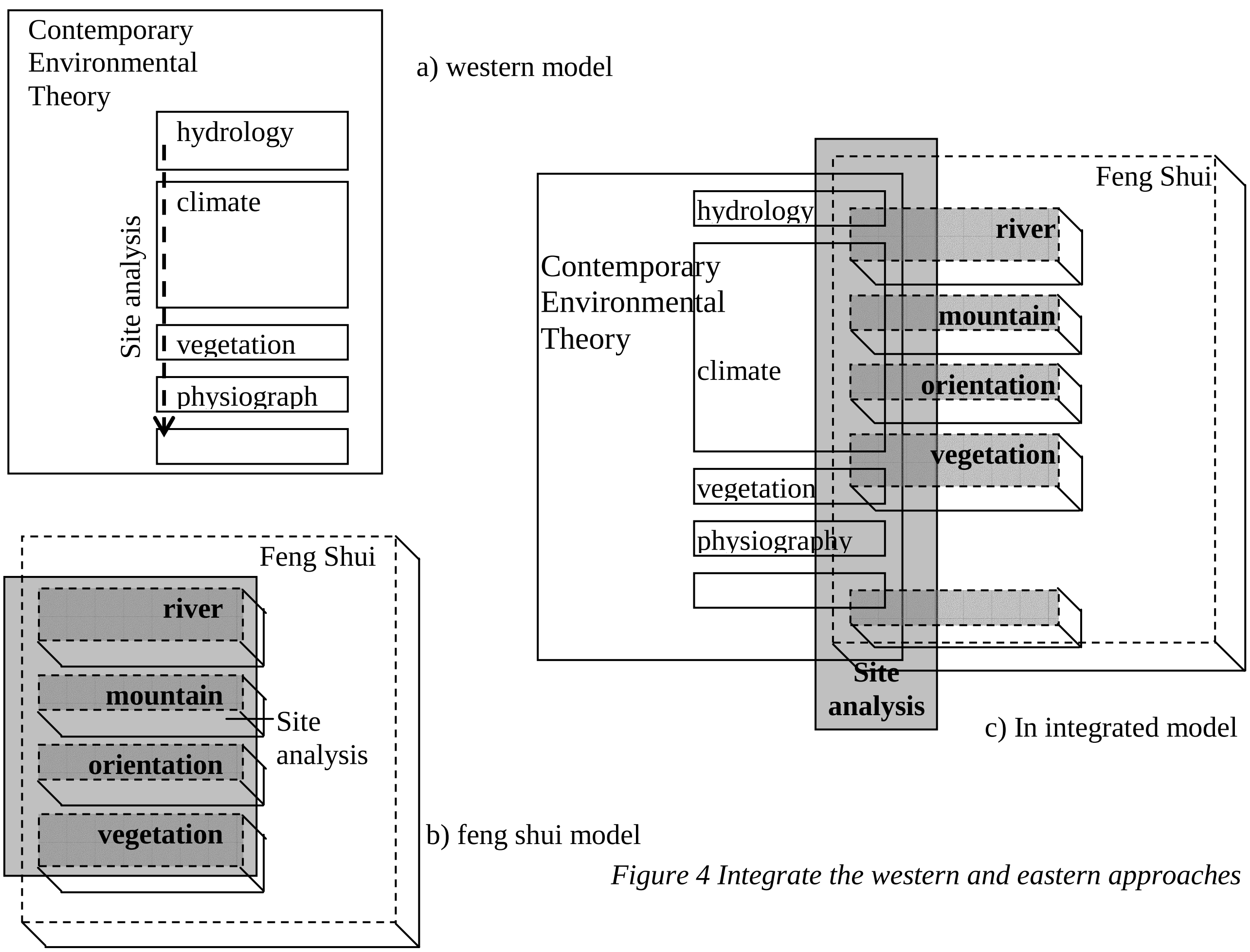


Figure 4 Integrate the western and eastern approaches

understanding of the relationships between humankind and the natural environment, and may create a more harmonious condition. If the applications of feng shui can be well analyzed and possibly combined with contemporary environmental theory, its principles need not remain simply an alternative approach, but could also lead to a new field of environmental science.

Reference:

- J. Chen and S.P. Kong (1999), *Feng-shui and Architecture (Fengshui yu Jianzhu)*, Jiangxi Science and Technology Publications, China

- E. J. Dukes (1914), Feng-shui, In *Encyclopedia of Religion and Ethics*, *Hasting (ed.)*, New York, NY

- E. J. Eitel (1993), *Feng-shui: the Science of Scared Landscape in Old China*, Synergetic Press Inc., Tucson, AZ

- L.T. Gu, eds. (1995), *Collection of the Secrets of Geographic (Dili Tianji Huiyuan)*, Taipei: Wulin Press Ltd.

- R. Hyde (2000), *Climate Responsive Design: a Study of Buildings in Modereate and Hot Humid Climates*, E & FN Spon, New York, NY

- I. L. McHarg (1969), *Design with Nature*, Natural History Press, Garden City, NY.

- J. Needham (1962), *Science and Civilization in China*, *Physics and Physical Technology* (Vol. 4), Cambridge University Press

- V. Olgyay (1973), *Design with Climate: Bioclimate approach to Architectural Regionalism*, Princeton University Press, Princeton, NJ.

- S. Rossbach (1983), *Feng-shui: the Chinese Art of Placement*, E. P Dutton, Inc

- P. Xu (1990), *Feng-Shui: A Model for Landscape Analysis (China)*, Dr. Dissertation, Harvard University, Boston, MA

- M. Yates (1868), Ancestral Worship and Feng-shui, In *Chinese Recorder and Missionary Journal*, Vol.1

- D. Yi, L. Yu, and Y. Hong, eds. (1996), *Geomancy and the Selection of Architecture Placement in Ancient China (Zhongguo Gudai Fengshui yu Jianzhu Xuanzhi)*, Hebei Science and Technology Publications, China

- K. Yu (1994), Landscape into Places: Feng-shui Model of Place Making and Some Cross-cultural Comparison, *Proceedings of 94's CELA Conference*, Mississippi State University

3-DIMENSIONAL COMPUTATIONAL METHODS FOR SIMULATING WIND FLOW PHENOMENA AND BUILDING STRUCTURE INTERACTION

Michael W. KUENSTLE, AIA
School of Architecture, University of Florida, U.S.A.
kuenstle@ufl.edu

Abstract:

This paper documents the progress of research to investigate the integration of 3-dimensional computational modeling techniques into wind mitigation analysis and design for building structures located in high wind prone areas. Some of the basic mechanics and theoretical concepts of fluid flow and wind pressure as well as their translation into design criteria for structural analysis and design are reviewed, followed by a discussion of a detailed Computational Fluid Dynamics (CFD) application case study for a simulated "3-second gust" hurricane force wind flow over a low rectangular building located in a coastal region of south Florida. The case study project models the wind flow behavior and pressure distribution over the building structure when situated in three varying conditions within a single terrain exposure category. The simulations include three-dimensional modeling of the building type constructed (1) on-grade in a flat coastal area, (2) above grade with the building elevated on structural columns, and (3) on-grade downwind of an escarpment. The techniques and parameters for development of the simulations are discussed and some preliminary interpretations of the results are evaluated by comparing their predictions to existing experimental and analytical data, with special attention paid to the numerical methods outlined in the American Society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-98*.

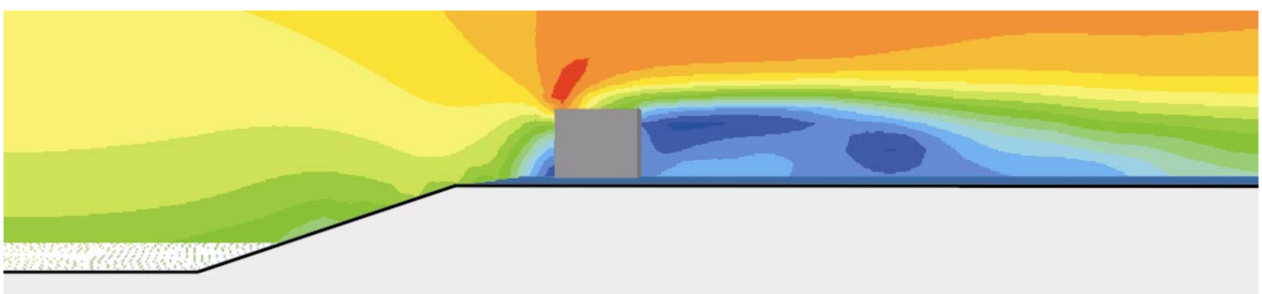


Fig. 1. Simulated hurricane force wind flow over a low rectangular building located downwind of an escarpment

Introduction

The analysis and prediction of atmospheric wind and its interaction with building structures continues to be a subject of intense research. This can be attributed to many factors which, in part, involve the emergence of a plethora of new building material science technologies and systems dedicated to improving our understanding of the diverse and complex web of environmental concerns related to the design and construction of our built environments. Among this broad range of environmental concerns, the study of the behavior of building structures subjected to hurricane force winds is of great importance to architects, engineers and city planners. In the United States alone, for example, the Federal Emergency Management Agency (FEMA) reported that in 1997 there were more than 45 million permanent residents located along the U.S. hurricane-prone coastline stretching from the gulf coast of Texas to the Carolinas. Recent data from a FEMA survey conducted in 2001 also suggests that despite a heightened awareness of the potential hazards associated with tropical storm phenomena, namely damage to life and property caused by storm surge and high winds, the population in these vulnerable areas continue grow at a rapid pace.

Since the enormous and costly devastation caused by hurricanes Andrew and Iniki in 1992, architects, engineers and the construction industry have learned important lessons regarding improved mitigation techniques for wind resistant construction. Field observations of damaged structures and building components, advanced research in the field of wind engineering, increased accuracy and reliability of meteorological data, and subsequent continued upgrades to building codes and standards including the American Society of Civil Engineers (ACSE 7-98), *Minimum Design Loads for Buildings and Other Structures,* have all played a key role in increasing the safety level of building structures sensitive to wind. Today for example, all compliant new construction in high wind prone areas implement structural systems that incorporate the strategic use of main wind force resisting frame systems constituted by diaphragms, shear walls, collectors, rigid and braced frames; all in combination with a detailed focus on component connections to transfer wind loads to the building foundation. Yet in structural terms, the fact still remains that even in the analysis of a very simple building, the dynamic loads associated with a probabilistic event such as a tropical windstorm can be sudden, complex, and unpredictable. Moreover, it is a well known fact that these loads are often characterized by rapid changes in magnitude, direction and distribution over a given structure making the design criteria for the expected structural behavior difficult to recognize (Schodek, 2001).

As a possible method for improving the understanding of wind phenomena and its dynamic interactions with the built environment, the following case study project was initiated to explore the potential application of Computational Fluid Dynamics (CFD) technology to simulate the behavior of wind flow and pressure distribution patterns developed over building structures when subjected to hurricane force winds. The simulation studies generated with the project have evolved within the framework of the commercial CFD code, Phoenics 3.4 with the implementation of a "standard" k-ε turbulence model. While there is great interest and value in the flow visualizations generated with this emergent and promising technology, it has also been a key objective of the study to schematically develop well-posed problems based on established governing principles. In this particular application it was also determined at the commencement of the project that geometrically precise and numerically homogeneous schemes would allow for more convincing comparisons of the simulation results with existing data and methods. Also it is worth noting that while the ASCE 7-98 presently makes no direct reference to methods for determining the wind load effects on building structures using the CFD method, the nomenclature and symbolic notation used in this study is consistent with that found in the ASCE 7-98 which will be more familiar to those involved in the building design disciplines. Finally, in an attempt to establish a theoretical foundation for the initial case study applications, some documentation of the preliminary groundwork developed for the study is provided to assist in defining the general perspective and scope of the investigation.

2. Statics, Fluid Mechanics and Wind Engineering

In an effort to promote a better understanding of wind as a dynamic load source, an outline of a few basic principles regarding the behavior of wind as developed in fluid mechanics and applied in statics for building structures can be appreciated. First, in the analysis and design of structural systems and components for buildings, engineers and architects are primarily concerned with two general classifications of loads acting on a structure, static loads and dynamic loads. In engineering practice, static loads and their resultant stresses and strains are, for the most part, considered highly predictable in character and can be computed with a great degree of confidence. Dynamic loads, on the other hand, are load sources generated by probabilistic events and involve motion in the delivery of an energy load to the building structure (Ambrose, 1995). The two primary conditions under which buildings are subject to dynamic loading are during seismic and windstorm events. In the later condition, which is the focus of this discussion, the dynamic loads associated with wind flow, as previously mentioned, can be hard to pin down. Examples of this elusive behavior can be observed in a wide range of situations varying from a brief gust of high wind associated with a seasonal weather storm to a turbulent flow of wind caused by vortex shedding of an adjacent building. Adding to the complexity of predicting flow behavior at the atmospheric boundary layer where buildings are situated is the potential influence and interaction of the many variables that must be taken into consideration in wind load analysis. These include wind speed, direction and probability of occurrence, adjacent topographic features (natural and man-made), building height and building geometry. All must be considered.

Further detailed definitions of wind phenomena, its physical properties and behavioral attributes can be found in fluid mechanics. From text on fluid mechanics, for example, we know that the fundamental behavior of a fluid regime follows the laws of conservation for mass, momentum, and energy as well as the basic principles of Newtonian physics extended from solid mechanics (Albertson, 1960). In this context, wind is fundamentally defined as a moving fluid. The fluid in question can be more precisely defined by the specific physical properties of air with a given mass density, temperature, viscosity, and its rate of flow at a determined velocity through some known domain with assigned physical boundaries. Additionally, as the fluid stream of air interacts with each of its physical boundary elements, some of the stream flow is deflected producing a force, referred to as dynamic pressure, which is applied to the surface of the boundary element. The point of application of the dynamic pressure (force) acts normal (perpendicular) to the surface and its direction can be either toward the surface or away from it (Albertson, 1960). The magnitude of the dynamic pressure generated from the fluid flow is derived from the potential energy of the kinetic energy (E=ma) of the fluid, in this case moving air, as summarized by application of the well-documented Bernoulli equation for fluid flow, which yields the expression

$$\boldsymbol{q} = \mathbf{1/2}\ \boldsymbol{\rho}\ \boldsymbol{V}^{\mathbf{2}} \qquad \text{(Eq. 1)}$$

where $\boldsymbol{q}$ is the resultant dynamic pressure of the potential energy, $\boldsymbol{\rho}$ is the mass density of the fluid, and $\boldsymbol{V}$ is the velocity vector of the fluid flow. We also know from fluid mechanics that when a fluid stream flow parallels a boundary element, the surface of the boundary element will retard the flow of the fluid due to friction caused by shear stresses developed between the fluid media and the adjacent surface (Albertson, 1960). The amount of deceleration (drag) to the flow stream near the boundary is directly related to the roughness of the boundary's surface and the viscosity of the fluid. In this study the boundary surface in question is defined by the topographic features at the ground plane and the viscosity of air is defined by a dimensionless "Reynolds" number which relates the internal stresses to the viscous forces inherent in the fluid. Figure 2 graphically illustrates the profile of this behavior which can be computed by application of the power-law scheme as is commonly used in engineering practice for approximating specified atmospheric boundary layer conditions (Ward, 1999) summarized as

$$\boldsymbol{V} = \boldsymbol{V}_{\mathbf{ref}} \, (\mathbf{Z} \,/\, \mathbf{Z}_{\mathbf{ref}})^{1/\alpha} \qquad \text{(Eq. 2)}$$

where $\boldsymbol{V}_{\mathbf{ref}}$ is the reference velocity, $\mathbf{Z}_{\mathbf{ref}}$ is the distance from the boundary corresponding to the reference velocity, $\mathbf{Z}$ is the distance from the boundary corresponding to velocity $\boldsymbol{V}$, and $\boldsymbol{\alpha}$ is the power law exponent related to the roughness for a given exposure condition. The $\boldsymbol{\alpha}$ exponents used throughout this study are those found in the *ASCE 7-98*, which were adopted from A. G. Davenport's pioneering research involving wind flow behavior in the atmospheric boundary layer. The Davenport exponents are given for four different general exposure categories; A. large city centers, B. suburban residential areas, C. open terrain with scattered obstructions, and D. shorelines of inland waterways. The analytical method delineated in the *ASCE 7-98* uses exposure category C for hurricane prone regions.

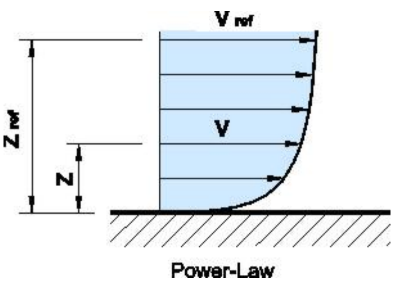


Fig. 2.

Finally and perhaps the most important principle from fluid mechanics related to the study of any flow regime is the principle that links fluid pressure with velocity along 2D flow streams. Numerically expressed as a derivative of the Bernoulli equation, and likewise referred to as the Bernoulli effect, the principle fundamentally states that there is a very simple and direct relationship between the fluid pressure and velocity at one point and the fluid pressure and velocity measured at another point along a 2D stream flow - specifically that the pressure plus the kinetic energy of the fluid at the first point equals the pressure plus the kinetic energy of the fluid at the second point (Ward, 1998). In other words, due to the laws of conservation of energy, as the velocity increases or decreases along its flow path, its corresponding pressure will decrease or increase to create a form of fluid equilibrium. This relationship can be summarized by the following expression;

$$\boldsymbol{P_1} + 1/2\, \rho\, \boldsymbol{V_1}^2 = \boldsymbol{P_2} + 1/2\, \rho\, \boldsymbol{V_2}^2 \qquad \text{(Eq. 3)}$$

and finds many applications in fluid dynamics. A significant attribute of CFD codes is their ability to extend these principles into a 3D domain in which the time averaged Navier-Stokes

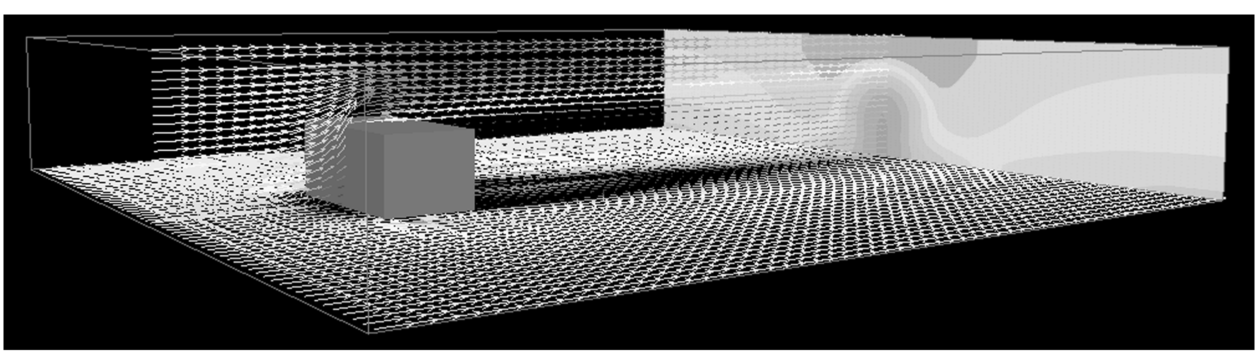
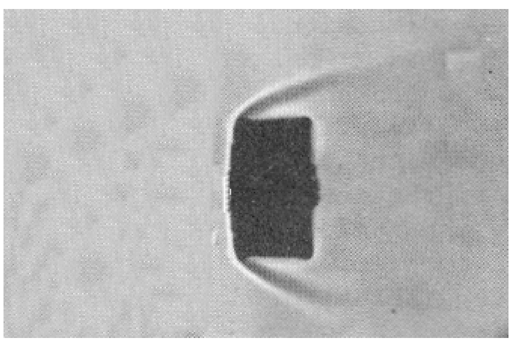


Fig. 3. 3D Flow Simulation over a bluff body implementing a time averaged Navier-Stokes equation

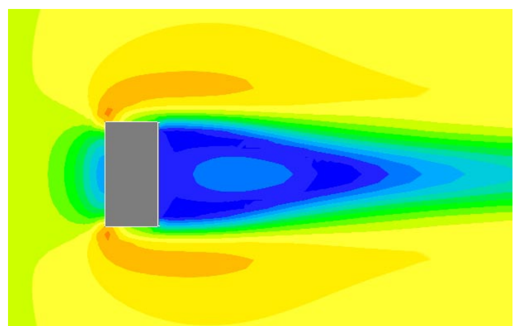
equations can be solved using computer algorithms for flows over bluff bodies.

3. The Computational Fluid Dynamics Approach and Flow Visualization

Wind engineering research is a diverse topic with much attention in modern fluid mechanics. It is traditionally conducted using a variety of established methods including numerical analysis, full-scale measurements, and wind tunnel experiments. Over the past few decades, however, the analysis of fluid motion and flow structure using CFD simulation modeling techniques have been developed and applied with considerable success in some areas within the discipline. Working with CFD simulations, one is able to construct a visual window onto the dynamic, viscous, and bifurcating world of fluid media interactions. The visual simulation of this phenomenon is developed and approximated through space and time based numerical solutions of conservation equations in terms of fluid velocity and pressure for flows within a specified fluid flow regime. Some notable example applications can be found throughout the automotive and aerospace design industries were CFD technology is already fully integrated into design, testing, and manufacturing processes. More recently, important work with CFD has emerged in other fields such as biomedical and environmental research as well as marine related design work. With the rapid development of commercially available CFD codes in combination with access to more powerful computers, CFD applications are beginning to surface as a new virtual design tool in the building design disciplines and their related material science industries as the trend in design moves increasingly toward simulation rather than physical model experiments.



A) Shadowgraph Experiment from 1975



B) Computer Generated CFD Flow Visualization

Fig. 4. Flow Visualization Techniques

In wind research on bluff bodies (which includes most building geometries), the application of CFD technology involves three primary elements: pre-processing, calculations, and post-processing (output for visualization). In brief, pre-processing includes some CAD model building and mesh generation techniques, a review of wind speed data, boundary and exposure conditions, and the determination of the physical and numerical properties for the flow regime. Among these components, mesh generation for the discretization of the flow domain is an important feature of the CFD process because it has a direct effect on both the speed and accuracy of the numerical solution. The mesh essentially divides the domain into a discrete number of cells or control volumes for which the partial differential equations can be solved by application of a numerical algorithm in an iterative process.

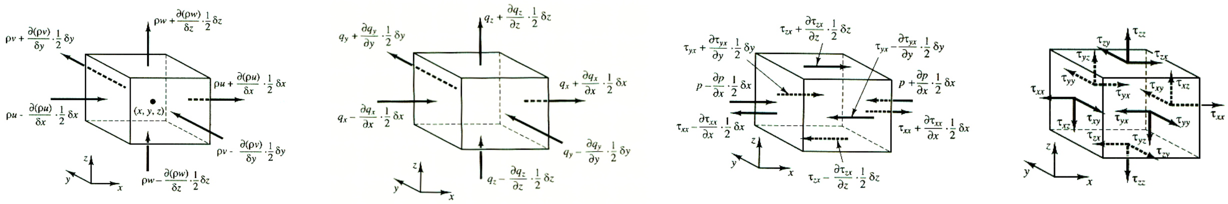


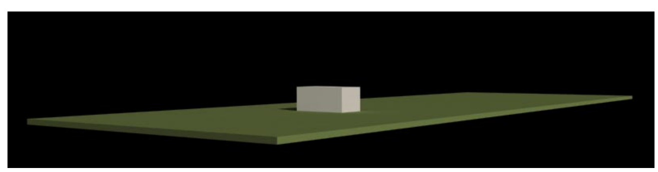
Fig. 5. Diagram of Governing Equations for a Fluid Flow, Fluid elements or control volumes from Versteeg and Malalasekera, 1995

Concerning the calculations, the fidelity of the CFD solution for turbulent flows is dictated by turbulence modeling, especially when it comes to flows around buildings and other structures due to the complex features of the flow behavior (Kim 1999) as alluded to previously. Among the many turbulence models in existence, the "standard" k-ε turbulence model (Launder 1974) developed almost three decades ago is the most widely used and validated (Versteeg, 1995). While *ad-hoc* modifications to the "standard" k-ε model continue to be developed for special applications, the accepted use of the "standard" k-ε model is nearly universal within the CFD community. While a full description of the numerical model is far beyond the scope of this paper, it can be readily accessed in the referenced literature along with other examples of converged and stable solutions for schematically similar problems.

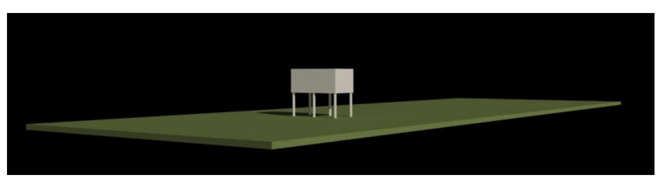
The final element of the CFD process involves the translation of the numerical data into graphic representations for flow visualization. The output data can take the form of 2D and 3D vector, surface, and contour plots, streamlines, and animations: some examples of which are included with this paper.

4. Case Study Project

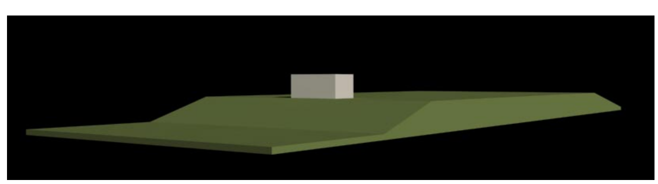
The parameters of interest for the case study project include developing trial studies for the integration of 3-dimensional computational methods for simulating wind flow phenomena and building structure interaction. The dynamic forces acting on building structures due to wind loading must be determined for the appropriate design of the structure's main wind-force resisting system and components and cladding. The study presented with this paper documents a CFD application for a simulated "3-second gust" hurricane force wind flow over a low rectangular building measuring 12m x 6m x 5m and located in a coastal region of south Florida. The case study project models the wind flow behavior and pressure distribution over the building structure when situated in three varying conditions within a



Scheme 1

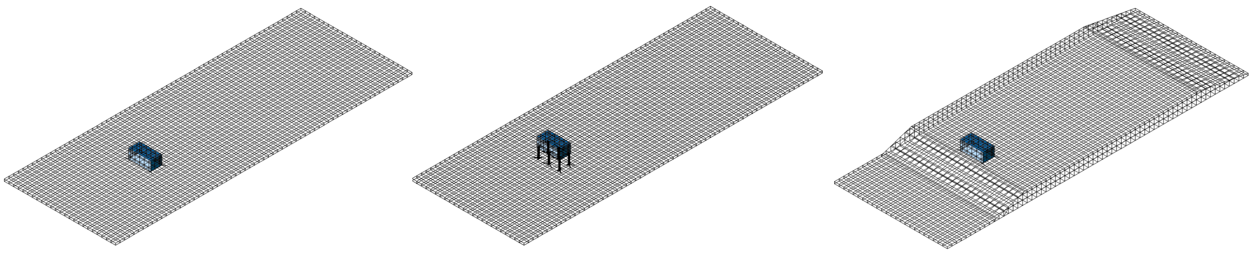


Scheme 2



Scheme 3

Fig. 6. Building Schemes



Scheme 1 *Scheme 2* *Scheme 3*

Fig. 7. Mesh generation

single terrain exposure category. The simulations include three-dimensional modeling of the building type constructed (1) on-grade in a flat coastal area, (2) above grade with the building elevated 5m on structural columns, and (3) on-grade downwind of a 5m high escarpment. A basic premise of the study was the assumption that building structures located in hurricane prone regions are vulnerable to both storm surge and high winds and that common strategies to mitigate storm surge, i.e. raising the building to higher elevations as in scheme 2 and 3, subject the building structure to higher wind loads.

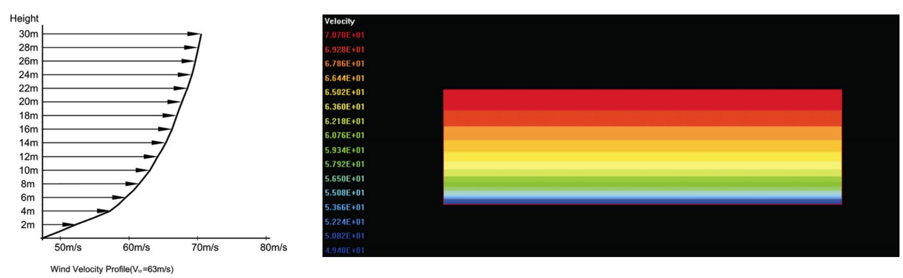
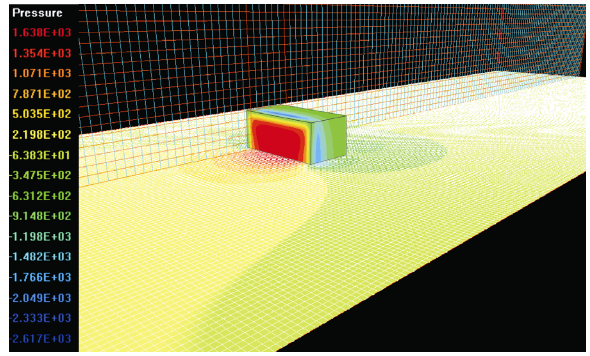


Fig. 8. Wind Velocity Profile

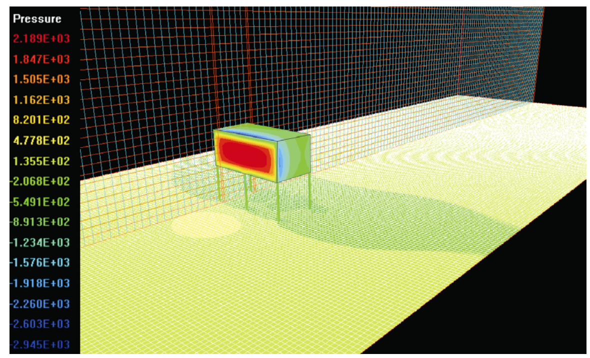
As an example CFD study for the schematic development of the parameters for the computational domain, the "Shah and Ferziger" solution for a fully developed turbulent flow over a wall mounted cube (Ferziger, 1999) was reviewed as a starting point and advanced with a previous study (Kuenstle 2001). The final domain parameters and placement of the building structure within the domain were determined after several trial study applications with the CFD solver. In an attempt to generate a more economical study, the overall domain parameters for the three schemes were kept constant. The building models and mesh generation were developed in Form-Z using a structured mesh, and then exported as stereo lithography (.stl) files for integration into the flow domain. The simulations are each single-phase flow, implementing the "standard" k-ε turbulence model, and are converged after 10,000 iterations. The attributes of the boundary conditions for the buildings were determined within the Phoenics software using a "solid with smooth wall friction" function. The number of cells for the three schemes varies between 280,000 and 290,000. To determine the inlet velocity, a "3-second gust wind speed" of 63 m/s (140 mph) was selected from the "Basic Wind Speed" map, figure 6-1b of *ASCE 7-98* which corresponds with the southeast Atlantic coastal region of Florida. A wind velocity profile was determined using the power-law scheme (Eq. 2), with the **α** exponent 9.5 for category C as specified in the *ASCE 7-98*, then input into the software to study the development of the flow and it's behavior with the domain boundary prior to incorporating the building into the simulation model. A fully developed wind velocity profile was achieved as demonstrated above (Fig. 8).

5. Observations

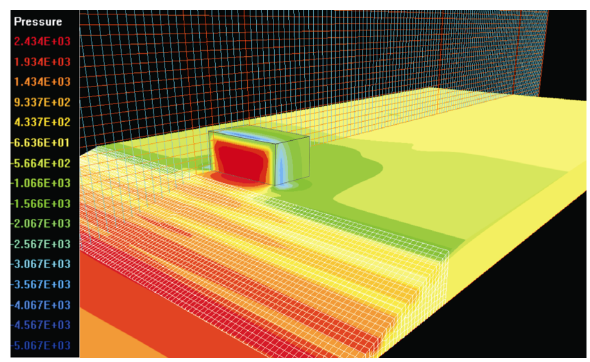
The primary sensitive issue that emerged from the trial results relating flow development, domain geometry, and mesh size to convergence of the governing equations involved a fine tuning of the placement of the building structure relative to the velocity inlet and outlet. Full development of the velocity profile was required windward of the building and could only be determined through preliminary testing. Some documented guidance by Versteeg and Malalasekera was relied upon for location of the outlet, "as the velocity profile downstream of an object can greatly affect the accuracy of the numerical results" (Versteeg, 1995). Additionally, as the original premise for the study is based on the concept of a "gust wind," it was determined that the flow had to envelope the entire structure (Ward, 1998).



Scheme 1



Scheme 2



Scheme 3

Fig. 9. Pressure Distribution

The CFD software computed pressure values and their distribution over the building structure for the three schemes are illustrated in (fig. 9). The highest positive pressures (inward forces) occur on the windward face with negative pressure (outward forces) occurring on the side, roof and leeward surfaces. The greater negative pressure generated at the leading edge of the side and roof surfaces (and the underside surface of scheme 2) demonstrate the expected behavior that is consistent with well documented results of physical model data and wind tunnel testing.

A comparative study of the pressure values for both the positive and negative forces acting on the building structure confirms the initial assumption that raising the building to higher elevations subjects the building structure to higher wind loads. The maximum wind loads are experienced with scheme 3 where the building is subjected to increased wind flow over the escarpment.

For verification of the simulation results the *ASCE 7-98* (Eq. 5) provides standard formulas and tabled coefficients relating to height, exposure, terrain, and building geometry for calculating design velocity pressures. In each of the calculations below the dynamic velocity pressure is derived from the kinetic energy of moving wind, as discussed previously, and is converted into an equivalent static load derived from the Bernoulli equation (Eq. 1) and Newton's law of a mechanical force (F=ma) yielding the following expression

$$\boldsymbol{q} = \mathbf{.613}\ \boldsymbol{V}^{\mathbf{2}} \quad (\mathrm{N/m^2}) \qquad \boldsymbol{q} = \mathbf{.00256}\ \boldsymbol{V}^{\mathbf{2}}\ (\mathrm{lb/ft^2}) \qquad \text{(Eq. 4)}$$

where (Eq.1) is modified to compensate for the units which relate the mass density of air (1.22 kg/m^3 at 15^0C or .07651 lb/ft^3 at 59^0F) to force (N/m^2 or lb/ft^2) by mean's of Newton's second law for which acceleration is g = 980.7 cm/sec^2 (32.2 ft/sec^2), (ASCE 7-98). For calculating the design pressure on the windward surface the *ASCE 7-98* provides the following expression

$$\mathbf{p} = \boldsymbol{q}\ \mathbf{G}\ \mathbf{C_p} \qquad \textit{ASCE 7-98} \qquad \text{(Eq. 5)}$$

where **p** is the design pressure, ***q*** is the equivalent static load coefficient (Eq. 4) modified by the building height and terrain factors and the wind velocity, **G** is a tabled gust factor and $\mathbf{C_p}$ is an external pressure coefficient. Application of the *ASCE 7-98* method for the windward surface of scheme 1 yields the following:

$\boldsymbol{q}$ = .613 (.865) (63 m/s)^2 = 2104.5 N/m^2 (43.95 lb/ft^2), then

$\boldsymbol{p}$ = 2104.5 (.85) (.8) = 1431.1 N/m^2 (**29.8 lb/ft²**)

For scheme 2:

$\boldsymbol{q}$ = .613 (1.0) (63 m/s)^2 = 2432.9 N/m^2 (50.8 lb/ft^2), then

$\boldsymbol{p}$ = 2432.9 (.85) (.8) = 1654 N/m^2 (**34.5 lb/ft²**)

For scheme 3, which incorporates a topographic factor for the wind flow over an escarpment:

$\boldsymbol{q}$ = .613 (.865) (2.25) (63 m/s)^2 = 4735.2 N/m^2 (98.8 lb/ft^2), then

$\boldsymbol{p}$ = 4735.2 (.85) (.8) = 3219.9 N/m^2 (**67.2 lb/ft²**)

The CFD pressure results for the windward surface, scheme 1, indicate a maximum pressure of 1638 N/m^2 (34.2 lb/ft^2) with an averaged reading over 216 cells of 1365 N/m^2 (28.5 lb/ft^2) which for the trial study is consistent with the *ASCE 7-98* calculated design pressure of 1431.1 N/m^2 (29.8 lb/ft^2).

The CFD pressure results for the windward surface, scheme 2, indicate a maximum pressure of 2189 N/m^2 (45.7 lb/ft^2) with an averaged reading over 216 cells of 1459 N/m^2 (30.4 lb/ft^2) which is also in close agreement with the *ASCE 7-98* calculated design pressure of 1654 N/m^2 (34.5 lb/ft^2).

The CFD pressure results for the windward surface, scheme 3, indicate a maximum pressure of 2434 N/m^2 (50.8 lb/ft^2) with an averaged reading over 216 cells of 2028 N/m^2 (42.3 lb/ft^2) which is significantly less (almost 25 lb/ft^2) than the *ASCE 7-98* calculated design pressure of 3219.9

N/m^2 (67.2 lb/ft^2). While the simulation model shows an increase in the wind load, which is consistent with the expected behavior for the wind speed-up effect over the escarpment, the discrepancy in the pressure values warrants further investigation for a fine-tuning of the model and a closer inspection of the ASCE 7-98 data and method.

Similar calculations for the above can be made for both the leeward and sidewalls as well as for the roof (not demonstrated here).

6. Conclusion

The initial trial studies developed with the project demonstrate that the CFD models were able to establish a clear relationship between the simulated wind phenomena and its interaction with the building structure. While the immediate potential of CFD modeling for use in wind engineering continues to exist primarily in its extraordinary graphic capabilities for visualizing complex flow phenomena, the current study suggest that as research and validation of CFD applications in building design continue to be developed and critically reviewed, the simulation model can provide engineers and architects with an important virtual tool to assist in the mitigation of wind damage to buildings.

Acknowledgements

This developing research project has been made possible, in part, by a grant from the FRSA Educational and Research Foundation, Inc. and the encouragement of the architecture faculty at the University of Florida. Dr. Gary Chen provided technical assistance for the initial CFD modeling and numerical solutions. Todd Whitehead and Ji-Youn Han provided assistance with the computer modeling as part of a special studies course taught at the University of Florida Graduate School of Architecture.

References

Albertson, Maurice L., James R. Barton and Daryl B. Simons. *Fluid Mechanics for Engineers*. Englewood Cliffs, NJ: Prentice Hall, 1960.

Ambrose, James and Dimitry Vergun. *Simplified Building Design For Wind and Earthquake Forces*. New York, NY: John Wiley & Sons, Inc. 1995.

American Society of Civil Engineers (ASCE). *ASCE 7-98, Minimum Design Loads for Buildings and Other Structures*. Reston, VA: 2000.

Ferziger, Joel H. and Milovan Peric. *Computational Methods for Fluid Dynamics*. Berlin, Germany: Springer-Verlag, 1999.

Kim, Sung-Eun and Ferit Boysan. "Application of CFD to Environmental Flows," *The Journal of Wind Engineering and Industrial Aerodynamics*, 81 (1999): 145-158.

Kuenstle, Michael. "Computational Fluid Dynamics Applications: Wind Engineering for the Design of Building Structures in Wind Hazard Prone Areas," *Proceedings of the 5th Iberoameerican Congress of Digital Graphics*, Sigradi 2001, Concepcion, Chile. (2001): 67-70.

Schodek, Daniel L. *Structures, 4th ed.* Upper Saddle River, NJ: Prentice Hall, 2001.

Versteeg, H. K. and W. Malalasekera. *An Introduction to Computational Fluid Dynamics.* Essex, England: Prentice Hall - Pearson Education Limited, 1995.

Ward, Del and Stan Crawly. *Wind Forces*. Washington, DC: National Council of Architectural Registration Boards, 1998.

Structural Solutions for the Design of a "Cyclonic"or Hurricane Resisting Home Adapted to Simple Construction Methods

Rima TAHER*, Ph.D.
New Jersey School of Architecture
New Jersey Institute of Technology
rtaher@attglobal.net

Abstract:
This current research is based on and directly linked to a prior research entitled: "Wind Loads and Architectural Design - Application to Tropical Cyclonic Dwelling", carried out at CSTB, Centre Scientifique et Technique du Bâtiment (Center for Building Science and Technology),and presented at the Tenth International Conference on Wind Engineering at Copenhagen, Denmark, by Jacques Gandemer and Sophie Hélary-Moreau from the Department of Aerodynamics and Climatic Engineering, at the CSTB Research Center of Nantes, France.

In the actual research, the author from the New Jersey School of Architecture is cooperating with the above named french researchers from CSTB, regarding the design of a "cyclonic" or hurricane resisting home. In the prior research, and in order to study the influence of architectural forms on wind loads, home models of different configurations were extensively tested in the sophisticated wind tunnel facility at CSTB. As a result of their extensive testing and research, CSTB researchers provided different architectural interpretations of aerodynamic concepts, and some practical architectural applications of research findings.They ultimately developed a concept of a "cyclonic dwelling", that would function more efficiently under wind loads in a hurricane environment. The proposed cyclonic home incorporates aerodynamic features and systems designed to reduce loads and pressures due to extreme winds.

The current research, in cooperation with CSTB, is supposed to complete some other aspects of the design of this cyclonic home, by looking mainly into the structural and construction aspects. In a first phase, the author's work focused on the analysis of damages caused to structures by high winds and hurricanes, by studying the main findings of post-disaster investigations carried out both in the United States and abroad, including the French overseas territories. It is important to remember that damages from hurricanes and windstorm events currently represent a loss of several billions of dollars in the US. A loss estimate of $30 billion was attributed to Hurricane Andrew alone. A comparative study of research results obtained by CSTB researchers and researchers elsewhere, regarding the influence of architectural forms on wind loads was also completed. The research work is currently focused on developing structural solutions for the design of this cyclonic home. These solutions should adapt to a modular architecture and simple construction methods. Economical issues and construction costs impacts will also be examined. This research will represent a contribution toward improving our understanding of the complex wind effects on buildings and structures. It will also help in applying research findings, and in using our knowledge in this area to improve the quality of design and construction to resist wind hazards.

*Ph.D. in Civil Engineering, Special Lecturer, New Jersey School of Architecture, New Jersey Institute of Technology, University Heights, Newark, NJ 07102

Structural Solutions for the Design of a “Cyclonic”or Hurricane Resisting Home Adapted to Simple Construction Methods

1- Introduction

As mentioned above, this paper provides an overview of an ongoing research related to the design of a “cyclonic” home. This work is based on a prior research entitled :”Wind Loads and Architectural Design - Application to a Tropical Cyclonic Dwelling“, carried out at CSTB, Centre Scientifique et Technique du Bâtiment (Center for Building Science and Technology) in France, and presented at the Tenth International Conference on Wind Engineering , Copenhagen, Denmark [3], by Jacques Gandemer and Sophie Hélary-Moreau, from the Department of Aerodynamics and Climatic Engineering, at the CSTB Research Center of Nantes, France.

In the actual research which is funded by a grant from New Jersey Institute of Technology, the author from the New Jersey School of Architecture is cooperating with the above named french researchers from CSTB, regarding the design of a “cyclonic” or hurricane resisting home. In the prior research, and in order to study the influence of architectural forms on wind loads, home models of different configurations were extensively tested in the wind tunnel facility at CSTB. As a result of their extensive testing and research, CSTB researchers provided different architectural interpretations of aerodynamic concepts, and some practical architectural applications of research findings.They ultimately developed a concept of a “cyclonic dwelling”, that would function more efficiently under wind loads in a hurricane environmemt. The proposed cyclonic home incorporates some aerodynamic features and systems designed to reduce loads and pressures due to extreme winds.

The current research, in cooperation with CSTB, is supposed to complete some other aspects of the design of this cyclonic home, by looking mainly into the structural and construction aspects. In a first phase, the author’s work focused on the analysis of damages caused to structures by high winds and hurricanes, by studying the main findings of post-disaster investigations carried out both in the United States and abroad. A comparative study of research results obtained by CSTB researchers and researchers elsewhere, regarding the influence of architectural forms on wind loads was also completed. The research work is currently focused on developing structural solutions for the design of this cyclonic home. Economical issues and construction costs impacts will be examined in a later phase.

2- Post-Disaster Investigations of Hurricanes and Windstorm Events

Damages from hurricanes and windstorm events currently represent a loss of several billions of dollars in the United States. A loss estimate of $30 billion was attributed to Hurricane Andrew alone in Florida. In order to assess damages to buildings and structures, and provide guidance and recommendations to building officials and professionals, some field investigations were carried out, both in the United States and abroad, in the aftermath of hurricanes and major winstorm events, over the past two decades. These investigations constitute important lessons to learn from.

In a first phase of this research, the author completed an analysis of some of the most important post-disaster investigations and their main findings. The analysis was presented in a report [14] which covered investigations both in the US and abroad, including investigations in the French Indies in the aftermath of Hurricane Hugo in 1989.

Extensive investigations led by FEMA, Federal Emergency Management Agency, for instance following Hurricane Andrew in Florida in 1992 [8], and other investigations of the same hurricane event [12], revealed some important facts. Some of their most important observations, in relation to residential construction, were: extensive loss of roofing, specially tile roofs, resulting for instance in water damage to the interior of the house, failure of gable ends and base connections (hip roofs performed well), failures in the attachment of roofing and siding. Greater attention to details and connections in particular was generally recommended. Careful consideration of uplift in the design of foundations and base anchors were suggested. Improved fastening systems were also recommended.

On the other hand, as a result of Hurricane Andrew's devastation to Dade County, Florida, a task force was appointed by the county to study the building code and make recommendations. Some building practices were criticized. Experts pointed out that some of the code provisions were overlooked in construction. The use of some types of building and roofing materials was questioned. Some changes were introduced later, such as banning the use of pressed board and staples for roofing, among other changes which also included improving building inspection practices.

In the French Indies, field investigations by french engineers from CSTB, for instance in Guadeloupe, in the aftermath of Hurricane Hugo in 1989 [1], also revealed a better performance of hip roofs. In wood homes, roof collapse often involved the presence of large overhangs that failed under hurricane-wind loads leading to the roof collapse. Generally, homes built according to codes performed relatively well. In reinforced concrete buildings, inadequate reinforcement, insufficient cover, as well as poor concrete quality in some cases, were believed to have contributed to structural failure under hurricane winds. Field investigations of hurricanes or windstorm events were also carried out in Australia, Canada and other parts of the world [14]. In the US, field investigations of tornadic events were carried out as well, especially by FEMA [14].

3- Wind Pressure Distribution on a Building

Winds generally create a complex pressure distribution on the walls and roof of a building. In a rectangular building, the windward walls are normally under high inward pressure, often called positive pressure. This pressure decreases near the edges of these walls. The leeward wall experiences outward pressures, called negative pressure, which increases near the wall edges and decreases near the center of the wall (Figure 1). Winds flowing around the building also create drag effects on surfaces parallel to the wind direction. Sidewalls generally experience outward pressures, and the corners a relatively large outward pressure due to turbulence in the flow. The wind-load action on a pitched roof is function of different factors, such as the pitch of the roof and the relative dimensions of the building. The effect on a flat roof is generally an outward pressure. Wind pressure distribution on the walls and roof is influenced by the presence of openings. Internal pressures depend on the location of openings.

4- Overview of Architecture Related Wind Engineering Research in Low-Rise Buildings

In the area of wind effects on buildings and structures, the basic research methodoly consists in physical modeling using atmospheric boundary layer wind tunnels. A comparative study of architecture related wind engineering research in low-rise buildings was completed by the author, and presented in a research report [15], which also included a summary of the state of research in the field of wind effects on buildings and structures.

The Boundary Layer Wind Tunnel Laboratory at the University of Western Ontario in Canada, directed by Dr. A.G. Davenport, pioneered the study of wind effects on buildings and structures in the 1960's, and helped establish research methodologies in this field. As a result, its work became the basis for most wind codes in North America. Early research in this field often dealt with low-rise buildings and gable roof models. Examples include a study by Stathopoulos [13], also reported by Stathopoulos, Surry and Davenport [2].

As mentioned earlier, field investigations following hurricanes, revealed that hip roofs generally performed better than gable roofs. Gable roof construction is more common in low-rise buildings, and generally costs less than hip roof construction. After dealing primarily with gable roofs, wind researchers began later on to focus more attention on hip roofs. The effects of wind loads on both roof types were studied and compared by different researchers. Hessig [6] performed a parametric comparison of these two roof types at Clemson University in 1986. In 1988, Meecham [10] studied wind action on hip and gable roofs at the Boundary Layer Wind Tunnel Laboratory, at the University of Western Ontario. Meecham's research showed that the maximum wind action on gable roofs was greater compared to hip roofs. As an example, and for the studied configurations, the worst local peak negative pressures on gable roofs were about 50% greater than those on hip roofs. Distributed pressures on the full-span trusses of the gable roofs were estimated to be roughly twice as important as pressures on the full-span trusses of the hip roofs. Meecham suggested a square hip roof of a steep pitch as the best roof geometry to resist global overturning failure. The effect of facia rounding of the roof was also studied by Meecham. Test results showed that the rounding alleviates leading edge pressures compared to the bluff-edged normal roof line.

In Australia, Holmes studied the characteristics of wind pressures on the walls and roof of gable-roofed tropical houses [7]. Experiments were carried out in the boundary layer wind tunnel at James Cook University in Australia, to study the effects of different factors such as: elevation of houses on columns above ground, roof pitch and grouping of buildings. Results showed, for instance, that the building elevation resulted in some significant increase in the external wind pressures. Other research examples include: Reardon and Xu [11], on the effect of roof slope on wind pressures of hip roofs, Ginger, Kane and Henderson [4], who also studied wind loads on hip end roofs at the Cyclone Structural Testing Station, James Cook University, Australia.

5- Wind Research at CSTB - Concept of a "Cyclonic" Home

In order to study the influence of a building's shape and architecture on its behavior under wind loads, wind tunnel tests were extensively carried out at the boundary layer wind tunnel at CSTB, at the research center of Nantes, France. Reduced scale home models were tested using different configurations. The appropriate wind conditions and wind turbulence were recreated, and wind pressures were measured in different locations. Research and testing over a period of several years resulted in some practical architectural applications. CSTB researchers ultimately developed the concept of a " cyclonic dwelling" that would incorporate some aerodynamic features and systems designed to reduce wind loads in a hurricane environment. This section includes some of their most important findings and a brief description of the "cyclonic dwelling". More details could be found in other publications [3],[5],[15].

In their wind tunnel testing, CSTB researchers studied the influence on wind loads of various parameters such as: the home shape and orientation with respect to wind, roof geometry and slope, roof overhangs and covered porches, and the control of internal pressure. Results generally showed that hip roofs performed better compared to gable roofs. A roof slope of about 30° was estimated to offer the best results. Roof overhangs were mostly subjected to important uplift forces. These uplift forces could sometimes trigger a roof collapse. Researchers recommended that roof overhangs do not exceed 50 cm (about 20"), specially for roofs with a small slope. They also recommended to structurally disconnect the overhangs from the main structure, if possible. In relation to the building's shape, a compact building of a square floor plan (or even better: hexagonal or octagonal), with a multiple-panel roof (4 or more), was suggested in order to reduce wind loads. Test results also showed that regardless of the building's shape, some roof locations (eaves and edges) were always subjected to important uplift forces. In order to reduce the local stresses at the roof's lower edges, some local devices and systems were suggested:

1- A horizontal grid, similar to sun visor louvers, with a permeability of about 25-30%, and a width of about 50 to 60 cm (20" to 24"). This grid could reduce the vertical component of the wind speed thus decreasing local depression (Figure 2a). The system must be continuous around the perimeter of the building, and attached to the vertical structure (not the roof).

2- A notched frieze in a vertical position, all around the building at the level of the gutters. This frieze would function as a vortex generator, minimizing the roof edge depression (Figure 2b).

The effects of these two systems is not cumulative. Based on tests, their use could reduce localized wind loads by a factor of 1.5 to 2.

In order to control global wind loads acting on a certain surface of the building's envelope, it is necessary to control both the external wind pressure distribution and the internal wind pressure. CSTB researchers estimated that the presence of a shaft in the center of the home would create a connection between the internal space and the roof ridge, considered as the zone of highest depression, thus allowing a balance of pressure between the exterior and the interior of the home, that could lead to a significant reduction or even a cancellation of roof wind loads. The shaft would also create a strong internal depression minimizing the risks of damage from suction (Figure 3). Tests were carried out using reduced scale home models equipped with a central shaft, and the results were compared to those relating to a regular home model with a closed central shaft. The edge treatment described above was also included. Test results clearly showed the benefits of the central shaft and these edge systems. For a good efficiency, a good airtightness of the home was recommended, and an area of about 1.5 to 2 m^2 (16 to 21.5 ft^2) was suggested for the shaft's section. A honeycomb system inserted inside the shaft would provide protection from rain without affecting the mechanism of pressure balancing. It was also suggested to raise the shaft for about 40 cm (15" to 16") above the roof ridge level. Finally, researchers stressed the necessity of maintaining a pneumatic connection between the shaft and the various internal spaces during the hurricane event. Based on research findings, CSTB researchers developed the concept of a "cyclonic home" (Figures 4 and 5). Some systems for the treatment of porch roofs were also suggested and tested by CSTB. Figure 6a shows a porch roof system consisting of vertical slats 15 to 20 cm wide (6"to 8"). It operates in two positions: closed for regular conditions, and open for hurricane conditions. Figure 6b illustrates another system which consists in dividing the porch roof into 3 parts (about 1m wide or 39"). The panels are swiveled to make an angle of 40° with the horizontal. An opaque element installed at the high part of the wall allows the system efficiency for any wind angle incidence.

6- Structural Considerations and Solutions for the Design of the "Cyclonic" Home-Building Envelope

In addition to the regular loads normally considered in the design, a structure exposed to a hurricane can be subjected to high wind loads and flood loads. Flood loads could take different forms. They could be hydrostatic, hydrodynamic (from moving water), they could include breaking waves and debris impact. The effect of flood loads could be magnified by erosion and localized scour, which lower the ground surface around the foundation thus reducing the load-bearing capacity. The wind design is addressed somewhat differently by the various building codes. The ASCE 7-98 standard , " Minimum Design Loads for Buildings and Other Structures", of the American Society of Civil Engineers (ASCE) is considered the state-of-the-art in wind design. Its use is recommended by wind experts and by FEMA. Other helpful design documents include: " The High Wind Edition of the Wood Frame Construction Manual for One-and-Two-Family Dwelling", by the American Forest and Paper association (1996), and the Coastal Construction Manual (2000), published by FEMA.

One of the main objectives of this research is to focus on the structural aspect of the design of the "cyclonic" home, as described in the previous section. The following sections present a brief summary of some possible structural solutions using a wood-frame home, and some guidelines for the design of its framing. Suggestions are also given regarding the design of the building envelope. More details are given in a research report which is currently being prepared by the author. Suggestions are based on building codes and standards, and FEMA's Coastal Construction Manual. Other alternatives to wood products as well as construction costs impacts will be examined in a later phase of this research. Wood is basically the most used construction material for residential buildings in the US. In addition to its warmth and beauty, wood is strong, lightweight and easy to work with. The wood-frame home suggested for the "cyclonic dwelling" at this stage, is an elevated structure on an open foundation, with a hip roof and a somewhat cubical shape. Elevating a structure allows to reduce the risk of damage from flooding and hurricane-driven water. The home is supposed to be equipped with a central shaft and edge treatment systems as described earlier.

Figures:

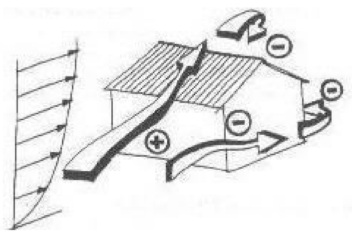
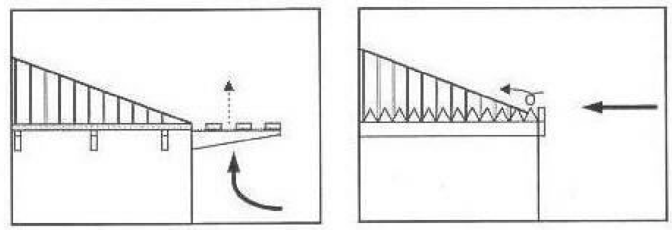


Figure 1 Wind Pressure Distribution on a Building



a) Horizontal Grid

b) Vertical Notched Frieze

Figure 2 Edge Treatment Systems

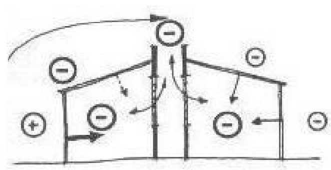


Figure 3 Balancing Pressure Using a Central Shaft

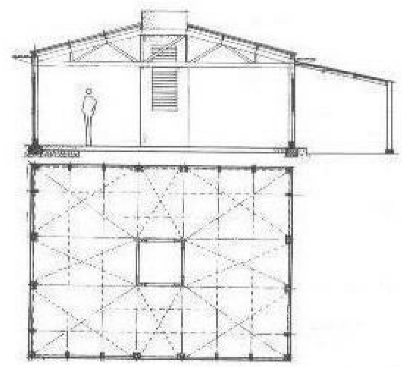


Figure 4 Cyclonic Home Concept as Developed by CSTB

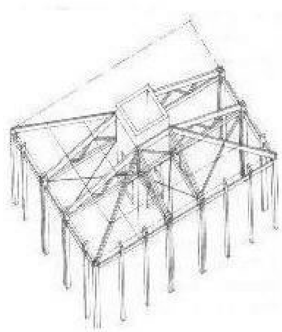
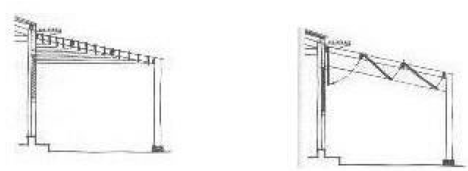


Figure 5 Cyclonic Home Frame as Seen by CSTB



a) Vertical Slats

b) Revolving Panels

Figure 6 Porch Roof Treatment

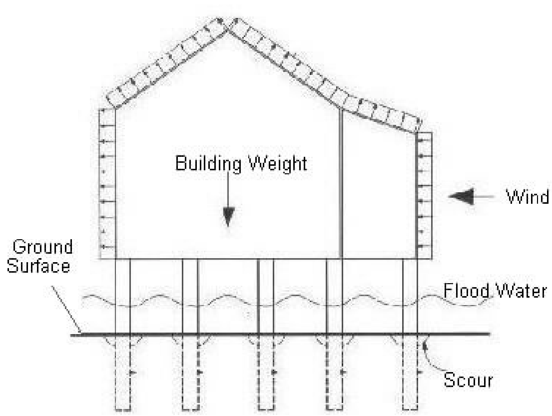


Figure 7 Elevated Structure on Pile Foundation

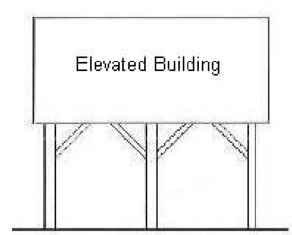


Figure 8 Knee Bracing

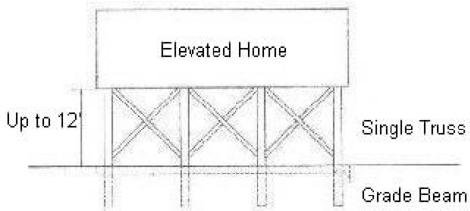


Figure 9 Truss Bracing

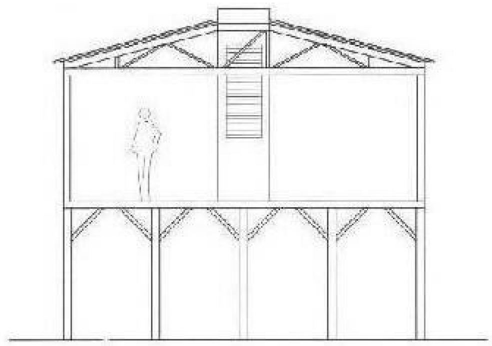


Figure 10 Elevated "Cyclonic" Home

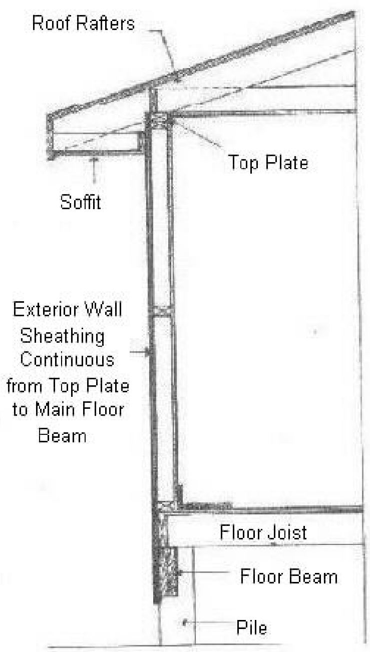


Figure 11 Wall Sheathing
After FEMA, Coastal Construction Manual

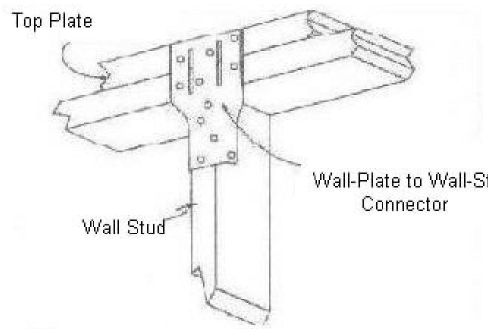


Figure 12 Top Wall-Plate to Wall-Stud Connection
After FEMA, Coastal Construction Manual (2000)

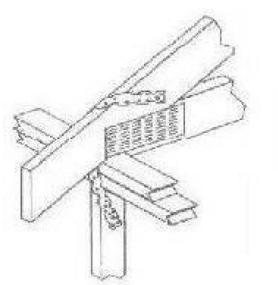


Figure 13 Example of a Roof Framing to Wall Connection Using Metal Connectors
After FEMA, Coastal Construction Manual (2000)

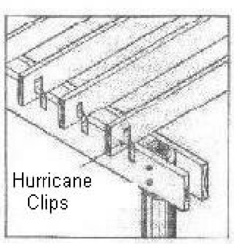


Figure 14 Mechanical Fasteners (Hurricane Clips) between Beams and Joists
After FEMA, Coastal Construction Manual

6.1- Foundations

In hurricane prone areas, foundations are at risk from wind forces, and from loads due to hurricane-driven water, flooding, wave action and water-borne debris. Wave action can scour support from beneath a foundation. For the cyclonic home in this study, wood piles are suggested for the foundation system (Figures 7 & 10). Piles could be driven or water-jetted. Driven piles offer a higher pullout resistance. Two types of wood piles are generally used: square timbers or tapered round timber piles. The most common sizes of square timbers are 10-in. and 8-in.(25.4 and 20.3 cm) square rough sawn lumber. The minimum required in coastal high hazard areas is the 8-in (20.3 cm) size. Piles should be embedded well below the scour depth. Horizontal bracing or grade beams could be used for additional pile resistance. The use of grade beams is sometimes criticized by engineers, as it may lead to increased wave action and scour around the foundation. In order to resist lateral loads, piles must be braced. FEMA recommends the use of diagonal bracing or knee braces (Fig. 8) for homes elevated less than 8 to 10 ft (2.4 to 3 m). Truss bracing (Fig. 9) is recommended for higher elevations or a wind speed of 100 mph (161 km/h) or more [9].

6.2 - Main Framing System

1- Floor Framing

For this relatively small cyclonic home, sawn lumber beams are suggested such as 4x10 or 4x12 (10.2cm x 25.5cm, or 10.2cm x 30.5cm - nominal size). Built-up members could also be used such as: two 2x10's (5.1cm x 25.4cm) or two 2x12's (5.1cm x 30.5cm). For longer spans, glulam members could be used. It is recommended to span the primary floor beams in the direction parallel to the flow for better protection from storm water forces and floating debris. Beams must also be treated with chemicals to protect them from decay and the effects of salt air and water. Splices should be located directly over supports. Joists could be sawn lumber members or wooden I-joists. Cross-bridging of all floor joists is generally recommended for floors of elevated homes.

2- Subflooring

Plywood is typically used and is suggested in this case. Guidelines for its use are given in the "Plywood Construction Manual" by the Engineered Wood Association (American Plywood Association). Under these humid conditions, the adhesive between layers must be exterior glue. Subflooring is usually nailed to the joists. In this case, the use of deformed shank nails is recommended for a higher pullout resistance.

3- Wall Framing

Common wood wall studs are suggested such as 2x4 studs (5.1cm x 10.2cm), or in some cases 2x6 studs (5.1cm x 15.2cm) spaced at 16"o.c.(40.6 cm). Special attention must be given to wall bracing, sheathing and nailing. Walls must be placed above solid support such as a beam. Connections to the floor above and below must be firm. Plywood could be used for sheathing of exterior walls, which could also constitute a method of wall bracing, providing a resistance against the effects of lateral loads. In this case, sheathing should span the height from joists to top plate, covering the bottom plate, floor joist and the top wall plate (Figure 11). Another method of wall bracing is the diagonal bracing of studs. The use of exterior glue and deformed shank nails is recommended.

4- Roof Framing
As mentioned earlier, a hip roof is suggested for the cyclonic home because of its significant structural and
aerodynamic advantages compared to the gable roof. Details of the hip roof framing, and its advantages compared to a gable roof are discussed in a report currently being prepared by the author. The roof should be properly constructed and braced. Roof overhangs and porch roofs require careful detailing. Attention must also be given to the roof-wall connections. Trusses could be covered with plywood sheathing. Truss members are often made of 2x4's (5.1cm x 10.2cm) or 2x6's (5.1cm x 15.2cm). A spacing of 16" (40.6cm) or 24"o.c.(61cm) is typically used between trusses. In this case, a spacing of 16" (40.6cm) is suggested for a better framing and connection to the wall studs. The area near the central shaft opening in the roof requires some adjustment in the framing pattern.

5- Connections
There is an important difference between conventional connections in standard construction and connections in construction in high hazard hurricane prone areas, due to loads from high winds, flooding, wave action and floating debris. Connections using toe-nailing and anchor bolts are insufficient in this case. Toe-nailing is generally not acceptable, and fasteners must perform well under humid conditions. Galvanized bolts and metal straps are suggested. The load path in the structural system must be continuous. The most critical connections are: roof sheathing to roof framing, roof framing to exterior wall, top wall plate to wall studs, wall studs to window header, wall to floor framing, floor joist to floor beam, and floor beam to foundation (pile). FEMA's Coastal Construction Manual [9]
includes examples of recommended connections (Figures 12 to 14), and provides guidance to engineers and designers regarding the design and construction of connections.

6.3- Decks, Covered Porches and Stairways
Decks and attached structures often fail during hurricanes, therefore special attention must be devoted to their design and construction. A deck or covered porch for the cyclonic home should be structurally independent of the main home, and carefully attached to it. It should be also supported in a way similar to the main structure. The deck could be cantilevered from the main structure, if its dimensions are appropriate. It is important to prevent the entry of wind-driven water by lowering the deck surface, or by following special flashing techniques. Porch roof treatment systems could be included as described earlier. Stairs move and get disconnected from the main structure under flood loads, presenting the risk of becoming the source of debris. Open-riser stairs must be used to allow the flow of water, and stringers must be anchored to a pile, and driven to a sufficient depth to prevent scour. The use of the retractable type of stairs is also possible.

6.4- Building Envelope and Breakaway Walls
1- Breakaway Walls
In certain high risk areas, both The International Building Code (IBC 2000) and The Residential Building Code (IRC 2000) require elevating buildings on an open foundation. Obstructions below elevated buildings are prohibited, but enclosures are permitted to allow for a limited use of

the space below the elevated structure, provided that they are designed to fail under specific lateral loads (wind and water). Walls designed to fail under certain loads are referred to as breakaway walls. The construction of strong walls is prohibited because they would allow excessive scour and damaging wave runup during storms.

To enclose the space beneath the elevated cyclonic home, metal or synthetic screening, wood or plastic lattice or solid breakaway walls could be used. To construct the breakaway walls, wood studs are suggested. Studs are typically 2x4's (5.1cm x 10.2cm) and are usually attached to top and bottom nailer plates which are in turn attached to permanent top and bottom plates nailed to the floor beam and grade beam. The wall is designed to fail at the connection to the permanent plate due to nails that are sized and spaced for a required lateral capacity.

2- Building Envelope

The most important risk in the performance of the building envelope is from breaching (loss of roof covering and windows), and subsequent water infiltration. A damaged envelope also becomes a source of windborne missiles. The following guidelines could be applied to the envelope design of the cyclonic home.

If the home is near the ocean, then sheathing of the underside of the bottom floor joists is recommended [9], to protect the insulation from water effects and to reduce the risk of corrosion of connectors and fasteners. For satisfactory performance of the exterior walls in hurricane prone areas, proper attachment of siding and panel systems using a sufficient number of corrosion resistant fasteners is necessary. More blowoff problems were encountered with vinyl siding compared to other types of siding.

Regarding roof coverings, some systems perform better than others during hurricanes. Tile roofs as well as cement fiber systems are generally brittle and vulnerable to breakage from windborne missiles. The wind performance of metal panels and shingles varies. Few data is available on the wind resistance of slate, due to its limited use in the areas affected by hurricanes in the US. Field investigations showed that properly attached wood shingles and shakes can perform well. In this case, preservative treated wood is recommended. Liquid applied membranes are not common on the continental US, but are common in the US Virgin Islands, Puerto Rico and some other areas. Field investigations following hurricanes showed a good wind resistance of some of these systems. Specific guidelines for the use of asphalt shingles with self-seal tabs are provided in FEMA's Coastal Construction Manual. Proper application of fasteners and adequate underlayment design are important for a good performance.

Doors, windows, skylights and their assemblies must be strong enough to resist positive and negative wind pressures. Corrosion and water leakage problems could occur under hurricane conditions. FEMA recommends the use of aluminum or painted galvanized steel doors for locations within 3,000 ft (914 m) from the ocean. FEMA's Coastal Construction Manual also provides recommendations regarding the use of sealants. It is recommended that glazing be designed to resist windborne missiles or be protected by shutters. A variety of designs and materials are available for shutters from the Engineered Wood Association. Shutters could also be made of plywood panels or using 2x4 boards (5.1cm x 10.2cm).

8- Conclusion

It is important to improve our understanding of the complex wind effects on buildings and structures, and to apply research findings and our knowledge in this area to improve the quality of design and construction in order to better resist extreme winds and hurricanes. This research is a contribution toward these goals.

References:

1- Barnaud, G. , Berlianu, I.V., Mission du CSTB en Guadeloupe aprés le passage du cyclone Hugo (le 17 Septembre 1989). CSTB, Centre Scientifique et Technique du Bâtiment - Centre de Recherche de Nantes (PSL/S.89?IVB - EN-ECA 89-13 L).

2- Davenport, A.G., Stathopolous, T., Surry, D., A Simplified Model of Wind Pressure Coefficients for Low-Rise Buildings, in Proceedings ICOSSAR'85, 1985.

3- Gandemer, J., Helary-Moreau, S., Wind Loads and Architectural Design - Application to Tropical Cyclonic Dwelling, " Wind Engineering into the 21st Century", Proceedings of theTenth International Conference on Wind Engineering, Copenhagen, Denmark, June 21-24, 1999, (Larsen , Larose & Livesey, editors), A.A. Balkema, Rotterdam, Brookfield, 1999.

4- Ginger J.D., Kane R., and Henderson D.J., Wind Loads on Hip End Roofs, 8th AWES Workshop, Perth, Australia, February, 2000.

5- Hélary-Moreau, S., Caractérisation et développements aérodynamiques de l'éspace intermédiaire en climat tropical humide: Conception d'une architecture de confort adaptée à la contrainte cyclonique. Thèse de Doctorat, Université de Nantes / Ecole d'Architecture de Nantes, Octobre 1999.

6- Hessig, M.L., A Wind Tunnel Study of Roof Loads on Common Residential Structures. Master's Thesis, Clemson University, 1986.

7- Holmes, J.D., Wind Pressure on Tropical Housing. Journal of Wind Engineering and Industrial Aerodynamics N0 53, 1994, pages 105-113.

8- FEMA, Federal Emergency Management Agency, Lessons of Hurricane Andrew. The 15th Annual National Hurricane Conference, April 13-16, 1993, Orlando, Florida. FEMA, Washington, D.C. 1993.

9- FEMA, Coastal Construction Manual, Third Edition, June 2000.

10- Meecham, D., Wind Action on Hip and Gable Roofs.Master's Thesis, University of Western Ontario, Canada, 1988.

11- Reardon, G. F. and Xu Y.L., Effects of Roof Slope on Wind Pressures of a Hip Roof. Proceedings of the 4th Asia-Pacific Symposium on Wind Engineering. Gold Coast, 1997. Pages 147-150.

12- Rojahn, C., Preliminary Assessment of Damage to Engineered Structures Caused by Hurricane Andrew in Florida. Natural Hazard Quick Response Research Report 55, Natural Hazard Research and Applications Information Center, Boulder, Col., 1993, 11 pages.

13- Stathopolous, T., Turbulent Wind Action on Low Rise Buildings. Ph.D. Thesis, University of Western Ontario, 1979.

14- Taher, R., General Analysis of Damages Caused to Structures by High Winds and Hurricanes.Research Report 1, New Jersey School of Architecture, New Jersey Institute of Technology, in Cooperation with CSTB, Centre Scientifique et Technique du Bâtiment (Center for Building Science and Technology- France), 2001.

15- Taher, R., Designing for High Winds and Hurricanes: General Analysis of Architecture Related Wind Engineering Principles and Research - Concept of a "Cyclonic" Home, New Jersey School of Architecture, NJIT, in Cooperation with CSTB, Centre Scientifique et technique du Bâtiment, France, 2001.

The Structural Origins of Form: A Digital Approach to Investigate form

Shahin VASSIGH, Assistant Professor
School of Architecture and Planning
State University of New York at Buffalo
vassigh@ap.buffalo.edu

Abstract:
The origins of modern form in architecture engages many significant issues such as philosophical and ideological discourse, social/cultural issues, symbolic intents, construction tectonics, and structural logic. Although all these issues can be equally significant in many situations the following paper will focus on the "structural logic of form" and will introduce a method to investigate and analyze form in relation to structures using advanced media. Specifically this paper will focus on introducing an alternative teaching tool, which aims to increase students' understanding of the structures and enhancing their interest in the expression of form through creative and innovative use of structures.

The paper will present a small aspect of a much broader project, which is supported by the Fund for the Improvement of Postsecondary Education, a program of the U.S. Department of Education involving faculty at various Institutions. The funding is used to develop a teaching tool that utilizes a wide range of digital and graphic technology including detailed and realistic three-dimensional computer generated models and animations to communicate the basic structural principles in relation to form development. The strong visual approach used in the development of this tool, also provides an intuitive understanding supported by experiencing the structural behavior and engaging the students with the consequences of architectural form selection.

Typically, studying the variation of forces and moments in a structural member is a critical component of teaching structures. In most traditional teaching methods, this is achieved through numerical exercises, which involve longhand calculations of the internal forces and moments, followed by plotting shear and moment diagrams that indicate the critical stress areas and values. The final stage of this exercise is the design of the structural member. Although this is a very important exercise in analyzing structural behavior, most often it does not go beyond a quantitative exercise, does not foster an intuitive understanding of structures and remains detached from any exploration of form. However, this exercise could be significantly improved if the relationship of the structural forces, moment diagram, and deflection mechanism of a structure or structural member were to be explored simultaneously in relationship to form generation.

This teaching tool provides an option to view the loading, deflection mechanism and dynamic behavior of structures under the application of loads. Visualizing the structural deformation at key locations such as mid-spans, connections to other members, and anchorage to the foundation can demonstrate how the form can be a direct derivation of the structural logic.

The paper will present progress in development of this teaching tool through analysis of several structural principles used in the work of Santiago Calatrava and Norman Foster.

The Structural Origins of Form: A Digital Approach to Investigate Form
Shahin Vassigh

Introduction

The design of architectural form is the product of the investigation of a number of issues, including philosophical and ideological approaches to architecture, social and cultural issues, symbolic intent, construction tectonics, and structural logic. Although all of these issue areas are significant in the design process, structural behavior, or "structural logic of form," has been used by modern architects to produce entirely new and aesthetically appealing architecture.

This paper introduces a new method to investigate and analyze form in relation to structures using digital media, and more importantly, show that digital media technology can be used to produce an alternative teaching tool that increases students' understanding of, and interest in, structures. These new tools provide opportunities for students to apply structural principals to their design work, ultimately fostering innovative structural design and more creative expressions of architectural form.

Under a project supported by the U.S. Department of Education *Fund for the Improvement of Postsecondary Education* (FIPSE), State University of New York at Buffalo faculty are developing the *Structures E-Book — a* teaching tool that utilizes a wide range of digital and graphic technologies including detailed and realistic three-dimensional computer generated models and animation to teach basic structural principles. The visual approach used in the development of this tool also provides an intuitive understanding supported by experiencing structural behavior and engaging the students with the consequences of architectural form selection.

Typically, studying the variation of forces and moments in a structural member is a critical component of teaching structures. In most traditional teaching methods, this is achieved through numerical exercises that involve longhand calculations of the internal forces and moments, followed by plotting shear and moment diagrams that indicate the critical stress areas and values. The final stage of this exercise is the design of the structural member. Although this is a very important exercise in analyzing structural behavior, most often it does not go beyond quantitative exercises or foster an intuitive understanding of structures, consequently remaining detached from any exploration of form. However, this exercise could be significantly improved if the relationship of the structural forces, moment diagrams, and deflection mechanisms of a structure or structural member were to be explored simultaneously in relationship to form design.

In addition to providing extensive structures instruction, the Structures E-Book provides functions to view the loading, deflection mechanism and dynamic behavior of a limited number of building structures under the application of loads. Visualizing structural deformation at key locations such as mid-spans, connections to other members, and anchorage to the foundation can demonstrate how form can be a direct derivation from structural logic.

The following examples from the Structures E-Book shows how digital tools facilitate an understanding of how common structural members such as beams, columns, frames and arches can be turned into expressive structural forms through knowledge of their behavior. Using the work of Santiago Calatrava and Norman Foster, the E-Book explores and demonstrates the relationship of structural analysis to the development of innovative architectural form.

Arch profile: Orient Station, Lisbon, Portugal, 1998, Santiago Calatrava

The construction of the Orient Transportation Hub is as a great demonstration of a successful approach to integration of structure and form. Calatrava's use of innovative structural elements coupled with expressive architectural gestures shows how structural principles could be interpreted and used to arrive at form.

The Orient Station includes standard rail services, a tram and metro network and several bus terminals. Calatrava was successful in obtaining the project through his winning entry in an international competition called by the Expo' 98 World organizing body in 1993[1].

Calatrava proposed to place the station platforms on a bridge structure composed of 10 rows of reinforced concrete arches creating a two-level park and ride facility. The design scheme also called for large-scale steel and glass canopies that covered the bus platform located on the ground level. The roof canopies of the bus station were to rise five meters above ground level to cover the elevated entrance gallery of the station. Calatrava's proposal was accepted and construction of the station was completed in 1998.

Figure 1 shows images of a computer-generated model that was prepared to highlight the structural features of the building. All images in figure 1-a are selected frames of an animation that provide a general view of the structure supporting the station platforms. Figure 1-b is a front view of the arch structure. The deep section of the arch on two sides of its central axis suggests that higher stresses are present at those locations and the structure must have more mass and stiffness to resist them. The arch profile tapers off toward the center and the base suggesting lower bending stresses. Figure 1-b also shows the moment diagram for a three-hinged arch transposed on the model. The moment diagram profile and the arch form are closely matched. The location of maximum moment and the deepest concrete section are the same. In addition, the zero moment location at the center of the arch and at the supports corresponds to the smallest cross sectional area of the arch.

The images in Figure 2 relate to the canopy structure covering the bus terminal. They demonstrate how the form of the canopy's support structure is interpreted as a direct reflection of the moment diagram. Figure 2-b shows a simply supported beam with overhangs at both ends. The lower image of the figure illustrates the moment diagram for the beam subjected to uniform loading. The moment diagram is also placed directly on the canopy's steel support. The series of images demonstrate how the tapering form of the steel structure follows the intensity of bending moment as drawn on the moment diagram.

---

[1] Anthony Tischhauser and Stanislaus Von Moos, Calatrava-Public Buildings, Birkahauser, Basel, Switzerland 1998, p.99

Rigid Frame: Lyons Airport Railway Station, France 1994, Santinago Calatrava

The Lyon Railway Station is a landmark building for the City of Lyon. The building structure is composed of two parts; a station hall placed over the train tracks supported by tapering steel beams and roof platforms supported by a concrete structure that covers over 500 meters of railways.[2]

Figure 3-a and 3-b are images of a computer-generated model showing interior space of the structure supporting the roof platform. Image 3-a has a moment diagram of a rigid frame under lateral loads transposed on the top. Figure 3-b and 3-c show the defection diagrams of the frame. As evident in the images, the frame has its maximum mass at the corners where the moment is maximum and where the deflection curve changes its direction. The frame tapers towards the connections at the base where the bending moment is zero.

Center, Wiltshire, 1983, Norman Foster and Associates

The Renault Center is a car manufacturing facility. In order to accommodate change and future growth, Foster and Associates selected a square modular building system that could be expanded and assembled in a variety of configurations. The structure of the unit module is a steel frame with four pre-stressed masts located at each corner and tapered arched beams supporting the roof. The masts are composed of circular steel tubing that is tensioned by steel rods. The roof beams are continuous elements, which are supported on the top by the steel masts at quarter points. Each side of the square module is about 80 feet long and the column masts rise to a maximum height of 53 feet[3]. There are 42 modules constructed in the first stage of construction.[4]

The images in Figure 4-a, 4-b and 4-c show the structural module and the load distribution path to the four columns located on the corners. The corner columns are laterally supported by perforated steel members that connect to the top and bottom of the column with cables. The perforated steel bracing and the cables act together to reduce the buckling length of the column thus allowing the column to extend much higher. Although this lateral bracing system primarily has structural function, it creates expressive elements that create undistinguishable form.

Figure 4-e shows three frames of the animation showing the buckling or deflection of the column without the lateral bracing system and how the addition of the bracing stabilizes the column. Figure 4-f shows other possible profiles and column forms that enhance the column performance.

---

[2] Alexander Tzonis, Santiago Calatrava: The poetics of movement, Universe publishing, NY, New York, 1999, p.156

[3] Chris Abel, Modern Architecture in the Second Machine Age-The Work of Norman Foster, Architecture and Urbanism, 1988, pp.170

[4] Foster and Associates, Norman Foster, International Academy of Architecture Varese, Italy,, 1991, p.95

Freestanding Structure: Rennes viaduct, Rennes France, 1992, Norman Foster and Associate.

This project is a design for an elevated inner city viaduct transit system. One of the critical design considerations was to devise a light structural system that imposed minimal intrusion to the fabric of the city. The proposed design was a structure consisting of tall steel pylons that hold up the pre-cast concrete deck units by suspension cables. The deck units are connected to the pylons by rigid connecting elements that act as cantilevered beams extending out from the pylon. The structure extends over 2000 meters.[5]

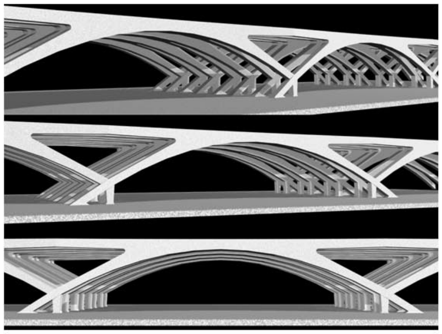
When observing the form of the steel pylons, it is evident they are designed to withstand lateral loads. As the bending moment produced by wind load accumulates toward the base of the pylon, the pylon profile becomes larger to provide adequate stiffness for resisting stresses. The tapered form of the precast deck units are a response to the gravity loads. Larger stiffness is required at the fixed end of the deck to support the weight of the entire deck.

Figure 5 uses three frames of the animated model to demonstrate these concepts. The first frame, figure 5-a shows the overall structure and identifies the various structural members; Figure 5-b superimposes the moment diagram of a pylon for lateral load. The last frame of the animation focuses on the form of the pre-cast deck units. The corresponding moment diagram of the deck is drawn for two cantilever beams thus clarifying the formal relationship.

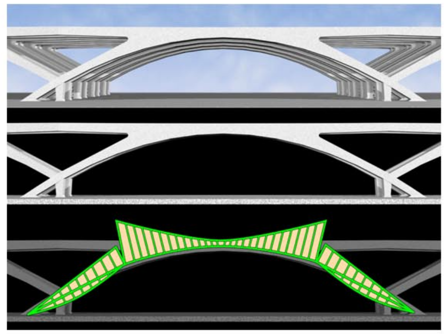
Closing Remarks

The possibilities for using digital modeling to effectively teach and investigate structural concepts used in architectural design are encouraging. Use of the E-Book so far have shown that the use of digital models and highly visual graphics as an alternative instructional delivery system can better meet the needs and capabilities of architecture students and improve their understanding of the subject matter. While digital technology is by no means a panacea for the difficulties in learning how form and structure can be integral parts of the design process, it can be an effective teaching tool. Further work on the project is aimed at expanding the library of architectural case studies and providing interactive characteristics to the computer-generated models.

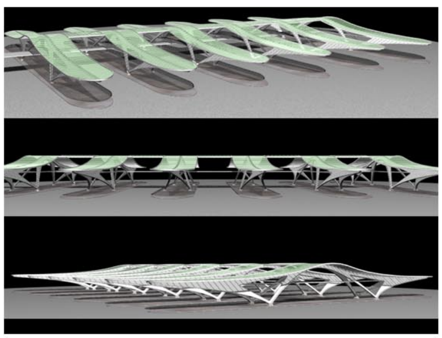
[5] Norman Foster, Architectural Monographs No. 20: Foster Associates Recent Works, Academy Editions, London, 1992,



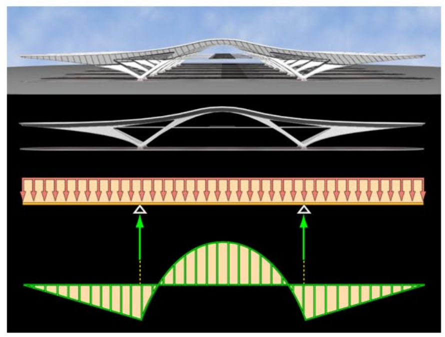
1-a



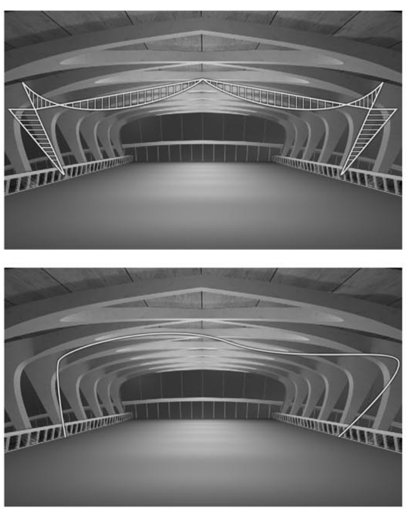
1-b



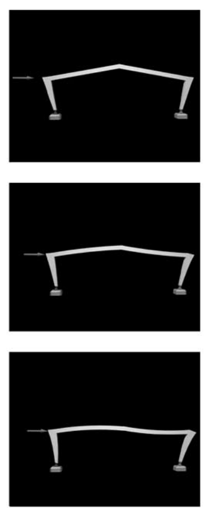
2-a



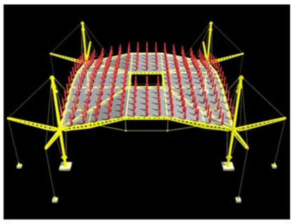
2-b



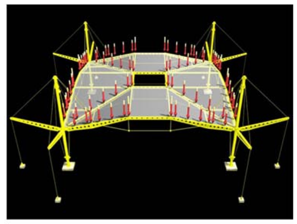
3-a & b



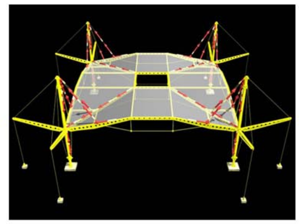
3-c



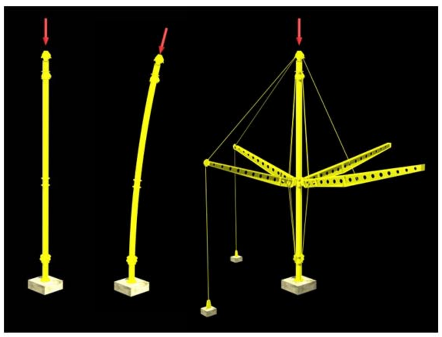
4-a



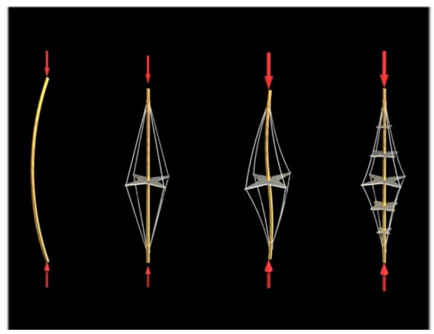
4-b



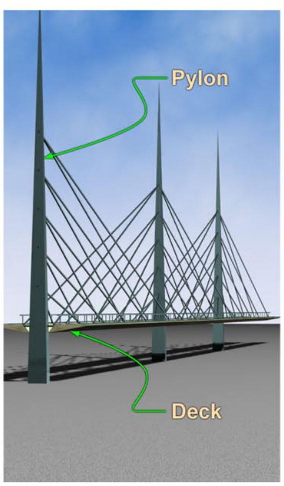
4-c



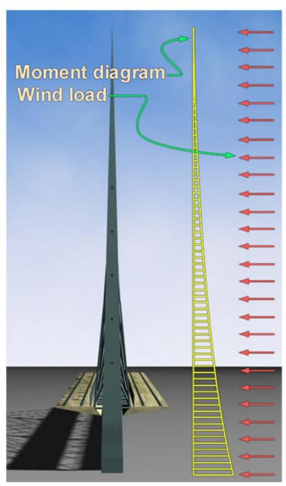
4-e



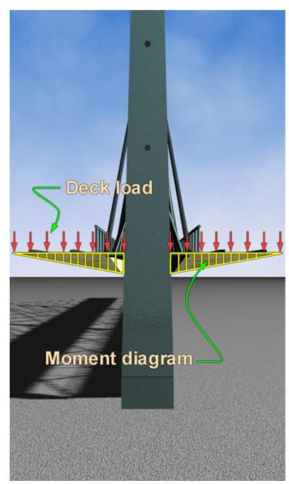
4-f



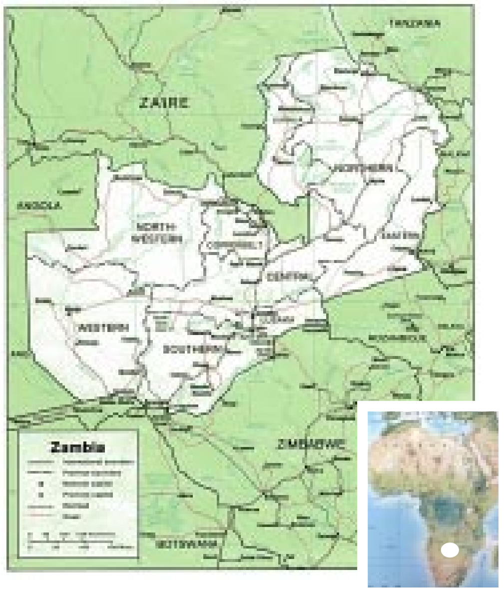
5-a



5-b



5-c



Tamara's House[i]:
Research into a [hi]Story of African Dwelling

Prof. Yvan-pier Cazabon

ARCC/EAAE Conference Montreal, May 2002

Introduction

> *"The problem is this: mankind as a whole is on the brink of a single world civilisation representing at once a gigantic progress for everyone and an overwhelming task of survival and adapting our cultural heritage to this new setting. To some extent, and in varying ways, everyone experiences the tension between the necessity for the free access to progress and, on the other hand, the exigency of safeguarding our heritage"[ii].*

Along with the present pressures of globalisation numerous developing/recovering African nations are struggling with the remnants of a recent release from colonial occupation. In the case of Zambia in southern Africa after a successful (and bloodless) revolution (1962), this struggle includes an attempt to secure political and economic self-determination along with reviving a fragmented cultural identity. The term "recovering nation" is perhaps more appropriate to Zambia's situation than the more commonly used term "developing nation". With the later comes the biased perception of incremental progress and gradual accumulation of techniques, tools, and knowledge whether applied to politics, economics or science and engineering. Following Paul Ricoeur's assessment of the conflict between universal development pressures and the need to re-establish cultural identity, I would propose that Zambia as a recovering nation defines her identity from the deepest roots of cultural history. One example of this rooted stance is demonstrated by the co-existence of seventy-two tribal languages officially recognised by Zambia's constitution (English being one of them). This is not to say that Zambia, as she lays claim to her cultural origins, does not recognise the necessity of access to an international modern civilisation. In fact, Zambia's future depends on her ability to engage in a complete dialogue and exchange with the international community.

> *"Whence the paradox: on the one hand, [a society] has to root itself in the soil of its past, forge a national spirit, and unfurl this spiritual and cultural re-vindication before the colonialist's personality. But in order to take part in modern civilisation, it is necessary at the same time to take part in scientific, technical, and political rationality, something which very often requires the pure and simple abandon of a whole cultural past"[iii].*

The House as Human Right

Architects throughout the Northern Hemisphere are beginning to respond to an urgent call - to build millions of houses for communities lacking in the most basic of human comforts. Architecture in the context of international aid and development is seen as a generous act of helping less privileged societies attain a basic standard of living. From the point of view of international aid agencies this represents a significant part of the foundations of basic human rights which include health, education, freedom of speech, access to income, etc. Numerous architectural interventions however, while based on noble intentions, often present concepts and techniques foreign to the

cultures within which they operate. Inevitably, along with the architectural project comes the western (northern) bias of practise over theory driven by definitions of progress as cumulative betterment. Practical questions of technique and 'how-to' often override theoretical concerns of cultural perception, tradition and world-view. Herein a balance must be stricken. Development history is "littered with shelter interventions based on the wrong assumptions, i.e. that materials and approaches are what are important - they almost never are."[iv] More important issues revolve around land ownership and a sense of identity and stability. Also, it is all too often assumed that a shelter has the same function in different contexts. "John Turner (Ex Prime Minister of Canada) was right when he coined the phrase that 'housing is a verb', i.e. it's what it does for you (brings an income, provides a stake in the city, becomes an asset, etc.) that counts".

This is not to say that innovation in the *practise* of affordable housing has no merits. Architectural experiments going back to the 1960's and 70's raised international awareness on issues of ecology, traditional methods, indigenous materials along with promises of affordability through mass production and economy generating labour participation. The complexity of the problem lies in the adaptability of a given culture to a system which is applied from 'without' as opposed to possible engagements with a host country where systems are allowed to evolve from *within*.

> *"... throughout the world an equally universal way of living unfolds. This way of living is manifested by the unavoidable standardisation of housing and clothing. These phenomena derive from the fact that ways of living are themselves rationalised by techniques which concern not only production but also transportation, human relationships, comfort, leisure and news programming as well. ... There is a culture of consumption of world-wide dimensions, displaying a way of living which has a universal character"*[v].

International Non-Governmental Organisations (N.G.O.), such as *Habitat for Humanity*, *Builders Without Borders*, and *Food for the Poor*, are already making significant inroads in developing low-cost quality housing alternatives with improved design characteristics. Private-sector Canadian development firms also have highly developed programming and technical skills in this area. From a critical standpoint based on direct experience however, projects like these operate at a distance from the community's full potential. Standardised plans and community layouts using 'efficient' materials and methods make it possible for numerous shelters to sprout-up instantly while personalisation, family adaptation and specific programmatic needs are left wanting. More importantly, the potential of community based management to ensure the gradual evolution of houses and neighbourhoods along with culturally defined expression are rarely components within the design process. On the other hand, universal practises as defined by Ricoeur are 'good' because they promote the availability of elementary possessions to the masses of humanity. In his words, "no kind of criticism of techniques will be able to counterbalance the absolutely positive benefit of the freedom from want and of the massive access to comfort."[vi]

The House as Subject of Cultural Research

> *"... we should have to be prepared to conduct our research up to the stable images and the permanent dreams which make up a nation's cultural resources ... Images and symbols constitute what might be called the awakened dream of a historical group"*[vii].

In order to more thoroughly investigate the Africa housing crisis *CARE Canada* has initiated a working relationship with *Carleton University's School of Architecture* and the *CARE International* centre for urban development (*INSAKA* in Zambia). The primary objective of this collaboration is in researching and developing practical skills and knowledge that would contribute directly to the collective's competitive advantage in obtaining and implementing large-scale donor-funded urban housing projects. More importantly however, in seeking out an academic centre for its housing research, *CARE* anticipated a 'cultural exchange' that would reciprocally benefit both the host country and the research team. *CARE* representatives understood that students of architecture, our future international architects, could afford a more profound research extending beyond the 'real-life' limitations of normal architectural practise. 'In-the-field' investigations culminating in architectural proposals would benefit from a prolonged contact with Zambian communities with the likelihood of personal experiences with deeper meaning. Indeed, students were quick to observe the superficial evidence of internationalisation. Strewn amongst the fabric of a '*culture not their own*' the young architects could discern the all-too-familiar discarded remnants of a universal consumer society as they walked past the smouldering garbage heaps of plastic *Coca-Cola* bottles and package wrappers.

"A threat [to the great civilisations of the past] is expressed, among other disturbing effects, by the spreading before our eyes of a mediocre civilisation which is the absurd counterpart of elementary culture. Everywhere throughout the world, one finds the same bad movie, the same plastic or aluminium atrocities, the same twisting of language by propaganda, etc. It seems as if mankind, by approaching en mass a basic consumer culture, were also stopped en masse at a sub-cultural level"[viii].

But with a deeper, penetrating glance and intense inter-personal exchanges the research team would eventually begin to appreciate that below the superficial signs lay the creative nucleus of a traditional culture. This realisation would not be possible until the displaced Canadians entered the very fabric of everyday life in an attempt to decipher the hidden stories. After spending hours with individual families in their modest homes and conversing repeatedly with merchants and craftsmen in the local markets each and every student would return with unique fragments of a cultural puzzle.

"Yes I believe it is possible to understand those different from me by means of sympathy and imagination, just as I understand a character in a novel or at the theatre or a real friend who is different from me. Moreover, I understand without repeating, portray without reliving, make myself different while remaining myself. To be a man is to be capable of this projection into another centre of perspective".[ix]

The Structure of Exchange

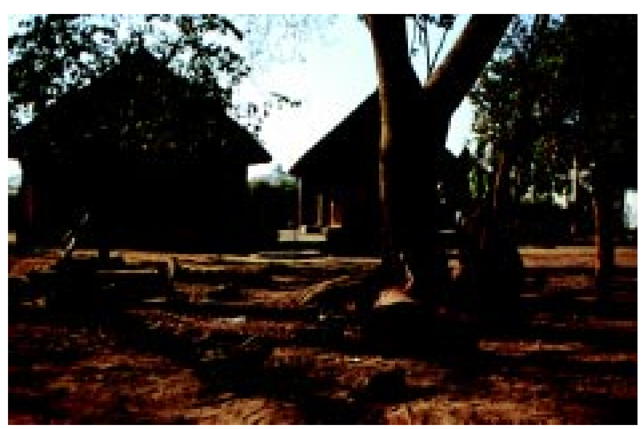
Students participating in the *Directed Studies Abroad* (DSA) program were enrolled in three required courses including a materials application workshop, a full design studio and a history/theory elective (culture). Distinct lines were not drawn between these courses. Instead, the research based program aimed at unifying the various modes of investigation in an attempt to deliver a wider range of critical output. Students were able to align their observations with multi-

ple input ranging from on-site interviews, presentations by local experts, drawing exercises, 1:1 material and methods experimentation, lectures in cultural studies and studio based design. While each course would ultimately revolve around similar issues, the mode of research and therefore the resulting assignments differed in scale, medium and focus. Each course included a survey/research component which took place in Zambia over a one month period, and was followed-up by design based assignments upon the group's return to Canada.

For the first four weeks of the term (while in Zambia) participants in this course ventured into the field of community work as defined by numerous national and international programs. This first phase was one of gathering and documentation as well as a research which required dialogue and the exchange of ideas with members of host communities. Students sought to know about the aspirations and the frustrations; the desires and the concerns of people who they met in the underprivileged neighbourhoods - in short, students engaged in the exchange of stories.

Etymologically, the words story and history have evolved from the same root - *historia* (L.). This is made evident in Latin based languages such as French and Italian wherein the same word, *histoire* and *historia*, are undifferentiated. While much has been discussed with respect to the role of History in the understanding of architectural theory and practise, this research aimed at shifting the focus to the source of meaning imbedded in a people's stories. The act of narrative story telling is a creative endeavour that bears two faces. Stories rely on a recollection of the past as well as a creative projection into the *very*-present (*present as lived*). Furthermore, in contrast to other modes of interpersonal exchange (such as music performance), storytelling oscillates between speaker and listener in a moment of observation/reflection/response. It is with this reciprocity in mind that the course structure for the Directed Studies was established. In addition, it became clear from the outset that the student group would experience urban Zambia in a near-nomadic way. With the exception of rudimentary sleeping accommodations, all participants made their homes within the fabric of Lusaka's urban settlements (compounds) and their inhabitants.

In lieu of a permanent studio space in Zambia, students were asked to create for themselves, a nomadic portable 'studio' and to continually evaluate and transform it during their stay in Zambia. All aspects of the *Studio* and *Workshop* courses including 'desk reviews', public presentations and seminars were conducted in full mobility. Further to this, the theme of 'storytelling as documentation' was set as the foundation to most



course exercises. This concept stems from the *Tjuringa* from the novel: *The Songlines* - by Bruce Chatwin. While Chatwin's book is based on observations made during travel in another continent (Australia's Outback), his observations on the importance of storytelling and dreaming were deemed appropriate to our adventures into the ancient cultures of Africa. The *Tjuringa*, an ancient Australian-Aboriginal object of recording, ensured the survival of cultural identity and ritual by engraving narrative content on a physical artefact. Similarly, the students' nomadic studio in effect became their personal *Tjuringa*. Its definition was to ensure that their experience in Zambia became a physical as well as a narrative record. More importantly, the reconciliation of our presence in what is a "*culture-not-our-own*" could only be made by the communication of our personal stories alongside the stories of the culture that welcomed us. The *Tjuringas* were conceived to promote this reconciliation and to give it an abstract physical form.

> *"The Tjuringa is usually an oval-ended plaque carved from stone or wood and covered with patterns which represent the wanderings of its owner's Dreamtime Ancestor"*[x]

Workshop

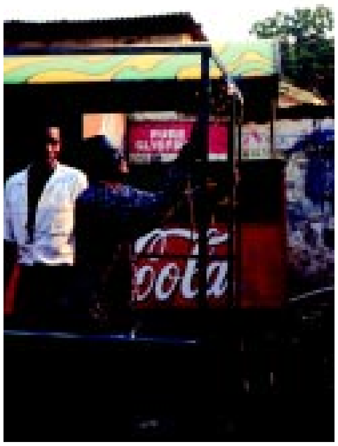
The Workshop course was concerned primarily with the teaching of the architect's fundamental tools: i.e. drawing (*drawing from*) and documenting the experience of a place. It was equally a drawing course and a course that focused on making. Both modes of representation were important components able to formalise the abstract and represent (*re*-present) the lived experience of new and foreign places. The architect's diary or sketchbook is often a juxtaposition of sketches, text and images which help to inform and recollect existing buildings, cities, landscapes and artefacts. In addition to this, through this workshop (and the studio that ran in parallel), additional media investigations were encouraged: i.e. sound samplings, music, photography, video, material investigations and constructions, and eventually - upon our return to Canada - computer based media. All of these were to support the ideas found in the *Tjuringa* - that layered traces of recording reflect the collage-narrative of the nomadic experience.

The Table/*Tjuringa*

The actual construction and development of the Table/*Tjuringa* was reviewed during the travel component of the workshop. In preparation for the table's design and construction, the Workshop projects ex-

plored issues of making, documenting and transportation. This was to include consideration for wear and tear, weight, weather, instructions for use, programmatic transformation, etc.

Every architect will express different preferences for tools, layout, materials, instruments, etc. It therefore became possible for each student to reflect carefully on the program for his/her portable workspace. This course asked of each student to speculate on the inter-relationships between program and architectonics, use and construction, by developing a program outline in narrative form while critically challenging conventions within the tradition of representation in architecture. The three parts to this project addressed separate yet similar issues all geared to an overall questions, namely: How does the place, the objects and the inten-



tions of making (process) affect the product and work of an architect? Can drawing conventions be challenged by questioning, not their 'style' but their 'making'? Does a re-interpreted drawing board lead to a re-interpreted drawing? The response to these questions (if not the answer) can most clearly be demonstrated by the personal and interpersonal qualities in each of the Table/*Tjuringas*. It is in the integrated 'logbooks' displaying sketches and text that personal intentions are best understood. Meanwhile the individual *Tjuringa* which incorporate all aspects of observation/reflection/response demonstrate the exchange between the students and the local trades who would help them resolve their personal constructions while giving insight into local traditions and contemporary craft.[xi]

> *"Unlike a set of tools which accumulates, sediments, and becomes deposited, a cultural tradition stays alive only if it constantly creates itself anew. Here we have two ways for mankind to pass through time: civilisation fosters a certain sense of time which is composed of accumulation and progress, whereas the way in which a nation develops its culture is based upon a law of fidelity and creation; a culture dies as soon as it is no longer renewed and recreated".*[xii]

After numerous iterations and critical 'renovations' the individual logbooks, now merged with the *Tjuringa* can be read, can be touched, and can be interpreted. The logbook/Table/*Tjuringa* are at once a studio space, a personal diary, a 'cabinet of curiosities', and a graphic novel with physical attributes.

The 'Drawing-From' Exercises

Both workshop assignments start from historical traditions and artefacts that have influenced architects and artists throughout the centuries. This was to enable students of architecture to 'ground' themselves in a tradition which they have inherited in order to more completely understand the potency of precedents that they are so eager to observe. These exercises were constructed as vehicles for the analysis and comprehension of historical representations in order to spring from their origins into contemporary speculations. One exercise examined medieval triptychs as a model for

the representation of a narrative (in space/place and time). The other, based on *Cubist* paintings, sought to complete the gathering of experience into its final form based on the song-lines of the *Tjuringa*; hence reinforcing the representation of space-time while reconciling the physical juxtaposition of numerous found conditions.

> *"Only a living culture, at once faithful to its origins and ready for creativity on the levels of art, literature, philosophy and spirituality, is capable of sustaining the encounter of other cultures - not merely capable of sustaining but also of giving meaning to that encounter... In order to confront a self other than one's own self, one must first have a self".*[xiii]

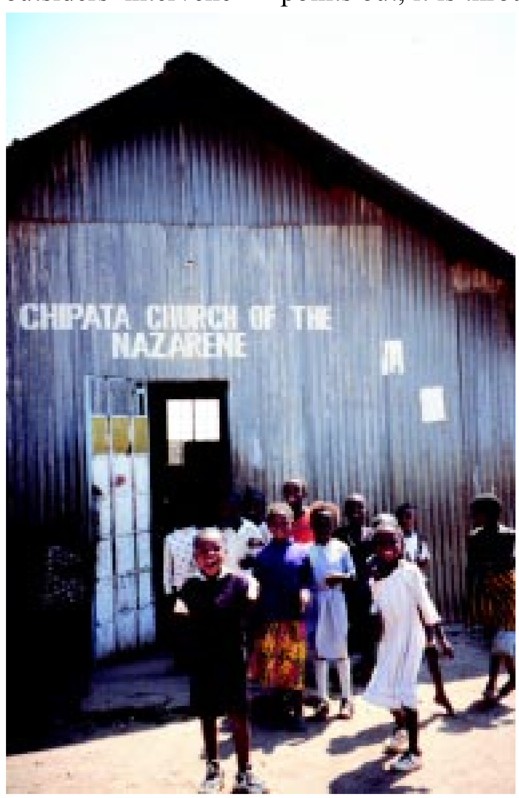
All courses in the DSA Zambia line-up (Theories Elective, Workshop elective and Studio) were conceived as inter-related and complimentary - the product of one influencing the outcome of the others. For this reason students were asked to formulate relationships between them to satisfy their personal interpretations of the course objectives.

Design Studio

The studio course, in direct parallel with the workshop component, was structured around the articulation of discovery through *Recording, Sampling and Replay* leading to a proposal for an architectural speculation in the city of Lusaka. The building pro-

posals, as outlined in the Studio assignments were *urban* interventions. While these are interventions of opposite scales (one is modest - a market vendor's stall, while the other is of a public/urban scale - neighbourhood and house design) they speak of similar issues and concerns. How does architecture respond to complex urban issues which have more to do with cultural anthropology and tradition than with issues of form? With this we find ourselves in a situation where our actions, whatever they are, demand of us ethical contemplation and ethical action. Furthermore, the very idea of urban intervention is put to question when we as outsiders 'intervene' upon a physical condition with hidden underlying orders.

"The phenomenon of universalisation, while being an advancement of mankind, at the same time constitutes a sort of subtle destruction, not only of traditional cultures, which might not be an irreparable wrong, but also of ... the creative nucleus of great civilisations and great cultures, that nucleus on the basis of which we interpret life, ... the ethical and mythical nucleus of mankind".[xiv]



History/Theory (Culture)

A significant portion of our involvement in Zambia revolved around the existing efforts of CARE Canada, CARE Zambia, Urban Insaka and other national and international groups. As part of our investigation into urban and peri-urban living conditions and our eventual proposals for housing we were introduced to relief efforts which are more structural (in a social sense) than physical. This is to admit at the outset that housing issues are not specifically architectural issues and rarely does architecture resolve the problematic of economic, political or social struggle. We can nonetheless hope that the process of community building and the direct involvement of a community in the process of architectural delineation can lead to the successful implementation of community structure - including buildings.

Our success in communicating with/to our hosts in Zambia, especially the communities which could most benefit from our input can best be measured by the 'documentation' of an *experience as lived* and the interpersonal communication of that experience. To witness from a distant stance can only lead to solipsism and a denial of the necessary reciprocity in the creative process of thoughtful-making. As Ricoeur points out, it is through an 'engaged creativity' that a culture survives as it continues to invest in its present. Our involvement in a reciprocal exchange was and continues to be crucial to a successful speculation.

In Canada

Upon our return to Ottawa, the Zambia group set up a studio bay devoted to the continued explorations of the Africa experience. In the Workshop component this meant a laboratory-like setting for materials and media exploration aiming at the 'complete' documentation of each participant's *story-line*. These experiments, in turn, were to supplement/compliment the *Tjuringa* whereby exercises took on the "pure and applied" aspects of construction projects as well as the more illusive qualities of interpretative narrative. From the experience in constructing the *Tjuringa* in Zambia completed with significant input from local crafts (wo)men, students had gained significant insight into the ever-evolving traditions of *making*. It is with this knowledge that the group set out to experiment with indigenous materials and traditional methods of construction. The specific location and program for the house proposals suggests that material application experiments and constructions were to consider the many facets of material inquiry including: Availability, structural integrity, workability, import vs. export potential, local construction means and conventions, technological adaptability - workmanship and appropriateness. In considering appropriateness, "design" issues in response to traditional and adapted ways of life figured prominently. These were derived from an open dialogue with the community in question.

In the Design Studio component, students were to propose a public Architecture by responding to their gathered research. The contents of their *Tjuringa* which now included notes, sketches, sound-bites, video, photographs and artefacts would suggest a point of departure in defining an architectural program which would develop a speculative architecture focusing on urban living and large-scale housing projects for *Chepata Compound*, Lusaka. In some instances and in response to individual research, community infrastructure (architectural) programs relating to health, culture and education (or hybrid versions of these) were encouraged.

The focus has been on developing demonstrated capacity to create affordable low-cost quality housing units and well-designed communities for the benefit of poorer urban families in countries faced with rapid urbanisation needs. While the central 'topic' of such research can be signified by the term 'housing', greater issues of urban development, urban anthropology, urban economics, employment generation, social and cultural contexts, materials development, housing and urban design, appropriate applications technology, community management, government relations, institutional and financial sustainability, cost structure, and potential donor interest also figure significantly.

Projects from the Design Studio were submitted using traditional and non-traditional representational techniques and depicted an elaborated architectural program (use) as well as a specification/speculation on eventual implementation (process). Each student was expected to propose an architectural program or a hybrid program of their own. While housing was the central focus of the studio, community infrastructure (architectural) programs relating to community, health, culture and education (or hybrid versions of these) were encouraged. The course pedagogy focused on research, observation, documentation, and especially process.

The long-term expectations of the *CARE Canada/Carleton University* partnership aim at the implementation of housing projects. At *Carleton University* Design/Build Studios have, for a number of years been structured such that students are encouraged to find alternative methods of design based on the context of the problem and with the most limited of means. While good solutions rarely come down to materials and methods, we remain optimistic that architectural solutions can be found from within the communities in which they are set. In this way architects and future architects can find their role as members of a community (universal or national) focused on the specific and inherent problems at hand.

"... [Cross-cultural] encounter has not yet taken place at the level of an authentic dialogue. That is why we are in a kind of lull in which we can no longer practise the dogmatism of a single truth and in which we are not yet capable of conquering the scepticism into which we have stepped. We are in a tunnel, at the twilight of dogmatism and the dawn of real dialogues".[xv]

Endnotes:

i Tamara's House is the working title of a program for affordable housing in Zambia, Africa signifying: "Toward a Modest, Appro priate, & Responsive African House" and was inspired by a young Zambian mother interviewed by architecture student Andrea Macecek. This housing project is a collaborative effort between Carleton University School of Architecture and CARE Canada begun in 2001.

ii Paul Ricoeur: "*Universal Civilizations and National Cultures*" in History and Truth; - p. 271.

iii. Ibid., p. 277.

iv. David Sanderson, CARE U.K.

v. Paul Ricoeur "*Universal Civilisation and National Cultures*" in History and Truth. - p. 274.

vi. Ibid., p. 275.

vii. Ibid., p. 280.

viii Ibid., p. 276.

ix Ibid., p. 274

x. Bruce Chatwin, The Songlines - p. 43.

xi. By 'local tradition' one will instantly make associations to the historical crafts of African wood and bone carvings, basket weav ing, fabric printing, drum making, etc. Today's Zambia displays a truly 'honest' creativity in the way that craftspeople transform dis carded materials such as wire, tin cans and plastics in the making of toys, functional objects and works of art.

xii. Paul Ricoeur "*Universal Civilisation and National Cultures*" in History and Truth. - p. 280-81.

xiii Ibid., p. 283.

xiv Ibid., p. 276.

xv. Ibid., p. 283.

Appendix

Country Description

Zambia is a southeastern African nation with five distinct topographical regions: the central highlands; the western plains, swamps and semiarid deserts; the Rift Valley of the Zambezi Lowlands; the Muchinga Uplands; and the swamps and lakes of the northeast. Despite progress in privatisa-tion and budget reform, Zambia's economy is struggling. With the drop in copper prices, Zambia's copper mining sector, which accounts for over 80 percent of the nation's foreign currency intake, is struggling. Meanwhile, inflation continues to be a serious concern. Adding to economic woes, many of Zambia's donors withdrew aid after political instability in the elections of 1996.

COUNTRY FACTS

Location: southern Africa
Climate: tropical
Population: 9,508,200
Economy: agriculture, brewing, cement, chemicals, mining (cobalt, copper, lead, zinc)
Government: republic
Religion: predominantly Christian with some Muslim/Hindu
Literacy: 72 percent
Language: English; 70 indigenous dialects

Community Description
The original capital city of Lusaka, in south central Zambia is home to approximately 300,000 people. Surrounding the city are numerous squatting neighbourhoods termed “compounds” with colourful names such as Kamwala, Freedom, Chiesa, Linda, etc. These dense communities, ranging from 30,000 to 80,000 souls add to Lusaka’s growing urban population of 1.3 million and have recently been included in the official delineation of Lusaka proper. For the purposes of our design exercise, Chipata Compound, located in the northwestern extension of the city, was selected as the site for our housing proposals. The CARE/Carleton Group had grown fond of this neighbourhood where they had witnessed evidence of gradual growth and increasing stability. Through their numerous interviews and social contacts, students had also made friends in this friendly and open community. The group recognised the potential for community involvement, labour and craft input as well as the visible desire for community betterment. Precedents for community building and housing initiatives were documented from numerous visits to surrounding compounds including “Linda” where the Africa Housing Fund proudly exhibits its housing program.

Family Unit Description - Program
The implementation of the housing prototype was conceived with urban implementation and community development in mind. This ‘house-type’, a construction of approximately 24 m2, was designed based on the basic programmatic needs of an extended family living in the high-density peri-urban area. In order to identify potential user families, students spent numerous hours in difficult conditions interviewing family members of the most diverse make-ups. A life of poverty and struggle is impacted by myriad social and economic factors. The search for work drives young Africans from their villages in search for work and a better life in the city creating a continuous influx into already crowded squatting neighbourhoods. High unemployment limits dreams of success and gradually affects a family’s earning potential and education access while squalid living conditions invite disease and health complications. A family member’s good fortune, as rare as this may be, promotes additional influx of families coming to benefit from their relative’s tenuous stability. The impact of HIV/AIDS especially has transformed the African family unit. It is not uncommon to meet a grandmother caring for 5 or 6 grandchildren whose parents have recently been taken by the disease. We met a great number of young adults who were caring for the children of their siblings along with their own all the while struggling to make a better life for their extended family. These harsh realities have a profound effect on what would be considered a straightforward house program. Hence, built into the exercise of program definition was the requirement for direct contact and an exchange by storytelling. With this direct contact, students could more readily focus their designs on a real clientele while pondering the necessary flexibility of architectural programming. The house therefore was to accommodate the most basic of a family’s needs while responding to cultural traditions, changing lifestyle and eventual physical or financial growth/change within the family unit.

Participants in
Carleton University DSA Zambia:

Sarah Lee
Andrea Macecek
Mariam Shaker
Sarah Colven
Ryan McLennan
Steve Kenyon
Matt Galvin
Yvan P. Cazabon
John Scoggan (CARE Canada)
Yannick Muriel Noah
Chris Davis
Dan Smith
Jin Feng

Building technologies, local resources and empowerment: A low cost housing project in East London, South Africa

Jean D'ARAGON
School of Architecture
McGill University
Jean.Daragon@mail.mcgill.ca

Abstract:
The poverty and housing problems of the black, coloured and Indian communities of South Africa did not disappear with the end of the apartheid era. Besides a housing backlog of 1,5 million and a demand for 220 000 new houses every year, South Africans are suffering from underdevelopment at economic and social levels. This situation is not disconnected with the recrudescence of violence that is happening now in South Africa. Besides the persistence of the tensions between the different groups inherited from the former regime, the poor seem to be weary of waiting for a fairest redistribution of the wealth that is too slow to happen.

Housing is only a part of the problems faced by developing countries. It should not be treated independently from the whole. The choice of a material, a technology is everything but innocent. It reflects political choices, values and cultures. In front of tremendous housing of developing countries, cost criteria often weight much in the balance. For that reason and in situation of emergency, project stakeholders often borrow models and technologies from overseas which are not suited to their new context. Beside not being adapted to the local climate and culture, these models often prevent the housing project to bring positive socio-economical impacts on the community.

This paper is about a low cost housing project in East London, South Africa. Through the introduction of the compressed earth block technology, the project succeeded to reintroduce the use of a traditional material, and to bring it into urban areas. In maximising the use of local (material and human) resources, the project aimed to use housing to be a lever for local development and to bring positive socio-economical impacts on the community and the less possible negative impacts on the local and global environment. By modernising the use of a material that could be found almost anywhere in the world and that shelters more than a third of the humanity, the project succeeded to valorise earth as a noble local material, helping the communities to reduce their dependency on external materials, components and technology.

The paper attempts to contribute to the development of local solutions to the universal housing problem rather than universal solutions to local housing problems. It also tries to present housing as a lever on which other local needs such as health, education and economy could find support to develop. It aims to propose economical solutions and building details that maximise the use of local (human and material) resources, that are simple enough to facilitate a technology transfer but not simplistic since it also wants to serve educational purposes. For these reasons, it tries to favour solutions that are respectful and correspond to the local know-how, and the cultural values of the communities that will benefit from such projects.

Building technologies, local resources and empowerment: A low cost housing project in East London, South Africa

**Note: Images are by the author unless otherwise indicated*

Duncan Village, East London – South Africa

Masonry training at the *C.C. Lloyd Community Centre*; Haven Hills South Housing Project, East London – Republic of South Africa

This paper is about a low cost housing project in East London, South Africa. Through the introduction of the Compressed Earth Block technology, the project successfully reintroduced the use of a traditional material in housing built in urban areas. By maximising the use of local (material and human) resources, the project aimed to use housing as a way of promoting local development and of bringing positive socio-economical changes to the community, while having a minimal negative impact on the local and global environment. By using earth, a substance that shelters more than a third of humanity, in the creation of modern buildings, the project introduced the notion of earth as a noble local material. This new perception of a humble and easily obtained building material is helping the communities to reduce their dependency on foreign and/or manufactured materials, components and technology. This project attempted to contribute to the search for local solutions to the universal housing problem, rather than looking for universal solutions to local housing problems. It also tried to demonstrate how housing, if well understood, could be a powerful agent in support of other local needs such as education, health and economy. It aimed to promote solutions that would maximise the use of local (human and material) resources. These solutions would be simple enough to facilitate a technology transfer while being rooted in a sound methodology that would serve educational purposes. For these reasons, it tried to favour solutions that are respectful and correspond to the local know-how and the cultural values of the community that will benefit from such project.

For most of their history of cohabitation with Whites, the Black, Coloured and Indian peoples of South Africa were prevented from directing their own destiny. Despite the optimism that followed the 1994 election, South Africa began a process of *healing* and *reconstruction* at many levels. The result of April 1994's first democratic election in South Africa was the beginning of an important challenge for the Black (75% of the overall South African population), Coloured (8,6%) and Indian (2,6%) peoples of the young Republic of South Africa.

In addition to the tremendous challenges facing these groups as a result of the lack of attention to education, health-care, water and sanitation, the provision of adequate housing is another cause of major concern for the new South African Government. The new administration inherited a deficit of 1.5 million houses from the former apartheid regime. Moreover, there is a demand for 220,000 new houses every year in order to meet the regular growth (2,26% annually) of the South African population of 42,5 million inhabitants; 66% of which are found in the cities and their peripheries. Approximately 61% of the urban households live in formal housing, or share formal housing with other families; an estimated 13.5% live in squatter housing nation-wide, and approximately 5.2% live in private sector, grey sector (privately owned hostels constructed on public sector land) and public sector hostel accommodation (Department of Housing White Paper, 95). The project was the result of an agreement between *the Van der Leigh Habitat Foundation* (VLH) from Amsterdam, *the East London Municipality* (ELM) and *CRATerre–EAG* (International Centre for Earth Construction-École d'Architecture de Grenoble) from France, establishing a Technology Transfer Program to pass on and disseminate the French earth building expertise to the local partners in East London.

East London is situated at the mouth of the Buffalo River and is the second most important city of the Eastern Cape, after Port Elisabeth. Its railroad links to King William's Town and Johannesburg recall East London's past as an important port city on the Indian Ocean. Sparsely populated at its founding in 1847, it served as a port for the imperial troops during the War of the Axe (1846-47). Today, the municipal area of East London has 560,000 inhabitants and its projected annual population growth of 5% could mainly be attributed to the migration from the Ciskei and Transkei, two former Xhosa homelands on the western and eastern sides of East London, respectively created in 1981 and 1976. The non-European population of East London, of whom 80% are Xhosa (and include Nelson Mandela and Thabo Mbeki the two first presidents of the new democracy), is highly politicised. It is not surprising to learn that East London was involved in the first battles against apartheid. As the *Central Business District* (CBD) of East London deteriorates, newer, more profitable buildings and developments spring up in the inland outskirts. It is in this protected environment that the White population and the new Black bourgeoisie live. They are shielded from the extreme poverty that is so evident in the downtown area, where *hawkers* (informal itinerant dealers) travel in from the townships and giving life to the sidewalks.

Although there have been some improvements in the lives of East London residents, only 2/3 of the town's active workforce of East London is employed. Of this group, 16% find work in the informal sector. In 1997, the need for houses among all residents, including those in the informal settlements, rose to an estimated 30,000 (Makalima, 97). Other, more realistic reports which counted other forms of informal housing such as rented rooms and *back yard shacks* (informal dwellings in the grounds of a house, for which residents pay rent to the landowner), revaluated the 2002 housing need as 50,000 (City of East London, 98a). It was found that as many as 30% of the households in the periphery of East London do not have a legal title of ownership. The downtown and industrial sector areas are overcrowded and even the urban cemeteries are often occupied by illegal settlements. The local authorities are very tolerant of these temporary housing arrangements, particularly since the formal housing delivery process is not able to make up for the existing housing backlog or even to contain the growing demand.

The new South African housing policies are unable to produce unanimity among the Black, Coloured and Indian populations because each group sees itself as a loser to the others groups. The dimensions and the quality of the subsidised houses are, however, no longer related to the race, but to the income of the beneficiaries. The unfortunate perception of each group as being less favoured than the others works directly in opposition to the new government's objectives of reducing animosity among the groups. The groups who are being slowly integrated in the townships return to their own racial groups to denounce and fight the new measures. The attempt to achieve equality would mean that everyone, regardless of race or ethnic background would be entitled to a small starter house measuring between 15 and 25 square metres. For Coloured people, the subsidised housing would be smaller than the size allocated during the former regime. The Black people, on the other hand, were offered a bare minimum of housing space (so-called Sites and Services), and facilities that amounted to no more than a toilet and a tap. This group is understandably, upset to have been denied the privileges enjoyed by the Coloured people during the apartheid years.

East London is certainly one of the most dynamic regions applying the *Reconstruction and Development Program* known as RDP (ANC, 94). As one of the poorest regions of South Africa, East London is one of the RDP's priorities. Although many housing projects have been implemented in order to provide better housing conditions to people living in the townships of East London and its surrounding area, most of them never addressed the quality of the space in architectural and in urban terms. The architects seem to have been ejected from the design process long ago by the engineers who often see the housing part of such projects as a by-product of the infrastructures to be built. It is not uncommon for infrastructure costs to count for more than 50% of the overall budget for such projects. Also, it seems that every increase in cost translates into smaller, inferior quality housing, while the scale of the infrastructure costs are never questioned. This situation reflects the fact that, for many years, the living conditions of South Africa's poor were looked at in terms of what was the minimum that could be provided—the existence of the [1]*hostels* being a testimony of that period.

In South African urban areas like East London, subsidised houses are most commonly made of concrete blocks. For the beneficiaries this modular industrialised building material represents a high level of development. It reassures the dwellers that they have made a successful transition from their country homesteads to the city. It tells them that they have completed the journey from the rondavel (*rontawuli*) – a thatched cone-on-cylinder hut built of adobe (sun-dried mud bricks), wattle-and-daub, sod or stone, depending on the region – to the shanties made of discarded materials, and finally to a government subsidised starter house made of concrete blocks roofed with galvanised metal or asbestos sheets. Despite the diminished levels of insulation and comfort compared to the thatched, round huts they built in the country, the residents are proud of their new town dwellings and the important image of success that it carries. The stark contrast between the humble local material that is well-suited to the climate, and the poor quality concrete blocks with their inferior masonry and plaster-work, is of no consequence to the newly-settled town dwellers.

The fascination for cement and maintenance-free concrete premises does not in itself account for the lack of critical awareness of the bad workmanship by the residents. A gradual erosion of traditional building know-how that is particularly prevalent in South Africa since apartheid, has undoubtedly contributed to this attitude.

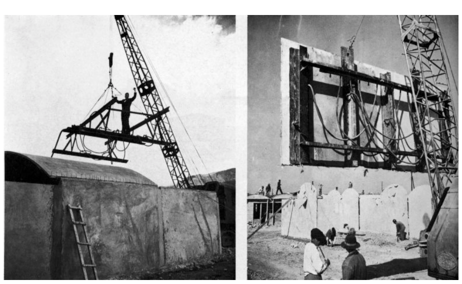
[1] The importance of the *hostels* in the South Africa's history is undeniable. These huge dormitories where migrant workers were living away from their families for most of the year appear as sad witnesses of the apartheid era. They are partly responsible for the rejection of the row housing schemes and other forms of densification by the population who claim the right to live in a house in the middle of plot. Today, it is not without problems and indignation from the population that the South African Government is trying to rehabilitate these buildings, even in imaginative ways, to turn them into family housing or rooming houses, offering the poorest alternative shared housing accommodations.

The deteriorating condition of the existing housing stock in the country villages illustrates how, even when traditional houses are constructed knowledge of traditional building methods is no longer taken for granted. An example can be seen in the straw roofs that used to last seven to ten years, but due to inferior workmanship, will now only last approximately two years.

Sometimes new and foreign materials add more confusion and even danger, when mixed with existing local ones. Even in the country it is not unusual to find peasants making adobe to build their houses as they have for generations, but using cement as a stabilising agent for the raw clay bricks, which are allowed to dry in the sun. Of course, one could argue that these details are not so important in view of the tremendous housing needs faced by these groups. There are, however, serious safety issues and this method of building sometimes has disastrous consequences. When the materials and their inherent techniques are incompatible, it is possible to cause as much damage as an earthquake. It is difficult to convince the builders of this, however, because they believe that cement will add strength to the structure.

This situation is not only restricted to South Africa. In many developing countries the vanishing of traditional know-how—the process of cultural loss—began a long time ago with the arrival of the first missionaries who "regarded the abandonment of traditional economic practices and material culture, including architecture, as a visible signifier of conversions, and strove to promote it" (Japha, 97: 8).
Previous identification and feasibility studies took into consideration the availability of materials and the specific local needs of this urban context. Noting the moderate level of industrialization and the very high rate of unemployment, it was found that the Compressed Earth Block (CEB) technology was the most suitable for East London because it was believed that the CEB would respond the best to the common objectives of the three groups (Garnier, 97).

The critically high level of housing need has forced governments to seek external, technical and financial assistance to help them develop and implement housing programs. Although most politicians know that lack of housing is never an isolated problem, their craving for keeping the power leads them to seek short-term, visible results. Pressure from foreign aid institutions forces accelerated production of houses. This in turn encourages government administrators to choose foreign materials and technologies, and even to model their housing and building standards on those in industrialised countries. The consequences are devastating social, economic, and environmental impacts. In addition the existing miserable housing conditions are worsened because the finished product is unaffordable to the target groups and discredits the local (human and material) resources (UN, 76; UN, 90).



Foreign Materials
+
Foreign Technology

= Fast Construction ≠ High Productivity

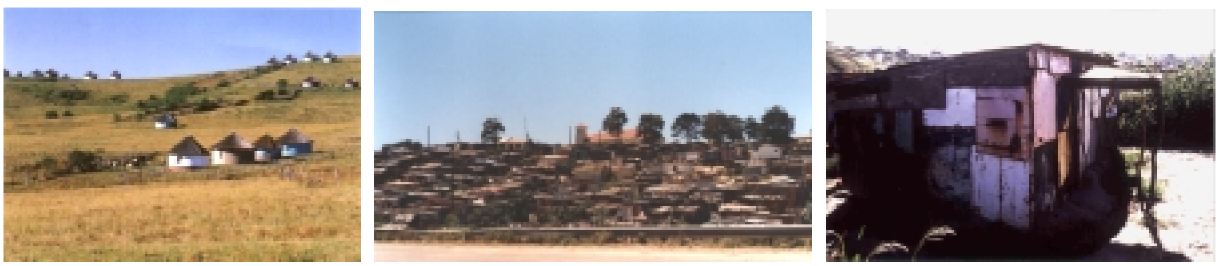
Versus

Local Materials
+
Local Know-how

≠ Fast Construction but = Strong Productivity

Photo: Galaor Carbonel, (1989)

The goal behind this project was to offer a training and housing programme involving the CEB technology that would not only help to reduce the dependency on foreign materials and technologies, but also to demonstrate a viable alternative model for Low Cost Housing programs. The ideal would be houses of better spatial, material and craftsmanship quality than those normally found on the market. They would be offered at a competitive cost and would create more jobs for skilled labourers within the communities. Use of local materials containing fewer pollutants and/or lower embodied energy than ordinarily used, reduce the negative impact of the housing industry on the environment. In this project, we used the local material, the *Sabunga* earth which is an inert material, directly found underneath the topsoil. The topsoil being useless for building was put aside for the extraction and then put back in its place where it could find its former agricultural use. The *Sabunga* soil could be manually extracted. Beside being manually passed through a sieve to clear the bigger pebbles and stones, the soil does not require any more transformation to become the main component of the Compressed Earth Blocks.



From the countryside to town, the landscape, the density, the materials and technologies change drastically the dwellers' lives

With few exceptions, newcomers are reluctant to use traditional materials and techniques when they move from the countryside to the towns. Their traditional way of building reminds them of the misery they left behind. However, when looking closely at the salvaged rubbish and scrap shacks that comprise the informal settlements, it is possible to see the remains of the traditional peasant building culture. These settlements, although different in density and size, share similarities with the latter in terms of space layout or use, building details or solutions to different problems or needs. For example, a two-panel stable door is a useful addition to a country hut. The closed lower panel prevents the animals from escaping, while the upper panel allows the light and air in, providing a draught for the fire. It does not, however, seem such an obviously useful addition to housing in the informal townships. The small numbers of animals found in the squatter settlements would not justify the use of such doors for the township shacks. On the other hand, this type of door is enormously useful to facilitate ventilation, helping to evacuate paraffin fumes that would otherwise accumulate inside. The lower door panel, when closed, prevents the unpredictable and strong rain from flooding the shacks, in the same way as it does for the country dwellings. These and many more examples seem relatively unimportant but are part of the group's building culture, which through time, has adapted to respond to new problems and needs. To the dwellers these were always significant enough for them to spend time designing constructive and efficient solutions. Architects or engineers who pretend to design healthier and more environmentally-friendly houses for the people living in so-called substandard housing should consider such details in their design. If through their study they don't find solutions, they will at least have a clearer idea of the problems.

Although earth is probably the oldest building material used by man—it still shelters a third of humanity—the Compressed Earth Block is associated with the idea of a new and industrialised product. In an urban context such as East London, this played a key role in its acceptance, as much by the workers as by the residents.



The Compressed Earth Block is associated with the idea of a new and industrialised product.

The first intervention took place between September and December 1997 in six different townships of East London and its periphery, that is to say *C.C. Lloyd*, *Cambridge*, *Duncan Village*, *Scenery Park*, *West Bank* and finally, *Mdantsane*, a homeland township outside East London that was created in the early 1970s, being the second major township of South Africa, after Soweto. From these six townships 30 unskilled men were selected to participate in the CEB (Compressed Earth Blocks)-making and masonry training programme. The location of the *C.C. Lloyd Community Centre Township* became our headquarters and first training site. They provided us with a roof under which we could teach the making of CEB (Compressed Earth Blocks), and accumulate CEB for the masonry training. Sharing the space of the *C.C. Lloyd Community Centre* with one of our local partners, Buffalo Flats Community Development Trust, a very active NGO in the communities, grounded us very much in the reality of the townships everyday life and needs.

As part of our strategy to involve as much as possible local partners in our projects, the trainees went to the *East Cape Training Centre*, based in East London to receive the basics of masonry construction. A few weeks later, the trainees came back to the C.C. Lloyd Township for their on-site training, erecting their first permanent masonry walls, closing the existing open steel structure of the *C.C. Lloyd Community Centre*. Beside accommodating the thirty trainees at the same time, this was an opportunity to consolidate the infrastructures belonging to the community. After the completion of the community centre, the 30 trainees were ready to split into smaller groups to build demonstration starter houses in the five remaining townships.


Masonry training at the *C.C. Lloyd Community Centre*

Building a starter house in *West Bank*

At the end of this four-month first stage of the overall project, we had built only three of the six *starter houses* that were previously planned. From the first on-site interventions it was evident that the local population were beginning to accept that the *Compressed Earth Block* (CEB) was a superior building material to concrete. People experienced a greater level of physical comfort in the houses built with earth blocks, which do not become uncomfortably hot in the midday sun, as do the concrete block houses. Because of the high quality of the block-laying work, and, as a result, the fact that the CEB (Compressed Earth Block) masonry walls don't need plastering, people tend to compare the CEB houses to fired brick houses. These houses are more prestigious, with a higher standard of workmanship. In addition, the material itself is a symbol of permanence that can be traced back to the Boer pioneers' settling patterns (Hilton, 98: 226).

In order to guarantee the permanence of the project, we brought the Compressed Earth Blocks through a series of tests, necessary steps to have the new material approved by the South African Government. This would mean that houses built with the Compressed Earth Block would be eligible for the Government Housing Subsidy scheme, opening the market to the new local industry. After building a demonstration *Compressed Earth Blocks* wall, the latter underwent and successfully passed a series of tests performed under the supervision of the *South African Bureau of Standards* (SABS) in the C.C. Lloyd Township in East London in December 1997. This was a significant step in gaining approval for CEB housing all over South Africa.

Tests performed by the South African Bureau of Standards (SABS) to obtain the *Compressed Earth Blocks* (CEB) approval for all the regions of the country.

As a consequence of the positive results of our incremental approach, the project followed subsequent phases of implementation. A new, semidetached house prototype was built in May 1999 and was then evaluated and re-adapted. A few houses later, the project, by now divided into two components—Compressed Earth Block production and the House Building—has now attained a capacity of more than 150 houses a year and is expected to eventually attain its full capacity of 450 houses per year.


In June 2001, there were 150 houses built by the trained masons.

These numbers might not be impressive when compared to the tremendous need or to mass housing programs in other regions of developing countries. Having in mind long-term goals, this housing project has the potential to give the communities greater independence from foreign materials and technologies as well as from foreign aid. Many mass-housing projects claim to produce houses more efficiently than local enterprises, but the technology used by our project is, in fact, better suited to being adopted by local builders and contractors. It is important to stress here that, generally speaking, salaries in developing countries are too low to justify a building approach involving high-tech methods. In this context, the use of machinery should be reduced to the minimum this, generating more job opportunities for manual labourers within the communities. In the same way, the size of the building components should be thought to fit the existing local building components which the majority uses. Following this idea houses should be designed and built in a way that facilitates modifications by the users over time. A complicated building system does not offer this possibility. (Spence, 93)

Providing shelter alone to the poor who live in squatter settlements is not enough to alleviate the problems that come with poverty. If we insist that most of the money involved in a housing project stays in the community where the project is taking place, it is as though we were investing four times the initial amount in the local economy. Money invested in the community will multiply and will generate an economy within it, and helping the residents to function as an autonomous group. In this project, the product is not only houses but also a mechanism that strengthens the community. It initiates a movement through which the real people in need are not only passively receiving a house but in some way, they become partners of the housing industry, as they are not kept away from benefiting from the low cost housing business. Housing for them, stops to be something for which they are begging for and becomes an opportunity for well-remunerated work, gaining professional qualification and pride of the good workmanship.

The importance of the user participation has been highlighted over the last thirty years. From the passive receiving end he was standing, the user was promoted to the active role of building his own shelter. Without being against this position we believe that it should be carefully looked at according to the context. Although self-help found lots of supporters in the sixties and seventies (Turner, 72; 76), it is hard to believe that self-help could find a place in the urban context of developing countries today (Ward, 82). Already in the sixties Charles Abrams questioned its efficiency, arguing that the urban dwellers would always be caught in an endless cycle of searching for job opportunities and working, and consequently, the shelter would never be fully constructed (Abrams, 64: 164-181). Sharing this line of thought, training people as self-help builders was out of sight for our project. It is unlikely that it would be cost-effective to spend money on expensive training programmes for self-help builders who will each produce only one or two houses in their lives. Our position is that in an urban context, it would have a greater impact on the local economy if the time and skills used in training programmes were invested in teaching building techniques to, perhaps a lesser number of people, but to concentrate energy on helping them to become contractors or subcontractors. We don't feel uncomfortable with our position as our experience with the formal and informal sectors showed us that, beside the fact that this is the best way to bring positive impacts on the local economy, this option carries a strong probability for a large dissemination of the know-how in the community. For instance, we know that the new contractors or subcontractors will train their helpers, mostly coming from the community. Chances are that after awhile the helpers will appropriate the technology to build their own houses, to the point they will start to work on their first contracts on weekends or holidays, and eventually, they will become subcontractors and/or contractors.

Another important aspect of this argument concerns training and/or housing programmes and the choice of technology to use in development projects. Many architects and engineers involved in housing projects for developing countries work very hard to develop and design very sophisticated building systems to "facilitate" the life of the workers who according to the designers' prediction, will not have to know anything about building because they will only have to "fit the pieces together" like a kid's game until the house is built as if by magic. We believe that this approach is wrong. It is our responsibility to develop training and/or housing programmes that make people more skilled and knowledgeable, which helps them to appreciate good workmanship. We prefer to invest in people by enabling them to do good work, and to be proud of it. If for some reason the project ends abruptly, the workers who are trained to do conventional masonry work will be adequately qualified in order to find a good job on the conventional market. In this way the investment in teaching the people is not wasted as it sometimes happens in many housing and development projects that use fancy and impractical technologies.

Working with the informal sectors showed us how it is hard to set up long-term goals for people who are constantly struggling for their day-to-day survival. A way to ensure permanence of the project and to meet the goals that were set up, is to plan its implementation in many autonomous stages so the participants have always a definite level of qualification, for which they received gratification by the certificate awarded. This type of short-stages training is particularly tailored on the needs of the majority of the participants coming from the squatter settlements. With this approach, the trainees, who had to stop the training programme for economic reasons as they sometimes find a temporary job with a better salary, are given incentives to reintegrate their training when they can, and this, without having to start over again.

As well as discussing a housing and training project in South Africa, through this paper we also tried to demonstrate the importance of greater involvement by architects in the choice of technology and materials used in the design of their buildings. This applies to housing and, indeed, to any other type of building constructed. Although the importance of being efficient architects might be more clearly evident in the developing environments where the needs are so tremendous and the resources so scarce, we believe that this is also sound in the context of wealthier environments. The architects wherever they are, should not have their choices of materials and technologies only limited by the shapes, colours, textures, or the imagery they evoke. If they really want to play an active role in a development that is meant to be sustainable, architects must also take their inspiration in practical elements such as the structural, economic and environmental qualities of the system they choose. While discussing the empowerment of the poor in developing countries, this paper reflects the notion of empowerment as a general principle. It also points to the importance of the architects' knowledge, which should be used to the benefit of those who do not have an architect’s expertise. It is important that they remember also that the choice of a material or a technology is never without impact but always affects a country, a region, a community, someone's life or the environment.

References:

ABRAMS, C. (1964) *Housing in the Modern World*. London: Faber and Faber.

AMIS, Philip and Peter Lloyd. (1990). *Housing Africa's Urban Poor*. Manchester: Manchester University Press..

ANC (African National Congress) (1994). *The Reconstruction and Development Programme. A Policy Framework*, Johannesburg : ANC (African National Congress).

Building Advisory Service and Information Network. (1998). "A South African solution to Standards". *BASIN NEWS*. No. 15. St. Gallen, Switzerland. May.

CARBONELL, G. ed. (1989) *Alvaro Ortega: Prearquitectura del bienestar*. Bogota: Escala.

City of East London: Directorate of Development Planning.(1998) *Haven Hills South*. East London, South Africa. February.

City of East London – Directorate of Urban Planning. (1998a). Haven Hills South Demonstration Project: A new approach towards sustainable urban planning in East London. February.

City of East London: Directorate of Development Planning. (1998b). *Draft Brief and Terms of Reference: Haven Hills South Demonstration Project*. East London, South Africa. September.

Department of Housing / National Business Initiative. (1995) *White Paper : A new policy and Strategy for South Africa*. Johannesburg : Department of Housing.

D'ARAGON, J. and ELOUNDOU, L. (1998) *East London High Rendement Housing Project : Mission Report.* Grenoble: CRATerre-EAG. January.

D'ARAGON, J. (2000) *Low Cost Housing Models, Local Resources and Empowerment:* A project in the periphery of East London, South Africa *: Mission Report.* Montreal: McGill University. (Master's Thesis).

(The) Duncan Village Planning Team. (1996) Evaluation Report of the Model Houses in N4 Section C Extension, Duncan Village. East London. June.

Garnier, P. (1997). *East-London Low Cost Housing Project: Identification, Feasibility Study and Definition of Project First Phase* (Mission Report . Villefontaine (France): CRATerre-EAG. April.

GILBERT Alan and Josef Gugler. (1981). Cities, Poverty, and Development: Urbanization in the Third World. Oxford: Oxford University Press.

HILTON, Judin and Ivan Vladislavic eds. (1998). *Blank__Architecture, Apartheid and After*. Rotterdam: Netherland Architecture Institute.

MAASDORP, Gavin and A.S.B. Humphreys eds. (1975). *From Shantytown to Township: An Economic Study of African Poverty and Rehousing in a South African City*. Winberg, South Africa: Juta and Company Limited.

MOSIENYANE, L.M. (1997) *Duncan Village B-Hostel Redevelopment and Upgrading*. East London: Osmond Lange Mosienyane.

SMITH, David (ed.) (1982). *Living Under Apartheid: Aspect of urbanization and social change in South Africa*. London: Georges Allen & Unwin.

SPENCE, R., WELLS, J., DUDLEY, E. (1993). *Jobs from Housing: employment, building materials, and enabling strategies for urban development*. London and Cambridge: It Publications / ODA (Overseas Development Administration).

TURNER, J.F.C. (1972). *Freedom to build: Dweller Control of the housing Process*. . New York : J.F.C. Turner & Robert Fitcher, Eds. Macmillan.

TURNER, J.F.C. (1976). *Housing by People: Towards Autonomy in Building Environments*. New York : Pantheon.

United Nations Centre for Human Settlements (Habitat) (1976) *The Vancouver declaration on Human Settlements*. Vancouver: UNCHS.

United Nations Centre for Human Settlements (Habitat) (1990). *Un logement pour tous: La Stratégie Mondiale du Logement jusqu'à l'an 2000*. Nairobi: UNCHS.

WARD, P. (ed.). (1982). *Self-Help Housing: A Critique*. London: Mansell.

A Proposed Design System Model for the Delivery of Mass Custom Homes: Learning from Japan's Prefabricated Housing Industry

Masa NOGUCHI, Ph.D. Candidate
Avi FRIEDMAN, Ph.D. Associate Professor
Director, Affordable Homes Programme
McGill University, School of Architecture
masayoshi.noguchi@mcgill.ca

Abstract:
Buying a new home is a significant investment usually undertaken only once or twice in a lifetime. Therefore, today's consumers are cautious and selective when buying a house, because it must satisfy their personal requirements in terms of customisation, product quality and affordability. Housing manufacturers in North America claim that they can customise a home to the same extent as conventional homebuilders. Their design process for the creation of customised homes, however, does not reflect the advantages of industrialisation of housing, in which mass-production of housing components helps reduce the design and production costs, while in-factory production ensures a steady supply of quality products.

'Mass Customisation' is a seemingly contradictory term, for how can one combine mass production and customisation? In 1987, this revolutionary concept was first introduced in North America, recognised as a means to produce customised products on a mass basis. In many industries, the concept of mass customisation is applied to product design in order to satisfy the unique demands of each consumer. The housing industry is no exception. Today, Japanese housing manufacturers have already succeeded in mass customising housing, and their high-quality, reasonably priced homes have a good reputation.

This paper examines how Japanese housing manufacturers apply the mass customising approach to improve their products, and the public's perception of industrialised housing. The authors surveyed five manufacturers on their mass customising techniques by visiting their manufacturing plants in order to analyse their production capability. The authors found that the manufacturers have developed a 'mass custom design system' in order to

totally coodinate their design, production and marketing approaches. This paper describes the principles of the design system and its effect on the delivery of industrialised housing.

Keywords: Housing, Prefabricated Housing, Industrialized Housing, Customization, Mass Production, Mass Customization, Design Management

MASS CUSTOMIZING HOMES

Mass customization is a relatively new concept that has taken years of research to put into practice. The concept was introduced in 1970 by Alvin Toffler but it was not until 1987 that the term itself was first coined by Stanley Davis. In 1993, B. Joseph Pine II developed a general strategy for mass customizing products and services. Today, Japanese housing manufacturers have brought the concept into full play, mass customizing their homes. Therefore, in this study, five major housing manufacturers in Japan were examined thoroughly in terms of their mass customization approaches (Table 1).

TABLE 1. Company Profile

Company Name (1)	Plant Location (2)	Production (3)
Daiwa House Industry Co., Ltd.	Nara	Steel hybrid panelized housing
National House Industrial Co. Ltd.	Shizuoka	Steel hybrid panelized housing
Resco House Co., Ltd.	Ibaragi	Concrete panelized housing
Sekisui Chemical Co., Ltd.	Saitama	Wood and steel modular housing
Toyota Motor Co.	Yamanashi	Steel modular housing

Table 1: *Company profile*

Mass customization is an oxymoron. The term is composed of two opposite notions: mass production and customization. The mass production of housing is effective in reducing construction costs, as well as in increasing product quality. In general, the higher the rate of the in-factory completion of the house, the shorter the elapsed time for the construction, which reduces the production costs (Hutchings 1996). In addition, the quality of the components of the home can be maintained under optimum conditions inside the factory, where the materials are not exposed to outside climate. On the other hand, mass production usually produces identical, monotonous homes that hardly correspond to the market demands for personalized design. Custom design, on the other hand, is an influential factor in satisfying homebuyers' individual requirements; however, customization increases design costs (Smith 1998). Mass customization is not a 'trade-off'—it does not require one to choose between mass production and customization. It is rather a situation in which the disadvantages of one system are 'offset' by the advantages of the other; it is "the paradox of the simultaneity of opposites" (Davis 1987).

One of the most effective methods of mass customization is to create modular components that are mass-produced but can be configured into a wide variety of end products. This method minimizes costs, while maximizing individual customization (Pine II 1993). Also, Japanese housing manufacturers produce a number of modular components, while developing communication tools that effectively adapt the client's choices to housing. As a result, the manufacturers have succeeded in mass customizing their homes, having enjoyed a good reputation for their industrialized housing, which the public had perceived as inferior until the mid-70s, since the manufacturers focused only on mass-producing their products with little thought to the design quality (Fig.1).

Figure 1: *A typical prefabricated house in Japan.*

Top: The exterior

Bottom: Interior open space arrangements of the living and dining rooms

(Source: Daiwa House Industry Co., Ltd.)

Mass Custom Design System

By the 1980s, the ‘high quality’ of products had become a requisite for market entry. The concept of quality had developed from a focus on reliability in the 1970s, to a demand for personalization of products. In general, today’s consumers are no longer satisfied with generic, ready-made products; rather, they prefer to purchase customized products that meet their immediate needs (Anderson 1997). Today’s Japanese housing manufacturers focus on the custom design of dwelling units, mass-producing a variety of housing components, which end users are given the freedom to choose from. However, although custom design helps upgrade housing quality, it also leads to an increase in design costs, while the market still demands affordable homes. By using a “mass customizing” approach, Japanese manufacturers have succeeded in avoiding a conflict between the demands of customization and the increase of design costs (Pine II 1993).

To bring the concept of mass customization into full play, Japanese manufacturers have developed a ‘total coordination’ approach to their design, production and marketing. In particular, their design techniques are well integrated into a system that is composed of two design-support sub-systems: product (P) and service (S). In other words, the system can be referred to as a ‘mass custom design system’ (MCDS) and explained by using an analogue model as follows:

$$\text{MCDS} = f\,(\text{PS})$$

The service sub-system concerns communication techniques that lead users to directly participate in customizing their new home, while the product sub-system covers production techniques to encourage housing suppliers to mass-produce housing components. Both sub-systems can be considered as the indispensable functions of mass-producing customized homes. In general, mass production of housing components is regarded as an effective method of reducing production costs (Sekisui Chemical 1998a). Moreover, the higher the rate of in-factory completion of housing components, the more the product quality can be maintained under optimum conditions inside the factory, where materials are not exposed to adverse outside climate (Hutchings 1996). Moreover, the elapsed time for the production, which influences the product’s costs, is fully controlled.

The Service Sub-System

In customizing products, ‘user participation’ is considered important, and therefore manufacturers provide design support communication services for their clients. During the design stage, manufacturers encourage clients to participate in customizing their home in three ways: by giving catalogs to the client, by visualizing the client’s image of the house, and by estimating the product’s costs (Daiwa 1999). Before actually making a contract with the client, manufacturers offer these services as part of their design consultation process, which normally takes place in the company's display house located in the Housing Park or in the salon of the Housing Information Center. A housing park offers a collection of display homes built by a variety of housing companies, located in commercial centers readily accessible by transit or train. The scale of the parks varies in size; however, 20 to 40 model homes are usually built in the park. The housing information centers also function as exhibition and design consultation areas.

In general, manufacturers provide the client with three types of catalogs, concerning housing types, technology and component selection. The first two catalogs are usually provided during the marketing stage, while the component selection catalog is used during the design consulting stage. The housing component selection catalog corresponds to the housing styles, and helps the client choose the standard components for the exterior and interior arrangements of the home. The catalog describes the material, size, color, texture and functions of each component; however, it does not include any prices. In addition, manufacturers use a computer-aided design (CAD) system for the creation, modification, analysis and optimization of a design. Furthermore, as the virtual image of the house is erected, based upon the housing components selected by the client, the manufacturer provides a cost estimate. Once the client is satisfied with the plans, the manufacturer will finalize the design and, at last, enter into a contract with the client (National 1997).

The Product Sub-System

In this study, five major manufacturers were examined; however, their communication approaches during the design stage were quite similar. Therefore, the trends within two of the manufacturers, such as Sekisui Chemical and Toyota, were re-examined in order to identify their communication techniques during the design stage.

An important part of mass customization is that the user directly determines the configurations from choices given as client input during the design stage. This could hardly be achieved without the standardization of housing components for the structural, exterior and interior arrangements. The concept of component standardization can be illustrated with Lego® building blocks. A number of simple, modularized blocks can be connected in a variety of ways, because of their interlocking tabs and holes. Likewise, Japanese manufacturers offer a variety of housing components to their clients and then encourage them to participate in combining the components to design their new home. These are visually arranged in a component selection catalog to enable clients to easily choose from the many options. Housing components can be divided into three categories: structural, exterior and interior. The structural components are used to construct the housing models that determine the number and size of each room, while the interior and exterior components serve to coordinate both the decorative and the functional elements that customize housing.

Structural Components

This category often applies to modular homes, because a panelized housing system does not define spatial limitations with its size and volume of interior space. However, most prefabricators who produce panelized components still adopt a conventional modular system based on the size of a “tatami” mat (909 mm by 1818 mm) to a room layout of their products, so that the number of tatami mats determines the size of each room. Tatami mats made mainly of straw are Japanese traditional flooring mats of a standardized size, used to describe the size of a room. On the other hand, prefabricators who produce unit components precisely standardize the size and volume of each structural unit component that is simply a box-shaped frame made of either steel or wood. Spatial variation of housing can be achieved by the combination of standard units.

Sekisui Chemical, for instance, produces modular components, standardizing nine basic units (Fig. 2). Toyota also manufactures unit components, providing three basic units. The width of the units ranges from 5,700 mm to 4,800 mm, and 3,900 mm, while the depth is basically 2,400 mm; however, half-sized units are also available for each. In addition to these units, Toyota offers two extensions to further increase the variation of housing forms.

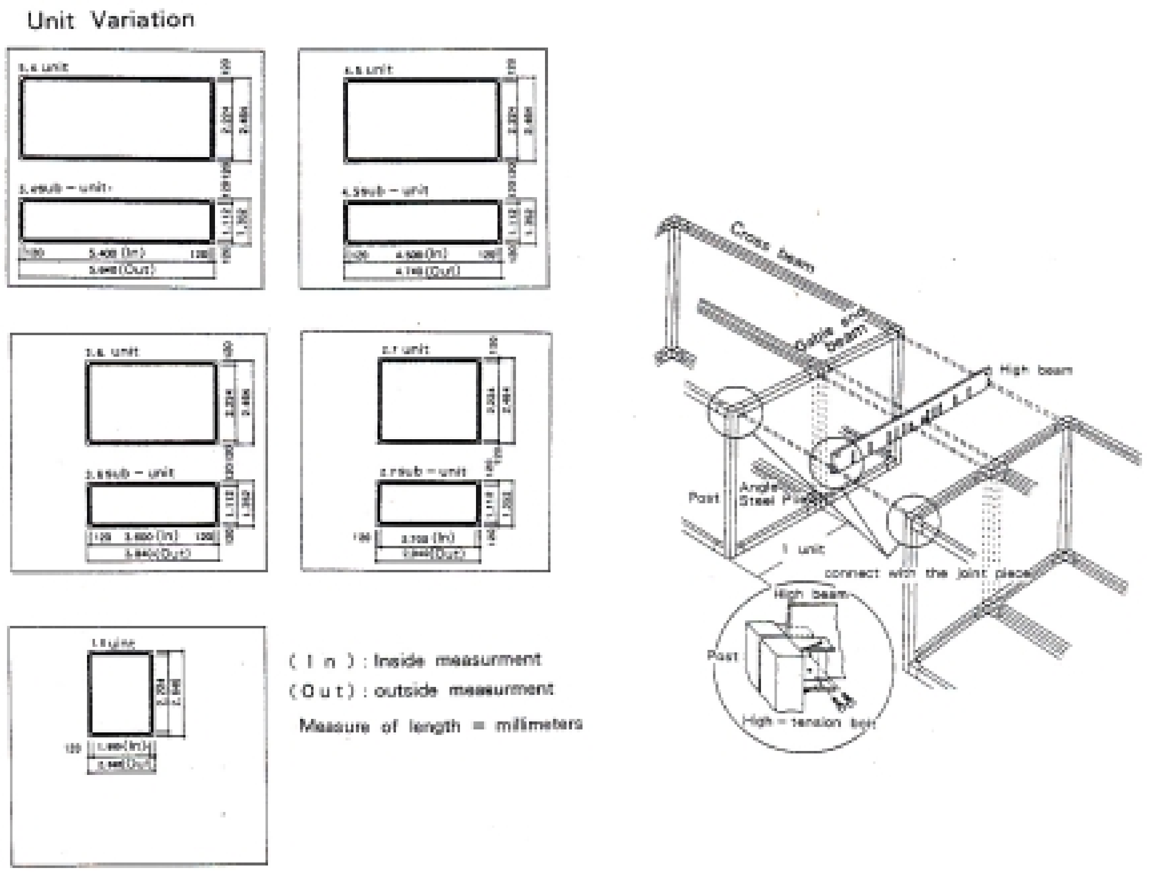


Figure 2: *Structural unit variation*
(Source: Sekisui Chemical Co., Ltd. 1998)

The manufacturers expand the variation of spatial arrangements with a few numbers of structural unit components for which the size and volume of each are standardized. According to Toyota and Sekisui Chemical, there are roughly 8-10 standard unit components in use that include half-sized units and additional modules. By combining these standard unit components, manufacturers can produce a great number of individualized housing forms to meet clients' spatial requirements.

Exterior Components

The exterior of a house is vital to first impressions and also enhances a sense of ownership. A house's identity is defined by its external design features such as roofs, walls, openings, verandas, balconies, and entrances. In order to customize their products, Japanese prefabricators offer a variety of external components to meet clients' preferences. In the sections covering exterior components, Toyota's component selection catalog will be used. The catalog covers four types of their products: Meleze Premier, Meleze, Chene, and Foret (Toyota 1998).

Roofs

Two types of roofs are commonly offered: a pitched roof and a flat roof. The former is a more conventional roof shape, and has a classic appeal. The latter is also becoming popular because efficient land use is essential, and a flat roof is as a multifunctional space and can be used, for example, as a garden. In order to increase roof variation, the manufacturers provide several types of roofs with different shapes, colors, and textures. Toyota, for instance, produces two types of pitched roofs (gable and hipped) with an overhang of 450mm, 600mm, or 900mm. In addition, they also offer five different slate materials.

Walls

Walls vary mainly in color and texture. Many manufacturers apply walls made of ceramic-based materials that can be molded into certain types of walls, as though the house is built of brick or stone (Fig.3). The wall surface is more articulated by coating, weather-resistant acrylic resin often used to burnish the surface of the wall. Toyota offers six colors for brick-type walls, eight colors for sandstone-type and Oya tuff stone-type walls, six colors for Teppeiseki stone-type walls, and five colors for general masonry-type walls.

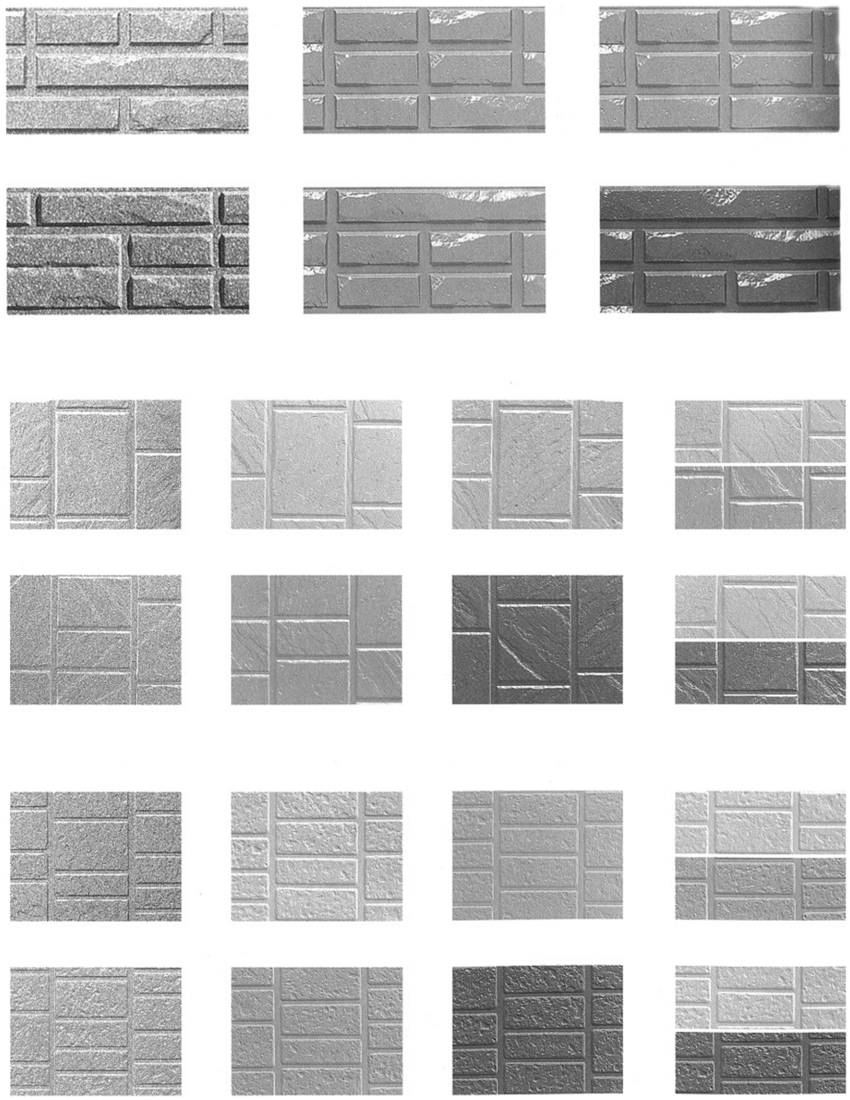


***Figure 3:** Wall Variation*
(Source: Toyota Motor Co. 1998)

Windows

Windows not only create a sense of identity on the housing facades, but also allow each room to gain access to natural light and ventilation. The larger the window, the larger the room looks, because one focuses on the outside; however, the larger the window, the higher the rate of heat loss. In order to improve the heat insulation property of windows, insulating glass and sash are preferred by most manufacturers. Toyota's catalog categorizes windows into five types: large-sized bay windows, bay windows, patio windows, waist-height windows, and small windows. Also, Toyota provides additional windows to fit specific locations such as kitchens and bathrooms.

Balconies

Verandas and balconies are prominent features of any home's exterior, and can function as gardens, hobby spaces or laundry rooms. Japanese people frequently prefer to dry their laundry outside in the sunshine rather than use dryers and therefore the location of verandas or balconies is important. In the case of Toyota, the size of the veranda is determined by the combination of structural units, and the overhang of balconies is standardized to be 900 mm from the surface of the external wall. The appearance of verandas and balconies is harmonized with the wall materials selected by the user. In addition, each housing type has its own style of balusters and balustrades (Fig. 4).

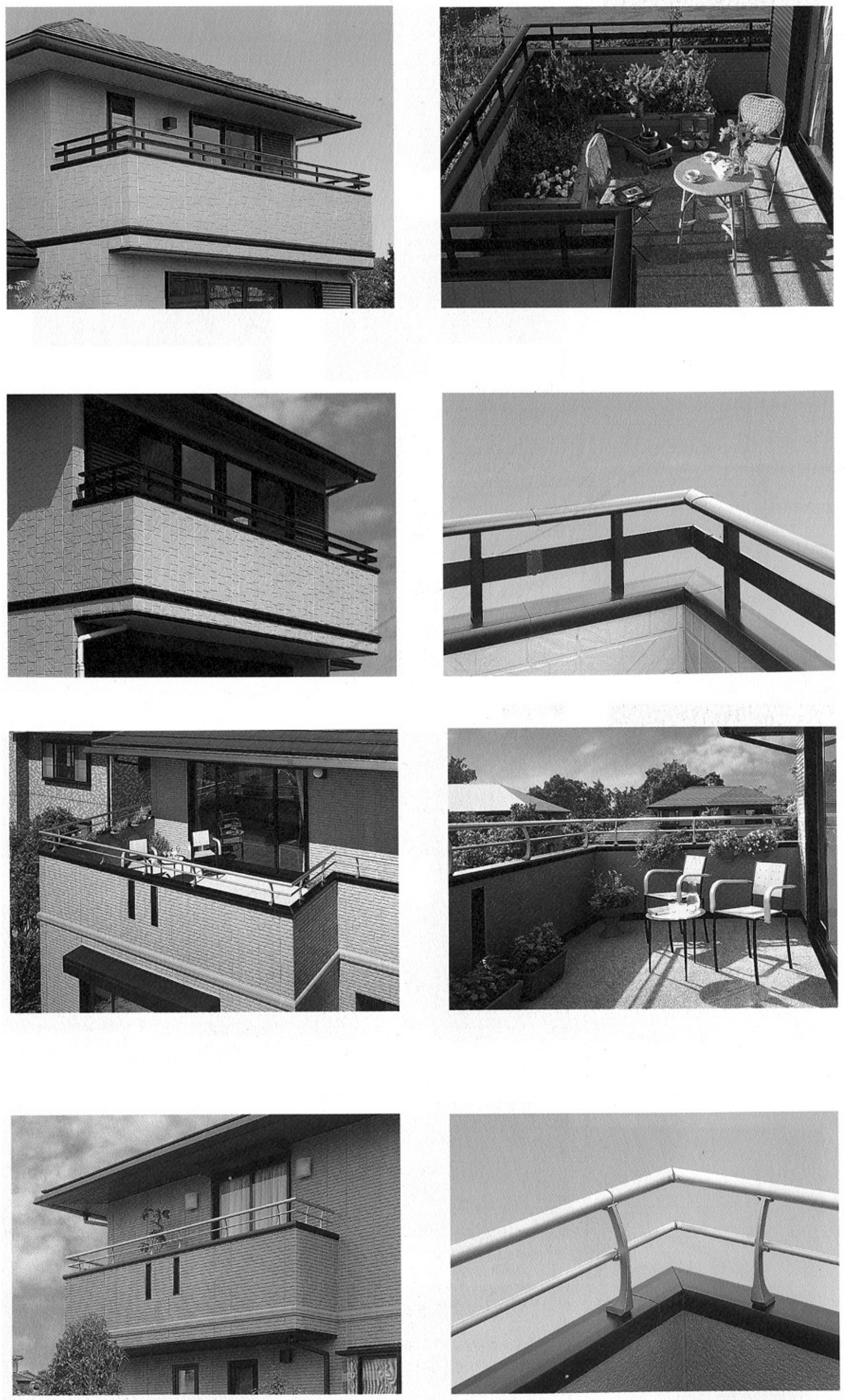


Figure 4: *Veranda and balcony variation*
(Source: Toyota Motor Co. 1998)

Entrance Doors

The entrance is another important decorative feature of a house. Toyota provides two types of entrance doors, aluminum and heat-isolating steel, which are used in three types of their products (Meleze Premier, Meleze, and Chene). The aluminum door expands into five additions: single-swinging lattice doors, double lattice doors, double decorated doors, double-slit doors, and double quasi-fire-preventive doors. There are also three types of heat-isolating steel doors: double doors, single-walled doors, and double-walled doors. As an additional option, some of these doors can be equipped with a remote control key system.

Front Entrance

Japanese people usually take their shoes off at the entrance, when entering a home, so that the entrance must have sufficient space for taking off shoes and storing them. The inside floor is normally built a few steps higher than the entrance floor level. Toyota provides two types of front entrance configurations: flat and alcove. In order to decorate entrance façades, a variety of eaves are used, and the location and size of the entrance also influence the design. To enhance the façade variation of the entrance, Toyota offers entrances with eaves, with roof-shaped eaves, located under the overhanging balcony, and under the veranda with eaves.

Interior Components

Interior components are more diversified and are designed to coordinate the living environment for each client. The main interior components are the kitchens, sanitary facilities, storage, interior finishes and amenities. In this section, the variety of interior components will be reviewed, based on the Sekisui component selection catalog for their products known as 'Two-U home'. To meet the varied client requirements, Sekisui Chemical allows freedom in interior design and, at the design stage, introduces a complete selection catalog that enables clients to customize interior components (Sekisui Chemical 1999).

Kitchens

The kitchen's layout must be carefully designed in order to provide a convenient place for cooking, serving, storing, and cleaning. Sekisui, for example, provides two kitchen types: I-shaped and L-shaped (Fig.5). The former is the simpler shape, where the sink is central and counter space extends horizontally on either side (Fig.6). The space is large enough for two people to use at the same time. The L-shaped kitchen is also designed to allow the user ease of movement while cooking, but provides a shorter distance from the sink to the refrigerator and stove. As for kitchen variation, Sekisui provides eleven styles for the I-shaped and nine styles for the L-shaped. Such variation is mainly achieved by using a variety of partitions to separate the kitchen from the dining room. These partitions come in four styles: open, open hatch, hatch, and separation. Sekisui Chemical also offers fifteen different colors for kitchen furniture. In addition, many other options are available for the sink, oven, dishwasher, and storage.

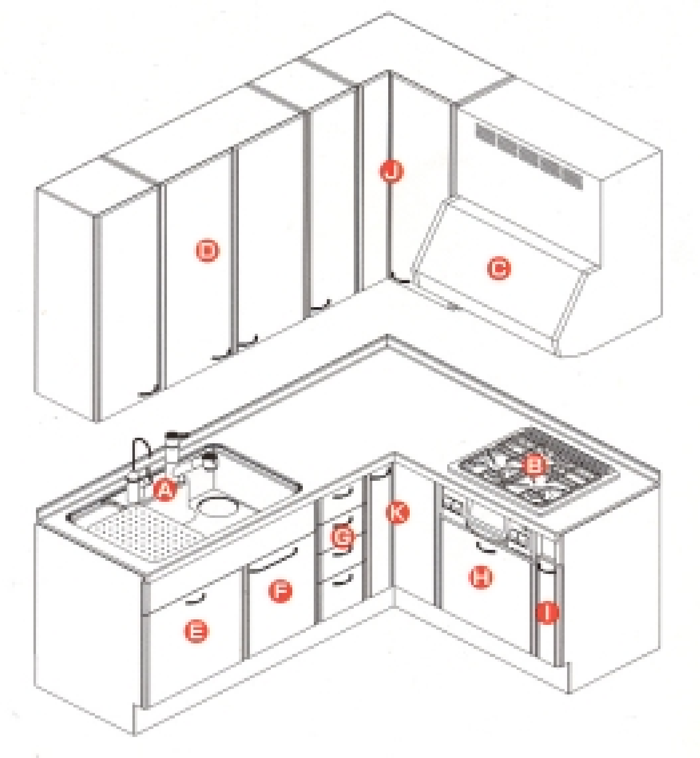


Figure 5: *I-shaped and L-shaped kitchen types*
(Source: Sekisui Chemical Co., Ltd. 1999)

Figure 6: *I-shaped and L-shaped kitchen variation*
(Source: Sekisui Chemical Co., Ltd. 1999)

Sanitary Facilities

Sanitary facilities include bathrooms, washrooms and toilets, and are essential for everyday life. In Japan, these facilities are usually separated by permanent partitions, and are designed for people of all ages to use comfortably and safely. Most prefabricators use barrier-free design strategies for sanitary facilities, especially for the elderly. For instance, Sekisui equips bathrooms and toilets with handrails.

Bathrooms

A bathroom consists of many components: a floor, ceiling, shower, bathtub, counter, storage, walls, doors, windows, lights, fans, and metal work. The variation in the bathroom is mainly in the size, color, texture, and additional equipment. Sekisui Chemical produces three types of bathrooms: Ageless, New Wide and New Custom. They also offer clients a choice of 14 colors of bathtub and counter. In order to improve users' choice, Sekisui Chemical increases bathroom variation with optional equipment such as emergency call buttons, wide handrails, and shower-sliding hooks.

Washrooms

In Japan, a washroom does not usually have a toilet—the area is normally used only for hand washing. It consists of a washstand, racks and mirrors. The racks are arranged according to the side of the bathroom and the choice of door color allows for a sense of variation. Sekisui Chemical produces three types of washrooms: Ageless, Refiny, and Basic. In general, the Ageless washroom has a modern appearance, while the other two types are more traditional, and have laminated wood doors. In order to enrich the variation of the racks, the user can choose from a wide variety of colors and sizes (Fig.7). The size variation is essentially created by means of horizontal extension of the racks, mirrors, and counter.

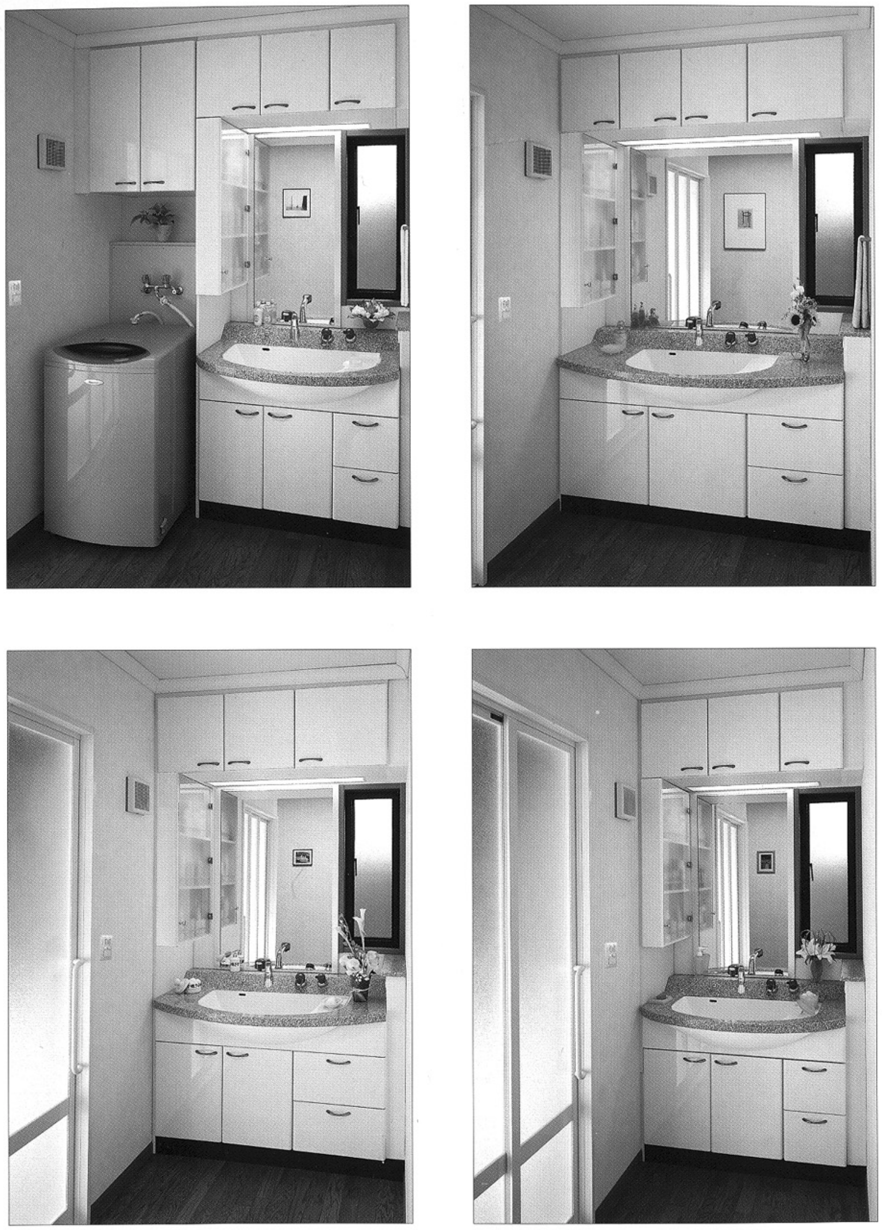


Figure 7: *Washroom variation*
(Source: Sekisui Chemical Co., Ltd. 1999)

Toilets

In Japanese homes, the toilet is usually separate from the bathroom and is similar to the North American 'powder room'. It is a small space with a toilet, washstand, and mirror. Using barrier-free design techniques, the prefabricators ensure toilets are comfortable, safe, and equipped with handrails to help the user's vertical motion. In addition, they provide electric toilets with such functions as heating, cleansing, drying and deodorizing. Some electric toilets are equipped with a moveable seat that helps the user to sit down and stand up. Sekisui Chemical's toilet rooms come in two sizes, standard and wide. They also provide, as standard equipment, a spot heater that is strong enough to instantly warm up the small toilet room when needed.

Storage systems

A house is required to have enough storage space for users to store their family's belongings. Usually, 10 to 20% of the floor area is used as storage space for clothes, cookware, bedclothes, books, foods, cookware, and household utensils. Sekisui Chemical illustrates the usability of storage, dividing the uses into two types: concentration and diversion. The former concerns belongings that are used seasonally and then stored away. The latter involves those items that are frequently used, and therefore each room needs such storage spaces to allow for easy access. Once clients understand the spatial needs for the storage space, under the manufacturer's guidance, they will select the rack systems as well as the entrance- and laundry-storage systems from a catalog. In addition, storage is often placed under the staircase and in the attic in order to use indoor space more efficiently.

Racks are designed to fit every room and function as both concentration and diversion storage spaces. The location of these racks is determined according to the client's spatial arrangements and needs. Rack variation is based on the volume that determines the capacity for storing, the shelf combination, and the door variation. Sekisui Chemical carefully categories their rack systems into 11 types, and, with some exceptions, most types can extend to a certain size based on modules. For the horizontal extension, Sekisui Chemical standardized the width of racks at intervals of 900mm, 1,000-1,200mm, 1,300mm, 1,800mm and 2,200mm, while the depth are also fixed by 400mm, 600mm and 900mm modules (Fig.8). In total, Sekisui Chemical offers 81 configurations and 48 door arrangements to satisfy clients' tastes and storage requirements.

Figure 8: *Rack system variation*

(Source: Sekisui Chemical Co., Ltd. 1999)

As is the Japanese tradition, people usually keep all shoes on the entrance shoe shelves. Even though the entrance space is limited, entrance storage is required to have sufficient space for all forms of outerwear. Sekisui Chemical presents several types of entrance storage spaces: a waist-height shelf with a counter on the top, a counter shelf with storing spaces below and above the counter, and a tall shelf without a counter. Configurations and door colors increase the variety of options. Sekisui Chemical produces two basic shelf units of 440mm and 760mm in width. In combination with the two units, the widths of the shelves can be extended to 1200mm, 1520mm, and 1960mm. In addition to these, Sekisui Chemical provides 16 colors for doors and 4 colors for full-length mirrors to help customize the entrance storage.
Laundry space is required to be large enough to enable the user to launder clothes and store all the necessary laundry cleaning materials that are usually kept in the space. As a result, a laundry space is usually filled with shelves for detergents and other small articles, as well as a washer, a dryer, and a washstand. However, these items are conditional, because each household differs from the other in terms of the user's needs and spatial limitations. Sekisui Chemical divides their laundry space into five storage arrangements. Normally, they put one or two shelves above the washer space, and selectively, one tall shelf can be placed on either side of the upper shelf. As for the shelf doors, clients can choose from 11 colors.

Interior Finishes

Sekisui Chemical has been practicing their own design approach, and gives clients the opportunity to coordinate the interior space of their new home. They provide two styles of rooms, Decorating and Shaping, with four colors (ecru, medium, dark and light) for flooring and molding materials. The Decorating style is designed to represent the elegance of Western classic ambience, while the Shaping style is simplified and modern. In addition to these two styles of rooms, Sekisui Chemical also produces a Japanese-style room. Most clients like to have at least one room in their house designed in this traditional way.

Flooring

Flooring helps decorate the interior of a house, and flooring materials such as wood, carpet, and tatami are preferred in Japan. Flooring varies mainly in color and texture (Fig.9). In wood flooring, the combination of wood boards that differ in size also helps increase flooring variation that the user can select. In addition, Sekisui Chemical provides more selections in wood flooring, with eight decorated floors in four basic colors, and, in total, they offer 32 types of wood flooring to their clients.

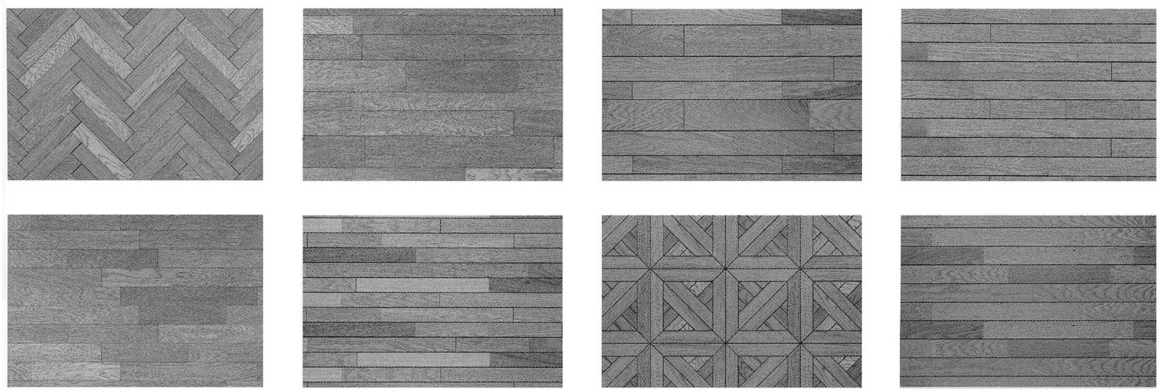


Figure 9: *Flooring variation*
(Source: Sekisui Chemical Co., Ltd. 1999)

Interior doors

Interior doors not only provide visual and acoustical privacy when closed, but also allow for natural ventilation when opened. Two types of doors are normally used: swinging and sliding. Swinging doors suit most rooms and are relatively easy to install; however, they require a certain space for opening and closing. In order to use the limited space efficiently, sliding doors are more effective. The parallel sliding system for the opening and closing of sliding doors does not require much space. In terms of the variation of interior doors, Sekisui Chemical provides, in total, 24 prototypes of interior doors that are applicable to two types of their interior arrangements called Decorating and Shaping. Most of the doors are swinging doors, but the manufacturer also provides one sliding door among them. These doors vary in size and decorative pattern, some of which have transparent windowpanes that allow for a visual link to adjoining rooms. In addition, Sekisui Chemical offers four colors for the laminated wood doors. Therefore, in total, 96 interior door styles are offered.

Staircases

A staircase serves as a link between the levels, and is designed with consideration for safety in terms of the shape, length, and pitch of the stairs, which are determined by the height of risers and the depth of treads. Also, staircases must be safe enough to be used by people of all ages. Handrails are often put in place to prevent users, especially the elderly, from falling, and to help them climb up the stairs. As well, the treads must be non-skid. Japanese prefabricators offer a variety of staircase designs: I-shape, J-shape and U-shape. Each manufacturer differs as to the length and pitch of the stairs; in particular, such manufacturers as Toyota and Sekisui Chemical that produce modular homes standardize staircase units to fit their specific housing types. Sekisui Chemical, for instance, produces 18 different staircase units that correspond with one specific housing type (Fig.10). The location of the staircase is not predetermined. Instead, during the design stage, clients choose a staircase type from a catalog and then decide on its location.

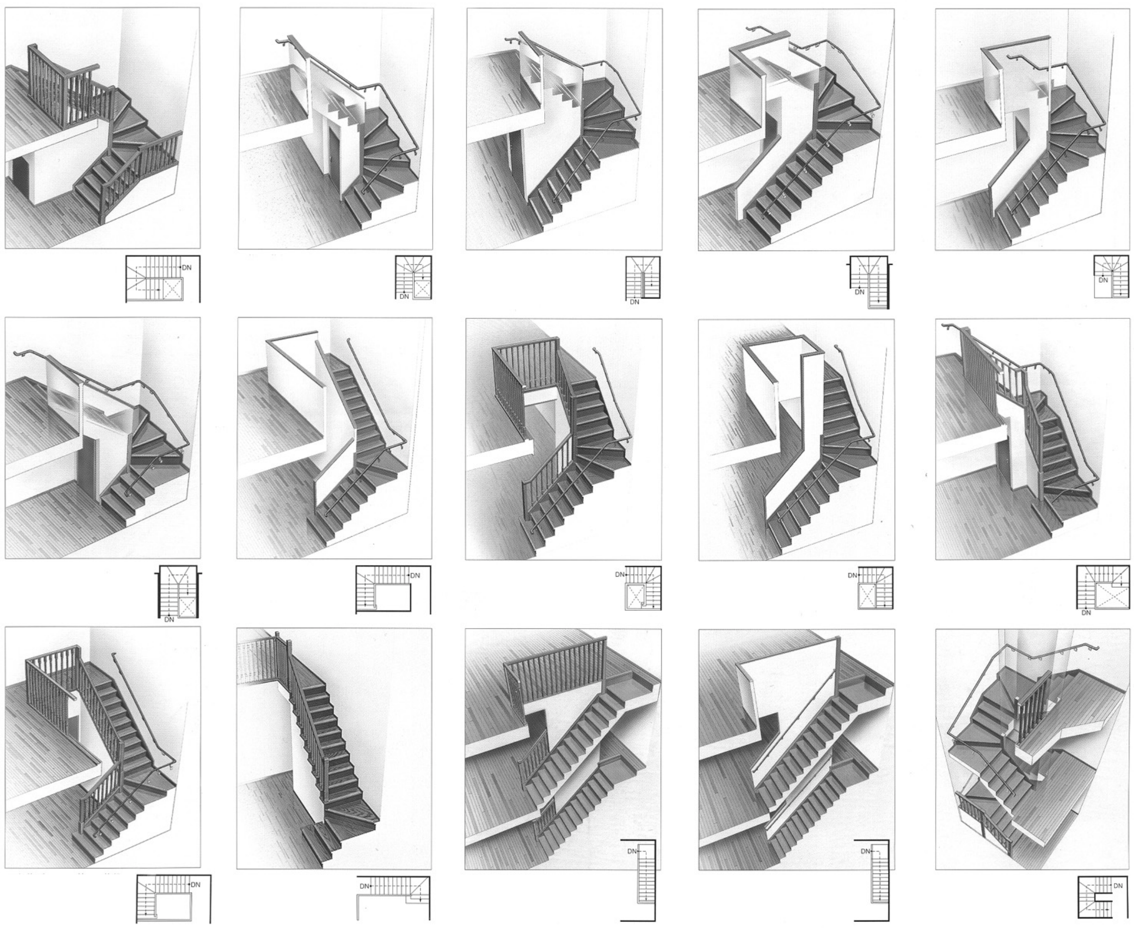


Figure 10: *Staircase unit variation*
(Source: Sekisui Chemical Co., Ltd. 1999)

MASS CUSTOM DESIGN

The manufacturers' design approach can be referred to as 'mass custom design' (MCD) which is a result of the combinations of three basic design elements of housing: the volume (V), exterior (E) and interior (I). In addition, the manufacturers usually provide optional equipment (O) in order to improve the quality of the housing. In principle, these housing components must be mass-produced, but the home itself can be customized by the user's direct choices of such components. Furthermore, the design approach can be explained by using an analog model as follows: MCD = f (V, E, I, O)

Furthermore, the exterior and interior designs include sub-categories such as the roof, walls, doors, windows, balconies, and front entrance arrangements for the exterior, as well as the kitchens, sanitary facilities, bathrooms, washrooms, toilets, storage, and finishing arrangements for the interior. In addition, the variety of sizes, materials, colors, and textures available for each component, as well as the variety of amenities offered, help expand the number of variations. Consequently, in order to meet clients' individual requirements, the manufacturers are able to provide thousands of housing variations for their clients without producing model homes that are designed on a speculative basis.

The Cost Performance Approach

Japanese housing manufacturers have succeeded in mass customizing homes, and have increased productivity by adapting integrated inventory systems and automated production lines. Most manufacturers have acquired ISO 9000 and 14000 series that certify the quality control of their products, as well as the companies themselves. However, it still remains a paradox that the industrialization of housing cannot help to provide affordable housing. A housing survey conducted in 1997 by the Government Housing Loan Corporation in Japan showed that the construction cost of a site-built wooden house in Japan was estimated at 2,193 $\$/m^2$ (Cdn. \$) on average, while a prefabricated house was at 2,375 $\$/m^2$. This result shows that a prefabricated house is approximately 8% more expensive than a site-built house.

On the other hand, Japanese housing manufacturers have been producing 'better quality' homes for about the same price as conventional homes. In fact, their products are quality-oriented in response to the marketing strategy called "cost performance." This marketing strategy is often used in the automobile industry as well (Sekisui Chemical 1998a). Even though today's automobiles can be produced with lower production costs than those in the past, their selling price does not seem to be affected dramatically by the high productivity and cars are still regarded, in general, as expensive. On the other hand, the standard items offered on new cars, such as air conditioning, a stereo set, automatic transmission, airbags, remote-control keys and adjustable mirrors were only offered as more expensive options on older models.

Therefore, it is clear that the quality of the newer model is much higher than that of the old model. The housing industry is no exception. The quality-oriented production contributes toward producing a high cost-performance home, which, as standards, contains modern conveniences installed optionally in conventional housing, in order to improve the housing quality, while the selling price of prefabricated housing is slightly higher than that of the conventional housing (Suzuki et al. 1995). In Japan, there is a tendency for today's housing manufacturers to compete to improve the quality of their products, rather than to merely reduce the selling price, even though they have drastically reduced their production costs (Sekisui Chemical 1998a).

Clearly, the product quality, which appeals to many homebuyers during the decision-making process, has been drastically improved by the manufacturers. In fact, according to a survey conducted by the Japan Prefabricated Construction Suppliers and Manufacturers Association (JPA), 49% of the 3,500 surveyed households, who purchased prefabricated housing in 1998, answered that the product quality with regard to safety, durability and amenities of housing was the primary factor that prompted them to buy a prefabricated home. In addition, 7% of the buyers regarded the price of prefabricated housing as relatively low (JPA 2001). These results indicate that their cost performance marketing approach is successful in the sense that housing price is considered of secondary importance to quality in the purchase of a prefabricated home.

CONCLUSION

Japanese homebuyers often attach importance to two basic factors in the buying process—quality and price. Also, the elapsed time for the design and construction, as well as the after-purchase maintenance services, are influential factors in a buyer's decision to select a housing supplier. In order to meet the housing demands of today's market, Japanese manufacturers have applied the concept of 'mass customization' for their housing design, and have eventually developed a total coordination approach to design, production and marketing.

Furthermore, the manufacturers' design techniques are well integrated into a system, which can be referred to as a mass custom design system (MCDS). It is composed of the product and service sub-systems to produce mass custom homes. The system was explained by using an analog model as follows: MCDS = f (PS). The product sub-system (P) covers the production techniques that encourage housing suppliers to mass-produce housing components, while the service sub-system (S) refers to the communication techniques that lead users to participate in customizing their new home. In consequence, the two design-support sub-systems function as the key elements that make the manufacturers successful in mass-producing customized homes that satisfy today's consumers.

Although the manufacturers have already succeeded in producing mass custom homes, the selling price does not seem to reflect their production efforts. In fact, their products are slightly more expensive than site-built homes. The higher prices are explained by their marketing strategy known as ‘cost performance.’ Originally, a mass custom design (MCD) approach was explained by using an analog model as follows: MCD = f (V, E, I, O). In order to upgrade the quality of housing, the cost performance marketing approach encourages manufacturers to install standard equipment (SE) that used to be offered only optionally. In consequence, the manufacturers do not reduce their selling price. Therefore, such an addition needs to be made to the original model. Thus, the model can be modified as follows: MCD = f (V, E, I, O) + SE. This implies that such standard equipment contributes towards increasing the price of housing, while upgrading the quality to a great extent.

Housing affordability is considered a crucial factor in determining whether or not the buyer actually proceeds with the purchase of the house. For this reason, the Japanese cost performance approach may not be applicable, unless consumers regard housing price as of secondary importance to quality. Moreover, according to the market needs and the company’s capability in mass-producing housing components, the component variations within the product sub-system need to be re-arranged. In principle, the mass custom design system helps both local homebuilders and housing manufacturers produce mass custom homes that can directly meet the housing demands of today.

References

Anderson, D. M. *Agile Product Development For Mass Customization*. Irwin, Chicago, 1997.
Cheng, T. C. E. *Just-In-Time Manufacturing: An Introduction*. Chapman & Hall, London, 1993.
Daiwa House Industry Co. Ltd. *Daiwa House Jyutaku Sogou Catalog*. Daiwa, Osaka, 1999.
Davis, M. S. *Future Perfect*. Addison-Wesley, New York, 1987.
Government Housing Loan Corporation (Tokyo@jyukou.go.jp). (11 15 1999). *Subject Unknown*, E-mail to M. Noguchi (masayoshi.noguchi@mcgill.ca).
Government Housing Loan Corporation (2001). *Kaku Kenbetu no Kojihi Tanka Chosa* [online], Available from:
http://www.sumai-web.or.Jp/nankan/tyousa/chousa.Html
[Accessed Jul 03 2001]
Hutchings, J. F. *Builder's Guide to Modular Construction*. McGraw-Hill, New York, 1996.
Ikegami, H. *Yokuwakaru Jyutaku Sangyo*. Nihon Jitsugyo, Tokyo.
Japan Prefabricated Construction Suppliers and Manufactures Association (1999). *Prefab Club* [online], Available from:
http://www.purekyo.or.jp/3-1.html
[Accessed Feb 01 2002]
Matsumura, S., and Shinichi T. *Kinmirai Jyutaku no Gijyutsu ga Wakaru Hon*. PHP Kenkyujo, Tokyo, 1996.
Misawa Homes Co. Ltd. *Technology Catalog*. Misawa, Tokyo, 1998.
Mishima, S. *Jyutaku*. Jitsumu Kyoiku, Tokyo, 2000.
National House Industrial Co. Ltd. *Pana Home: Pana Home Sogo Catalog*. National, Osaka, 1997.
---. *Technical Guide*. National, Osaka, 1999.
Noguchi, M. *User Choice and Flexibility in Japan's Prefabricated Housing Industry*. Unpublished M.Arch. Report. McGill University, Montreal, 2000.
Pine II, B. J. *Mass Customization: the New Frontier in Business Competition*. Harvard Business School, Massachusetts, 1993.
Sato, K. *Maker House*. Space Design Kenkyushitsu, Tokyo, 1996.
Sekisui Chemical Co. Ltd. *Cost Performance Seminar.* Sekisui, Tokyo, 1998a.
---. *The Housing Business of Sekisui Chemical Company*. Sekisui, Tokyo, 1998b.
---. *Two-U Setsubi '99*. Sekisui, Tokyo, 1999.
Smith, C. *Building your Home: An Insider's Guide*. NAHB, Washington, D.C., 1998.
Suzuki, H., Kato K., Wakayama T., and Sato T. *Jyutaku Sangyokai*. Kyoikusya, Tokyo, 1995.

Toffler, A. *Future Shock*. Random House, New York, 1970.
Toyota Motor Co. *Toyota Home Selection Catalog*. Toyota, Tokyo, 1998.

THE IMPACT ON ADULT ATTITUDES TO HOUSES OF CHILDHOOD EXPERIENCES OF HOME

Mahnaz PEJAM
Rob COWDROY
School of Architecture and the Built Environment,
University of Newcastle, NSW, Australia
mahpej@hotmail.com

Abstract:
This paper discusses how childhood experiences of one's house have consequences in adulthood, particularly in respect to preferences for openness and closedness of the house. Openness and closedness refers to the apparent transparency of division between interior parts of a house and between the inside and outside of a house.

The hypothesis for this study is that the interior spaces of a house (including form, material and dimensions) and the degree of their perceived openness and closedness have an important effect during childhood, as it is one of the most important experiences of non verbal communication with the world, society and family. The hypothesis also includes that the child's experience of the degree of openness and closedness in the arrangement of the house becomes embedded in the child's memory and that this experience will show its effect in attitudes toward house and home in adulthood.

Introduction

An individual's childhood experiences of one's house may have consequences in adulthood, particularly with respect to preferences for house location, type, layout, orientation, architectural features and details. This possibility is derived from literature on early childhood enculturation and its effects on adult behaviour and attitudes. The paper discusses a research project which is intended to provide empirical confirmation of a direct connection between childhood experiences of a house and an individual's adult preferences for particular aspects of a house. The significance of the study is that it is expected to provide a basis for more sensitive consideration of individual preferences in preparation by an architect of briefs and designs for houses for individual clients, particularly those from differing cultures.

This study focuses on one aspect of houses: the relative "openness" and "closedness" of the house. Openness and closedness refers to the apparent transparency of division between interior parts of a house and between the inside and outside of a house. The hypothesis for the study is that the interior spaces of a house (including form, material and dimensions) and the degree of their perceived openness and closedness have an important effect during childhood, as it is one of the most important experiences of non verbal communication with the world, society and family. The hypothesis also includes that the child's experience of the degree of openness and closedness of the house becomes embedded in the child's memory and that this experience will show its effect in attitudes toward house and home in adulthood.

Convergent reflection: towards a personal position

The author of the research, Mahnaz Pejam has always felt the deep affect of her childhood house, and that this memory, which is a part of her, has been influential in defining the meanings of new situations and environments. Mahnaz also finds resonances for her own anecdotal feelings in the literature, for example, Gaston Bachelard (1994) says of the childhood experience:

> *"House is the human being's first world, before he casts into the world".*

Ittelson (1974), writing on the adult condition, says:

> *"Spaces and places, no less than people can evoke intense emotional responses. Rooms, neighbourhoods, and cities can be 'friendly', 'threatening', 'frustrating', or loathsome;' they can induce hate, love, fear, desire, and other affective states."*

Juhani Pallasmaa (1996) brings the childhood and adult conditions together, saying:

> *"Surely the fact that certain early memories retain their personal identifiability and emotional force throughout our lives provides convincing proof of the importance and authenticity of these experiences, just as our dreams and daydreams reveal the most real and spontaneous contents of our minds."*

Pallasmaa also sees the house as providing some profound experiences:

> *"The house as a sign of culture in the landscape, the house as a projection of man and a point of reference in the landscape";*
> *"Stepping into a house, entering through the door, crossing the boundry between exterior and interior";*
> *"Coming home or stepping inside the house for a specific purpose, expectation and fulfilment, sense of strangeness and familiarity".*

Architectural design could have an important role in what a child learns of social and cultural messages during the continuous contact with the childhood house. The childhood house is a scene for experiencing the personal and social life and (it is hypothesised) this scene persists in reminding the adult person of those memories and influencing the adult's preferences and attitude towards his or her house. Memories of shapes, forms, arrangements, aromas and many other aspects of the childhood house therefore impact on the adult's experiences throughout life.

In this respect, Bachelard goes on to say:

> *"A house constitutes a body of images that give mankind proofs or illusions of stability. We are constantly re-imagining its reality: to distinguish all these images would be to describe the soul of the house; it would mean developing a veritable psychology of the house."*

This study is intended to provide empirical evidence to confirm (or deny) that there is a direct connection between our childhood experience of a house and the way we perceive the houses we live in as adults. The study tests the hypothesis that childhood experience of one aspect of a house (the openness/closedness) is directly related to adult preferences in relation to the same aspect (the openness/closedness). If the connection is confirmed, then it provides a basis for confirmation of the philosophical and anecdotal basis of the assumption of these writers about the impact that our childhood house and home has had on us as adults.

Divergent reflection: from the personal to the World

In this research the differences and similarities of, respectively, childhood and adult house and home become an important consideration. When we occupy a house we tend to "personalise" it in order to satisfy our individual preferences, which might be aimed at enhancing our physical or psychological comfort (or both). When a couple or family settle into a house they start to relate and define the meaning of its spaces individually, in terms of their separate social or personal values and interests.

This personalisation raises the question of differences in meaning between “house” and “home”. Attempts to define the respective meanings of house and home, however, are not conclusive. Architectural literature tends to refer to “house” as a physical object, a building providing sufficient space for physical activities, and modifying the physical environment, eg in terms of thermal and acoustic control. The psychological, sociological, anthropological and cultural literature, however, tends to refer to “home”, as a “place”, where a person lives for comfort and security, alone or with family members, including (for many people) raising children. It is a place, where a person spends time for essential day-to-day activities (eating, bathing, sleeping), as well as for retreat from the external world, and for leisure.

The boundaries of our ‘home’, however, may vary depending on our feelings of control and security and may be limited to parts of a house (eg for a child within a family) or may extend beyond the house to the garden (or “yard”), and to the neighbourhood. The boundaries of our home may also vary according to time of day (eg when we are “at home” or “at work”) and from one individual to another within a family or “household”. We may not be able to recognize these boundaries as definite borders, but they can have an effect on our sense of “belonging” and therfore on our perceptions and attitudes towards our immediate world and life.

Our house, therefore may be part of our home and our home may be part of our house. When the occupants can accommodate their respective physical and psychological needs in different parts of the house, the house can be defined as a part of the home for the inhabitants. In this respect, Dovey (1999) sees a house as a “social setting”:

> *The house is a “social factory”, the “engine room” of society. It is the setting which makes interaction meaningful and predictable, linking intimate emotional and sexual life to economic and political life. It both reflects and reproduces the social world of gender, age and class relations.”*

The degree of openness and closedness (or “transparency” in architectural terms) of a house can be related to our respective perceptions of the boundaries of our home. Individual houses differ in the degree of openness and closedness, and two types of openness and closedness can be identified. One is the degree of contact between outside and inside of the house. Another is the degree of contact between the different spaces inside the house. We can experience these transparencies through various senses including visual, hearing, touch and so on.

Openness and closdedness between outside and inside of the house:

Some examples of houses are presented below, illustrating differing degrees of openness and closedness in architectural terms according to visual sense (other senses cannot be engaged here).

Figure .1 illustrates a house with low levels of transparency. The small windows are covered with blinds, presenting a very low degree of visual transparency. Apparent *closedness* between inside and outside of the house is therefore indicated. This arrangement could be a result of culture or climate.

Figure .2 illustrates a house that presents a high level of transparency between outside and inside and, therefore, apparent *openness* is presented. The arrangement of the house is inviting the inhabitants to engage with the natural environment and to experience it not only visually but also through other senses, including hearing sounds from outside and feeling the outside temperature.

Figure 1- Low level of transparency

Figure. 2- High level of transparency

Figure 3 illustrates a "Queenslander" style house from north-eastern Australia, having a charasteristic veranda around the rooms, that moderates the openness/closedness by moderating the feeling of contact between inside and outside (and therefore of transparency). A low height fences provide another type and degree of hierarchical transparency.

Figure 4 illustrates a house that presents a high level of visual closedness. The covering of metal sheets, provides a very low degree of visual contact with outside, however the type of material allows high levels of transparency of noise and temperature between outside and inside for the occupants, and so the house could be considered to present selective transparency. These adaptations by the inhabitants could be responses to environmental conditions, or could be intended to achieve higher levels of privacy or security.

Figure. 3 Moderated transparency

Figure. 4 selective transparency

Openness and closdedness between interior spaces of the house:

A conventional house, with solid walls and doors separating rooms, presents high levels of closedness for each room. Opening a door will reduce the visual and acoustic closedness (increase the transparency) between adjacent rooms, and can be used as a device for adjusting the levels of transparency from time to time. A house with lightweight (low-mass) walls maintains high visual closedness but (usually) provides reduced acoustic closedness, which may be preferred.

An "open-plan" house (eg as illustrated in Figure 5), however, has no strict separation between the spaces, and presents a high level of transparency and low level of privacy, with interior spaces open to each other, the bedroom visible from the living area and with visual, auditory and aromatic contact between different spaces throughout the house.

Figure 5

The importance of previous experience on later perceptions of an environment

What we understand from our environment is not a complete reality but it is filtered by our perception of that situation, based on our previous experience of related environments. Brown (1972) says:

> *"The nature of the information that an individual acquires in such a setting (eg a specific room) depends not only on what is available in the setting but also on the character of the information that the individual brings into the perceptual situation."*

We also interact with our environment, so that our total (or net) perception is conditioned in part by our sensory contact with the present environment and in part by our previous experiences. Thus, we can see our environment as negative or positive depending on both our immediate responses to the environment and our interpretation of that environment according to our previous experiences. In this respect, Strongman (1987) asserts:

> "*It is indisputable that the environment has an emotional impact on the individual."*

Epsar (1989) says:

> *Some psychologists believe that the power of cognitive control effects the way that a situation is understood. Cognitive control changes what the situation is, based on perceptions of the situation, to a subjective reality.*

Ittleson adds:

> *"We behave as if the environment is structured in a certain way. Such perceptions are frequently influenced by one's previous experience with an environment"*.

The importance of childhood experience on later perceptions of an environment

At this point, perhaps the question is of how far in the past our "previous experience" can be while still having a significant effect on our present perceptions. That is, how long can our memory of such experiences be sustained. Epsar observes that:

“ Long-term memories are unlimited. Whatever we have experienced, it is presented in the form of networks in the mind. Each piece of concept links to others, which are associated with them.”

Thus, when we find something familiar, we connect together a range of memories from the past. As a result, we are “activated” to feel comfortable or uncomfortable when entering a place or when occupying a room or a part of a house, not only on account of our immediate response to the place itself, but also in response to our memories of previous experiences over long time periods.

Bachelard (1994) extends these long-term memories back as far as childhood, saying:

“A demonstration of imaginary primitive elements may be based on upon the entity that is most firmly fixed in our memories: the childhood home.”

The importance of of such long-term meries from early childhood experience is then established by Pallasmaa (1996) who says:

“One of the most important “raw materials” of phenomenological analysis of architecture is early childhood memory.”

Questions arising at this point are: whether an adult can remember his or her early childhood experiences, and whether high degrees of sensibility, in either or both the child and the adult are required to establish such memories to the extent that they are embedded. Pallasmaa observes:

“I personally, for instance, cannot bring to mind from my own childhood a single window or door as such but I can sit down at the windows of my many memories and look out at a garden that has long disappeared or a clearing now filled with trees. I can also recognise the dark warmth and special smell of the rooms that are there on the other side.”

The discussion to this point, based on selections from the literature, suggests that our early childhood experiences of home do influence our adult perceptions of our environment, including our home and the house as part of our home environment. There is also the suggestion that such early childhood experiences play a very important role in determining our adult perceptions of the environment including particularly the architectural environment, which includes the house. While we may not be able to remember some specifics such as architectural details, our remembered experiences of our childhood home environments are likely to be sufficiently clear to establish a connection to our adult preferences in relation to our adult home environment, including with respect to the openness/closedness of those respective environments, and the present study is proceeding on this basis.

Intended method

The research question is whether a statistically-significant connection can be established between an individual’s present (adult) preferences with respect to the houses he or she occupies, and the remembered (or recalled) perceptions of their childhood houses.

An attitude survey, by cross-cultural interview methods, is being made, to study the preferences of people in adulthood and to find out about their perceptions of their childhood homes. The reasons for the particular preferences will be considered, as correlations are thought to be more likely to occur between reasons why than between the attitudes themselves. Significant features of the respective houses, as indicated by the subject’s responses, will be recorded and compared.

Subjects are selected from three social groups of people with differing cultural backgrounds. One is a group of people who were born and are living in Australia. Another is a group of people who were born in Iran and experienced another culture and architecture there and are now living in Australia. The third group will consist of Iranian people who are still living in Iran. Comparison of results for these three groups is expected to indicate differences in adulthood preferences stemming from differences in childhood experiences.

Significance in psychology and architecture

In psychological terms this research focuses on the roots of peoples' attitudes in relation to one of their most important cultural instutions: their home. As the house forms a most important component of home, the study is justifiable in terms of psychology and the understanding of enculturation, and in terms of architectural practice and design of houses.
If the hypothesised connections are confirmed, then architects' design of houses might require reconsideration, on one hand to allow for the impact of their clients' early childhood experiences on their present briefing of architects, and on the other hand to allow for the possibility that the architects' own early childhood experiences will intrude into the interpretation of a client's needs and into the design of a house for that client. A further consideration is that a client couple may well have significantly different preferences for their joint house, driven by their respective childhood experiences, that may confound the traditional briefing and design processes. Norberg-Schulz (1996) foreshadows this outcome saying:

> *"A place is therefore a qualitative, "total" phenomenon, which we cannot reduce to any of its properties, such as spatial relationships, without losing its concrete nature out of sight"*.

Bibliography:

Bachelard, G. (1994). The Poetics Of Space. Boston: Bacon Press. (originally published in French in 1958, first translation 1964)

Brown, H. (1972). Perception And Meaning. Studies In The Philosophy Of Mind: American Philosophical Quartely Monograph Series

Dovey, K. (1999). Framing Places. London: Routledge

Epsar, D. (1989). (Video) Discovering Psychology, Program 9, Remembering And Forgetting. United States: Intellimation WGBH in association with the American Psychological Association.

Ittelson, W. H., Proshansky, H. M., Riviln, L. G., & Winkel, G. H. (1974). An Introduction To Environmental Psychology. New York: Holt, Rinehart, Winston.

Norberg-Schulz, C. (1996). The Phenomenology Of Place. New York: Architectural Press, Edited by Kate Nesbitt

Pallasmaa, J. (1996). The Geometry Of Feeling. New York: Princton Architectural Press. (Edited by Kate Nesbitt)

Strongman, K. T. (1987). The Psychology Of Emotion. New York: Willey.

Contact information:

Mailing address: Mahnaz Pejam,
School of Architecture and the Built Environment,
University of Newcastle,
University Drive,
Callaghan, NSW 2308, AUSTRALIA

Building Smarter Infrastructure: Resource Productivity in a Residential Development for Steinhatchee, Florida

Stephen LUONI
University of Florida
sluoni@ufl.edu

Abstract:
Environmental reforms in America have developed a significant repertoire of conservation practices directly proportional to the boom in suburban development since World War II. The chief obstacle to past comprehensive reforms in land development has been the fragmented approach of individual conservation practices, as their particular science and application were developed independently of one another. The following is a case study in design for *The Conservancy*, a "green development" for a 56-unit rural residential community on the Gulf of Mexico. The goal of design and research is to recombine environmental technologies in planning, infrastructure, landscape architecture, and architecture towards more integrated community development. Design methodologies are implemented to address three conservation criteria common to all green economy business models. First is *advanced resource productivity* to ease the energy economy's reliance on nonrenewable resources. Infrastructural logics, otherwise isolated in conventional development, are bundled into a mosaic with new operational overlaps. Second is the *creation of closed-loop energy systems* that promote the recycling of energy and materials to eliminate waste. Building and site utility systems are modeled after "feedback" in biological systems. Third is the *responsible stewardship of existing resources* that harness the ecology to create sustainable land use configurations. Landscape and architecture are integrated into a unified planning module as biological systems serve urbanizing functions. Since the lack of integrative thinking has been the obstacle to sustainable land development, recombinant design modalities, such as those used in *The Conservancy*, rather than technological innovation, will play the more critical role in developing sustainable environments.

Introduction:
Suburban Infrastructure, Environmental Reform and Green Development
Environmental reforms in America have developed a significant repertoire of conservation practices directly proportional to the boom in suburban development since World War II. Though we have not avoided the subsequent sprawl resulting from ill-planned suburban growth, reform initiatives have provided us with new conservation planning and design strategies to reorient the direction of suburban growth towards greater sustainability. The chief obstacle to past comprehensive reforms in land development has been the piecemeal approach of individual conservation practices as their particular science and application were developed independently of one another.

Individual reforms over the last 50 years have addressed land use, septic tank pollution, water quality, wildlife protection, energy efficient home design, erosion control, and wetland and floodplain protection in their relation to suburban residential development (Rome: 260). Yet, their applications were never administered in a collaborative manner. Among other reasons, obstacles to integrated design standards were mostly due to the fragmented nature of political authority in the United States, the resourcefulness of the building industry in avoiding regulation, and the strength of individual property rights politics in resisting holistic planning (Rome: 266). Thus, the bedrock value environmentalists placed on synergistic management and design—that everything is connected to everything else—was historically impossible to exercise.

Since buildings now consume over 30 per cent of our national energy budget and 60 per cent of our electricity (Rocky Mountain Institute: 7), institutionalized incentives are encouraging “smart growth”, with particular consideration for the flows of energy in the development of land and buildings. Recent community developments have successfully overcome financial and political barriers to achieving profitable projects that integrate progressive social and environmental goals. Known as “green development”, this emerging paradigm in real estate development emphasizes natural resource productivity and conservation. Here, natural resources are viewed as a form of economic capital in terms of their positive capacity to provide energy and life-affirming ecological services. Their negative outputs in the form of waste, pollution, and non-renewability are liabilities no longer ignored in real estate cost-benefit analyses. Realization of the conservation criterion governing green development requires different standards in design goals and methodologies. The goal is to achieve what author, Ernst von Weizsacker calls the “factor four principle: doubling wealth while halving resource use”. Since the lack of integrative thinking has been the obstacle to sustainable land development practices, design as it addresses interdisciplinary modalities, rather than technological innovation, will exert a more critical influence in building sustainable environments. Hence, design methodologies are implemented to address the three conservation criteria common to all green economy business models (Hawken et al: 10). First is *advanced resource productivity* to ease the energy economy’s reliance on nonrenewable resources. Second is the *creation of closed-loop energy systems* that promote the recycling of energy and materials to eliminate waste. Third is the *responsible stewardship of existing resources* that harness the ecology to create sustainable land use configurations. Such criteria will direct design towards more integrated methodologies that leverage economic, ecological, and aesthetic processes in land development.

Integrative Design Methodologies

Recombination is the key logic behind design methodologies implemented to realize the three-part conservation criteria of green development. Recombinant design employs integrative methodologies in three ways. First, in order to realize greater resource efficiency, project planning bundles different, infrastructural logics otherwise isolated in conventional development. Services related to transportation, waste treatment, water supply, stormwater remediation, and recreation are developed as an infrastructural mosaic to create new operational overlaps. How might infrastructure become less of a transport mechanism and more of an ecology?

In tandem with the first, the second strategy of recombinant design is to model building and site utility systems after "feedback" in biological systems. Feedback is a natural system's capacity for self-correction and responsiveness to internal and external fluctuations acting upon the system. Such capacities are necessary for the creation of functional closed-loop energy systems and effective resource exchange between and within systems.

Third, design addresses landscape and architecture as one planning unit, rather than as isolated systems. The site's biological systems, valued for their ecological services that are difficult to replicate in human infrastructure, are treated as "natural capital". Recombination of biological and human systems accomplishes responsible stewardship of existing resources, establishing an ecological compatibility between development and environmental protection. These three recombinant design strategies propose new land use configurations for exurban contexts without relying on traditional models of urbanism to address the unique logics organizing the suburb.

The following is a case study in design for *The Conservancy*, a 56-unit rural residential community on the Gulf of Mexico. The design's aim is to enhance the ecological capacity of new development through the integration of natural and social systems. Design combines environmental technologies in planning, infrastructure, landscape architecture, and architecture towards integrated community development. Though none of the project's individual design technologies break new ground, their recombination with one another offers new prospects for sustainable real estate development.

Advanced Resource Productivity and Creating Infrastructural Mosaics

In advanced resource productivity, value and economic vitality are measured by greater efficiencies in the use of natural resources while enhancing productivity. Planning for *The Conservancy* abandons the land-wasting patterns of subdivision design in favor of more integrated land use configurations without sacrificing privacy. The project masterplan features clustered townhouse units around a pedestrian oriented main street to conserve 85 per cent of the site as a wooded preserve and wildlife corridor. Unit clustering, shared auto courts, and commonly held recreational amenities save more than 60 per cent in infrastructure costs from conventional layouts. One of the more novel land uses in *The Conservancy* involves the bundling of different infrastructural logics into a mosaic, with the "shared street" as its unifying element. Just as recombinantion enhances biodiversity in the site ecology, recombinant infrastructure enhances the opportunities for social interaction within the community.

The Shared Street Concept

Local residential streets in America constitute 80 per cent of total national road miles. While they only convey 15 per cent of total vehicle miles traveled (Southworth and Ben-Joseph: 5), many local streets are designed with the same engineering standards instituted for highways. Their spaces privilege the movement of traffic over accommodations for a vital pedestrian life, and this is evidenced by the higher rate of pedestrian fatalities in suburbs than in cities. The civic ecology of the traditional urban street with its mixed uses, pedestrian vitality, and territorial claims from residents via windows or porch stoops—what Jane Jacobs referred to as "eyes on the street"—is absent from the contemporary suburb. The shared street concept is an attempt to integrate housing with pedestrian spaces and vehicular networks. Modeled after the Dutch *woonerf* (meaning residential yard), the main street in *The Conservancy* combines social uses of the street with the needs of local traffic. In the reclamation of the street as a public space populated by pedestrians, cyclists, and children at play, the street is designed as a garden for calming traffic rather than as a transportation corridor for segregating and optimizing traffic flows. The "shared street" as it is known in England, also called the "living street" in Germany or the "integrated street" in Israel has been used in progressive residential communities throughout Japan, Israel, Australia, and Europe, particularly in The Netherlands, Great Britain, and Germany, with a remarkable safety record (Southworth and Ben-Joseph: 118).

Essentially, the street is designed as a series of landscaped urban rooms or yards that integrate walks, plazas, courtyards, and the roadway onto one surface without the use of curbs, sidewalks, and other rigid means for segregating pedestrians and traffic. Playing and walking are allowed everywhere. Engineered traffic calming devices like speed bumps, humps, tables, and roundabouts are avoided in favor of street enclosures shaped to encourage slower speeds and simultaneous pedestrian use. Traffic speed is regulated by landscape groupings that force shallow bends, deviations and undulations in the course of vehicular movement. Bands of decorative paving material, shell rock, and permeable ground covers alternate with asphalt to distinguish the various yards comprising the street. Tree, shrub, and bench arrangements further reinforce the street's configuration as a linear series of yards organizing adjacent residential courts. These residential courts extend the domestic realm of the dwelling unit into the street without sacrificing individual privacy. In contrast to the smooth undifferentiated space of the highway, the shared street is shaped by a porous and fuzzy edge logic characteristic in ecological relationships. The shared street facilitates an active pedestrian life and pioneers a more equitable relationship between automobiles and pedestrians, as it has already proven, particularly in The Netherlands (Southworth and Ben-Joseph: 117).

Stormwater retention gardens for collection and treatment of polluted storm runoff are incorporated into the space of the street. Eliminating the need for unsightly detention ditches and underground sewer lines to transport runoff, decentralized retention gardens with hyper-accumulator plants for absorbing pollutants participate in the creation of the street's urban rooms. The street becomes another component in the site's ecology, providing environmental services like on-site waste treatment, pollution abatement, flood control, enhanced biodiversity, wildlife habitat, and local aquifer recharge. Acting more like a biological filter increasing runoff absorption, the shared street reverses the problems of sediment erosion and runoff channelization associated with impervious road surfaces. Construction and maintenance costs from sewer lines and other catchment infrastructure are eliminated honoring the factor four principle mentioned earlier (doubling wealth while halving resource). Another collateral benefit is the new aesthetic opportunity for spatial expression arising from conceptualization of the street as a landscape. Functioning as a meshwork logic that recombines the biological with the

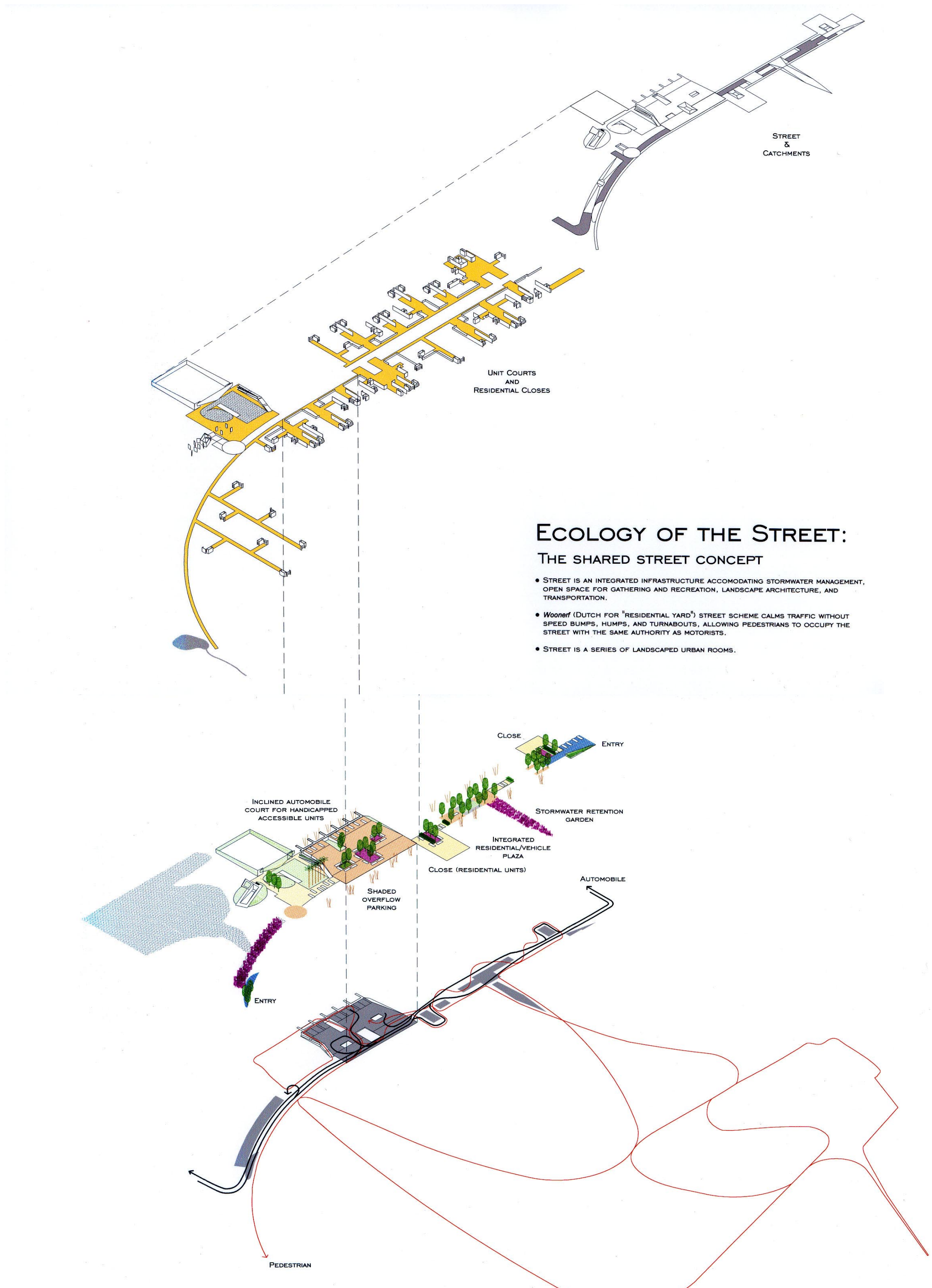


Figure 1. The Ecology of the Street.

social, planners Michael Southworth and Eran Ben-Joseph note, “streets would not only be evaluated in terms of their capacity to carry traffic, but also environmental quality as measured by noise, pollution, social activity, pedestrianization, and visual aesthetics” (110). Advanced resource productivity works exponentially, enriching social capital as it enhances the biological capital of place.

Figure 2. The Shared Street.

Creation of Closed-loop Energy Systems Through Feedback

Closed-loop systems are cyclical organizations of energy distribution that recycle their own energy flows, approaching self-sufficiency and elimination of the concept of waste. Besides trimming energy budgets based on nonrenewable resources, closed-loop organization decreases environmental stress caused by the human movement of material. Humans now move around more material than nature, geological and atmospheric forces combined (von Weizsacker et al: 237). Excessive material movement creates environmental stress equally as damaging as toxic emission. Feedback in closed-loop organizations would improve economies in material movement through alignment of outputs from one system as nutrients for another. Utility systems designed for *The Conservancy* are modeled after the closed-loop logic governing material flows in nature.

Material Flows: Closed-loop Versus Open-loop Energy Distribution

Nature’s modes of transport are ecologically constructed systems with self-regulating capacities for aligning outputs from one organic system as nutrients for another. As ecosystems mature into multiple feedback loops, their nutrient chains undergo a process of shortening and branching to produce rhizomatous systems of significant biological wealth with progressively less energy needs. Their dendritic path structures favor responsiveness over stability and are readily adaptable to disruptive internal and external fluctuations. Through an internal messaging structure known as feedback (Peet: 75), closed-loop systems are continually self-corrective, recycling and switching energy among alternative paths with a consequent multiplier effect. Matter is regenerative in every phase of its circulation, serving symbiotic functions in composition, decomposition and morphosis. Here, ecological thinking demonstrates that everything is connected to everything else. In contrast, open-loop systems are typified by dissipative linear flows with energy-intensive inputs and non-useful outputs in the forms of pollution and waste (Peet: 13). Industrial production systems are classic open-loop organizations, making man the only species whose outputs are not usable as nourishment for another species (Kibert: 19). Given their closed-loop behavior, ecosystems are paradigms of energy distribution since their "climax" systems are the most efficient users of energy and the concept of waste is nonexistent.

Unlike multiple feedback in biological systems, industrial open-loop dynamics are path dependent, conditioned by narrow measures of productivity, performance, and design. Especially with industrial cultures, open-looped energy systems suffer from an inefficient metabolism, requiring high quality resource investments—usually nonrenewable—with resultant low-grade material outputs of limited functional life spans. This is particularly evident in the diminishing returns intrinsic to productive processes in industrial economies. Based on nonrenewable fossil fuel energy, production often requires 100 to 10 000 times the energy for extraction and processing than available energy returns in the final product (Hawken et al: 50). Expenditures on extraction and processing—a product's or service's embodied energy—represents a cost rarely proportional to functional returns and is further outweighed by post-functional liabilities from pollution, residual toxicity, and long hazardous half-lives. In Germany, this hidden history is known as "ecological rucksack" (von Weizsacker et al: 242), calling attention to the environmental stresses stemming from the movement of material and not just that caused by toxic emission.

Building and Site as Generators of Energy

Infrastructure in green development aims to create energy-neutral environments. Like closed-loop systems approaching maturity, infrastructure will bundle conservation, regeneration, and other ecological services with its primary transport function to achieve a balanced energy economy. Considering the imperative of advanced resource productivity in the emerging green economy, infrastructure will move beyond energy consumption to become a net producer of energy. As a foundation for progressive economic development, infrastructure enhances social capacity by transferring surplus energy to the power grid.

Through a combination of passive and active solar building strategies, townhouse units for *The Conservancy* operate as "mini-utilities". Units are equipped with a solar photovoltaic cell system that concurrently serve as a wind scoop to amplify ventilation, and a sunshade to shield portions of the unit and its roof garden. Given Florida's solar availability, conditions are optimal for photovoltaic technology to meet all energy needs and generate a surplus. Surpluses are banked at the power company for credit in an exchange known as "net metering". Photovoltaic systems are supplemented by solar panels for hot water heating and other various passive solar strategies for regulating heat gain and loss. Rather than treat solar building technologies as accessories applied upon completion, unit designs follow a more integral solution for improved energy performance, conservation, comfort, and aesthetic expression.

Since cooling loads dominate energy budgets in Florida and high humidity excludes natural cooling by moisturizing the air, townhouse units are designed to amplify natural ventilation. Raising units off of the ground maximizes their envelopes' exposure to sea breezes. In addition to the use of wind scoops, townhouse units contain an open-air light court at the center. Light courts function as microecologies, filling the center of the townhouse with indirect light while cooling the unit through convective ventilation. Light courts operate as thermal chimneys that vent rising warm air as cooler air is drawn from beneath the unit. The light court's glass skins contain an array of operable windows and terraces to extend indoors the benefits of amplified ventilation. As a governor of further feedback in the unit, light courts include cisterns for rainwater harvesting, and ground water loop heat sinks for air conditioning output. The latter eliminates the need for noisy and unsightly air compressors, preserving the site's acoustical environment.

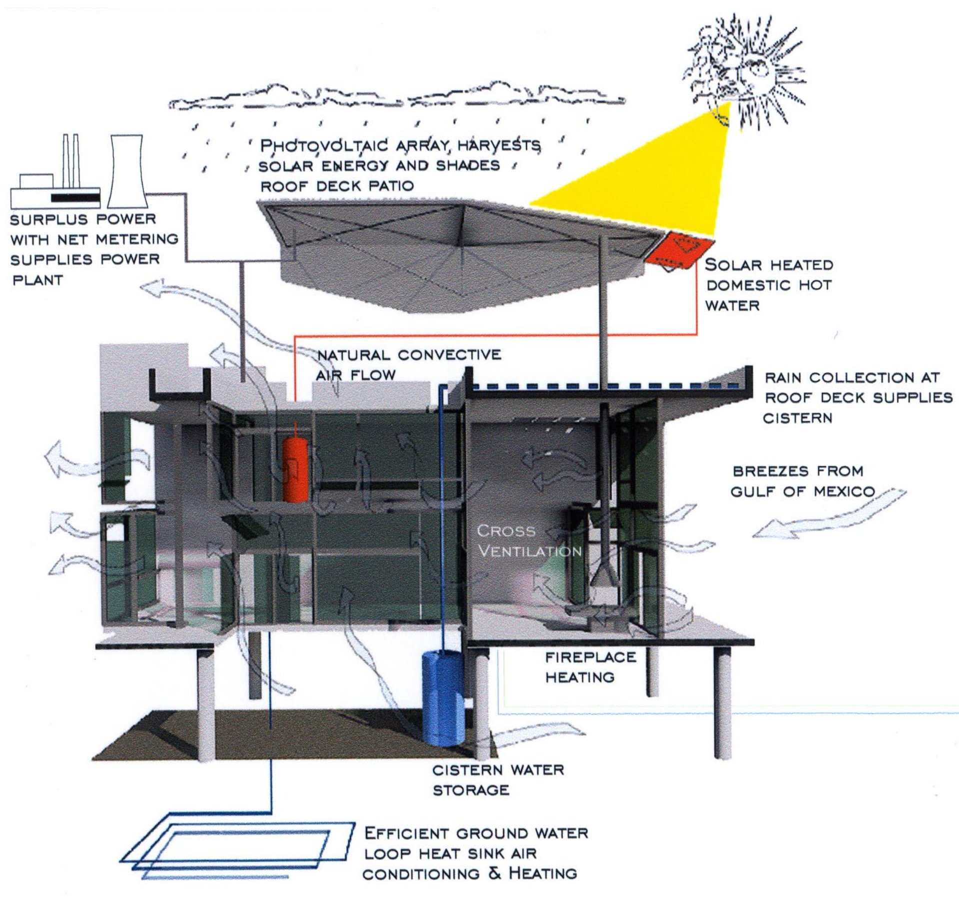


Figure 3. Cross-section Through Interior

Wastewater Treatment

The circulation of water is the single most important life supporting service provided by nature and sets the limits for nature's ability to function. Since wastewater constitutes 80 per cent of all annual waste flows in America (Hawken et al: 51), the impact of its movement on land development is significant. Designed as elaborate transport systems to relocate waste from its source points, water treatment infrastructure projects the same environmental liabilities as other open-loop systems. First, conventional wastewater infrastructure produces toxic byproducts and uses even more toxic substances like aluminum salts (linked to Alzheimer's disease) to mitigate the effects of its initial treatment outputs. Second, treatment processes use hazardous chemicals like chlorine, which, when combined with organic matter, produce carcinogenic residues. Third, centralized wastewater treatment plants are not cost effective, requiring large federal subsidies for their construction (Todd and Todd: xvi). Nor are they energy efficient. *The Conservancy* uses constructed wetlands, akin to "living machines", as a substitute for the conventional mechanical treatment facility. Since sewage contains an abundance of valuable nutrients like nitrates, potash and phosphates (Todd and Todd: xvii), waste treatment systems should be organized as recycling facilities, rather than as disposal systems.

The use of constructed wetlands as core components in decentralized water treatment is gaining acceptance worldwide. Engineer, Scott Wallace likens wetlands to: "the 'kidneys' of our planet, wetlands exchange dirty contaminants for clean, pure water and provide wildlife habitat in the process" (57). In a process known as bioremediation, combinations of living plant and microbe communities are engineered to neutralize volatile compounds in wastewater and recycle their byproducts back into the environment without the use of toxic chemicals. More specific examples of bioremediation, like phytoremediation for instance, incorporate hyper-accumulator plants like those from the Brassica plant family (cabbage, mustard, and radishes) to absorb toxic metals. Cabbage, in particular, is an excellent accumulator, absorbing metal deposits up to 1 000 times higher than concentrations in surrounding soils (Grace: 151). In addition to facilitating nutrient exchange, wetland plants and soils function as biological filters, trapping colloidal particles like petroleum hydrocarbons and otherwise hard to break down suspended solids. Through a treatment train of nutrient exchange and mechanical filtering, constructed wetlands use closed-loop logic in eliminating the production of waste while lowering construction and maintenance treatment costs by as much as 60 – 95% (Rocky Mountain Institute: 146).

To naturally treat wastewater at *The Conservancy*, an on-site treatment plant combines ultraviolet disinfection—replacing chlorination, which produces excess ammonia—with constructed wetlands as core treatment strategies. Wetland design varies from one region to another based on climate and site ecology. However, the basic wetland cell for wastewater treatment is a waterproof, rock-lined pond housing local hydrophytes, or flood tolerant plant species like cattails, bulrushes, reeds and other hard tissue plants. Unlike stormwater treatment, a more narrow range of plants is chosen for its vigorous rooting structures, which attract productive microbial bacteria to promote oxygenization in an otherwise anaerobic root zone. The cell cross-section accommodates a combination of anaerobic and aerobic conditions driving many healthy chemical transformations produced by the interface between plants and sediment (Wallace: 58). Treated effluent is discharged at twice the purity index than water treated in a conventional system, requiring negligible energy input for pumping and aeration. Treatment cells in this particular closed-loop system become internal links in larger biological treatment trains, serving as switching mechanisms to redirect cleaned effluent towards other purposeful uses. Effluent is harvested as irrigation for organic community gardens, aquifer and groundwater recharge, and as a gray water supply for domestic uses not requiring the highest quality water. The latter should cut potable water consumption by as much as 40 per cent since flushing toilets and washing driveways do not require drinking grade water.

Side effects of biological treatment, like that from increased mosquito population, are mitigated through the intensification of feedback protocols. Integrated pest management introduces local bat species and mosquito fish into the treatment ecology. Mosquito fish feed off of mosquito larvae while bats typically consume hundreds of mosquitoes in an evening. Feedback protocols also eliminate odors typically associated with waste treatment since odors are nonexistent in treatment systems that balance inputs with outputs. Organic treatment systems eliminate the usual source of odor that stems from hydrogen sulfide produced in systems lacking aerobic capacity (Campbell: 187). Closed-loop dynamics resolve their own imbalances since they create ever more productive feedback as they approach climax maturity. Wastewater treatment infrastructure then, may prove to be the most radical example of recombinant infrastructure as its protocols abandon steel, concrete, and chemicals to embrace the function and aesthetics of biological meshworks.

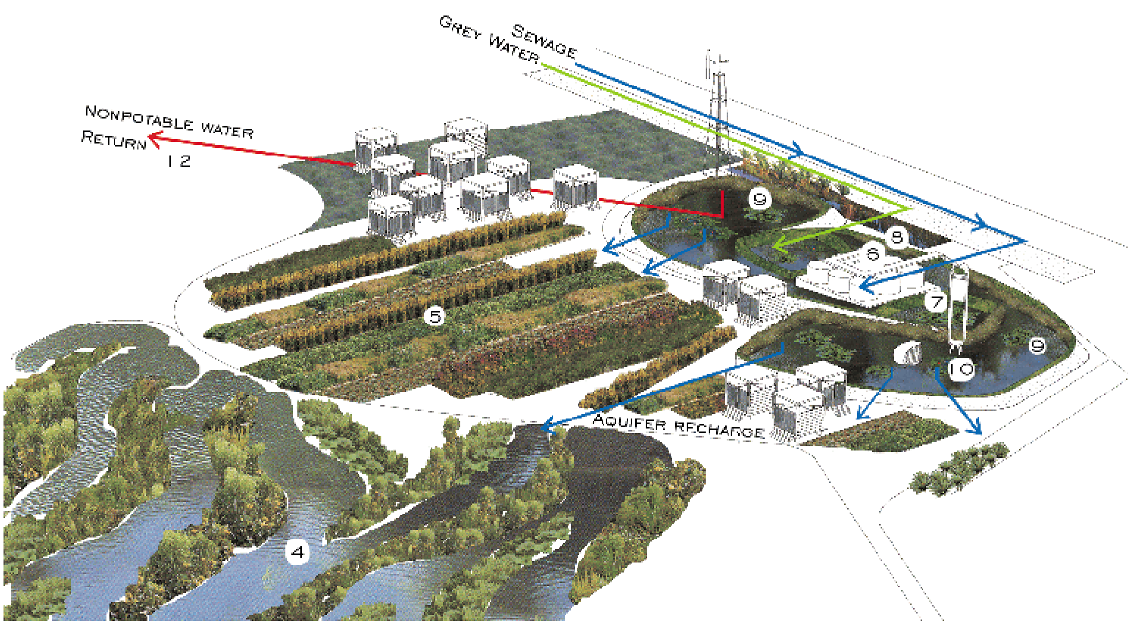


Figure 3. Wastewater Treatment Garden.

Responsible Stewardship of Existing Resources and New Land Use Configurations

Responsible stewardship of natural resources involves more than the preservation of environmentally sensitive areas set apart form the city. Environmental reform can no longer exclude the city from the theoretical and practical considerations of the ecological sciences. Meaningful stewardship now involves the integration of environmental and urban systems. It is now understood that biological systems can serve urbanizing functions (see Platt et al). Indeed, recombinant design seeks an ecological capacity in infrastructure to create intelligent systems with a high degree of interconnectedness and positive feedback. Material exchange in infrastructure for *The Conservancy* will provide collateral services like natural resource regeneration, conservation, and nutrient production, entailing more integrated land use configurations than those produced by classic zoning patterns.

Stormwater Treatment

The stormwater management plan for *The Conservancy* completes the hydrological loop in the delivery of ecosystem services. While the dynamics between storm and waste treatment differ, environmental consequences from stormwater should not be slighted as the first half-inch of urban runoff from a storm event has a pollution content greater than that of raw sewage (Cavanaugh and Spontak: 86). Rather than channelize stormwater runoff into unsightly, centralized detention basins apart from public space, the objective is to create an ecological meshwork whose movement, storage, and treatment patterns resemble the sheet flow of natural wetlands. Conventional stormwater treatment facilities are simply detention/conveyance systems, whereas retention systems, favored by more ecologically sound water management practices, address problems of water quality, groundwater recharge, and conservation. Detention strategies are simply path dependent, concentrating water pollutants beyond the carrying capacity of local landscapes to biologically neutralize their toxicity. Hydrological infrastructure for *The Conservancy* harnesses water as a biological and aesthetic amenity to organize the neighborhood fabric and open space network.

The proposed treatment train links existing wetlands with constructed stormwater retention gardens. Existing marshes, hardwood forests, springs, wetlands, aquifer recharge areas, and wildlife corridors are preserved and integrated into the hydrological infrastructure. The plan's full typological range of new retention including biofiltration ponds, swales, stormwater gardens, water harvesting ponds, and marshes creates a community-scaled watershed for treatment, flood control, and biodiversity enhancement. As mentioned earlier, stormwater gardens are integrated within the space of the street, providing a regional character to the street. Ecological feedback governs the functioning of this new treatment network, eliminating the need for gutters, concrete catchments, pipeline, and other transport apparatus used in conventional runoff management. Automobile parking is clumped in stormwater gardens to minimize distances between surface pollutants and their treatment destinations. While land use configurations become more decentralized as ecological functioning entails greater scales of organization, these configurations simultaneously undergo a greater degree of horizontal and vertical integration. The watershed serves equally alongside the street as a planning module for community development, countering the tendencies of open-loop infrastructure towards concentration, while creating aesthetically superior landscapes.

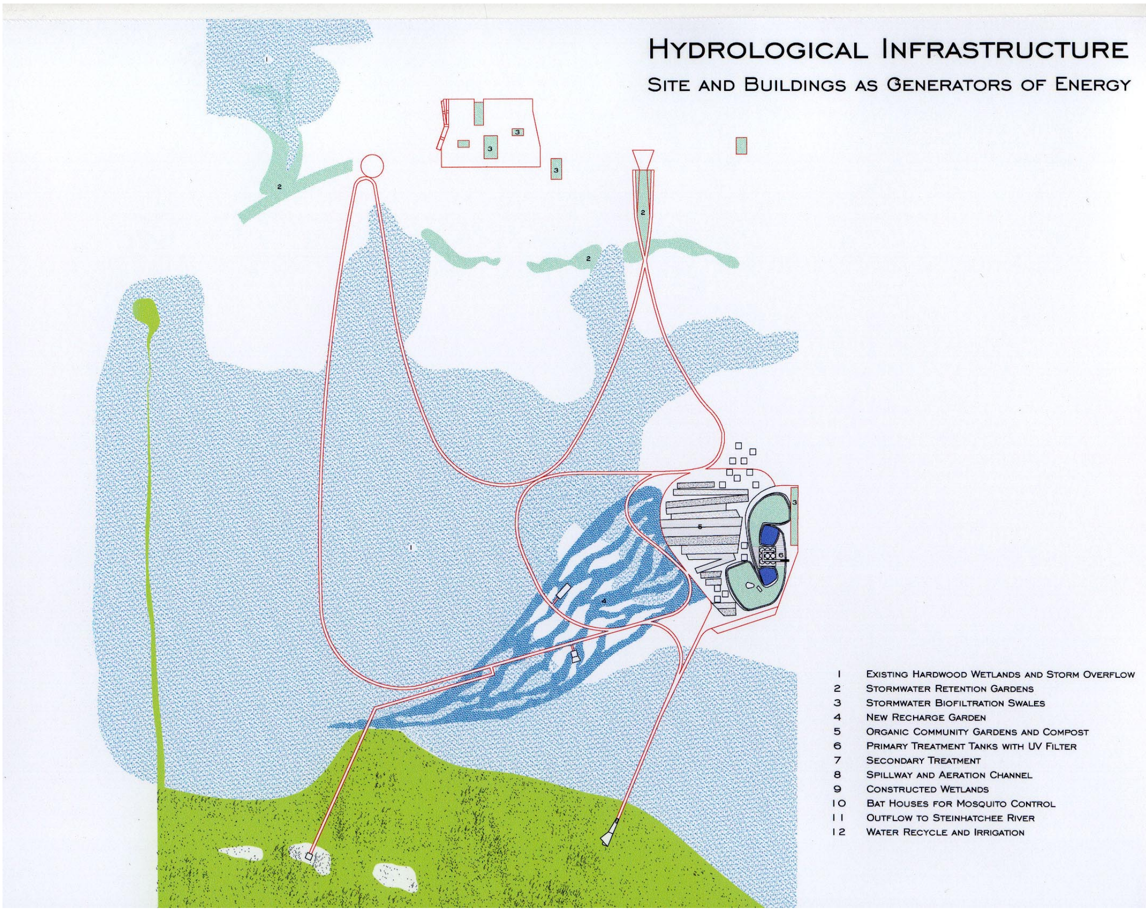


Figure 4. Hydrological Infrastructure.

Conclusion: Infrastructure and Creating New Economies of Feedback

Environmental reforms in America developed land conservation practices that failed to prevent ill-planned exurban growth. The chief obstacle to comprehensive reform has been the fragmented application of individual conservation practices as their particular sciences were developed independently of the others. Recent community developments have overcome political and economic barriers to realize profitable conservation-oriented developments. This new paradigm in real estate development, known as "green development", is based on recombinant methodologies of design. Recombinant design seeks an ecological capacity in infrastructure to create systems with a high degree of interconnectedness and positive feedback. Ecological capacity indicates degree of decentralization, multiple and positive feedback, resource productivity, integration, diversity, and resilience. The collateral benefits will not just add, but multiply.

Spatial configurations from recombinant thinking entail new protocols for formatting space. Standards of design based on the fixed optimization of narrow goals—demonstrated in conventional street design, energy networks, and water management infrastructure—are exchanged for protocols based on the new conservation criteria for radical resource productivity. Protocols supporting greater economies of feedback will bundle otherwise specialized infrastructural logics into a mosaic with novel integrated operational overlaps. Rather than view human habitats begrudgingly as necessary interventions apart from the environment, buildings and their supporting infrastructure should be designed as part of the ecological web. A new planning poetics emerges reflecting novel collaborations between machine and garden as human agency can indeed regenerate life and biodiversity.

Bibliography

Campbell, Craig S. and Michael H. Ogden. 1999: *Constructed Wetlands in the Sustainable Landscape*, New York: John Wiley & Sons, Inc.

Cavanaugh, P. and M. Spontak. 1992: *Protecting Paradise: 300 Ways to Protect Florida's Environment*, Fairfield, Florida: Phoenix Publishing.

Grace, Eric. 1997: *Biotechnologies Unzipped: Promises and Realities*, Washington, D.C.: Joseph Henry Press

Hawken, Paul; Amory Lovins, Hunter Lovins. 1999: *Natural Capitalism: Creating the Next Industrial Revolution*, Boston: Little, Brown and Company.

Holtz Kay, Jane. 1997: *Asphalt Nation: How the Automobile Took Over America and How We Can Take It Back*, New York: Crown Publishers.

Kibert, Charles. 1999: "The Promises and Limits of Sustainability", *Reshaping the Built Environment: Ecology, Ethics, and Economies of Sustainability*, ed. Charles Kibert, Washington D.C.: Island Press.

Marshall, Alex. 2000: *How Cities Work: Suburbs, Sprawl, and the Roads Not Taken*, Austin: The University of Texas Press.

Melosi, Martin. 2000: *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present*, Baltimore: The Johns Hopkins University Press.

Peet, John. 1992: *Energy and the Ecological Economics of Sustainability*, Washington D.C.: Island Press.

Platt, R., R. Rowntree, P. Muick (eds). 1994: *The Ecological City: Preserving and Restoring Urban Biodiversity*, Amherst: The University of Massachusetts Press.

Rocky Mountain Institute. Wilson, Alex, Jennifer L. Uncapher, Lisa McManigal, L. Hunter Lovins, Maureen Cureton, William D. Browning. 1998: *Green Development: Integrating Ecology and Real Estate*, New York: John Wiley & Sons, Inc.

Rome, Adam. 2001: *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism*, Cambridge, UK: Cambridge University Press.

Southworth, Michael and Eran Ben-Joseph. 1997: *Streets and the Shaping of Towns and Cities*, New York: McGraw-Hill.

Todd, Nancy Jack and John Todd. 1994: *From Eco-Cities to Living Machines: Principles of Ecological Design*, Berkeley: North Atlantic Books.

Von Weizsacker, Ernst, A.B. Lovins, Hunter Lovins. 1997: *Factor Four: Doubling Wealth, Halving Resource Use*, London: Earthscan Publications.

Wallace, Scott. 1998, July: “Putting Wetlands to Work”, *Civil Engineering*, Vol. 68, No. 7, pp. 57-59.

The Frustrating Realities of Cold Climate Design: Piercing the Skin: Ins-U-lation versus Ins-O-lation

Terri Meyer Boake B.E.S. B.Arch. M.Arch.
Associate Professor
School of Architecture
University of Waterloo

When glazing (windows and skylights) accounts for 7.5 to 19 times the losses based on the same area as the wall or roof they displace, even slight modifications in U-values can account for large variations in overall energy efficiency.

From First Principles:

The first principle of energy efficient environmental building design for a cold climate is as follows: First INSULATE, and then INSOLATE. The use of passive solar design principles can be key to reducing the overall amount of energy consumed by residential buildings. Create warm tight walls, then, perforate with an adequate number of windows to absorb free energy. Ensure that there is adequate thermal mass present to absorb and then, later, reradiate the free heat. The principle is simple. Its detailed application is complex. Apertures effectively puncture the building skin, resulting in a discontinuity of the thermal integrity of the envelope. Piercing creates a thermal hiatus, as the thermal resistance of the windows is normally a fraction of the insulation value of the wall. Environmental concerns arise out of the loss of heat through these openings as well as the control of solar gain as it affects cooling loads. Orientation must be intrinsically considered for each and every opening. Shading devices need to be designed in order to manage the amount and quality of solar gain and light. Daylighting should also factor into the design equation, in its potential to reduce energy costs as well as a “D”esign element.

The art of creating adequately insulated wall assemblies has by and large been perfected. The Energy Crisis of the mid 1970’s resulted in code and subsequent practice changes that succeeded in drastically increasing the minimum insulation values in cold climate building envelopes. Ensuing envelope research defined the need for an air barrier as a means to control infiltration and exfiltration through the building envelope. Even the simplest “skin” of the cold climate building has become an increasingly thick, multi-layered assembly. By code, it can be nothing less. Current building and energy codes mandate a high minimum level of thermal resistance in walls.

Glazing, on the other hand, in spite of major technical advancements to improve its energy performance, has remained a thin and relatively vulnerable design element. Windows are at risk as they are both fragile and costly. Whereas a reasonable minimum thermal performance standard can be easily maintained throughout the detailed design of the opaque portion of the building envelope, cost cuts will often decrease the level of quality, design and performance of the window systems actually installed in the building. Windows and glazing systems often appear as quite expensive single “line items” on preliminary cost estimates for construction. The environmental quality of a window is directly proportional to its cost. Highly efficient windows are many times as expensive as their low quality counterparts. Budgeted values for window systems are all too easy for clients to attack in the effort to save capital cost. Changes in manufacturer, quality, number of glazing layers, etcetera, can dramatically reduce the energy effectiveness of such systems. Unless designers provide accurate comparative energy simulation results, it becomes difficult to convince budget conscious clients to spend extra funds on Insolation.

The Model National Energy Code of Canada for Houses 1997:

The Model National Energy Code of Canada for Houses was published in 1997 and is intended as a “progeny” or stand-alone document. Unlike traditional model codes which normally address health and safety issues, it addresses the issues of environmental protection and resource conservation. The MNECH provides model national technical requirements for use or adoption, in whole or in part, by local or provincial authorities. These regulations can be ignored if they are not part of their government’s agenda. As such, the MNECH outlines a set of technical regulations that expect a higher standard than those outlined in the National Building Code of Canada. The NBC is the national model code, which is either adopted by the Province or improved upon in the creation of specific provincial codes such as the Ontario Building Code

According to the Model National Energy Code of Canada for Houses 1997, (for a specific region [1]), the minimum RSI and *R* values for a zone having up to 5000 Celsius *(9000 Fahrenheit)* Degree Days are as follows for above ground elements [2]

Attic-type roofs:	5.6 m^{2}x^{o}C/W	or a	U-value of	0.178 W/m^{2}x^{o}C
	31.8 hxft^{2}x^{o}F/Btu			*0.031 Btu/hxft^{2}x^{o}F*
All other roofs:	4.3 m^{2}x^{o}C/W	or a	U-value of	0.233 W/m^{2}x^{o}C
	24.4 hxft^{2}x^{o}F/Btu			*0.041 Btu/hxft^{2}x^{o}F*
Walls:	2.9 m^{2}x^{o}C/W	or a	U-value of	0.345 W/m^{2}x^{o}C
	16.5 hxft^{2}x^{o}F/Btu			*0.061 Btu/hxft^{2}x^{o}F*
Floors:	4.5 m^{2}x^{o}C/W	or a	U-value of	0.217 W/m^{2}x^{o}C
	25.5 hxft^{2}x^{o}F/Btu			*0.039 Btu/hxft^{2}x^{o}F*

Windows[3], on the other hand, may demonstrate a maximum U-value of 2.60 W/m^{2}x^{o}C *(0.457 Btu/hxft^{2}x^{o}F),* or a minimum RSI value of 0.385 m^{2}x^{o}C/W *(R value of 2.2 hxft^{2}x^{o}F/Btu).* By piercing the wall envelope, we replace highly efficient walls with components that by area transmit 7.5 times as much heat per hour. Skylights are permitted to have a thermal transmission value of 3.4 W/m^{2}x^{o}C *(0.599 Btu/hxft^{2}x^{o}F),* which will permit the loss of approximately 14.5 to 19 times as much heat as the roof areas they are replacing.

The values cited for windows are different for operable versus fixed versus sashless windows. It is accepted that operable windows will have poorer performance because the sashes and hardware needed to make the unit operable will have a negative effect on its energy efficiency. The frames for the operable portion decrease the glass to frame ratio for an operable unit versus a fixed unit. The various types of operable units incur air leakage as a result of the type of operation. Casement windows with pressure locking hardware will have a higher degree of efficiency than windows that slide. Fixed glazing without a sash is expected to perform substantially better than either operable or fixed windows with sashes.

The Energy Rating (ER):

The Guidelines of the Model National Energy Code for Canada 1997 outline minimum energy ratings for windows that meet CSA Standard A440.2: Energy Performance Evaluation of Windows and Other Fenestration. Until CSA Standard A440.2 was developed, it was not possible to compare the overall energy performance of different windows. If energy performance information was provided by the manufacturer, it was often quoted as the R-value or the U-value for the center-of-glass area. This did not take into account the effect of the frame and sash, so it usually over-represented the energy performance of the entire window. In addition to outlining a method for the calculation of solar heat gain coefficients, U-values and air leakage, CSA Standard A440.2 also provides a method for calculating an overall Energy Rating (ER) for a window to be used in a self-contained low-rise residential building by combining the three properties

(a) solar heat gain coefficient (SHGC);
(b) overall heat transmission coefficient (U-value); and
(c) air leakage

into a single overall rating. The ER provides a means to compare the energy performance of one window for use in a low-rise residential building with another. The Energy Rating (ER) provides a method of rating the relative thermal performance of windows that gives, in a single number to a window's *combined response* to solar heat gain, conductive heat loss and air leakage in typical Canadian climatic conditions. It is based on the total performance of all window components, including glazing, spacers, glass and frame.

However, because of the manner in which the ER is determined, there are limitations to its applicability. ER is only applicable when comparing windows and sliding glass doors that will be used in houses under specified heating conditions. The ER calculation assumes vertical installation in a typical residence and is based on average conditions for solar radiation incident on windows facing the four cardinal compass directions (north, east, south, and west) and for representative climate zones in Canada. The ER may be positive or negative. A positive ER indicates that the window generally gains more energy through solar gain than it loses over the heating season. Most ER ratings for windows are negative. This means that the window loses more energy over the heating season than it gains from solar exposure. This is the typical case.

Additionally, the ER value is derived as an average of the performance of windows facing north, south, east and west. This is a suitable approach if designing for general energy efficiency rather than passive solar design. For example, where traditional builders are constructing a subdivision, there will be approximately the same numbers of windows facing each direction. Builders normally will use the same type of window throughout the project. The ER will provide a fairly accurate overall picture of the energy efficiency of the development.

For passive solar design, it is absolutely necessary to differentiate the ER for all orientations. Passive solar design may specify different types of windows and glazings for the various directions as a direct result of the solar design strategy. Where Low-E glass may be suitable to decrease conductive losses on shaded elevations, its incorporation will be detrimental if used on south elevations. The Low-E coating will decrease heat losses, but will at the same time, decrease solar gains by increasing the value of the shading coefficient. CSA Standard A440.2 does include a methodology for the differentiated calculations of ER values as depended on various exposures.

Where the Energy Rating can be an excellent "general" means of comparing the quality of glazing products, the ER value is typically not the information required for input into many thermal performance computer simulation programs. Energy-10, being a U.S. based product, requires U-values and SHGC values in order to run a simulation.

The Ontario Building Code 1997: Requirements for Window Design

The 1997 Ontario Building Code adopted parts of the window criteria as posed by the MNECH 1997. The OBC differentiates between window/glazing requirements for "standard" building design and "Thermal Design" (a.k.a. Passive Solar Design). The thermal insulation requirements for "standard" residential buildings are assumed to work with the table of "minimum" window area requirements, below. The assumption seems to be that builders who use this portion of the Code will be working to more "cost effective" minimum standards. The thermal integrity of these types of buildings is not likely to be compromised by the inclusion of excessive amounts of windows.

Glass Areas for Rooms of Residential Occupancies: [4]

Location	Minimum Unobstructed Glass Area	
	With No Electric Lighting	With Electric Lighting
Laundry, basement, recreation room, unfinished basement	4% of area served	Windows not required
Water closet room	0.37m^2	(4 ft^2)
Kitchen, kitchen space, kitchen alcove	10% of area served	Windows not required
Living rooms and dining rooms	10% of area served	10% of area served
Bedrooms and other finished rooms not mentioned above	5% of area served	5% of area served

For windows that meet the above criteria, the only energy requirements are:

(a) Air infiltration shall not exceed 0.775 dm3/s for each meter (0.5 cfm for each foot) of sash crack when tested at a pressure differential of 75 Pa (0.011 psi))

(b) All glazing that separates heated space from unheated space shall have a thermal resistance of not less than 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu)

The OBC requirements are slightly more stringent for residences with electric heating and copy the MNECH in their requirement of an ER of not less than –13 for operable windows and sliding glass doors, and an ER of 0 for fixed glazing.

Additionally, the Code requires that the maximum amount of glazing (including windows, skylights and doors) can not exceed 20% of the floor area of the story being served by the glazing nor exceed 40% of the total area of the walls of that story.

The OBC Regulations: Glazing and Passive Solar Design

The Ontario Building Code uses a separate set of requirements for glazing in the case of "Thermal Design". The Code states that this section applies to the thermal design of a building of residential occupancy where such design is an *alternative* to the normal thermal insulation requirements.[5] This section of the Code creates a series of alternate regulations that take into account the use of windows of a higher thermal value, modifications as a result of shading coefficients, and the need to increase the area of glazing to achieve passive solar design. Passive thermal design is regulated for buildings with thermal values for windows that exceed the 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu) set point. The MNECH presents a similar set of guidelines that are designed to "prevent this Code's limitation of window area from being an impediment to the intelligent incorporation of passive solar heating in house design"[6].

The 20%/40% rule may be broken, i.e. the amount of glazing increased, if the thermal values for the windows are higher than 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu). To meet the 20%/40% rule, the actual amount of glazing is calculated as being equal to the actual area of window, multiplied by the ratio of the required thermal resistance divided by the actual thermal resistance of the window. For example, if the Code permitted the building of 10m^2 of window with a resistance value of 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu), if you selected a window with an insulation value of 0.40 $m^{2o}C/W$ (2.27 ft^2xhx^oF/Btu), your ratio would be 0.30/0.40 = 0.75. You could actually have 13.3 m^2 of windows as when 13.3 is multiplied by 0.75, it translates to the value of 10m^2. Therefore, the higher the thermal value for the window, the proportionally higher amount of glazing is permitted – resulting in theoretically identical heat losses.

Glazing areas can also be increased where the design is using passive solar gain principles on "south" facing orientations. In such cases the glazing area may be calculated at 50% of what is actually being constructed, provided that:

(a) the area contains clear glass or has a shading coefficient of more than 0.70 (the MNECH uses a value of 0.61), *and*

(b) faces a direction within 45^o of due South, *and*

(c) is unshaded in the Winter (calculating angles based on Dec. 21 at noon), *and*

(d) the building is designed with a system that is capable of distributing the solar gain from such glazed areas throughout the building.

Where houses are designed for cooling, window areas cannot be increased, as outlined above, except where the glazing is shaded in the summer with exterior devices. The shading is to be calculated using noon sun angles for June 21.

The minimum accepted values for air infiltration are the same for both Passive and standard building types.

The Difficult Task of *Finding* the *Right* Information:

Now we know the rules. But, before the merits of any glazing design can be assessed, the designer faces the task of gathering technical information about the specific types of glazing and windows. This can be a very difficult and frustrating task. Whereas the thermal resistance values of opaque building materials are readily available, thermal resistance or more normally, conductance values of glazing products, glass block and windows are not generically listed in the same publications. These items are excluded from the broad category of “building materials”. The resistance and conductance values for glazing materials are specifically attached to proprietary products. The values are highly dependent on the conducting of tests which must account for glass types, thicknesses, coatings, air spaces, spacer types, glass to frame ratios for each window size, frame materials, operability, air leakage, and shading coefficients. The final values are available only from the manufacturer because of their product specific nature. The values are produced sometimes in cooperation with CSA or ASTM approved testing agencies, and at other times by independent testing agencies whose services are purchased by the window manufacturer.

To add to the frustration, Standards, Testing Methods, Computer Simulation Programs and product information are available in an inconsistent combination of SI and Imperial Units. The U-value and R-value are universal terms whose units may be readily converted from SI to Imperial and vice versa. The Solar Heat Gain Factor, values for UV Blockage and Light Transmittance are standardized percentages. The ER rating is specifically Canadian. Although a useful value, it is not available for the majority of products that are produced by U.S. based manufacturers.

As a result, specific information is required in order to properly assess the thermal performance of windows, and subsequently produce accurate heat loss/gain calculations for the entire building. This information is difficult to obtain and often unreliable. Where practitioners and researchers may have the facility to keep up to date catalogues on a wide range of glazing products at their fingertips, most students do not. The two most readily used sources that students use for finding building information are the Internet and Sweets Catalogue. The 2000 Sweets Catalogue CD, under Division 8: Windows and Doors, lists a great number of manufacturers of window products and is a good place to start. Many of the sections also provide hot links to manufacturers’ web sites that may have more and more up to date information. On the surface, this is a great resource, however, a review reveals that the information provided is very inconsistent from manufacturer to manufacturer. Some manufacturers provide detailed descriptions, specifications and details, and, some do not. Because of their different frame to glass ratios, different values are required for operable versus fixed glass units. These values could not be found in the manufacturers specifications.

The most common piece of technical information listed was the coefficient of airtightness. A rare few manufacturers listed any information regarding conductance, solar heat gain factor or light or UV transmission. Many are quick to proclaim their product as “Insulating”, “Energy Efficient”, thermally broken, or having low-e glass with argon fill. Few manufacturers back up these claims with data. This becomes very problematic when attempting to create an accurate estimate of the contribution windows make towards the energy efficiency of the overall building envelope.

When glazing (wall windows and skylights) accounts for 7.5 to 19 times the losses based on the same area as a wall or roof, even slight modifications in U-values can account for large variations in overall energy efficiency. Many manufacturers may quote thermal resistance values for the center of glazing in their windows. This value is always higher than the effective thermal resistance of the window when the effects of the edge seal and window frame are taken into account. If these values are used instead of a lower, more accurate thermal resistance value, the calculations of overall losses can be erroneous. It is also a problem when a U- or R-value is quoted for a glazing unit and the manufacturer is unclear as to whether the value is for the center of glass or overall performance.

The Canadian Wood Frame House Construction Handbook 1997/8 cites the following table to compare "typical" window thermal efficiencies. The comparison is only based upon a casement style window.

Comparison of Typical Window Thermal Efficiencies:

Thermal Performance of a Typical Casement Window with Low Conductivity Edge Seal			
Glazing Type:	***Aluminum Frame with Thermal Break***	***Wood or Vinyl Frame***	***Fiberglass Frame***
	R (RSI)/ Energy Rating	***R (RSI)/ Energy Rating***	***R (RSI)/ Energy Rating***
Double Glazed Clear with Air Fill	1.59 (0.28)/ -40.6	2.04 (0.36)/ -24.9	2.38 (0.42)/ -19.0
Double Glazed Low-E with Air Fill	1.99 (0.35)/ -32.7	2.67 (0.47)/ -17.1	3.12 (0.55)/ -11.5
Double Glazed Low-E with Argon	2.10 (0.37)/ -29.0	2.90 (0.51)/ -13.3	3.46 (0.61)/ -8.0
Triple Glazed Clear with Air Fill	1.99 (0.35)/ -32.7	2.84 (0.50)/ -11.8	3.18 (0.56)/ -10.8
Triple Glazed Low-E with Air Fill	2.21 (0.39)/ -27.9	3.41 (0.60)/ -9.5	3.86 (0.68)/ -6.2

The guidelines in the Canadian Wood Frame House Construction Handbook also make recommendations with respect to the minimum standards for energy efficient windows. It concurs with the MNECH that at the minimum windows should have an ER of –13 or higher. This translates into a double-glazed window with Low-E coating and argon gas fill. Higher efficiency windows are recommended for the colder regions of Canada. A glance at the chart above would indicate that thermally broken aluminum frame windows would never meet the ER criteria. Only wood, vinyl and fiberglass frame windows with higher quality glazing would meet the ER rating conditions. However, only one window would fail to meet the OBC code requirement of 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu). The Handbook makes no mention of Shading Coefficients.

Comparing this type of “idealized” data with actual manufacturers’ test results is interesting. The only window manufacturer that I could find on the “web” that published a thorough spreadsheet of test values was Loewen Windows[7]. They had complete spreadsheets for all of its wood and door types, both metal clad and non clad, including Canadian ER ratings, NFRC total unit SHGC and Visible Light Transmittance Factors and Imperial U-values. The Velux Roof Windows and Skylights website had similar, although less comprehensive, charts of statistical data.[8] The chart below is an excerpt for the purposes of comparing the test values for casement windows with the CHMC chart.

Loewen Windows Test Data:

Thermal Performance of a Typical Casement Window with Low Conductivity Edge Seal		
Glazing Type:	***Metal Clad Wood Frame***	***Non Clad Wood Frame***
	R (RSI)/ Energy Rating/ SHGC	***R (RSI)/ Energy Rating/ SHGC***
Double Glazed Clear with Air Fill	2.04 (0.36)/ -27 0.52	2.13 (0.38)/ -25 0.51
Double Glazed Low-E with Argon	2.13 (0.38)/ -25 0.29	2.22 (0.39)/ -22 0.28
Triple Glazed Clear with Air Fill	2.86 (0.50)/ -14 0.47	2.94 (0.52)/ -12 0.46
Triple Glazed Low-E with Air Fill and Argon	3.57 (0.63)/ -18 0.26	3.85 (0.69)/ -16 0.26
Triple Glazed 2 Low-E with Argon	4.17 (0.73)/ -14 0.24	4.55 (0.80)/ -12 0.24

Compared to the generalized "ideal" results table posed by the Canadian Wood Frame House Construction Handbook, the Loewen results would indicate that only 2 of their windows would meet the ER criteria of a maximum rating of –13. Both of these windows types call for triple glazing – a type I would suggest is beyond the budget of most housing. All of these windows, however, exceed the minimum thermal rating of 0.30 $m^{2o}C/W$ (1.70 ft^2xhx^oF/Btu) as described in the Ontario Building Code. All would be able to be used in "Thermal Design" as a means to increase the maximum allowable glass (the 20%/40% rule). None of these windows has a high enough SHGC to allow for an increase in area based upon thermal solar gain principles.

The best source that I have found thus far, limited to window types available in the Canadian market, and that have been tested and rated, is available for free download on the Enermodal Engineering web site. It can be found at

http://www.enermodal.com/catalognew.html.

This links to CATALOGUE, a very comprehensive listing of all energy rating criteria for a wide range of residential windows and does include ER values – values that cannot be found elsewhere. Enermodal Engineering is one of the new genre of consultancies that has chosen to specialize in the design and testing of windows and is also producing other software that can be used to design/evaluate sustainable buildings.

The Balancing Game: Comparing the Merits of Ins-U-lation versus Ins-O-lation

The thermally efficient detailed design of the typical exterior wall or roof is a relatively straightforward task. Codes, combined with tested practice, have given us rather formulaic assemblies for standard wall compositions: brick veneer, precast concrete veneer, EIFS systems and metal cladding on a choice of wood frame, concrete block, or steel stud backup systems. There have been adequate research documents produced that publish details that address the more difficult construction issues associated with standard envelope or cladding systems. In addition, it is a relatively straightforward task to perform quick comparative overall thermal resistance calculations for typical wall or roof assemblies using easily accessible tables of thermal resistance or conductance values for a wide range of wall and roofing materials. Thermal performance simulation programs make fast work of predicting overall loss values for a number of scenarios where materials and insulation types and thicknesses can be changed. Values are typically based on calculations of losses and do not take into account solar gains, shading or orientation. The focus of the thermal resistance calculations for opaque portions of the building envelope is on INSULATION.

There are two routes that can be taken when designing/selecting windows. The "easy way" is to simply specify windows that meet the minimum standards as set by the Code. The task of designing *thermally effective* openings – windows or skylights – is a much more complicated undertaking – a balancing game. Not only must the INSULATION value of the openings be calculated, but in order to be accurate, their INSOLATION values must also be incorporated. Including the Insolation values will help to offset the considerable heat losses created by window openings. If using a computer simulation program to perform the energy calculations, it is also possible to incorporate the effect that Daylighting has on the overall energy picture.

There are significantly more variables to incorporate when accounting for the effectiveness of the insolation value of openings. To properly calculate the role of the "window" elements as they pierce the thermal effectiveness of the building envelope we must look carefully at three primary areas:

1. INSULATION:

Calculate Heat Loss: this requires that an *accurate* R or U-value be attached to the area of the window. Certain calculation methods will also account for airtightness/leakage values. The windows must meet or exceed Code requirements. *(This is the minimum that is required by Code).*

2. INSOLATION:

Calculate Heat Gain: this requires accounting for a Shading Coefficient of the glass (knowledge of the actual type of glass); precise orientation of each glazed portion; local site shading characteristics that may affect each glazed unit; design/ use of shading devices; use and extent of thermal mass.

3. DAYLIGHTING:

Calculate Daylighting Payoffs: determine the amount of energy that can be offset where daylighting can complement or displace the need for electric lighting.

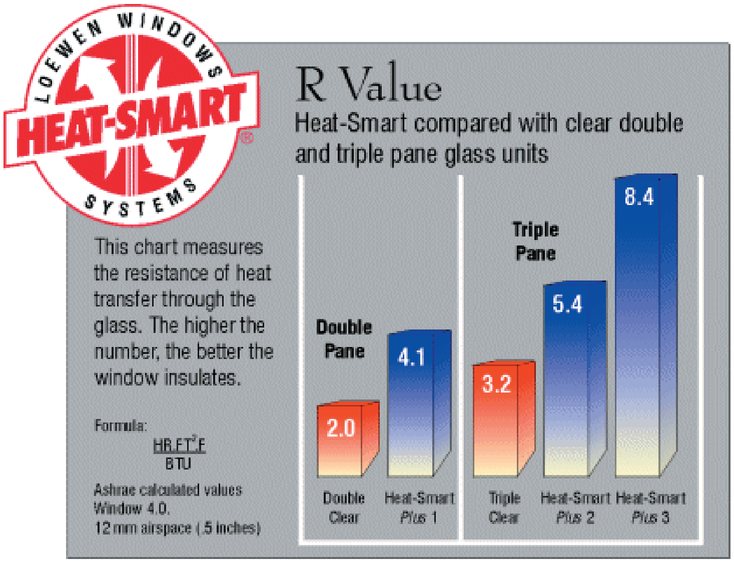
Looking at windows in this way asks that Architects take a more challenging and comprehensive approach to the question than is legally required. The Building Code normally requires insulation calculations. Codes have varied responses or even rules to account for the incorporation of Insolation strategies. Daylighting is only required in residential buildings to meet minimum health and safety requirements and is not generally considered as an energy strategy.

Selling Energy Efficient Window Design:

When looking at window design and selection, the standards that are mandated “by law”, fall well short of providing an energy efficient solution to a high standard. Manufacturers are successfully selling windows that do not meet the Code requirements. Responsible architecture should strive to pierce building skins with environmentally effective openings. Architectural education can play a very important role is encouraging future Architects to approach window design in a thorough and environmentally responsible manner – in spite of relatively lax legal requirements.

The majority of clients and builders regard Codes and Standards as maximums rather than minimums from a performance point of view. Their viewpoint is based on budget-founded decisions. Better windows, more windows, shading devices and thermal mass cost money. How can an Architect or Designer encourage that kind of expenditure when the Code is being met? In order to sell clients on energy efficient window strategies that are going to increase their capital cost, it is necessary to provide easy to understand, cost reflective data, to substantiate the claims that environmental payback will be created by passive solar design strategies.

Both Energy-10, from the United States (Imperial Units), and Hot-2000, from Canada (SI Units), provide computer simulation machines that are, to varying degrees, capable of handling the task of energy efficient window design that goes beyond insulation values. They can also run comparative simulations so that various energy strategies can be assessed as to their relative value (both dollar and environmental). Questions can be posed. Is it worthwhile to increase the thermal resistance value of a window? Is there any benefit to adding shading devices or thermal mass? Does daylighting substantially reduce the requirement for electric lighting? Does daylighting negatively impact heat loss? These questions should be answered, with numerical data, in order to back up and verify the employment of many passive design strategies.



Increasingly environmentally interested clients will be seeking products that provide accurate, comparative information, related to the thermal performance of windows.

In Conclusion:

We can identify three “levels” of energy efficiency that can rate the environmental aspects of windows.

Level One, *minimum efficiency*, is by far the simplest method. It entails specifying windows and skylights that simply *meet* the minimum energy standards as set by the Building Code. Some quality control is required during installation to ensure that air leakage is also minimized. This method produces openings that still account for 7.5 to 19 times the heat losses based on the same area of wall or roof. Meeting minimum standards does not constitute responsible energy efficient or environmentally conscious design. Losses can be drastically reduced if additional energy efficient strategies are applied.

Level Two, *medium efficiency*, suggests the adoption of the Model National Energy Code for Houses. This simply applied strategy raises the standards of window selection/specification to meet the National Model Energy Code. This code requires that window specification be related to the environmental characteristics of the primary fuel source, requiring better windows where fuel is more “expensive”. This approach limits the range of windows and skylights that meet the criteria, as well as decreases general heat losses = fuel burned. It also requires quality control on site installation against air leakage. The NMECH, which bases its chart on average orientation is suitable for “builders” as it adopts rules that work irrespective of solar orientation, hence not requiring much “thought”.

Level Three, *high efficiency*, aims even higher and asks that designers account for a combination of the Insulation, Insolation and Daylighting potential of openings. This necessitates the incorporation of passive solar design strategies. This level of energy efficiency requires that windows be “designed”, not just “specified”. Orientation and interior building materials (thermal mass), and colors (daylighting) must be accounted for. Different window construction will be required on the different cardinal directions. The Appendix of the NMECH gives some procedures that can be followed. There are many computer programs that can be used to make the task “simpler”, although even these launch the energy efficient design in windows into a realm that will be beyond the patience of most designers. It begins to open up a field for yet another area of specialization and consultancy.

To properly design energy efficient openings for cold climate applications is not an easy task. It is, however, essential.

Notes:

[1] National Model Energy Code for Houses 1997. Appendix A. Ontario. Region A - <5000 C Degree Days. Table A-3.3.1.1 Prescriptive Requirements for Above Ground Assemblies

[2] Considering Natural Gas Heat. The tables note more stringent values for Oil and Electric heating.

[3] Windows that do not meet CSA Standard A440.2: Energy Efficiency Values for Windows; i.e. are not tested and labeled as such.

[4] Ontario Building Code 1997. Table 9.7.1.2. Forming part of sentence 9.7.1.2.(1)

[5] Ontario Building Code 1997. Section 9.38. Thermal Design, Sentence 9.38.1.1. Application

[6] MNECH 1997. E-3.3.1.5.(2) South Facing Glass

[7] Loewen Windows information can be found at http://www.loewen.com/heatsmart.html

[8] The Velux glazing descriptions can be found at: <http://193.163.166.226/252.asp>

Differential Durability and the Life Cycle of Buildings

Ted KESIK Ph.D., P.Eng.
Faculty of Architecture, Landscape and Design
University of Toronto
ted.kesik@utoronto.ca

Abstract:
This paper presents findings from research conducted into the differential durability of major components comprising modern buildings, and how this impacts their life cycle energy demand, and hence their sustainability. The purpose of the research is to provide architects with better insights into the life cycle energy implications of material, assembly and system selections.

Differential durability is a term used to describe how the useful service life of building components, such as structure, envelope, finishes and services, differs - both between components, and within the materials, assemblies and systems comprising the components. A fuller consideration of recurring embodied energy (maintenance, repair, retrofit and replacement) during the design process has the potential to realize significant opportunities for enhancing the life cycle sustainability of modern buildings.

A review of international research generally indicates that with exception to structural elements, all of the other components require varying levels of maintenance, repair and replacement during the life cycle of the building. The extent and intensity of these recurring embodied energy demands vary significantly, depending on how appropriately the durability of materials, assemblies and systems are harmonized, and how accessible they are for periodic maintenance, repair and replacement.

Differential Durability and the Life Cycle of Buildings

Introduction

The life cycle of buildings includes design, construction, occupancy, maintenance, repair, renovation, alteration, retrofit and deconstruction. Occupancy, or operation, normally accounts for the largest proportion of the environmental impacts over the life cycle of the building, due to the relatively high non-renewable energy demands of most buildings. Maintenance, repair, renovation, alteration, and retrofit vary in degrees of impact depending on the durability of the building components, and the flexibility/adaptability of the building system.

As building technology gains sophistication in the integration of systems, it is important to consider the durability of constituent elements. In components such as walls and roofs comprised of multiple materials that are layered and/or overlapped, the resultant serviceability is limited by the least durable material. For building services, their accessibility for repair and replacement is critical, and when these are concealed within the fabric of the building, premature deterioration and failure, or obsolescence, imply the costly and disruptive deconstruction of well performing fixtures and finishes.

In all cases the value and importance of intelligent design is reinforced by contrasting the influence of this relatively brief, conceptual process on the life cycle outcome afforded the building.

Terminology

Before continuing with the body of this paper, the following terminology is presented to provide a basis of discussion [1]:

Durability - The ability of a building, its parts, components and materials to resist the action of degrading agents over a period of time.

Service Life - The period of time during which all essential performance characteristics of a properly maintained item (product, component, assembly or construction) in service exceeds the minimum acceptable values.

Design Life - The service life that the designer intends an item (product, component, assembly or construction) to achieve when subject to the expected service conditions and maintained according to a prescribed maintenance plan.

An important term that is often absent in durability literature is service quality. This term goes beyond the purely functional performance of a product, component, assembly or construction to include attributes such as aesthetics. For example, two different roofing materials may have an identical service life, but exhibit different visual deterioration. One may appear unsightly after a fraction of its service life has expired, while the other may preserve its appearance until only a few years before becoming unserviceable. Functionally both keep out the water for as long a period of time, but the service quality of the latter is higher for longer, as depicted in Figure 1.

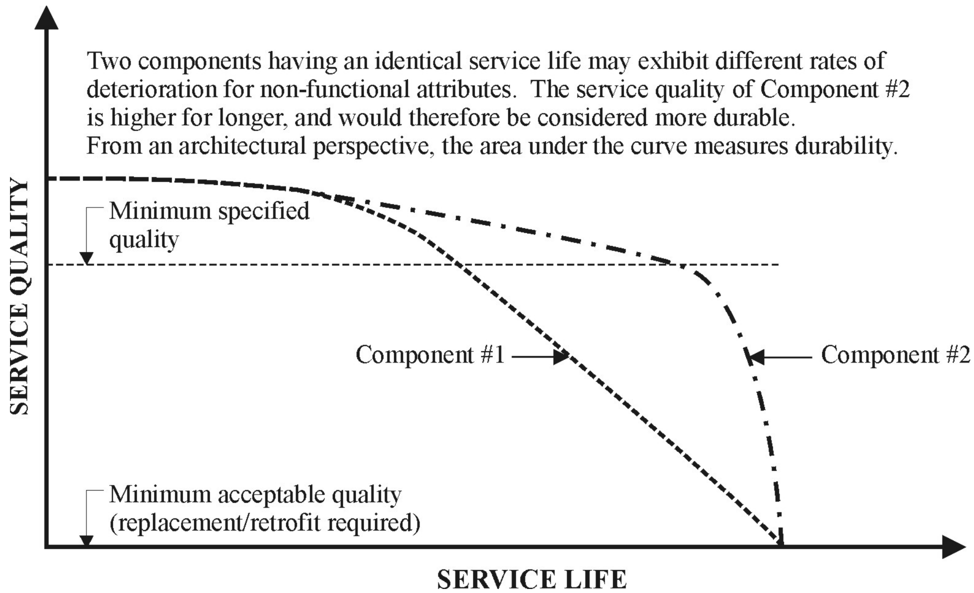


Figure 1. Service Quality X Service Life = Durability

Differential Durability Defined
Differential durability is a term used to describe how the useful service life of building components, such as structure, envelope, finishes and services, differs - both between components, and within the materials, assemblies and systems comprising the components. The term may also be used to describe the whole building system by comparing between the service life of the building and its functional obsolescence.

A review of international research generally indicates that with exception to structural elements, all of the other components require varying levels of maintenance, repair and replacement during the life cycle of the building. The extent and intensity of these recurring embodied energy demands vary significantly, depending on how appropriately the durability of materials, assemblies and systems are harmonized, and how accessible they are for periodic maintenance, repair and replacement.

Figure 2 depicts the key characteristics and relationships associated with differential durability concepts. As discussed earlier, durability may be expressed as a function of service quality and service life. There are three critical service quality thresholds related to durability: 1) the specified quality, established by the designer and/or minimum codes and standards, representing the typical new service condition; 2) the minimum acceptable quality indicating the need for replacement or retrofit; and 3) failure, where the material or assembly is considered completely unserviceable.

Failure may occur suddenly as in the case of a lamp, pump or similar type of equipment, or it may result after gradual deterioration. Maintenance or restoration taking place prior to failure can extend the service life, whereas deferred retrofit or replacement beyond the minimum acceptable quality threshold can accelerate total failure. It is important to note that in some cases, the initial service quality of the material or assembly may exceed the specified quality based on codes and standards.

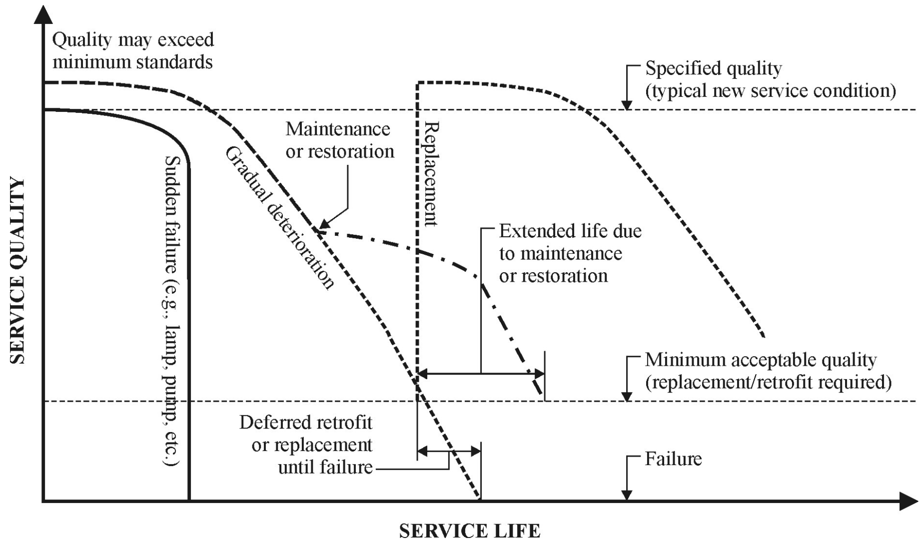


Figure 2. Durability characteristics and relationships as a function of service quality and service life.

Given these basic characteristics and relationships, it is possible to explore various aspects of differential durability. Figure 3 depicts the underutilization of durability in assemblies with interdependent components exhibiting differential durability.

A practical example of interdependent durability is the case of bricks and brick ties, where the former deliver a longer service life than the latter. When the inferior durability component reaches the end of its useful service life, the superior durability component is often replaced at the same time, resulting in an underutilization of its durability. The lesser the degree of durability harmonization, and the greater the degree of difference in initial service quality between components, the greater the underutilized or wasted durability (embodied energy) of the assembly. This underutilization has a direct impact on the recurring embodied energy demand over the building life cycle.

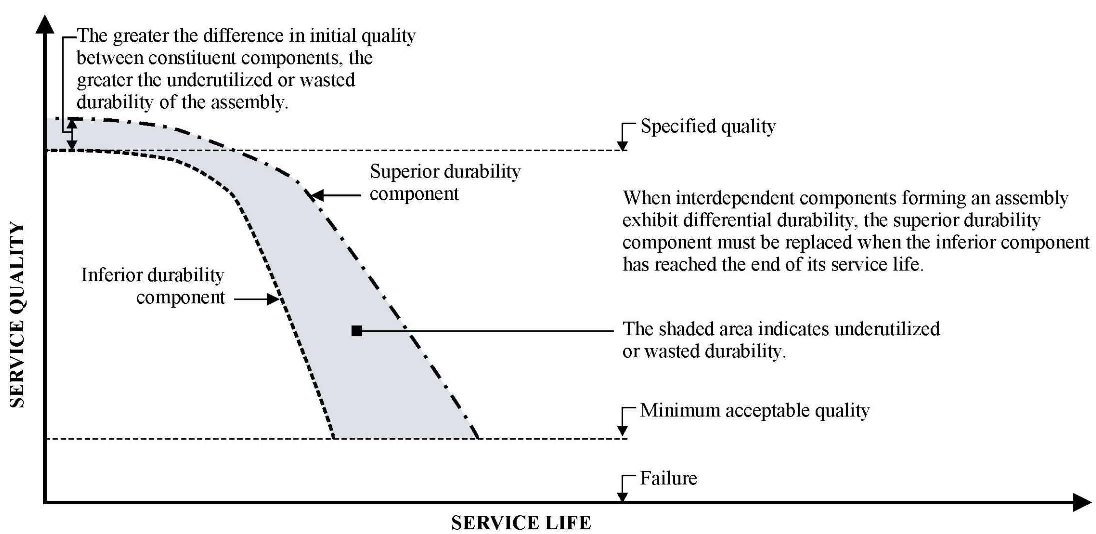


Figure 3. Underutilization of durability in assemblies with interdependent components exhibiting differential durability.

The magnitude of recurring embodied energy is compounded when the assembly is replaced at the end of the inferior component's service life, as depicted in Figure 4. This prematurely expended durability must be added to the underutilized durability when assessing the impacts of differential durability.

This type of accounting is not normally conducted in durability research related to the recurring energy content of buildings. At this time, it is difficult to accurately assess the magnitude of these compounding effects due to the scarce availability of verifiable data. However, a tour through any typical building demolition/reclaim yard indicates that many of the materials and components are serviceable. In the case of old windows where the glazing is serviceable long after the frames have deteriorated, the compound recurring energy for the glazing may easily approach 50%.

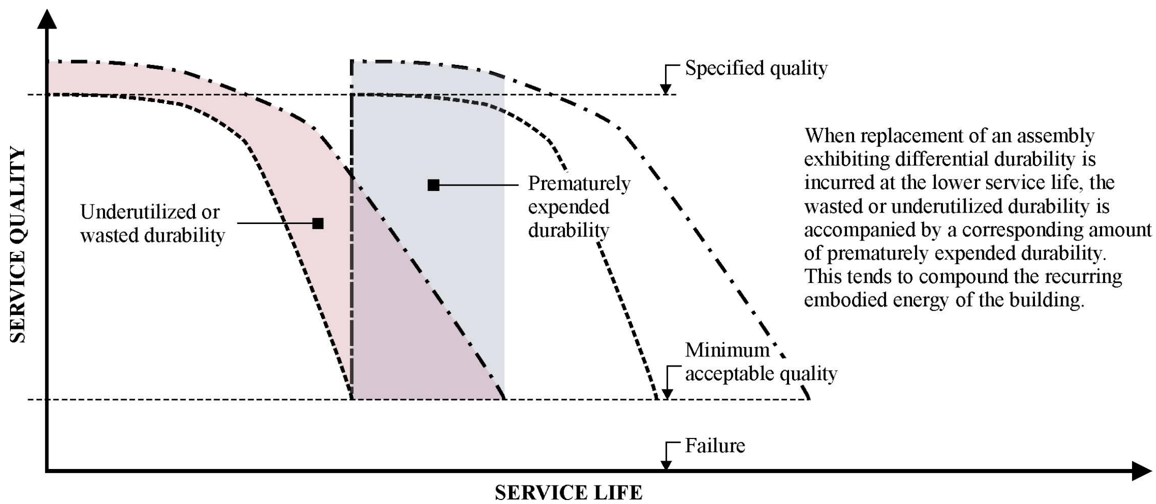


Figure 4. Compounding of recurring embodied energy due to underutilized (wasted) and prematurely expended durability.

Service Life of Building Components

In order to deal effectively with differential durability issues, it is important to examine the service life of components within the following context:

What is the acceptable amount of underutilized (wasted) and prematurely expended durability?

This is a difficult question to answer fully at this time, however, some insights may be gained by reviewing existing data. The service life of building components are reported in numerous publications, and vary significantly between countries, climatic regions, and among building types. Table 1 lists excerpts of recent service life estimates for wall elements in Canadian high-rise residential buildings [2].

		Average Range		
Building Element	**Type**	**Min**	**Max**	***Avg.***
Exterior Walls	Precast Concrete	39	44	*41.5*
	Brick Veneer	32	37	*34.5*
	Curtain Wall	32	38	*35*
	Stucco	20	22	*21*
	Avg.	30.75	35.25	*33*
Windows	Metal Casement	22	25	*23.5*
	Metal Double-Hung	21	23	*22*
	Vinyl Casement	18	20	*19*
	Vinyl Double-Hung	16	19	*17.5*
	Metal Sliding	21	24	*22.5*
	Avg.	19.6	22.2	*20.9*
Flashing	Sheet Metal	22	25	*23.5*
	Non-Metallic	16	19	*17.5*
	Avg.	19	22	*20.5*
Caulking	All Types	10	11	*10.5*

Table 1. Typical service life of high-rise residential wall elements.
[Source: *Service life of multi-unit residential building elements and equipment: final report.* Prepared by IBI Group for Canada Mortgage and Housing Corporation, May 2000.]

These estimates represent thresholds after which either repair/restoration, in the case of exterior walls, or replacement for the other elements is normally required. Walls exhibit the greatest variability in service life by almost a factor of two. The other elements exhibit relatively minor variability between types, particularly so for caulking. An interesting relationship may be noted between flashing and exterior walls where the durability of the flashing is not harmonized with three of the four wall types. Ideally, the flashing would remain serviceable until it was time to repair or restore the exterior walls.

This problem extends to many other building elements. The harmonization of durability, or rather the lack of it, has been identified in the area of building services for items such as piping [3]. It has been advocated that the life cycle of building sub-systems be prudently selected so that multiples of the typically shorter service life of these elements fit wholly within the overall building life cycle (e.g., three 25-year sub-system life cycles within a 75-year building life cycle).

Common outcomes of differential durability include:

1. ***Superfluous upkeep*** - the staging of excessively numerous maintenance, repair and replacement activities due to the differential service life of building components;
2. ***Deferral of upkeep*** – the staging of upkeep activities is costly and disruptive when activity cycles are not harmonized due to asynchronous differential durability, and when fewer than the required or recommended cycles are observed, accelerated deterioration may occur to neglected elements;
3. ***Prematurely expended upkeep*** - where staging is expensive, such as in the case of exterior elements on high-rise buildings, serviceable elements may be replaced at the same time as unserviceable elements to minimize staging expenses and disruptions, leading to prematurely expended durability.

The question of whether or not the typical service life of building components is appropriate, or sustainable, also deserves consideration. Based on the Canadian data in Table 1, most major building elements, except for the structure, tend not to survive much longer than 20 to 30 years. The incremental cost of providing greater durability should be closely considered within the building life cycle as for many components the marginal improvements are highly cost effective. Consider metallic flashing, a vital element where about a 50% increase in service life would better harmonize its durability with exterior wall claddings. The incremental cost of harmonizing its durability only applies to the material quality, assuming manufacturing and installation are price neutral.

Harmonized durability and "just in time" facilities management represent ideal constructs. Acceptable margins for underutilized and prematurely expended durability clearly require further study, but a reasonable target should observe economic and practical realities. Damage associated with a leaky roof may far outweigh premature replacement, but few owners would tolerate replacement midway through the predicted service life of building components.

Despite the international development of durability standards for buildings, and supporting programs of collaborative research, a major problem encountered when designing for durability has been identified:

"*The principal barrier to the use of these standards has always been the fact that there are few quantitative methods for reliably predicting the service life of materials and components in a building. To overcome this problem, it is necessary to provide the designer either with quantitative information on the in-service properties of building materials and components or with a method for modeling their performance as a function of time* [4]."

Physical deterioration within and between materials and components remains a formidable challenge. An equally significant and complex aspect of durability involves the notion of obsolescence.

Obsolescence
Another facet of differential durability is associated with the degree of flexibility and adaptability in buildings, commonly referred to as obsolescence.

Figure 5. Demolition is more often the outcome of obsolescence rather than physical deterioration.

"*From a general point of view when the capacity of a property to perform the function for which it was intended declines, it becomes functionally obsolete. Functional obsolescence may originate from several sources following changes in the market, in equipment design or process or because of poor initial design* [5]."

Poor initial design leading to functional obsolescence is not normally considered in building durability, yet the recurring embodied energy implications may easily compare to those associated with physical deterioration. When the costs of retrofitting for adaptive re-use equal or exceed the construction cost of new facilities, the value of the original design is fairly questionable.

Software for building retrofit studies has been developed and implemented, enabling a more intelligent management of existing building resources to improve flexibility and adaptability [6]. There remains a genuine need for better predictive models of functional obsolescence. Eventually, it is reasonable to expect that such tools may generate invaluable insights that inform the design of new buildings.

It is important to appreciate the difficulty inherent in reconciling the two aspects of differential durability identified in this paper – physical deterioration and functional obsolescence. Even when these are balanced, factors such as "locational obsolescence" owing to shifting market demand and land value patterns may result in enormous expenditures of embodied energy. The incentive to address architectural aspects of differential durability is strengthened when their implications are better understood.

Implications of Differential Durability

Differential durability causes significant economic impacts, and can also affect sustainability in terms of environmental degradation, resource depletion, greenhouse gas emissions, and reduction in bio-diversity – the four commonly recognized environmental impacts of buildings.

First, this paper looks at an economic perspective on differential durability. The total value of investment in the Canadian housing sector was $42.7 billion in 2000, up 3.9% from 1999. The biggest contributor to the advance was the renovations component, which rose 5.9% compared with 1999. The cumulative value of residential repairs and renovations for the year 2000 was $18.2 billion. The total number of housing units in Canada was 11,908,049 in 2000. [7]

This represents an average expenditure of a little over $1,500 per housing unit, roughly equivalent to the annual purchased household energy. Durability, measured both as physical deterioration and functional obsolescence, ranged between 24% and 73% of these annual expenditures, depending on how the data are interpreted. Hence, it is reasonable to assume that differential durability, in its larger sense, is not insignificant when compared to operating energy in housing, which accounts for 15% of Canada's annual greenhouse gas emissions [8].

Second, the sustainability implications of differential durability are considered. Using durability as an indicator of sustainability is unavoidable because when other measures are employed, these typically attempt to quantify resource depletion and/or environmental degradation over the service life of the building. Interesting relationships have emerged when durability is considered in conjunction with other measures. For example, the sustainability of high embodied energy building components with a relatively long service life may be better than lower embodied energy alternatives with a shorter service life, especially if the former provide superior operating energy performance (e.g., thermal insulation, high performance glazing [9], etc.). Embodied energy and operating energy performance being equal, the relationship between durability and sustainability is linear – the more durable, the more sustainable.

Figure 6. Durability precedent based on sustainable yield of natural resources.
[Cedar shake-clad shed, Fruitvale BC, circa 1900.]

When sustainability parameters are properly considered, current standards for building durability become questionable. For example, some 100 years later, the shed depicted above remains serviceable long after the trees, now replacing those cut down to construct it, have grown back to maturity. From a sustainability perspective, a material, component or system can only be considered durable when its service life is fairly comparable to *the time required for related impacts on the environment to be absorbed by the ecosystem*. The service life of a shed suggested by current durability standards would fall far below any realistic threshold of sustainable yield.

The embodied energy implications of differential durability provide another perspective on sustainability. Figure 7 is based on the work of Cole and Kernan, 1996 [10]. Their research included a comparison of initial embodied energy content to recurring embodied energy content (maintenance, repair and replacement), for a wood-structure building over a 100-year life cycle. Periods of 25 years were selected to quantify the recurring embodied energy associated with 6 major components of a building. The sustainability implications of building durability are significant notwithstanding the exclusion of underutilized and prematurely expended durability (embodied energy) in their analyses.

First, to the credit of civil engineers, the structures of buildings normally do not expend recurring embodied energy, lasting the life of the building. By year 25, however, a typical office building will see an increase of almost 57% of its initial embodied energy due mostly to envelope, finishes and services. By year 50, recurring embodied energy will represent about 144% of the initial embodied energy, and it was projected that by year 100, this proportion would rise to almost 325%.

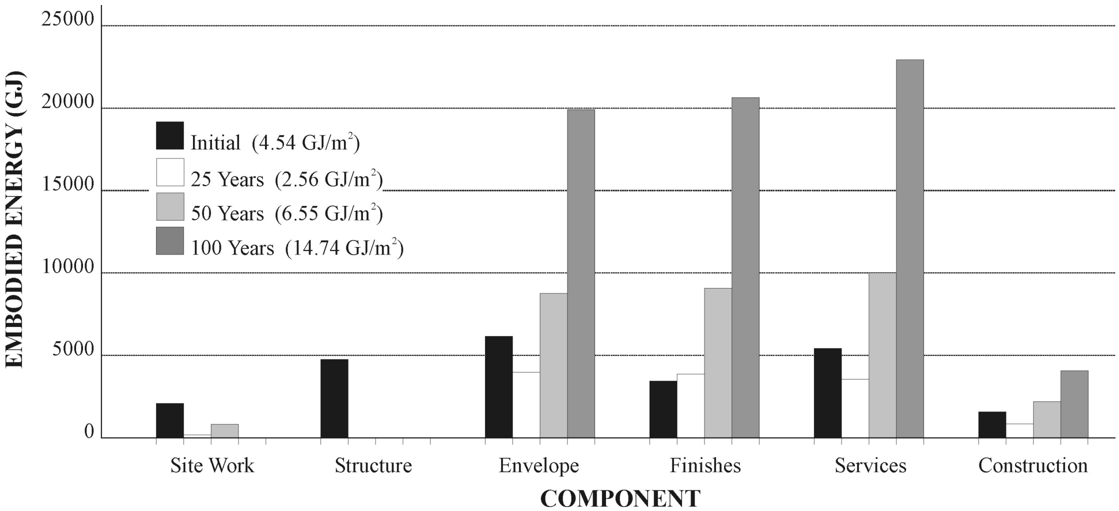


Figure 7. Comparison of Initial to Recurring Embodied Energy for Wood Structure Building Over a 100-Year Life Cycle [Cole and Kernan, 1996].

This relationship is a direct result of differential durability, where the service lives of the six major components comprising the building differ dramatically. Although difficult to quantify from available data, the significance of underutilized and prematurely expended durability cannot be ignored. The current preoccupation with lower first costs in buildings, coupled to misguided facilities management planning, reveals the widespread disregard for sustainability when viewed from a building life cycle perspective.

Another reason that the sustainability implications of recurring embodied energy consumption are not given the serious attention they merit is due to dramatically higher levels of non-renewable operating consumption in contemporary buildings. Figure 8 depicts the relationship between initial, recurring and operating energy for a typical office building. The recurring embodied energy accounts for 8.3% of the total life cycle energy consumed by the building.

Recent analyses for single-unit housing in Sweden indicate that over a 50-year life cycle study period, operating energy accounts for 83%-85% of the building life cycle energy consumption, embodied energy represents between 11%-12%, and recurring embodied energy for maintenance and renovation ranged between 4%-5% [11]. This compares favourably with the Canadian estimates for small office buildings as depicted in Figure 8.

Most building, however, tend to serve useful lives beyond 50 years and this is commonly identified in the current literature as a limitation in life cycle analyses. Potentially enormous recurring embodied energy expenditures can take place as buildings age beyond the 50-year horizon, especially when retrofit activities address both deterioration and obsolescence [12].

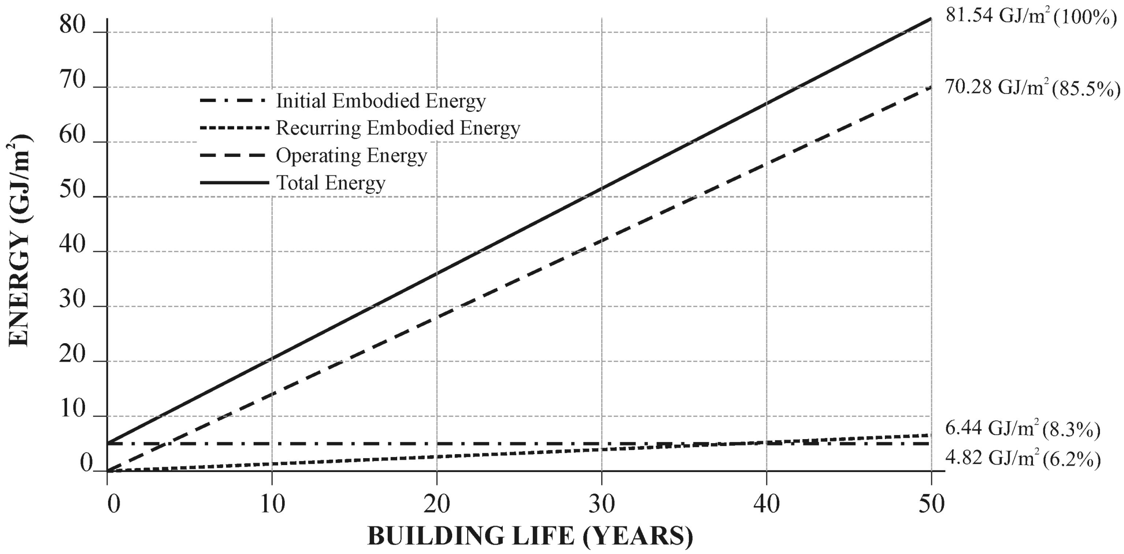


Figure 8 - Components of Energy Use During 50-Year Life Cycle of Typical Office Building with Underground Parking, Averaged Over Wood, Steel and Concrete Structures in Vancouver and Toronto. [Cole and Kernan, 1996]

Further, as modern building technology improves upon the energy efficiency of buildings, and passive environmental control systems, and/or benign sources of renewable energy, increasingly displace non-renewable energy sources for the operation of buildings, the initial and recurring embodied energy content becomes more significant in the life cycle of buildings. Typically, recurring embodied energy surpasses the initial embodied energy of buildings, and as we approach "zero non-renewable energy" buildings, it is reasonable to expect that careful consideration of differential durability will grow in future importance.

Durability and Total Building Performance

Durability, traditionally referred to as *firmness*, remains a cornerstone of sustainable architecture. It must now be reinterpreted within the context of the "total building performance" concept, which recognizes the environmental, economic, technical and social dimensions of buildings as cultural resources rather than real estate commodities.

In order to effectively apply this holistic concept, means of reconciling qualitative and quantitative data with incommensurable parameters must be incorporated into the architectural design process. Recent research has suggested that tools with this sort of sophistication are yet to be developed [13]. It is also unclear how training on the use of these tools could be delivered to design professionals within current disciplinary structures. However, with respect to durability issues, the challenges associated with implementing the total building performance concept have been identified as:

1. Preparation of comprehensive guides on the performances of various building details;
2. Development of tools for durability analysis and life expectancy prediction of building elements and major building parts; and
3. Follow-up and monitoring of projects built under the performance concept for more practical and reliable feedback into the process. [14]

The importance of addressing the durability challenge can be appreciated by considering the four key parameters governing total building performance: 1) user satisfaction; 2) organizational flexibility; 3) technological adaptability; and 4) environmental and energy effectiveness [15].

Differential durability, when it is understood to include the service life of materials and assemblies, and the obsolescence of whole building systems, plays a significant role in the total building performance concept. It directly impacts three of the four key performance parameters, and may in some cases influence user satisfaction when differential durability affects aesthetics or ergonomics.

Conclusions

Differential durability affords a different perspective on the sustainability of buildings because it takes into account both physical deterioration and obsolescence. These two aspects of differential durability are not yet fully appreciated or understood in conventional approaches to durability design and assessment.

When environmental criteria are applied to physical deterioration, the minimum performance requirements for materials and components, or assemblies, differ from current normative standards. They become based on the time it takes for the environmental impacts associated with extraction, processing, transportation and installation (initial embodied energy), as well as the recurring embodied energy between replacement cycles of building elements, to be absorbed by the ecosystem. This implies more durable building elements with better harmonized durability incorporated into flexible and adaptive architectural design.

In order to advance differential durability research and practice, numerous barriers and opportunities have been identified in the recent literature. It must be recognized that a concerted research effort undertaken across a number of disciplines will be required to effectively address the differential durability issues raised in this paper.

For the next phase of research associated with the work presented in this paper, the following areas will be investigated:

1. Estimates of the amount of underutilized (wasted) and prematurely expended durability for typical building envelope components;
2. Estimates of the economic and environmental impacts associated with these forms of recurring embodied energy demand in existing build stock; and
3. Forecasts of the required levels of durability corresponding to sustainability thresholds for commonly employed building materials.

It is acknowledged this represents a modest contribution to the entire issue of differential durability, and it is hoped related efforts by others will reinforce the view that research in this area is vital. Much gratitude is owed to those who have initiated fundamental durability research underpinning the ideas presented in this paper. But above and beyond these contributions, the task of integrating differential durability in daily design practice remains most daunting.

The acceptance of sustainability criteria to derive durability parameters will require careful consideration on the part of the architect. The building must be viewed at varying levels of resolution, from the detail through to the whole artifact, and beyond to its community interactions. Failure of a minor detail, such as the attachment of stone cladding to the structure, could undermine the durability of the façade. Similarly, an inflexible building which is not adaptive to evolving use could face demolition even though all of its components are durable and performing adequately. To achieve a level of durability which fully utilizes natural resources within sustainable thresholds, idiosyncratic notions of design must be reconciled with proven precedents and typologies. The timeless desire by humans for shelter, health and well being must be balanced with material chemistry, statistical models of environmental loads, and ecological carrying capacities. Innovation so constrained represents the challenge of differential durability research applied to sustainable architecture.

Acknowledgements

The author wishes to gratefully acknowledge Arriscraft International for financial support of architectural science research and education in the Faculty of Architecture, Landscape and Design at the University of Toronto. Special thanks to my academic and professional colleagues who shared their insights on building durability issues related to this paper.

References

[1] T. Nireki, Service life design. *Construction and Building Materials*, Vol.10, No. 5, pp.403-406, 1996.

[2] *Service life of multi-unit residential building elements and equipment: final report*. Prepared by IBI Group for Canada Mortgage and Housing Corporation, May 2000.

[3] Cheng-Li Cheng, A physical study of plumbing life cycle in apartment houses. *Building and Environment* 36, pp. 1049-1056, 2001.

[4] G. Soronis, Standards for design life of buildings: utilization in the design process. *Construction and Building Materials*, Vol. 10, No. 7, pp.487-490, 1996.

[5] Dominique Allehaux, Philippe Tessier, Evaluation of the functional obsolescence of building services in European office buildings. *Energy and Buildings* 34, pp. 127-133, 2002.

[6] F. Flourentzou, J.L. Genre, C.A. Roulet, TOBUS software – an interactive decision aid tool for building retrofit studies. *Energy and Buildings* 34, pp. 193-202, 2002.

[7] Statistics Canada, Table 026-0013 - Residential values, by type of investment, quarterly (dollars), Ottawa, March 2001.

[8] *Energy Efficiency Trends in Canada 1990 to 1999 — An Update*, Natural Resources Canada, Ottawa, 2001.

[9] Stéphane Citherlet, Francesca Di Guglielmo, Jean-Bernard Gay, Window and advanced glazing systems life cycle assessment. *Energy and Buildings* 32, pp. 225-234, 2000.

[10] Raymond J. Cole, Paul C. Kernan, Life-cycle energy use in office buildings. *Building and Environment*, Vol. 33, No. 4, pp. 307-317, 1996.

[11] K. Adalberth, Energy use during the life cycle of single-unit dwellings: examples. *Building and Environment*, Vol. 32, No. 4, pp.321-329, 1997.

[12] Michiya Suzuki, Tatsuo Oka, Estimation of the life cycle consumption and CO_2 emission of office buildings in Japan. *Energy and Buildings* 28, pp. 33-41, 1998.

[13] L. Reijnders, A. van Roekel, Comprehensiveness and adequacy of tools for the environmental improvements of buildings. *Journal of Cleaner Production* 7, pp. 221-225, 1999.

[14] Rachel Becker, Research and development needs for better implementation of the performance concept in building. *Automation in Construction* 8, pp. 525-532, 1999.

[15] Volker Hartkopf, Vivian Loftness, Global relevance of total building performance. *Automation in Construction* 8, pp. 377-393, 1999.

Lighting Quality Evaluations using Images on a High Dynamic Range Display

Guy R. NEWSHAM (National Research Council Canada)
Helge SEETZEN (University of British Columbia)
Jennifer A. VEITCH (National Research Council Canada)
Avi CHAUDHURI (McGill University)
Lorne A. WHITEHEAD (University of British Columbia)
Guy.Newsham@nrc.ca

Abstract:

Limited research comparing participant ratings of luminous environments to ratings of *images* of those environments indicates that images can be a reasonable surrogate for the real space, particularly on ratings related to aesthetics. However, the realism of such images when presented on computer screens is potentially limited by conventional display technologies that cannot reproduce the full range of luminances in real spaces. In this pilot experiment we used a new, high dynamic range (HDR) computer monitor capable of producing screen luminances and contrasts comparable to those in a real space. Fifty-four participants viewed three images of a conventional office in two display modes: HDR monitor and conventional monitor. Participants rated each image for room appearance, environmental satisfaction and realism. These ratings were also compared to similar ratings made by participants in an earlier experiment (reported in 1998) who occupied the real spaces depicted in the images. Results indicate that computer screen images are perceived in a similar way as real luminous environments. HDR images are perceived differently than images on a conventional monitor: they are rated as brighter and less attractive, as expected. Given their more authentic luminances, HDR images should be perceived as more similar to the real space, but our results neither support nor refute this.

Introduction

The traditional method of exploring preferred luminous conditions involves participants evaluating full-scale physical mock-ups of spaces lit in different ways. While high in external validity (the fit between the experimental condition and a real world setting), these studies are expensive, especially if manipulation of the lighting design is desired. This is not only a drawback for the researcher: Lighting manufacturers and designers who wish to present design solutions to their clients are often required to create expensive physical mock-ups.

Partly as a response to this, there has been some interest in other, cheaper presentation methods, such as scale models, photographs, or renderings from computer simulation packages. Researchers in areas such as forestry and architecture [e.g. Daniel & Meitner, 2000; Danford & Willems, 1975] have established that images can be a reasonable surrogate for the real space, particularly on ratings related to aesthetics. The limited research in lighting on this topic concurs with this, when representing the real space with photographs [Hendrick et al., 1977], or with detailed simulations [Eissa & Mahdavi, 2001].

Nevertheless, there are significant challenges if we are to make progress in this direction. Ashdown [1996] detailed some of these challenges, and described some of the image processing tools that might be used to increase the realism of images displayed on computer screens. One reason why this processing is necessary is the limited range of luminances and luminance contrasts that can be produced by conventional display technologies. In the experiment described in this paper, we used a new high dynamic range (HDR) computer monitor to display images. Conventional computer displays produce only 256 brightness levels (8-bit), the HDR display optically combines two 8-bit devices to yield over 16,000 brightness levels, with a luminance range comparable to those seen in a real luminous environment.

Method and Procedure

Participants viewed images of an open-plan office lit in different ways. The three images used are shown in Figure 1, and were chosen to reflect a wide variety of non-daylit office luminous conditions. The photographs were taken of real lighting installations in a full-scale mock-up office, which was used for a previously published study of office lighting quality [Veitch & Newsham, 1998]. The original slide images were scanned to digital images of 345 x 230 resolution, and were enlarged to 1280 x 1024 for display. The original resolution is regrettably low, perhaps low enough to bias results, but these images were all that were available in the archive of Veitch & Newsham's work, and we felt that the ability to compare ratings to those expressed in Veitch & Newsham outweighed the disadvantages. The images are labelled "a", "c", and "g", consistent with the designations given to these lighting designs in Veitch & Newsham. Table 1 describes the lighting designs and provides photometric measurements made in the real space.

Participants viewed images on the 17" (diagonal) screen of the HDR display device, as depicted in Figure 2. Luminance measurements made in the real space were used to calibrate the image on the HDR display, up to a maximum luminance value of 1800 cd/m^2. In conventional display mode the luminance range was compressed to that of a conventional colour monitor with a maximum luminance of 100 cd/m^2.

Participants began by viewing four example images, two in HDR mode and two in conventional mode. Participants then viewed the three images shown in Figure 1 in each of the two display modes. Images were presented in random order, and there were no known visual or auditory cues indicating which display mode was in use. While viewing each image participants provided ratings of room appearance, environmental satisfaction and realism. After rating one image, participants were asked to look away from the display at a side wall while the image was changed. The whole procedure took about 30 minutes.

Room appearance and realism ratings were made using 15 bipolar adjective pairs (*bright - dim, uniform - non-uniform, interesting - monotonous, pleasant - unpleasant, comfortable - uncomfortable, stimulating - subdued, radiant - gloomy, tense - relaxing, dramatic - diffuse, spacious - cramped, glaring - not-glaring, friendly - hostile, simple - complex, formal - casual, realistic - unrealistic).* Adjective pairs were printed on paper separated by a line 100 mm long on which participants made a pencil stroke to indicate their rating. The mark was converted to a score of 0 – 100 by measuring its location on the line.

Satisfaction ratings were made on a variety of scales. For environmental satisfaction, participants indicated their level of agreement with the following statements on a 5-point scale from Strongly Disagree to Strongly Agree (scored 0 – 4): *I could work efficiently in this workplace; All things considered, I would be very satisfied with this workplace; The physical layout of this workspace is well-suited to office work; Compared to offices where I have worked I like this workspace.* They then answered: *Overall, how satisfied would you be with the lighting of this workspace?* on a 5-point scale from Very Satisfied to Not at All Satisfied (scored 0 – 4). Next they answered: *How much would the glare bother you?* on a 5-point scale from Not at All to Extremely (scored 0 – 4). Finally, as a rating of environmental features, participants used a 7-point scale from Extremely Poor to Excellent (scored 0 – 6) to respond to the following questions: *How would you rate the quality of light for office work?; How would you rate the quantity of light for office work?* These scales were derived from previous research [Veitch & Newsham, 1998].

Fifty-four students from the Department of Psychology at McGill University were recruited to participate. Participants were aged 18 – 26, and approximately ¾ were female.

Our hypotheses were that the HDR images would be perceived as significantly brighter than conventional images, and that the higher luminance contrast of HDR images would lead to lower levels of satisfaction. Furthermore, we expected the ratings made by observers in a real space would more closely resemble the ratings of an HDR image of that space than the ratings of a conventional image of that space.

Results

The experimental design is 2 (display type) x 3 (lighting design) within-subjects. Our primary interest is whether the images on the two display types are perceived differently. We analysed the data initially using multivariate analysis of variance (MANOVA). Two separate MANOVA's were run on two sets of related variables: the room appearance & realism ratings; and, the satisfaction ratings. The results of the MANOVA on the room appearance and realism ratings are shown in Figure 3, for the main effect of display type. The graph compares mean ratings for each of the 15 adjective pairs. Images displayed on the HDR, particularly lighting designs "a" and "c", have substantially higher luminances and luminance ratios, and this is manifest in Figure 3. The offices shown in the HDR are rated as significantly brighter and more glaring that the offices shown on the conventional display. Higher luminances and luminance ratios are also the most likely explanation for the HDR display being rated as significantly more radiant and more dramatic.

Samuelson et al. [1999] suggested that spaces with higher luminance gradients would be less satisfactory. Certainly, lighting designs "a" and "c" exhibit large areas with luminance ratios in excess of 10:1, the maximum recommended for office spaces by the IESNA [2000]. Figure 3 shows that offices on the HDR display were rated as significantly less pleasant, less comfortable, more tense and more hostile. Interestingly, despite rendering the image with authentic luminances, the HDR display is rated as significantly less realistic. We suggest this is because participants were still aware they were viewing a computer screen. Because no other computer screen they had previously experienced was capable of delivering more than 100 cd/m^2, the HDR display, delivering up to 2000 cd/m^2, was judged to be an "unrealistic" display. There was also no significant difference on the spacious-cramped or formal-casual items. We think these concepts require presence in a real 3-d space to have any meaning, and so discrimination on differing 2-d displays is unlikely.

For the MANOVA on satisfaction ratings, a composite environmental satisfaction score was constructed for each participant from the mean of their response to the four environmental satisfaction questions. Similarly, a composite rating of environmental features for lighting score was constructed for each participant from the mean of their response to the two rating of environmental features questions. The results of the MANOVA on the satisfaction ratings, shown in Figure 4, support the above findings. Glare was rated as significantly more bothersome (GLAREBO in Figure 4) for the images on the HDR display, as expected. The composite measures of environmental satisfaction (ENVSAT) and environmental features (REFLITE), as well as the single item on overall satisfactions with lighting (SATLITE), were all significantly worse for the HDR display.

We also conducted MANOVAs on the effect of display type for each of the lighting designs. We do not have space to go into detail, but we can report that, as expected, there were many more significant univariate effects for the lighting designs with higher luminances ("a" and "c") than for the lower luminance design ("g"). MANOVAs on the effect of display type contrasting designs "a" and "c" taken together vs. design "g" confirmed this observation. The contrast on room appearance and realism ratings was significant (*Wilks'* $\Lambda=0.367$, $F(15,39)=4.5$, $p<0.001, r^2_{ave}=0.075$), as was the contrast on satisfaction ratings (*Wilks'* $\Lambda=0.777$, $F(4,50)=3.6$, $p<0.05, r^2_{ave}=0.058$).

We suspected that the results might be confounded by familiarity with the lighting designs used. It is very likely that design "c" would be far more familiar to the participants that design "g", and, particularly, design "a". To test this we conducted MANOVAs on the main effect of lighting design, contrasting design "c" vs. designs "a" and "g" taken together. The contrast on room appearance and realism ratings was significant (*Wilks'* $\Lambda=0.095$, $F(15,39)=24.7$, $p<0.001, r^2_{ave}=0.306$), as was the contrast on satisfaction ratings (*Wilks'* $\Lambda=0.34$, $F(4,50)=24.3$, $p<0.001, r^2_{ave}=0.266$). Design "c" is rated as significantly more realistic, and the effect is large ($F_{1,53}=56.7$, $p<0.001$, $r^2=0.517$; mean "c"=24.4, mean "a"&"g"=41.3). A variety of other univariate effects (not detailed here due to space limitations) indicate design "c" is rated significantly brighter and more glaring, but also significantly more satisfactory. These seemingly contradictory results suggest that in any future tests of the effect of display type careful attention should be taken in selecting images that are not biased by experience.

The value of viewing lit scenes on a computer display is predicated on the assumption that people perceive the scenes in a similar way as they perceive a real scene. The images we used for this experiment were taken in a mock-up office space that had been previously used for a human factors study of lighting quality [Veitch & Newsham, 1998]. In that study 96 participants experienced the three lighting designs (between-subjects) for a day, doing simulated office tasks and completing a variety of questionnaires, including room appearance and satisfaction ratings very similar to the ones used in this experiment. Direct comparison of ratings between this study and Veitch & Newsham is tempting but, on reflection, we believe misleading. Participants in Veitch & Newsham made their ratings while working at a computer screen, and therefore with a very different field of view, which included potential reflected glare. They had also experienced the space for much longer. Finally, their ratings were potentially affected by more than the light distributions shown in the photograph. For example, design "c" employed magnetic ballasts, which operate at a lower frequency that is associated with disrupted visual processes in comparison to the electronic ballasts used in designs "'a" and "g".

Rather than comparing absolute ratings, we instead compared the correlations between items using factor analysis, a statistical technique that seeks to reduce a large matrix of ratings to a smaller number of underlying factors. If different methods of viewing a lit scene have similar factor structures then we can have some confidence that the scene is being interpreted in a similar way. We performed three separate factor analyses, on the ratings from the conventional display, the ratings from the HDR display, and the ratings for these three scenes from Veitch & Newsham [1998]. In this study each participant saw three lighting designs on each display. To reduce the effect of within-subject variance, a composite score on each room appearance rating was constructed for each participant for each of the two display types. This composite score was the mean of the responses to the three images presented on each display. We used only the 13 room appearance items that were common between this experiment and Veitch & Newsham. We employed principal components analysis with varimax rotation, and forced a three factor solution (as in Veitch & Newsham); the results are shown in Table 2. The results show clearly that the factor structures from all three analyses are very similar. The spacious-cramped and formal-casual items do not load consistently on the three factors, but that can be expected as explained above. Of the remaining 11 items, nine load on the same three factors in almost identical fashion in the three analyses.

Conclusions

This study can only be considered a pilot study with many limitations. Nevertheless, we found interesting results that justify further study. Images displayed on a computer screen in both conventional mode, and in high dynamic range (HDR) mode with realistic luminances, were perceived in a similar way as the same real luminous environments. This supports the proposition that images are a reasonable surrogate for experiencing the real space in some circumstances. Our results also demonstrate that HDR images are perceived differently than conventional images; they are viewed as brighter and less attractive, as expected. HDR images should be perceived as more similar to the real space, but our results can neither support nor refute this.

Any future study should employ higher resolution and higher quality images than we had at our disposal. A future study should also compare the real space and its image from similar points of view. Finally, studied lighting designs should be equally familiar to participants.

Acknowledgements

This work was partially supported by a Strategic Grant from the Natural Sciences and Engineering Research Council of Canada. The authors thank Alexandra Pelley and Donna Pelley for their assistance with data entry, as well as Harry Turner (NRC) for providing the original photographs of the space.

References

Ashdown, I. 1996. "Luminance gradients: photometric analysis and perceptual reproduction," *Journal of the Illuminating Engineering Society*, Winter, pp. 69-82.

Danford, S.; Willems, E.P. 1975. "Subjective responses to architectural displays," *Environment and Behavior* **7**(4), pp. 486-516.

Daniel, T.C.; Meitner, M.M. 2000. "Representational validity of landscape visualizations: the effects of graphic realism on perceived scenic beauty of forest vistas," *Journal of Environmental Psychology* **21**, pp. 61-72.

Eissa, H.; Mahdavi, A. 2001. "Subjective evaluation of architectural lighting via computationally rendered images," Proceedings of IESNA Annual Conference (Ottawa), pp. 547-558.

Hendrick, C.; Martyniuk, O.; Spencer, T.J.; Flynn, J.E. 1977. "Procedures for investigating the effect of light on impression: simulation of a real space by slides," *Environment and Behavior* **9** (4), pp. 491-510.

IESNA. 2000. Lighting Handbook, 9th Edition (Ed: Rea, M.S.). Illuminating Engineering Society of North America, New York.

Samuelson, C. E.; Ashdown, I.; Kan, P.; Kotlicki, A.; Whitehead, L. A. 1999. "A proposed lighting quality metric based on spatial frequency analysis," Proceedings of IESNA Annual Conference (New Orleans), pp. 51-61.

Veitch, J.A.; Newsham, G.R. 1998. "Lighting quality and energy-efficiency effects on task performance, mood, health, satisfaction and comfort". *Journal of the Illuminating Engineering Society,* Winter, pp. 107 - 129.

Table 1. The lighting designs depicted in the images viewed by participants, and photometric measurements for the designs in the real office space.

Design	Luminaires	Luminance (cd/m^2)				
		PUB	DTR	DTL	PRU	CMX
a	Furniture-mounted indirect + undershelf task light + angle-arm desk light	110	45	75	30	400
c	Prismatic lens	23	70	75	55	2800
g	Parabolic louvre	10	60	65	35	160

PUB = partition under binder bin (maroon cupboard) - in Design "a" this is illuminated by a linear task light
DTR = desktop right, near bottom right corner of mousepad - in Design "a" partly illuminated by desk light
DTL = desktop left, near document holder PFR = partition behind computer, to the right of the corner, about $^2/_3$ up
CMX = ceiling max, in Design "a" this is illuminated ceiling tile, in Designs "c" and "g" this is on the fixture

Table 2. Results of factor analysis on semantic differential appearance ratings for images on the conventional display, images on the HDR display, and data from Veitch & Newsham [1998]. Items with the same number in the table loaded on the same factor, based on a rotated factor loading of ≥0.5. Where an item loads on two factors, the one with the higher loading is listed first. Only the 13 items in common between this study and Veitch & Newsham are included.

ADJECTIVE PAIR ↓	Conventional display	HDR display	Veitch & Newsham
bright - dim	2	2	2
uniform - nonuniform	3	3	3
interesting - monotonous	2	3, 1	1
pleasant - unpleasant	1, 2	1	1
comfortable - uncomfortable	1	1	1
stimulating - subdued	2	1	3
radiant - gloomy	2	1, 2	2
tense - relaxing	1	1	1
dramatic - diffuse	2, 3	3, 2	3
spacious - cramped	1		1
glaring - not glaring	2	2	2
simple - complex	3	3	3
formal - casual	1	3	
% Total Variance explained by rotated components	63.7	65.0	57.3

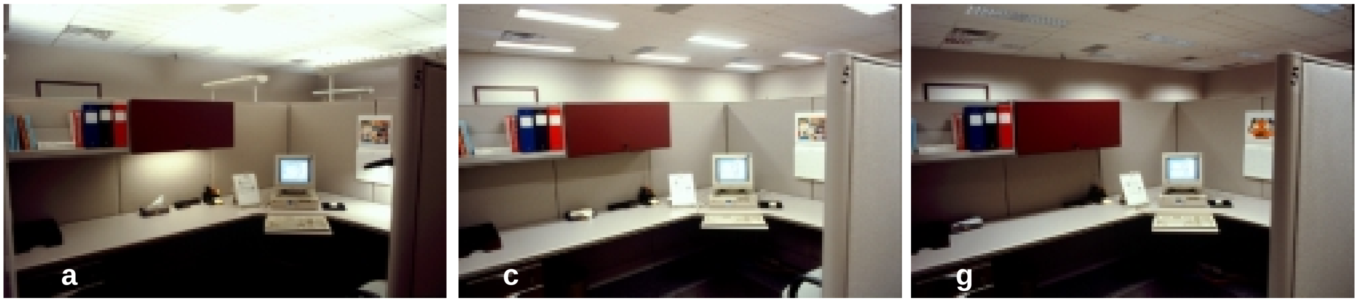


Figure 1. The three images viewed by participants.

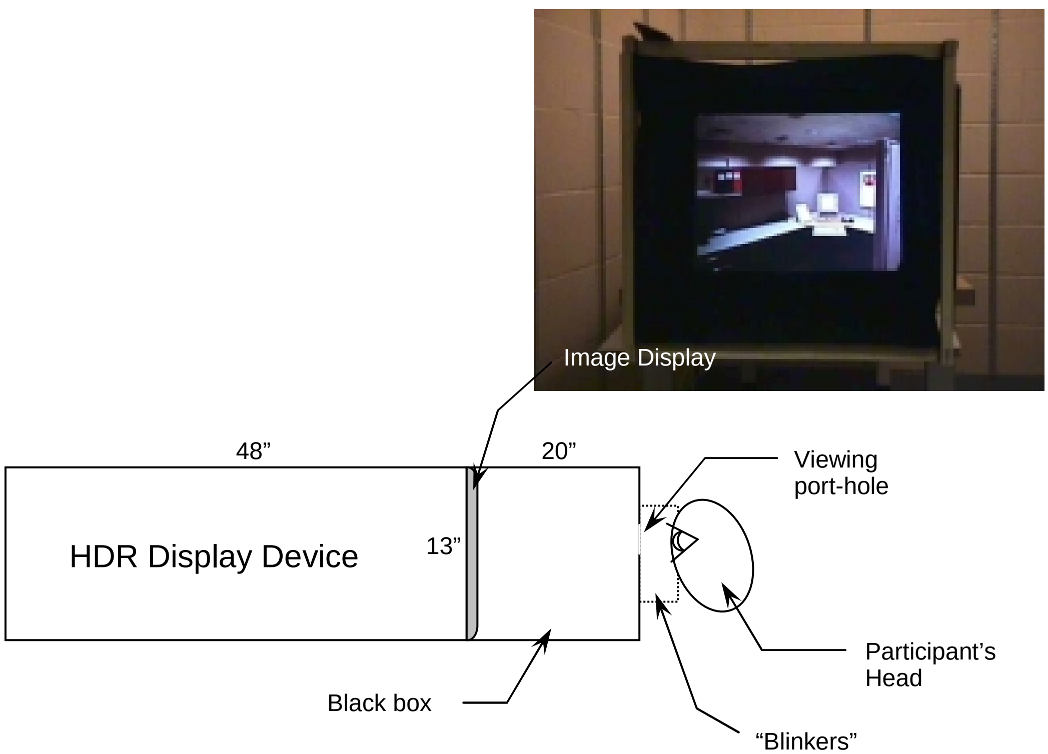


Figure 2. Display set-up, side view (apparatus was 14.5” wide). An example of a displayed image (with black box removed), is shown above.

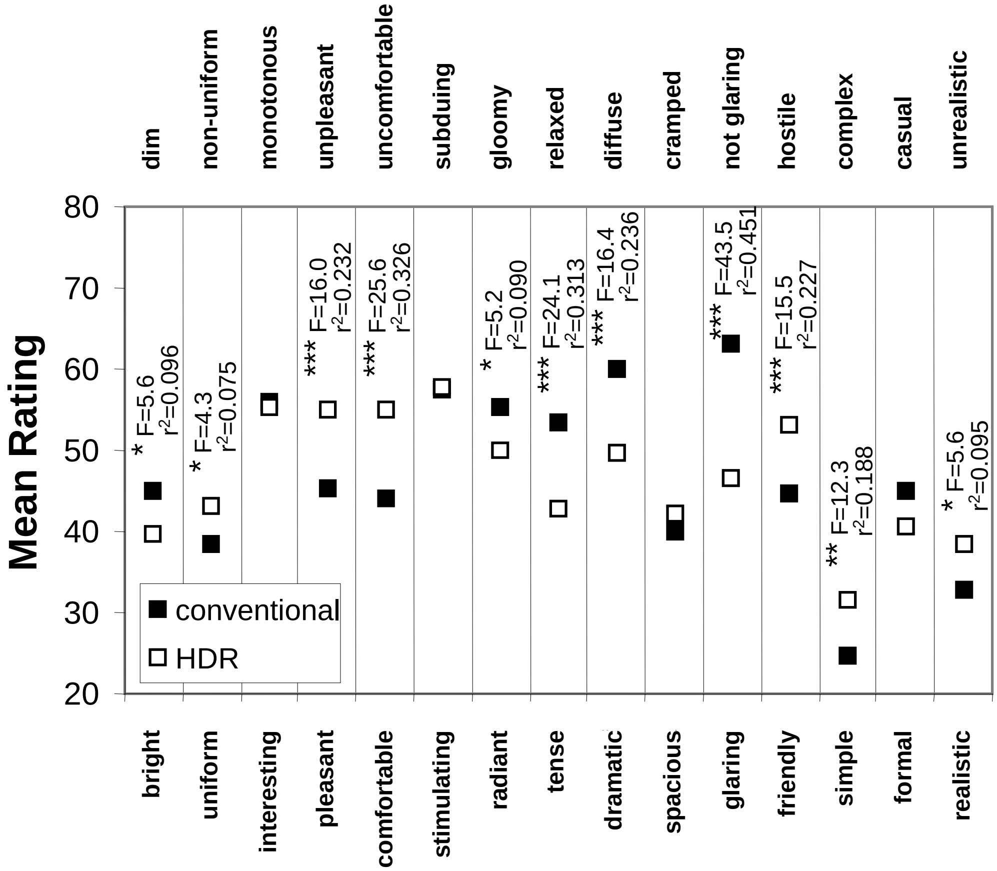


*Figure 3. The effect of display type on room appearance and realism ratings. Overall MANOVA was significant, Wilks' Λ=0.364, F(15,39)=4.5, p<0.001,r^2_{ave}=0.162. Asterisks on the graph indicate significant univariate effects: * p<0.05; ** p<0.01; *** p<0.001. F-values (df 1,53) and fraction of variance explained (r^2) are also shown.*

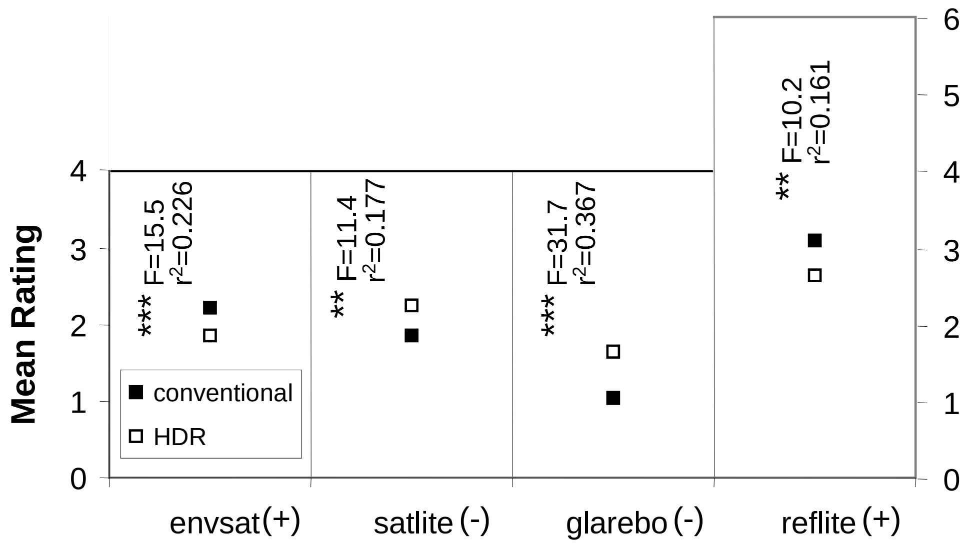


*Figure 4. The effect of display type on satisfaction ratings. A "(+)" following the rating label indicates that a higher rating is desirable, a "(-)" indicates a lower rating is desirable. Overall MANOVA was significant, Wilks' Λ=0.590, F(4,50)=8.7, p<0.001,r^2_{ave}=0.235. Asterisks on the graph indicate significant univariate effects: * p<0.05; ** p<0.01; *** p<0.001. F-values (df 1,53) and fraction of variance explained (r^2) are also shown.*

Using Virtual Cities in Teaching Architecture and Urban Planning: Auroville

Peter RUSSELL
Tom HEUER
Thomas STACHELHAUS
Aachen University of Technology (RWTH)
russell@caad.arch.rwth-aachen.de
heuer@caad.arch.rwth-aachen.de
thomas@caad.arch.rwth-aachen.de

Abstract:

The paper describes the Auroville project, which is in essence, the creation of a virtual and fictional city for use in architectural education. The project is firstly a didactical method for teaching fundamental Computer Aided Architectural Design (CAAD). Furthermore, by encouraging the design of infrastructure projects for the city, the students are initiated in co-operative work practices. Thirdly, as the virtual city has grown, the students have been confronted with urban planning issues such as conservation and renewal. Auroville is a fictive city based on the writings of the Guru Sri Aurobindo. The authors have mapped out the city using CAD software and essentially have created a palette of lots on which students can "build". The lots are assigned or acquired by each student at the beginning of the semester and in a series of exercises stretching over the semester, a built environment is created for these lots. The lot descriptions are connected to a central CAAD server so that a complete three-dimensional city file structure is created. This allows the students to see the city as a whole as well as the urban effects of their designs (as well as those of their neighbour's.) In the past three years, approximately 900 students have taken part in the Auroville project. Indeed, the city, as originally laid out, is well nigh full. This led the organisers to focus work on infrastructure issues such as urban transit. Nonetheless, many students wish to continue work on individual parcels. This has also led to planning proposals by the students to "remove and replace" so called unsightly buildings. This has allowed urban planning issues to be raised. As well, the group has attempted to find ways to democratically resolve conflicting views. These resolutions are also used to plan larger scale infrastructure projects. A seminar dedicated to designing light rail transit lines and their stations focused on the balance between commonality and individuality. Auroville can be seen as a microcosm of current urban planning problems. The accelerated speed of development in the city serves the pedagogical role well. The negligible monetary costs in renewing the lots serve to highlight the other costs involved in real-world urban fragment issues such as cultural heritage, time and the image of the city. Current work is focused in three areas. Firstly, on a social engineering level, the authors are seeking to establish a "city council" in order to allow the students to autonomously direct the development of Auroville. Secondly, the technical conversion of the CAAD files into immersive VR files will allow real time exploration of the city. Lastly, the extension and structuring of the CAAD files could allow a wider range of analysis to take place. Additional functionality through and time-based simulation will allow technical issues such as solar gain, wind movement, traffic analysis, etc to be taught using the virtual city Auroville.

Key Words: Education, Virtual Cities, CAAD

Using Virtual Cities in Teaching Architecture and Urban Planning: Auroville

The Teaching Chair for Computer Supported Planning at the Aachen Technical University was established in 1999. Part of the mandate of the institute is to carry out introductory courses in Computer Aided Architectural Design (CAAD) for lower level students of architecture. As is the case in most every school of architecture, the dilemma in introducing CAAD to architecture students lies in balancing principles of data organisation with specific functions particular to the computer program being used to teach these principles. In this spirit, AutoCAD is used as the program with which the strategies of using CAAD in design are taught.

Experience has also shown that merely explaining the functions and principles of CAAD are not sufficient for students to retain the course content after the lessons are completed. Goal based assignments that engage the students allow the methods to be used and applied. Attempts had been made to allow the students to use the CAAD system to model the design problems they concurrently were trying to solve in the design studio. This, however, has led to large problems. Work slowed to an insufferable speed owing to either the unfamiliarity of the students with the CAAD system or difficulties with the design problem itself. In pursuing design ideas, it seems that speed with which the author can test the idea, often through repeated sketches, is of extreme importance. In trying to use an unfamiliar CAAD system for this sketching proved detrimental to the design development. This frustration was also mirrored in learning the CAAD system. Learning and using different commands was far easier when done with meaningful content. However, if the design was not well formulated, the students had little with which they could manipulate. In both cases both the CAAD course and the design studio work suffered. Nonetheless, using a design problem sufficed to engage the students. It was decided that rather than assign a building to be modelled with CAAD, the course employed a reduced design problem independent of the larger design studio projects. This also allowed the students the "freedom" to design unencumbered by weighty design studio criticism. In effect, the students were freed from design responsibility.

Concurrently, research in the field of Computer Supported Co-operative Work (CSCW) has demonstrated the potential and need for students to understand the methods being introduced into practice. To this end, the authors have developed a syllabus that employs collective as well as individual assignments. In essence, the students receive a parcel of "land" from a fictive city and in collaboration with their neighbours, the students must design a building for the site and do so using the CAAD system.

Attempts to use this didactical approach at the University of Karlsruhe used the City of Karlsruhe itself as the "site". This met with varied responses. On the whole, the use of a real city brought more issues into the project than any clarification owing to its reality was worth. As was the case with the design studio assignments, the real cities encumbered the CAAD didactics with other non-trivial issues. Urban planning problems tended to dominate the student projects when the real goal was simply to learn to effectively use the CAAD to design. Again the engagement of the design topic was positive, but its scope was too far reaching for the purpose intended.

The CAAD Teaching Department in at the Technical University in Aachen sough to alleviate these problems by using a new city, fictive city. This city is called Auroville. In fact, Auroville is a real city located in India. Auroville was a fictive city based on the writings of the Guru Sri Aurobindo and in the late 1960s and early 1970s, an attempt was made to create a city using these writings. The state of the city today is rather disappointing, but for the students, the Auroville exists as an imaginary and fictive place. In creating the course context, the master plan for Auroville was used as a city map. At the beginning of each semester, each student then receives a parcel on which they are to place their building. The CAAD Department teaches approximately 250 students each year. Over the past 2 and 1/2 years, it has been possible to fill up this city with buildings. As of this writing, (in the winter of 2001), the city of Auroville is almost full. This naturally begs the same questions facing all cities with rapid growth concerning expansion, renewal and capacity. This allows the Department to pursue two strategies simultaneously.

In addition to the introductory CAAD courses, the Department teaches courses involving CSCW as well as general computer aided design training using net based design studios. A third aspect of the pedagogy is the introduction of interdisciplinary teamwork. Auroville, with its rapid growth and complexity, serves as a platform for these secondary and tertiary issues. That is to say, the introductory CAAD courses serve to populate the city. Advanced CAAD courses use the city structure to commonly create the city's infrastructure. Lastly, the city serves as a common platform for related disciplines. In this way, Auroville is a microcosm simulating the real issues affecting the real cities we as Architects, Planners and citizens deal with.

Figure 1: Initial seeding of Auroville

CAAD I

The initial CAAD courses are taught with design in mind. This means that the CAAD system is seen as a support for design as opposed to a replacement for drawing. The course is divided into five assignments. These are three-dimensional modelling (massing models), model refinement (manipulations in X, Y, Z), special forms (rotations and surfaces), plans and sections design development), and presentation (Basic Photomontage). By starting with three-dimensional modelling, the students are thrown full on into the CAD system. While this entails a relatively steep learning curve, it reflects the way the students are trained to attack design problems.

The students are instructed to pick a parcel on which they can "build". Initially, all parcels were empty. As each semester's work is added to the city, the empty parcels have become scarcer. Students now have the option of redesigning for parcels with existing buildings.

Each student must then communicate with his or her neighbour in order to divine the design directions on neighbouring properties. As the designs become more detailed, the level of co-operation and communication also shifts to smaller scales.

The parcels are defined using an Auroville-wide co-ordinate system. This allows the city to be readily constructed from the constituent parts using either BLOCK or XREF AutoCAD commands. One of the more difficult aspects of the city at the moment is its size. An in-house database system allows the students to easily submit their 5 assignments. The database then arranges the student's work in a common web site. This facilitates easier tutor access to the student's work and enables quicker and a common communication path between neighbouring parcels.


Figure 2: Auroville City Plan in AutoCAD

CAAD II

The focus of the second CAAD course is twofold. On the one hand, the students are shown how CAAD models can serve as a core data model of the building. From this core model, the students learn about general rendering techniques, detailed lighting simulation, connection to CAM techniques used in the manufacturing and construction processes, rapid prototyping techniques used in building physical models as well as immersive virtual reality systems such as the CAVE system in Aachen.

On the other hand, the communication and co-operation process involved in large construction projects is simulated. This is carried out through a collective assignment to create a light rail transit loop for Auroville. The students are split into 8 groups of three students each. Collectively, the students are responsible for co-ordinating and planning the rail lines and the stations. Each group must then design and model their part of the complete line (with naturally perfect alignment of the rail lines at the area borders). These train stations are then modelled using Rapid prototyping, Rendered and converted to VR files for immersive walkthroughs. In this way, the city of Auroville has not only become populated, but also served with an initial infrastructure.

The student discussions as to where to route the light-rail-transit line through city brought up the question of which the Mayor of Auroville is. Furthermore, this question begged the question as to who would elect this virtual mayor. For some students, it was assumed that the tutor holding the course held this position. Despite the power available to a course tutor, the goal of the exercise cannot be to exercise Machiavellian authority over a fictive dominion. The citizens of Auroville must make these decisions. To be fair, the city of Auroville has a population of zero and so creating elected representatives must either lie with the planners themselves or await the introduction of spatial agents.

Planning and Theory

The discussions that arose from the student's negotiations have led to the need for a city council. To date, the "building permits" for unused or occupied parcels are decided by an expert panel, namely the tutors. While this "god-like" position of authority is not without certain advantages, it is the intention of the Auroville project to create a simulation of real world urban problems using the virtual city. Additionally, owing to the high rate of change (with approximately 125 new buildings each semester, Auroville replicates the renewal process of real cities, but at a much higher speed. The goal then, is to create a political structure so that the city is self-regulating.

The first attempts to instigate self-regulation have met with mixed results. The CAAD I course is placed relatively early in the curriculum and so the theoretical or practical experience with urban planning issues is mostly absent. The following semesters will attempt to remedy this situation by providing introductory lessons in city government. This method, combined with the experience gained from other concurrent engineering training sessions using interdisciplinary teams, should serve to engage the students in steering the direction of Auroville development.

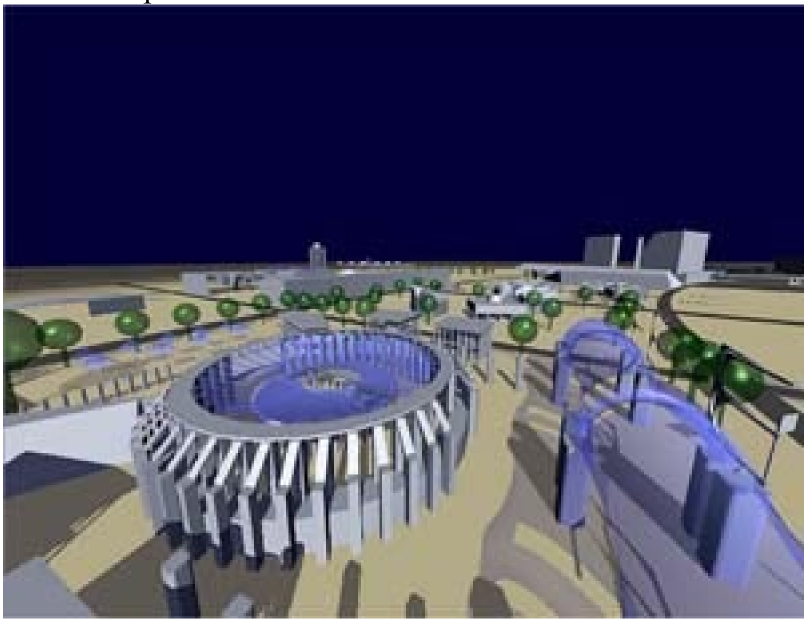


Figure 3: Auroville Detail

Further Development

Auroville is at turning point. The city according to the original Auroville plans is effectively full. The core concept in the CAAD I course is quite successful and so the authors are loath to abandon Auroville or restart the populating process. Instead, the potential is there to create a sustainable process of city development. This process of development and redevelopment is the basic framework for Auroville. The authors contend that the larger potential lies in using this virtual city as a framework for other city oriented planning exercises. Work is underway to extend Auroville in the following areas:

a) Planning Theory - courses in urban planning will use role-playing techniques to create and revise zoning laws for Auroville

b) Spatial Agents - By populating the City with inhabitants, use and behaviour can be used to evaluate the effects of certain urban interventions (within the limits of the simulation algorithms)

c) Immersive VR - The current size of the city is beyond the visualisation capacity of most workstations. Some experiments in the CAAD II course point towards streamlining methods, which would allow the students or visitors to actively explore the city. This, in conjunction with a spatial agent system and multi-user access could allow heretofore-unforeseen virtual urban experiences.

d) Interdisciplinary Development - The development of Auroville must not be restricted to architectural issues. The city data structure is undergoing a revision to allow other fields to work on the city. These include civil engineering projects such as water, gas and electrical grids as well as GIS information about traffic flow and regional development.

The City of Auroville has, over the past two and one-half years grown from a simple CAAD grid for placing artefacts to become a pedagogical platform for teaching a broad range of planning and design issues. While it is not suitable for every didactical approach, the city and its acceptance in the school has well exceeded the author's expectations. Its further success will depend on the high level aspects of its self-determination and the low-level aspects of data structuring.

References

Links

Auroville	http://auroville.arch.rwth-aachen.de
CAAD	http://caad.arch.rwth-aachen.de

History of Architecture 101

Antonio SERRATO COMBE
University of Utah
serrato@arch.utah.edu

Abstract:
This paper documents research in the field of virtual archaeology as an assist in teaching history of architecture. Virtual archaeology or re-creating ancient worlds digitally is not a new item. While the virtual reconstructions of Cahokia on the Mississippi or the Royal Cemetery at Ur in Iraq have provided us with glimpses of how those ancient sites might have looked, the 'quality' of the digital end product has been lacking and not well used within the structure of traditional history of architecture classes. This is because virtual archaeology is in its infant stages. And, architectural historians are just beginning to use digital tools. This paper makes the point that in order to truly develop the bases of a new cognitive science, virtual archaeology has to incorporate a willingness to achieve higher digital modeling and rendering qualities. And, it has to be well integrated into history of architecture classes. In other words, our ability to explore, to interpret and to appropriately use digital tools needs to aspire to greater and more penetrating abilities to reconstruct the past.

This paper presents the theoretical reconstruction of the Aztec Templo Mayor in Mexico and how this research project was integrated into the course 'Pre-Columbian Architecture'. Students in this class have been fascinated not only by the use of animated sections, visualizations and animations, but how these new digital approaches helped them grasp and appreciate the very significant architectural contributions of the early inhabitants of the Americas.

History of Architecture 101

Abstract

This paper documents research in the field of virtual archaeology as an assist in teaching history of architecture. Virtual archaeology or re-creating ancient worlds digitally is not a new item. While the virtual reconstructions of Cahokia on the Mississippi or the Royal Cemetery at Ur in Iraq have provided us with glimpses of how those ancient sites might have looked, the 'quality' of the digital end product has been lacking and not well used within the structure of traditional history of architecture classes. This is because virtual archaeology is in its infant stages. And, architectural historians are just beginning to use digital tools. This paper makes the point that in order to truly develop the bases of a new cognitive science, virtual archaeology has to incorporate a willingness to achieve higher digital modeling and rendering qualities. And, it has to be well integrated into history of architecture classes. In other words, our ability to explore, to interpret and to appropriately use digital tools needs to aspire to greater and more penetrating abilities to reconstruct the past.

This paper presents the theoretical reconstruction of the Aztec Templo Mayor in Mexico and how this research project was integrated into the course 'Pre-Columbian Architecture'. Students in this class have been fascinated not only by the use of animated sections, visualizations and animations, but how these new digital approaches helped them grasp and appreciate the very significant architectural contributions of the early inhabitants of the Americas. Figure 1 shows an aerial view of the Aztec Templo Mayor. All the topics presented in the following chapters were based on this reconstruction (1).

Figure 1

Introduction

> *"Don't take History of Architecture 101. It's a boring class. You won't learn anything. Besides, you have to memorize all these words that don't mean a thing and are hard to spell. You also have to read these thick volumes that cost a lot of money. They have hundreds of pages with small print talking a lot about all these places and buildings, but don't really tell you how those spaces looked like. The professor is OK, but shows all these old slides in the dark auditorium, and you can't help but to fall asleep. The worst part is that I don't see the use of going through all this old stuff. Not only it's dull, but I just don't see the point in relation to what I plan on doing in the future…"*
>
> History of Architecture Student

A typical student that at age three began to be immersed in a variety of media, from electronic toys and devices to a barrage of television and cinematic imagery, by the time he or she reaches college has become a media saturated creature. He or she finds that many of the instructional approaches that have not kept the pace with the times are dry, dreary and devoid of purpose. While such negative attitude and perspective is debatable, it nevertheless raises questions on using new digital technologies in the classroom, especially in history of architecture courses. Why? Because unlike other courses within the architectural curriculum, history courses provide a unique window of opportunity to integrate theoretical reconstructions, animations of ancient sites, as well as many other pioneering approaches. This paper is not intended to argue that a history class has to be 'flashy' and use all kinds of pyrotechnics in order to be first-rate. Instead, it presents a range of tactics that can easily be integrated to history of architecture courses.

Approaches

While there are many visual aids that can assist in understanding, interpreting and projecting the value of history of architecture studies, none of those traditional assists compares with the power and capabilities derived from using virtual explorations of the past. The reason for this assertion comes from the wide range of tactics now available to enhance education. Not only a professor can discuss heretofore unknown qualities of places or buildings using theoretical reconstructions, but the presentations themselves, the messages, can be easy to comprehend and astonishingly attractive.

From a wider perspective, the assists that virtual reconstructions of the past provide fall into the following categories:

1. Planar representation
2. Three-dimensional visualization
3. Static and animated representation
4. User interface and immersive technology

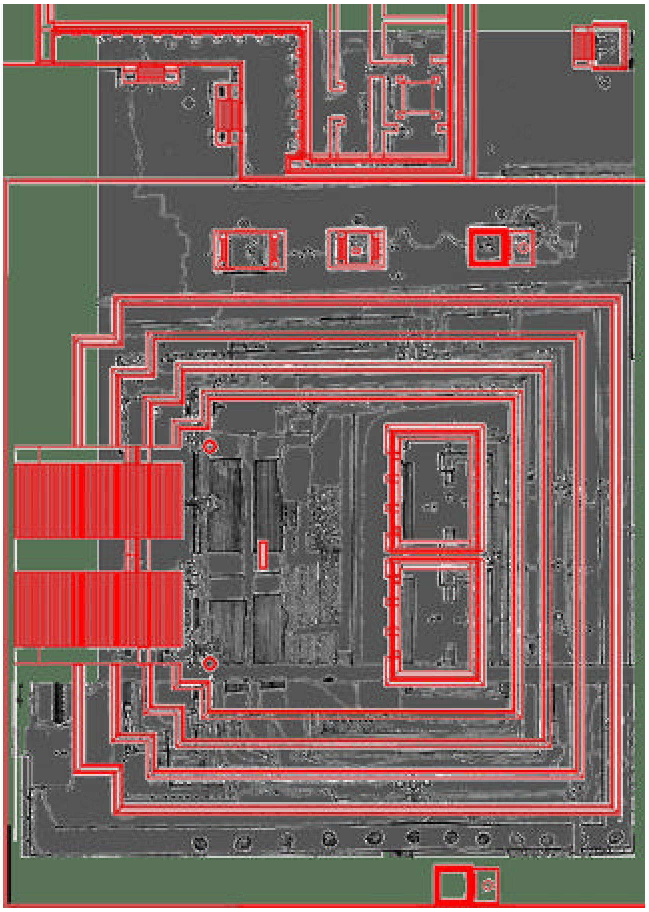


Figure 2

Planar representation

There is no question that traditional orthographic plan, elevation and section drawings of places and spaces are essential components in history of architecture courses. Because these techniques of representation have been easy to draw and reproduce, they have been used for centuries. However, this is where the effort has ended. How can we develop these traditional representation methods further and, for example, connect archaeological mapping of existing remains with potential theoretical virtual reconstruction using graphic overlays? Could we complement the discussion of a site by analyzing the evolution of construction layers? With digital technology, we can now add to the discussion topics that were almost impossible to present some years ago. And, we can do this in very visually attractive ways. For example, we can illustrate how archaeological data can be used to locate foundations of ancient structures. Figure 2 presents a digital overlay where in gray color one can visualize site plan data coming from archeological mapping via satellite aerial imagery. In red color one can begin to see a potential theoretical reconstruction outlining the foundations of ancient structures. The overlay is from a section of the Aztec Templo Mayor.

Figure 3 presents the superimposed site plans of two Mesoamerican cities: Tula, the capital of the Toltecs, and the theoretical reconstruction of the Aztec Templo Mayor site. In this overlay, it becomes clear that the Aztec designers of the Templo Mayor site in Mexico City used composition principles first developed by Toltec designers several centuries earlier. Even the dimensioning modules appear to be similar. The illustration shows in black color the Aztec scheme. The Toltec city is shown in orange color. Both are drawn at the same scale.

Another way of presenting enhanced architectural information is through the use of photocomposition. This technique basically consists of manipulating graphic elements in a photograph in order to illustrate or highlight a particular argument. Elements can be distorted, scaled, colorized, etc. While this procedure has been available for many years using multi-layer acetate film and other darkroom techniques, it has been cumbersome,

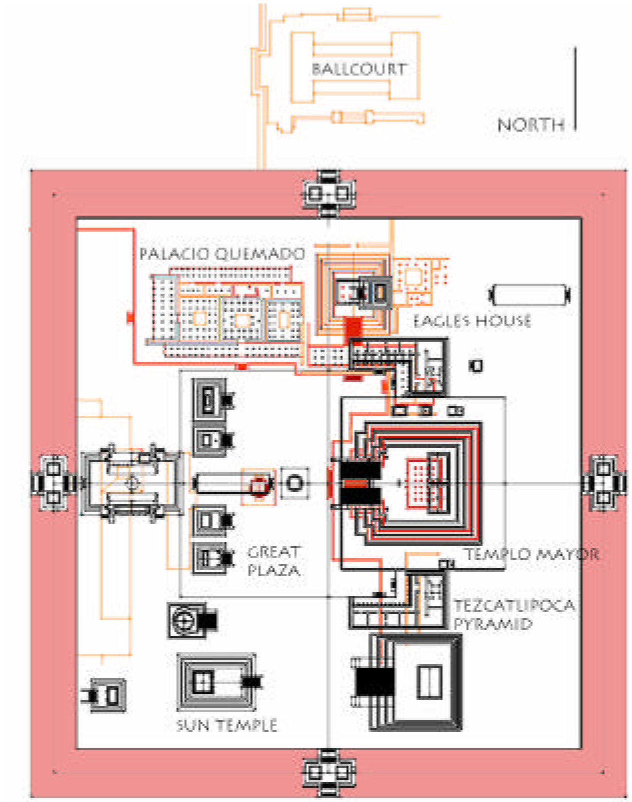


Figure 3

time consuming, and rather expensive.

Digital photocomposition has addressed these issues and is now quite easy to carry out. The application of this technique proved invaluable in understanding how Mesoamerican architects created their first designs using a very unique system of planar representation. Unlike the symbols we use today to represent buildings that include plans, elevations and sections, Mesoamerican architects used a rather clever system that combined in the same drawing or illustration one or more facades and one or more sections. To the untrained eye this system is quite difficult, if not impossible to comprehend. However, with the assist of digital photocomposition procedures, we can shift and scale elements in the original drawing or photograph using current architectural representation systems in order to recreate theoretically how the original structure may have looked. An ancient pictogram that only a few highly trained specialists could decipher can now become an attractive drawing that all can easily read and interpret.

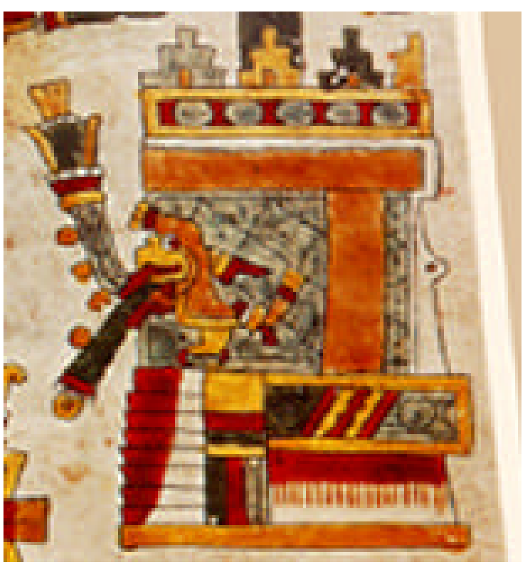


Figure 4

Figure 4 shows a section of the Cospi Codex, a skin screenfold manuscript at the Biblioteca Universitari in Bologna. This particular illustration shows in traditional Mesoamerican fashion how 'tlacuilos' or Indian graphic artists represented buildings. Some elements like the roof termination are illustrated in frontal elevation. Other building components like the base are only partially shown. The outer walls of the structure are illustrated with some elements drawn as elevation while others are sketched out as section. In the classroom, one could show and discuss the original pictogram and verbally attempt to 'reconstruct' it in

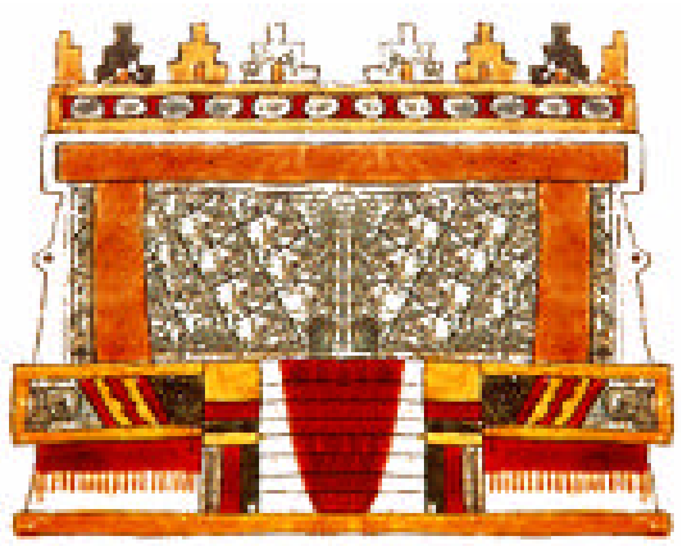


Figure 5

order to get an idea of how this structure might have looked. On the other hand, it is now a lot less painless to actually perform 'digital surgery' on the original drawing and recompose it. Figure 5 shows a theoretical reconstruction elevation based on the Aztec pictogram shown in figure 4 where all the building elements are drawn using current conventional drawing techniques. In this case the digital photocomposition has only included the relocation of some building components. But, the process could certainly continue to explore issues of building scale, proportions or tectonic qualities.

Many of us have attended presentations where the silver screen revealed poor, almost unreadable material. Mediocre publications containing illegible imagery abound. These conditions can be improved significantly by applying new digital technologies. Better and more visually attractive depictions of historic drawings, artifacts and buildings are just a few clicks away. A case in point is shown in Figure 6 where new digital graphic techniques have resulted in the re-discovery and enrichment of ancient documents. This particular figure contains a representation of Mictlancihuatl, the female deity of the Mictlan or Mansion of the Dead in Aztec mythology. The original Indian pictogram of this deity is in the Fejervary-Mayer Codex at the Free Public Museum in Liverpool England. It is barely readable. Even the first facsimile edition published by Lord Kingsborough in 1831 has lost most of its colors and textures. In order to arrive at the graphic shown in Figure 6 a high resolution scan of the original pictogram was first obtained. It revealed minute traces of pigmentation. Higher levels of magnification then brought to life a faint black outlining the various colors that were used originally. Using those minute original samples of color, the process continued by carefully applying the same original pigment to contiguous areas that had lost the color

Figure 6

over the years. Clarity and intelligibility in the representation of the deity slowly began to emerge. Facial features, hand delineation, and other symbolic elements finally came back to life resulting in a brilliant impression of the Aztec goddess. To further enhance the readability, the outline was digitally embossed and placed against a contrasting color background. It should be pointed out that in this case the effort was not meant nor intended to give a different look to the original pictogram. The goal was simply to explore ways to make understandable an otherwise unreadable pictogram.

Three-dimensional Representation

Before the advent of three-dimensional digital modeling tools, architectural historians had to rely on existing photographs, sketches and relatively few three-dimensional illustrations to complement their texts or presentations. Many of these sources were in obscure inaccessible locations. New illustrations were difficult and time consuming to generate. Older illustrations suffered from a variety of ills. Perspective deformation, wrong placement of elements, incorrect scale and proportion problems were just some of the problems encountered. While three-dimensional digital modeling is still a difficult tool to use not because it is too intense, but because it requires a high level of precision and complete data sets, it nonetheless addresses and solves many if not most of the previously listed problems. In fact, three-dimensional modeling tools are great assists in solving mysteries related to building placement and delineation. They too can debunk myths that have plagued historical accounts for centuries. A case in point is the architectural delineation of shrines within the Aztec Templo Mayor archaeological site in Mexico City. For many decades architectural historians had relied on sketches and drawings based on Aztec clay models. These very small clay models were found during archaeological excavations done in and around the Templo Mayor site. It is not known if these models were actually used by the Aztecs for design and construction purposes. Perhaps they were simply decorative objects and had other symbolic meaning attached to them. Even though historians were not sure if these models were actual small scale representations of the real temples, they were nevertheless used as the base for theoretical reconstructions. Numerous historians fell in the trap and produced works that envisioned and depicted Aztec temples as very tall structures. Some even introduced imagery that combined stylistic features from Mayan architecture and Aztec production!

Figure 7 shows on the upper left corner a photograph of an Aztec clay model perhaps representing a shrine resting on a pyramid base with an attached staircase. Immediately on the right is a computer model that adheres to the clay model form and proportion qualities. While studying this particular model it quickly becomes apparent that this structure could not have been built with this particular physical delineation. The Aztecs simply did not have the necessary structural or engineering expertise at the time to build such svelte temple. Its shrine at the top can certainly be made out of clay in a small model, but to use the same proportions at full scale is not possible. Below the image of the clay model is another digital model based on sketches produced in the 1960’s. For those not familiar with the stylistic building characteristics of Aztec architecture, such delineation would be entirely acceptable. However on close scrutiny, this image contains a long list of problems that the length of this paper cannot afford to enumerate. Suffice to point out that it is the bottom image that most likely paints the reality of the actual Aztec temple. This image was derived from recent archaeological evidence uncovered by the

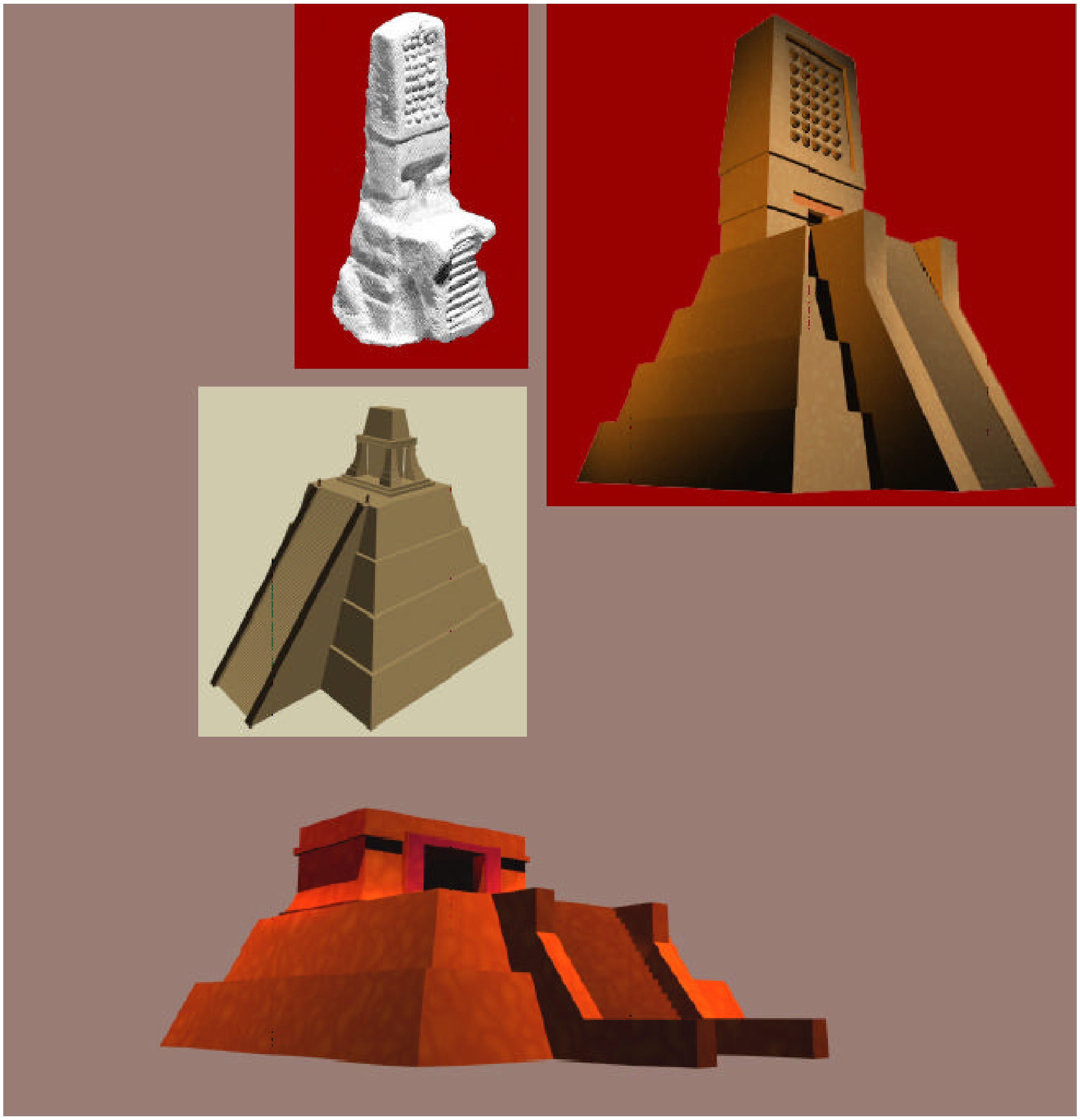


Figure 7

Mexican Institute of Anthropology and History. The temple and its base have correct proportions, and the stylistic attributes pertain to the architectural definition used by the Aztecs just before the arrival of the Spanish.

Digital tools can greatly enhance the teaching and understanding of architectural history in other ways. Their ability to quickly generate a variety of views is truly fascinating. Not only we can now generate isometric, axonometric, and perspective views by pressing a few keys, but it is also possible to generate close-up, eye-level and aerial views that heretofore were not possible. Being able to look at the shrine of Huitzilopochtli atop the Aztec Templo Mayor from the Ytualli or Patio of the Dances in front of the temple and without perspective distortion provides beyond doubt a most direct way of comprehending the synesthetic qualities of Aztec design.

Finally, the ability to explore architectural characteristics that go beyond basic geometric representation is probably the most attention-grabbing innovation made possible by digital technologies. For example, the interface with sites can easily be investigated with terrain modelers. Landscape integration can be studied using fractal generators as shown in Figure 8 visualizing the vegetation characteristics of the Aztec Templo Mayor site.

Figure 8

Also in this category is the ability to explore the expressive qualities of historic sites or buildings. Photographs and drawings of ancient sites usually depict them as bare assemblages of cold stone and rubble. When looking at these images architecture students see them as too removed from today's architecture. For many of them, it is very difficult, if not impossible, to discover the links between a pile of rubble and the actual physical and expressive qualities the ancient site might have had. In the case of the Aztec Templo Mayor, archaeological evidence has documented numerous instances of highly decorated and colorful environments. Added to such physical evidence is the commentary written in the sixteenth century by Spanish friars painting scenes where thousands of individuals danced and sang while hundreds of braziers spilled fire and smoke. With the assist of digital tools we now can recreate such vibrant expressive qualities leading to a much better understanding of not only the basic architectural form qualities, but the total synesthetic feeling and emotion of the place. Figure 9 is a close-up view of the shrines of Tlaloc and Huitzilopochtli atop the Templo Mayor. These two twin temples were placed at the rear of a large platform whose center was the sacrificial slab where thousands of Aztecs had their hearts ripped out as an offering to the deities. This platform most certainly had a dreadful and appalling quality. Cortes, the Spanish conqueror, and other contemporary chroniclers did not sketch out this part of the Templo Mayor site, but wrote extensive accounts describing such frightful space. These accounts formed the base for the theoretical reconstruction.

Figure 9

Static and Animated Representation

Animated drawings and 'walk-through' or 'fly-through' animations can also enrich the study of historic sites. This is particularly true when kinematics reveal how a special quality or attribute was actually achieved. A case in point is an animation showing how ancient sites were assembled in layers. Aztec architecture is the perfect match for this approach because it is a well known fact that every fifty-two years most temples and shrines received a new building layer covering previous construction phases. 'Walk-through' films do not hold exclusive rights under this category. More subtle and profound investigations using carefully orchestrated animated sections can reveal qualities not known or perceived previously. For example, we can generate an animation where a series of vertical sections can slowly reveal spatial transitions and hierarchies. Such visualization could demonstrate that a particular sequence of spaces most likely was devised by the designers to inspire awe or admiration. Or, it could also show how designers used spatial sequences of compression and decompression to make the occupants of spaces go about in certain directions. Aztec architecture included many symbolic associations between mountains and temples. Ultimately, the result was the generation of canyon spatial effects between pyramids. One quickly grasps this valley-ravine outcome by studying an animated series of sections cut through the main axes of key pyramids. Figure 10 shows one frame of an animated vertical series of slices cut through one of the major axis of the Aztec Templo Mayor site. This particular animation clearly illustrates the mountain-temple scheme and

Figure 10

resulting canyon spatial effect. In addition to this mountain-temple association, there also was a directional building quality tied to astronomical observations. Temples not only included physical manifestations or symbolic decoration linking the structure to particular deities but were quite accurately aligned to celestial bodies. With the assist of animated sections both points can easily be appreciated. Visualizing the movement of the sun during the equinox between the twin shrines of Tlaloc and Huitzilopochtli atop the Aztec Templo Mayor is truly a fascinating experience.

Walk-through or fly-through theoretical animations are the most elaborate assists. While their production is currently somewhat problematic, their educational value can oftentimes justify their very demanding and time-consuming attributes. Because the generation of a one-minute animation requires the creation of 1280 individual images on average, the process generally involves a substantial amount of time. It is also complicated by the fact that one has to generate credible imagery based on reliable historic data which sometimes is not readily available. Despite their inherent difficult production, walk-through animations are probably one of the best ways to not only analyze but to 'feel' the qualities of ancient places or historic buildings. In the case of the Aztec Templo Mayor, the ability of being able to virtually walk along the side of the Tzompantli where thousands of skulls were strung along wooden poles is an experience that cannot be generated by any other means. Figure 9 is from an animation clip running along the Tzompantli or Aztec skull rack in front of the main temple.

Figure 11

User interface and Immersive Technology – Virtual Reality

Interactivity, or the opportunity that an individual is given to choose or direct the course of study, is probably the most intriguing topic in this presentation. While all the different approaches mentioned above greatly enrich the way we can read and study historic environments and buildings, there is still one element missing. The learning environment is passive: students just listen inactively and look at a variety of visual material. The only opportunity for interaction comes with open discussions or testing. A subject of great debate within academia, the concept of self study and direction, if well implemented, brings stimulating prospects to the study of world architecture. In broader terms, user interface options include instances where a student can: (a) virtually navigate solo or along pre-determined paths through buildings or environments, (b) interact virtually with the environments, and/or (c) be given the opportunity to virtually modify or alter single physical instances such as lighting, or other major changes including scale transformations or modification of tectonic qualities.

Virtual reality began when the concept of immersion in a simulated world with complete sensory inputs and outputs was first proposed. The idea was to see a screen as a window through which one could see a virtual world that looked real, acted real, sounded real and felt real. The potential of using virtual reality systems in the study of architecture as a more intuitive metaphor for human-machine interaction is enormous because the student can exploit his or her existing cognitive and motor skills for interacting with the world in a range of sensory modalities. For the study of architectural history virtual reality is a lot more than just interacting with historic reconstructions of three dimensional worlds albeit this option is most likely the most important one. By offering presence simulation to students as an interface metaphor, it allows them to potentially perform tasks on historic reconstructions, remote computer generated worlds or any combination of both. The reconstructed environment does not necessarily have to obey certain laws of behavior. The following describes potential application areas were the benefits are more straightforward than others:

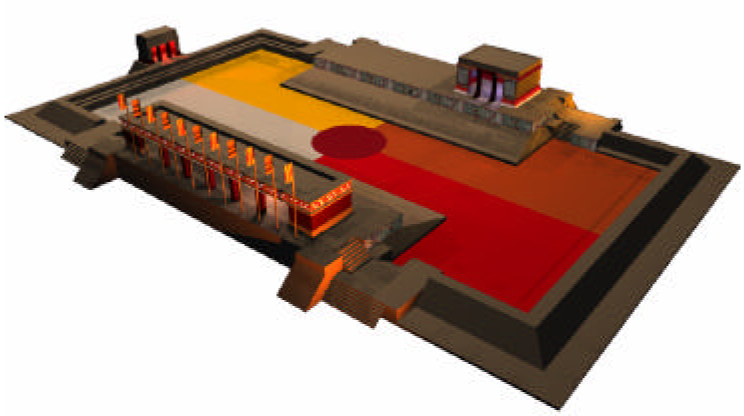


Figure 12

User-Directed Walk-Through

Architectural building or place user-directed walk-throughs have been one of the most successful applications of virtual reality. Figure 12 shows a frame of a fly-through VRML file that models the theoretical reconstruction of an Aztec ball court. In this virtual reconstruction the student can virtually fly around this structure, pan the views and even zoom in on some building details.

Natural interaction using (a) digital panoramas, (b) immersive technologies, or (c) virtual reality modeling systems with digital reconstructions can be important in history of architecture courses because they provide an unlimited number of viewing angle opportunities thereby forming in the viewer a much better and richer mental model of complex objects, buildings and environments. This, in turn, augments the understanding of that object's identity, attributes, functions, and so on. On the market today there are a number of cross platform application packages with the capability to play movies, synthesize music, display animations, view virtual reality worlds and add multimedia options to the computer desktop. These applications are implemented as a set of extensions on the Macintosh platform and a dynamic-link library (DLL) on Windows. They can process video data, still images, animated images (also known as sprites), vector graphics, multiple sound channels, MIDI music, 3D objects, virtual reality objects, panoramas and text. The number of data formats they recognize is impressive. Currently, more than 70 different formats can be imported or exported and as formats are added, applications created today will probably work with them automatically.

Virtual Simulation

How did the shrines atop the Aztec Templo Mayor look like? While the historical record contains a variety of sketches illustrating how these temples might have looked, this question has not been answered satisfactorily. Figures 13-14 are examples where user-directed virtual simulation has helped in determining the most probable architectural configuration for these shrines. Figure 13 is based on the Codex Ixtlilxochitl, an ancient Indian manuscript, whereas figure 14 is based on more recent archaeological data. This particular study demonstrates in a most vivid way to students of architecture that historical interpretations change over time. In other words, what was once considered an absolute truth has now been debunked by new scientific tools and upgraded archaeological data.

Figures 13-14

Virtual simulation is more than only high tech applied to historic buildings or places. When correctly applied to the study of architecture, there is a virtualization of the whole being. We encounter this phenomenon in everyday media worlds. The classical difference between appearance and reality becomes blurred. The simulation, in which students can walk around, is not fictive. It is not pure imagination, but something realized. It is reality although it is virtual. From this viewpoint, it can potentially become a major determinant or consideration when applied to everyday life.

Telepresence, Teleoperation and Increased Sense of Realism

As we begin to complete the first phase of being able to virtually recreate the past, it is important to pay attention to both the awareness and behavior of the individuals participating in the new technologies. We are now at a crucial moment where the machine-human interface can increase the sense of realism of a virtual experience as well as convey information about a building's identity, qualities, location, function, and so on. We can now increase the range of textural information. We can also examine roughness perception of a set of force feedback generated textures in order to better understand the range and resolution of textural information available through such interaction. We too can add audio stimuli to increase further the potential for conveying more varied and realistic texture percepts through force feedback interaction. With telepresence and teleoperation students can perform actions within virtual environments. They can even generate synthetic characters or avatars to be inserted in models to study their responses to visual, haptic and auditory textural stimuli.

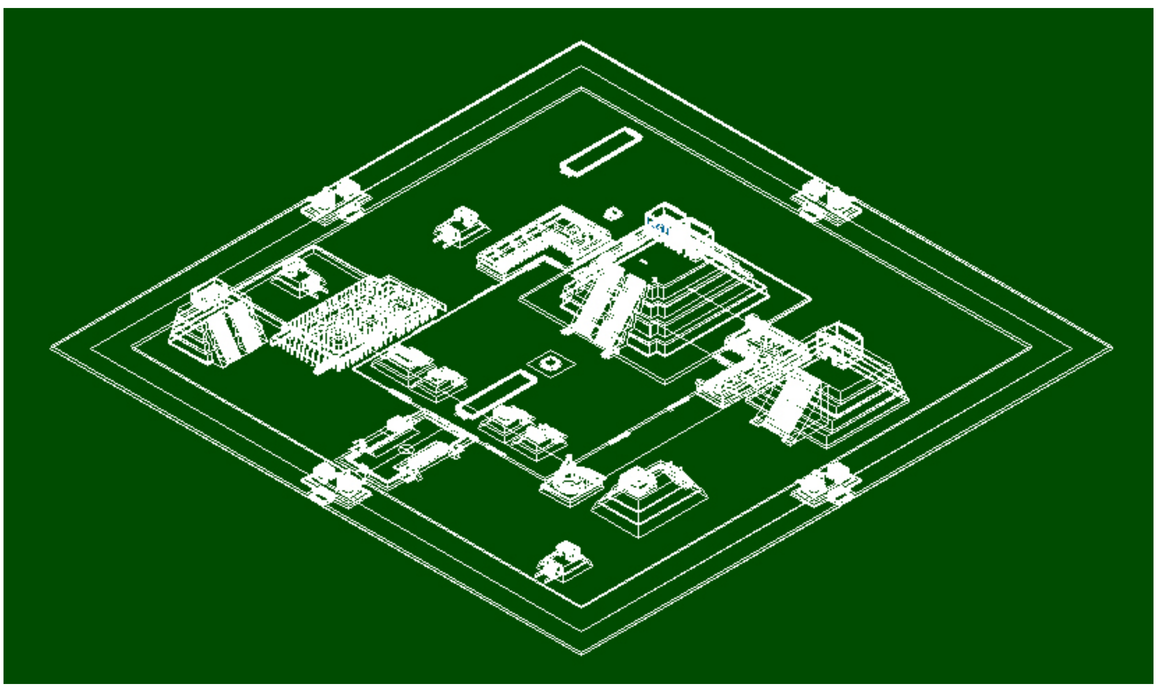


Figure 15

Image 15 is a screen capture of a virtual reality model where students can follow a do-it-yourself tour and navigate freely through the site of the Aztec Templo Mayor. This model includes markers where students can obtain additional information such as a description written from the Aztec point of view about what happened when Moctezuma, the last Aztec ruler, and Cortes first met. There is also the possibility of following a guided tour where students select a viewpoint on a pre-selected position for viewing a scene. In this case each vantage point has a name and students can use a menu to cycle through the viewpoints. The model includes provisions catering to those who wish to see the reconstruction in full detail. Clicking on other markers activates movement of objects using script nodes, sensors and routes. Special virtual reality modeling elements called billboards can also be activated where messages appear on transparent background layers. At particular nodes students can appreciate the path of sun rays on the spring equinox. On this date as the sun rises, the rays pass between the shrines atop the Templo Mayor. At the intersection of major axis there are nodes that activate 360-degree panoramas of the scene. Finally, there's a fair amount of activity in this virtual reconstruction that students can teleoperate: flames and sparks rising from the braziers, boats sailing around the lake, and birds flying overhead.

Conclusion

Architectural history education has been developing as an island community with few ties to the information technology mainland. It currently lives inside its own structure and is dependent on a limited set of specific educational approaches for authoring and presenting. This paper submits that architectural history education should relocate to the mainland and live and benefit from very exciting new ways to look and study old worlds. Far from suggesting that old educational approaches be abandoned, this paper recommends that those insular approaches pack-up and set sail for the mainland, and integrate into the mainstream. It is cool.

Bibliography

(1) Serrato-Combe, Antonio, The Aztec Templo Mayor, 2001, The University of Utah Press, Salt Lake City.

VISUALISING THE ARCHITECTURE OF FEDERATION: Digital Media and Cultural Identity in Australian Architecture

Emma WILLIAMSON
Curtin University of Technology, Perth, Australia
e.williamson@exchange.curtin.edu.au

Introduction

This paper is drawn from recently completed research and a CD-Rom project entitled "Visualising the Architecture of Federation", funded by a grant awarded by the National Council of the Centenary of Federation, History and Education Programme, whose charter is to promote research on the period surrounding the federating of Australian colonies in 1901.[1] The project explores the spatial and visual history of the period using digital media.

Usual histories of Federation Style[2] in Australian architecture focus firstly on the domestic architecture of the time and secondly on generalised stylistic categories. I would argue that this type of representation does not take into account the subtleties of the architecture of the period which was distinctively Australian, encompassing a range of styles with international connections and unique local variants.[3]

This paper explores the origins and influences on Australian federation architecture, looking at the processes of collage, eclecticism and adaptation used by the architects of the day. In addition the paper will illustrate how digital media and visual manipulation were used within the CD-Rom to create a dense and image rich re-presentation of the buildings of the time, making reference to the variety of sources that were used simultaneously in the design of single buildings. This process of architectural collage reflects, as Paul Carter has more generally discussed, the 'normal' mode of constructing meaning and identity in the post-colonial context of Australia'.[4]


[i]

---

[1] Co-grant holders Dr Hannah Lewi, Professor David Dolan. CD-Rom Design Kieran Wong at CODA. Programming design DUIT Multimedia

[2] Bernard & Kate Smith 1973, *The Architectural Character of Glebe*, University Co-operative Bookshop, Sydney, pp.90

[3] David Saunders August 1969 'Domestic Styles of Australia's Federation Period: Queen Anne and the Balcony Style', in *Architecture in Australia*, pp.655

[4] Paul Carter 1992, *Living in a New Country*, Faber and Faber, London, pp.187.

Cultural Identity and Federation

The issue of defence and the imagined threat of Australia's Asian neighbours was significant in the minds of many Australians and fuelled the debate for a federated nation.[5] Support for federation was based largely within the Eastern colonies with many Western Australians sceptical of the benefits it would provide to their colony. Under a federated agreement with inter-state free trade Western Australia would lose almost 90% of the state revenue that came from customs duties,[6] in addition to sharing the spoils of the recent goldrush. Although there was support for federation within the metropolitan region it was the migrant prospectors in the goldfields that swayed the vote to join the federated colonies. Despite the efforts of the government in Western Australia to influence the vote away from the federated agreement by allowing women to cast their vote for the first time,[7] at the referendum held on 31st July 1900, Western Australians agreed to join the other Australian colonies in the formation of the Commonwealth of Australia.

ii

Although regional centres had been strengthened in the eastern colonies, Western Australia existed largely as a 'primitive frontier town'[8] until the beginning of the goldrushes in 1892. The goldrush created an economic boom in the west whilst the east struggled in recession. The period saw a huge population growth as 't'othersiders' from the eastern states came to find their fortune on the goldfields[9]. Amongst these were a large number of eastern states architects who came to satisfy the need for housing and infrastructure. Townships such as Kalgoorlie were literally built in a matter of years; transformed from hessian and iron shacks to permanent towns with large, classically styled, civic buildings and brick houses. As a consequence of this influx of wealth and population, and the continuing recession that occurred in the eastern parts of Australia, Western Australia became a fertile testing ground for many architects who migrated either permanently or temporarily during

5 Manning Clark 1969, *A Short History of Australia,* Heineman, Melbourne pp.188

6 Manning Clark 1969, *A Short History of Australia*, pp 188 and F.K. Crowley 1970, *Australia's Western Third: a history of Western Australia from the first settlements to modern times* Heineman, Melbourne, pp.115

7 F.K. Crowley 1970, *Australia's Western Third: a history of Western Australia from the first settlements to modern times* Heineman, Melbourne, pp.113. The vote in the metropolitan region was two to one in favour whereas the vote in the goldfield was 13 to one in favour. It was in the southern regional areas that the vote was two to one against.

8 J.M. Freeland 1972, *Architecture in Australia*, Penguin Books, England, pp.198

9 Margaret Pitt Morison & John White 1981, 'Builders and Buildings', in *A New History of Western Australia,* ed T. Stannage, University of Western Australia Press, Perth, pp.533

this period. Reflecting this shift in architectural manufacture from the east to the west the CD-ROM project, and this paper, have a West Australian focus.

'The creation of a federated Australia was on the minds of the politicians in 1890, and the creation of an Australian architecture was on the minds of the architects.' [10] Vigorous national debate around issues of appropriate architectural languages and styles was played out through the various architectural Institutes and reported in the national press and publications such as *The Building and Engineering Journal* and later *The WA Building Mining and Engineering Journal*. These debates highlighted the struggle to respond to the wants of local communities (to keep the status quo) and the will amongst the profession to create a unique response to the Australian context. Therefore, conversation was largely centred around the adaptation of existing styles of architecture, following the stylistic motifs of Classical, Gothic or Romanesque, and modifying these as appropriate to a new country, culture and climate. Foreign architecture was seen more as a source than the answer to the problems of designing in Australia, with the changes necessitated by the extreme climate and the availability of local materials.[11]

Discussion surrounding the need for an Australian style of architecture began in the late nineteenth century. In the 1880's, the artist Lucien Henry devised an 'Australian Order of Architecture', and whilst his designs for the use of native flora and fauna as motifs on traditional Greek orders[12] remained largely on paper his ideas were promoted by some architects of the time. In particular E. Wilson Dobbs in an 1891 paper reported in 'News', 11 June 1892 stated that Henry's ideas were 'worthy of serious attention'[13] by all those who believed in the possibility of something original evolving from existing styles of architecture. In the same paper Dobbs referred to the process of 'eccentric eclecticism' in reference to the methods of architectural production being employed throughout the nation by many architects of the time.

Dobbs incorporated some of the ideas of Henry in the ornamentation of the façade of the South Yarra Post Office, Melbourne, completed in 1893. As a vocal admirer of the Romanesque style he sought to explore the potentials of 'combination'[14] as a method of architectural production. The building has been described as a synthesis of American Romanesque and Norman Shaw influences where the carvings in the spandrels of native flora and fauna is seen as a way of nationalising the combined influences of the Richardsonian[15], Arts and Crafts and Queen Anne styles.

---

[10] Myra Dickman Orth 1975, 'The Influence of the American Romanesque in Australia', *The Journal of the Society of Architectural Historians*, pp.3

[11] Conrad Hamann 1979, 'Nationalism and Reform in Australian architecture 1880 – 1920', *Historical Studies*, Vol. 18 no. 72, University of Melbourne, Melbourne pp.394

[12] Donald Johnson 1980, *Australian Architecture 1901 – 1951*, Sydney University Press, Sydney, pp.2

[13] E. Wilson Dobbs 1891, 'An Australian Style of Architecture' in *Building and Engineering Journal,* February

[14] E. Wilson Dobbs 1891, 'An Australian Style of Architecture' in *Building and Engineering Journal,* February

[15] Myra Dickman Orth 1975, 'The Influence of the American Romanesque in Australia', *The Journal of the Society of Architectural Historians*, pp.16

iii

Michael Cavanagh, president of the West Australian chapter of the Institute of Architects addressed fellow members in his opening address in 1903, raising the issue of an Australian style of architecture saying:
"We are placed here in novel circumstances in a new country which is in an absolutely primitive condition. And we are engaged in the task of attempting in our generation to graft on all the arts and conveniently and comfort of the highest stage of civilisation. If we are to do this successfully we must be equipped with the knowledge and arts of the old world, and we must also possess the practical ability to apply them to successfully meet the new conditions."[16]

Cavanagh's suggestion of 'grafting' can be likened to Dobbs' 'eccentric eclecticism'. Both advocated architectural reconciliation through the collaging of disparate elements in order to build a specifically different architectural model for Australia responding to issues of style, place, climate and materiality. This method of architectural manufacture, or 'mongrelism'[17] as more generally described by Howard Raggatt has been a critical tool in the search for a distinctively Australian Architecture throughout the twentieth century.[18]

Debate within the press encompassed the methods of manufacture of architecture and revealed emerging qualities of Australian cultural identity. In particular the desire for truth and honesty. At the "Report of the Fourth Meeting of the Australasian Association for the Advancement of Science 1892", Alan C. Walker spoke of the need for an Australian style of architecture stating that with 'logical truth and honest self-sufficiency" will come a period of 'architectural magnificence'.[19] This concern for material "truth" in architectural style may be seen as a precursor to early modernism that occurred in post war Australia.[20] Some argued that the Australian style of architecture should develop slowly through the rigorous following of existing

---

16 Michael Cavanagh, 1903, 'Architecture as an Art' as reported in *WA Mining Building and Engineering Journal*, June 20, pp.19

17 *Collins Concise Dictionary Australian Edition* 1995, Harper Collins Publishers, Sydney, pp.859 defines mongrel 1. a plant or animal, esp. a dog, of mixed or unknown breeding. 2. *Derog.* A person of mixed race. *–adj.* 3. of mixed origin, breeding, character, etc.

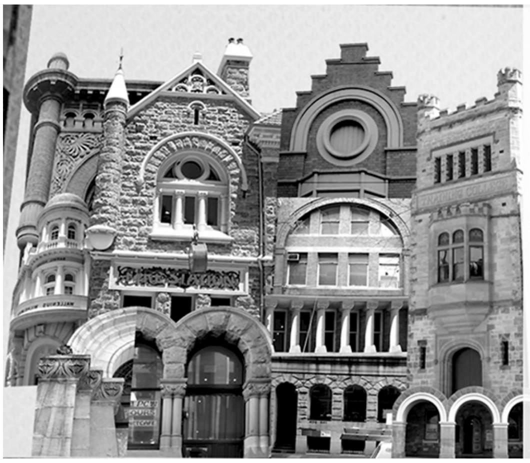
18 Howard Raggatt 1993, 'Notness: Operations and strategies for the fringe', *Fin de Siecle? And the twenty-first century Architectures of Melbourne,* 38 South, Melbourne

19 Alan Walker 1892, *Report of the Fourth Meeting of the Australasian Association for the Advancement of Science 1892*, Sydney

20 Conrad Hamann 1979, 'Nationalism and Reform in Australian architecture 1880 – 1920', *Historical Studies*, Vol. 18 no. 72, University of Melbourne, Melbourne, pp.393

styles and the slow adaptation to the specific Australian environment.[21] Whilst others believed that an Australian architecture would come from the combination of elements drawn from a variety of sources.

Before 1895 around 95% of architects in Australia were immigrants, and the vast majority of these were from Britain. By 1900 this British focus had shifted. As well as architects being educated within Australia, young architects came in contact with a range of international architectural styles through overseas travel and the increasing number of architecture and building journals.[22] In addition to British architectural journals a large number of American journals were held in Australian collections.[23] Australia's situation was likened to that of America; as a new country, with new conditions and new requirements and as such it provided a unique opportunity to do original work.[24] Increasingly America became a destination for their travels.[25] New American influences emphasised the expression of local materials as ornamentation rather than the intensely applied, often pattern book derived, decoration of the Melbourne Boom style in the decades preceding the Federation period. The resultant architecture came to reflect the shift in focus of Australian architects and the population more generally. Rather than the singular connection to England, the buildings of the period reflected a growing awareness of America and the combined influences of both.


iv

Materials and Local Contexts

As mentioned in the previous portion of this paper architects of the Federation period were able to create an Australian identity through building with the careful consideration of particular local contexts. Local influence came with the addressing of concerns of local climates, building materials and functions. The availability of materials in different locations across Australia had a great impact on the styles of the Federation period. Subtle shifts in style and texture were achieved through the employment of local materials. In Sydney buildings tended to use sandstone, in

---

21 E. Wilson Dobbs 1891,'An Australian Style of Architecture' in *Building and Engineering Journal,* February

22 Conrad Hamann 1979, 'Nationalism and Reform in Australian architecture 1880 – 1920', *Historical Studies*, Vol. 18 no. 72, University of Melbourne, Melbourne, pp.393

23 Myra Dickman Orth 1975, 'The Influence of the American Romanesque in Australia', *The Journal of the Society of Architectural Historians*, pp.6

24 Michael Cavanagh 1893, 'An Architecture Racy of the Soil' reported in *The Building and Engineering Journal*, October 14, pp.156

25 Donald Johnson 1980, *Australian Architecture 1901 – 1951*, Sydney University Press, Sydney, pp.8

Melbourne brick and render and in Perth many buildings employed limestone and other locally available stones.

The issue of material availability was nowhere more felt than in the remote and unique conditions of the Western Australian goldfields. The pressing demand for building materials in Western Australia, from Perth to the goldfields, inspired the search for locally available materials. The rapid transformation of Kalgoorlie initially required all building materials to be imported. Even bricks were sent from eastern Australia. The difficulty of transportation to the goldfields during the early years of the goldrushes required resourcefulness in material use. Timber was readily available but over time was considered somewhat unsightly and also a fire risk. The development of the railway line between the western port city of Fremantle, Perth and the goldfields toward the end of the nineteenth century, enabled materials such as brick, iron and steel to reach the goldfields townsites.

PANORAMIC VIEW

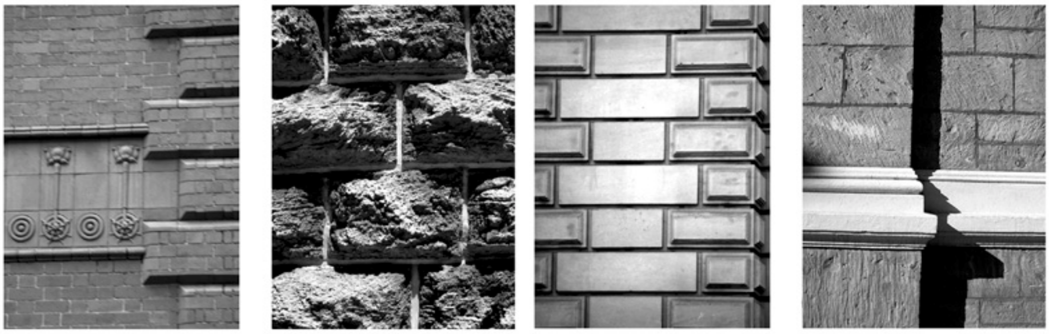
v

vi

Migrant architects from the eastern colonies brought with them styles and preferences for materials they were familiar with. This created a debate within the Western Australian community who expressed the desire to use locally available materials for reasons of economics and a sense of local pride. The development of locally produced and quarried materials underpinned this debate for regional specificity in building at a time when both regional independence and national unity was sought. With its policy to use locally manufactured products, the Public Works Department played a significant role in the development of local industries for the production of building materials.[26] During this period locally quarried stones such as Meckering granite, Donnybrook stone, Cottesloe and Rottnest limestone came to be used in large public buildings. The expression of materials and the influence of material selection upon ornamentation in buildings were intimately bound with a

[26] Ingrid Van Bremen 1990, *The New Architecture of the Gold Boom in Western Australia: Government Buildings 'Under the Direction of G.T.Poole, 1885-1897*, unpublished thesis, University of Western Australia, Nedlands, pp.119

search for an Australian style. The same stylistic element became dramatically altered with different materials such as plaster, cement render, rough stone or brick.



a. b. c. d.[vii]

The virtual Federation Museum

Within the project it was our intention to create virtual surfaces that begin to describe the rich influences of the period. This issue of surface has not been fully explored in previous histories of the period. As William J. Mitchell discussed in the essay 'Architechtonics: The Poetics of Virtuality', virtual spaces are almost entirely concerned with space and surface, not needing to concern themselves with issues of thickness, construction or structure.[27] The use of the computer allows for collage to become an illustrated mechanism in the mismatching of styles where collected imagery is recomposed to create hybrid spaces and surfaces.

The metaphorical construct of 'architecture' is often applied to the structuring of digital information systems. This metaphor was taken further in the 'Visualising the Architecture of Federation' project in the structuring and design of a 'virtual Federation museum'. The combination of the media and the metaphor created the organisational strategy for the information. A hierarchy was created through the layering of information. Although rooms are hinted at through graphic representation, the relationship between one room and another is left floating, allowing for users to navigate in non linear sequences through the virtual space of the museum. This method of re-presentation provides an important shift in the usual delivery of architectural histories where buildings are depicted as 'isolated, monotone, objects floating on the space of the page.'[28]

viii

[27] William J. Mitchell 1998, 'Antitechtonics: The Poetics of Virtuality', in The Virtual Dimension, ed. John Beckmann, Princeton Architectural Press, New York pp.207.

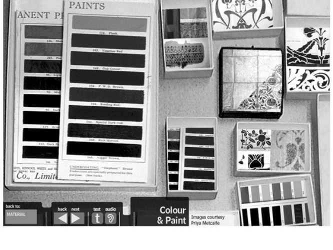
[28] Hannah Lewi & Philip Goldswain 2000, Hyper History: writing architectural histories for digital media *Formulation Fabrication: the Architecture of History Proceedings of the seventeenth annual conference of the Society of Architectural Historians, Australia and New Zealand*

The CD-Rom also provided a number of opportunities for the representation of visual information. Through the digitisation process we were able to collect and archive a vast range of information including drawings, maps, historical and contemporary photographs, materials and texts. The CD-Rom allowed for this to be easily stored, transported and accessed in the future. Important also to this project was the range of computer graphic software packages that allowed for the manipulation and re-presentation of the information.[29] The final spaces of the museum are literally collaged from the archive of images that were collected during the project.

Structure of the CD-Rom

There are a number of ways of reading and viewing the visual and textual information exhibited in the CD-ROM. The user can either follow specific works of Federation architects in the ‘Architects Hall of Fame’ galleries, or they can follow a series of thematic pathways, or catalogues, which reveal issues of style, material, place, type and so on. It is in the style catalogue that we focus on the notion of eclecticism and collage.

The CD-Rom contains the following rooms, foyers and exhibits:
i)Foyers: These are rooms in which the visitor explores for information and signs which lead to the access of other parts of the museum. The design of these main foyers is dense with images, information, cabinets and curiosities in the manner that nineteenth century museums were arranged.
ii) The Catalogue Room: This room contains a series of drawers, cabinets, boxes and books filled with information on particular themes including Style, Place, Material, Type and Function.
iii) Thematic Catalogues: These are the catalogue paths that organise the material content according to theme. These reflect actual modes of collection and display for example slides on a light table, material fragments in specimen drawers or images pinned in a scrapbook. Accompanying these catalogues is academic text establishing thematic pathways by which other parts of the museum can be viewed.
iv) Architects Galleries: The selected works of particular Federation architects are displayed in the walls of long galleries, viewing, reading and listening in much the same way as a contemporary museum exhibit. Hyperlinks between the gallery and the catalogue rooms allow visitors to create connections between the two.
v) Dado Cabinets: These are small drawers of detailed information which are directly linked to particular exhibits of an architects work. These are virtually accessible via the wall of the gallery.
iv) Map Rooms: A space where maps are laid out and moved across as a horizontal surface.

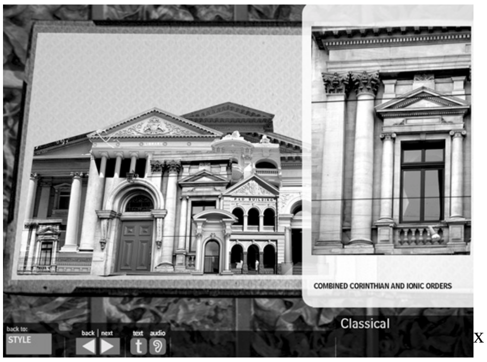


a.   b.[ix]

[29] Primarily Adobe Photoshop was used for the digital collaging techniques employed in the creation of the virtual museum.

Style and Surface
We have demonstrated in the pages of the Style catalogue book that individual buildings built during the federation period, and particularly some of those built in the West of Australia, introduce a style of Australian architecture that relies on the collaging of a variety of architectural styles, and the adaptation to suit the local environment.

Reflecting this interpretation, the style catalogue is depicted as a series of interactive collages on some of the prevalent styles of the time including Romanesque, Queen Anne, Classical, Arts and Crafts and Art Nouveau. In these images, style is no longer defined by individual buildings, but as the grafting together of elements from parts of many buildings. (Users can move their cursor over the collages to get further images of where these elements and features have been derived from.) In this manner, the conventional way of cataloguing styles with almost botanical specificity is avoided.[30]



x

The most direct comparison to this project can be made with Apperly, Irving and Reynods' book 'Identifying Australian Architecture', where 12 styles are nominated for the architecture that occurred in the period between 1890 and 1915. As Willis and Goad comment in their paper 'A Myth in its Making: Federation Style and Australian architectural history', 'the divisions are too numerous and too prescriptive, clouding the important and significant hybrid nature of the design tradition ... ignoring the inventive borrowing and assimilation that underpins the tradition.'[31]

By contrast we reveal the hybrid and indeterminate architectural process of both reconciliation and mis-matching through the potentials of digital media. It is hoped that through the images of the CD-Rom, the potentials of multi-media histories have begun to be hinted at in finding new ways of vividly demonstrating and understanding the actual techniques by which our visual and spatial environments were created and re-created. Terms such as reconciliation, collage, assemblage, grafting and eclecticism take on new applications in multi-media, which are not merely contemporary graphic design fashions, but have deeply rooted precedents in the very architectural ideologies of the late nineteenth century; an architectural tradition that continued through out the twentieth century in Australia.

---

[30] David Saunders August 1969 'Domestic Styles of Australia's Federation Period: Queen Anne and the Balcony Style', in *Architecture in Australia*, pp.655
[31] Julie Willis & Philip Goad 2000, 'A Myth in its Making: Federation Style and Australian architectural history', *Formulation Fabrication: the Architecture of History Proceedings of the seventeenth annual conference of the Society of Architectural Historians, Australia and New Zealand* pp.117

xi

Illustrations

i Virtual Museum façade. Image taken from the CD-ROM *Visualising the Architecture of Federation.*

ii 'Federal Poll, July 31st 1900', image courtesy Battye Library 499, Passey Collection.

iii Details taken from the South Yarra Post Office built by Dobbs in 1893. Local flora and fauna were used to nationalise the ornamentation. Image courtesy of the authors *Visualising the Architecture of Federation.*

iv Romanesque style collage, taken from CD-ROM *Visualising the Architecture of Federation.*

v Kalgoorlie in 1895, 'The Richest Mile in the World': image courtesy of the *Battye Cyclopedia*.

vi Kalgoorlie Town Hall built 1908, image courtesy the authors *Visualising the Architecture of Federation.*

vii The impact of locally available materials on the surface and ornamentation of buildings.

A. Brickwork, Melbourne. B. Rottnest limestone, Perth. C. Melbourne blue stone, Melbourne.

D. Coolgardie stone, Kalgoorlie. Images courtesy the *authors Visualising the Architecture of Federation.*

viii Foyer of the 'Virtual Museum', image taken from the CD-ROM *Visualising the Architecture of Federation.*

ix Screens taken from the *Visualising the Architecture of Federation* CD-ROM. A. Architects Hall of Fame. B. Colour and Paint, taken from the 'Materials Drawers'.

x Classical style collage, taken from the CD-ROM *Visualising the Architecture of Federation.*

xi 'Catalogue Room', taken from the CD-ROM *Visualising the Architecture of Federation.*

THE UNIVERSAL DESIGN OF BUILDINGS: AN EMPIRICAL TEST OF THE PRINCIPAL CLAIMED BENEFIT *

Gary Scott DANFORD, Ph.D.
State University of New York at Buffalo
danford@ap.buffalo.edu

There is an emerging consensus about seven Principles of Universal Design that define universally designed products and environments not only as being (1) equitable in use, (2) flexible in use, (3) simple and intuitive in use, (4) easy to perceive, and (5) tolerant of error, but also as (6) requiring low physical effort and (7) being better sized and arranged to accommodate all users (Connell, et al, 1997)(Danford, 2001)(IDEA Center, 2001).

A principal claimed benefit of designing products and environments following these principles is that they will be more usable for everyone. To test that claim, a research project was initiated to examine people's experiences with universal design through a case study of a universally designed building currently in use.

The Ideals of Universal Design

Universal design is an approach to the development of "products and environments that can be used effectively by all people, to the greatest extent possible, without the need for adaptation or specialized design" (North Carolina State University, 1997). Its goal is designs that can approach two ideals: "universal usability" (i.e., designs that are usable by everyone) and "equal usability" (i.e., designs that do not privilege one person/group over another).

Because that goal is unattainable in any "absolute" sense, universal design can be more accurately characterized as a continuous, iterative process that approaches those ideals asymptotically. And the reason is simple: with each iteration, with each lesson learned, and with each success achieved, the inclusive aspirations underlying universal design's ideals grow higher.

Objective and Hypotheses

The objective of this research project was to examine and document the ability of universal design to produce a building that is indeed usable by all people. Toward that end, three hypotheses about this claimed benefit of universal design were tested:

1. Compared to people without impairments, people with impairments will consider most other buildings they have experienced (i.e., non-universally designed buildings) to be less usable;
2. Both people with impairments and people without impairments will perceive a universally designed building to be more usable than most other buildings they have experienced (i.e., non-universally designed buildings); and
3. People with impairments will experience the same usability as people without impairments in a universally designed building.

---

* The research reported in this paper was funded by a grant from the National Institute on Disability and Rehabilitation Research, U.S. Department of Education, to the Rehabilitation Engineering Research Center on Universal Design, School of Architecture and Planning, University at Buffalo, The State University of New York.

Research Design

This project examined the extent to which the principal claimed benefit of universal design is actually realized through a case study of Lighthouse International's New York City headquarters building by Mitchell/Giurgola Architects. Lighthouse International is an organization that primarily serves people with vision impairments. Its headquarters building was selected because it was one of the first buildings explicitly designed to embrace the concept of universal design.

The case study utilized a multi-method combination of recorded behavior observations and follow-up interviews. The case study examined subjects' "general attitudes" about the typical usability of most other buildings (i.e., non-universally designed buildings) as well as their on-site "environmental perceptions" and "functional performance" as indicators of the case study building's relative and actual usability respectively.

Subjects

Twenty-four adults with single impairments (i.e., eight with mobility impairments, eight with hearing impairments and eight with vision impairments) and eight adults without impairments - none of whom were users of the case study building - were recruited as subjects. The four groups of eight were matched to ensure their general equivalence (i.e., equal numbers of males and females, all of whom were adults 21-65 years old, capable of self-directed functional independence, English speaking U.S. Citizens, etc.) with the exception of their impairments. All subjects were paid $50 to compensate them for their participation in the research project.

Data Collection Procedures

The subjects were first greeted and provided an innocuous scripted overview of the study (which only revealed that they would be asked a few questions after performing specified tasks at a local building) after which informed consent was obtained. Subjects were then individually escorted into and through the case study building by one member of the on-site research team who functioned as a tour guide (and provided assistance when requested/required) while a second member recorded the tours on a digital video camera. The guided tour typically took 30-45 minutes.

The resulting videotaped record captured the subjects' observable behaviors during and verbal responses to subsequent questions about a scripted sequence of fourteen person-environment transactions in the presence of nominal universal designed features in the public areas of the building:

1. Transaction: Locating the building
   Feature: Multi-sensory landmark
2. Transaction: Finding the entrance
   Feature: Talking signs system
3. Transaction: Entering the building
   Feature: Automatic door with motion detection activator
4. Transaction: Getting to the information desk 1
   Feature: High-contrast carpet runner

5. Transaction: Locating the elevator
   Feature: Multi-sensory map
6. Transaction: Calling an elevator
   Feature: Large high-contrast elevator call buttons
7. Transaction: Getting to another floor
   Feature: Dual-level elevator control panels
8. Transaction: Getting to a public restroom
   Feature: Talking signs system
9. Transaction: Getting a drink of water
   Feature: Dual-level water fountain
10. Transaction: Getting to the information desk 2
    Feature: High-contrast carpet runner
11. Transaction: Locating a public telephone
    Feature: Multi-sensory map
12. Transaction: Identifying the top step of a staircase
    Feature: Wall-mounted proximity indicator
13. Transaction: Using public seating area
    Feature: Open bench with high-contrast perimeter markers
14. Transaction: Exiting the building
    Feature: Automatic door with motion detection activator

Procedurally, the tour guide always employed scripted instructions designed to ensure each subject's awareness of the universal design feature's availability. However, there was purposely nothing in those instructions that would predispose the subject to view the design feature favorably/unfavorably or require the subject to use the design feature.

For example, for the transaction "identifying the top step of a staircase," each subject was instructed: "Next, I want you to identify the top step of the staircase. There is horizontal molding on the wall to your right. Along the rounded bottom edge of that molding there are notches at the end near the top step. Let me know when you identify the top step."

"Environmental Perceptions" as Indicators of a Building's Relative Usability

Immediately after a subject completed a transaction, the guide paused the tour to ask the subject eight follow-up questions while the second research team member continued videotaping the question/answer process.

The tour guide began by asking four "environmental perceptions" questions delivered verbally to all subjects (as well as by sign language to the subjects with hearing impairments who required an interpreter) that were simplified derivatives of a previously developed Environmental Utility Measure. That measure, developed through previous funding provided by the U.S. Department of Education's National Institute on Disability and Rehabilitation Research, includes two conventional seven-point bi-polar rating scales (scale values ranging from -3 to +3) called the Difficulty Rating Scale and Acceptability Rating Scale that are each presented in both verbal and printed forms in two steps (Danford & Steinfeld, 1999)(Steinfeld & Danford, 2000).

For example, the original Difficulty Rating Scale first asks the subject whether the transaction is "easy," "difficulty" or "moderate." After the subject makes the initial choice between these three anchor points (e.g., "easy"), the Difficulty Rating Scale then asks the subject to chose between the three closest points on the seven-point scale that pertain to that initial choice (e.g., “very easy” which is rated +3, “moderately easy” which is rated +2, or “barely easy” which is rated +1).

For this study only the first step of both the Difficulty Rating Scale and Acceptability Rating Scale was employed and the derivative language used to present the three anchor point choices for both scales was provided only verbally since not all subjects would have been able to see it in a printed form:

1. “Compared to your typical experiences (*insert transaction*) in most buildings, was your experience (*insert transaction*) in this building ‘easier,’ ‘more difficult’ or ‘somewhere in between’?”
2. “Why?”
3. “You said (*insert answer to question #1*). Would you consider that ‘acceptable,’ ‘unacceptable’ or ‘somewhere in between’?”
4. “Why?”

The subjects’ anchor point choices were rated +1 for “easier” and “acceptable” answers, -1 for “more difficulty” and “unacceptable” answers, and 0 for “somewhere in between” answers.

"General Attitudes" About the Non-Universally Designed Building's Typical Usability

Immediately after asking the four “environmental perceptions” questions about the relative usability of the universally designed building, the tour guide asked each subject a second set of four questions probing their “general attitudes” about the typical usability of “most other buildings” (i.e., non-universally designed buildings) while the second research team member continued videotaping the question/answer process. This made it possible not only to discern attitudinal differences between people with impairments and people without impairment but also to ascertain their general attitudes about the usability of non-universally designed buildings.

Posing questions that were, again, drawn from simplified derivatives of the aforementioned Environmental Utility Measure’s two ratings scales, the tour guide asked:

1. “About your experiences (*insert transaction*) in most buildings, are they typically ‘easy,’ ‘difficult’ or ‘somewhere in between’?”
2. “Why?”
3. “You said (*insert answer to question #1*). Would you consider that ‘acceptable,’ ‘unacceptable’ or ‘somewhere in between’?”
4. “Why?”

The subjects’ anchor point choices were rated +1 for “easy” and “acceptable” answers, -1 for “difficult” and “unacceptable” answers, and 0 for “somewhere in between” answers.

"Functional Performance" as Indicators of the Case Study Building’s Observed Usability

The videotaped record of each subject's guided tour was sent to an off-site research team for data retrieval and analysis. After retrieval of each subject’s answers to the tour guide’s “environmental perceptions” and “general attitudes” questions, two off-site research team members independently examined each subject’s observable behaviors.

Each of the fourteen scripted person-environment transactions in the case study building was scored on the subject's “effort expended” and “assistance received” as indicators of the case study building’s experienced usability employing simplified derivatives of a previously developed Functional Performance Measure. That measure, also developed through previous funding provided by the U.S. Department of Education's National Institute on Disability and Rehabilitation Research, includes two uni-polar eight-point scales called the Level of Effort Scale and the Level of Assistance Scale (Danford & Steinfeld, 1999)(Steinfeld & Danford, 2000). For this study, only five/six of the original eight points on the Level of Effort Scale and Level of Assistance Scale, respectively, were applicable.

The Level of Effort Scale scores were determined by (1) whether the opportunity to perform the transaction was accepted and, if so, (2) the length of time taken to perform the transaction, (2) the frequency of any complaint (e.g., verbal or non-verbal expression of frustration, aggravation, inconvenience or anxiety), (3) the frequency of any interruption in continuity while performing the transaction (e.g., hesitation or starting over), and (4) whether the transaction was completed. The assigned Level of Effort scores ranged from *minimum = 1, moderate = 2, maximum = 3, impossible = 4, to declined = 5.*

The Level of Assistance scores were determined by (1) whether assistance performing the transaction was requested or received, (2) whether the opportunity to provide assistance was accepted and, if so, (3) whether the assistance received constituted direct performance of the transaction, facilitated performance of the transaction, or was merely incidental to performance of the transaction, and (4) whether the assisted transaction was completed. The assigned Level of Assistance scores ranged from *none = 0, minimum = 1, moderate = 2, maximum = 3, impossible = 4, to declined = 5.*

These two derivative scales made it possible to determine the level of usability actually experienced both for people with impairments and for people without impairments (e.g., the highest level of usability being defined by minimum effort expended and no assistance received).

Results for Hypothesis 1 - Compared to people without impairments, people with impairments will consider most other buildings they have experienced to be less usable

Hypothesis 1 was tested by the "general attitudes" data from the derivative Environmental Utility Measure's "typical difficulty" and "acceptability" ratings for "most other buildings."

Compared to the subjects without impairments, two of the three groups of subjects with impairments (i.e., subjects with vision impairments and subjects with mobility impairments) clearly rated most other buildings (i.e., non-universally designed buildings) as being more difficult and less acceptable for performing the fourteen transactions (see Figures 1 & 2). However, the differences in "general attitudes" between several of the groups of subjects were pronounced.

The subjects without impairments rated only three of the fourteen transactions in most other buildings as being difficult (operationally defined as mean < -.2) (i.e., "getting to a public restroom," "getting a drink of water" and "locating a public telephone" and none as being unacceptable (operationally defined as mean < -.2).

The subjects with hearing impairments rated only four of the fourteen transactions in most other buildings as being difficult (i.e., "getting a drink of water," "locating a public telephone," "identifying the top step of a staircase," and "using the public seating area") and, again, none as being unacceptable.

The subjects with mobility impairments, on the other hand, rated six of the fourteen transactions in most other buildings as being difficult (i.e., "finding the entrance," "entering the building," "getting to a public restroom," "getting a drink of water," "locating a public telephone," and "exiting the building") and six as being unacceptable (i.e., "entering the

Figure 1 - Groups' "general attitudes" mean difficulty ratings for "most other buildings"

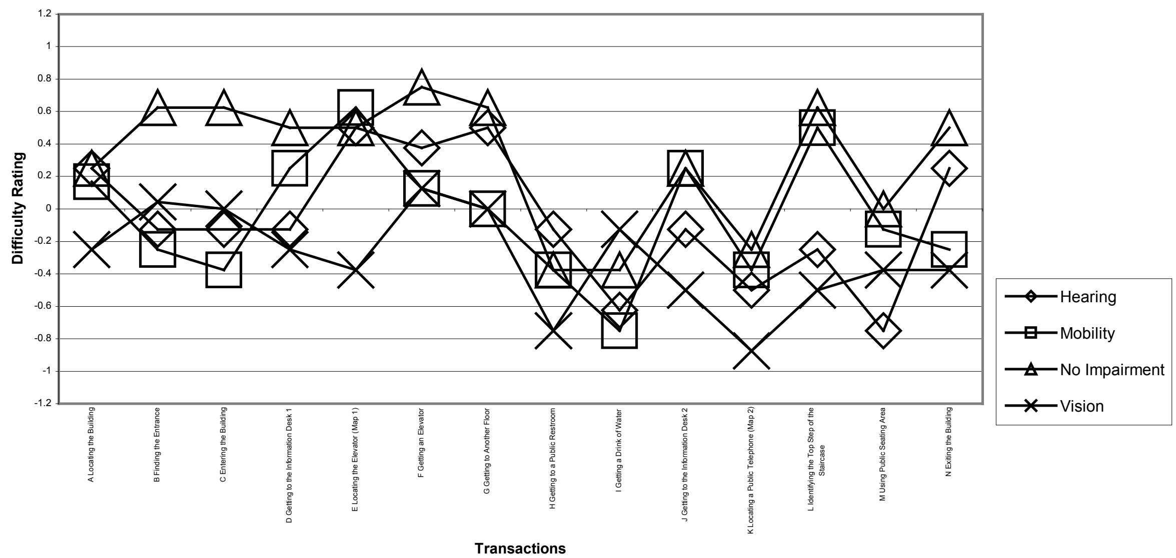
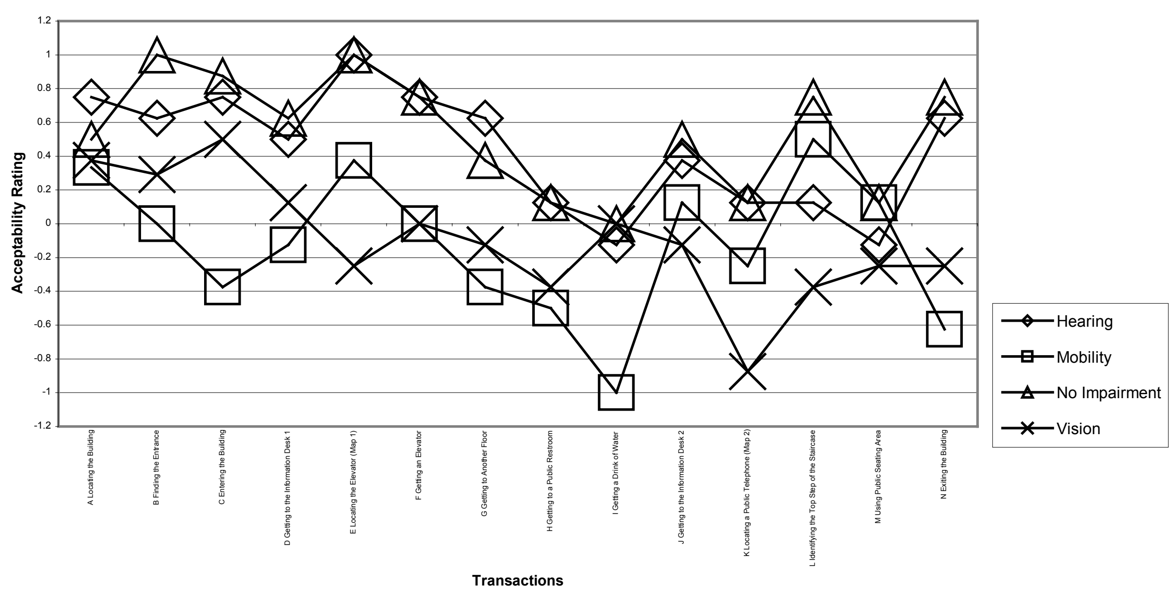


Figure 2 - Groups' "general attitude" mean acceptability ratings for "most other buildings"



building," "getting to another floor," "getting to a public restroom," "getting a drink of water," "locating a public telephone," and "exiting the building").

And the subjects with vision impairments rated nine of the fourteen transactions in most other buildings as being difficult (i.e., "locating the building," "getting to the information desk 1," "locating the elevator," "getting to a public restroom," "getting to the information desk 2," "locating a public telephone," "identifying the top step of the staircase," "using the public seating area," and "exiting the building") and six as being unacceptable (i.e., "locating the elevator," "getting to a public restroom," "locating a public telephone," "identifying the top step of the staircase," "using the public seating area," "exiting the building").

The fact that these "general attitudes" were obtained immediately after the subject had performed each transaction in the universally design building may have made the ratings for performing the same transaction in "most other buildings" more negative across all groups of subjects than otherwise would have been the case (i.e., the rated difficulty and acceptability of performing these transactions in most other buildings generally compared unfavorably to the case study building). This effect may have been even more pronounced for the subjects with mobility impairments and vision impairments since the case study building's design features was so conspicuously designed to be accessible to people with mobility impairments and inclusive of people with vision impairments.

That the "general attitudes" about "most other buildings" of the subjects with hearing impairments were nearly indistinguishable from the attitudes of the subjects without impairments is not really all that surprising. Even ADA-compliant buildings make relatively few accommodations for people with hearing impairments compared to those made for people with mobility impairments and for people with vision impairments, for example. And even the three or four transactions that the subjects without impairments and the subjects with vision impairments rated, respectively, as difficult might not have been rated that negatively had those subjects not just had such generally "easy" experiences with those same transactions in the case study building.

The more negative "general attitudes" about "most other buildings" of the subjects with mobility impairments and the subjects with vision impairments are also not particularly surprising. Even more than a decade after passage of the ADA, "most other buildings" today are still not fully accessible to people with mobility impairments and people with vision impairments. And, again, the fact that these subjects had just experienced those same transactions in the case study building that so obviously went well beyond the ADA's minimum requirements to promote their inclusion had to make "most other buildings" suffer by comparison – particularly for the subjects with vision impairments.

Results for Hypothesis 2 - Both people with impairments and people without impairments will perceive a universally designed building to be more usable than most other buildings they have experienced

Hypothesis 2 was tested by the "environmental perceptions" data from the derivative Environmental Utility Measure's "relative difficulty" and "acceptability" ratings for the case study building.

All four groups of subjects overwhelmingly perceived the case study building to be more usable than "most other buildings" for performing the fourteen transactions (see Figures 3 & 4).

Figure 3 - Groups' "environmental perception" mean difficulty ratings for the case study building

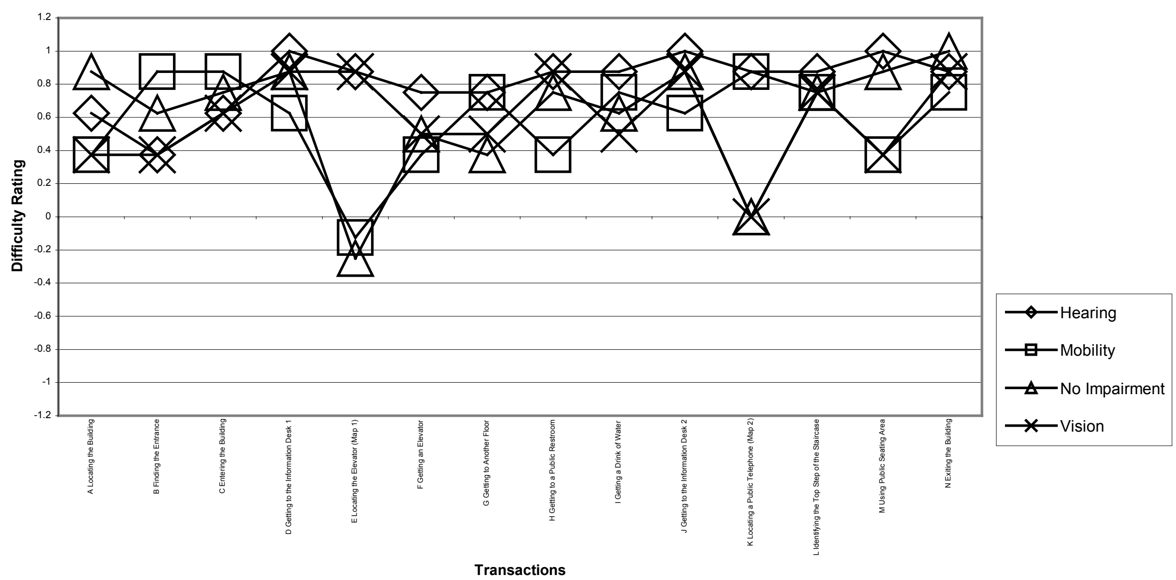
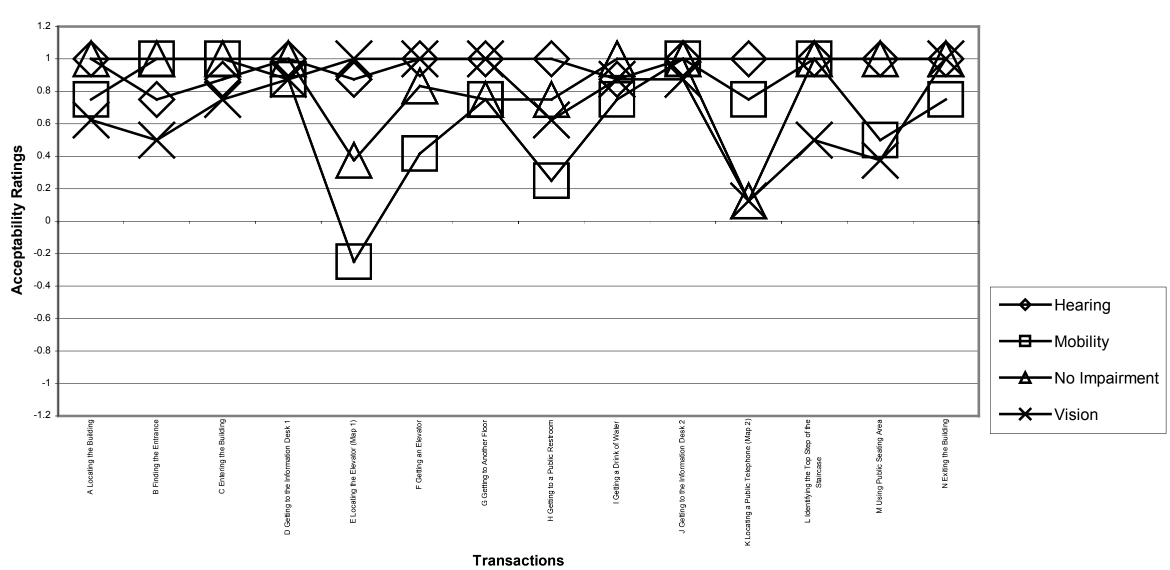


Figure 4 - Groups' "environmental perception" mean acceptability ratings for the case study building



The subjects with hearing impairments rated all fourteen of the transactions as being both easier (operationally defined as mean > +.2) and acceptable (operationally defined as mean > +.2) in the case study building.

The subjects with mobility impairments and the subjects with vision impairments both rated thirteen of the fourteen transactions as being both easier (i.e., "locating the elevator" excepted for subjects with mobility impairments; "locating a public telephone" excepted for subjects with vision impairments) and acceptable (i.e., "locating the elevator" excepted for subjects with mobility impairments; "locating a public telephone" excepted for subjects with vision impairments).

Even the subjects without impairments rated twelve of the fourteen transactions as being easier (i.e., "locating the elevator" and "locating the telephone" excepted) and thirteen as being acceptable (i.e., "locating a public telephone" excepted).

The considerable effort that had been made to design the case study building so that it would promote inclusion was not lost on these subjects. Even in the face of the few transactions that were not rated "easier," all four groups of subjects were effusive in their praise of this building.

The fact that a few transactions were singled out by three of the four groups of subjects for criticism (i.e., not rated "easier" and/or not rated "acceptable") actually provides reassurance that these incredibly positive ratings were not just reflective of some "halo effect" attributable to an overall appreciation for the building.

Overall, it is clear that performing these fourteen person-environment transactions was widely perceived to be both easier and acceptable in the case study building.

Results for Hypothesis 3 – People with impairments will experience the same usability as people without impairments in a universally designed building

Hypothesis 3 was tested by the "functional performance" data from the derivative Functional Performance Measure's "observed effort" and "observed assistance" scores for the case study building.

Had the case study building "perfectly" achieved the theoretical ideals of both "universal usability" and "equal usability," all the Level of Effort scores for all four groups of subjects would have been 1.0 (i.e., minimum effort expended) and all the Level of Assistance scores would have been 0.0 (i.e., no assistance received). Of course no building's design, universal or otherwise, is ever "perfect." Still, the mean Level of Effort and Level of Assistance scores for all four groups of subjects' fourteen transactions hovered near those ideal numbers with only a few notable exceptions (see Figures 5 & 6).

The subjects with no impairments who would normally rely more on traditional directional signage to locate features like the elevator and public telephones were frustrated by its conspicuous absence in the case study building and proved to be predictably inexperienced in the use of the multi-sensory map as an alternative way-finding device. Still, they managed to locate the elevator (that was not visible from the map location) with only a little more than minimum effort expended and to locate the public telephone (that was visible from the map location) with only minimum effort expended.

The subjects with the mobility impairments were affected similarly to the subjects with no impairments when forced to rely solely on the multi-sensory map to locate the elevator (i.e., only a little more than minimum effort expended) and also had no problem locating the public telephone (i.e., only minimum effort expended).

Figure 5 - Groups' "functional performance" mean level of effort scores for the case study building

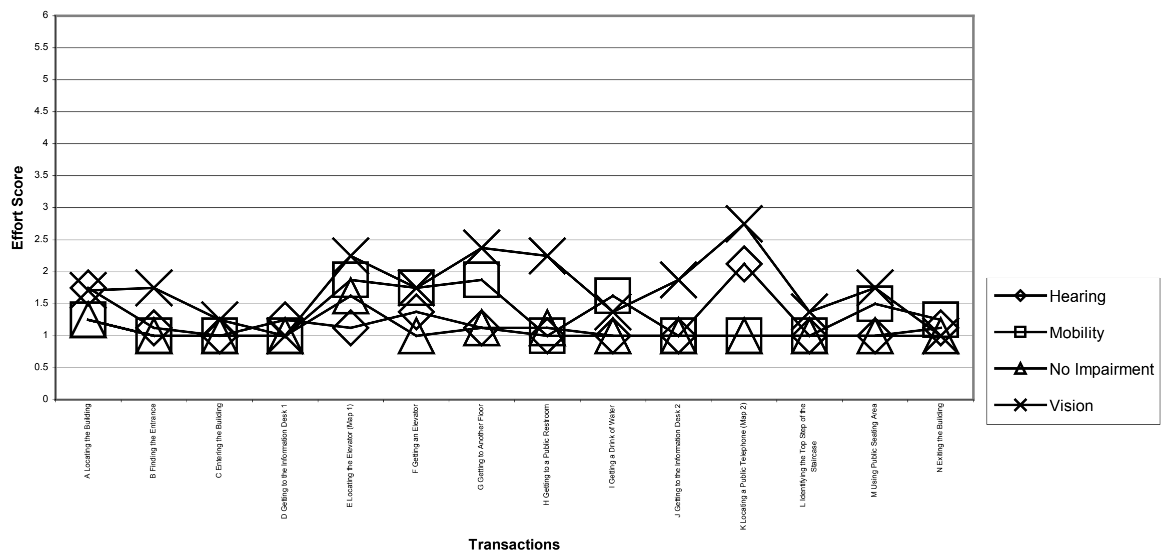
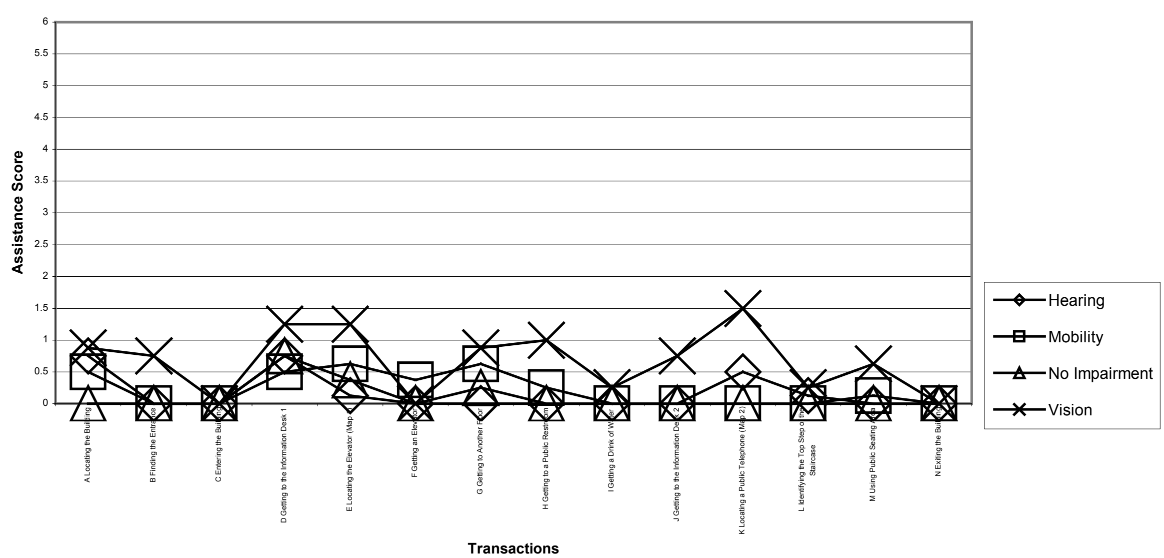


Figure 6 - Groups' "functional performance" mean level of assistance scores for the case study building



The subjects with vision impairments were understandably affected when they discovered that the multi-sensory map was inadvertently missing Braille to denote the public telephone that they were required to locate. That oversight translated into these subjects' highest mean "effort" and "assistance" scores for any of the fourteen transactions (i.e., effort expended being midway between "moderate" and "maximum"; assistance received being midway between "minimum" and "moderate"). They also expended more than minimum effort for several transactions where technical design execution problems with the talking signs system proved problematic (e.g., the variable positioning of the sensor that the hand-held receiver had to be pointed toward precisely affected their "finding the entrance," and "getting to a public restroom" transactions) and where the high contrast carpet runners misled them (e.g., the carpet runners' leading "past" rather than "to" the information desk affected both their "getting to the information desk" transactions).

Compared to the other groups of subjects, these subjects with vision impairments also tended to expend slightly higher than minimum levels of effort and/or receive slightly higher than no assistance across several of the remaining transactions. This appeared to be attributable to a combination of their inexperience with the novel designs of several of the universal design building features in the case study building (e.g., the oversized and unconventionally shaped elevator call buttons made them difficult to recognize as devices for "getting an elevator") combined with "oversights" in the designs of other building features (e.g., positioning a support column so it presented an obstruction in the middle of the public seating area).

However even in the face of these obstacles, the subjects with vision impairments required, on average, only marginally higher levels of effort and assistance to perform most transactions and, it must be noted, still considered all but one of these transactions (i.e., "locating the public telephone" without benefit of Braille on the multi-sensory map) to be both "easier" than in most other buildings and "acceptable" (see Results of Hypothesis 2 above).

Discussion

This research study sought to verify the ability of universal design to produce a building that was usable for everyone ("everyone" operationally defined in this study to be the aforementioned four groups of subjects). Given that universal design's goal is, being realistic, the achievement of "unattainable" absolute ideals (i.e., "universal usability" and "equal usability"), this study's data provide remarkably strong support for its three hypotheses.

Compared to subjects without impairments, two of the three groups of subjects with impairments (i.e., subjects with vision impairments and subjects with mobility impairments) clearly considered most other buildings they had experienced (i.e., non-universally designed buildings) to be far less usable for performing these fourteen transactions. Obviously, non-universally designed buildings still present a significant "usability gap" and continue to discriminate differentially against people with certain impairments.

On the other hand, the subjects with impairments as well as the subjects without impairments all perceived the universally designed building to be far more usable than most other buildings they had experienced (i.e., non-universally designed buildings). As they address the three hypotheses, the study's data were the strongest on this point.

And while all three groups of subjects with impairments did not uniformly experience precisely the same (i.e., equal) usability in this universally designed building as did the subjects without impairments, the additional effort required and assistance received to enable selected subjects to perform certain of the fourteen transactions was remarkably small – certainly smaller that the differences in usability that could be inferred from the "general attitude" "typical difficulty" and "acceptability" ratings that at least the subjects with vision impairments and the subjects with mobility impairments assigned to "most other buildings."

Finally, in some ways this study presented a particularly stringent test of the relative usability of the case study building. After all, these subjects all had to perform the fourteen transactions in a novel building with which they had no prior experience – heightening the necessity for this building's design features to be simpler to use and more intuitively obvious than would normally be the case.

Conclusion

On balance, Lighthouse International's New York City headquarters came surprisingly close to both "absolute" ideals of universal design – i.e., "universal usability" and "equal usability." And with only minor corrections to a relatively few design features, this building would have come even closer to achieving those "unattainable" ideals.

Certainly there are obvious "oversights" and technical design execution problems in the design of this building that compromised its ability to come even closer to perfect "universal usability" and, especially, perfect "equal usability" for the subjects in this study. Although describing all the "best" or, more theoretically correctly, "better" universal design implications of this research study's data is outside the scope of this paper, some implications are so transparent that they virtually speak for themselves.

The absence of directional signage in a building will differentially affect people without impairments who more typically rely on it for way-finding information. Multi-sensory maps that lack Braille for identifying all key building features will differentially affect people with vision impairments who often rely on it for location information. The absence of visual information displays on hand-held receivers for talking signs systems will still differentially affect people with hearing impairments even if the problems with the variable positioning of its sensors were resolved. This study's data provide literally dozens of implications for the design of building features that will be more usable by everyone … far more than can even be mentioned here.

So, even though the case study building did not "perfectly" achieve the theoretical ideal of "equal usability," it did come surprisingly close to being "universally usable" for this study's four groups of subjects. Given universal design's inherent nature as a continuous, iterative process that is always approaching those ideals asymptotically, these data are hardly discouraging.

A building that's design predates the formal publication of the defining principles of universal design by half a decade (1) was overwhelmingly perceived by all four groups of subjects to be more usable for performing fourteen person-environment transactions than most other buildings and (2) required only marginally higher expended effort and/or received assistance to enable particular subjects to perform certain of the fourteen transactions. These data are not only very supportive of the claimed that universal design can produce designs that can be more usable for everyone but also enormously encouraging for universal design's continued iterative development.

References

Connell, B, Jones, M, Mace, R, Mueller, J, Mullick, A, Ostroff, E, Sanford, J, Steinfeld, E, Story, M, & Vanderheiden, G (1997). The principles of universal design: Version 2.0. Raleigh, NC: The Center for Universal Design.

Danford, G.S. & Steinfeld, E. (1999). Measuring the Influences of Physical Environments on the Behaviors of People with Impairments. In E. Steinfeld & S. Danford (Eds.) *Measuring Enabling Environments*. New York: Kluwer Academic/Plenum Publishers. 111-137.

Danford, G.S. (2001). Principles of Universal Design. In G.S. Danford & B. Tauke (Eds.) *Universal Design New York*. New York: New York City Mayor's Office for People with Disabilities. 19-24.

IDEA Center (2001). Principles of Universal Design. In G.S. Danford & B. Tauke (Eds.) *Universal Design New York*. http://www.ap.buffalo.edu/idea/publications/udnypub.htm

Steinfeld, E. & Danford, G.S. (2000). Measuring Handicapping Environments. In G. Gresham (Ed.) *Rehabilitation Outcomes Measurement: The State of the Art in the Year 2000 (Special issue), Journal of Rehabilitation Outcomes Measurement*, Volume 4:4, 5-8.

North Carolina State University, The Center for Universal Design (1997). What is Universal Design? www.design.ncsu.edu/cud/univ_design/princ_overview.htm

The Airport and the Calculus of Retail

Kay EDGE
Virginia Tech
kedge@vt.edu

Eero Saarinen's desire to evoke an upward soaring quality in his TWA terminal at Kennedy Airport seems innocent now, and almost irrelevant against a backdrop of demographic and market studies that tell us: the average annual income of the 23 million passengers traveling through Philadelphia International Airport is $75,000; the average yearly income for all U.S. airline passengers is $50,000 to $68,000 while the income of an average shopping mall customer is $29,000 annually. Further, the average expenditure per departing passenger at the Pittsburgh Airmall is $9.50. Before the Airmall, passengers spent an average of $1.70. The average Japanese passenger leaving San Francisco International to go home spends an average of $200. The average passenger at Chicago's O'Hare Airport is there for eighty minutes of buying time. Travelers at the Detroit Airport spend an average of ninety minutes of "dwell time" there. Seventy per cent of them pass through the 125,000 square feet of retail space. At Heathrow's 600,000 square feet of retail space, the average expenditure per passenger is $25. Heathrow employs 55,000 workers who are also potential retail customers. A typical urban retail space earns about $600 per square foot; airport retail earns $1200 per square foot.[1] *(figure 1, figure 2)*

New types of buildings and public spaces are produced and shaped by consumer culture as it intersects with design and demographics. The activities of shopping, leisure and consumption have served to create a convergence of several types of buildings into few. Pure retail space (i.e. the shopping mall) begins to disappear as buying and entertainment space is incorporated into other building types, and goods, services and experiences are made available to potential consumers in many different settings. There is a parallel in what has happened to farming and to the deregulated airline and banking industries—that is the many have become the few and the small have joined to become the conglomerate. *(figure 3)* The new building types of the 20th century, the parking garage, the shopping mall and the entertainment complex have converged at the airport.[2] *(figure 4)* The behavioristic diagramming and computer animation of predicted consumer activity, marketing and demographic studies of consumers, and retail design

[1] These statistics are from the following sources: average annual income at Philadelphia: T.J. Becker, "Long Overdue Changes in Store for Airport Retailing;" in Urban Land, August, 1996, p.26; average of all airport passenger and of shopping mall customers: Margery Al Chalabi, "Airport Retailing Takes Wing;" in Urban Land, April 1998, p.104; AirMall expenditure: Margery Al Chalabi, "Airport Retailing Takes Wing;" in Urban Land, April 1998, p.103; expenditure before AirMall: Anita Dunham-Potter, "Airport Shopping Takes Off," on wysiwyg://257/http://www.smarterlivingcom/columns/real/Airport19991209.1.html; average passenger time at O'Hare: T.J. Becker, "Long Overdue Changes in Store for Airport Retailing;" in Urban Land, August, 1996, p. 26; average expenditure of Japanese passenger at SFO: Marisa Milanese, "SFO is Set to Soar with Scores of Stores," on http//www.sfbaytraveler.com/sf/stories/sfoshop_20001013.htm; square foot earnings of airport retail: Gary Wolf, "Exploring the Unmaterial World," http://www.wirednews.com/wired/archive/8.06/koolhaas_pr.html; Detroit passenger information: Amy Morgan, "Flying the Friendly Skies of Airport Retail," http://www.specialtyretail.net/issues/october99/flying.htm; Heathrow retail space: Deyan Sudjic, 1992 *The 100 Mile City*. Harcourt Brace & Company, p.155; passenger expenditure at Heathrow: Robert Bruegmann, 1996, "Airport City" in *Building for Air Travel: Architecture and Design for Commercial Aviation*, John Zukowsky, ed. Prestel/The Art Institute of Chicago, p.205; Heathrow employees: Koos Bosma, 1996 "European Airports, 1945-1995 Typology, Psychology, and Infrastructure," in *Building for Air Travel: Architecture and Design for Commercial Aviation, John Zukowsky*, ed. Prestel/The Art Institute of Chicago, p.64

[2] Michael Brawne, "Airport Passenger Buildings," in Architectural Review, November, 1962, p. 341

“rules of thumb” employed by the new hybrid marketing/design firms have given us a sameness that Walter Benjamin calls “always the same, masquerading as the ever-changing.” The purpose of this paper is to critically examine design that is generated by these methods, not in terms of retail success, but in terms of a larger issue, that of Durand’s claim that architecture is made by joining a concern for economics with a concern for convenience. My methodology was simply to observe with my eyes and record with my camera at two airports: Philadelphia International Airport and Pittsburgh International Airport.

The issue is brought into focus through an investigation of the airport as a building type that is particularly representative of our time. The current cultural landscape in which the airport sits represents historical continuity: the dream houses of the 19th century—the arcade, the train station, the exhibition hall, the museum, the department store and the diorama are now transformed for 21st century consumers and incorporated into a 21st century building type—the airport—to make the dream house of the present. The airport, in its peripherality and large expanse of separation from other things, provides a captive population of demographically correct potential consumers and it serves to illustrate the intersection of design, demographics and market study. *(figure 5)*

Deregulation, the resultant lowering of landing fees, the trend to privatization and the heightened security measures that began in the 1970s have served to dramatically increase the amount of non-aviation, revenue-producing space included in airport design. The income from retail, concessions and parking has served to offset the lower landing fees that airports have been forced to offer and has helped pay for necessary new construction and renovation.

James Ogilvy noted in American Demographics that our economy now is based more on the search by consumers for “vivid experiences” rather than the desire to acquire goods. Today’s airports place themselves in a position to offer both goods and vivid experiences. Singapore’s Changi Airport offers a karaoke lounge, a sauna, a swimming pool and a putting green. Heathrow has four caviar shops. Frankfurt has the largest discotheque in Germany, twenty six restaurants, a bowling alley, three cinemas, including an erotic cinema, a wedding chapel, a furrier, an antique shop and a supermarket. *(figure 6)* Amsterdam’s Schiphol offers a casino and tanning booths. At Hong Kong’s airport, Cathay Pacific offers first class passengers a luxurious spa and bathtubs for two. Chicago has a full service medical clinic. The San Francisco airport has a library, and recent museum exhibitions at Philadelphia International include: Totemic Sculpture, Political Memorabilia, Dance Photography and Vitra Experimental Chair Designs.

The role of the airport as a business has dramatically affected the master plan, the building diagram and the interior space planning diagram. Building typology, once based on Platonic ideals in the 18th century and used as a compositional device in the 19th century, now in the 20th and 21st centuries is based on computer models of consumer movement, demographic market studies, and projections of spending behavior. The various airport plan diagrams and the forces behind their generation call to mind Durand’s 19th century exhortation that “architecture is economy joined to convenience.” These diagrams bear this out as they rationalize for modern use and a modern building type, Durand’s philosophy of an architecture generated by economy and convenience. Only now, the generator is retail space joined to crowd flow studies. *(figure7, figure 8)* The various terminal diagrams were developed around parking, walking distances, passenger flow, and most recently, exposure to retail areas. Henri Lefebvre noted that increasingly, space is expected to pay for itself. An analysis of airport retail and design illustrates Lefebvre’s notion of abstract space, hyper-rationalized and diagrammed to arrange space and its contents in the most profitable way possible, always with an eye toward how space rules the available time of those who might buy.

Airport specific demographics, market studies and spending behavior studies have emerged in the attempt to make airport time and space as profitable as possible. In the same way that a biochemist might describe the human body as a collection of chemicals, the throngs of humanity passing through the airport are conceived by these studies in purely behavioristic terms—as a flow to be channeled, controlled, manipulated and persuaded to spend. Consumer behavior is analyzed, diagrammed and turned into statistical charts and tables, and these facts and figures are used to make predictions and design recommendations. The passengers amount to a tide of demographic facts spilling through the airport spaces. A 1943 Pencil Points article described the passenger as “a mobile unit, [which] must be controlled and guided for safety and operating efficiency, in his own interest.”[3] In the current airport landscape, the “mobile unit” must not only be controlled and guided, but he must be induced to pause and spend his money; airport space and his “dwell time” must be manipulated and calculated to produce as much profit as possible.

The needs and buying behavior of various demographic groups that use airports have been studied in detail through surveys and market analyses. One study conducted by an airport official at the Brisbane airport in Australia considered the buying behavior of airport shoppers. The awkwardly titled paper, “The Effects of Emotion and Time to Shop on Shopping Behaviour in an International Airport,” was presented at a 1999 Consumer Research Conference in the United States. The study draws the seemingly self-evident conclusion that the emotions of the shopper and the available time the shopper has are two factors which influence spending behavior at the airport. The study showed a correlation between shopping and available time: every minute of extra time spent at the airport increased the likelihood of shopping by a factor of 1.0114.[4]

The Portland International Airport conducted its own market and demographics research, investigating traveler needs, traffic counts and projections, and traffic flow patterns. They used the data to inform a major renovation and retail expansion. They took into account passenger and visitor demographics for each airline and each concourse in order to understand consumer behavior and passenger flow for separate areas of the airport. They sought to place concessions and retail areas responsive to those conditions. One of their studies combining market share with flow studies, tracked passengers entering the airport and progressing through security to their gates. The concessionares counted their sales per hour and calculated the percentage of passenger traffic captured—the capture ratio, and how much in sales was made from that traffic.[5]

The purpose of such studies is to find a way of rationalizing, quantifying and analyzing passenger behavior, and based on this analysis, to predict the factors involved in the propensity to consume. This analysis then is meant to generate design. There is a market niche now for firms specializing in airport retail design. They take into account passenger flow and shopping behavior, and their product consists of 3-D computer models and animations showing passenger movement and anticipated exposure to retail areas. The philosophical issues of space and time are contemplated now in terms of how much income they yield up, and human movement through time and space is considered in terms of spending behavior. Airports are now planned around parking expedience, and the comfort, convenience and amusement of the airline passenger as retail shopper. The flow diagrams wed the predicted consumer path and what Jean Baudrillard calls the object path. A “calculus of objects” is created that includes space, commodity and buyer. The role left for designers now seems to be in bringing these together in an attractive and ultimately profitable way.

---

[3] author not noted, “Aviation as a Stimulus to Architecture: Basic Requirements for Ground Facilities,” in Pencil Points, November, 1943, p. 43

[4] Brad Bowes, “Research Highlights Unique Airport Retail Environment,” on http://www.bne.com.au/corp/media_releases/29_09_1999.html

[5] Margery Al Chalabi, “Airport Retailing Takes Wing,” in Urban Land, April, 1998, p. 105

This new genre of firms has emerged to answer the call for more revenue and more revenue-producing space at the airport. These firms join design and market study as they consider passenger flow and shopping behavior. The use the tools of three dimensional modeling and animation to show passenger movement and exposure to retail areas, and they present their findings as factors that should heavily influence terminal design. This kind of retail philosophy has its origins in 19th century department store design and was written about extensively in Emile Zola's Au Bonheur des Dames. The main character of the novel, the owner of the first department store in Paris, was "an unrivalled master" in retail design, using display design and circulation layout to direct and manage the crowd and to fill them with the unavoidable impulse to buy. These hybrid firms are the modern day version of Zola's department store owner.

One firm that combines passenger flow studies and shopping behavior studies with design recommendations for clients is Space Syntax, a research facility at UCL (London). Space syntax is described as "a set of techniques for the analysis of spatial configurations of all kinds, especially where spatial configuration seems to be a significant aspect of human affairs, as it is in buildings and cities." The firm has served as a consultant on a variety of mixed use urban projects and sports facilities, and recently applied their methods in the study of passenger/shopper flow and behavior in airports. They published an article titled "Passengers, Pedestrians and Shoppers" in the journal Passenger Terminal World which described their techniques. Their method is based on the idea that "movement and communication are essential to the social and economic success of public and private space and that it is the design of space, above all, which determines the movement and interaction of people in the built environment." Their method seems to combine sophisticated computer analysis and graphics, the old psychological theory of behaviorism, and the self-evident idea that space determines movement. They have developed their own software for this analysis. Another of their articles specifically addressed the area of airport retail design. Titled "Moving, Browsing, Buying: Forecasting Passenger Behaviour," it was presented at the third Passenger Terminal World Conference in March, 2000. The difference between themselves and other passenger flow analysis models, Space Syntax says, is that while other models analyze "programmed activities" such as check-in, security check and boarding, the researchers at Space Syntax also look at "informal" passenger activities in reaching their recommendations on airport retail design. They claim a 75% success rate in predicting passenger movement—such unprogrammed activities as "shopping, eating and waiting," asserting that the consideration of this kind of behavior is essential to the economic success of "mixed-use" facilities.[6] Simmel's complaint that we constantly reduce the qualitative to the quantitative is thus illustrated. He says: "The calculating exactness of practical life which has resulted from a money economy corresponds to the ideal of natural science, namely that of transforming the world into an arithmetical problem and of fixing every one of its parts in a mathematical formula. It has been money economy which has thus filled the daily life of so many people with weighing, calculating, enumerating and the reduction of qualitative values to quantitative terms."[7]

The Pittsburgh and Philadelphia airports offer material evidence for the themes covered in this paper. The Pittsburgh airport is a part of USAir's hub and spoke route system which airlines began employing as a result of deregulation. At the hub and spoke airport, passengers are gathered from many originating points and dispersed to their final destinations. Most passengers at a hub airport are connecting passengers with time to spend. The plan of the Pittsburgh airport itself works in much the same way as the route system, gathering passengers at

---

[6] http://www.bartlett.ucl.ac.uk/spacesyntax/retail/retail.html

[7] Georg Simmel, "The Metropolis and Mental Life," in *Rethinking Architecture: a Reader in Cultural Theory*, Neil Leach, ed., New York and London: Routledge, 1997, p. 71-72

its shopping mall center and dispersing them to their departure gates. The main terminal building is connected by means of an underground people mover to an X-shaped satellite departure terminal with pier concourses making up the "arms" of the X. From the main terminal building, passengers originating in Pittsburgh are taken, by way of the people mover, directly and inescapably into the Airmall, the 100,000 square foot retail center of the terminal. *(figure 9)* Any of the more than 20 million annual connecting passengers who must change concourses to change planes are also channeled through this buying space. In this shopping center the passenger can buy printer paper, a Big Mac, or she can choose from among the bodiless negligees hanging in the Victoria's Secret. Body and mind can be soothed between flights—the body for a price at the gym or cosmetics counter, the mind at the chapel or reflection room, still free of charge. A chiropractor is also on the list of amenities at Pittsburgh International.

Philadelphia International Airport is another hub of the USAir hub and spoke route system. The terminal is a long rectangular building with four "finger" concourses extending from it. Narrow connector corridors take passengers from parking and drop-off areas to ticket counters and security. Retail stores and concession areas stand as a second point of passage; beyond security, departing passengers must go through the buying space in order to get to their gates. *(figure 10)* Museum space mingles with retail space there; plexiglas cases house sculptures and interchangeable displays. *(figure 11)* White rocking chairs and faux stone planters are placed in niches facing out onto the tarmac and along the mall-like spaces that lead to the individual concourses. Except for the airport signs, it is indistinguishable from a shopping mall corridor. *(figure 12)* The Philadelphia MarketPlace is located between the B and C "finger" concourses. For the connecting passenger, moving sidewalks and mall spaces tie the fingers together so that anyone changing concourses to change planes is routed through the shopping mall. Those using the moving sidewalk as they make connections can look out on one side to the tarmac and the waiting and taxiing planes below; on the other side are the commodity windows. The passage provides a sort of compromise of two opposing views of the airport, the idea of efficient flow and the idea of enticing those with time, to buy. The airport has the contradictory task of promoting efficient movement of ever-increasing numbers of passengers while seducing the hurried crowds to pause and buy. The moving sidewalk, with its adjoining commodity windows, may represent a massive compromise between the efficient flow necessary for a busy international airport and the pause necessary to choose and ultimately buy. In the constricted space of the moving sidewalk, retailers "exploit the power of place to facilitate consumption"—the departing planes visible on one side, the articles of travel and luxury on the other.[8] The untouchable objects, like the "look but don't touch" protocol of a world's fair or museum, are "valuable [in] that [they] resist our desire to possess them," occupying the space between pure desire and immediate enjoyment.[9] In the glass windows the consumer's gaze can take in simultaneously his own image and the accouterments of lifestyle creation. The commodity windows create a linear diorama of stuff beckoning the passenger, once off the moving sidewalk, to circle back around to the familiarity of the shopping mall and buy. Dioramas, once a substitute for travel, are now a prop and an invitation to buy in a space facilitating travel. With the store entrances on the other side, the retail planners knew enough about the relationship between looking and buying to provide the windows. They constitute the perfect ingredients for a dream world: movement, changing scenes, desire, visions of travel and commodities abundantly displayed. The space of flow joins with the stationary store windows full of what Benjamin called "wish symbols." The original 19th century shopping arcade, its commodities still there, now has a moving sidewalk; the flaneurs have less time to linger. Neon

[8] Michelle Lowe, Neil Wrigley, "Towards the New Retail Geography," in *Retailing, Consumption and Capital: Towards the New Retail Geography*, Longman Group Limitd, 1996, p.21
[9] Georg Simmel, *The Philosophy of Money*, New York and London: Routledge, 1978, p. 67

light sculptures replace the iron and glass above. The flaneurs have changed; the objects have changed; but the calculus of objects remains. When design bows to the calculus of objects, we give in to the "excessive organization of our lives" and we abandon our own humanity.[10]

[10] Gadamer, Hans-Georg, *The Beginning of Philosophy*, New York: Continuum, 1998, p.17

Figure 1: Buy, Sell, Roam

JFK International Airport
Photo: the author

Figure 2: Shopping/Departure Concourse

JFK International Airport
Photo: the author

Figure 3: Parking Delta Air Lines Terminal

JFK International Airport
Photo: the author

Figure 4: Shoppers/Flaneurs
Philadelphia International Airport
Photo: the author

Figure 5: Giorgio Armani
JFK International Airport
Photo: the author

Figure 6: Airport Fitness
Pittsburgh International Airport
Photo: the author

Figure 7: Philadelphia MarketPlace
Philadelphia International Airport
Photo: the author

Figure 8: Victoria's Secret

Pittsburgh International Airport
Photo: the author

Figure 9: Museum/Shopping Space

Philadelphia International Airport
Photo: the author

Figure 10: Museum/Shopping Space

Philadelphia International Airport
Photo: the author

Figure 11: Moving Sidewalk

Philadelphia International Airport
Photo: the author

Figure 12: Shopping Concourse

Philadelphia International Airport
Photo: the author

The Virginia Speedways Project: Researching the Landscape of the Virginia Speedways

Brian KATEN
Landscape Architecture, Virginia Tech
bkaten@vt.edu

Abstract:
In the late 1940's rural Virginia and North Carolina saw the rise of a regional sport - stock car racing - that would come to epitomize for many people an image of the rural south of the mid to late twentieth century. The evolution of stock car racing was accompanied by the development of a significant social and physical Virginia landscape that thus far has been neglected in contemporary scholarship: the short track. Carved from farmer's fields and natural amphitheaters new tracks, or "speedways" first appeared as temporary landscapes associated with the weekly ritual of racing competition. But by the 1950's full time tracks and their featured event, "Saturday Night Racing", were significant features in the social and recreational landscape of small towns throughout Virginia. Deeply rooted in their communities, today those tracks that remain are important landscapes of community pride, social intercourse, ritual, and entertainment.

Viewed collectively the Short Tracks offer a unique opportunity to add to our understanding of the Virginia landscape as a rich and varied series of layers to be experienced. More importantly the short tracks can be clearly presented and understood as a significant *contemporary* layer to the Virginia landscape. As such, they can augment the more commonly recognized layers of the Virginia landscape: the James River plantations, the state's civil war battlefields, the Virginia county courthouse complexes, and the Virginia mineral springs.

Despite their significance within their communities and the larger Virginia landscape, the short tracks are at risk. Changing economics and expanding development have led to the closing of many of the early tracks, but a significant number of tracks have survived. These tracks comprise a significant cultural landscape that deserves to be recognized as a landscape of historical importance and contemporary economic potential.

This paper will present on-going research on the lost vernacular landscape of the Virginia short track circuit of the 1940's 50's and 60's. Through interviews with former drivers and track officials over 60 lost community tracks have been thus far been identified in addition to the twenty-four tracks still in operation. Mapping of the lost tracks is underway and their landscapes are being reconstructed through period images and maps, written descriptions, and interviews with participants, track officials, and sponsors. This paper will also demonstrate the important role of GIS in mapping and understanding those landscape layers associated with the tracks and GIS's expanding role in understanding historic landscapes. The lost and existing tracks will be revealed as landscapes of community pride, social intercourse, ritual, and entertainment of interest to

landscape historians, historical landscape architects, preservationists, and contemporary designers.

The Virginia Speedways Project: Researching the Landscape of the Virginia Speedways

The Virginia landscape has long been a place of particular interest to historians and designers alike. Its evolution, from the earliest English settlement at Jamestown through the plantation landscapes of the eighteenth and nineteenth centuries to contemporary sustainable communities, can be understood as an important chapter in the making of a truly American landscape. It is, for many Americans, a familiar place recalling images and memories of the James River plantations, tidewater towns, courthouse complexes, Revolutionary and Civil War Battlefields, the piedmont, Blue Ridge Mountains, and the Shenandoah Valley. There are, however, significant Virginia landscapes, not part of that familiar understanding that, thus far, have been neglected in contemporary scholarship. If revealed, these landscapes, embedded in both the state's cultural memory and it's memorable places, can challenge our understanding of the Virginia landscape and provide new sources of inspiration and understanding for landscape projects throughout the Commonwealth. This paper presents the research currently underway by the Virginia Speedways Project to document one such Virginia landscape: the Landscape of the Virginia Speedways.

In the late 1940's rural Virginia and North Carolina saw the rise of a regional sport - stock car racing - that would come to epitomize for many people a mid to late twentieth century image of the rural south. The evolution of this sport was accompanied by the development of a remarkable number of local racetracks that, collectively, comprise a statewide cultural landscape. Carved from farmer's fields and natural amphitheaters the first new race tracks, or "speedways" were temporary sites for the weekly ritual of racing competition. But by the 1950's, construction of new, more permanent speedways had begun in earnest. Through the 1960's and 70's these speedways, and their featured event, now known as "Saturday Night Racing", were significant features in the social and recreational landscape of small towns throughout Virginia. Thus far, the Virginia Speedways Project has identified over 130 Virginia speedways at more than 80 sites throughout the state. The first phase of the Project, to document the locations, layouts, landscapes, and photographic record of the Virginia speedways, is currently underway. In addition, over thirty nearby speedways in North Carolina, West Virginia and Maryland where Virginia drivers raced are also being documented.

Automobile racing in Virginia did not begin with the development of the post World War II speedways. Open-wheel Indianapolis-style and "midget" racing were popular throughout America during the early years of the century. Sponsored by the American Automobile Association (AAA), the International Motor Contest Association (IMCA), the Central State Racing Association (CSRA), and the American Racing Association (ARA), these races were commonly held on the one mile and half-mile horse racing tracks at county and state fairgrounds[i]. The earliest documented automobile race in Virginia occurred in 1907 on the one-mile oval at the Virginia State Fairgrounds in Richmond[ii]. From that date through the 1930's, the primary sites for automobile racing in Virginia remained the state's fairgrounds. The fairgrounds at Winchester, Norfolk, Suffolk, Roanoke, Tasley on the Eastern Shore, and the Virginia State Fairgrounds in Richmond, all served as automobile racing venues during this period[iii]. It was natural that the fairgrounds, social gathering places serving as a focus of community and regional celebration and competition, with their existing tracks would be the sites of the state's first automobile races. A central feature of the typical fairground was a one mile or half-mile dirt track oval used for horse racing. With wide sweeping curves and a grandstand for spectators, these fairground tracks were easily adapted for the new sport of automobile racing.

Following World War Two there was a revival of automobile racing at the old fairground venues. Again, it was the open wheel cars that were featured. The Virginia State Fairgrounds in Richmond and the Suffolk Fairgrounds both hosted races in 1946. Automobile racing also appeared for the first time in 1947 at the fairgrounds in Danville and Keller, on Virginia's Eastern Shore[iv]. The open-wheel race cars were a significant presence at the fairground tracks well into the 1950's. But during this period a very different type of auto racing was gaining acceptance in the mountains of western North Carolina and Southwest Virginia – stock car racing - that would soon supplant the open-wheel race cars at racing venues throughout Virginia.

Many of the Virginia fairgrounds proved suitable venues for racing stock cars. By 1953, the fairgrounds at Lynchburg, Petersburg, Tazwell, Fredericksburg, and Wise all saw the introduction of stock car racing to their featured events[v]. The growing popularity of this new type of racing was soon accompanied by a new generation of automobile racetracks in Virginia. These new "speedways" were built specifically for the racing of stock cars. More local in character and intimate in scale than the earlier fairground tracks, the speedways proliferated. By the 1990's stock car speedways had been in operation on over 80 sites throughout the state. The research of the Virginia Speedways Project is revealing the Virginia speedways to be significant sites in the social and recreational landscapes of small towns throughout Virginia. Collectively, the speedways constitute a important vernacular Virginia landscape that offers a unique opportunity to add to our understanding of the Virginia landscape as a rich and varied series of layers to be experienced.

The growth of the Virginia speedways parallels the growing popularity of stock car racing throughout the south[vi]. The primary organizing body for stock car racing throughout the region was NASCAR, the National Association for Stock Car Racing founded in 1948 by Bill France. Once considered a strictly regional sport, stock car racing as promoted by NASCAR and its premier racing division, the Winston Cup Series has developed into one of the largest spectator sports in America. The roots of that sport run deep into the Virginia landscape and its speedways. But researching the history of the Virginia speedways poses special challenges. Stock car racing has not been, at least until very recently, a mainstream sport. Its rough and tumble early days, with legendary stories of "racin' and fightin' ,"and its association with bootlegging resulted in little attention to the sport's competition sites and even less focus on the social landscape of the sport.

As a result, today, no single archive or resource has a complete list of the lost Virginia speedways and the documentation of the speedway's sites and histories is limited at best. Most speedways had no track historian, no official photographer, or publicity staff. Posters and local newspaper ads announced the week's race and the local paper published the results of each week's competition. Some speedways printed weekly programs with driver standings, photographs of the previous week's race, and perhaps information on the local competitors. Few of these documents survive. No plans, written descriptions, or photographic records of the local speedways are known to exist. To date, most interest in the old speedways has been focused on early careers of those Virginia drivers who have gained fame after their talent took them to higher levels of racing and to venues far removed from their hometown speedway. More significantly, the generation of racers who pioneered the sport and the development of the local speedways is passing on. Soon the remaining primary sources and first person histories of the speedways will be lost.

The Virginia Speedway Project's research has, thus far, relied on several critical sources. First, the memories, personal documents, and photograph collections of surviving racers, along with their knowledge of the old speedways and their locations has been invaluable. Speedway photographs and documents have been found in the personal collections of the competitors and their families, track officials and announcers, reporters, spectators, and racing enthusiasts. The archives and collections of local newspapers, historical societies and racing related organizations such as the International Motor Sports Hall of Fame in Talladega, Alabama and the Virginia Carolina Old-Tine Dirt Racers Association also contain important information about the speedways and limited photographic records. Period Air Photos taken by the U.S. Department of Agriculture's Agricultural Stabilization and Conservation Service and the Virginia Department of Transportation have proven to be critical to confirming the location of many of the speedways. Importantly, many of the old speedway sites, though long abandoned, are still extant. Site visits to the old speedways, contemporary photographs, and recent air photos have also contributed significantly to the emerging understanding of the evolution of the speedway landscapes. Finally, an invaluable secondary source of information has been Allan E. Brown's *A History of America's Speedways: Past and Present* which lists the names and locations of many of Virginia's lost and existing auto racing venues.

What has emerged from the research thus far is a tantalizing glimpse of a significant Virginia landscape. Beginning in the late 1940's the consistent and recognizable landscape of the early fairground's was augmented by a rich fabric of speedway sites and designs. As the sport grew, inferior sites and poorly run facilities were replaced by better venues run by more professional promoters. The speedways evolved in response to driver, spectator and sponsor demands, growing business pressures, safety advances within the sport, changing insurance regulations, encroaching development and, to the eventual shortage of the competitor's preferred race cars. The results were fewer, often shorter, speedways, better facilities, and a transition from the early dirt tracks to primarily paved speedway ovals.

The documentation of the speedways has focused first, on the physical landscapes of Virginia's lost speedways and, second, on understanding the social landscapes of the Virginia speedways past and present. Documenting the lost speedway sites has, in some cases, proven difficult. Long abandoned, often overgrown or heavily wooded, the exact locations of some sites are difficult to recognize today. Other speedways have disappeared completely as their sites were developed. Interviews with former drivers, car owners, and spectators have been critical in locating those speedway sites on contemporary maps. The speedway locations are then confirmed using both period and contemporary aerial photography. The contemporary aerial photographs, available on-line from the USGS, are also used to determine each speedway's UTM Coordinates which can then be used to map the speedway sites using the Arc View GIS program.

Finding period air photos has proven particularly important since no plan of any lost speedway has been discovered thus far. Combined with period photographs, these air photos allow site features such as track layouts, entry roads, seating areas, grandstands, supporting structures, parking areas, pit areas, and landscape features such as ponds, streams, and period vegetation to be located and identified (fig. 1). But photographs from any single vantage point, including aerial photographs, are limited in what they reveal about the landscape composition of each speedway. Period photographs, for instance, rarely show the entire speedway site. Typically they are focused on the participants and specific race action. But photographs from different sources, vantage points, and races are being combined to recreate the lost landscapes of the speedways (fig. 2). Contemporary photographs of taken from the same vantage points as period photographs are being used to document the evolution of those speedways that are still in use today (fig. 3)

The evidence to date indicates that as the speedways developed distinctive typologies emerged. The original fairground tracks were flat tracks suited to horse-races. If the fairground featured harness racing, the track's turns were elevated and, in some cases, a tunnel under the curve provided access to the infield (fig.4). Like the old fairground tracks, there were generally two general types of speedways: flat tracks and those with elevated or banked turns. There were also distinctive types of sites chosen for speedways. The fairgrounds were located on large, flat, well drained, open sites. Many of the new speedways were sited on similar, flat, open sites, often located in floodplains adjacent to streams. A significant number of the speedways were sited in natural amphitheaters or narrow valleys. These speedways took advantage of existing topography to provide spectators with natural hillside vantage points for viewing the race (fig.5). Eventually, the hillsides were augmented with temporary and, later, permanent seating. The natural slopes allowed the spectators to be safely separated from the action on the track. Other speedways, less permanent in nature, were sited on agricultural fields. All three typical sites allowed speedways to be constructed with a minimum of earthmoving. Only the elevated turns of the banked tracks required significant ground manipulation. Occasionally, however, significant effort was undertaken to create a speedway site. In one case, Route 58 Speedway outside of Danville, the owners carved deeply into an existing ridge to create a three-sided amphitheater for their speedway. It was then necessary to import suitable clay soil from a nearby location to surface the track. That amount of intervention on a speedway site, however, appears to be unusual.

Natural water features were found at most of the early speedways. All of the early speedways were dirt tracks and a significant amount of water was required to prepare the track surface for competition. Typically a nearby stream or pond served as the water source and was a significant feature of the speedway's landscape composition and occasionally a race hazard (fig.6). At a few speedways, ponds were even located in the speedway infield[vii]. A water truck was usually used to wet the track surface, but at least one speedway installed an irrigation system to wet down the track before each night's racing card[viii].

The speedways themselves varied in size and configuration. The fairground tracks were typically a half-mile in length. Many of the early speedways continued the half-mile tradition. But, as new speedways were built on a variety of sites, shorter speedways evolved. 4/10th , 1/3, and quarter-mile speedways all became common. Over time, some of the longer speedways were reconfigured to shorter distances and slower speeds. In at least one instance that reconfiguration was in response to higher insurance rates charged for the longer, faster half-mile ovals[ix]. As the larger speedways were reconfigured into shorter ovals, the result was often several speedways overlaid on one another on the same site (fig.7).

Documenting their physical landscapes, however, can provide only a partial understanding of the Virginia speedways. The Virginia speedways continue to constitute a significant social landscape. From its inception stock car racing was, and remains today, a family activity. Brothers, fathers, uncles, cousins, wives, and husbands participate in the sport as drivers, crew members, and in support positions. Family members work together as teammates or, while supporting each other's efforts, compete against one another. Rooted in their communities through strong family ties, the speedways remain community social and recreational gathering places. A race is a day-long event, with drivers and crews arriving early in the day to prepare for the testing and qualifying trials that precede the evening races and establish each race's starting order. Community gatherings at holidays are common at the speedways and many speedways serve as informal community centers in times of need[x].

Interviews with drivers have revealed that, in the past, there was another social landscape associated with the speedways. Many of the local speedways were part of informal racing circuits that developed throughout the state. The competitive nature of racing soon saw drivers anxious to test their cars and skills against the best drivers at other nearby speedways. Local speedways often coordinated their racing schedules allowing drivers to race on several nights of the week at different speedways. It was not at all uncommon for drivers to race on Friday and Saturday nights and then again on Sunday afternoon; all at speedways within easy driving distance of home. One such local Virginia circuit was comprised of Eastside speedway in Waynesboro, which raced on Friday night, Natural Bridge Speedway, which raced on Saturday night, and the Craigsville Motor Speedway, which raced at 2pm on Sunday afternoons[xi]. Similar informal regional circuits existed throughout the state. A step up in scale and competition was the more formally organized and promoted Dixie Racing Circuit, which in 1952, sponsored races at Lynchburg, Danville, and Roanoke, Virginia and at Henderson and Camp Butner, North Carolina[xii]. Drivers from both states traveled the circuit on a regular basis.

As the sport grew, some speedways began to offer larger purses and better competition through the sponsorship of promoters such as the Dixie Racing Circuit and NASCAR. The result was the development of a multi-level racing circuit frequented by the state's better drivers. These drivers often raced at local speedways on weeknights and then, seeking better competition and larger prize money, they traveled farther distances to more competitive speedways with races on Saturday nights and Sunday afternoons. Some drivers raced as often as five times each week, racing at nearby local speedways on Wednesday, Thursday, and Friday nights in preparation for each weekend's competition[xiii].

Understanding that the speedways were not just isolated local sites, but rather part of a larger cultural landscape that spanned the entire state of Virginia and extended into North Carolina, suggests that mapping analysis of the speedways could provide significant additional understandings about the speedways collectively. Mapping is currently underway, using the Arc View GIS program, to investigate the speedways as a statewide cultural landscape. Each speedways is being mapped by date, type, length, surface, site characteristics, racing schedule, and whether it was part of a regional or local racing circuit. Work is also underway to map both where the Virginia drivers lived and where they raced. Finally, the regional economic influence of today's speedways is being investigated by mapping the location's of corporate and small business sponsors who support racing at the each of the states existing speedways. Slowly the complex fabric of the speedway's physical and social landscapes is being revealed.

Today over 20 Virginia racing venues remain in operation. Deeply rooted in their communities they, like their predecessors, are landscapes of community pride, social intercourse, ritual, and entertainment. Collectively they offer a unique opportunity to add to our understanding of the Virginia landscape. We believe the work of the Virginia Speedways Project will reveal these speedways to be a significant *contemporary* layer of the Virginia landscape and a cultural landscape of historical importance and significant economic potential.

---

[i] Allan E. Brown, *The History of America's Speedways* (Comstock Park, Michigan: America's Speedways, 1994), p. 13

[ii] Brown, p. 14.

[iii] Brown, p. 518-26.

[iv] Brown, p. 519-20.

[v] Brown, p. 518-26.

[vi] Stock car racing was not a new phenomenon. America's first stock car race may have been held as early as 1907. It gained only a limited following in the years leasding up to World War Two. After the war, stock car racing was reintroduced by promoters and saw growing popularity in the mid-west before finding its strongest support in the southern states. See Brown, pages 75-8.

[vii] Interview with Harlan Reynolds, Lynchburg, Virginia, December, 2001. Harlan and others have noted that 501 Speedway north of Volens had a pond in its infield.

[viii] Interview with Peanut Turman, Dugspur, Virginia, November, 2001. The speedway was Log Cabin Speedway in Henry County.

[ix] Interview with Peanut Turman, Dugspur, Virginia, November, 2001.

[x] A good example is the New River Valley Speedway in Dublin Virginia, which served as a primary collection site for relief supplies for victims of flooding in nearby West Virginia in the summer of 2001.

[xi] Interview with Richard Fox and Arbil Welcher, Craigsville, Virginia, December, 2001.

[xii] Advertisement, The Lynchburg Virginia News, April 18, 1952. Collection of Harlan Reynolds.

[xiii] Interview with Carlton Pugh, Danville, Virginia, November, 2001.

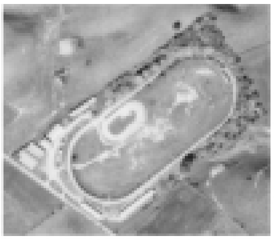


Fig. 1 Tazwell Fairgrounds c.1962. (Virginia Tech Geology Library)

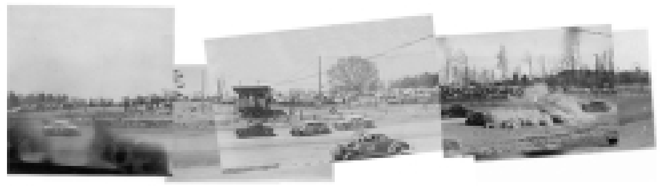


Fig. 2 58 Speedway, Hillsville, Va. c.1958. (Photoghaphs courtesy of Peanut Turman.)

Fig. 3 Above: Pulaski County Speedway c.1960's. (Courtesy New River Valley Speedway.) Below: the New River Valley Speedway photographed by the author from the same location in 2001.

Fig. 4 An early photograph of the Tazwell Fairgrounds. Note the tunnel under the first turn. (Library of Virginia)

Fig. 5 Spectators on the hillside at the Floyd Speedway in the 1950's. (Courtesy Laverne Zachary.)

Fig. 6 The pond at Pulaski County Speedway. (Courtesy New River Valley Spedway).

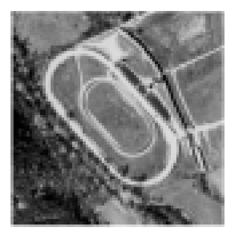


Fig. 7 Starkey Speedway c. 1962. A quarter-mile paved speedway has been built within the old half-mile dirt oval. (Virginia Tech Geology Library.)

Co-Production of Public Space: Redefinition of Social Meaning Through Participative Laboratories

Rob COWDROY
Paola MICHIALINO
School of Architecture and the Built Environment,
University of Newcastle, Australia
paola.michialino@studentmail.newcastle.edu.au
michialino@urba.ucl.ac.be

Abstract:

This paper provides an outline of particular aspects of a research project evaluating the pilot development and trial of a new strategy using participative laboratories in an integrated process for the design of public space in France. The participative laboratory strategy was trialed in five projects realised with the support of the State and of the Region Nord – Pas de Calais.

The context of the present study was a series of pilot participative laboratories developed by the research team Habitat and Development (H&D), based at the Catholic University of Louvain (UCL), Belgium. The projects related to the present study were at Avion, Haubourdin Centre, Haubourdin Petit Belgique, Saint Pol sur Mer, and Tourcoing. Other laboratories initiated at Bruay-la-Buissière and the Communauté de Communes du Val de Sambre were only partially completed, and are not included in the present study. A further laboratory, Saint-Josse-ten-Noode in Belgium, will offer comparisons with a laboratory in a different political and administrative system.

The pilot participative laboratories included in the present study involved politicians, bureaucrats, professional experts and lay citizens in multi-cultural and multi-disciplinary discussion-based design processes, and expanded the agenda of the design process beyond technical and logistics considerations to include local social, cultural and lifestyle issues. The purpose of the present study was to evaluate the impact of the new strategies on development of social meaning of public spaces and of the design process itself. This paper focuses on the innovative process of participative laboratories and its contribution to achievement of development of social meaning.

This paper focuses the proposed theme 2: research results concerning design and culture: architecture as a medium of cultural identity.

CO-PRODUCTION OF PUBLIC SPACE:
REDEFINITION OF SOCIAL MEANING
THROUGH PARTICIPATIVE LABORATORIES

• Introduction

This paper provides an outline of particular aspects of a research project evaluating the pilot development and trial of a new strategy using participative laboratories in an integrated process for the design of public space in France. The participative laboratory strategy was trialed in five projects realised with the support of the State and of the Region Nord – Pas de Calais.

The context of the present study was a series of pilot participative laboratories developed by the research team Habitat and Development (H&D), based at the Catholic University of Louvain (UCL), Belgium. The projects related to the present study were at Avion, Haubourdin Centre, Haubourdin Petit Belgique, Saint Pol sur Mer, and Tourcoing. Other laboratories initiated at Bruay-la-Buissière and the Communauté de Communes du Val de Sambre were only partially completed, and are not included in the present study. A further laboratory, Saint-Josse-ten-Noode in Belgium, will offer comparisons with a laboratory in a different political and administrative system.

The pilot participative laboratories included in the present study involved politicians, bureaucrats, professional experts and lay citizens in multi-cultural and multi-disciplinary discussion-based design processes, and expanded the agenda of the design process beyond technical and logistics considerations to include local social, cultural and lifestyle issues. The purpose of the present study was to evaluate the impact of the new strategies on development of social meaning of public spaces and of the design process itself. This paper focuses on the innovative process of participative laboratories and its contribution to achievement of development of social meaning.

• Nature of the problem

The participative laboratory strategy emerged from the Politique de la Ville, a broad strategic plan for the urban and social development of towns in France, that evolved gradually from a series of individual local initiatives commencing in the late 70's. The fundamental structures of the Politique de la Ville are instituted in the Decree 88-1015 of 28 Octobre 1988, which articulates national priorities for social and urban development.

From among the objectives of the Politique de la Ville stated in Article 1 of the Decree, the present study focused on two particular objectives in terms of *attributed social meaning*:

- *Promotion of programmes of social , economic and cultural development, aiming to improve life’s conditions in cities and in urban agglomerations;*
- *Definition of new modes of association between the State, the territorial organizations, and the socio-economic partners.*

Adopting these policies as objectives represented one level of initiative: that of the State and the Region, who were responsible for effective organization at the local level to enact the Politique de la Ville. Establishing the Politique de la Ville as sustainable practice, however, required social initiatives at another level that would incorporate the intentions of the policies into everyday life (Anderson & Vieillard, 2000). For the ‘chefs de projet’ in charge of the Politique de la Ville in the local communities, this raised the question of *how could the 'chefs de projet' initiate and sustain involvement of the inhabitants in the thought and debate about the transformation of local public spaces?*

A multi-level research organization to address the question was established with the acronym FAR (*'Formation – Action – Recherche pour la coproduction et la gestion de l'espace public'*), supported by the Region and the State, financed under the Politique de la Ville, and organised, led and facilitated by H&D. FAR was developed as a multi-level organisation, providing laboratories at three levels:

- Participative laboratories for individual town projects (the cases studied)
- Inter-town (exchange) laboratories
- Follow-up research laboratories

• The research question

The research question for the present study was whether the first level participative laboratories, involving direct participation of residents in relation to planning of their own urban environment achieved the two focal political objectives. (This question also formed parts of the agenda of the other two levels of laboratories within FAR, but their performance and conclusions are outside the scope of the present paper).

The first of the two focal political objectives *(promotion of programmes of social , economic and cultural development, aiming to improve life's conditions in cities and in urban agglomerations)* was considered in relation to individual and group meanings attributed to the public space itself, and in relation to changes in meaning arising from proposed and realised redevelopment. In this respect, individuals and groups were expected to attribute various meanings and values to a public space or precinct, in terms of its use (eg, domestic, commercial, social interaction, symbolic) and its relationship to other spaces or precincts (inclusive, exclusive, adjoining, complementary), and in relation to time (eg, varying uses according to time of day, night), seasonal differences and changes over extended time scales (generations, social change, political change) (Maser et al, 1998; Lescieux-Macou, 2002).

The present study considered the different stakes of various stakeholders, about inevitable competition and conflict in relation to expectations about the present and future state of a public space or precinct, and about its contribution to quality of life. This paper looks particularly at the way changes in these various meanings varied by "negotiation" through the interactive laboratory process (Romice, 2001).

The second of the two objectives (*definition of new modes of association between the State, the territorial organizations, and the socio-economic partners)* was considered in relation to "political" meanings associated with perceived authority and responsibility for the space or precinct and the people and uses associated with it. In this respect, proposals for decentralization of the power and direct participation of citizens challenged the established orders of authority and responsibility (eg by tradition, by custom, by consensus or by appointment) (Lacaze, 1997; Radcliffe & Wingenbach, 2000).

This paper considers the way in which the participative process overcame various forms of inertia, reluctance and resistance, on the one hand to relinquishing of assumed authority and responsibility by some (eg by professional experts) and, on the other hand, to acceptance of some unfamiliar authority and responsibility by others (eg by lay residents), and how the process led to a redefinition of meanings of authority, responsibility, expertise and the planning process for the various participants (Declève, 1994; Madanipour, 2000).

• Research method

The study reviewed the pilot participative laboratory process in relation to the five projects realised with the support of the French State and of the Region Nord-Pas de Calais. Primary data on which this research was based were largely in the records accumulated by the research team Habitat and Development (H&D) as a consequence of their experiences in development of the pilot participative laboratories in relation to the five projects. Those records included statistics about participation, opinions and perceptions collected in the form of notes of meetings, pictures, plans and diagrams, and communication tools (discussed later in this paper). These data reflected the planning process and recorded sequences of outcomes.

The present study compared these outcomes with policies, directives and objectives reflected in formal public documents at the state, region and local levels. The comparisons were intended to indicate the extent to which outcomes had satisfied the formal agenda embodied in the policies.

The present study also compared elements of the process with the literature in the general domains of social science and philosophy. These comparisons were intended to indicate the extent to which the process, which itself was a social innovation, conformed with the general environment of social, cultural and political change.

Synthesis of the results of the two comparative studies then gave an indication of the extent to which the policies were "sustainable" in terms of the dynamic environment of social change.

• The participative laboratories

The participative laboratories approach to the design of the public space was a new strategy for an integrative process, intended as a multi-cultural and multi-disciplinary discussion process around planning issues and design proposals. The purpose was to facilitate opening-up of the planning agenda beyond strictly design issues of rational technical and logistics considerations, to include both general and local social, cultural and lifestyle issues, and to include consideration of the perceptions and expectations of the widest possible range of stakeholders in each particular location. The pilot participative laboratories developed by the H&D team took the form of a forum in which the design process was an outcome of meeting, communication, discussion, and confrontation, among participants with a diverse range of backgrounds, experience, social status and influence, and commitment to the locality and to changes that might impact on the locality.

The primary roles of the H&D team were facilitation of the events that constituted the process, and recording the process and progress. It was accepted, however, that the facilitator needed theoretical knowledge of mediation skills and familiarity with the technical languages in both the urban design and social science disciplines (Declève, 1994; Romice, 2001).

• The laboratory process (demarche)

The participative laboratories approach as conceived in the French experience was intended to be a manifestation of direct popular participation in decision making but inevitably retained some elements of the hierarchical rationalist social organization that created it. In this respect, the Politique de la Ville was acknowledged as the political power giving legitimacy to the right of the inhabitants, individually, or in groups or associations, to take an active part in the determination of the choices interesting them directly (Lescieux-Macou, 2001). Consequently, it is evident that some outcomes of the participative laboratories, run in the context of the Politique de la Ville, are obligatory applications of its (national) priorities in urban planning projects at the local level (Anderson & Vieillard-Baron, 2000).

Notwithstanding this intrusion of national policies into local considerations, it is apparent that the laboratories were genuinely participative. Each laboratory consisted of three general categories of participants: technical experts, elected representatives and inhabitants: The participation of all categories was considered necessary to give social meaning and legitimacy to the process.

• Inhibitions

The study indicated that discussion and debate were initially inhibited by inertias that reflected several customary hierarchical "peck order" authority structures (Warren, 1996; Madanipour, 2000). Customary processes of consultation allowed lay citizens participation only at an advanced stage in a project's development, inhibiting their opportunity to contribute to the definition of objectives or the characteristics of the outcomes, and thereby denying them recognition as stakeholders.

This customary process promoted several inhibitory structures. A political hierarchy was dominant and was tacitly acknowledged in the form of a shared expectation that the most politically-senior person present would provide leadership by controlling the agenda and by controlling the contributions from those present. This expectation resulted in reluctance of participants to comment until invited to do so, and initial stalemating of discussion (Touraine, 1988).

A second inhibitory structure was a "professional" hierarchical structure that imposed itself in the form of a shared expectation that professional expert specialists would provide leadership in all technical issues, and would be subject to limited questioning or challenge only by politically-senior participants. In this case, the expert specialists were also reluctant to comment outside their respective specialisations, and lay people or those with lower political status were reluctant to question or challenge the experts directly. Questions and comments would be "filtered" through participants of higher status (ie, indirectly) and would have no legitimacy until they were "endorsed" and presented by higher authority.

A third (and perhaps the most crucial) inhibitory structure was a "parochial" structure (in some respects an anti-hierarchical structure) manifested in an expectation among the local community that, firstly, "outsiders" had no right to participate in discussion about local issues (particularly local social and cultural issues) and, secondly, that only the most senior resident (eg, the mayor) had the right to speak publicly on local issues. Thus, this structure imposed an expectation that local issues would not be discussed in the presents of outsiders, including politicians, bureaucrats and experts who were not immediate residents, resulting in strong tendency to discuss local issues "in camera" and to have only "resolutions" presented formally on behalf of the lay citizens.

Ad-hoc strategies were not sufficiently powerful to overcome the entrenched inertia against open discussion and debate. Various tentative models of "collaborative organisation" were applied, but all failed to achieve adequate participation.

• Facilitating effective participation

The three inhibitory structures were apparently mutually-reinforcing, and initially provided a powerful inertia that challenged the key policies of the Politique de la Ville (Healey, 2000). Anticipation of this inertia had been the basis for establishment of FAR's multi-level structure.

A "research laboratory" organisational model was adopted to neutralise the hierarchical structures and overcome the inertias. A laboratory would allow free discussion and debate, but as a legitimate process, under the auspices and supervision of the State and Region. Inter-town exchange lqborqtories were also introduced, to stimulate dialogue and debate about local urban and social issues, and "Follow-up" research laboratories were introduced to stimulate discussion and comparative review of the effectiveness of “local” participative laboratories in contributing to local urban and social development.

- ## Sub-strategies (tools)

Several sub-strategies (communication tools) were adopted in each laboratory to overcome, or at least minimise, the impact of the inhibitory structures. The communication tools included a connection bulletin, exhibition panels, and a guide aiming to explain the purpose and method of the participative laboratory strategy. The several tools were co-produced with the participants in the various laboratories of FAR and finalised by the “independent” facilitators of H&D (who were outsiders but with official status). The tools presented development of the “experience” of the laboratory, including theoretical and practical aspects, official policy and professional views of the process, and proposals intended for discussion.

The intent of the tools, particularly the graphic tools (including exhibition panels, plans, diagrams and other pictorial media) was as a primary medium for communication of information (Maser et al, 1998). Plans, maps, diagrams and other graphic media, however, are essentially collections of ciphers representing abstract ideas, and often not understood (or mis-understood) by people who are not used to reading them or who are not familiar with the particular symbolisms used. They are subject to multiple interpretations and mis-interpretations according to what is “read into” them by various individuals. In this respect, even architects, engineers and surveyors are unlikely to reach a common interpretation of each others plans. This suggests that the graphic media were of limited value in direct contribution to the communication, particularly two-way discussion between people of various backgrounds (Reed, 2000).

The present study indicates, however, that perhaps the most important contributions made by the graphic tools was that they provided a focus for discussion and debate. In this respect the graphic and print media were accessible to all participants in each laboratory and served as a catalyst that stimulated discussion at all levels in each of the hierarchical structures and facilitated true interactive participation (Tang, 1989; Emery, 1993).

The graphic media therefore appear to have provided a primary mechanism for circumventing the three inhibitory structures by acting as neutral ground for discussion between various participants, regardless of custom. It is also possible (but less clear) that the print media tools (bulletin, guide, etc) also contributed more as catalysts to discussion and debate than as direct information channels, and that they, also, served to circumvent the inhibitory structures (Emery, 1993; Reed, 2000).

- ## Interaction, education, empowerment and participation

There is considerable evidence that the customary inhibitions were not eliminated, but that they were sufficiently diminished to allow effective discussion and debate that extended well beyond technical and logistic agenda into local social, cultural and lifestyle issues related to the respective project. The graphic media in particular provided a “neutral ground” on which residents (in particular) could ask for explanation, raise challenges and objections, and suggest alternatives.

Further, it is evident that successive generations of graphics, incorporating suggestions and indicating their implications and consequences, stimulated further involvement in discussion and debate, and encouraged more comprehensive engagement of all participants with each other and with the process as a whole (Emery, 1993).

There is also considerable evidence that the enhanced discussion and engagement on a broader agenda was both informative and educational to all participants (Lescieux-Macou, 2001). In this respect, there was a clear shift, from entrenched individual and group *disinterest* in other people's agenda, to increased *awareness* of the implications of one person's agenda on another, and on to general *understanding* of the whole framework of agenda. This shift from disinterest through awareness to understanding is clearly recognisable as bona fide educational advancement (Radcliff & Wingenbach, 2000).

This educational advancement can be seen to have empowered all participants to contribute to discussion and debate beyond their customary (inhibited) agenda, and to make more complex suggestions and more comprehensive contributions to discussion and debate (Emery, 1993). The professional experts can be seen to have extended their contributions beyond technical issues to informed engagement in debate on both local social and cultural issues and broader policy issues. Similarly, lay residents can be seen to have been empowered to make informed contributions into technical and policy issues outside their traditional local focus (Declève & Forray-Claps, 1994-1995).

There was also a reciprocal effect of progressively increased recognition and acceptance of contributions on all issues from all participants in each laboratory. This increased recognition of others' perceptions and agenda reinforced the empowerment of individual participants. This reciprocal education and empowerment process can be seen to have enhanced the individuals' communication skills, but also to have enhanced the planning and design abilities of the professional experts, and the political skills of the politicians and bureaucrats (Reed, 2000). It can also be seen to have achieved meta-objectives, in education in citizenship, political and strategic decision-making of all participants, and social development and integration of the respective community (Lescieux-Macou, 2001).

It is evident that this empowerment of individuals and groups was progressively transferred to the respective laboratory as a whole. Consequently, the laboratory itself was empowered to address a widened field of technical and social issues, and to recognise and resolve a wider range of opportunities and consequences, challenging the so-called "civil pact" aiming at finding a minimal solution that would achieve a reciprocal tolerance (Declève, 1994)

• Conclusions

This study indicated that the participative laboratory strategy extends the boundaries of the design process and challenges conventional (eg, authoritarian, paternalistic) models of public consultation (Emery, 1993). The study also showed that the participative laboratory model developed by H&D within the FAR framework is very effective in contributing to the two targeted policy objectives, that is, to:

- *Promotion of programmes of social , economic and cultural development, aiming to improve life's conditions in cities and in urban agglomerations;*
- *Definition of new modes of association between the State, the territorial organizations, and the socio-economic partners;*

The strategy makes a significant contribution to the first objective by facilitating expansion of the planning agenda to include social and cultural issues, including quality of life issues, at the general and local levels, and by allowing all agenda to be debated and resolved by consensus (Reed, 2000). This strategy can, therefore, also be seen to contribute significantly to the second objective by providing a viable alternative mode of association between the State, the territorial organizations, and the socio-economic partners for the purpose of urban management, planning and development (Touraine, 1988; Lacaze, 1997).

The process also provides an educational outcome in the form of increased *and shared* awareness of all participants of the extent and complexity of the planning and logistics framework surrounding urban management, planning and redevelopment, and (reciprocally) of the extent and complexity of the impact of management, planning and redevelopment decisions on the social and cultural fabric. This increased shared awareness empowers all participants (including politicians, bureaucrats, professional experts and lay citizens) to re-define their individual positions and contributions to progress in both material development and in advancement of quality of urban life (Healey, 2000).

These extensive re-definitions are consistent with general trends that characterise postmodern society by “fractalising” former “factual” institutional and organisational structures, structuralist processes and rationalist, hierarchical states of mind. The subsequent redistribution of authority and responsibility is consistent with the general direction of change in Europe from representative democracy towards participative democratic frameworks (Ricoeur, 1985; Emery, 1993). and can therefore be expected to be increasingly viable and sustainable in the climate of social reform pervading Europe.

• References

Anderson A., Vieillard-Baron H. (2000), "La politique de la ville. Histoire et organisation", Editions ASH, Paris.

Declève B.(1994), "Habiter le changement. L’urbanisme comme école de démocratie", Thèse de Doctorat en Sciences Appliquées, Université catholique de Louvain, Unité Architecture, Louvain-la-Neuve.

Declève B. & Forray-Claps, R. (1994-1995), "Travail urbain, espace public et démocratie locale", Cahier n.1, Atelier de Travail Urbain de Grande Synthe, Habitat et Développement, Université Catholique de Louvain.

Emery, M. (1993), "Participative Design for Participative Democracy", 2^{nd} edition, Canberra, Australia: Centre for Continuing Education, The Australian National University, Canberra, Australia

Healey P.(2000), "Institutionalist Theory, Social Exclusion and Governance", in : Madanipour A., Cars G., Allen J. (eds.), "Social Exclusion in European Cities. Processes, Experiences and Responses", The Stationery Office, London.

Lacaze, Jean-Paul (1990), "Les méthodes de l’urbanisme", PUF.coll. “Que sais-je?”, Paris.

Lescieux-Macou A. (2001), "D'Héritiers en Batisseurs… L'Atelier d'Urbanisme Participatif du 'P'tit Belgique'", Maîtrise en Sciences de l'Education, Université de Lille III, Lille.

Madanipour A.(2000), "Social Exclusion and Space", in : Madanipour A., Cars G., Allen J. (eds.), "Social Exclusion in European Cities. Processes, Experiences and Responses", The Stationery Office, London.

Maser C., Beaton R., Smith K.(1998), "Setting the stage for sustainability : a citizen's handbook", Lewis Publishers, Boca Raton.

Radcliff B., Wingenbach E.(2000), "Preference Aggregation, Functional Pathologies, and Democracy: A Social Choice Defense of Participatory Democracy", The Journal of Politics, Vol. 62, No. 4, November.

Ricoeur P., "Ethique et Politique", Esprit, No. 101, mai 1985, pp.1-11

Reed, S.R. (2000), "Sharing Design Ideas:Conversational Groundings in Collaborative Design", CoDesigning, eds Scrivener, S., Ball, L., & Woodcock, A., Coventry, Springer

Romice O.(2001), "The participation of community groups in design: an approach based on visual literacy and environmental evaluation".

Tang, J. (1989), "Listing, Drawing and Gesturing in Design: A Study of the Use of Shared Workspaces by Design Teams", PhD thesis, Stanford University.

Touraine, A. (1988), "Return of the Actor: social theory in postindustrial society", University of Minnesota Press, Minneapolis.

The Rhetoric of an Architectural Presentation to a Client

Peter MEDWAY
Bob CLARKE
Department of Linguistics, Carleton University
gurduloo@sympatico.ca

Abstract:
In a small observational study in two Canadian architectural firms, the authors tracked the interactions (person-to-person, person with non-human sources such as documents) that took place during specific parts of the design process. This pilot study helped us to secure a grant which is currently allowing us to investigate the relationship between designing (in schools of architecture and architectural practice) and semiotic activity (processes of representation and communication).

In one firm the development of a preliminary elevation design for a proposed corporate laboratory facility was followed over three continuous days to the point at which it was ready to be presented at an internal team meeting. Some months later, a senior designer, in frequent interaction with other members of the firm, spent a day preparing a Powerpoint presentation in which the elevation would be presented and justified to a committee of the client organisation. We recorded the day's transactions–the main subject of our paper--with fieldnotes, audio recording and the collection of documents.

In making the transition from being a concept that circulated amongst the designers to one for external presentation, the design remained unchanged. However–and this is the point of the paper–the invisible ‘semiotic envelope' within which it had its meaning and was readable in a certain way had to undergo radical and arduous reconstruction.

The design process had been as much a matter of the collaborative building of an ‘envelope' of relevance criteria, intentions, values and associations as of the conceptual configuration of materials in space. It was in reference to this envelope that the design had a clear logic and meaning for the designers. But, unlike the drawings, sketches and models, the semiotic envelope could not be directly transmitted to the client participants, who would bring their own envelope of expectations and meanings to the meeting.

Specific rhetorical strategies had to be devised, therefore, to ensure that the design would be ‘read' correctly. This involved, for instance, a sort of fictional retrospective reconstruction of the design process in terms of choices between alternatives most of which were never actually entertained, and the conjuring up of ‘bad', ‘rejected' solutions for the sake of presenting the design as a desirable solution. It also involved the post-hoc identification of passages from the client's brief which could be cited as if they had directly governed the design process: ‘Look, we're simply following your requirements here.' The construction of a new justificatory envelope was partly informed by knowledge of the values, assumptions and perspectives (Aristotle's

pathos) that framed the client committee's perceptions, as revealed at a previous meeting.

In the paper we will briefly summarise our findings about the 'semiotic envelope' that evolved during the earlier design stage, and then deal more fully with the preparation of the presentation, particularly as it addressed issues of glazing and massing. We will draw on transcripts of our audio-recordings and on the slides and other artefacts produced during the day.

The Rhetoric of an Architectural Presentation to a Client

The subject of this paper is the profound difference we observed between the semiotically (mainly verbally) constructed context that emerges as a necessary element in the design of a building and the context that has to be created in order that the client may understand the design. We are in sympathy with two papers, presented at a recent design conference, which argued that the context of design is potentially infinite in its constituents, and that in order to start work the designer has to put together his or her own operative version of the context, through a particular selection and combination of relevant circumstances and considerations, and that this assemblage may be achieved through the use of words and other semiotic resources, such as sketching and gesture, in design discussions (Hekkert & van Dijk 2001, Glock 2001) [1].

Thus, out of all the possible factors that might be taken to have a bearing on the design, we suggest that a particular subset is 'marked' [2] as relevant for the job in hand. In another paper we have analysed the nature of this constructed 'context' in one design project (Medway & Clark 2001). We speak of an emerging 'envelope of coordinates' (183) and characterise its elements. In this paper we draw on later data from the same project, relating to the preparation of a presentation of the same design for an important client meeting. We proceed as follows: first we describe the nature of the research in which we were engaged; next we briefly review the characteristics and manner of emergence of the 'envelope' that got made by the designers alongside the 'design itself' (in the sense of the technical specifications of the building); third, in our most substantial section we describe the reconstruction that the senior designer found necessary in order that the client would be given an effective frame for understanding; and we finally propose some tentative conclusions of a more general nature.

1. The research

The larger (though still quite small) study from which we are drawing took place in two Canadian architects' firms, A and B. 45 hours of observation were carried out (three continuous days in each firm). Six hours of audio tape were recorded and four reporters' notepads filled with fieldnotes. We also had a long discussion on a different day with our key informant in Firm A, one of the senior designers. Documents generated or referred to by the participants were photocopied or collected. In addition, we returned to Firm A for a further day seven months later, and supplemented the above procedures with video recording. This paper is about Firm A, and draws considerably on that single day's observations.

In Firm A about six staff were to a greater or lesser extent involved in the design of a laboratory facility for a US corporate campus. What follows relates to one strand of the work, concerning the external elevations of the building's administration wing. The culmination of the work that Bob Clark observed between Tuesday and Thursday in one week in February was an elevation drawing to be presented at a team meeting on Friday. On his return visit to the firm in September, Joe, the senior designer [3], was preparing a Powerpoint presentation of the same elevation, in readiness for a meeting with client the next day.

2. 'Context' as constructed 'envelope' in the design process.

The answer to the question, 'What do architects make in designing?' is not as simple as 'The design', if by the design we mean 'the constructed-in-advance representation that will determine essential features of the eventually-to-be-constructed artefact' (Medway & Clark 1991: 169). If we regard architects as working primarily with signs – that is, as working *semiotically*, handling not concrete, bricks and steel but drawn lines, spoken words etc that *stand for* 'real things' – then what gets made is not confined to drawings, models, videos and written specifications. The latter are the more obviously durable products of certain kinds of semiotic activity, particularly acts of representation. But ephemeral semiotic acts may persist as memories that continue to exert a powerful formative influence on design; comments and the enacting of shapes with hands in the air are as much making as are drawing and modelling, and our understanding of what gets made in the office must include this cluster of mentally deposited ideas. What is there at the end of the design process, associated with or surrounding the design as its 'context', is a second construction, not visible in material form but fully real to the designers as an object of their cognition, an 'envelope' of ideas that are not dimensions, angles and indications of materials but that in some cases have had a powerful determining effect on those characteristics.

Over three days we closely observed the shaping of this construction alongside the construction of the design, although it was only afterwards, during analysis, that we came to this way of seeing what had happened. Here we instance some of the semiotic activities (often interactive – as in speech accompanied by gesture between two designers) that generated some of the different sorts of ideational elements (i.e. ideas, broadly conceived) that went into the 'envelope of coordinates within which the building must find its bearings' (Medway & Clark 2001: 183). We saw two main groups of elements coming into play: qualitative specifications (of a sort that do not get recorded in the documentation that passes to the contractor) and 'criteria and considerations' that are deemed important in the making of design decisions.

It was often the ideas of the Principal Architect, Rachel, that prevailed over those of Joe, the Senior Designer. The qualitative specifications that 'stuck' – i.e that continued to exert a constraining or enabling influence on the work – typically came from Rachel. First, she proposed what at first sight seem like simple descriptions of the look and feel she has in mind for the building's elevation. While shaping a piece of foam, she wonders "what would happen if we put a bit of a curve in it...(in order) to lighten the beast" -- the building as it stood being a "too rigid box." Thus 'curved' and 'light' emerge as qualitative specifications, but we note that both these terms implicitly invoke binary polarities: curved vs straight, and light vs heavy. Rachel is in fact making two successive sorts of selection, first of the binary opposition (or scalar dimension) that is relevant to the design (she doesn't select rough/smooth or dull/shiny), and second of the pole or position within that construct (curved *rather than* straight). Again, Rachel says she wants a building that is "elegant (and) distinctive" but not "strident", thus implicitly *marking* a reference dimension of, perhaps, 'noticeability', that might run from the undesirable extreme of 'unremarkable' to a desirable mid-position of 'distinctive' and an opposite undesirable extreme of 'strident' (raucously seeking attention).

Very frequently, the designers resort to metaphor (cf Coyne, Snodgrass & Martin 1994, Coyne & Snodgrass 1995): 'strident' literally refers to sounds; the fridge (glimpsed in a newspaper ad) that provides inspiration for Rachel's proposed profile is not literally 'sculptural', nor does it have 'rounded shoulders'. As she goes on she hits on an existing form that provides an appropriate model, both formally (in terms of the shape she wants) and symbolically, that of a crucible. Thus through metaphorical allusion or more direct reference, objects that are not buildings – fridges and crucibles – enter the 'envelope' within which the design takes place, providing, along with the indication of value positions along scales or in binary oppositions, a repertoire of general qualitative characteristics that do not require immediate precise definition in drawing (which would demand a particular curve, particular dimensions and so on).

'Criteria and considerations' enter the envelope in ways that include the following. While Rachel is working on the form she comments that she wants to "play with the mass in three dimensions" and that her reference to the fridge is "tongue in cheek", thus 'putting on the table' not what the building is to be like but the sort of activity her current actions constitute, or what the process is for. Later, running with the idea of the crucible, she explains to Joe that she thinks "there's value in exploring (it)...to take a very rational thing and have it teeter a little, and also be a lot more fun," indicating the sort of criteria that might be applied to her work (judge it as *exploratory*) as well as qualities of the building that can't be translated directly into physical description (as 'curved' can). Another consideration brought in by Rachel is the need to avoid placing too much reliance on the quality of the contractor's work: she sees an elevation that is distinctive for its profile and massing (sculptural) rather than for its surface texture as more contractor-proof.

Evaluation – which involves both marking which values are relevant and applying them to yield a positive or negative or relative judgement of a particular act or artefact – contributes important elements to the envelope: attempting to follow Rachel's conception, Joe builds a model as best he can, but declares, to anyone within earshot (not Rachel) that it's 'ugly' and that "sometimes the boss is just wrong," and then embarks on what he regards as a preferable design which he assesses as "better than a bloody crucible".

In short, constructing the envelope which provides the bearings within which design can navigate involves putting in place semantic realities that do not relate directly to, or cannot be translated immediately into, the physical configuration of the building. Amongst the things identified and articulated or gestured toward have been principles according to which success should be measured, dimensions and polarities in terms of which the building's positioning is critical, and identifications of constraints (aesthetic, economic, functional, what Rachel wants, the limitations imposed by construction methods) and of affordances and opportunities.

3. Reconstructing the envelope for the client

During our one-day September visit Joe was preparing to present the current state of the design to a committee of the client corporation the following morning, using Powerpoint slides and an accompanying oral commentary. This process is obviously different from that of design, in which a building is made that didn't exist before. In this case the building is there and it won't change by being presented. That is to say, it will not change in its material configuration, dimensions etc. It may, however, acquire an overlay of new meanings, an alternative overlay to that which constituted the envelope of design.

Let us consider Joe's treatment of issues that related to the elevation the development of which we have been describing. Joe's mode of working is most convenient for a researcher since he proceeds not only by operations on the computer – especially considering and selecting images and text passages – but also by conversing more or less continuously with his junior, Alan, whose job is to make the Powerpoint slides, dig out material and offer feedback.

The building, it has been determined, is to have glass over much of its frontage. In the design process, the decision to use glass more or less made itself – it was what the situation demanded; there was little need for the elaboration of an envelope within which this aspect of the design might proceed. However, Joe knew the committee and some of their concerns from a previous meeting at which an earlier, less resolved version of the design had been shown. They were worried that they were getting a *reflective* mirror building. He responds to this concern first by reformulating the architects' aims in more abstract terms. Taking the view that the audience have certain preconceptions about glass-faced buildings, he needs to move them away from the idea that it is glass that the designers like: rather, what is sought is a *quality*, transparency, the opposite of the reflective mirror effect. The use of glass is simply a means of achieving this quality; it's not that glass as a material is particularly desirable in itself. The thinking develops like this. At 9:48 Joe comments:

> they're concerned that it's reflective, which it's not, and we have to get some images of the ability to see through that curtain wall... that's the issue we're trying to portray, the transparency...

At 11:26 he says to Alan:

> it's about transparency, and the ability to understand what's going on inside... there's a quote in the Master Plan [a document supplied by the client describing the sort of building that is wanted] about the ability to display to the campus what it is you're doing in the building... We have to take the idea of glass away from being glass, and take it to being a concept -- it's not a material, it's a concept...

And a couple of minutes later, reviewing a sequence of images, Joe observes "glass is used not only functionally, but conceptually, OK?"

The point is, in the course of design it had never occurred to the designers that the glass wall would be anything but transparent; they have -- instinctively, we might almost say -- handled the glass in such a way that it would be. There had never been any occasion, explicitly at any rate, to invoke (that is, to include in the envelope) the contrastive construct *transparent/reflective*; the possibility of 'reflective' was simply never entertained. But now Joe has to, as it were, backtrack to a lay person's way of thinking, a way long forgotten by him and his colleagues (probably since their first year or two of training). He can only address the client by turning those lay conceptions against themselves. What we see therefore is a highly rhetorical process, in the Aristotelian sense of rhetoric as a means of persuading an audience by such techniques as anticipating their responses and forestalling or exploiting them.

We can identify three strategies within Joe's rhetorical response to the communicative challenge he faces in justifying the large areas of glass on the building's frontage. The first is to throw the client's own words back at them. Early in the day, at 9:39, Joe has found in the Master Plan and has read out to Alan a passage (mentioned by Joe in the later remark quoted above) that states: "The building should be designed as a figurative or literal showcase so the public has a clear sense the building is occupied and feels open." He instructs Alan to "put that in for the glass part," that is, include it in a slide. Later he explicitly makes the link between that demand and the concept of transparency.

Secondly, Joe selects an image that will clearly say 'transparency' rather than glass. He advises Alan (11:21), "I would include one at night, too... glazing at night makes the place feel occupied. I think that's an interesting way to spin it."

A third strategy, to drive home the relevance of the bipolar construct 'transparent/ reflective' and to say "*not* reflective", was to show the negative, the building the designers *didn't* want. At 3:55 Joe says to Alan:

> I think we should get a picture of a mirror glass building and put an X through it... They're thinking it's reflective, it's not. What we're doing is specifically designing large areas of glass that you can see through.

At 4:14 he asks Alan, "Did you find a bad mirrored glass building? [We'll put it] here with the glass stuff with an X through it." Then he adds, as if speaking now directly to the client and not to Alan, "We don't mean that, there's nothing to be worried about." Alan comes up with an image, eliciting the comment: "Yuck, I think that's a good one, Alan -- you know ugly when you see it." Joe then puts a stroke through it on the screen.

What makes the difference between the sort of envelope-making Joe was doing during design (often, as we saw, in conflict with Rachel) and what he is doing here is that the current exercise is demandingly *rhetorical*; and what makes the imagining of the presentation possible is Joe's strong sense of the virtual presence, there and then, of the following day's audience. So, often, when ostensibly talking to Alan, he seems really to be making the presentation: his real, present interlocutor functions as a stand-in for tomorrow's audience; or, put another way, his explanation for Alan is a *rehearsal*. Thus he uses language that he would not normally use with Alan, because it would imply Alan lacked basic architectural knowledge.

The preoccupation with the audience shows in three ways. First, as we saw, Joe addresses what he knows the audience thinks and how he expects they'll react. Second he uses the client's own written words as authoritative texts to justify the architectural decisions. Third, he incorporates into his own speech with Alan lay expressions that he remembers the clients using. So, in relation to another elevation issue, the massing, variety and articulation of elements, Joe recalled that the previous committee had found the facade excessively fussy or busy, and had used the phrase 'nooks and crannies'. He then keeps using this phrase himself, perhaps as a mnemonic to keep the attitude he has to counter in the forefront of his attention. And as in his treatment of the glazing issue, Joe looks for an image to represent the negative against which the firm's design will stand contrastively as the positive. He says to Alan, at 13:36:

> In light of the comment about nooks and crannies, that's about how you break up the mass of the building... What form is it, it's still a fairly blocky building, how do you come to terms with that? Well, you emphasize certain lines, you pull planes off, you give it detail, play materials against each other to give it a complexity that decreases the apparent mass of the building.

So he hunts for an early drawing that was produced simply to "block the massing" (and not intended as an indication of the eventual appearance): I'm looking for something crude." When he finds the drawing he manipulates it, commenting that even the existing relatively crude drawing is still "too complex... I just want two boxes." Twenty minutes later Joe is saying, "I just want a box -- to make it look really stupid..." and later again, "Does this look ugly enough? It's supposed to be crude..." and "If we were to extrude the program, that would be it, a box. They wanted that to be a box all along and it looks pretty bloody awful." He devises a title for this section" "How do you make a big building look smaller?", and once again orally runs through the argument they had never really had to work through. On the manipulated 'crude' drawing he adds the caption, "Simple extrusion of the building creates a bulky mass overpowering the site on which it sits" – giving explicit articulation to knowledge that never has to be articulated within the office because it is in every architect's bones.

Note once again that Joe is not returning to possibilities that had once been entertained and then rejected: solutions such as that represented by the crude drawing would never have entered the heads of these architects in the first place. But it did enter the heads of the lay audience, forcing Joe artificially to come up with a bad solution *as if* it had been considered and rejected.

4. Concluding remarks

In preparing the presentation Joe isn't redesigning the building. But he is recontextualising certain of its features, locating them within constructs that hadn't been part of the original design envelope, except perhaps implicitly as tacit and taken-for-granted knowledge, contrasting those features with negatives that had never previously been entertained, and embedding them in a new justificatory framework.

There is an educational argument implicit in all this. To present a design is not simply to give narrative form to the arguments, considerations and decisions that constituted the design process, though the presentation may draw on these. It is to do something quite different, something rhetorical, that means addressing the nature of the audience, drawing on one's knowledge or best guesses about its expertise or lack of it and its insightfulness or prejudices, and then constructing something new for that purpose. In other words, the presentation is a design job in itself, with its own necessary envelope, and is perhaps a mode of communication that needs to be taught in architecture schools more deliberately and systematically than we have seen it to be.

Acknowledgements

The authors gratefully acknowledge the funding from the Social Sciences and Humanities Research Council of Canada which made this research possible.

Notes

1. On the relationship between language and other semiotic modes employed in design see especially Forty (2000). For the authors' own discussions of the issue, in the References see works by Clark and Medway and by Medway and also the architecture chapters of Dias et al (1999) and Dias and Paré (2000).

2. 'Marked' forms in linguistics are ones that foreground some characteristic as significant; thus, 'officer' is an 'unmarked' term whereas 'waitress' 'marks' its referent as a special case, specific (because of sex) rather than universal.

3. In the interests of anonymity, architecture in Canada being a small world, we have assigned gender to participants on an arbitrary basis.

References

Coyne, R., Snodgrass, A., & Martin, D. (1994). Metaphors in the design studio. Journal of Architectural Education, 2, 113-125.

Coyne, R., & Snodgrass, A. (1995) Problem Setting within Prevalent Metaphors of Design, Design Issues, 11 (2), 31-61.

Dias, P. & Paré, A. (eds) (2000) Transitions: Writing in Academic and Workplace Settings, Hampton, Cresskill, NJ.

Dias, P., Freedman, A., Medway, P., & Paré, A. (1999) Worlds Apart: Acting and Writing in Academic and Workplace Contexts, Lawrence Erlbaum, Hillsdale, NJ.

Forty, A. (2000) Words and Buildings: a Vocabulary of Modern Architecture, Thames & Hudson, London.

Glock, F. (2001). Design work in contexts -- contexts in design work. P. Lloyd, & H. Christiaans, Designing in Context: Proceedings of Design Thinking Research Symposium 5: Delft University of Technology, 18-20 December 2001, pp. 199-217. Delft: Delft University Press.

Hekkert, P., & van Dijk, M. (2001). Designing from context: foundations and applications of the ViP approach. P. Lloyd, & H. Christiaans, Designing in Context: Proceedings of Design Thinking Research Symposium 5: Delft University of Technology, 18-20 December 2001, pp. 383-394. Delft: Delft University Press.

Medway, P. (1994) The Language Component in Technological Capability: Lessons from Architecture, International Journal of Technology and Design Education, 4 (1), 85-107.

Medway, P. (1996a) Virtual and Material Buildings: Construction and Constructivism in Architecture and Writing, Written Communication, 13 (4), 473-514.

Medway, P. (1996b) Writing, Speaking, Drawing: the Distribution of Meaning in Architects' Communication, M. Sharples and van der Geest (eds) The New Writing Environment: Writers at Work in a World of Technology, pp. 25-42, Springer Verlag, London.

Medway, P., & Clark, B. (2001). The semiotics of design processes in architectural offices. P. Lloyd, & H. Christiaans, Designing in Context: Proceedings of Design Thinking Research Symposium 5: Delft University of Technology, 18-20 December 2001, pp. 169-186. Delft: Delft University Press.

Research Based Decision Making in Architectural Programming of Workplaces: Case of Pamlico County Government Offices, North Carolina

Umut TOKER (North Carolina State University)
Zeynep TOKER (North Carolina State University)
Fatih A. RIFKI (North Carolina State University) fatih_rifki@ncsu.edu

1. INTRODUCTION

Social, economical and technological developments in the recent decades, especially in the early days of the twenty-first century have consistently revealed the importance of knowledge as a base for decision-making processes. The ever-increasing dependence of productivity and competitiveness on knowledge in many fields has resulted in perception of knowledge as a commodity itself (Castells and Hall 1994). Consequently, the emphasis on knowledge generation has been identified by extensive research based applications in many fields and many societies.

Within the field of architecture, knowledge generation and knowledge-based practices have started to be complementary to decision making and design processes especially in the last decades. The connotation of architecture with "art and design" has been accompanied by increased knowledge generation efforts, which has also brought architecture a connotation with "science". The resultant forces have complemented the term "architecture as art" with another: "architecture as a knowledge-based tool" (Toker and Rifki 2001).

2. ARCHITECTURAL PROGRAMMING

Architectural programming forms an important practical part of the efforts for the objective of architecture as a "knowledge-based tool", which is also complemented by architectural research in the scholarly realm. Increasingly being accepted as an integral part of the architectural design process, architectural programming has become an important element of contemporary architectural practice.

Architectural programming is an essential tool for decision-making in contemporary architectural practice, and is an integral part of architectural design in various contexts. A review of related literature reveals that architectural programming is composed of three major phases (Duerk, 1993; Pena, 1987; White, 1972; White, 1991). While various authors have adapted different terminologies, these three main phases can be clearly identified in literature.

The first phase is characterized by information gathering about the "facts" of the project about various issues: the site, users, culture, behavior patterns of users, preferences, environmental history and many potential other "facts" according to the project context. In other words, the first phase is mainly composed of information gathering and evaluation about the existing situation. The second phase in architectural programming is basically composed of the identification of "goals, needs and requirements". Similar to the first phase, the identification of goals, needs and requirements is based on different issues as they arise within the project context. Finally, the third phase consists of the production of design recommendations, design issues, or generally, pointers for design decisions, based on the first two phases (Duerk, 1993; Pena, 1987; White, 1972; White, 1991).

3. WORKPLACES AS KNOWLEDGE-BASED TOOLS

The twentieth century has formed a scene for the development of workplaces through many attempts to architectural programming as a decision-making tool. While the needs and requirements of workplaces have been increasingly different for different work sectors and work patterns, it has been increasingly clear that architectural programming is a major tool for design and decision making for workplaces (Toker and Rifki, 2001).

As increasingly complex and different requirements for various work patterns arose, different information gathering techniques have been integrated to the design process (Duffy et al. 1998; Worthington 1997). In addition to the developing information gathering techniques, the number and variety of issues to be considered have also increased, based on the results of extensive research in this area (Wineman 1982). Some main issues can be exemplified as the increasing use and development of information technologies in workplaces, issues of environmental comfort, ergonomics, compliance of spatial configuration with work patterns, and satisfaction of users with the workplace. In this respect, workplaces constitute a major field of application for architectural programming and “architecture as a knowledge-based tool” (Toker and Rifki, 2001).

4. THE CASE OF PAMLICO COUNTY GOVERNMENT OFFICES, NORTH CAROLINA

A recent project undertaken by the authors constitutes an effective example of architectural programming for workplaces. In fall 2000, the County Manager of Pamlico County, North Carolina contacted the authors for a programming study of the county government offices. Pamlico County Government offices are currently located in town of Bayboro, NC.

The departments of the County are scattered around the town, occupying buildings that have been designed for various purposes in various time periods. A common feature of the buildings occupied by the County is that, they were designed in general for purposes other than workplaces. One exception within these is the Courthouse building, which was custom designed in early twentieth century, and its annex custom designed in sixties. Both blocks of this building reflect the characteristics of the period they were designed in. Therefore, two initial points that existed were the location of departments and the characteristics of the buildings occupied by them.

4.1. Methodology

The project was handled within a three phase framework, parallel to the major approaches existing in the related literature as discussed above:

1. Understanding and evaluating the existing situation;
2. Identifying future workplace needs and requirements;
3. Generation of design recommendations and alternatives for long-term decision-making strategies

While the first two phases of the project were oriented towards information gathering, the third phase was oriented toward knowledge-based decision making.

4.1.1. Information Gathering

The first phase of the project consisted of information gathering and evaluation about the existing situation. Within the efforts to understand and evaluate the existing situation, three main issues were considered: *interdepartmental interactions, workplace satisfaction* and *environmental comfort*.

Interdepartmental interactions were examined in order to evaluate the relative distance of the buildings occupied by departments according to each other. An "interactions log" were developed, and distributed to all employees in each department. The employees kept a log of all interdepartmental interactions for a sample week. The typical business week was selected according to the interviews held with the County Manager and Board of Commissioners in order to avoid misleading responses. Based on the "interactions log", data about the frequency, type and direction of interdepartmental interactions were gathered. The four main interdepartmental interaction types considered were: face-to-face interactions, telephone calls, e-mails and faxes.

Workplace satisfaction was examined based on the compatibility criteria of work patterns / practices of departments and spatial configuration of their workplaces. An instrument was developed, on which all employees from all departments were able to evaluate their workplaces according to their work patterns and daily practices. The evaluation was considered in thirteen subheadings: Support for work and productivity; Appropriateness for work; Privacy; Distraction from work; Proximity to colleagues; Ease of contact in office; Enhancement of communication; Noise level (from office environment); Personal comfort; Attractiveness; Size and area; Furniture; Overall satisfaction.

Environmental comfort was evaluated based on the personal responses of all employees from all departments. An instrument was developed on which the employees were able to evaluate the physical comfort levels of their workplaces. Environmental comfort was evaluated through fourteen subheadings: Temperature in winter; Indoor air quality in winter; Lighting in winter; Daylighting in winter; Temperature in summer; Indoor air quality in summer; Lighting in summer; Daylighting in summer; Noise from environmental control systems; Degree of control; Frequency of control; Control improvements; Environmental issues; Overall satisfaction.

The second phase of the project consisted of information gathering about the future workplace needs and requirements of departments. For this purpose, a new instrument was developed based on an extensive review of literature about workplaces. Various workplaces of different work patterns from different sectors were examined, and a typology of workplaces was constructed. Twelve types of individual and common workplaces were identified as significantly common examples, along with two meeting – oriented types. All the types were three-dimensionally modeled using computer-aided design software, and two images were generated (an overview and a close-up) for each type. An example of these types is provided in figure 1.

Figure 1. One of the types that was included in the instrument.

Specifications of these workplaces (i.e. floor area, objectives, potential uses) were provided to each department along with the three-dimensional images. Using this instrument, each department head was requested to identify the number of employees in their departments, their job titles, and the appropriate workplace type for each of these job titles, based on their everyday practices. Consequently, the workplace needs and requirements for all departments and their employees were identified.

4.1.2. Towards Decision Making

In the **third phase** of the project, the efforts of the team were oriented towards generation of design recommendations and alternatives for long-term decision-making strategies. A three-step procedure was undertaken, and this procedure is still under progress.

In the first step, department specific design recommendations were generated based on the evaluation of existing situation for each of the departments. Information that was gathered about interdepartmental interactions, workplace satisfaction and environmental comfort was evaluated. For interdepartmental interactions, the frequency, type and direction of interactions were compared to the distance among departments in pairs. Through an analysis of all the combinations of pairs, it became apparent that interdepartmental interactions did not form a basis for a relocation decision for any of the departments. An example of interaction – distance comparison is provided in figure 2.

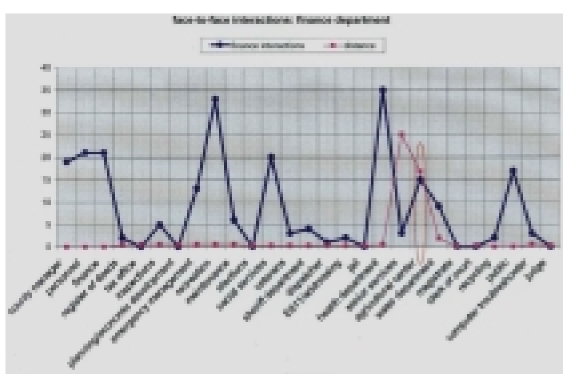


Figure 2. Face-to-face interdepartmental interactions between finance department and all other departments vs. distance.

For workplace satisfaction and environmental comfort, the data gathered was analyzed for each of the departments under each subheading, and department – specific design recommendations were generated based on this information. An example of workplace satisfaction and environmental comfort evaluations are provided in figures 3 and 4 respectively.

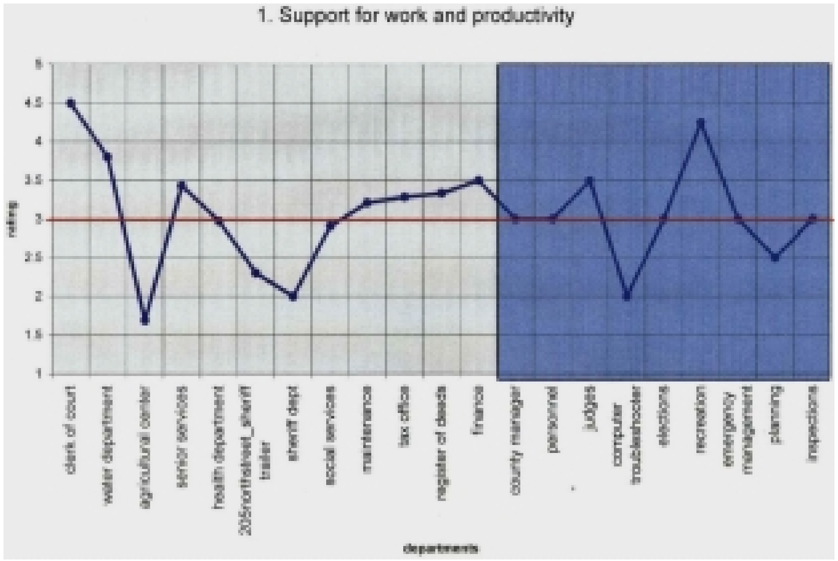


Figure 3. Workplace satisfaction: "support for work and productivity" as rated by all departments.

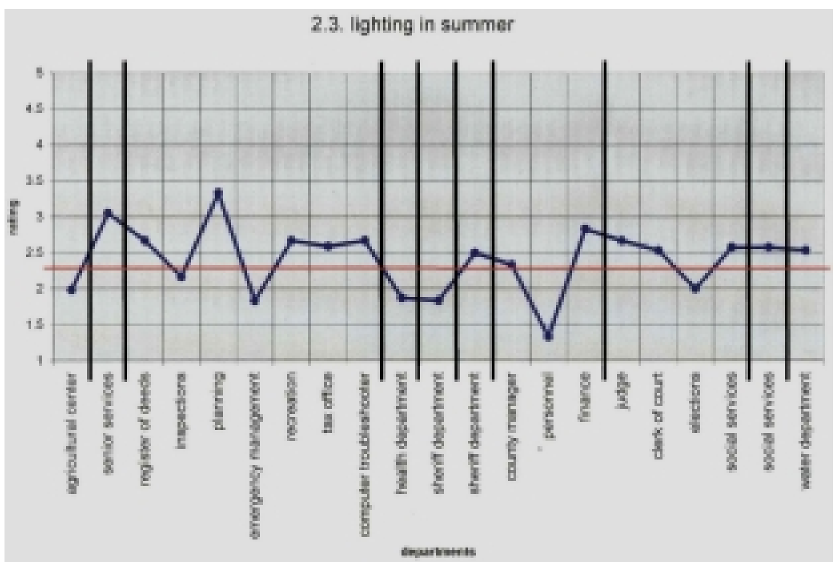


Figure 4. Environmental comfort: "lighting in summer" as rated by all departments.

In the second step, department specific workplace requirements were identified based on the information gathered in the second phase of the project. For each of the departments, specific charts were prepared that identified all job titles, the number of employees with these jobs, the required type and number of workplaces for each job, existing floor area of the whole department, and estimated net and gross area requirement for that department. An example of these charts is provided in figure 5.

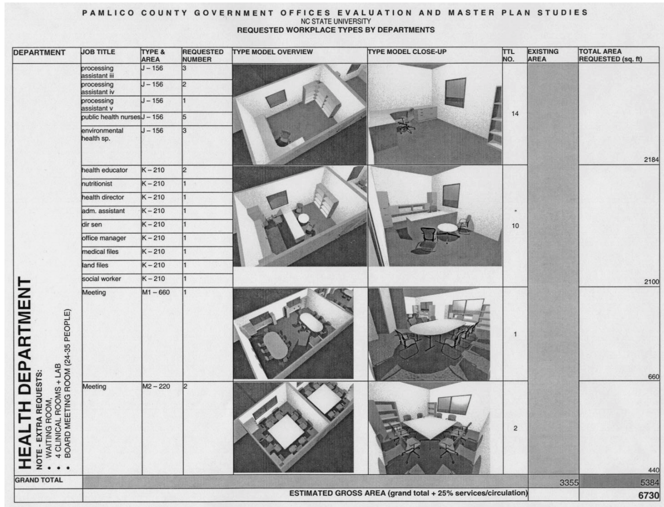


Figure 5. Workplace needs and requirements: health department.

Within the same step, the existing floor areas and required floor areas (net and gross) were also compared by means of graphs. Based on these comparisons, those departments with excessive need of extra floor area were identified, in order to inform the County Government about those departments with most "urgent" needs. An example of these comparison charts is provided in figure 6.

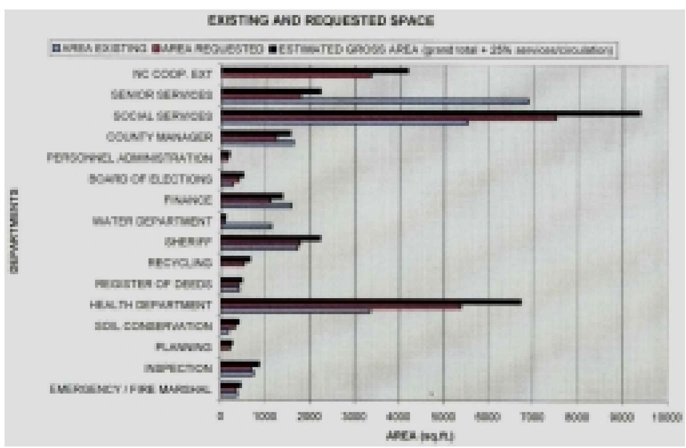


Figure 6. Floor area requirements compared: all departments.

The third step of the last phase of the project is still under progress. This step complements the department-specific design recommendations by focusing on the long-term urban scale decisions. Therefore, recommendations and alternatives that are being generated in this step focus on urban scale and long-term decision-making alternatives as opposed to department scale recommendations. The programming team is currently working on two major long-term strategies within this step. Both alternatives have been developed in the light of information gathered and interpreted in the first two phases. The first alternative focuses on the possibility of consolidation of all departments within a single "government block". While this alternative currently under consideration can be graphically represented as in figure 7, it must be noted that it is still under evaluation of the programming team in terms of issues such as work patterns, environmental comfort, and urban and local sustainability (i.e. traffic, solar control, effects on surrounding blocks, etc.).

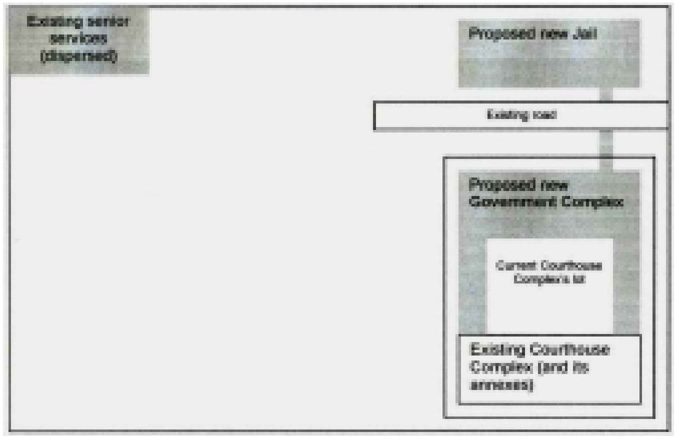


Figure 7. Phase 3, step 3: alternative 1 – consolidation of departments.

The second alternative focuses on the possibility of leaving the majority of departments in their current locations, but by following the department-specific recommendations generated in the first step (workplace satisfaction, environmental comfort recommendations) through minor modifications. This alternative also includes the possibility of the relocation of two largest departments with highest floor area requirements and lowest evaluations in terms of workplace satisfaction and environmental comfort. Such a relocation is currently envisioned in a new building in the current courthouse complex's block in this alternative. This alternative can be graphically represented as in figure 8, and similar to the first alternative, is under evaluation of the programming team under the same criteria.

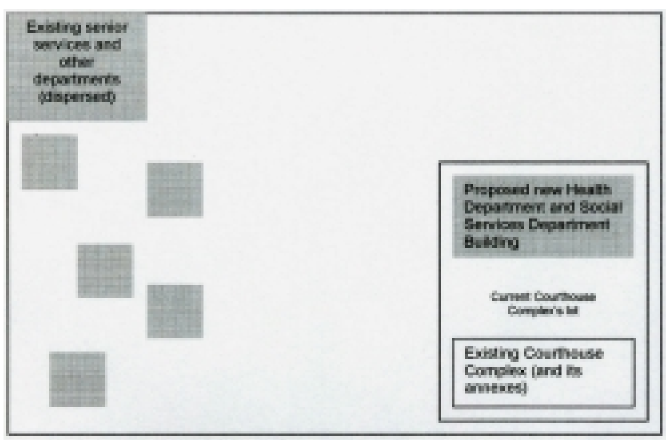


Figure 8. Phase 3, step 3: alternative 2 – dispersed locations for departments.

4.2. Methodological Implications

Throughout the whole process of this project, frequent visits to the town of Bayboro, as well as feedback meetings with the County Manager and Board of Commissioners were realized. Starting with the launch of the project, it was made clear to the County Manager, Board of Commissioners and Department Heads that this was a knowledge-based decision-making process. In the subsequent meetings this issue was consistently emphasized, and the process was graphically represented to them as in figure 9.

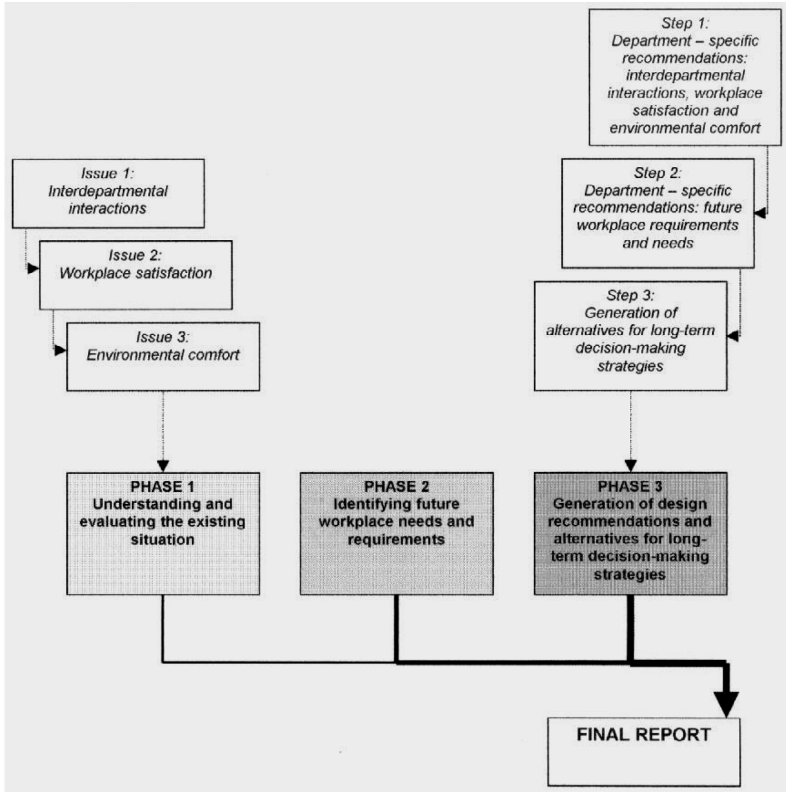


Figure 9. The project process.

Frequent feedbacks and active communication with the County Government has resulted in accurate results and increased satisfaction of the "end-users". It was observed that such efforts not only made the efforts of the team legitimate in the eyes of the user group, but also has resulted in clear and accurate recommendations.

5. CONCLUSIONS

The project is envisioned to end by the time this paper is presented in ARCC Research Conference. A final report will be produced, in which department-specific recommendations as well as long-term decision making strategies will be elaborated. The main objective of the programming team is to provide the County Government by a final document, by which they can communicate their needs and requirements to future decision makers (architects, city planners and policy makers) clearly and effectively.

The conclusions that can be derived from such a case study are threefold. First, forming the architectural programming process, systematic information gathering and consequent decision-making results in accurate results both for the users and future decision makers. Second, such efforts not only provide accuracy, but also provide a medium of clear communications between professionals and user groups. Third, such a clear communication medium provides the users with good understanding of issues at stake, and results in a productive collaboration between users and professionals for the good of the project.

As a result, it is our belief that such knowledge-based efforts must be increased in architectural design processes. A broad framework for architectural programming to be used in workplace projects can be proposed as in figure 10.

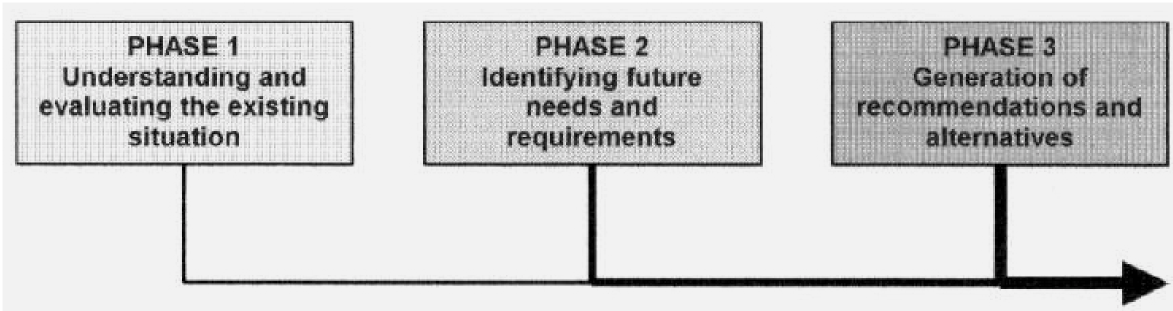


Figure 10. A broad framework for architectural programming of workplaces.

This framework can be modified based on the specific conditions of the project context. However, it must be emphasized here that knowledge-based processes have a great ***complementary*** potential for architectural design towards providing satisfactory results for both design professionals and users, as well as towards providing a legitimization of the products of architecture. Therefore, it is our belief that architectural programming forms an important part of the building process from the start to the end, but is itself complementary to the design process.

6. REFERENCES

- Castells, M., Hall, P. 1994. *Technopoles of the World: The Making of Twenty-first century Industrial Complexes.* Routledge, London.
- Duerk, D. P. 1993. *Architectural Programming: Information Management for Design.* New York: Van Nostrand Reinhold.
- Duffy, F., Laing, A., Jaunzens, D., Willis, S. 1998. *New Environments for Working: The Re-design of Offices and Environmental Systems for New Ways of Working.* London: Construction Research Communications Ltd.
- Pena, W. 1987. *Problem Seeking: An Architectural Programming Primer.* Washington: AIA Press.
- Toker, U. and Rifki, F. A. 2001. "Architecture as a Knowledge-Based Tool: the Architectural Transformation of Workspaces." in *Proceedings of the Architectural Research Centers Consortium Spring 2001 Research Conference at Virginia Tech.* Blacksburg, VA.
- White, E. T. 1972. *Introduction to Architectural Programming.* Tucson, Arizona: Architectural Media.
- White, E. T. 1991. Project Programming: A Growing Architectural Service. Tucson, Arizona: Architectural Media.
- Wineman, J. D. (ed.) 1982. *Behavioral Issues in Office Design.* New York: Van Nostrand Reinhold.
- Worthington, J. 1997. "Introduction: The Changing Workplace", in *Reinventing the Workplace, ed.* J. Worthington, Oxford: Architectural Press.

Housing, Development and Cultural Resistance: the amaXhosa of East London, South Africa

Jean D'ARAGON
School of Architecture
McGill University
Jean.Daragon@mail.mcgill.ca

Abstract:
Research on human settlements over the last four decades has changed the views of scholars in the field who now accept housing less as a problem to solve than as an important aspect of overall sustainable development. This led stakeholders to concentrate most of their energy on the economic and, more recently, environmental dimensions of development to evaluate its costs and impacts. The cultural dimension was, however, neglected despite having been identified as being not dissociable from the others in the Agenda 21 at the Earth Summit held in Rio de Janeiro in 1992 (UNICED, 92).

At the social housing level, under pretext of the pressure created by the state of emergency left by the tremendous needs, the projects tend to propose standard solutions seldom related to the context and that ignore the cultural values of the group or people affected by these projects. This approach often aimed for quantitative results and mainly considers the economic and environmental impacts, and thus engenders its own failure in the near future.

This paper is about the life in the informal townships (squatter settlements) of East London in South Africa, where almost one third of the 560,000 inhabitants of the city reside. Specifically, it looks at the locations occupied by the Xhosa people, who make up 80% of the non-European population living in East London. This port city on the Indian Ocean is wedged between the *Ciskei* and the *Transkei*, former *homelands* where most of the Xhosa people find their roots and where they still migrate back and forth.

Through a recall of parts of their history, the description of objects, spaces, dwellings and building techniques of the *amaXhosa* (Xhosa people), this paper aims to identify and unveil some signs of persistence and/or resistance of the peasant culture of this group in the urban context. Rather than seeing them at odds with their new setting (Mayer, 63), the goal of this paper is to seek ways to reinforce, and to build on them as important elements of the cultural core of the Xhosa People. These elements are essential for the permanence and continuity of the group, and should be taken into consideration by any project involving the built environment, especially a housing project, that aims to be supportive of the concerned group, and of the blossoming of its culture and identity.

Traditional rondavel built in town beside a church being built of wooden planks salvaged from dismantling transportation pallets – Duncan Village, East London

Housing, Development and Cultural Resistance: the amaXhosa of East London, South Africa

Research on human settlements over the last four decades has changed the views of scholars in the field who now accept housing less as a problem to solve than as an important aspect of overall sustainable development. This led stakeholders to concentrate most of their energy on the economic and, more recently, environmental dimensions of development to evaluate its costs and impacts. The cultural dimension was, however, neglected despite having been identified as being not dissociable from the others in the Agenda 21 at the Earth Summit held in Rio de Janeiro in 1992 (UNICED, 92).

At the social housing level, under pretext of the pressure created by the state of emergency left by the tremendous needs, the projects tend to propose standard solutions seldom related to the context and that ignore the cultural values of the group or people affected by these projects. This approach often aimed for quantitative results and mainly considers the economic and environmental impacts, and thus engenders its own failure in the near future.

Professionals searching for the solution to the housing deficit should not only rely on the use of particular materials, technologies or construction systems. It is important that they understand that the solution goes beyond the project's acceptance by the users as it includes its appropriation and its potential to foster the dynamism of the community. The latter is not only defined by its physical borders and/or the common use of infrastructures but also through the sharing of common problems, hopes and goals (Awotona, 95: 4).

For the built environment to play an important qualitative support role in the development of the community, the project must find its route and roots through the identification and a better understanding of the elements that are part of the fundamental nature of the community. These elements are an essential aid to the definition of the group’s identity. Through these elements the group recognize itself, and others understand it. They become factors in ensuring the group’s own permanence and continuity. The taking into consideration of the group's specificity and cultural values by the project of the built environment provides the kind of support that goes beyond the production or the creation of a milieu that is more humane. The latter, if really playing its role of physical support favourable to the blossoming of the group's culture and identity, could also influence the economic development of the community. This is perhaps even more the case in locations where the needs are important and the means limited (Rapoport, 97: 20-21).

The relevance of studying housing in developing countries needs no further debate. Especially studies of houses of the humble people, which are probably the most powerful bearers of the details and the universal character of a given milieu, must be undertaken in order to improve our understanding of theoretical concepts as well as the practical application of architecture. Comparing this type of setting with historical examples of architecture the first has the advantage of being inhabited, offering the possibility of a more complete study and a better comprehension of the built environment. The extreme conditions that often predominate allow a refined and perhaps more universal reading of the human aspects of the built form as does vernacular architecture (Rapoport, 83), since both show a direct relationship between everyday life and the built form. Looking at this direct relationship (lifestyle and built form) could even help us to determine what could be our own models of rituals today – those which do not necessarily have historical precedents – and, as designers, to respond to them in a perspicacious manner.

Cases of living environments such as squatter settlements where dwellings have been designed to adapt to new surrounding conditions and the materials at hand i.e. salvaged remains, rubbish or waste, to which new meanings and functions had been attributed, were studied by scholars who accepted it as neo-vernacular (Oliver, 97; Rapoport, 88; Peattie, 92; Kellet, 95). Touching on the subject of squatter settlements in his work *Rural Shelter in South Africa*, Frescura presents the squatter as the link between the rural (peasant) and the urban (citizen) (Frescura, 81:172). We see the squatter settlement as a buffer zone that helps to reduce the shock between these two worlds (rural and urban), where often the values, significations, activities, roles and institutions are confronting each other within the same group or culture. It is where the resistance of the peasant culture takes place when in a new (urban) environment. It is also the place of its transformation and of passing to a new culture.

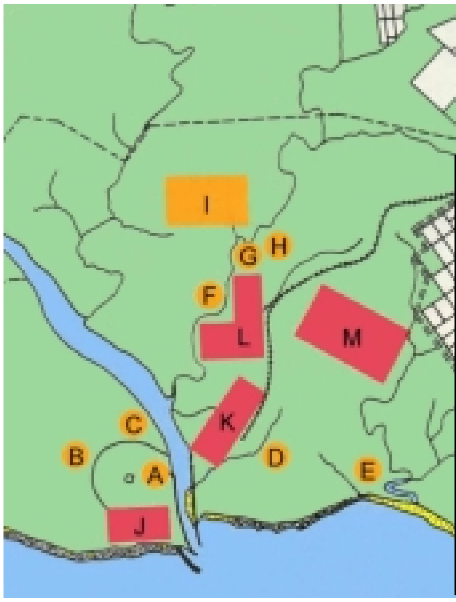
This paper is about the life in the informal townships (squatter settlements) of East London in South Africa, where almost one third of the 560,000 inhabitants of the city reside. Specifically, it looks at the locations occupied by the Xhosa people, who make up 80% of the non-European population living in East London. This port city on the Indian Ocean is wedged between the *Ciskei* and the *Transkei,* former *homelands* where most of the Xhosa people find their roots and where they still migrate back and forth.

Through a recall of parts of their history, the description of objects, spaces, dwellings and building techniques of the *amaXhosa* (Xhosa people), this paper aims to identify and unveil some signs of persistence and/or resistance of the peasant culture of this group in the urban context. Rather than seeing them at odds with their new setting (Mayer, 63), the goal of this paper is to seek ways to reinforce, and to build on them as important elements of the cultural core of the Xhosa People. These elements are essential for the permanence and continuity of the group, and should be taken into consideration by any project involving the built environment, especially a housing project, that aims to be supportive of the concerned group, and of the blossoming of its culture and identity.

East London was founded as a port in April 1847. It functioned as a supply station for the imperial troops during the War of the Axe (1846-7). Within a matter of weeks, an early community of soldiers and merchants was established on the western bank of the Buffalo River, close by a Xhosa village from which the new settlers depended on the know-how of its members for their survival in this new environment. A year later the good neighbours became unwelcome on their own territory. The native village was then seen as a Location by the White local authorities.

This was only the beginning of a life of segregation, of carrying of passes, of migrant labourers (1849-50), curfews and repeated forced removals imposed by the White on the amaXhosa of this region. Nine years later (1856), the existing Xhosa village was razed to the ground, its inhabitants pushed further west to a place known as the *West Bank* Location. In 1890 they were then relocated again, this time, to the north-east, on a site to which the group was removed and relocated once more in 1965, leaving room for extension of the city and its industrial park, where a Mercedes Benz plant stands today (Tankard, 01).

West Bank was not the only Location to be established at that time. In 1890, in order to keep the Native labourers drawn by the port activity outside the town, *East Bank* Location was created on the other side of the Buffalo River. Then followed smaller locations such as *Fingo, Seaside,* *Newsam's Town*, *Wesleyan*, and *Cambridge*. Of these, *West Bank, Cambridge* and *East Bank* still exist; the latter being the largest and the most significant.



A. West Bank Location, 1835-56
B. West Bank Location, 1856-90
C. West Bank Location, 1890-1956
D. Fingo Location, 1874-76 E.
Seaside Location, 1876-78 F.
Newsam's Town, 1878-90 G.
Wesleyan Location, 1877-90 H.
Elite Location, 1882-90 I. East
Bank Location, 1890-1930*J. East
London (West Bank) K. Panmure
(East Bank) L. North End M.
Southernwood

Displacement of the African population in East London, 1847-1930 (K. Tankard, 2001)

Initially an outsider wouldn't have been shocked when glancing at these locations. On the contrary, the order that seemed to reign in the *East Bank Location* – designed and established as a *model township* – with its wide streets and the *wattle and daub* round huts built close to the Black townspeople's churches, would have shown a well organized, defined and controlled (*temporary*) community. Even municipal lodging houses (later known as *hostels*) were built to accommodate single men working in town. (Tankard, 01) However, twenty years of thrift and neglect on the part of the local (White) authorities had resulted in insufficient accommodation and services overcrowded groups of round huts and a growing number of square tin shacks had drastically changed the quiet appearance of the *East Bank Location*.

Despite the small numbers of plots and inadequate surface areas with high rents, there was no decrease in migration from the country. The 40' x 40' lots which Charles Lloyd (*East London's* Location Superintendent for the first thirty years of its existence) deemed to be adequate space for Round Huts became insufficient when the Natives started to build Square Houses, and the location began to be congested. In one of the joint reports with the Medical Officer of Health, Lloyd wrote:

> "Initially, the Square House, if it was a 'better type of house' (than the Round Hut), was made of 'poor quality galvanised iron'; but as time went on, it was made more often of tin-lining i.e. the lining taken from packing cases' and of 'any other material to hand: wood, branches, cloth, scraps, mud". (Minkley, 98: 204).

Perhaps in spite of himself, Lloyd was speaking in praise of the ingenuity of the Native builders and their capacity to easily adapt to their new environment, recognising the potential of the materials within reach. At the same time he was also giving some credit to the Round Hut as a house type better suited for building on small plots, as he declared the square house "built by the Natives, not desirable dwelling places" for sanitary and security reasons. His point was that such square houses did not have sufficient space between them. Instead of questioning the dimensions of the sites they were renting to the location residents, the council and Lloyd himself preferred to explain the overcrowding situation of the Locations thus:

> "the Native is a tribal being… he is not able to think or to build in the same way as the European. As long as he is left to himself the square House he replaces (the hut) with will be undesirable" (ibid.).

Perhaps the purpose of such slander was to divert the attention of higher authorities from the evidence of neglect by the local council who did not build a single municipal house between 1928 and 1940, a period of heavy Native migration from the country to town. The Municipality eventually built some houses over time but were unable to keep pace with the requirements and by 1955, the majority of the locations residents were still living in overcrowded dwellings they had built themselves, while only one fifth of the residence lived in municipal buildings.

In 1955, *East Bank Location* (officially renamed *Duncan Village* at that time) was far more heavily populated than the other locations, with 44,610 of the 51,340 Bantu living in all the East London's Locations.. The population density of this location was 141 inhabitants to the acre (348.4 persons per hectare) while West Bank had 5,660 residents at 166.5 per acre (411.4 per hectare) and 1,070 persons in Cambridge at a density of 85.6 per acre (213.7 per hectare). These numbers contrast dramatically with the average density of 12 persons per acre (29.6 per hectare) for the white urban population of East London for the same period. (Reader, 61: 36-52)

Living conditions in the locations were very similar to those experienced by squatters. The only difference between the two types of residents was in their legal status. Those living within the well-defined limits of the Locations were paying rent to the Municipal government. The Municipality's unwillingness to provide accommodation for the majority of the residents resulted in most newcomers settling in the existing ramshackle wood-and-iron structures, which extended to the limits of the plots. Reader counted 2,089 private houses in the *East* and *West Bank Locations* with an average of 20 to 24 persons living in a same house in 1955 (ibid.).

Another strategy to increase living space consisted of re-subdividing the existing structures. Some were divided into 10 or more rooms that led out into a corridor which was the only source of ventilation. Most of these rooms accommodated one household of 4 to 5 adults with 4 to 5 children, with all the domestic activities such as cooking, eating and sleeping, taking place in the room. (Minkley, 98: 204)

East Bank Location, 1900 (K. Tankard, 2001)

Square tin shacks: Each room could accommodate a household of ten people or more (P. Mayer, 1963).

Most Europeans living in the region were sensitive to the living conditions that prevailed in the locations. In the late 1930s, the Thornton Commission affirmed that *East Bank Location* was probably the worst location in the Union saying it was "a blot to our civilisation that such place exists". On May 11th 1949, Councillor Taylor who seemed to share similar preoccupations said that the Natives were "cramming themselves into already unsanitary and second hand houses with no regard to moral and human dignity" (ibid.).

The Europeans fostered the traditional system of homestead production within Native reserves in order to feed and support the male migrant labour system, on which depended the White manufacturing industry and other production activities, but the lifestyle and customs of the African peasantry stood in profound contrast with the Whites' beliefs and values (Walker, 90: 10-14). This contrast became more accentuated when the Natives came to live in the towns.

If Europeans were shocked by the overcrowded conditions in the locations it is likely that their irritability was stimulated more by prudishness than by sanitary concerns. To them, even as a reduced model, the multi-functional single-room shacks suggested the Native life in the round hut of the homestead, with its heart built on the centre of the floor and around which, all the domestic activities took place (Peters, 97: 2154; Walton, 97: 2169).

Europeans considered this pattern of living as primitive. Perhaps in their minds, the huts evoked the medieval European houses, where one large room served as a place to prepare and share the meals, receive visitors, deal with business, and where at night, everyone slept, often in the same bed (Rybczynski, 89: 27-61. Having succeeded in breaking free from this way of living in the 16th century, Europeans were now judging this model inappropriate or even fiendish, since they might have considered that, with the whole family living in the same room, children would be traumatised by the experience of witnessing the sexual activities of their parents.

The amaXhosa are polygamous, and their sexual openness was undoubtedly repugnant to the Europeans. On the other hand, even though the customs of the Xhosa society were regulated by very strict codes depending on, and supporting the system of homestead production to which the migrant workers were still intimately linked, such codes and structures, even if not completely broken down, nevertheless became less rigid in the urban context of the locations. (Mayer, 63: 252)

Life in the locations forced a drastic change in the Xhosa culture. Unlike the Zulu, whose pre-colonial clustered towns could exceed a population of 10,000 people, the Xhosa had no village tradition but lived in large extended family homesteads. These were dispersed on the ridges above valleys of the hilly country where wood and water was easily found. Eight to fifteen round huts were organised in a half circle, facing the cattle *kraal* (enclosure) where the animals were kept for protection at night, after a day in the pastures. The dwellings faced the rising sun and were built close to the top of the ridges where they were protected from the wind and drained by the downward slope. (Beinart, 94: 16-17; Peires, 82: 3)

Traditional Xhosa homestead, Transkei.

The African and the European notion of space and ownership was very different. The latter often describing the African landholding system as *communal tenure*. This is however, an oversimplification of a more sophisticated system where rights to land were set up in function of lineage, chiefdom or family organisation. Hierarchies of age, gender and rank facilitated the control of the production system and exchanges between homesteads. This, being the spearhead of the group, ensured its permanence and continuity (Beinart, 94: 18-19).

For the Xhosa the invisible world strongly influenced the material one. Religious and secular lives were completely intertwined in one and the same world. Success and bliss were directly dependant on one's fervour and faithfulness to the group's rituals which were determined by the diviners through communication with the unseen world (Peires, 82: 67).

Patriarchy was observed through avoidance customs (*hlonipa*) in speech and behaviours expected of women. For instance a wife could not use words containing the names of her husband's male kin, or handle cattle or even drink milk in many situations. Cattle, which express the richness, carried other symbolic meanings. The evidence of this could be seen in the location of the cattle-enclosure at the centre of the homestead. Cattle sacrifices appeased the deceased forefathers. Cattle were the responsibility of the boys and young men who herded them. If polygamy was the ideal it was not necessarily generalised. Women counted for an important part of the production system, and a husband had to pay a *bridewealth* (dowry – *lobolo* in Xhosa) in cattle to his new wife's family. Ambitious men tried hard to accumulate cattle so they could marry and procreate in order to extend their lineage and labour force. (Peires, 82: 4; Elliott, 70: 53).

Women took care of the gardens, prepared the meals, collected the firewood, carried water from the streams and maintained the dwellings (including the roof thatching and the walls plastering), which like all the permanent structures, were erected by the men. The women were also responsible for sewing, making pots, weaving baskets and the reed mats, but the craftwork of wood and iron was the men's domain, as was the preparing of the hides. (Peires, 82: 4; Elliott, 70: 20-21)

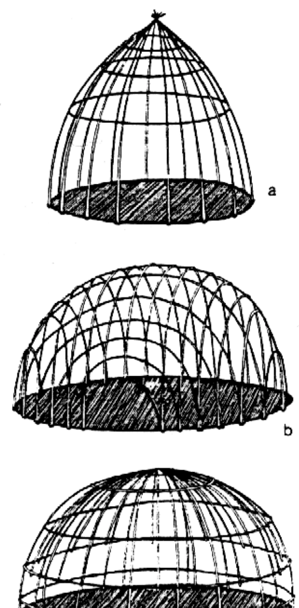
Woman and her daughter carrying home head-loads of wood, Transkei (J. A. Broaster, 1967).
Women also collect the straw and reeds which they use to weave reed mats and thatching the roofs.

Each wife lived in a separate hut with her children. When married, a son built his hut for himself and his wife close to his mother's hut. The main hut, being the hut of the first wife, was built facing the gate of the cattle kraal. The second wife had her hut built on the right-hand side of the main hut and was called the "right-hand wife". The hut had only one small entrance, which was raised to prevent the rainwater to flood in. People accessed it by its one, two or three steps. The right-hand side of the hut was reserved for men, while female visitors kept to the left side. The wife, was allowed to sleep on the same side of her husband when not menstruating. It was forbidden, however, for a woman to sit on the men's side in her father-in-law's wife's hut.

If a hut had other openings, they were two small air holes or windows on each side of the doorway. These were closed most of the time in order to prevent evil spirits from entering. During the day, the lower panel of the stable-like door was kept closed to keep out the pigs, dogs and fowl. The open upper panel open allowed in light and air in and created a draft so the smoke from the hearth at the centre of the hut escape trough the thatched roof. At night time the upper panel door was closed and the reed sleeping mats were unrolled and laid on the rammed earth floor, which was often smeared with a mixture of clay, cow dung and water by the female owners of the dwelling. (Broster, 67: 8-9; Walton, 97: 2,169; Peires, 82: 3)

Cattle are important to the Xhosa people as is the cattle kraal (*Uthango*). In front of it, in the yard (*inkundla*) formed by the 30-metre or so space between the dwellings and the gate of the cattle fold, most the social and formal activities of the group take place. It is the place where men meet to chat. Here, under the chairmanship of the headman, every man has the right to express his opinion. The *inkundla* was the traditional location for all the tribal and ritual ceremonies such as weddings or initiation feasts for the young men. In the lee of the kraal walls, protecting themselves against the wind, men drank the beer brewed by the women, who danced around the barrel of the sacred alcoholic drink. (Broster, 67: 128; Mayer, 63: 51; Peires, 82: 3)

The original *Xhosa* dwelling, the *ngqu-pantsi*, with its thatched beehive dome is very similar to the nomadic pastoral, *Khoikhoi* (wrongly called *Hottentots*) portable and re-usable hut which is distinguished by a high degree of refinement. It appears likely that the *Xhosa* possibly borrowed and adapted the design for their own use during an early period of commercial exchanges and intermarriages. (Walton, 56; Frescura, 81: 33-4; Davenport, 91: 8). These huts had a light sapling framework. The vertical structure was distributed in a circle that reached about 4,2 metres in diameter, fixed into the ground and brought radially to a central crown. Taking the shape of rings, the horizontal structure was distributed from the ground to the apex, each section being smaller on its way to the top. While the *Khoikhoi* used leather strips to tie the uprights and horizontal bracings together, the Xhosa, less preoccupied by the concept of portability and re-usability at that time, simply used woven grass ropes to secure the structure together. The *Khoikhoi* covered their portable hut with reed mats, closely woven for protection against rain. In a more permanent way, the Xhosa covered their beehive domes with thatch. (Kolbe, 1,727; Walton, 97: 2,169)



The first image on the left represents beehive hut frameworks from different groups – a: Sotho, b: Zulu/Swazi, c: Xhosa (F. Frescura, 1981).
The second illustration shows the *Khoikhoi* pastoralist (*Hottentot*) **beehive dome structures which are very similar to the Xhosa structures (image c, bottom left). The second illustration is called: "How the Hottentots build their Houses" and was drawn by Peter Kolb (Kolben) (1719) published in: *Capnt Bonea Spei Hodiernum*. Nurnburg: P.C. Monasth.**

The use of this kind of beehive dome as a permanent *Xhosa* house was not recorded after the 1920s, this form having evolved over time to at first a cylindrical structure with a dome at its top, (*isi-tembiso*) , and finally as the structure we know today, the *rontawuli*, which is a cone on cylinder, similar to the Afrikaans rondavel (Duggan-Cronin, 39; Japha, 97: 14; Walton, ibid.). In early versions of the *isi-tembiso* (dome on cylinder), the *ngqu-pantsi* (beehive dome) structure remained. Branches were horizontally intertwined and the monolithic structure was finally plastered with clay and dung on both sides. This was a great technical improvement against fire hazards. Otherwise, the structure was surrounded by a 2-metre (6.5 feet) vertical wall made of sod or stone. The roof was thatched with long grass that was sewn to the framework and then secured by a spider web-like grass rope network on top. Depending on the site and material at hand, today the Xhosa build their *rontawuli* (cone on cylinder) of adobe (clay and straw sun-dried blocks) – as the Afrikaans rondavel – or sod and stone. Very often, however, they build with wattle and daub. They make a vertical sapling structure on which branches are intertwined, and cover the basket-like framework with a mud plaster made of a clay and dung mix, to which different colours may sometimes be added. (Peires, 82: 3; Walton, ibid.)

The *ngqu-pantsi* (beehive dome) is still in use today in its original shape, but only on temporary basis in two particular moments related to the *amaXhosa* traditions and rituals. A beehive hut is built as the ritual lodge where the young men will live for the time of the *Abakweta* (initiation into manhood). When the ceremonies are over, the hut is burned. (Broster, 67: 138; Eliott, 72: 92). Even in urban conditions, the persistence of the *Abakweta* is strongly manifested in the *Xhosa* culture. Some parts of this initiation ritual such as circumcision, may be related to early contacts through commerce and intermarriage with Arab traders (Soga, 31: 8-10). In the country, the headman of a homestead builds a beehive dome as a first home for his son and his bride until the end of the wedding ceremony. It is here that the couple lives until they build their own house, or until the son goes to establish his own homestead (Walton, 97: 2,169).

***Abakweta* or initiation into manhood ritual where the *ngqu-pantsi* (Xhosa beehive dome) is built for two or three months, to shelter the initiate or *umhwetha* (plural *Abakweta*) during the overall period of the ceremonies (A. Elliott, 1970)**

Despite the important presence of the *Red* people, a conservative group among the *amaXhosa* today, the loss of traditional know-how is evident through the deterioration of the housing stock in the country around East London. A thatched roof used to last a minimum of seven to ten years. The roofing materials on today's houses must be replaced every two years. Sometimes, new materials add to the confusion because they are unsuited to traditional techniques and materials.

This process of cultural loss began when the missionaries arrived and "regarded the abandonment of traditional economic practices and material culture, including architecture, as a visible signifier of conversions, and strove to promote it" (Japha, 97: 8). Dispossessions, relocations and overnight evictions also interfered with the transfer of the culture from generation to generation, with the shift from use of traditional building techniques to new methods provoked by temporary necessity. In the same way that apartheid policies affected the traditional building techniques, buildings in the locations, now called townships, were also affected. Here, with minimal manpower, the developed form of a temporary building can be built, dismantled, moved and rebuilt within 24 hours. These buildings are constructed from materials provided by the surrounding urban environment.

One important resource available to the township dwellers of East London today are the wooden pallets used in transportation. They are cleverly reassembled into panels of about 3 metres wide by 2,20 metres high for reuse by the township dwellers. Despite a lack of cross bracing, these prefabricated panels create perfect modules and many of them are sold to residents to build their own homes. They have, in fact, become very important to the flourishing informal local housing industry. It is likely that this ingenious way of building is connected in some way to the group's prior experiences. If so, the researcher who looks closely at the group's early history should not only put this technique in the context of the evolution of the overall group material culture but perhaps also imagine its place in the group's future and prepare the ground for the next steps.

An important resource for the East London townships dwellers: the wooden transportation pallets.

Without a complete understanding of the lives of the townships residents, it is difficult for an outsider to connect everyday life in these settlements with the rituals anchored in a tradition that external factors have almost eliminated. Unfortunately, the inadequate understanding of the facts too often confirms the prejudice of the outsider. Yet greater awareness and assimilation of such details in the planning of the built environment could have a tremendously positive impact on the development of the community. Understanding of life in the townships today should be rooted in a more thorough knowledge of the group's background, its ritual traditions, its religious and secular activities. Its use of building techniques and materials and the configuration of the available space are also fundamental to a complete grasp of the group's past, present and possible future. All these elements join together to form a picture of the nature of the community and changes it has undergone that influence its life today.

An outsider walking in a township today might not see the order that exists amidst the apparent disorder. A walk at night in this extremely violent place where all residents lock themselves in after midnight would also reveal that, despite the lack of fences around the gardens, nobody touches the crops. This sacred respect for private garden is rooted in the traditional homestead, where the head man allocated a piece of land to each of his relatives to grow the sorghum to which was later added to the maize, the *mielies* (corn cobs) still being a very important ingredient of everyday life of Xhosa people today. Where individualized urban agriculture takes place in townships today, the traditional African landholding system is agitating for new forms of cooperatives where women, who developed their ability in trading and who gained emancipation in town, could play an important role.

The outsider who walks in the township might be also very impressed to see the frail silhouette of a seventy-year-old men facing a group of *tsotsis* (young delinquent men), keeping order in a township where the police do not go after dark. This situation illustrates the confrontation between the traditional and the modern, showing how traditional patriarchal authority has taken a foothold in the townships after being challenged by the women and their sons. It too has been forced to adjust to a new environment.

***O'Martin*, headman of C.C. Lloyd Township. Urban agriculture in C.C. Lloyd and Duncan Village Townships.**

An enlightened outsider in the location in a peaceful evening, with no wind to carry away the smell of the kerosene lamps, or the voices of men and women whose faces seem sculpted by a shadowy light, might not misjudge the people enjoying a beer outside their one-room shack where the kids are sleeping. Hopefully he would be able to relate them to the people in the traditional homestead *Inkundla* (yard) in front of the *Uthango* (cattle kraal) where women used to dance and men spoke their voice sharing the sacred alcoholic drink. Finally, if the outsider happens to be a designer involved in the planning of the built environment for a community, the minimum he could do is to try to recognise these elements that are parts of the group's culture core and to make room for them in the designing of spaces where they and the community, could happen.

References:

AWOTONA, A. and TEYMUR, N. eds. (1997). *Traditions, Location and Community : Place-making and development*. Aldershot : Avebury. 315 p.

AWOTANA, A., PELED, A. and COOKE J. (1995). *How the inhabitants of South Africa construe their spatial environment: the relevance of ecoanalytic method*. Newcastle upon Tyne: ODA, University of Newcastle and University of Cape Town. September. 46 p.

BEINART, W. (1994). *Twentieth-century South Africa*. Oxford : Oxford University Press.

BROSTER, J.A. (1967) *Red Blanket Valley*. Johannesburg: Hugh Kartland Publishers. 199 p.

BUNDY, C. (1983) "The Transkei Peasantry, c 1890-1914" in PALMER, R. and Parsons, N. ed. *The Roots of Rural Poverty in Central and Southern Africa*. London : Heinemann.

Cape Archives 3/ELN6 (1917a). "Evidence of C. Lloyd to Committee re Nursing and Medical Treatment of Native at the Locations". 20 November. DAVENPORT, T. R. H. (1991). *South Africa : A Modern History*. Toronto : University of Toronto Press. 662 p.

DUGGAN-CRONING, A.M. (1939). "The Bantu Tribes of South Africa : The Nguni - The Xhosa and Thembu" Vol. III Section I. in FRESCURA, Franco. (1981). *Rural shelter in South Africa*. Johannesburg : Ravan Press. p. 122.

ELLIOTT, A. (1970). *The Magic World of the Xhosa*. Cape Town: Collins. 144 p.

FOURIE, Morne. (1999). *Mêmes in amaNdzundza Architecture* (M.A. Thesis). Montreal : McGill University. 166 p.

FRESCURA, F. (1985). *Major Developments in the Rural Architecture of the Post-Difaqane Period*. (PhD Dissertation) University of Witwaterstrand.

FRESCURA, F. (1981). *Rural shelter in South Africa*. Johannesburg : Ravan Press. 208 p.

HALL, Martin. (1987). *The Changing Past : Farmers, Kings & Traders in Southern Africa 200-1860*. Cape Town : David Philip Publisher.

JAPHA, Derek and Vivienne. (1997). "Two Missions: Case Studies in the meaning of Tradition in tcontemporary Development in South Africa". in *Traditional Dwellings and Settlements Review*. 8.2 : 7-20.

JUDIN, Hilton and Ivan Vladislavic eds. (1998). *Blank_ Architecture, Apatheid and After*. Rotterdam : Netherland Architecture Institute. 488 p.

JUNOD, Henri-Alexandre. (1936). *Mœurs et Coutumes des Bantous: La vie d'une tribu sud-africaine.* Paris: Payot.

KELLETT, Peter and Mark Napier. (1995). "Squatter Architecture? : A critical examination of vernacular theory and spontaneous settlement with reference to South America and South Africa". in *Traditional Dwellings and Settlements Review*. 6.2 : 7-24.

KING, A.D. (1980). *Building and Society: Essays on the social development of the built environment*. London: Routledge. 318 p.

KOLBE, P. (1727) " Beschryving van de Kaap de Goede Hoop: How the Hottentots built their homes". in FRESCURA, F. (1981). *Rural shelter in South Africa*. Johannesburg : Ravan Press. P 33.

KUPER, A. (1980). "Symbolic Dimensions of the Southern Bantu Homestead". In *Africa*. 50: 1. Pp. 8-23.

MAYER, P. ed. (1963). *Townsmen or Tribesmen : Conservatism and the Process of Urbanisation in a South African City (Xhosa in Town : studies of the bantu-speaking population of East London)*. Cape Town : Oxford.OLIVER, P. ed. (1997). *Encyclopedia of Vernacular Architecture of the World*. Cambridge: Cambridge University Press. Volumes 1, 3.

PETERS, W. (1997) "Southern Africa: Indigenous)". in OLIVER, P. ed. (1997) *Encyclopaedia of Vernacular Architecture of the World*. Cambridge: Cambridge University Press. Vol.3.

PIERES, J.B. (1982). *The House of Phalo: Ahistory of the Xhosa People in the Days of their Independence*. Berkeley: University of California Press. 281 p.

PETTIE, L. (1992). “Aesthetic Politics : Shantytown or New Vernacular ?” *Traditional Dwellings and Settlements Review*. 3.2. 23-32.

RAPOPORT, A. (1983). "Development, culture change and supportive design. *Habitat International* Vol.7, No 5/6. pp. 249-268.

RAPOPORT, A. (1988) "Spontaneous settlements as vernacular design". in PATTON C.V.(ed.). *Spontaneous Shelter : International Perspectives and Prospects*. Philadelphia: Temple University Press.

RAPOPORT, A. (1997). “Some thoughts on people, place and development”. in *Tradition,* Location *and Community: Place-making and* Development. Avebury: Ashgate. Pp. 7-26.

RAPOPORT, A. (1969). *House form and culture*. Englewood Cliffs, NJ: Prentice-Hall.

READER, D.H. (1961). *The black man's portion: history, demography, and living conditions in the native* Locations *of East London, Cape Province*. Cape Town: Oxford University Press. 180 p.

RYBCZYNSKI, W. (1989). *Le confort: Cinq siècles d'habitation*. Montreal: Éditions du Roseau. 283 p. (Translation of: *House: A Short History of an Idea*, published in 1986 by Penguin Books of Canada Limited).

SMITH, D. ed. *Living Under Apartheid: Aspect of urbanization and social change in South Africa*. London: George Allen & UNWIN. 1982.

SOGA, John Henderson. (1931). *The Ama-Xhosa : Life and Customs*. Lovedale, Cape Town : Lovedale Press.

SWITZER, Les (1993). Power & Resistance in an African Society : The Ciskei Xhosa and the Making of South Africa. Madison : The University of Wisconsin Press. 452p.

TANKARD, K. (2001) *Labyrinth of East London Lore*. http://www.sael.org.za/e4menu.htm, version updated the 24 December 2001.

UNCED (1992). Agenda 21, Chapter 7: *Promoting sustainable human settlements development*. United Nations Conference on Environment and Development. Rio de Janeiro. 14 June.

WALKER, C. ed. (1990). *Women and Gender in South Africa to 1945*. Cape Town: David Philip.

WALTON, J. (1997) "Xhosa: Cape Nguni (Ciskei ; Transkei)". in OLIVER, P. ed. (1997) *Encyclopaedia of Vernacular Architecture of the World*. Cambridge: Cambridge University Press. Vol.3.

Privacy Patterns in Homes of Middle-Class Shaamy Immigrants in Montreal

Mahmoud Essam HALLAK
Ph.D. Architecture, McGill University

Abstract

After the Second World War, several waves of mostly highly educated, middle-class, traditional Muslim families from the Shaam arrived in Canada. As a result of cultural differences they found that their new living environment in Montreal did not respond to their *privacy* needs. This paper examines the privacy patterns observed in homes of the Shaamy community in Montreal by analyzing physical characteristics and modifications made to their single family detached homes and townhouses, usage patterns of domestic spaces, and inhabitants' privacy behavioral modalities.

In the context of the discussion, the paper alludes to some salient characteristics of the traditional living environment, indigenous lifestyle, and the socio-religious and cultural privacy concepts of this community. It scrutinizes briefly the correlation between these elements and the physical characteristics of Montreal housing patterns and of privacy concepts which are embodied in their designs. Both internal home layouts and functions and outdoor settings are analyzed in relation to the community and privacy. Consequently, the paper diagnoses major privacy deficiencies in the design of community homes and highlights domestic privacy mechanisms and utilization modes of the home environment. Finally, criteria are established for improving the design of detached homes and townhouses, with minimal change applied to their physical structure and patterns.

1. Introduction:

Privacy is an intrinsic requirement of every human being in various environments and cultures[1]. However, people differ widely in their understanding, feelings, and practices related to privacy. These differences are manifest in social behavior and in the ways in which inhabitants develop their living environment. The home is the most liberal milieu where people can, individually or collectively, practice their freedom and mold their environment according to their cultural views and religious beliefs without interference or compromise under outside pressure[2]. This is particularly true for members of the Shaamy community, who, as expatriates, live in a culturally foreign environment embodying different social values, perceptions of privacy, and cultural practices. In addition to these general differences, the religious and cultural background of the Shaamy community contains clear and distinct references to privacy in the form of religious principles, social laws, and traditional customs. These sources perpetuate particular privacy perceptions and practices and reinforce their influence on the Shaamy family lifestyle and living environment.

2. Objectives of the study

The study assumes that there are in the homes of the members of the Shaamy community characteristic modes of privacy which are based on the differences between the background of the community and the social content of the Canadian housing environment. Therefore, the study aims to discover how do people from Shaam fulfill their distinct cultural and religious privacy needs within the Montreal housing environment, an environment born as a direct product of Canadian lifestyles and values. It also attempts to identify the diverse privacy patterns implemented in Shaamy homes, to adjust Canadian housing to comply with their privacy needs. At the same time, it tries to find how the designs of Canadian houses influence privacy-related practices of the Shaamy community. Moreover, the study aims to discover the level of responsiveness and satisfaction Canadian homes offer to this community, to probe the relationship between the different patterns of housing on the one hand and the living patterns and efficacy of privacy-induced patterns of change on the other, and, finally, to establish a matrix of privacy requirements in the homes of the community.

3. Methodology

The research method adopted for this study is twofold. The first step involves examining the concept of space from a privacy point of view through a review of privacy traditions which have characterized the dwellings of the Shaamy community over history. This is done in order to find the roots of the contemporary privacy phenomenon in community homes in Montreal. The second step involves analyzing privacy patterns in fourteen case studies in order to assess the impact of privacy concepts on physical environment, space usage and social behavior. The research identifies patterns of change for improving privacy conditions in the community homes, then searches for repetitive patterns of privacy and change in order to establish cause-effect relations among the set of intricate factors which define privacy mechanisms. By building a matrix of privacy modalities in relation to housing forms, the different factors which affect privacy-related practices in Shaamy homes are defined and a typology of change is uncovered.

To document the needed data of each case study, a comprehensive multiple-response information form was developed to be filled out by the researcher. This form employs multiple tools to effectively extract all the required information, observation and evaluation, interviewing and questioning, as well as photographing and drafting.[3] This form is comprised of two sections, architectural and socio-cultural. The first section of the form encompasses extensive physical, behavioral, and usage-related aspects of domestic privacy. It divides homes into functional domains investigating plan arrangement, characteristics of home space, spatial usage, domestic activities, alterations, and furniture arrangement. The second section provides cultural and social information such as age groups, gender, family size, social compatibility with the host society, and many other specifics which contribute to the understanding of domestic privacy.

4. Privacy constituents:

Privacy principles which form the bases of many of the community's social practices are derived from Islamic religious teachings[4]. In addition, cultural roots of privacy extend deep into the history of Shaamy civilizations which continuously reflect rich and rather homogeneous privacy traditions. Acknowledged by religion, privacy traditions -or "*urf*"- represent one dimension of the cultural aspect of privacy in the current practices of the Shaamy community. Another cultural dimension is based on the textual exegesis and the practical implementation of Islamic privacy principles as colored by location, time, and the accumulation of privacy experiences throughout the history of the community. After immigration to Montreal, the community's religious and cultural understanding and practices of privacy interacted with different cultural norms, social perceptions, and design conceptions embodied in the Montreal housing environment. This interaction contributes to the production of idiosyncratic privacy modalities, and mechanisms in the community's homes aim to overcome the gap which exist between the community's privacy ideas and practices and the cultural and physical reality of their home environment.

The study takes into consideration the cultural, religious, and environmental factors which influence the privacy practices of Shaamy people in their domestic environment before and after immigration to Canada. On these bases, the study goes on to determine privacy living patterns resulting from the interaction between the community's socio-cultural and religious background and the privacy content in the design of their Canadian homes. The paper then diagnoses the privacy-induced patterns of change or the mechanisms which the Shaamy community performs to adjust their living environment to their privacy needs.

5. Historical overview:

By exploring the history of the Shaamy home, the role of privacy as a determining factor in developing and preserving inward looking homes in the Shaam from ancient times until the beginning of 20th century, becomes evident. Traditional Shaamy homes were mostly composed of two separate domains which varied in organization, function, and size. The first domain is dedicated to the family in general and to female household and female guests in particular. The other domain is used for entertaining male guests, in particular, and serves as the living area for the family's males, in general. The courtyard of the family domain provides private outdoor space for collective social family interaction, whereas the sub-domains and individual spaces provide the other functional and personal levels of privacy. After colonization and modernization, the inward looking principle of design and internal home layouts, which are conducive to privacy, were replaced with Western-style, outward looking homes which have little consideration for the indigenous Shaamy lifestyle and privacy norms. After more than fifty years of interaction with their new environment, Shaamies developed a repertoire of privacy mechanisms to address some privacy concerns in their environment. However, due to their design limitations, the outward looking homes fail to fully respond to the traditional privacy requirements of the community. Therefore, functional and behavioral modalities evolve with time to bridge the remaining gap between the deficient physical environment in the Shaam and the cultural and religious privacy standards of Shaamy people.

Unlike their traditional introverted homes and their modern dwellings in the Shaam, Montreal home patterns represent a new challenge for the privacy norms of the Shaamy community. This novel environment calls for the development of new privacy mechanisms utilizing the previous experiences in adapting their modern (Western) homes in the Shaam to their privacy standards. As a result, there is a multi-dimensional process of interaction initiated between the socio-religious and cultural background of the community and the physical manifestation of mainstream privacy principles in Montreal homes. This process resulted in developing distinct patterns of privacy mechanisms which partially helped to reclaim the "inadequate" privacy characteristics of the community's homes.

6. Categories of privacy and their physical manifestations:

In the case studies,[5] privacy can be divided into two major categories. The first is indoor privacy, and comprises two subdivisions: one between family and guests, and the other among family members themselves. The second category is outdoor privacy, which includes privacy between family on the one hand, and neighbors and the street on the other.

Indoors, privacy with guests calls for the separation of the guest domain from the family domain, including the shared-use circulation area. The guest domain is understood by the community to include separate male and female guest spaces, a dining room, a guest bedroom, bathroom, and sometimes an office, all for the exclusive use of guests. Since most of these requirements are absent in the community's homes, a multi-faceted process of change takes place to compensate for the discrepancy between what the community needs and what their homes offer. Consequently, in homes where a guestroom is often lacking, the living room is converted into a guestroom[6]. However, when adhering to gender separation, the guestroom is usually occupied only by one gender, relegating the other to using various family spaces, including the basement[7]. Due to these unintended functions in the original design of the transformed spaces, in most cases, function transformation solves some problems and creates many others, leading to manifold complications in the treatment of privacy. These entanglements are also a result of the juxtaposition of these spaces within a home's scheme, its spatial configurations, and the compulsory usage of the family domain for guests.

The family domain not only implies separation between family and guests, but also contains an internal hierarchy of sub-domains or privacy zones that are based on gender, age group and / or function. The living room and kitchen are general family spaces which tend to be used more by female members of the household.[8] The bedroom floor is also part of the private family domain and is used by parents and by female children, rather than male ones. Male youth, who tend to be more independent, often seek privacy in the basement by transforming it into a male living and sleeping domain.[9] However, when children are young and need the care of the parents, all children use the bedroom floor for sleeping, while the basement in this case is usually used as a play and activity space for both male and female children, in addition to other functions.

7. Reasons for privacy problems and home patterns:

Privacy problems in the community's homes can be attributed to various environmental factors. The first is related to the lack of sufficient domestic spaces and the incapacity of the home to accommodate the family's diverse privacy needs. This factor is particularly aggravated as the size of a Shaamy family is often larger than that of the average Montrealer. The second main reason pertains to design deficiencies including a lack of spatial hierarchy, enclosure, and separation between various domains and spaces in the home[10]. As a result of these two environmental shortcomings, intersection between family and guest domains becomes unavoidable in most of the community's homes. Because of this involuntary lack of privacy, permanent and provisional physical, functional, and more often behavioral privacy mechanisms tend to be applied to restore the privacy balance within the different zones of the domestic spaces.

Based on comparing privacy conditions in various homes, it can be concluded that privacy complications usually increase in small homes mainly due to a lack of specialized and flexible spaces, while such complications decrease in larger homes. Cottages, for example, which have in their original design separate living and guestrooms, relatively offer the best possible territorial definition and privacy in home spaces among other homes patterns, provided the enclosure of the guest domain and the circulation area is assured.[11] Homes with a typical small surface area, such as townhouses, usually do not have distinct guestrooms in their original design with the result that the family living area tend to double as an entertainment area for guests.[12] This arrangement affects furniture type and usage pattern and grants an indefinite identity to this heterogeneous space. The mixed functional settings involuntarily decrease the household usage of this space, relegating them to using their individual bedrooms as living spaces, particularly when the basement is used as a second guestroom, an office, or a guest bedroom.

The ability of split-level cottages and bungalows as appears in the case studies to provide privacy is defined by one of the two patterns of level splitting which they might have. When level variation occurs at the entrance and within a staircase, privacy between the home's various spaces is well maintained.[13] However, when the level split occurs at the fringes of the lobby or in another of the home's spaces, it tends to have an open plan where domestic spaces are exposed to each other.[14] In contrast with typical bungalow plans, some split-level bungalows with enclosed layouts have a favorable territorial differentiation between the family bedroom domain, which is located on the upper floor, and family living and guest domains located on the ground floor.[15] However, having only two floors in a bungalow not only reduces the home's surface area, but also decreases the level of separation among various domains, including guest and family ones in particular. The lack of privacy which results from this situation often leads to significant physical and functional transformations in the home's spaces and initiates various kinds of behavioral privacy mechanisms.

8. Privacy solutions and mechanisms:

As can be seen, due to the difference between the privacy practices of the community and the privacy conceptions embodied in the Montreal home environment, these homes often deny Shaamy community members many of their privacy needs. This lack of congruence between the community and its environment has led Shaamy inhabitants to develop privacy mechanisms, bringing domestic privacy up to levels that meet their religio-cultural standards. These patterns of privacy are comprised in two main categories: first, in preferences for home design and site specifications; second, in a set of a codependent patterns of change including physical, functional, and behavioral mechanisms that are applied indoors as well as outdoors.

8.1. Design preferences:

Usually, when buying a home, the community applies its privacy criteria to identifying a set of preferences in their new homes. These preferences aim to ensure specific privacy features imbedded in the site and home design, or exist as a potential possibility for easy and practical change of the home's layouts in the future. Regarding a home's internal layout, the community tends to choose homes with enclosed plans, large areas, and three-level settings.[16] As to preferred design details, it is desirable to have the guest domain on the first floor secluded from the family domain and circulation area, comprised of separate male and female guests spaces and including a dining room, washroom, and ideally a guest bedroom.[17] As for the family domain, it is preferred that it include a living room, a family dining room, an area for male children including bedrooms in the basement, a sleeping domain for the rest of the family, and a female activity space.[18] Preferences for external features include avoiding direct face to face position of home elevations and openings with neighboring homes. Therefore, many homes among the case studies tend to face public gardens or undeveloped lots.[19] Additionally, it is desirable for a home to be located at the end of a cul-de-sac, a situation which allows for a minimum number of neighboring homes and street pedestrians, as well as for deep backyards.[20]

8.2. Privacy patterns of change:

A change representing the second category of privacy mechanisms includes three interrelated privacy mechanisms varying in their frequency, effectiveness, and sequence of application according to the home's pattern as well as space layouts, and the level to which the inhabitants feel settled in their homes to name just a few. These mechanisms include change of the home's physical configurations, space usage patterns, and patterns of domestic behavior among family and with guests. These mechanisms vary in the rate at which they are applied in each case study and function codependently and integrally in order to balance economically and easily the negative aspects of home design and to achieve satisfactory levels of privacy both indoors and outdoors.

8.2.1. Physical privacy mechanisms:

Physical privacy mechanisms vary in nature and scale, ranging from adding temporary light screens to adding an entire floor. Examples of small-scale physical changes include adding permanent doors to separate a guestroom from the lobby, the basement from the rest of the home, or the kitchen from the circulation area, living room, and dining room.[21] Large scale physical mechanisms include demolishing walls to enlarge rooms, adding walls to divide spaces, extending spaces outside the home's peripheries, and altering space configurations.[22] Physical privacy mechanisms of the home's exterior are usually minor due to the inability of the community to achieve an acceptable level of privacy in outdoor spaces. The incapacity to apply significant changes is due to the outward-looking principle of design, suburban bylaws, and mainstream social norms which are incongruent with and restrictive of privacy applications. Therefore, physical changes are minor, concentrating on setting up visual barriers such as erecting bowers adjacent to a home's rear facades, planting trees and lush plants close to the fence, or raising the fence to the legal height.[23]

8.2.2. Change of usage:

Change of usage is a frequently applied mechanism, being a flexible, economic, and practical solution to many domestic privacy problems. Functional mechanisms take various static (permanent) and dynamic (temporary) forms, including the change of the function of a space,[24] appropriating an abandoned space,[25] combining several functions in one space,[26] and changing the usage pattern of a space.[27] One of the most common changes of use in the community's homes is transforming the living room into a guestroom.[28] Another example represents transforming the original function of the basement (bar, storage, etc.) to serve as a second guestroom, an office for non-family guests, a guest bedroom, a living and sleeping area for male children, a living room, or more than one of these functions simultaneously.[29] Sometimes, one of the family bedrooms is transformed into a guest bedroom, a study, or a living room. In some case studies, appropriating spaces involves successfully converting unused spaces -such as basements and storage- into reception rooms, offices, or spaces having many other functions.[30] Another functional mechanism includes combining several disharmonious functions in one space. The need for this mechanism is mostly due to the small size of typical Montreal homes compared to the large size of Shaamy families, the diverse and specialized spatial functions inherent to community tradition and the need sometimes for gender separation. Common examples of combining functions include joining family living and guest entertaining functions in one area,[31] and sharing the family and guest sleeping functions of the same space.[32] Finally, the change of usage patterns includes increasing, decreasing, temporary, and situational restriction on the use of some spaces.[33] This phenomenon tends to be a by-product of the combining function mechanism.

8.2.3. Behavioral mechanisms:

Privacy-based change of behavior represents a complementary mechanism that supplements the shortcomings of physical and functional privacy techniques. It functions as the last resort in acquiring privacy when other measures fail, become ineffective, or are inapplicable. Behavioral mechanisms involve various modalities including refrainment, restriction, and regulating the time of space usage. It also includes the regulation of social communication through the various types of verbal, paraverbal, and physical behaviors[34].

8.3. The interplay of various privacy mechanisms:

Usually, there is a certain sequence for implementing various privacy mechanisms mainly determined by the extent to which a home responds to the community's privacy norms. Initially, after buying a home, the inhabitants primarily apply behavioral, then functional, privacy mechanisms to fulfill their urgent privacy needs. With the progression of time, increased settlement, and growth of the family, environmental mechanisms become more viable and tend to be increasingly implemented. Therefore, one of the main deterrents for applying fundamental privacy solutions is lack of stability. Accordingly, factors such as family size, religious observance, and settlement are not always binding for implementing environmental changes, even though such factors are extremely influential.

9. Results:

Based on the survey conducted and analysis of the case studies conclusions were reached regarding home characteristics that are most responsive to privacy traditions of Shammy community and their lifestyle. Other findings were reached in respect to the interplay between the various privacy mechanisms in relation to the pattern of housing in which they are implemented.

9.1. Criteria for home responsiveness to privacy needs:

A general examination of the characteristics of the case studies, privacy problems, and types of privacy mechanisms in application reveals that a home's responsiveness depends upon definite criteria which are comprised of three elements; enclosure, size, and hierarchy of the home's spaces. Based on these criteria, homes of different patterns and designs embody varing capacities to address the community's privacy needs. Accordingly, an analysis of home patterns reveals that, relatively, the cottage is the most responsive home pattern among the case studies. Split-level bungalows, townhouses, simple-plan bungalows, and finally open plan split-level cottages -in that sequence- reflect decreasing tendencies to provide adequate privacy for the Shaamy community.

9.2. The relationships between home and privacy patterns:

Analysis of the case studies also indicates that some privacy mechanisms have a tendency to be associated with certain home patterns. For example, high rates of physical changes are more likely to happen in cottages and enclosed-plan split-levels homes,[35] whereas high rates of usage and behavioral privacy mechanisms occur increasingly in townhouses and open-plan, split-level homes. These trends are based on several factors, including the previously identified design criteria, inhabitants' adherence to privacy rules, inhabitants' preferences for home patterns, and the feasibility of applying a particular privacy mechanism in each home pattern. Further factors accounting for the kind of privacy mechanisms at work are family size, financial ability of the household, and degree of settlement a family has in its environment.

These factors suggest trends and hierarchies for implementing different privacy mechanisms in various home patterns. These hierarchies can be explained in light of the fact that the relationships among various privacy mechanisms are inversely proportionate. Accordingly, with the increase in the rate of applying physical changes, functional and behavioral mechanisms tend to decrease and vise versa. Conditioned to accept certain kinds of mechanisms, the pattern of each home then follows a certain hierarchy for applying different kinds of privacy mechanisms. As a result, homes with greater potential for physical change - such as cottages- contain high rates of physical mechanisms and fewer functional and behavioral ones, while homes with a slim potential for accommodating physical changes -such as open-plan split-level homes and townhouses- have relatively high rates of functional and behavioral mechanisms.

10. Conclusion:

This paper has offered matrices of Shaamy community members' preferences for home patterns and designs, as well as for various privacy mechanisms which they implement in their homes. These matrices help establish an understanding of privacy as a major cultural factor that distinguishes the Shaamy community lifestyle and domestic environment. Finally, the paper reports criteria for homes that are responsive to the culturally-specific needs of the Muslim Shaamy community in Montreal.

Footnotes:

[1] Rapoport, Amos. House Form and Culture. Englewood Cliffs, NJ.: Prentice, 1969, .14.

[2] Westin, Alan. F. Privacy and Freedom. New York: Atheneum, 1967, 29.

[3] Observation and evaluation were important tools for documenting visible aspects of privacy patterns. This process included touring all internal and external parts of the home. Moreover, numerous photographs were taken to help document home features, and for analyzing and interpreting the visual data at later stages. Plans were drawn to record house layouts, in addition to the position of furniture pieces and patterns of spatial usage. Furthermore, interviewing inhabitants provided an understanding of the non-material aspects of privacy, such as behavior and usage. The researcher's visits used to last mostly four continuous hours, during which the researcher was able to witness different faces of interaction among the occupants and with the researcher himself. These diverse methods helped in the collection of extensive data and assisted in encompassing a wide range of privacy patterns and unveiling the real motives for change.

[4] According to Islamic teachings, privacy is a part of the Islamic socio-moral system regulated by Islamic law, defining the material, environmental, and behavioral practices among Muslim community. A code of privacy is built in support of the main objectives of the Islamic socio-moral system, which aims to protect the personal creed, honor, life, and property of the members of society. Consequently, physical, visual, acoustic, and behavioral privacy boundaries are drawn in order to safeguard these four comprehensive aspects. Privacy principles, as part of the basic Islamic individual and social laws and moral system, are not subject to modification through the evolution of society or change of environment, since they relate to the unchangeable and innate part of humans. However, applications and manifestations of privacy vary based on the input of the environment and cultures. The explicit articulation of the notion of privacy through law results in a unity of social practices, architecture, and civic life. At the same time, flexibility in accommodating cultural and environmental variables allows for creativity and diversity in privacy practices.

[5] Symbols used for plans and figures of the various types of case studies:
A = Single family detached home
B = Bungalow
C = Split level detached home
D = Townhouse
P =Plan
I = Image
e.g.: A1-P1 (First floor plan of case study A1)
C2-I3 (Image number 3 of case study C2)

[6] See B1-P1, C2-P1, and D1-P1 as examples where living rooms on the first floor were transformed into guestrooms.
[7] This can be noticed in case study B1, where the living room in the basement is used occasionally for guests. See B1-P1, B1-P2. In case study D1, the living room on the first floor was transformed into a guestroom to accommodate, along with the guest suite in the basement, guests of both genders. See D1-P1, D1-P3.
[8] This situation was observed in several case studies such as A1, A2, C1.
[9] Examples of this situation can be found in case studies A1 and B1. See A1-P2 and B1-P2.
[10] The open layouts of the home as in case studies C2 and D1 embody all these characteristics. See C2-P1, D1-P1.
[11] The provision of a living room, though used temporarily as an informal guestroom, in case studies A1 and A2, for instance, secures a high level of privacy for both the household and the guests. See A1-P1, A2-P1.
[12] The lack of a guestroom in case study D1 necessitates that the living room assume this function as well. See D1-P1, D1-I2.
[13] This layout secures the separation of the circulation area from home's more private spaces. See C1-P1.
[14] This is evident in case study C2, where the guest room, dining area and bedroom floor are exposed to each other. See C2-P1.
[15] As plan C1-P1 shows, there is a clear separation between the guest domain on the first floor and the family domain on the second floor, attained through the location of the circulation area on one side of the house.
[16] See A1-P1, which represents a well enclosed plan for a cottage. C3-P1 shows a split level bungalow which the owner was encouraged to buy because it has the potential of being easily transformed into a three level cottage with clear privacy zones. Accordingly, after a short period of occupancy, an additional floor was built to enhance the privacy conditions of the house.
[17] As shown in A1-P1 and A2-P1, both houses include a guestroom and a living room that can be used temporarily by guests. In case study D1, a guest sleeping room, a guest living area, and a separate washroom were supplied in the basement, as shown in plan D1-P3.. In case study C3, a guest sleeping room was provided on the first floor after expanding the house.
[18] The requirements of this domain are provided in case study A1. See A1-P1 and A1-P2.
[19] As A1-I2 shows, the house faces an open space, while C1-I1 shows how the home is located at the corner of the street, so that there is no building facing the home's front.
[20] Plan D1-P1 shows an example of good privacy conditions of the home with the street, due to the location of the home at the end of a cul-de-sac. Figure C1-I2 shows the home's deep backyard that is a result of the home's location at the corner of a block. Such location ensures maximum distance between the case study's facades and neighbors' homes, granting more privacy on the interiors of the home.
[21] An example of this change is adding a door between the guestroom and the lobby area, as can be seen in images A1-I3 and D1-II, 2. Image A2-I3 points out a door that was added between the living room and the lobby.
[22] Plan A2-P1 and image A2-I4 show a solarium that was added to the living room which required demolishing part of the living room wall. One of the major purposes of this extension was to provide semi-separated spaces to accommodate informal guests of both genders. Plan C3-P1 shows an entire floor that was added to cater to the need for reception, dining, and sleeping spaces for guests.
[23] In accordance with this, images A1-I1 and A2-I1 show small trees that were planted in front of the living room and guestroom windows of two of the case studies as a visual barrier that can secure some privacy for home interiors vis-a-vis the street. Image C1-I2 shows bowers that were planted in front of the openings of the living room in the backyard to provide visual privacy from neighboring homes. Plan C2-P1 and image C2-I2 show a wall of hedges and trees that used as a visual barrier around the backyard.
[24] An example of this is using the living room as a guestroom, as in case studies A2 and D1. See A2-P1 and D1-P1.
[25] For example, in case study C1, an abandoned storage space was transformed into a guestroom. See C1-P1.
[26] As in the case studies A2, B1, and C2, where the same space is used as a living room and a guestroom. This mixed use disturbs the household's feeling of privacy, particularly when guests are being entertained.
[27] An example of this kind of change of usage exists in case study D1, where the need for preserving the household's privacy with a guest present has permanently changed the household's patterns of using the living/guestroom.
[28] As in case study D1, in which the living room is used mostly as a guestroom.
[29] As in case studies B1, C3, D1, A1, B1 in sequence
[30] This kind of transformation occurred in case study D1, where the basement was transformed into a guest living and sleeping area.
[31] An example of this privacy mechanism is the use of the guestroom as a living room as well in case study B1.

[32] Case studies A1 and C1 are examples of this type of usage where family bedrooms are used temporarily as guest bedrooms when needed.

[33] This applies to most shared-use spaces such as living/guestrooms. These spaces are used by both guests and family members as in case studies B1, C2, and D1.

[34] This is a very prevalent mechanism due to the inadaptability of some of the home layouts to the needs of the inhabitants. Case study C2 gives a good example of this mechanism where the household restrict their use of many of the home's spaces upon entertaining guests because of the home's open plan and the consequent lack of privacy between them and the guests.

[35] An example of this is case study A2, where the living/guestroom was expanded, while in case study C3 an entire floor was added to provide separate family and guest domains.

Works Consulted:

Abraham, Sameer Y. and Nabeel Abraham. Arabs in the New World: studies on Arab-American Communities. Detroit, Mich.: Wayne State University, Center for Urban Studies, 1983.

Abu-Laban, Baha. An Olive Branch on the Family Tree: The Arabs in Canada. Toronto: McClelland and Stewart, 1980.

Ait Sabbah, Fatna. Woman in the Muslim Unconscious. NY: Pergamon Press, 1984.

Al-Hathloul, Saleh A. "Tradition, Continuity and Change in the Physical Environment: the Arab-Muslim City." Diss. Massachusetts Institute of Technology, 1981.

Al-Qaradawy, Yusuf. The Status of Women In Islam. Cairo: Islamic Home, 1997.

Al-Zuhayly, Wahbh. Al-Fiqh Al-Eslami Wa'Adillatuh. Vol.1. Dimashq: Dar Al-Fikr, 1989.

Alexander, Christopher. Houses Generated by Patterns. Berkeley, CA.: Center for Environmental Structure, 1969.

Altman, Irwin and Carol M. Werner, eds. Home Environments. New York: Plenum Press, 1985.

Altman, Irwin and Martin M. Chemers. Culture and Environment. Belmont, CA.: Wadsworth, 1980.

Altman, Irwin, and W. W. Haythorn. "The Ecology of Isolated Groups." Behavioral Science 12 (1967): 169-182.

Altman, Irwin. "Privacy Regulation: Culturally Universal or Culturally Specific?" Journal of Social Issues, 33 (1977): 66-84.

Altman, Irwin. "Some Perspectives on the Study of Man-Environment Phenomena." Representative Research in Social Psychology 4.1 (1973): 109-126.

Altman, Irwin. The Environment and Social Behavior. Monterey, CA.: Brooks/Coles, 1975.

Alwaz, Helal. "Decoding the building code in Damascus: a search for culturally reflected built environment." M.A. Thesis. McGill University, 1995

Archea, J. "The Place of Architectural Factors in Behavioural Theories of Privacy." Journal of Social Issues 33.3 (1977): 116-137.

Ardener, Shirley, ed. Women and Space: Ground Rules and Social Maps. London: Croom Helm, 1981.

Ardery, R. The Territorial Imperative. New York: Atheneum, 1966.

Argyle, M. and R. Ingham. "Gaze, Mutual Gaze and Proximity." Semiotica 6.1 (1972): 32-50.

Aswad, Barbara C. and Barbara Bilge., eds. Family and Gender Among American Muslims: Issues Facing Middle Eastern Immigrants and their Descendants. Philadelphia: Temple University Press, 1996.

Barazi, Muhammad Fuad. Hijab al-Muslimah: bayna intihal al-mubtilin wa-tawil al-jahilin. al-Tabah 1. al-Riyad : Maktabat Adwa al-Salaf, 1995.

Barbara Daly Metcalf, ed. Making Muslim Space in North America and Europe. Berkeley, CA: University of California Press, 1996.

Bates, A. P. "Privacy - A Useful Concept?" Social Forces 42 (1964): 429-434.

Baum, Andrew and Stuart Valins. Architecture and Social Behavior: Psychological studies of Social Density. Hillsdale, N.J.: L. Erlbaum Associates, 1977.

Beardsley, E. L. "Privacy: Autonomy and Selective Disclosure." Privacy. Eds. J. R. Pennock and J. W. Chapman. New York: Atherton Press, 1971, 56-70.

Becker, F. D. and C. Mayo. "Delineating Personal Distance and Territoriality." Environment & Behavior. No. 3. (1971): 375-381.

Becker, F. D. "Study of Spatial Markers." Journal of Personality and Social Psychology 26.3 (1973): 439-445.

Berscheid, E. "Privacy: A Hidden Variable in Experimental Social Psychology." Journal of Social Issues 33.3 (1977): 85-101.

Bindal, M. "Privacy Requirement and its Effects on Housing Design." International Journal for Housing Science and its Applications. 6 (1982): 301-312.
Bloustein, E. J. "Privacy as an Aspect of Human Dignity: An Answer to Dean Prosser. "Philosophical Dimensions of Privacy. Ed. Ferdinand David Schoeman. New York: Cambridge UP, 1984.
Bossard, J. H. S., and E. S. Boll. Ritual in Family Living. Philadelphia: University of Pennsylvania Press, 1950.
Brener, John, Environmental Psychology in Building Design. London: Applied, 1982.
Brower, S., Dockett, K. and R. B. Taylor. "Residents' Perception of Territorial Features and Perceived Local Threat." Environment and Behavior 15.4 (July 1983): 419-437.
Buttimer, Anne, "Social Space in Interdisciplinary Perspective." Geographical Review 59 (July 1969): 417-426
Byrom, Connie. "Privacy and Courtyard Housing." The Architects' Journal 151.2 (14 Jan. 1970): 101-106.
Canter, David, The Psychology of Place, London: The Architectural Press Ltd., 1977.
Chermayeff, Serge and Christopher Alexander. Community and Privacy. New York: Doubleday, 1963.
Cheyne, J. A. and M. G. Efran. "The Effect of Spatial and Interpersonal Variables on the Innovation of Group Control Territories." Sociometry 35.3 (1972): 477-489.
Churchman, Arza and Gilbert Herbert. "Privacy Aspects in the Dwelling: Design Considerations." Journal of Architectural Research 6.3 (July 1978): 19-27
Cooper, C. Easter Hill Village: Some Social Implications of Design. New York: Free Press, 1975.
Cooper, C. "The House as a Symbol of the Self." Designing for Human Behavior. Eds. J. Lang et al. Stroudsberg, PA: Dowden, 1979.
Cooper-Marcus, Clareand Wendy Sarkissan. Housing As if People Mattered. Berkeley, CA: University of California Press, 1986.
Daghmi, Muhammad Rakan. Himayat al-hayah al-khassah fi al-shariah al-Islamiyah. al-Tabah 1. al-Qahirah: Dar al-Salam, 1985.
Daunton, Martin J. "The Social Meaning of Space: The City in the West and Islam." Urbanism in Islam: the proc. of the International Conference on Urbanism in Islam (I
CUIT), Tokyo: The Middle Eastern Culture Center, 1989, 26-58.
DeLong, A. J. "Territorial Stability and Hierarchical Formation." Small Group Behavior. 4.1 (1973): 56-63.
Derlaga, V. J. and A. L. Chaiken. "Privacy and Self-Disclosure in Social Relationships." Journal of Social Issues 33.3 (1977): 102-115.
Edney, J. J. and M. A. Buda. "Distinguishing Territoriality and Privacy." Human Ecology 4.4 (1976): 283-296
Edney, J. J. "Human Territories: Comment on Functional Properties." Environment & Behavior 8 (1976): 31-47.
Edney, J. J., "Human Territoriality." Psychological Bulletin 81.12 (1974): 959-975.
Ellis, S. "Privacy in Byzantine and Ottoman Houses." Byzantinische Forschungen 16 (1991): 151-158.
Eoyang, C. K. "Effects of Group Size and Privacy in Residential Crowding." Journal of Personality and Social Psychology 30.3 (1974): 389-392.
Ernst J. Grube. et al. Architecture of the Islamic World: Its History and Social Meaning. Ed. George Michell. New York: Morrow, 1978.
Esser, A. H. "Theoretical and Empirical Issues with Regard To Privacy, Territoriality, Personal Space and Crowding." Environment and Behaviour 8.1 (Mar. 1976): 117-124.
Esser, Aristide H. "Designed Communality: A Synergic Context for Community and Privacy." Design for Communality and Privacy. Eds. A.H. Esser and B. B. Greenbie. New York: Plenum Press, 1978.
Esser, Aristide H. "Theoretical and Empirical Issues with Regard to Privacy, Territoriality, Personal Space and Crowding." Environment and Behavior 8.1 (March 1976): 117-124.
Finighan, W. R. "Privacy, People and Property." Architectural Science Review 22.1 (March 1979): 2-6.
Florence, L. S. Our Private Lives. Toronto: George G. Harrap, 1944.
Fried, Charles. "Privacy." Yale Law Journal 77 (1968): 475.
Friedhelm, Ernst. Arab Americans in Nordamerika: zur Geschichte und zu gegenwartigen Strukturen und Problemen arabischer Einwanderungs-communities. Berlin: Das Arabische Buch, 1986.
Fukushima, Masaharu. "An Analysis of the Transition between Community and Privacy In Urban Housing." M.A. Thesis, McGill University, 1975.
Goffman, Erving. Behavior in Public Places. New York: Free Press, 1963.
Gottlieb, Lois. D. Environment and Design in Housing. New York: Macmillan, 1965.
Greenbie. B. B. "Social Privacy in the Community of Diversity." Design for Communality and Privacy. Eds. A.H. Esser and B.B. Greenbie. New York: Plenum Press, 1978.
Guardo, C. J. "Personal Space in Children." Child Development 40 (1969): 143-151.

Haddad, Yvonne Yazbeck and Adair T. Lummis. Islamic Values in the United States: A Comparative Study. New York: Oxford University Press, 1987.
Haddad, Yvonne Yazbeck and Jane Idleman Smith, eds. Muslim Communities in North America. Albany, N.Y.: State University of New York Press, 1994.
Haddad, Yvonne Yazbeck, ed. The Muslims of America. New York: Oxford University Press, 1991.
Haddad, Yvonne Yazbeck. A Century of Islam in America. Washington, D.C.: Islamic Affairs Programs, The Middle East Institute, 1986.
Hagopian, Elaine Catherine and Ann Paden, eds. The Arab Americans; Studies in Assimilation. Wilmette Medina University Press International 1969.
Hakim, Besim S. Arabic-Islamic Cities: Building and Planning Principles. New York: Sydney and Henley, 1986.
Hall, Edward T. "The Anthropology of Space: An Organising Model." Environmental Psychology: Man and His Physical setting. Eds. H.M. Proshansky, W.H. Ittelson and L.G Rivlin. London: Holt, 1970.
Hall, Edward T. The Hidden Dimension. New York: Doubleday, 1966.
Hall, Edward T., The Silent Language, Anchor Press/Doubleday: New York, 1973.
Hill, A. R. "Visibility and Privacy." Architectural Psychology, Ed. D.V Canter. London: RIBA Publications, 1970.
Hillier, B. and J. Hanson. The Social Logic of Space. New York: Cambridge UP, 1984.
Hitti, Philip Khuri. History of Syria including Lebanon and Palestine. New York: Macmillan, 1951.
Hitti, Philip Khuri. History of the Arabs From the Earliest Times to the Present . 10th Ed. New York: St Martin's Press, 1970.
Hitti, Philip Khuri. Islam and the West, a Historical Cultural Survey. Princeton: N.J. Van Nostrand, 1962.
Hitti, Philip Khuri. Islam, a Way of Life. Minneapolis: University of Minnesota Press, 1970.
Hogben, Murray. "The Socio-Religious Behavior of Muslims in Canada: An Overview" The Muslim Community in North America. Eds. Earle H. Waugh, Baha Abu-Laban, and Regula Qureshi. Edmonton: The University of Alberta Press, 1983.
Husaini, Zohra. Muslims in the Canadian Mosaic: Socio-Cultural and Economic links with their Countries of Origin. Edmonton: Muslim Research Foundation, 1990.
Hutt, Antony. Arab Architecture, Past and Present. Durham, England: Centre for Middle Eastern & Islamic Studies, University of Durham, 1983.
Joiner, Duncan. "Social Ritual and Architectural Space." Architectural Research and Teaching 1.3 (April 1971): 11-20.
Kalay, Y. and E. Shaviv. "A Method for Evaluating Activities Layout in Dwelling Units." Building and Environment. 14 (1979): 227-234.
Kelman, H. C. "Privacy and Research with Human Beings." Journal of Social Issues 33.3 (1977): 169-195.
Kelvin, Peter. "A Social-Psychological Examination of Privacy." British Journal of Social and Cinical Psychology. 12 (1973): 248-261.
Kinney, J. M. , M. A. P. Stephens, and A. M. Brockmann. "Personal and Environmental Correlates of Territoriality and Use of Space." Environment and Behavior 19.6 (Nov. 1987): 722-737.
Klopfer, P. H. and D. I. Rubenstein. "The Concept of Privacy and Its Biological Bases." Journal of Social Issues 33.3 (1977): 52-65.
Knowles, E. S. "Boundaries around Social Space: Dyadic Responses to an Invader." Environment and Behavior 4.4 (Dec. 1972): 437-445.
Kuroda, Toshio. "On the nature of community in the Arab-Muslim world." Nature of the Islamic Community. Eds. Kuroda, Toshio and Richard I. Lawless. Tokyo: Keiso Shobo, 1991.
Kutub, Muhammad. Al-tatawur Wa Al-Thabat fi Hayat Al-bashariah. al-tabah 8. Beirut: Dar Al-Shuruq, 1991.
Lang, Jon. Creating Architectural Theory: The Role of the Behavioural Sciences in Environmental Design. New York: Reinhold, 1987.
Laufer, R. S. and F. Wolfe. "Privacy as a Concept and a Social Issue: A Multidemensional Development Theory." Journal of Social Issues 33.3 (1977): 22-50.
Laufer, R. S., H. M. Proshansky, and M. Wolfe. "Some Analytic Dimensions of Privacy." Architectural Psychology, Proceedings of the Lund Conference. Ed. R. Kullter. Stroudsburg, PA.: Dowden, 1973.
Lawrance, R. "Transition Spaces and Dwelling Design." Journal of Architecture and Planning Research 1.4 (1984): 261-271
Lawton, M.P. and J. Bader. "Wish for Privacy by Young and Old." Journal of Gerontology 25.1 (1970): 48-54.
Levy, Reuben. The Social Structure of Islam. 2d Ed. Cambridge: University Press, 1962.
Little, V. R. and M. Kane. "Person-Thing Orientation and Privacy." Man Environment Systems 4.6 (Nov. 1974): 361-364.

Longrig, S. H. The Middle East: A Social Geography. 2nd ed. London: Gerald Duckworth, 1970.

Lyman, S. M. and M. B. Scott. "Territoriality: A Neglected Sociological Dimension." Social Problems 15 (1967): 235-249.

MacCormic. M. J. "Privacy: A New American Dilemma." Social Casework (Apr. 1978): 211-220.

Madge, Charles. "Private and Public Spaces." Human Relations 3 (1950): 187-199.

Madge, John. "Privacy and Social Interaction." Transactions of Bartlett Society. Vol. 3, London: Bartlett School of Architecture, University College London, 1964-1965, 122-141.

Marcus. Abraham. "Privacy in Eighteenth-Century Aleppo: the Limits of Cultural Ideals." International journal of Middle East studies 18 (1986): 165-183.

Margulis, S. T., ed. "Privacy as a Behavioural Phenomenon: Introduction." Journal of Social Issues 33.3 (1977): 1-4.

Margulis. S. T. "Conceptions of Privacy: Current Status and Next Steps." Journal of Social Issues 33.3 (1977): 5-21.

Marshall, N. J. "Privacy and environment." Human Ecology 1.2 (1972): 93-110.

Marty, Martin E. and R. Scott Appleby, eds. Fundamentalisms and Society: Reclaiming the Sciences, the Family, and Education. Chicago: University of Chicago Press, 1993.

Maslow, Abraham. Motivation and Personality. 2nd. ed. New York: Harper Row 1954, 1970

Mawdudi, Syed Abdul A'Ala. Islamic Way of Life. Riyadh, Saudi Arabia: Co-operative Office for Call and Guidance Communities Dept., 1990.

McBride, Glenorchy. "Privacy: A Relationship Model." Man-Environment Systems 7.3 (May 1977): 145-154.

Meisels, M. and C. J. Guardo. "Development of Personal Space Schematas." Child Development 40: 1167-1178.

Moore, Barrington, Jr. Privacy: Studies in Social and Cultural History. New York: Armondk, M. E. Sharpe, 1984.

Moore, Barrington. Privacy: Studies in Social and Cultural History. New York: Pantheon Books, 1984.

Murphy, Robert F. "Social Distance and the Veil." Philosophical Dimensions of Privacy. Ed. Ferdinand David Schoeman. New York: Cambridge UP, 1984.

Naff, Alixa. Becoming American: the Early Arab Immigrant Experience. Carbondale: Southern Illinois UP, c1985.

Olsen, Donald. J. "Victorian London: Specialization, Segregation, and Privacy." Victorian Studies 17.3 (Spring 1974): 256-278.

Pardailhe-Galabrun, Annik. The Birth of Intimacy: Privacy and Domestic Life in Early Modern Paris. Philadelphia: University of Pennsylvania Press, 1991.

Parke, R. D. "Children's Privacy in the Home: Developmental, Ecological and Child-Rearing Determinants." Environment and Behaviour 11.1 (Mar. 1979): 87-104.

Pastalan, Leon. A. "Privacy as an Expression of Human Territoriality. "Spatial Behavior of Older People. Ed.Leon A. Pastalan and Daniel H. Carson. Michigan: Institute of Gerontology, University of Michigan-Wayne State University, 1970, 88-101.

Posner, A. R. "An Economic Theory of Privacy." Philosophical Dimensions of Privacy. Ed. Ferdinand David Schoeman. New York: Cambridge UP, 1984.

Proshansky, H. M. et al., eds. Environmental Psychology: Man and His Physical Setting. New York: Holt, 1970.

Rahbar, Mehrdad. "Privacy in Row Houses of Montreal." M. A.Thesis. Montreal: McGill University, 1996.

Rapoport, A. Human Aspects of Urban Form: Towards a Man-Environment Approach to Urban Form and Design. New York: Pergamon Press, 1977.

Rapoport, Amos. House Form and Culture. Englewood Cliffs, NJ.: Prentice, 1969.

Rapoport, Amos. "Human and Psychological Reactions." Architectural Science Review. 1.4 (Dec. 1971): 95-97.

Rapoport, Amos. "Sacred Places, Sacred Occasions, and Sacred Environments." Architectural Design 52.1/10 (1982): 75-82.

Rapoport, Amose. "Thinking of Home Environment." Home Environment. Ed. Irwin. Altman, New York: Plenum Press, 1985

Reiman, H. J. "Intimacy and Personhood." Philosophical Dimensions of Privacy. Ed. Ferdinand David Schoeman. New York: Cambridge UP. 1984.

Robertson, A. H. Privacy and Human Rights. Manchester:University Press, 1973.

Ruebhausen, O. M. and O. G. Brim Jr. "Privacy and Behavioral Research." American Psychologist 21 (1966): 423-437.

Sawaie, Mohammed. Arabic-speaking Immigrants in the United States and Canada: A Bibliographical Guide with Annotation. Lexington, KY.: Mazda Publishers, 1985.

Schoenauer, Norbert, 6000 Years of Housing: The Oriental Urban House. Vol. 2. London: Garland STPM Press, 1981.

Schwartz, Barry. "The Social Psychology of Privacy." American Journal of Sociology 73 (1968): 541-542.
Simmel, A. "Privacy is not an Isolated Freedom." Privacy. Eds. J. R. Pennock and J. W. Chapman. New York: Atherton, 1971, 71-88
Smith, R. H. et al. "Privacy and Interaction Within the Family as Related to Dwelling space." Journal of Marriage and the Family (Aug. 1969): 559-566.
Smith. D. E. "Privacy and Corrections: A reexamination. American." Journal of Community Psychology 10.2 (1982): 207-224.
Sommer, Robert. "Small Group Ecology." Psychological Bulletin 67.2 (1967): 145-152.
Sundstorm, Eric. "Field Study of Territorial Behavior and Dominance." Journal of Personality and Social Psychology 30.1, 1974: 115-124.
Translations of the Qur'an. Trans. Ali, Yusuf. 18 Feb 1999 <http://www.usc.edu/dept/ MSA/ quran/>
Vaziritavar, Shahram. "Design and Privacy in Modern and Traditional Housing in Iran." Diss. Oxford University, 1990.
Waddy, Charis. The Muslim Mind. 2nd ed. London: Longman Group, 1982
Warren, C and B. Laslett. Privacy and Secrecy: A Conceptual Comparison. Journal of Social Issues 33.3 (1977): 43-51.
Watson, O. M. Proxemic Behavior: A Cross-Cultural Study. Paris: Mouton the Hague, 1970.
Waugh, Earle H., Baha Abu-Laban, and Regula B. Qureshi. The Muslim Community in North America. Edmonton: University of Alberta Press, 1983.
Webster's Encyclopedic Dictionary of the English Language. Canadian Ed. New York: Lexicon Publications, 1988.
Westin, Alan. F. Privacy and Freedom. New York: Atheneum, 1967.
Willis, Margaret. "Designing for Privacy: Personal Relationships." The Architects' Journal 137.24 (12 June 1963): 1231-1236.
Willis, Margaret. "Designing for Privacy: What is Privacy?" The Architects' Journal 137.22 (29 May 1963): 1137-1141.
Willis, Margaret. "Planning for Privacy." The Architects' Journal 137.23 (5 June 1963): 1181-1187.
Willis, Margaret. "What is Privacy?" The Architects' Journal 137.22 (29 May 1963): 1137-1151.
Wilson, S. and G. Scott. "Architecture and an Ecology of Man." Architectural Science Review 15.4 (Dec. 1972): 69-76.
Wolfe, M. and R. Laufer. "The concept of privacy in childhood and adolescence." EDRA: Privacy. Ed. S.T. Margulis. 5: Part 6 (1974): 29-54.

Wood Frame Multi-Family Housing in Boston, 1865-1900

Peter H. WIEDERSPAHN
Northeastern University
wiederspahn@attbi.com

Abstract:
This research will broaden the historical knowledge of Boston's built environment by focusing on wood frame multi-family housing and its impact on Boston's urban evolution. Although Boston's historic core is primarily built of masonry construction, wood frame multi-family housing constitutes a vast majority of residential buildings in Boston's peripheral neighborhoods built between the Civil War and the end of the nineteenth century. First, this research will identify and explicate the significance of wood frame multi-family housing to Boston's social and urban patterns. Second, this research will document and analyze in drawings the architecture of wood frame multi-family housing in categories of three configuration types: row houses, three-family houses known as "triple-deckers," and two-family houses. Third, this research will document in three-dimensional models the construction of wood frame multi-family housing in detail.

The growth of industry in Boston and the influx of immigrants from Europe and rural America in the late nineteenth century forced the boundaries of urban development outward from the historic core to accommodate an expanding metropolis. The burgeoning streetcar system could transport the new city inhabitants out of the downtown core to Boston's peripheral neighborhoods. These neighborhoods, called "streetcar suburbs" by Sam B. Warner, Jr., in his 1962 book of the same title, were the first ring of Boston's outward development. New communities were rapidly constructed along the major transportation routes delineated by the radiating streetcar lines in a tightly-spaced pattern of free-standing wood frame houses. These neighborhoods became the place for the working class to escape the congestion, disease, and crime of the urban core. In 1920, Robert Woods and Albert Kennedy identified the expanding suburban ring as "the zone of emergence" in their book of the same title. Not only was this zone a place for the immigrant population to improve its living conditions, but also it was a place for this group to improve their economic and social standing by becoming property owners.

The predominance of wood frame multi-family housing in the emerging suburbs is due to its relative low cost and its ease of construction. Although wood frame construction was labeled "balloon framing" due to its thin, membrane-like enclosure and lightweight structure, this new building technology revolutionized the construction of domestic architecture in Boston and across America. Mass-produced, standardized wood members could be assembled with a modicum of typical framing details and a minimum amount of skill making the knowledge of building accessible to all. To further simplify the production of this domestic architecture, a limited number of house-plan types were repeated consistently throughout Boston's new suburbs. Wood frame construction democratized the building of domestic architecture by making its processes available to the commoner. This new building technology, combined with the streetcar, was the perfect engine for the rapid development of Boston's zone of emergence.

My research explicates the interrelationship between urban expansion, transportation, land-use patterns, and the construction of wood frame multi-family houses in Boston.

Wood Frame Multi-Family Housing in Boston, 1865-1900

My research focuses on wood frame multi-family housing and its impact on Boston's urban evolution. Housing as a topic of inquiry is inherently comprehensive in scope: it necessarily incorporates issues from the urban scale of the city and urban planning to the architectural scale of the building and construction detail. Although Boston's historic core is primarily built of masonry construction, wood frame multi-family housing constitutes a vast majority of residential buildings in Boston's peripheral neighborhoods built between the Civil War and the end of the nineteenth century. Wood frame housing is often discussed in a multitude of publications on the city's urban development and morphology, such as Walter Muir Whitehill's seminal book, *Boston: A Topographical History*,[1] and more recently, Lawrence W Kennedy's, *Planning the City upon a Hill: Boston since 1630*.[2] Similarly, there have been several books that focus on the great architectural heritage of Boston such as Douglass Shand-Tucci's, *Built in Boston: City and Suburb, 1800-2000*.[3] Most pertinent to the study of Boston's wood fame housing, however, is Sam Bass Warner Jr.'s study of nineteenth century suburban development, *Streetcar Suburbs*.[4] Warner's book explicates the interrelationship between urban expansion, transportation, and land-use patterns. None of these studies, however, has concentrated on wood frame housing at the smallest scale: its form and its construction.

My research will complete the full range of knowledge of Boston's urban evolution by including the configuration of wood fame multi-family housing types and detailing their construction. First, I will identify and explicate the significance of wood frame multi-family housing to Boston's social and urban patterns. Second, I will analyze the architecture of wood frame multi-family housing in categories of three configuration types: row houses, three-family houses known as "triple-deckers," and two-family houses. Third, I will analyze the construction of wood frame multi-family housing in detail.

Boston's Expanding Suburbs

At the beginning of the nineteenth century, Boston was a seafaring settlement of less than 25,000 people located on the Shawmut Peninsula.[5] This land mass of approximately one square mile projected into the Boston harbor and was attached to the mainland by an isthmus called the "Neck." At low tide, the Neck would measure no more than one hundred feet wide, and at extreme high tides, it would all but disappear. All land travel had to negotiate the Neck to gain access to Boston's active port. Beyond the Neck and across the Charles River to the north and the South Boston Bay to the south, the surrounding region was open farmland.

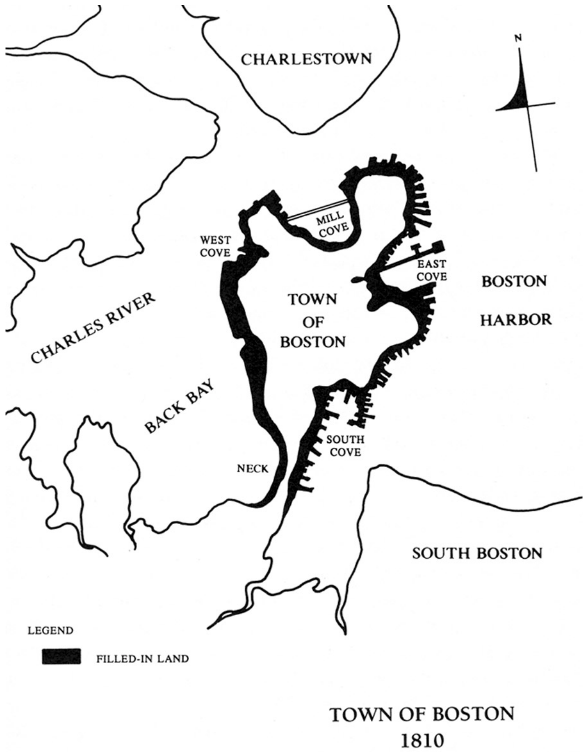


Figure 1: Boston City Limits in 1810 (from Kennedy, *Planning the City upon a Hill*)

At the end of the American Civil War, there was an influx of immigrants from Europe, Canada, as well as migrants from rural America---all seeking peacetime manufacturing opportunities, and Boston's population had grew to 140,000: more than five times greater than the turn-of-the-century population.[6] Housing in the historic core of Boston rapidly became insufficient to accommodate the increasing population. Poor and congested living conditions in the masonry tenements of the West End and the North End fueled the fires of drunkenness, immoral behavior, disease, and crime.[7] Massive land-fill projects had reclaimed enough land to create two whole neighborhoods for a wealthier upper class on either side of the original Neck: the Back Bay and the South End. These newly developed areas were populated primarily with four-to-five story, single-family masonry row houses. During this period, access from the original peninsula to the surrounding region was significantly improved by new roads built on the expanding landfill, and by new bridges that traversed the surrounding water ways.

After the economic depression of the early 1870s, the population growth intensified, and demographically, Boston represented an increasingly diverse population.[8] As economic opportunities increased and the mid-century immigrant families became established as skilled workers and business people, they became part of a burgeoning middle class. Hordes of new immigrants were arriving in the Port of Boston every day to fill the void left by their upwardly mobile predecessors. This created a demand for better living conditions away from the poverty-stricken tenements, yet still affordable to working families. The growth of industry in Boston in the late nineteenth century forced the boundaries of Boston's urban development outward from the historic core to accommodate an expanding metropolis. This outward expansion was facilitated by a loose network of privately run streetcar lines.[9] Together, these lines provided an imperfect yet serviceable transportation system that could transport the new city inhabitants out of the downtown core to Boston’s peripheral neighborhoods. These neighborhoods, dubbed “streetcar suburbs” by Warner, were the first ring of Boston’s outward development.[10]

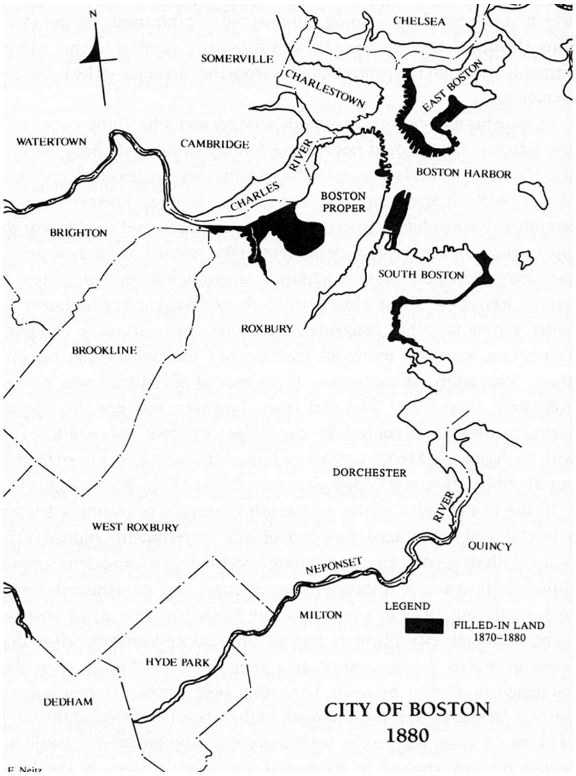


Figure 2: Boston City Limits in 1880 (from Kennedy, *Planning the City upon a Hill*)

By the end of the nineteenth century, Boston had quadrupled its post-Civil War population to 560,000 inhabitants.[11] Through the annexation of many of the surrounding towns, including East Boston, Charlestown, Brighton, Roxbury, West Roxbury, and Dorchester, and South Boston, Boston's land area increased to over twenty square miles. All of Boston's newly acquired land areas became connected directly to the downtown center of commerce through the streetcar lines. Although the towns of Brookline, Cambridge, and Somerville resisted annexation, these communities were also serviced by the streetcars, and therefore, they too were directly influenced by Boston's late nineteenth century physical, economic, and demographic transformations.

The Patterns of Suburban Settlement

The original streetcar lines of the mid-nineteenth century were horse-drawn coaches that followed preexisting roads and pathways that connected Boston's rural hinterland to the city.[12] The pattern of the original routes was generated over time by following the natural contours of the countryside and connecting dispersed centers of settlement. Dorchester Avenue in Dorchester, for example, follows the geologic interface between a hilly plateau and the flat lands next to the harbor. A road in some form has persisted in this location since Massachusetts was first settled by following the natural configuration of the land. Similarly, the present day Washington Street in Roxbury marks where the Neck was located: it represents the original land-bridge from the Shawmut Peninsula to the mainland. Both of these routes were subsequently serviced by streetcar lines and became the primary transportation arteries during the nineteenth century. The myriad of land routes emanating from Boston's historic core formed a radiating pattern like the spokes of a wheel.

Charles W. Cheape, in his book, *Moving the Masses,* describes in detail the evolution of Boston's mass-transportation system.[13] He explains how the independent competing streetcar companies were consolidated in the 1880's into one transportation monopoly: the West End Street Railway Company. During this period, it became obvious that the horse-drawn coaches were unable to satisfy the increasing demand for transportation services, so the streetcar lines were electrified. These new mechanized coaches could travel faster and hold more people than their horse-drawn antecedents. This also eliminated the necessity of maintaining large animal stables. Towards the end of the 1890s, the management of the streetcar system was transferred to municipal control.

Once streetcar transportation was provided along each radiating spoke, a new pattern of settlement and commercial activity developed. Unlike the distinct and isolated centers of commercial activity that were formed before the streetcar, the new development pattern was a continuous and linear settlement along the full length of these main arteries. The land area between each finger, however, was open farmland that was organized by a grid of parallel farm roads. The resultant pattern provided an ideal infrastructure for rapid suburban development: finger-like boulevards replete with all the urban amenities and services; direct access via streetcar to the plethora of employment opportunities in Boston's downtown; open land between the primary transportation arteries that was easily subdivided into discreet building plots.[14]

New communities were rapidly constructed along the major transportation routes delineated by the radiating streetcar lines. Unlike the continuous rows of masonry housing of downtown Boston, the suburbs pursued a pattern of tightly-spaced free-standing wood frame houses. These houses quickly populated the farmland between the primary streetcar boulevards and created an interstitial grid of residential side streets. The individual building plots were long and narrow, so two plots back-to-back could stretch between the parallel side streets. This provided each house with both a front façade towards the street and a private backyard.

The new suburban land-use pattern offered more light, air, and open space for each living unit. These neighborhoods became the place for the working class to escape the congestion, disease, and crime of the urban core. In 1920, Robert Woods and Albert Kennedy identified the expanding suburban ring as “the zone of emergence” in their book of the same title.[15] Not only was this zone a place for the immigrant population to improve its living conditions, but also it was a place for this group to improve their economic and social standing by becoming property owners. Working class families could buy a building lot and build a wood frame multi-family house relatively inexpensively. Owners of multi-family houses would then rent out the other living units in their building, thereby greatly increasing their income. The rented units allowed newcomers to get established in the city and eventually save enough money to become land-owners in turn.

Configuration of Housing Types

The configuration of wood frame multi-family housing types in Boston’s expanding suburbs of the late nineteenth century was remarkably consistent given the general lack of zoning restrictions and the plethora of architectural styles prevalent in the United States at the time.[16] There were three basic multi-family housing types built repeatedly during this period: row houses, triple-deckers, and two-family houses. The row house type was an inexpensive derivation of the masonry row houses so predominant in pre-Civil War Boston, but it did not proliferate due to a series of factors. First, even though the wood row houses were built with a masonry bearing wall between each unit, there was still a significant and inherent danger of fire spreading easily from unit to unit. Destruction by fire, in fact, is one of the main reasons why so few examples exist today. Second, this type was generally constructed as worker's housing, so it did not satisfy the new suburban ideal of one's own plot of land and detached house. The social connotations of the row house were too reminiscent of the blighted downtown neighborhoods that the new suburbanites were trying to escape. Third, since each unit within a row was bound on two sides like its masonry predecessor, the depth of the building was too shallow for sufficient natural light and air to penetrate into all of the habitable spaces. All in all, the row house type did not conform well to the deep and narrow plots that proliferated in the streetcar suburbs, so the wood frame row houses were built either directly on the main streets or on the building plots that could not efficiently be subdivided for the other detached types.

Figure 3: Typical Three-Story Row House (Photo by Author)

Most wood frame row houses were approximately 30 feet deep, and each unit was between 18 to 24 feet wide. They were either two or three stories tall which further distinguished them from the four-to-five story masonry row houses of the historic core. The two story versions were typically a single-family unit with an internal stair for access to the upper level. The three story row houses could either be a single-family, a two family, or a three family unit. The two and three family units have a single front door that leads to an internal common stair with a privatizing door at each level, and another external stair attached to a porch on the back. Given the restricted dimensions of the plan, the multi family row houses were particularly small in area, and therefore, were the domain of the poorest group of suburbanites.

Very few wood frame row houses were built after the triple-decker became the dominant choice of home builders in the 1870's. Warner argues, however, that the row house type may have been the precursor to the triple-decker: tall, slender buildings with the short side facing the street, and the long side extending into the depth of the lot.[17] The triple-decker consists of three one-family flats stacked on top of one another. Unlike the row house, however, there are no common walls, so the triple-decker could have windows around its entire periphery. This would allow for significantly larger floor plans and an abundance of natural light and air. Douglas Shand-Tucci explains that the origin of the term "triple-decker" most probably was derived from the naval description of a battle ship with cannons on three decks. He also describes the basic layout of this type as "a three story house with one apartment of six or seven rooms on each floor, opening off common front and rear stairwells."[18]

Figure 4: Typical Triple-Decker (Photo by Author)

Since the triple-deckers were constructed by a multitude of different independent contractors, there was no set footprint for this type. The dimensions did, however, typically fall within a fairly limited range from 22 to 28 feet wide and from 45 to 55 feet deep.[19] Most triple-deckers have a horizontal cornice line that hides a gently sloping roof to the back of the house, although a significant percentage do have mansard or gable roofs. Most triple-deckers also have a porch attached either to the front or the back of the house, and often they have porches in both locations. The variations of plan configuration, façade treatment, and optional architectural elements such as porches and bay windows that could be attached to the basic triple-decker volume provided a versatile building type that could be constructed for wealthy upper-class families as well as families of modest income. A prevalent building type derived from the triple-decker is the six-family type. This is an aggregate of two triple-deckers, side-by-side, sharing a central common wall.

The two family houses in Boston's streetcar suburbs have the greatest variation of configuration and style of the wood frame multi-family types. Although two family houses proliferate in Boston's streetcar suburbs, this type is not unique to Boston or New England like the triple-decker: two family houses were common in most American cities that were expanding in the late nineteenth century. In spite of the variations in style, two family houses are typically two story buildings with just two basic plan sub-types: a pair of two story one-family houses sitting side-by-side and sharing a common wall down the center, or two flats stacked one on top of another. Since the stacked flats typically have a smaller footprint, this sub-type is in the majority in Boston. A gable or mansard roof would add to the overall square footage of the house on the third level. These uppermost levels were used as either storage or as an extension of the habitable spaces of the house. Since it was socially prestigious to reside in a single-family house, often the two family homes had been articulated architecturally to appear as a large single-family house. This was achieved by having a common front porch and front door and a roof form that would span the full width of the house.

Figure 5: Typical Two Family House (Photo by Author)

Warner notes that the congested tenements in downtown Boston occupied 80 to 90 percent of their lot area while a triple-deckers and two family houses of the streetcar suburbs occupied only 50 percent of their lot area.[20] The greater open space, coupled with the fact that the wood frame buildings were free standing, provided both more light and air for the interior spaces and more green space surrounding the buildings. In contrast to the continuous masonry street facades created by the downtown row houses, the suburban streetscape provided a more porous street edge. This does not mean, however, that the suburbs lacked definition of the street space. On the contrary, the wood frame housing developments were tightly spaced and highly repetitive with rigorously aligned architectural elements such as front porches and front facades.

Since the typical footprints of the triple-deckers and two family houses were relatively consistent, the plot sizes were the determining factor for how closely spaced the houses would be. Naturally, the wealthier neighborhoods had larger yards, and therefore, a more porous street definition and a more bucolic character in general. Conversely, the triple-deckers and two family houses in the lower middle class neighborhoods stood as close as 6 feet apart on extremely narrow plots. In these cases, the natural light was still available along the entire perimeter of the building, but the light entering from the side walls adjacent to a neighbor would be greatly diminished. Also, this extremely proximity to neighbors would decrease a sense of privacy within the house since the neighbor's windows were so close. The exterior spaces were also dramatically affected by such close spacing: the side yards became little more than a dark alley between the front and rear yards. Ironically, the aggregate effect of such closely spaced houses created neighborhoods of tremendous density and all but eliminated the beneficial aspects of building in the countryside.

The styles of these three wood frame multi-family house types kept pace with the prevailing architectural fashions from across America in the nineteenth century, from Greek Revival to Queen Anne, and from Shingle Style to Victorian. Variations in the three basic configuration types also occur with the addition of architectural elements, such as a bay window or a porch structure. It is important to recognize these variations, because they occur with great regularity and consistency. These added elements provide an identifiable difference between neighborhoods consisting of buildings of a similar type.

Wood Frame Construction

The predominance of the detached wood frame multi-family housing in Boston's emerging streetcar suburbs was not only predicated on the desire for more interior light and exterior open space, but also its popularity derived from its relative low cost and its ease of construction. Wood frame construction evolved from a confluence of three technological developments of the late eighteenth and early nineteenth centuries: mechanized saw mills, machine manufactured nails, and the balloon frame.[21] The newly developed water-powered saw mills could produce the wood framing members, known as studs, joists, and rafters, with more accuracy and a greater efficiency than the traditional hand-sawn methods.[22] This made more economical use of each logged timber, thus reducing the cost of the primary structural frame. This also made the framing members easier and less costly to ship, so wood could be harvested farther from its ultimate destination. Since these mass-produced framing members could be fabricated to standardized dimensions, wood frame construction materials and procedures became universally consistent in all regions of the country.

Hand-forged nails gave way to machine manufactured nails, further reducing the overall material costs of wood framing.[23] Once the cost of the mass-produced nails dropped to an insignificant proportion of the overall building costs, a new type of wood framing based on nailing instead of mortise and tenon joints was developed: the "balloon frame." Balloon framing became the prevailing wood frame construction method, thereby eliminating the necessity for cumbersome heavy timber frames. Labeled “balloon framing” due to its thin, membrane-like enclosure and lightweight structure, this new building technology revolutionized the construction of domestic architecture in Boston and across America.[24]

There have been numerous attempts to pinpoint the date, the place, and the inventor of the balloon frame, but there is too much counter-evidence to assume that one particular person is responsible for its development. Sigfried Giedeon, in his book, *Space, Time, and Architecture*, makes an argument for crediting George Washington Snow with the invention of the balloon frame in the 1830s.[25] This version of the origins of the balloon frame is repeated frequently in prominent studies of building technology, including Cecil D. Eliot's *Technics and Architecture: The Development of Materials and Systems for Buildings*, and the popular collegiate textbook, *Fundamentals of Building Construction: Materials and Methods*, by Edward Allen.[26] Ted Cavanagh, in his article "Balloon Houses: The Original Aspects of Conventional Wood-Frame Construction Re-examined," offers significant evidence that the balloon frame was not the invention of one person.[27]

Cavanagh argues that the balloon frame is the result of an evolution of building practices spread over long periods of time and throughout the expanding limits of the young nation. Initially, there was great variation in the constructional detail of wood framing due in part to the lack of standardized building codes or the presence of the architectural pattern books that became prominent in the late nineteenth century. Wood frame houses were typically produced by small groups of craftspeople with a diverse set of building traditions which lead to a plethora of construction methods. The one thing, however, that builders of the rapidly expanding cities had in common was the desire to build economically.

By striving to produce buildings more easily and less expensively, builders realized that the repetitive, slender, vertical wood pieces that filled-in between the timbers of a traditional heavy timber frame could by themselves constitute a rigid structural frame. Eliminating the heavy timbers from the construction also eliminated the need for skilled craftsmen to produce the mortise and tenon joints required for heavy timber framing. The lighter, standardized wood members could be assembled with a modicum of standard framing details, making the knowledge of balloon framing accessible to all. The construction of wood frame houses, therefore, did not require great skill, sophisticated tools, or a great number of laborers. Instead, a pair of relative amateurs could erect a wood frame house with a few hand tools in a matter of months. The economic and constructional efficiency of the balloon frame put home ownership within reach of the growing working class.

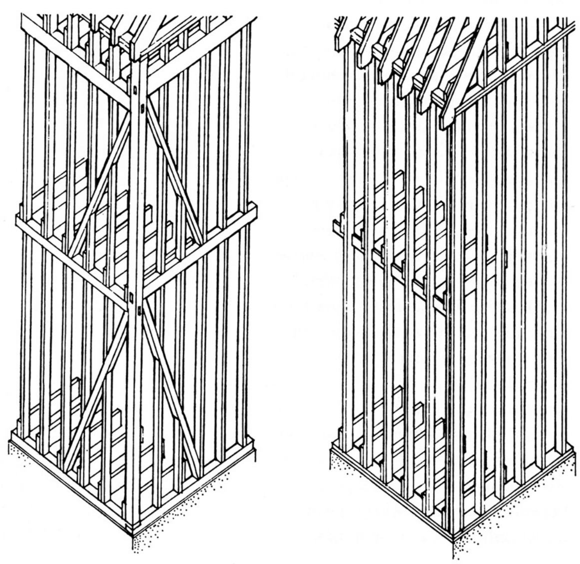


Figure 6: Left: Braced Frame; Right: Balloon Frame (from Elliott, *Technics and Architecture)*

To further simplify the production of domestic architecture, a limited number of house-plan types were repeated consistently throughout Boston's streetcar suburbs.[28] Given that the primary vertical wood members of a balloon frame were two stories tall, the two-family houses were perfectly suited for balloon framing. A balloon frame consists of a "sill plate" that is fastened to the foundation walls, then the two story 2" x 4" vertical framing members are nailed to the sill plate and terminated by a "top plate" running horizontally. The first level floor joists rest directly on top of the sill plate. A wood "ribbon" is recessed into the vertical members half way up to act as the bearing support for the second level floor joists. Finally, the roof framing is nailed to the top of the top plate.[29]

The finished surfaces and the architectural details of both the interior and the exterior of the balloon frame house were layers of material that were also simple to construct. A layer of 1" x 8" horizontal sheathing boards were nailed to the vertical studs, and the exterior siding was simply nailed to the sheathing. Similarly, layers of wood lath and plaster were added to the inside of the studs. Architectural detail, such as windows, doors, bay window units, and wood trim were available from catalogues of factory-produced, prefabricated elements. The larger elements such as the windows were complete units with integral window frame, sashes, pulleys and counterweights. They were easily set into place and simply nailed to the rough frame. The installation of the trim required just a few saw cuts to the correct dimension and they could be nailed in place, too. Typically, the trim was designed to cover and hide the joints between the rough framing and the other layers and elements.

The row houses and triple-deckers are typically three stories tall, so the construction of these types employs a variation of the standard balloon frame to extend an extra level vertically. Having inspected numerous wood frame houses while their frame is exposed during current renovations, I have found that the framing of the row houses and the triple-deckers are strikingly similar. The one major difference between these types is that the row house has a masonry dividing wall between each house. Otherwise, the row houses and the triple-deckers frame the first level as a more traditional braced frame. A braced frame is reminiscent of heavy timber framing: large posts in the corners that are supported laterally with diagonal bracing.[30] The first level vertical members are just one story tall, and they are terminated by a large 4"x 6" girder running horizontally. The next two levels are then framed like a standard balloon frame house sitting on top of the braced frame below. The construction of the three story houses is a hybrid of both a braced frame and a balloon frame.

Conclusion: Cycles of Expansion

Theodore Dreiser, in his 1900 novel, *Sister Carrie*, describes a scene common to most major American urban centers in the late nineteenth century when he writes, "Trains flashed by them. Across wide stretches of flat, open prairie they could see lines of telegraph poles stalking across the fields toward the great city. Far away were the indications of suburban towns, some big smoke-stacks towering into the air. Frequently there were two-story houses standing out in the open fields, without fences or trees, lone outposts of the approaching army of homes."[30] Although Dreiser was describing the periphery of Chicago, the imagery connotes both the industrial and residential expansion experienced across urban America. Like Chicago, the last third of the nineteenth century in Boston was a period of astonishing growth. A series of technological, economic, and demographic factors created a series of self-reinforcing cycles that propelled the discrete port town on the Shawmut Peninsula to develop into a sprawling metropolis. A cycle at the scale of the regional economy was created when a steady stream of immigrants were flooding into Boston to take advantage of the new economic opportunities wrought by the industrial revolution. The abundance of available labor was like fuel for the industrial fire: the growing population of wage earners in manufacturing created an even greater demand for the industrialized goods. The population in Boston began to grow geometrically, so the city limits had to expand to accommodate the masses.

A number of urban problems, however, quickly arose from the pressures of this intense cycle of production and consumption. First, the city became over crowded. Even though the perimeter of the peninsula had been expanded out further into the harbor, the urban core became intensely congested. Second, the income disparities between the established Boston families and the newly arriving immigrants grew exponentially. The poorest inhabitants incited frequent outbreaks of unrest due to the social and economic barriers that surrounded them. Third, the living conditions in Boston's core were increasingly unbearable for the middle and low-income groups. The row houses and tenement dwellings became over populated and bred disease, immoral behavior, and crime. Even working families had little opportunity for improved living conditions in the city due to the high demand and low supply of decent housing.

Expansion beyond the existing city limits and the construction of new housing was mandatory to feed the cycle of production and consumption progressing. This mandate for growth, however, was not the result of a governmental policy: instead, it was the rapaciousness of capitalism that demanded that the city expand to accommodate the emergent industries and the necessary populace both to work in the factories and to buy the goods that were being produced. The city government did, nonetheless, reacted to the pressures of capitalism to insure that urban and industrial development progressed in a mutually beneficial way. This generated another cycle of development at the scale of the city. An amalgam of private and public interests emerged where a farmer would sell his land to a developer, the City of Boston would build the roads and provide the services such as sewer and electricity, the developer would sub-divide the farm land and sell the plots to the middle-class working families, the families would build houses and pay taxes back to the city. As the population increased, the demand for services increased, and the tax revenues paid to the city would also increase commensurately.

The two technological advancements that were critical to the explosive development of the late nineteenth century city were the streetcar and balloon frame construction. The streetcar put the surrounding countryside in reach of the downtown core, and balloon frame construction offered a rapid and economical way to settle large tracks of available land with housing. The combination of these two factors became both the resolution to the deleterious effects of urban congestion and the instigation of yet another social/economic cycle at the scale of the individual house. Economical multi-family housing was built so that home owners could afford their mortgages by leasing out the other units in their house. The incoming immigrants were eager to lease a unit until they could afford to build their own multi-family house.

Balloon frame construction democratized the building of domestic architecture by making its cost and processes available to the commoner. Newly mechanized saw mills made lumber in more economical, standardized shapes and lengths that were far easier to transport than heavy timber framing. The tools required for balloon frame construction, namely a level, a hand held saw, and a hammer, were affordable and few in number. Additionally, the details of wood frame construction were simple and easy to master, and the layered nature of wood frame construction could hide all the rough framing with factory produced architectural elements and trim. This new method of building houses perfectly complimented the rapid development of Boston's nineteenth century suburbs.

Notes:

[1] Walter Muir Whitehill, *Boston: A Topographical History, 2nd ed* (Cambridge: Belknap Press of Harvard University Press, 1968)
[2] Lawrence W. Kennedy, *Planning the City upon a Hill: Boston since 1630* (Amherst: The University of Massachusetts Press, 1992)
[3] Douglass Shand-Tucci, *Built in Boston: City and Suburb, 1800-1950, 2nd ed.* (Amherst: The Massachusetts University Press, 1999)
[4] Sam Bass Warner, Jr., *Streetcar Suburbs: The Process of Growth in Boston 1870-1900, 2nd ed.* (Cambridge: Harvard University Press,1978)
[5] Kennedy, *Planning the City upon a Hill*, 39, 261
[6] Kennedy, *Planning the City upon a Hill*, 261
[7] Henry C. Binford, *The first Suburbs: Residential Communities on the Boston Periphery, 1815-1860* (Chicago: The University of Chicago Press, 1985), 179; see also Warner, *Streetcar Suburbs*, 10
[8] Warner, *Streetcar Suburbs*, 43
[9] Kennedy, *Planning the City upon a Hill*, 99
[10] Warner, *Streetcar Suburbs*, 3, 21-29
[11] Kennedy, *Planning the City upon a Hill*, 261
[12] Warner, *Streetcar Suburbs*, 22
[13] Charles W. Cheape, *Moving the Masses: Urban Public Transport in New York, Boston, and Philadelphia, 1880-1912* (Cambridge: Harvard University Press, 1980), 107-125
[14] Warner, *Streetcar Suburbs*, 61, 138
[15] Robert A. Woods and Albert J. Kennedy, *The Zone of Emergence: Observations of the Lower Middle and Upper Working Class Communities of Boston, 1905-1914* (Cambridge: The MIT Press,1962)
[16] Warner, *Streetcar Suburbs*, 117
[17] Warner, *Streetcar Suburbs*, 108
[18] Shand-Tucci, *Built in Boston*, 120
[19] Robert Rugo, *Boston's Triple-Deckers* (Boston Redevelopment Authority, 1978), 4, 8, 9
[20] Warner, *Streetcar Suburbs*, 140
[21] Edward Allen, *Fundamentals of Building Construction: Materials and Methods, 2nd ed.* (New York: John Wiley & Sons, 1990), 125
[22] Cecil D. Elliott, *Technics and Architecture: Development of Materials and Systems for Buildings* (Cambridge: MIT Press, 1992), 18, 19
[23] Elliott, *Technics and Architecture*, 18
[24] Allen, *Fundamentals of Building Construction*, 125
[25] Sigfried Giedion, *Space, Time, and Architecture: The Growth of a new Tradition, 5th ed.* (Cambridge: Harvard University Press, 1967), 352
[26] Elliott, *Technics and Architecture*, 18, and Allen, *Fundamentals of Building Construction*, 125

[27] Ted Cavanagh, "Balloon Houses: The Original Aspects of Conventional Wood-Frame Construction Re-examined," *Journal of Architectural Education*, September (1997), 5-15
[28] Warner, *Streetcar Suburbs*, 76, 130
[29] Elliott, *Technics and Architecture*, 18
[30] Elliott, *Technics and Architecture*, 18
[30] Theodore Dreiser, *Sister Carrie*, (New York: W. W. Norton & Company, Inc., 1970), 6

The Architecture of Background
Preserving spatial environment through flexible designing methods

Robert BARELKOWSKI
Polish Academy of Sciences
Poznan University of Technology
Department of Architecture
robert@armageddon.poznan.pl

Abstract:
The design process is the procedure in which the architect seeks for one of acceptable solutions (that may be evaluated in an objective way), which he or she finds to be one of the best (what stands for subjective content). Achieving good quality in design is the most important in curriculum, however it often takes unique design process into consideration. As the subject is taught, students usually omit or ignore several important questions, like an impact of architecture on social life, meaning of architectural solution in urban or rural context as a result of long term relationship etc.

The aim of the research is to define the term “Architecture of Background” and to implement new elements related to specified content in students’ curriculum. The research has been made simultaneously in scientific and professional activities to verify the theoretical basis. Architecture of Background may become a definition for common architecture that composes most part of spatial environment people live in. The teaching focuses on several aspects:

- understanding spatial context,
- consciousness and responsibility relating to cultural and historical heritage,
- understanding social needs and expectations,
- working on function and form independently from each other.

Structure of flexible designing method has been established to present the subject in methodical manner. Preliminary design data are taken from project guidelines, master plan and referential data. Architect uses or composes the definitions of spatial and architectural typology that refer to the site. Two definitions of vernacular and traditional architecture and their relationship to architectural concept are also developed. While comparing definitions with the concept itself, features are extended by contemporary ones, which reflect present utilitarian and esthetical expectations. Choosing final set of features determines further formal decisions.

In the same time functional-spatial (FS) scheme is to be established in accordance with site parameters, e.g. plot area, soil conditions, access etc. Then detailed scheme is fitted to the chosen set of architectural features to create formal solution. To manage all problems and questions additional conditions are to be taken into account, namely the building code (law regulations), technical and technological conditions and others applicable.
The idea of “the architecture of background” is meant to improve the quality of spatial environment by incorporating flexible designing techniques and methods. Students and professionals are both part of the research and first results are discussed in the paper.
As one can observe common urban or rural landscape, one finds unified architectural forms filling the surrounding. These are mostly low quality, low budget and uninteresting solutions lacking proper planning and designing efforts. The scope of the research is to develop better architecture for buildings that compose the proverbial bricks, of which our world is built.

Through “Architecture of Background” assumptions it is possible to implement new design techniques to develop so-called typical design and common design in flexible manner. This is to provide the inhabitants with variety of relatively high quality, low budget solutions and fit architectural objects into their environment – and also to establish these methods in students’ curriculum.

Introduction

Unification of experiencing the architectural work through problems of architecture itself as well as spatial planning questions is one of the most interesting topics in students’ curriculum at the Technical University of Poznan. “Architecture of Background” program and research was designed to force students to become involved in analyzing and evaluating various aspects of design.

The background means architecture addressed to common members of society, architecture that cannot be seen in fashionable journals or avant-garde publications. While discussing the impact of architecture and every single building or structure on sustainability of an environment it becomes apparent that harmony of forms and balance of environmental exploitation require the design based on two different sets of criteria:

- the space is marked with important, “publicly” exposed, exceptional buildings (being the result of a strictly individual design process, sometimes incontextual); this way of designing leads often to conforming the ambition of investor / developer, signifies the role of public building, creates a spatial sign, organizes space or is meant to last for centuries as frequently used structure; this way becomes too often the way to seeking and finalizing architectural solution and is omitted in this research,
- the space is filled with common buildings and structures whose task is rather or purely utilitarian; it was strongly marked, that designing simple forms and simple buildings should be seen as even more important for an environment because those structures are predominant in the landscape of cities, towns and villages.

To define the aims of methodology of designing the architectural background it is important to emphasize the role and value of this work, which is to maintain suitable spatial management and to convince students, that such an activity may be as well categorized as high architectural standard in design (because of its cultural and social sensitiveness).
The principles of Architecture of Background (AoB) can be explained in four aspects. The first aim is to rationalize architectural design process focused on creating common architecture conforming the cultural, environmental and utilitarian needs of contemporary society. The second one is to define a complex system of criteria and evaluation for adjusting common architecture (background architecture) to both individual (investor’s) and local (social) conditions. The third one is to systematize architectural typologies in context of space (urban or rural) and architecture itself. Last but not least, the fourth aim is to protect existing spatial and architectural values, expose them and support “calm” development that will not suppress monuments and elements of cultural (architectural) heritage. The method is thought to allow flexible adjusting to the necessities of an individual while maintaining the understandability for most if not all members of community.

The idea of AoB uses various scientific concepts discussed by Banka (1999) or Sanoff (1999). That means involving interested parties in the design process, looking for their evaluation and comparing professional understanding of architecture and space with common and often primitive knowledge of it. AoB was also meant to respond for P.R.S. planning method giving new information on environment and social expectations in another, detailed scale (Barelkowski, 2001a).

The implementation of the method runs against an additional difficulty in Poland, due to the distrustful attitude of the recipients. The inhabitants of that area are accustomed to the tradition of liberal spatial management and of regulating spatial developments by means of general commands and decrees. They have serious trouble in understanding the complexity of the area while the national policy for spatial management does not exist. What is more, many times they are unable to understand the impact one "bad" project executed in the area has on the environment and how long lasting are the results of such an activity. The authors of the method believed the following aims to be essential[1]:

- integrating the spatial planning and architectural activities;
- using the existing body of theoretical knowledge in the area of methodology and models of architectural designing;
- involving the public in the design process, with the intention of making involvement of non-professionals more effective and creative
- providing with education in the area of architectural aesthetics;
- extending the mechanisms responsible for the spatial order, to counterbalance the legislative and social deficiencies.

Architecture of Background methodology

Architecture of Background (AoB) is based on several concepts. One of them is an ideological principle claiming that living space for certain community should be composed of singular exceptional and unique objects and multiple common ones. This points toward another concept of close coordination between spatial planning and architectural design. Therefore P.R.S. method of spatial planning was chosen as a referential platform where sustainability and harmony should be guaranteed in the same ways (Barelkowski, 2000). Third question is the addressees of architectural activity – this means especially wide group of members of local community or future members, who are firstly interested in cheap designing and cheap building. In such cases functional factors (unfortunately) and esthetical factors are of minor significance[2].

Protection of landscape cannot be achieved without the existing precise space management definitions and valid law regulations – and this cannot be done by AoB methods while these are architectural procedures. However, the results of the research are open to inhabitants of other areas than Rakownia, where they can be helpful in fulfilling another important task – the education among people.

AoB as a method of designing is also connected to the theoretical model of architectural design. Among analyzed models Popper's appears to be the closest one. Putting behind the concept of treating the design process as a constant evaluation through acceptance or negation, the criteria proposed by Popper underline significance of external (in relation to architect's activities) conditions like usability, environmental relationship, cultural symbolism, environmental impact or economical impact (Powell, 1987).

The structure of AoB consists of several steps (Barelkowski, 2001b):

1. The process starts with compiling functional scheme for certain location.

2. Designer uses existing reference manual to the site, the area and the region to examine the features of local and traditional architecture. If no such data is available designer follows the additional program to acquire necessary references. During this step definitions of vernacular and traditional architecture are formulated.
3. Functional-spatial (FS) scheme is established.
4. Parametrical data on location is acquired – plot area, soil conditions, transportation and pedestrian access etc. – which defines technical conditions for design process.
5. The building code (law regulations), technical and technological conditions connected to specified function, economical factors are included in the process.
6. Typologies are analyzed in the context of selected FS scheme and plot data. Preferred typology is chosen to become the main reference for architectural solutions.
7. The choice between "vernacular" and "traditional" is made affecting the range of formal expression in architectural design.
8. The library of details is analyzed to determine the set of referential details for specified project.
9. Concept design is being prepared.

It is crucial to mention that AoB requires involving the coming users as well as local society to check their opinions on architecture, locality, spatial potential and expectations. That kind of participation and obtained evaluation of design process, although expressed by non-professionals, is the source of information on background architecture that cannot be underestimated.

AoB refers to specific Polish conditions, in which typical architectural designs are most popular. Therefore one of the main fields AoB should work is typical design. In that case AoB is intended to propose a group of projects, in which every project is "equipped" with alternatives, allowing choosing from interior design, exterior finishing, different economical standards.

The references in design

The references become the basis for all analytic questions. The collection of references is proceeded through processing data acquired from the site. This includes photographic, cartographic, environmental examinations and visits in site and in the surrounding. Those are accompanied by inquiry. Gathering, compiling and analyzing civilization, environmental and historic information from the area as well as from the region brings up the background, defines its character and specificity. Battle and McCarthy point out these factors as constantly influencing the design and its reception among addressees at least (1997).

Focusing on architectural form as a permanent element of spatial environment, with its quality well known to influence human life conditions, including social and psychic comfort, aims at receiving adequate parameters of architectural solution in accordance with the uniqueness of the location. The cited "calmness" and modesty are of great significance because working with AoB ideas means conscious creation of common product, which is designed not to take primary role in the selected area.

In the majority of well-known design process models and methods an architect takes many varied factors into account. This often includes a variety of information, sometimes similar to the references used in AoB. There are many differences affecting the approach to design according to an idea of background architecture. The table shows a comparison between common basic design tools used to acquire and analyze AoB references and mechanisms.

Table 1. The comparison of selected references processing in common and AoB design procedures

Design procedure content	Common architectural design procedure	Architecture of Backround method
Spatial analysis of contextual areas	1. Photographic documentation of site and the surrounding 2. Analyzing and/or acquiring existing various area documentation (e.g. infrastructure, environmental plans etc.) 3. Visits to the area	1. Imaging of selected site 2. Photographic documentation of contextual space including information from region 3. Analyzing and/or acquiring existing various area documentation (e.g. infrastructure, environmental plans etc.) 4. Visits to the area
Analysis of economic trends in planning area	Important economic premises or investor's budget definition	1. Investors preliminary assumptions on budget 2. Sociological examination on predominant types of inhabitants (possible clients) and their economical preferences 3. Preparing alternatives meeting various economic expectations (the lowest and highest budgets, even not resulting from examination mentioned in no 2)
Social participation and evaluation	Exceptional cases (like cooperative design and design in participation)	1. Series of inquiries depending on specificity of design task 2. Acquiring people's opinions; social evaluation 3. Forcing future users to join and participate in decision making
Typology analysis	Sketches and photo documentation – the typology of buildings located in the neighborhood	1. Urban or rural typology analysis (excluding the site context and its unique location) 2. Site context 3. Building typology analyses (related to function, inhabitant, etc.)
Referential database	None	Database with graphic additions or registers as well as parametric analyses
Vernacular and traditional architecture definition (in context of site and area)	None	1. The definition of vernacular architecture (more open). A set of features referred unconstrainedly to original composition and detailing allowing however the so-called contemporary re-interpretations 2. The definition of traditional architecture (rigorous). This definition describes present interpretation of historic composition and detailing in selected typology

Every referential element plays its role in process of improving architectural solution. It appears to be necessary to use those references in order to understand and create sustainable environment of human life as Peski (1999) comments. Banka (1999) points out that most inhabitants do not expect (what seems to sound like truism) any sophisticated architectural expression. They do prefer some architectural solutions that are easy to understand and harmonious with the environment – this means that common background architecture should use more traditional or tradition-based semantics.

Typologies

Typologies are important in AoB method not only because of their referential value. They record the evolution of individual and social expectations for usefulness and beauty in architecture and space. Common typologies and even more traditional typologies mark direction that seems unreasonable and improper while discussing the consistency of architecture. It has to be underlined that creativity in transforming old building ideas and preserving building structure "untouched" while adjusting interiors to contemporary standards and technical equipment seems to be very contradictory and insincere. In practice this contradictory approach appears to be environmentally justified.

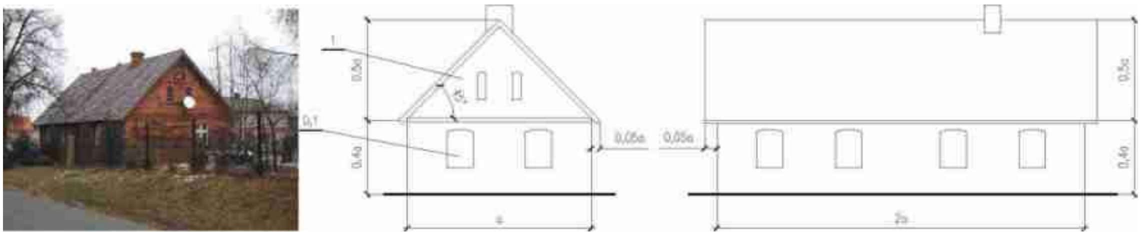


Figure 1. Analyzing general features of a typical house in the countryside (from 1904).

To determine the definition of certain typology detailed research is conducted. It includes measuring and recording numerical parameters of existing buildings, studying historical information on buildings and building technology. There are features of different scale and importance to the definition:

- general features like general shapes of buildings, roof types, function,
- parametric features like proportions, rates, etc.,
- detailed features like building or elevation materials, door and window shapes, etc.

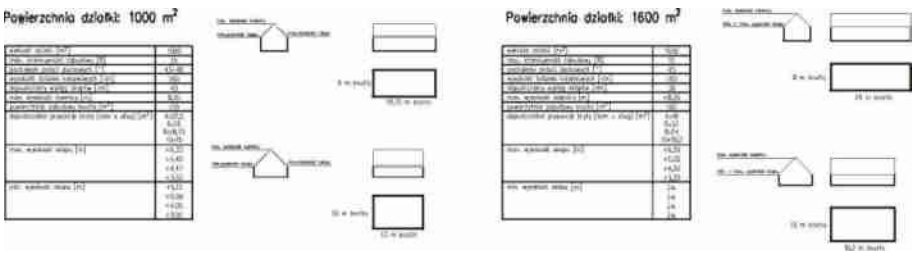


Figure 2. Analyzing parametric features of a specified house.

Vernacular and traditional

The AoB method uses stipulated differentiation between "vernacular" and "traditional" architecture. Both terms refer to relationship between the architectural heritage of an area and the way this heritage influences the design process. In this individually composed definitions vernacular means following general and parametric guidelines in a loose way while working with architectural scheme. The traditional method means rigorous approach to all three sets of features with possible exceptions.

That kind of variation gives AoB method a flexibility in composing larger areas – when architectural design results made with accordance to AoB are to be used in multiple applications in some group of plots or in the whole area[3]. AoB tries to explain the two terms by former obligatory composition rules, by building workshop potential which strongly influenced architectural look of buildings and by the very detail itself.

The Architecture of Background research

The research has been simultaneously conducted in two ways – one through professional application, the other through comparative analysis of students' works done during one semester. The first could provide the answer how common people perceive the procedure based on AoB method and how do they evaluate it. The second was more concentrated on creative approach to the design process presented by the students.

The research group started with preparatory works. The location for designing activity was chosen in the neighborhood of city of Poznan, Poland. Village named Rakownia was selected and the team initiated to gather wide environmental information on local architectural and spatial typologies. The material prepared in this way was intended to allow synthesis of data on building types and typologies, their function, relation to certain space (private and public spaces relationship). It showed also the environmental context (rural landscape) and it recorded functional structure of surrounding terrain.

The studies involved documentation of landscape areas to be filled in with newly designed buildings. Additional analysis was undertaken to find the predominant features of existing architecture. This village founded in the late 19th century had three phases of development – all of them were carefully investigated and recorded.

Several discussions with community members were organized, an inquiry was executed and in the same time preferred typologies were defined and consulted with inhabitants and county administration. While comparing the value of nature[4] with the standard of newly built houses an agreement was made to describe future development parameters taking old, early 20th century objects as a reference.

The research team composed nine typologies and all of them excluded new building types[5]. Simultaneously, the second inquiry was addressed to potential clients and plot owners to prepare preliminary cost estimation, which could be accepted. Additional questions concerning functional program, detailing and others were asked.

Then the first phase of practical part of the research was started. Thirteen design tasks were taken in order to verify the assumptions of architecture of background method principles. Seven design cases were finished and another six are currently under way. AoB, as it was said before, involves users and community members' participation (which can be limited in certain cases). This kind of cooperation refers to models from the 70s that have been continued furthermore until today according to so-called cooperative design and design in participation. Sanoff (1999) introduces those types of designing expressing their great impact on quality of final solutions, which appeared to become more functional and widely approved by both users and local communities. AoB research team found Van der Ryn + Clathorpe with Jeff Oberdorfer and Kaplan Mc Laughlin experiences suitable to profit from, especially that the first examined tasks were simple family houses in the countryside. One of the aims of the real work was to achieve the typical design fitted with large number of greater and smaller variations. Those differences were planned to please potential inhabitants and to force individualization in formally balanced architectural environment. The variety had to come in unified convention. Inhabitants' opinions, tastes and psychological perception of architectural space came as the first and most important factor for design.

The team prepared four different design types to conform various requirements. These proposals include two small single family houses, one medium sized and one residential type for larger plots. All of them were worked out as typical designs to be adjusted for individual needs. The third inquiry was prepared among the “clients”. Afterwards the mentioned designs were presented and discussed. Every concept had at least four versions of interior organization and different variants of exterior finishing.

Figure 3. An example of small house design 2

Figure 4. An example of residential design 4

During all stages the proposals were often reworked. After finishing all phases the addressees were asked to evaluate the whole process referring to how their needs and expectations were responded and solved and how much satisfaction they have got from participation in the design. The “clients” were satisfied with presented finishing options and with the way it affected the total cost of designed house.

Table 2. Results of AoB implementation in design process

“Client” no	The choice of design	Rate of concept acceptance	Choice of functional scheme (version)	Choice of architectural look (version)	Rate of substantial changes in original functional scheme	Rate of substantial changes in original architectural look	“Client’s” evaluation (0-10pts)
1	3	medium	B	II	no changes	no changes	10
2	2	high	A	I	low	low	8
3	4	high	A	III	high	low	6
4	1	medium	C	I	medium	low	6
5	2	low	C	II	high	high	3
6	none of presented[6]	n/a	n/a	n/a	medium	low	9
7	2	medium	A	I	high	low	8
8-13	still under way						

n/a – non applicable

Second part of the research was a part of students’ curriculum during year 2001[7]. Two groups of students were selected and presented with the site and the task. One group was free to choose designing methods and ways to seek solutions. Another group was rigorously tied with AoB procedures that included multiple visits to the area and contacts with local community (obligatory). No internal versions in design proposals were requested, however students were explained to be sensitive for flexibility of interior space and different arrangements of the designed houses. They were also told to focus on modesty of architectural look and its role as background conforming to the rules of expressing more the nature than the civilization presence in an area.

The students prepared numerous designs. It became apparent that some of them could not understand the idea, even if it was largely discussed during exercises. The quality of designs was not very satisfactory, only few works reached the point in which the most crucial principles of AoB method were performed. Final presentation in Rakownia showed how community members validated those works. Some of them received positive opinions even if from professional point of view they were inadequate.

Figure 5. An example of student's work that is positive as incontextual solution. Unfortunately this was an improper response for the AoB principles.

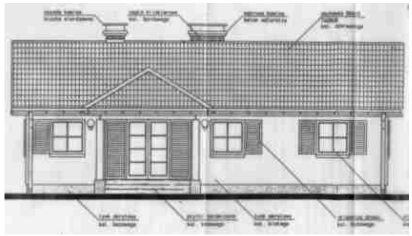


Figure 6. One of positive examples showing good understanding of what Architecture of Background means

Table 3. Results of students' work on AoB method in two groups

	1st students' group (free rules)	**2nd students' group (AoB rules)**
Number of students	23	19
Number of designs	22	17
Average quality of design work (0-10)	**5,72**	**5,85**
Minimum response rate of design work for AoB principles (0-10)	1	5
Maximum response rate of design work for AoB principles (0-10)	8	8
Average response rate of design work for AoB principles (0-10)	**3,19**	**5,77**
Average evaluation of design work made by members of Rakownia community (0-10)	**4,06**	**7,90**

The experiment with students can be, hopefully, taken as an examination of inexperienced designers. Their immature design proposals were often primitive and highly imperfect. The second group following the principles of AoB method found it easier to achieve the expected result. This was reflected in both evaluation made by professional designers (Polish Architects Assn. members, including jurors, were involved) and during meeting with Rakownia inhabitants. It was particularly interesting notice that the results of previously made inquiries were the same people found built design proposals (seen on some pictures above) nice and well-fitted into landscape before the discussion and presentation of students work and AoB method and after having heavily criticized that chaotic and low quality design that was executed in their neighborhood. It was closely observed how people became more open in presenting their opinions and more sensitive for esthetical attributes. In non-professional validation functional questions were of secondary importance.

Conclusion

The AoB method of designing is not a finished research program. The team is still working on and tries to take profit out of both theoretical contributions presented in Poland and worldwide as well as of practical, professional activities that allow to validate the efficiency of the method. In Poland Fikus and others in mid 80s conducted the trials of creating common design rules for housing in limited areas. Authors analyzed the examples of de Carlo at Mazzorbo, Venice, Italy, Kroll at Alencon, France (Tzonis and Lefaivre, 1992) and other works from abroad. It seems that the very new concept in AoB program is to make typical design with variables. To add another advantage of background architecture idea – its level of integration with spatial planning and mechanisms of understanding and managing space is very high and forces high quality simple architecture in countryside and in cities.

It is hoped to receive positive results in future. For now the first examples of professional work based on AoB method are going to be executed. Fortunately, it was possible to implement spatial regulations as well (P.R.S. method of spatial planning). The paper presented here is just a short excerpt containing a few aspects of AoB. Questions of relation to exploitation of natural resources and infrastructure solutions supporting the sustainability of architectural objects should be discussed more widely. This affects cooperation with local administration. Therefore the paper focused on problem sharing that it is more difficult to protect in case of weak law regulations – esthetical appearance of an area relating to architectural design and detailing.

Footnotes

[1] The research team members are: Robert Barelkowski, arch., Ph. D., Polish Academy of Sciences, FA PUT, Ireneusz Ratajczak, arch., PSP expert, architects and branch designers – Katarzyna Barelkowska, Piotr Jasiniak, Andrzej Balewski, Marcin Cellary, Karol Jankowski, Andrzej Barna, Henri Kelani Nikuna and others. Cooperants from county administration were Elzbieta Kujawa and Mateusz Szczepaniak.

[2] The AoB involves working with several inquiries including the preparatory ones. The first one executed showed minor importance of functional and esthetical factors as seen by local inhabitants. The examination involved a group of 322 people from Rakownia and Murowana Goslina county.

[3] This is the case in new developments realized based on P.R.S. planning method.

[4] Rakownia is considered to be an attractive place for building activity and recreation for Poznan inhabitants. It is located on the border of great forest complex with several lakesides.

[5] Different opinions were expressed. This is probably the result of misidentification of good quality in designing with good technical quality of a building.

[6] None of typical designs was accepted by this "client". However after preparing individual concept next phases of design were conducted according to AoB method

[7] Two groups of students worked during their 2nd year of education. This was their first fully programmed design task.

Bibliography

Banka, A.: 1999, *Architektura psychologicznej przestrzeni zycia. Behawioralne podstawy projektowania <The Architecture of Psychological Space of Life. Behavioral principles of designing>*, Gemini – Print, Poznan.

Barelkowski, R.: 2000, Metoda P.R.S. jako metoda sporzadzania miejscowych planow zagospodarowania przestrzennego a kontekst architektury regionalnej i tradycyjnej wobec procesow transurbacji na obszarach wiejskich <P.R.S. method as a spatial planning method preserving regional and traditional features of space and architecture in countryside in context of „transurban" processes>, *in* A. Kadluczka (ed.), *Dziedzictwo kulturowe fundamentem rozwoju cywilizacji <Cultural heritage – the foundation of civilization progress>*, conference proceedings, International Conference on Conservation Krakow 2000, Politechnika Krakowska, Krakow, 24-35

Barelkowski, R.: 2001a, Referential information systems as a source of architectural design solutions in P.R.S. method, *in* H. Penttila (ed.), *Architectural Information Management*, conference proceedings, 19 th ECAADE International Conference, Helsinki, 486-492.
Barelkowski, R.: 2001b, *Zalozenia metody projektowej „Architektura tla" <Principles of Architecture of Background Design Method*>, Poznan University of Technology, Faculty of Architecture, Studioteka Zarysy, Poznan, print, 5-11
Battle, G. and McCarthy, C.: 1997, Multi Source Synthesis. Working with Elements, *in* M. Toy (ed.), *Architecture after Geometry*, Architectural Design Profile, **127**, II-V.
Peski, W.: 1999, *Zarzadzanie zrownowazonym rozwojem miasta <Sustainable city development management*>, Wydawnictwo Arkady, Warszawa.
Powell, J. A.: 1987, Is architectural design a trivial pursuit, in *Design Studies*, 8/4, Butterworth & Co Publishers, 1987, 187-206
Sanoff, H.: 1999, *Integrowanie programowania ewaluacji i partycypacji w projektowaniu architektonicznym. Podstawy teorii Z <Integrating Programming, Evaluation and Participation in Design. A Theory Z Approach*>, Wydawnictwo Naukowe Stowarzyszenia Psychologia i Architektura, Poznan
Tzonis, A. and Lefaivre, L.: 1992, *Architecture in Europe since 1968. Memory and Invention*, Thames and Hudson

Myth, Culture and Landscape:
Classical Identity and Interpretive Design at St. Bertrand de Comminges

Barry Bell
McGill University School of Architecture (student)
Montréal, Québec

32 Churchill Ave., Apt. 1,
Toronto, Ontario, Canada
M6J 2B4
tel + fax: 416 534 7451
e: barrybell@sympatico.ca

Myth, Culture and Landscape:
Classical Identity and Interpretive Design at St. Bertrand de Comminges

Abstract:

The ordering principles of the Gallo-Roman city of Lugdunum Convenarum rest dormant within its landscape; the antique city and its topographic orders obscured by time. Yet the continued processes of academic excavation reveal only dusty foundations. Disconnected fragments of classical form, impoverished through autopsy, serve to confuse rather than illuminate. The desire to understand and experience the nature of this fairly modest Roman outpost clearly demands other forms of interpretive engagement than provided by the practices of archeology alone.

The challenge is one of method. This paper investigates the role of theoretical design as a means of appreciating the essential city which rests integral to the charged landscape of St. Bertrand de Comminges. Hypothetically this implicit presence can best be explored through careful intervention and extension. Indeed, perhaps it is only through exploring an imaginary future that the spatial power of the historic city may be investigated; its essential conditions revealed to experience.

This hypothesis will be explored through considering a theoretical master plan for an archeological park. Grounded on substantial archeological field work, this project attempts to bring the implicit principles there discovered to visibility. Systems of order, spatial sequence, and ideals of urban intent are identified and reflected upon through their transformation. This proposes to celebrate the specific nature of Saint Bertrand de Comminges, its classical and medieval attributes, along with the less tangible aspects of its landscape and urban sensibility. By extension the notion of design as a form of research may be considered. In this case the project investigates the ephemeral qualities of a place, and their potential extrapolation within contemporary form.

The Roman town of Lugdunum Convenarum rests dormant within Saint Bertrand de Comminges, a small t
of France. Its implicit ordering principles remain hidden; its architectural values cloaked. Yet in spite of t
city's Roman structure, and even its pre-Roman foundations resonate within the more visible medieval an
Perhaps they even direct these later expressions. The resultant combination of a layered architecture w
setting is a magical one, creating a landscape latent with moments of phenomenal significance. In its eni
the site provokes reflection.

St. Bertrand de Comminges

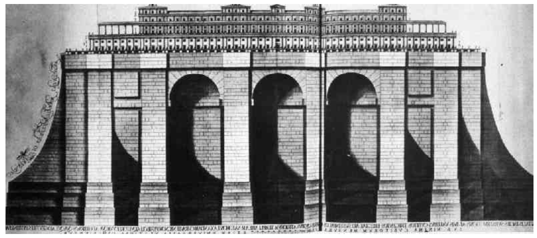
St. Just (detail)

Is is possible to tangibly uncover the spirit and operating principles of this synthetic condition? And if
appropriate tools? Knowledge of St. Bertrand's history is incomplete, the circumstances of its creatio
inhabitation unclear. Its textual records are fragmentary at best. As a result archival research is inconclus
practices of scientific archeology, while central to exposing the skeleton of the historical city and the sed
layers, tend not to illuminate issues of architectural intent. Nor do they manifest antique spatial experience
ued archeological excavation risks replacing the town's rich temporal frictions with an impoverished lan
foundations. Arguably St. Bertrand's special qualities must be inferred through other than these traditio
means.

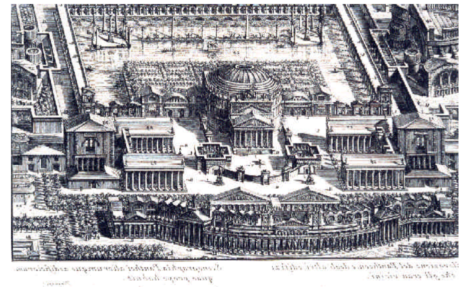
Odysseus and the Sirens
British Museum, London

Aeneas Leaving Troy
Vergilianus Vaticanus, The Vatica

In the textual world historical fiction has successfully played such a exploratory role. Homer's Odyssey, f
imaginative recreation of Bronze Age Greece, just as Virgil's Aenied reconstructs Rome's mythical his
coherent (and politically expedient) form. While it might be unwise to read either text as history proper, it



Temple of Solomon, Villalpanda



Campo Marzo, Piranesi

Related architectural efforts tend to follow this textual mode. Their creations can be provocative in their f the 'buildings' are primarily graphic, and intended to remain on the page. They support a story rather than construction. Dreams of Solomon's Temple, Pliny's Villa, or ancient Rome itself have provoked archit complete historic worlds through image. Perhaps the most striking example is Piranesi's Campo Marzo imagined away Baroque Rome in order to reanimate its antique predecessor. Though existing classical maintained, all later accretions are replaced by fantastic constructions of imperial grandeur. These great in describe a classical city more extreme than any historically accurate version, but one congruent with Ro The Odyssey we are presented with a history perhaps more true than the actual, and certainly more vivid th cal parallel.

But to publicly construct such an historic vision?1 Architecturally this seldom succeeds. Partly one i architecture's contextual reality. Due to their practical function and familiar presence buildings, especiall to be perceived as both active and 'real' (versus literature for example, and even it suffers similar chall partly dependent upon their programmes, most buildings do not clearly announce any explanatory or Indeed explicit historical commentary is rare from a building which resides in the world; the notion arch lematic. Would such a work present an artistic construct, reinterpreting the past for contemporary eff version of a dusty and crumbled original remade for cultural or artistic purposes, or simply a touristic mis historical reality? All of the above? Given this ambiguous relation between historical fiction and archite interpretive terrain for such architectural intent is a curious one. As a result constructed 'history' is ofte apologetic, losing any spirit of the original through a fear of misrepresentation. The temple fragment re Glanum, a classical site in Provence is a telling example. Such a construction may be necessary to bring rather modest archeological landscape, yet its lack of architectural conviction is readily apparent. It is a sig without any accompanying vision as to what might make such a reference meaningful. The avoidance interpretation, and the associated risk of being wrong, leads to a default image, a generic antique justi necessity alone. Conversely the opposite extreme may be equally unsatisfactory. Disney's ambitious recre Europe in Florida, though clearly fictional, is discomforting in its misplaced imagistic precision.

Glanum (St. Remy de Provence)

with immediate spatial and experiential effect. Indeed, perhaps it is only through design that the phenom antique city and its architecture may be fully appreciated. Spatial experience, liberated from academic retic modernity of its architectural interpretation, begins to explore the richness implicit in the historical remains to do so, perhaps paradoxically, as an imaginary future rather than a recreated past.

The Essential City

Saint Bertrand de Comminges is situated in the foothills of the Pyrenees, immediately south of the Gar town marks the meeting of plain and hill, crowning the first small summit with its cathedral. Though not urban construction powerfully projects a centralised elevation over the valley, foreshadowing the larger hi own strange microclimate, St. Bertrand is often shrouded in mist and and rain. Yet the clouds are rarely co the town's appearance changes by the moment. Part of a transforming landscape, yet always centred meeting of valley and hill, St. Bertrand maintains a mysterious presence; one strongly related to the context.

Roman Mask, St. Just

St. Bertrand de Comminges: Pl

The ideals of persistence and transformation, so casually apparent in the landscape and climate, are sequ the town's fabric. Its material presence, orientation and urban structure record consistent tendencies w ments. Seemingly 'organic' medieval streets loosely follow earlier Roman patterns, just as the cathedra classical temple foundations. St. Just, a small church resting in the plain, renders this historical co Geometrically simple, it internalises the realities of physical and symbolic metamorphoses in the very fab tion. Roman fragments populate the otherwise bare walls; formerly pagan characters repositioned in se Catholic practice. Its striking setting, earthy character, and mysterious interior enlivened by the magic rituals render it representational of the special qualities of the town itself.

More cryptically the settlement's earliest foundations persist in its festivals. The summer solstice is "Brandon", a ritualistic burning of a large tree, felled and transformed into a torch. Aerated for a week o tree virtually explodes when lit, its flames animating the night sky. Marking the setting sun on the year event also demonstrates an awareness of the coming winter with its ever increasing darkness. The orig event is unclear, but its endurance tenacious.

St. Just, Interior   The Brandon

The town's climate, patterned orientation, and historical sedimentation are all verifiable, brought to num through the practices of surveying, cartography, and archeology. Clarifying the historical roles of the e cycles of the days and seasons, or the function of sacrifice and ritual are more tenuous endeavours. Yet the active within the ethereal landscape, and may, arguably be central to the town's existence and continued rei very least they participate in the experience of the place, and provoke reflection. More significantly they n crucial factors underlying its history.

St. Bertrand's Roman name was Lugdunum Convenarum. The title literally celebrates the town as a place the hill of Lug. A beacon in the landscape, Lugdunum was a destination for a coming together of the tri meeting. The rhetoric of communication was central to its very existence. Lug was a Gallic deity, most with Roman Mercury, the messenger god. A multivalent figure, he was responsible for communicating b and from the gods to humans; a god of agreement and participation. His hill, projecting over the landsca setting for this activity. Arguably the Romans, and the Roman Catholic Church recognised the same qual and their subsequent use of the site follows similar preoccupations.

Lug   Theatre

Myth: Content and Means

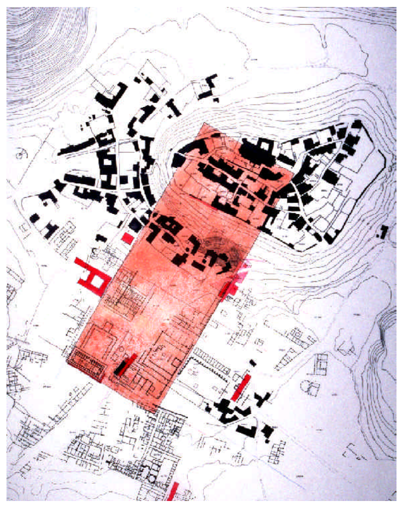
Like the ideals of landscape and transformation, this urban quality of directed communication, though so ble, is historically significant. Its meaning to the town is embedded in its very name. The irony is that, discussed earlier, its value the least likely to be exposed through traditional research practices. The cha more suitable means for the investigation of these implicit structures.

One possible guide, associated with murky but significant pasts, is the idea of myth. Hypothetically r qualitative and structural aspects, might direct an appropriate examination of such a landscape, its power each conscientious retelling has the capacity to assist in its revelation. St. Bertrand's different and succe point to the power of such a shared condition. By extension new constructions, by the nature of their enga the specifics of the site, might also play a role in illuminating this mysterious quality or ideal. In the case historically significant archetype these fresh creations might even be more significant as they would main presence and immediacy that a historical reference does not. Here the popular notion of myth, as a myste be paired with myth as structure of research. Each aspect potentially justifies design as a means for ref qualities of a mysterious and essential urban presence, and bringing them to visibility for historical reflec

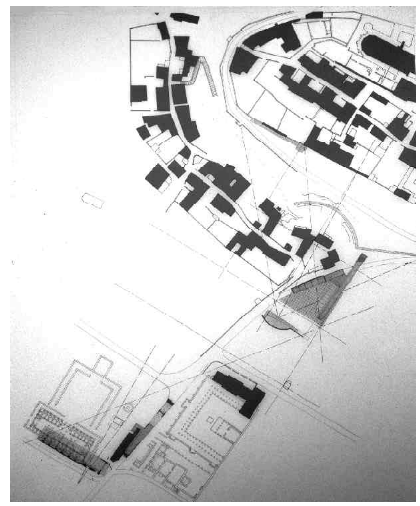
Design Strategies

The project, briefly presented here, explores these notions through the design of an archeological park. T is to create a comprehensive urban order which includes the medieval and Roman cities. It proposes to ree and reconnect its parts. More qualitatively the project addresses the ideals of sequential enclosures, p Orders are inflected, creating juxtapositions of landscape and building. Different programmes bring spe the place, where idiosyncratic events serve as reminders of the town's inner life.

Underlying these decisions is the desire to evoke a sensibility of subtle difference. Slightly uncomfortable sought, revealing the Roman foundations as distinct characters and provoking recognition that other pos also exist within the landscape. At St. Bertrand Celtic practices underlie a Roman appropriation, and both within the medieval constructions. All reside within a shifting ground. Here the attempt is to make this so tal history tangible. The revelation of this sensibility, along with the chance to celebrate the cultural valu characterize the design intentions.



site plan

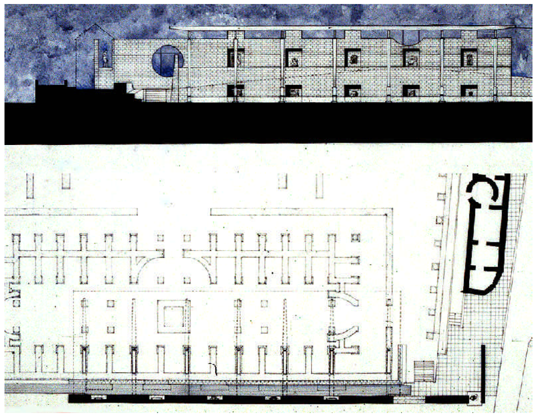


detail site plan

Site

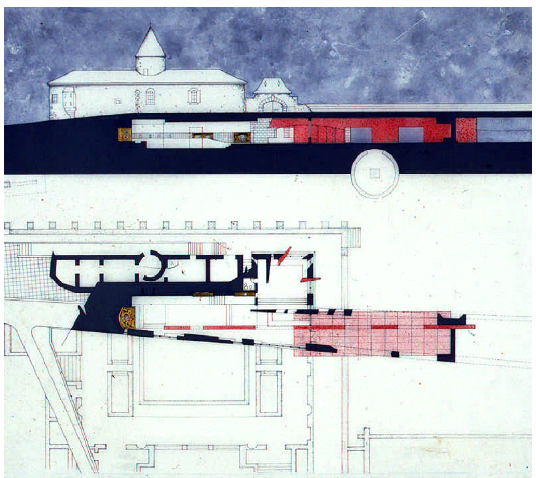
The classical city is outlined as a lower precinct, a variation on the essential Roman practice of enclosu addresses the practicalities of an archeological park, as well as creating a zone of architectural nature. Th establish sufficient spatial definition for the precinct while still maintaining an appropriately scaled relat building and setting. Here the attempt is to subtly define a precinct while also retaining the potential for e ships. This flexible boundary is structured through fragments, whose different principles of material qualit play out to define its edges. Shifts in expectation and ideals collide within a localised plan. The attemp sensibilities of continuity and transformation, to establish links with the foundations within a set of relat ated parts.

another. Functionally the wall protects architectural fragments, as well as establishing a viewing structure the town's facade.

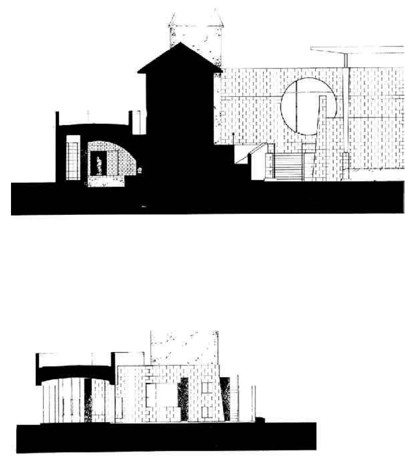


lapidary wall, plan

A descent to the archeological level allows a reconnection of the bisected park. Through excavation the rendered less natural, and inhabitation within, the site of the orientation centre, serves to invert the tradi historical layering. The colliding elements and fragments within perhaps make the space slightly unco dislocated. Its ideals of rearrangement and passage focus inwards, yet also direct attention to the landsca

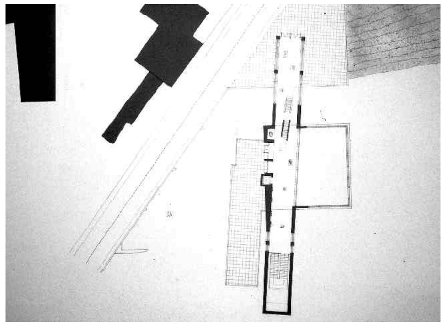


orientation centre

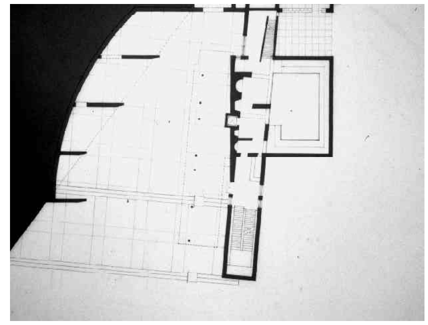


orientation centre

A visitor's residence, music school (related to the annual music festival) and recreation centre extend the a back to the river. This facilitates the creation of distant views, as well as establishing a reconnection to tl founding elements of river, plain and hill. The conversation of landscape elements is reconfigured, thoug attempt to reveal its mysterious qualities.



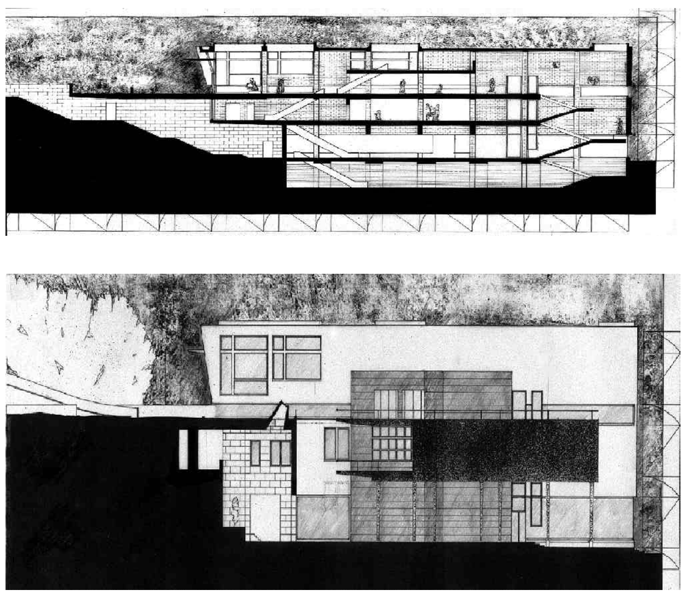
museum site plan



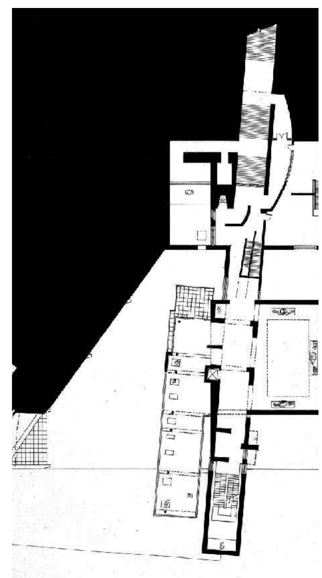
museum ground plan

Museum

These ambitions have been explored most directly in the archeological museum. Situated at the edge o adjacent to the Roman theatre, the museum becomes a significant character within the larger whole. boundary, it reinforces the theatre district by reforming one wall of its colonnaded precinct. As well as central role of the theatre in the city, this attempts to reconnect the lower town to the hill, and by extens medieval city. Visually focus is redirected away from the geometry of the modern road towards the Ro implicit in the town's elevation, with the theatre at its centre. The museum's interior posits a series of su animated by journey. Varied paths lead one back to the landscape, which is experienced in different wa positioned in response to these landscape conditions, to render their appreciation, and the perception of the less familiar. Path and edge; object in the landscape and part of the Roman precinct, the museum attempts shifting experience of the place.



museum elevation and section



museum upper floor plan

spirit of the town its phenomenal aspects were considered, and their spatial significance made tangible. Th
archetypal qualities of metamorphoses and transformation, as well as the particular attributes of the si
directed investigation of the specific conditions, analogous to the thematic role of human behaviour with
tion, the potential links to the past conditions of the city are identified for reflection. Secondly the structura
has been identified in its possible relation to the question of design as research in general.
The pairing of an archetype plus its narration evolves over time, and through many different variations.
can, more technically, be understood as a series. In a series, usually a combination of three terms, the arr
terms identifies the linking spirit which exists between them. The series 2:4:6 is qualitatively different
without the third term these structural differences would remain indistinct. In the case of Saint Bertrand i
sions - the sequence of Celtic Gaul, Gallo- Rome, and medieval France, - can be further extended, with ea
helping to reveal the essential conditions implicit within the series. This open-ended state keeps the integra
perceptually alive, just as its absence risks ossification. In the latter case our ability to perceive the sit
distinct from its somewhat impoverished historical fact, would be challenged, thereby hindering the dev
true historical sensibility.

The notion of series may here be seen as a provocation. Extending the evident layers also demands spe
interrelation, in order to imagine other forms of connection and influence. Equally our ideas of the lands
context of our mysterious predecessors, forces us to relate to their ambitions. This imaginary historic c
assist in revealing significant aspects of the site and its inhabitation. Possible continuities are discovere
difference. In the end these relationships may be imaginary, but they serve the purpose of redirecting c
perceptions, a necessary provocation for productive research.

The Poetic Narrative: Language, Syntax and Design Practice

Mr Scott GOWANS
Mr John GRAHAM
University of Dundee, School of Architecture
sgowans@architecture.dundee.ac.uk
jwfgraha@dux.dundee.ac.uk

Abstract:
This paper attempts to illustrate the importance of the conceptual initiative in the design process and how, through the development of a poetic narrative, it can inform the process of creative design and manufacture. The argument outlined proposes the adoption of a poetic narrative as a mechanism for defining and clarifying the designers' intention with the use of metaphorical associations advocated as a means of exploiting our innate ability for intuitive extrapolation.

Our approach gives emphasis to the conceptual corollary or intellectual process that underpins all considered design work and challenges the traditionally accepted methods of project development where this phase of the process is seen as having a pre-prescribed beginning and end. The paper is also intended as a statement of intent that celebrates the unique nature of our interdisciplinary working practices and, as a contextualising document that posits a realistic and contemporary vision for the future of collaborative endeavours. We illustrate how, through the adherence to a philosophy of creative realism and by the establishment of legitimate, ephemeral collectives; we can effectively instigate and address opportunities in many areas at any given time. In the paper we actively promote an expansive and creative engagement with the dynamics of project inception, development and control as a means of realising our collective aspirations and of ensuring project ownership in the widest sense. The paper discusses creatively critical architectural and new media projects that attempt to subvert a number of modern orthodoxies by supplanting them with an affective internal logic.

THE FUTURE OF DESIGN PRACTICE

"Historically, technology has been dominantly projected as a human-directed tool created to tame, exploit or re-fashion 'nature'. What is now becoming clearer is that it also acts to reshape its maker and user as much as, and perhaps more than, that which it is presented as making."

(Fry 1999)

The world is changing and changing fast. Fuelled by the fusion of technology with information, a melding that has bound technological liberation to the cognitive core of our collective culture; the rapid and continual metamorphosis of global environments has elicited a paradigm shift in the perceptions of the creative community.
This realignment of contemporary thinking has led to the re-evaluation and re-definition of traditionally accepted *modus operandi* and offers unparalleled opportunity for creative engagement in the global arena.

As Michael Speaks illustrates when he says:

"…architecture should no longer recoil from the degraded world of business and managerial thinking. On the contrary, it should aggressively seek to transform itself into a research-based business. This sober assessment has become the primary motivator for a fleet-footed generation of architects and urbanists who today must develop design strategies which are soft and flexible enough to compete in a constantly changing global marketplace."

(Speaks 2000)

Our work exhibits an unconscious synergy with this contemporary perspective.
The projects we have undertaken illustrate an adherence to a philosophy of *creative realism* and show how, through the establishment of legitimate, ephemeral collectives; creative individuals possessing a panoply of multidisciplinary skills can commune to effectively instigate and address opportunities in many areas at any given time.

These project-specific *'appropriate collectives'* actively promote an expansive engagement with the dynamics of project inception, development and control as a means of realising our collective aspirations and of ensuring project *ownership* in the widest sense. Within the context of each group's remit entrepreneurial creativity is promoted through a motivational synergy to allow for the generation of novel ideas with which we can secure new opportunities.

As Michael Speaks again illustrates, this approach uncannily parallels the emerging vision of contemporary architects and designers:

"Dutch architects Ben Van Berkel and Caroline Bos declared on the eve of the new millennium that architects would soon become the fashion designers of the future. Architects, they proposed should form alliances with marketing consultants, engineers, marketing specialists and other 'creatives' to become change managers in a world where change is the only constant."

(Speaks 2000)

The inclusive nature of our activities has led to the establishment of diverse yet interlinked creative communities and has facilitated interaction between individuals from a wide range of creative disciplines. This in turn has led to the development of a richly nuanced design philosophy informed and shaped by the creative exchange of divergent, discipline-defined perspectives.
Our collaborative strategy embraces the idea of 'value in diversity' and promotes the combination of unique perspectives in order to evolve exceptionally creative strategies and solutions. In addition to redefining the nature of 'specialist' input to the design process, our culture of *full immersion* allows for an innovative, unfettered approach to be taken to the 'architectural structure' of our collaborative endeavours. This in turn has allowed us to investigate alternatives to traditionally accepted and ingrained, arcane practices (with their traditional cycles of growth and decay) and has fostered the creation of impermanent bodies that alternate between their *dormant* and *active* states.
These loosely defined collaborative bodies are 'low dependency', allowing us to be more broadly exploratory. In addition to this, the intermittent nature of each

collective’s active state allows for a more selective and *sustainable* approach to project engagement.
Musician Richard Hell echoes our thinking with regard to this when he says:

“It’s not a linear thing, it’s trying a lot of different things and trying to figure out how to do various things well.”

(Hell 2002)

Where a degree of dissonance may exist between some contemporary commentators and ourselves is with regard to the influence and role of theory in design practice. Michael Speaks again states:

“Theory, or what little theory there is left of it today, remains resolutely critical and resistant to the emergent commercial reality driven by the forces of globalisation. Weighed down by its historical attachment to philosophy, theory has not been free or quick enough to deal with the blur of e-commerce and networked, open systems. Ultimately, Theory and the avant-garde work it supported, has proven inadequate to the vicissitudes of the contemporary world. And so today we stand at the end of a historical period…”

(Speaks 2000)

We however, regard the theoretical underpinning of any conceptual initiative as intrinsic to the validity and success of our endeavours. For us, this underpinning takes the form of a *poetic narrative*.

MEANING AND METAPHOR

For us the poetic narrative cannot be readily defined in the sense of a tangible or quantifiable essence. Rather it should be regarded as a descriptor for an attitude, a mode of thought which at a meta-level represents a *worldview* but which can also provide a structure for the process of creative investigation.
In short it is a framework for creativity.
If the design process can be seen as an unrelenting quest for certainty, it is undoubtedly designers who are most acutely aware of the conflicts inherent in what M.Merleau Ponty refers to as ‘*sense experience*’. For it is our passive association with fabric of the *real* world which represents the *‘intentional tissue which the effort to know will try to take apart’. (Merleau Ponty 1996)*
In design, innovation and insight are ultimately only possible through an understanding and acknowledgement of and, a necessary disassociation from, the *known* and the *familiar*.
Paradoxically it is designers, who through process of creative investigation and construction, both confirm and deny the *actuality* of the ‘here and now’ by simultaneously defining the present whilst alluding to the *possible*.
It is the act of creative synthesis that allows for the realisation of indefinite possibilities by revealing the potential for transition.
Here the narrative is used to provide a clear, overriding conceptual framework within which metaphor is utilised to elucidate the mind’s interaction with the world.
It is a mechanism that invites metaphorical allusions to help define and clarify the designer’s intention and to give interpretable expression to any resultant context for,

in harnessing the power of metaphorical association, designers can reveal a conceptual corollary and simultaneously present opportunities for further exploration. As Lakoff and Johnson argue, natural language presumes and expresses conceptual meanings represented in basic metaphors *(Lakoff and Johnson 1980).* Their standpoint indicates an innate human understanding of linguistic and one postulates, visual metaphoric triggers.
Sir Richard MacCormac adds:

"The potency of the metaphorical image lies in its ambiguity, because, not being one thing it can be many. It is neither literal nor abstract".

(MacCormac 1996)

Here, contemporary juxtapositions can provide new meaning whilst elusive lexicons of visual hieroglyphics and the rhetoric of detail can be employed as discrete (or overt) referential mechanisms.
This can allow the designer to formulate an approach or approaches unconstrained by unnecessary limitations or restrictive assumptions, and can facilitate the manifestation in built form of an interpretable, metaphor-based, matrix of information that will elicit intuitive and phenomenal understanding.
Within any piece of work the component parts can be used to convey language and syntax, a language derived from and expressive of, a clear and overriding intention. Any resultant work or piece then has the potential to be both memorable and immediately intelligible.
Whereas much of current architecture is defined by an obsessive concern with it's own construction character – a reductiveness brought about by an often myopic process of verifiable making – the poetic narrative assists in developing, sustaining and crystallising the conceptual initiative.
This is illustrated in a small school extension designed by the Hurd Rolland Partnership. The practices' intention with the project was to always allow children within the building to have a visual link with the outside world and in particular, a view of the sky.
The underside of the roof plane was seen as representing an extension of the sky. The narrative was then formalised and defined as the *artificial sky. (Figure 1)*

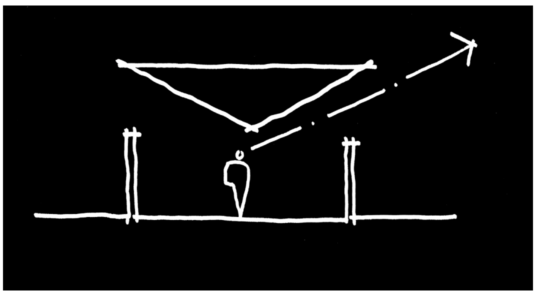


Figure 1

The adopted narrative determined the approach to the structural resolution, material, surface, detail, junction and surface colour. Particular attention was necessarily given to the junctions between glazing cill, the clerestory glazing and, the extending blue coloured soffit to ensure a seamless visual plane. *(Figures 2-3)*

Figure 2

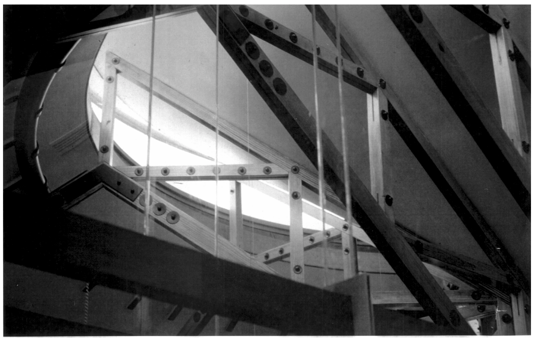


Figure 3

This narrative stream offers legibility and legitimacy yet has the potential to imbue work with a sense of *otherness*, a latent potential that does not preclude any instance of the possible.

If adopted, the narrative allows you to immediately supplant the initial concern of what something *is* and how it works with a desire to explore *what it can be*.

Within any overriding narrative, sub-narratives further inform the process of detail design, resulting in meaningful expression. In this way projects appear the same overall and in detail.

Throughout this process of investigation the narrative has direct relevance to each definable instance and to the totality of the endeavour.

In adhering to the narrative the component parts of any piece of work will necessarily display an inevitability, which will contribute to the understanding of the project as a whole.

The exploration of the narrative is undertaken as a continuous investigation, it both informs and is informed by simple diagrams.

Generative ideograms are to Hutton *"a form of visual thinking that represent a value-based theoretical position." (Hutton 2000)*

These illustrate the imposition of certain conditions determined by an individually prescribed hierarchy.

Within this hierarchy, degrees of primacy are attributed in accordance with the designer's experience and particular value system.

These are exploratory diagrams constructed over a backdrop of credible analysis.

Here, the *poetic* is characterised by metaphorical association and emotional syntax.

It is a representational mechanism that clarifies and guides creative intention and is embodied in a *thoughtstream* robust and rich enough to invite continual re-interpretation when applied to any new *condition* or *instance*.
Ultimately, the reading and true understanding of any piece of work, is not solely the result of intellectual analysis or the reading of implied meaning but the revelation of the organisational structure of the piece itself, what Hutton refers to as the *hidden order* of any design.
Here the narrative stream allows for a transparent reading of any given instance and of a project as a whole.
It makes apparent the infinite possibilities for transition whilst illustrating a conceptual lineage linking each instance to its antecedents.

As discussed, the initiatives we have undertaken attempt to investigate the potential of *design as intention*. In combining the apparently irreconcilable roles of project initiator, designer and *maker* we have attempted to illustrate the importance of the conceptual initiative in design by allowing for continual investigation throughout the process of creative design and manufacture.

AN ARCHITECTURAL PROJECT

The architectural project discussed is an intervention in an existing residential property.
Throughout the project the design process was seen as a *continual* part of project advancement, necessarily underpinned by a poetic narrative and afforded an *extended moment* within a malleable, company-defined timeframe.

The Jewel Box

The project is a small-scale incision in an existing building fabric and as such, immediately presented us with an opportunity to explore the potential for transformation, counterpoint and discovery. *(Figure 4)*

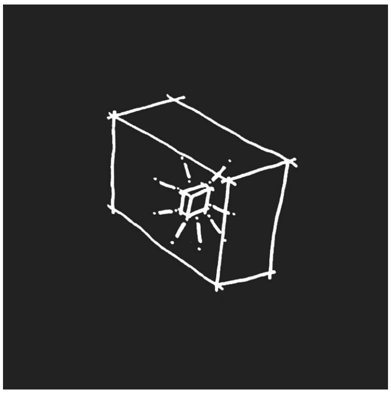


Figure 4

The volume we intended to create was conceptually defined as a *jewel box*.
These objects possess for us a mysterious and mesmeric quality, the magical potential to enthral and for me personally, an ill-defined redolence of childhood and the past.
In accordance with the developed - and continually developing - narrative, the spaces and objects created had to necessarily possess a phenomenological potency and, in

direct contrast to the surrounding areas, offer a rich and *discovered* sensorial experience.
This was especially desirable, as the intervention would form an internal volume.
Equally important was the desire to enrich - both functionally and conceptually - any associated space.
Here the narrative was developed into one of an *afterglow*, an essence that would emanate from the newly opened jewel case.
The project was primarily concerned with the twin themes *discovery* and *mystery*. *(Figures 5- 6)*

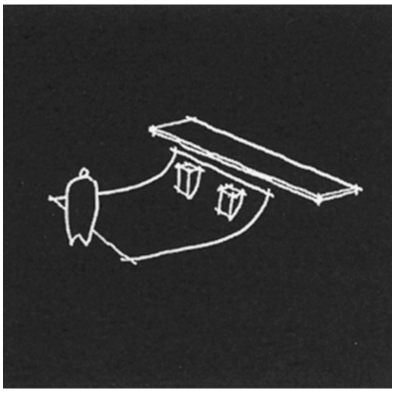


Figure 5

Figure 6

This was achieved using a number of devices:

- The substantial double doors are excessively scaled, beech-veneered on the inner surface (as are the worktops and box fronts) and they open outwards from the newly created volume (yet are narrow enough not to contravene regulations). This allows the interior - like the rich velvet interior of the jewel box - to be *revealed*.

- The new incision and the adjacent hallway then become two associated and mutually dependent zones whose characteristics are distinct and different. Counterpoint is maximised through material transition and by contrasting the obvious symmetry of the existing hall with the asymmetry of the new volume. The completeness of the new space is only revealed on entering, when the obvious balance in the compositional arrangement of elements becomes clear.
- The floor covering (Black Altro Mondopave) is used as a recognisable element to connect the existing and the new. It provides the interior of the jewel case with the necessary degree of mystery and *otherness* as it moves between the two zones sweeping up to the underside of the apparently ‘floating’ worktop whilst appearing to suspend the projecting boxes within it’s midst.
- In direct contrast to all other areas, the new space and its *gewgaws* are rich in colour. This lustrous interior exudes an almost hypnotic glow (an *afterglow*) that seeps out into the adjacent space.
  Here, discovery of the new space becomes a *revelation*.

Our direct engagement with the financial dynamics of the project allowed us to make immediate and informed decisions about the feasibility and *achievability* of our design aspirations.
Adaptation was narrative-driven *and* represented a creative response to financial concerns rather than being the result of enforced compromise.

NEW MEDIA

The multimedia piece ‘Count’ was constructed in order to promote the work of our multimedia collective. Again, metaphorical association within an omnipresent conceptual framework or narrative determined the development of the short interactive piece; in this particular instance the underpinning narrative was defined as ‘The Infinite’.
In the piece the supergraphics are visible only fleetingly yet loop in a potentially endless cycle of numerals from 1 through to 6.
The use of colour coding on the animation was based upon the numerical value of each component colour when individually placed upon a black picture plane.
By utilising this relationship of primary and secondary colours - a relationship adhering to the *golden section* – a layering of spatial field was achieved. The picture plane appears to have infinite depth.
The large numerals are never seen in their totality and are used to spatially stretch the picture plane by alluding to infinite space beyond the visible area. *(Figures 7-8)*

Figure 7

Figure 8

By synchronising the intensely colourful visual sequence with a 'high-octane' soundtrack an immediate sensory overload is created which refutes passive engagement.
Observers almost involuntarily, complete the numerals and register them as recognisable and meaningful shapes in an understandable and ordered sequence. They are forced to search for familiarity in the unfamiliar.
To finish the looping sequence, the word *seven* appears in response to a *mouse down* command, providing a counterpoint to the numerical representations of the preceding sequence. *(Figure 9)*

Figure 9

SUMMATION

"Cultural history is rarely straightforward. It's discontinuities, misdirections and contradictions are all compounded by contacts between cultures."
(Tashjian 1995)

Through our collaborative working practices we attempt to elicit new perspectives through a fusion of creative cultures *and* an expansive engagement with commercial dynamics.
To this end we are engaged in an alchemic process that also provides the 'creatives' involved with *complete ownership* of their work.
The approach outlined also highlights our reliance upon a guiding narrative to inform and structure the process of design.

In the emerging global environments where the often-unenlightened application of current and continually emerging technologies is instigating social change by forcing a break with certain categories of the past, it is vital that everyday associations held to be 'deeply known' within the collective subconscious, are treated as a reservoir of catalysts for any new situation.

If, as Alejandro Zaera Polo believes we *"no longer live in a single world…but a world made of worlds, each governed by its own set of conjectures about the truth" (Speaks 2000)*, then the displacement of innately understood signifiers (metaphors) from traditional contexts to new associations will lend them an abstracted sense of the contextual and provide any new situation with a resonance of the 'strangely familiar'. *(Rattray and Hutton 2000)*

References

1 Fry, T. (1999) *A New Design Philosophy: An Introduction to Defuturing*, University of New South Wales Press Ltd, Sydney.

2 Hell, R. (2002) Adventures in Modern Music, *The Wire, Issue216*, pp. 34-38.

3 Hutton, G. (2001) Ideograms, *Discussion Paper (Not Published*,) School of Architecture University of Dundee.

4 Lakoff, G. and Johnson, M. (1980) *Metaphors we live by*, University of Chicago Press, Chicago.

5 MacCormac, R. (1996) From Architecture Memory and Metaphor, *The Architectural Review, Volume CC Number 1197*, pp. 79-81.

6 Ponty, M. Merlau (1996) *Phenomenology of Perception* (Translated from French by Colin Smith) Routledge Publishing, London 1996.

7 Rattray, C. and Hutton, G. (2000) Concepts and Material Associations in the work of Gigon/Guyer, *Architecture Research Quarterly, Volume 4, No1*, pp. 16-31.

8 Speaks, M. How the New Economy is Transforming Theory and Practice, *Proceedings A of the Research by Design International Conference*, Delft, The Netherlands, November 1-3, 2000, pp. 52-55.

9 Tashjian, D. (1995) *A Boatload of Madmen: Surrealism and the American Avante-Garde*, Thames and Hudson, New York.

Wandering intellect, intuition and chance in architecture

Gregory MEYER
Boston Architectural Center
gmeyer2002@hotmail.com

Abstract:
Improvisation is the art of fabrication with what is at hand. It fosters spontaneous decisions, but it is not random. It becomes a spiritual wandering of intuitive, intellectual, and chance components. Improvisation happens in the process of making art and architecture, and is experienced by wandering through the process using rational, intuitive, and chance components. This phenomenon is expressed in architecture, Abstract Expressionism, and jazz improvisation. These art forms are a synthesis of intellect, intuition, and chance based on culture, environment and memory, which reconstruct our *place* in the world. Heidegger and Piaget provide the philosophical foundation for this argument. Architecture engages these issues and is a vivid reflection and expression of our environment. The art forms of jazz improvisation and abstract expressionism also exhibit aspects of wandering and gathering. Classical and Avant-Garde literary sources will be used in support of wandering through the intellect by intuition and chance. Through wandering, such as Odysseus in Homer's epic, one's *place* in in the world is found.

Wandering intellect, intuition and chance in architecture

> *"… remembrance of going back and forth over the bridge, going to a job which was death, returning to a home which was a morgue, memorizing Faust looking down into the cemetery, spitting into the cemetery from the elevated train, the same guard on the platform every morning, an imbecile, the other imbeciles reading their newspapers, new skyscrapers going up, new tombs to work in and die in, the boats passing below, the Fall River Line, the Albany Day Line, why am I going to work, what will I do tonight. ...”*[i]
>
> **Henry Miller, *Tropic of Capricorn***

I. The Philosophical Basis of Wandering

The context of wandering provides a realm for architecture's creation to be a meaningful concretization of place through the continuous interplay between intuition, chance and intellectual actions and events. Wandering expresses freedom within a framework. The act of wandering is the whole where the intermediate fragments of experiences are freely collected and juxtaposed against, on top, below one another and which exhibit some fruitful composition that makes one feel complete and which perfectly compliments and reveals the moment. This is true for the artist whether it is John Coltrane and Sun Ra, Jackson Pollock, Henry Miller, or Le Corbusier. As for the jazz improviser, intuitive impulses based on a collection of experiences are the bulk of the creation within a framework.[ii]

Architecturally speaking, this is true to Le Corbusier's later work in the 1950's that specifically revealed an assemblage of ideas fostered over his career such as in his work The Carpenter Center. It is a process that explodes the *microstructure* of the overbearing control, preconceptions, and restrictions on freedom of creation and expression.[iii] Diffusion of these restrictions ultimately reveals an essence of a place in time through a work. This is precisely accurate when looking at Pollock's ‘poured and flung’ paintings where nature is intertwined through his process. The wandering harvests these creative works through the gathering, combining, and positioning of fragmented experiences and emotions within a spatial structure.[iv] The philosophical basis and the ‘why’ for this exploration of the act of wandering is that it is recognition of this process that helps one to remove the shackles over expression and therefore the ‘dehumanization of man by (systematic) world technology’.[v] Wandering does this through a primitive and fundamental way of being, becoming mindful of the basic elements of life. Wandering is a continuum and is a search for completeness.

As one wanders, gathering, and collecting the remnants and residuals of such action, the human condition prompts one to hold on to, and to let go of, a variety of experience and the veritable flotsam of influence along the way. It is a time-based process that too is directional-implying movement. As a wanderer moves through any medium (space, time, place, intellect, experience), that medium exerts pressure in achieving or meeting a specific goal is unpredictable and perhaps unknowable. The phenomenon of wandering allows the freedom for creativity and chance events to occur. And so the contribution of the research is to investigate and put forth the notion of considering the action, (intuition through a framework) and subsequent (chance) events of wandering as expressed in other avant-garde arts as a valid method for the design process. It is believed that in following such a process a more humanistic and meaningful architecture will result. [vi]The design process utilizing intuition and chance reaches down in the gut of *place* or culture and pulls out a concretized reality of the synthesis of experiences, structure of space, and environment.[vii]

The Elements of Wandering

The basic elements of wandering include *intellect*, *intuition*, and *chance*. Of these elements intuition is subconscious and is directed through an amalgam of emotions, ones schemata, that is ones own framework that is carried through life, and the immediate environment[viii]. In Abstract Expressionism for example artists use these elements in their process in hopes of revealing their inner being. Abstract expressionists were mainly concerned with the tendency in modern society for individuals to be stripped of their identity as in a technocratic state. Heidegger expressed quite clearly that technology was disrupting the connection between ‘man’ and nature, and man's sense of being.

> *“…modern science, which develops a mathematical picture or model of the world and thereby reduces the world to a predictable and hence controllable object…”*[ix]

In response, the abstract expressionists used gestural painting as a method in pursuit to re-establish a balance of reason and intuition. The need for individualism and identity became paramount.[x] Wandering by its free nature, its lack of a definite path and perhaps seemingly infinite path, is a method in producing something that is highly individual. If one were to take a multitude of slices through the wandering path the unique essence of its existence it’s being would be revealed. The *intellect* component is the necessary element that provides a way in which the individual, gestural, and spontaneous actions may wander, explore, and create, and ultimately reveal a sense of place through the work. Pollock’s seemingly chaotic paintings, known as ‘all-over’ or drip paintings incorporated a consistent level of structural components that allowed his freedom of expression to flourish. However, whether in jazz, painting, or literature, the reduction of more dominant hierarchical order produces a ‘microstructure’ that is peripheral, blurred, and particulate. [xi]It is within this ubiquitous structure where the energy for expression lies without the dominance found in Renaissance painting, for example. [xii]

The process of merging intellect and intuition ultimately leads to the third element-*chance*. It is indicative to Arendt’s reference to ‘action’. There is a link with wandering as a boundless course of action that is often unpredictable. The actual path taken, set a part from the *ideal* action, measured goals, is said to be *real* because of this unpredictable medium.[xiii] In this unpredictability, the accident becomes a beautiful component of the artistic process. Although many criticized Pollock for seemingly ‘purely accidental paintings’ he spontaneously composed through controlled manipulation and acceptance of the accident.[xiv] Abstract Expressionists are consistent with Arendt's idea of action and unpredictability as the expression of man's freewill. There becomes a disclosure as an image the rhythmic energies of place though the action of freewill.[xv,xvi]

II. The Art of Wandering

The wandering process is not perfunctory. It is very much rooted in the “inner need” for meaningful expression.[xvii] Kandinsky expresses this more directly,

> *“I value only those artists, who are artists, that is who consciously or unconsciously, in an entirely original form, embody the expression of their inner life; who work only for this end and cannot work otherwise”*[xviii]

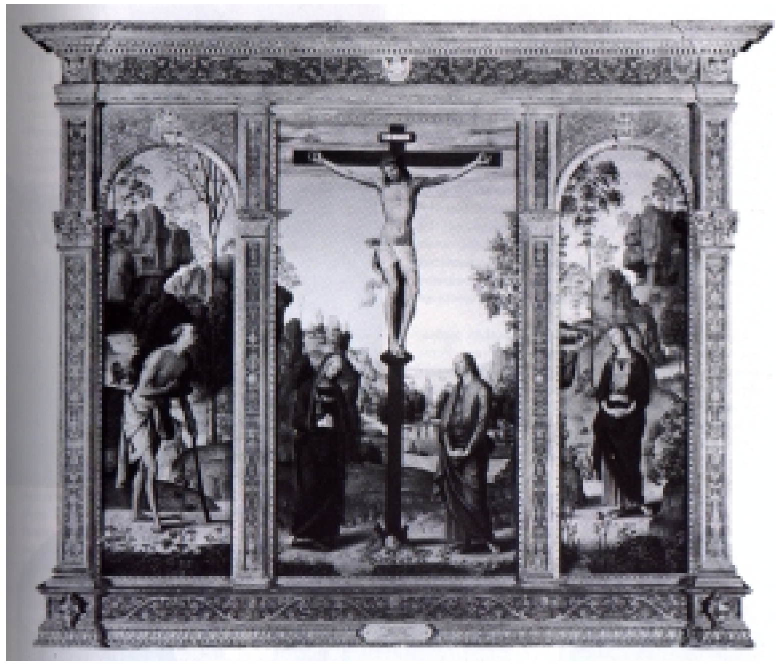
For the arts explored herein the necessity of the framework is paramount for which intuitive and the freedom of expression are able to flourish. And so the process of wandering becomes non-existent without its framework. This applies to all the aforementioned arts, where architecture should be certainly included. It is here perhaps where we as architects can benefit in learning about the art of wandering.

While we can not be integrated daily with the abstract painting of Jackson Pollock, jazz of Sun Ra, nor the literature of Henry Miller, architecture can be made to invoke the polemic of wandering as a design process or technique. As architects how can we learn through the other arts in utilizing this more expressive balance between intuition and structure?

Abstract Expressionism as Wandering

In this exploration in the ‘Art of Wandering’ we look at Jackson Pollock’s work that epitomizes the notion of a greater freedom of expression of place through the merging of intellect, intuition, and chance. It becomes apparent, when examining the works of Pollock from 1947 to 1950, that there are fundamental structures within those works. Pollock's paintings can be analyzed in four structural levels: microstructure, primary structural configuration, secondary configuration, and format.[xix]

The levels of structure in Pollock's works are precisely opposite to the hierarchical levels in the Renaissance painting *The Crucifixion with the Virgin, Saint John, Saint Jerome, and Saint Mary Magdalene*, by Pietro Perugino in 1485.[xx] The Crucifixion illustrates a highly structured painting where the *primary structure* is clear and dominant. Christ on the cross and his disciples and the Virgin on the ground form two nearly perfect geometric triangles. The smaller triangle is within the larger, where the larger is an equilateral triangle and the second an isosceles triangle. Both rely on Christ at the high center as forming the symmetry and hierarchy in the painting. [xxi]The *secondary structure* is seen as the inverse of the primary structure and is indicated by the horizon and tree line in the background in the shape of a 'V'. Here, the subservient *microstructure* is in the detail such as the rolls in the clouds and foliage in the background. The *format* is a tripartite paneled structure that sets up a horizontal rhythm that accentuates the verticality of the cross as the organizing element of the work.



Pollock's *Cathedral*, painted in 1947, on the other hand barely reveals the primary and secondary structures, where instead the microstructure is ubiquitous and dominant. Its particulate equivalence through out the painting is compared to atonal music in avant-garde jazz.[xxii] The painting can be seen as a simple expression of 'internal rhythms' made up of poured, flung, and splattered paint. These varying techniques further detail a substructure within the microstructure. Each technique is identifiable in general and gives the painting its *all-over* character, and its energetic microstructure. The aluminum enamel paint is strategically controlled in its nearly even dispersion throughout the entire vertical format of the canvas. The enamel reflects and glares back slightly from the surface and contributes to the web of controlled explosions and clusters of black paint. Increasing the indeterminacy and the peripheral blur of the painting there are thin whips throughout the field that unify and dominate the work.

The primary structure is certainly not clear, but is suggested in three long main streaks that are interrupted and diffuse, forming a structure that accentuates the verticality of its format, but also assists in a dissolving of any hierarchy and dynamically leads the eye through out the painting's field. The secondary structure, its splatter also contributing to the microstructure, consists of arabesque swirls that are strategically placed to complete the balance of the entire field. It is also mutli-centered and hinged which changes the linear dynamic of the painting.[xxiii] By regulating the structure of the painting, Pollock regulates the tension in the painting.

It is also clear that Pollock's techniques was not solely invented by him, nor was his technique only apparent when his poured and splattered paintings began in 1947. It was a collection of techniques and experiences along a wandering path. For instance, it is clear that his apprenticeship from Thomas Benton include intensive training in the schematic of a painting through composition and 'rhythmic dynamics'. Clement Greenburg, Pollock's leading critic, reinforced Pollock's rooted-ness in structure by connecting the modern styles of cubism with Pollock's work. [xxiv]The abstract expressionist's use of the cubist's syntax was usually for structural articulation, not as an investigatory tool in itself "…it would serve as a graph or a blue print with which various shapes would be subsumed." The cubists grid provided a "basic modernists vocabulary of modernity, while the surrealists provided a working method; the two combined to form the basic tools that were determinant without being constraining." [xxv] Also, it is known that Pollock was very much influenced by Mexican painters and muralists. In particular Pollock was exposed to modem art techniques-tools and materials were he "poured, dripped, splattered, and hurled paint at the picture surface" under the tutelage of David Alfaro Sequeiro.[xxvi] Further the Mexican muralists Jose Clemente Orozco and Diego Rivera had profound influence on Pollock.[xxvii]

Linking a connection from this act of wandering, this merging of intuition with framework and unpredictability, to a meaningful grounding of sense of place with primitive aspects are sifted. It is through the sublime nature of Pollock's paintings, its indeterminate framework, and freedom of expression that brings a connection to nature, and therefore a connection to place and environment.

Looking again at *Cathedral*, the composition's abstraction, through its dim 'cave-like' colors and arabesque swirls are mindful of Piranesi's sublime etchings. It was Motherwell, the most articulate of the Abstract Expressionists that likened their sublime works to a tour of Homer's Hades and river Lethe in his epic The Odyssey. [xxviii]Therefore, it is through this sublime wandering, for painter and for observer, that we become closer in connection to the primitive unconscious mind.[xxix]

<u>Avant-Garde Jazz as Wandering</u>

John Coltrane's *Ascension* is a piece that exhibits the intuitive actions within a broad framework. Over the entire piece there is a framework from which improvisation, largely collective improvisation, takes place. This work again shows us the freewill that is allowed in and around the arrangement with fluctuations between varying degrees of collective improvisation. In *Ascension* there is a high degree of unpredictable-ness and boundlessness as Arendt suggests in society as a whole-it is the arranger that leads (action) where the followers finish by seeing the work through (consequences).[xxx]

Through years of experience in Jazz improvisation and arrangement John Coltrane assembles his microstructure. Through out the piece the microstructure is made of various types of bop, including bebop, cool bop, and hard bop.[xxxi] It consists of intense polyrhythmic fragments of various types of bop that make up the microstructure with in each collective improvisation. The percussion in particular recalls the improvisational and loud drums that are often equated with hard bop. The fragments also recall the periodic bebop timing held by the high-hat cymbal. In earlier recordings Coltrane's cool bop riffs and characteristics can be recognized such as from the works *A Love Supreme* and *Olé*. As part of the overall structure there is a continual reciprocation between collective and solo improvisation. There is no real hierarchical climatic statement. The scale of the work, two-forty minute pieces, resembles Pollock's sublime canvas size. Both arts blur the format or periphery of their work, implying infinitum and indeterminacy and therefore encourage a divine and spiritual quality.

Eric Nisenson, in his book *The Murder of Jazz*, illustrates this with an existential approach:

> *"it is in a loose atmosphere that jazz musicians feel relaxed and unpressured, and in which they feel as if they have the freedom to let their music take them wherever it goes...the only way for music to evolve is not through theories or even practice, but in the existential situation of musicians defining themselves in the moment"* [xxxii]

Avant-Garde Literature as Wandering

The idea of wandering in architecture as a creative method is supported through looking at avant-garde literature. In reading the work *The Tropic of Capricorn*, by Henry Miller one peers into a dense medium of experience, of action, of consequence not only through Miller's stories but more specifically by the *way* that he writes and by the *way* that one reads his book. The writing grabs you and holds you until you finish each long sentence or sequence of short sentences, with each long paragraph, with in each long chapter. The book is a layering of wandering from the unmarked chapters to the sentence. The style is in fact similar to the works of Pollock and Coltrane, there is a freedom that is entirely unrestricted and without inhibition. All utilize a field of indeterminacy. The structure of the Miller's novel is inherent by its lack of a detailed and obvious framework. For example, there are very few dialogues; there are no chapter numbers and therefore no preconceived overall order of events. The events simply unfold and are often continuous strokes or swirls as in perhaps the secondary structure of Pollock's *Cathedral*. He is circuitous in its writing; he wanders through his story by using the microstructure as his framework. The microstructure is fabricated within his sentences through his repetitive leading subject and predicate such as "I wanted..." or continuously leading with the infinitive such as "to be...".

Using his structure Miller freely and expressively paints the essence of the struggling existence of a man in New York City in the 1920's mainly by digging into the chaos of his work and also describing in clear spatial terms his 'meaningless' existence. His emphasis on this 'meaningless' existence is inherently an ontological question that he is in search for the meaning of his Being. He writes,

> *"...fish will come and bite, tomorrow a new life, where, anywhere, why begin again, the same thing everywhere, death, death is the solution, but don't die yet, [wait another day], a stroke of luck, a new face, a new friend, million chances, you're too young yet, you're melancholy, you don't die yet, [wait another day]...maybe being up high between two shores, suspended above the traffic, above life and death, on each side the high tombs, tombs blazing with dying sunlight, the river flowing heedlessly, flowing like time itself; maybe each time I was up there, urging me to take it in, to announce myself …"* [xxxiii] *(my underline and bracket)*

There is a driving, but easy syncopated rhythm of independent clauses that seem to be indefinite. He blurs that boundary of the novel and poetry. Illustrating this below, Miller uses this technique in describing his longing to feel human, close to nature, not separated from nature because of the consequence of modern society. He writes,

> *"I wanted the earth to open up, to swallow everything in one engulfing yawn. I wanted to see the city buried fathoms deep in the bosom of the sea. I wanted to sit in a cave and read by candlelight. ..I wanted something of the earth, which was not man's doing, something absolutely divorced from the human of which I was surfeited. I wanted something purely terrestrial and absolutely divested of idea. ..I wanted the dark fecundity of nature, the deep well of the womb, silence, or else the lapping of the black waters of death. I wanted to be that night which the remorseless eye illuminated, a night diapered with stars and trailing comets. To be of night so frightened silent, so utterly incomprehensible and eloquent at the same time. Never more to speak or to listen or to think. To be englobed and encompassed and to encompass and to englobe at the same time…"* [xxxiv] *(my underline)*

III. Conclusions-Architecture as Wandering:

Framework and Freedom as Cause-Wandering as Consequence

Through the research of the art of wandering it was found that all of the seemingly most abstract and free works whether in painting, music or literature, achieve not just the gestural and spontaneous freedoms, but bring to light the necessity of a framework. It is only thought this recognition of a broad framework then can a truly meaningful improvisatory and spontaneous expression of the moment take place. For each art the elements of the artists' wanderings were analyzed where the framework was revealed.

Initially it was hypothesized that architecture has not obtained the freedom of creation, as have the other arts. After performing research however of the other avant-garde arts, uncovering there own dependency to structure as a spring board and a sustaining tool for their creativity, it was realized that architecture in fact was parallel in many regards in painting, music, and literature. In architecture, however the difficulty of the *use* of abstraction such as in a work of Pollock, or the words Miller is apparent. However, their works do provide a method of using an innovative and inventive structure to act out ones spontaneous and gestural qualities. As an emphasis in describing the importance of structure, it is almost antithetic where creativity is not found in the gestural move or the spontaneous act, but rather in the invention of a new structure, new framework to move and think with in. It is the continual reinvention of structure that becomes replenished through the amalgam processes and events of previous framework, previous spontaneous gestures, and revealing consequences. The image, the Pollock drips are the effect of the controlled cause of his action. He decides on the large or small black swirl and the confluence or clash of colors, based on perhaps unconscious empirical actions, but largely he understands the overall framework, sticks to its essence. [xxxv]

Pursuant to utilizing the microstructure for expression, defying and blurring the boundaries of architecture as a means of architectural design process, Le Corbusier mixes and redefines the hierarchy of interior and exterior spaces. This is shown clearly in Le Corbusier's Carpenter Center in Cambridge, Massachusetts built in 1964; Corbu took this opportunity given by Josef Sert, to represent the culmination of his ideas into his only United States building. Its relevance here demonstrates the extension of his method of creation, still true to his roof deck, his pilotis, in a newly found expression. The Carpenter Center is an example, more so than Ronchamp, a merging his previous framework of design with those gained in his buildings of the early 1950's. Here, even more so, the interior and exterior spaces collide, mix, and swirl all within an orthogonal context where Ronchamp had none. The deep recesses of modular fenestrations, the penetrating ramp, the pilotis with lower program, the gestural forms that appear as if the interior free space from his 'open plan' spaces were turned inside out, so that interior and exterior spaces are treated equally, are without hierarchy while creating a energetic free architectural expression.

---

[i] Miller, The Tropic of Capricom, p50
[ii] erry Coker, Improvising Jazz, p 3
[iii] "Microstructure " as opposed to a clear hierarchical order. As in Jackson Pollock's 'all over painting' the dominant framework is the microstructure-an egalitarian composition.
[iv] Christian Norberg -Schulz, *Existence, Space, and Architecture*, p10
[v] Strauss, *History of Political Philosophy*, p897
[vi] Mitchell, Redefining Designing, From Form to Experience, p29
[vii] Norberg-Shulz, *The Phenomenon of Place*, p418
[viii] Christian Norberg -Schulz, *Existence, Space, and Architecture*, p10
[ix] Strauss, History of Political Philosophy, p897
[x] Australian National Gallery, *The Spontaneous Gesture*, p5
[xi] Rohn, Visual Dynamics, pl07
[xii] Ibid, p5
[xiii] Arendt, The Human Condition, pl84
[xiv] Rohn, Visual Dynamics, p40
[xv] Arendt, The Human Condition, pl85
[xvi] Rohn, Visual Dynamics, pl07
[xvii] Kandinsky, Concerning the Spiritual in Art, p26
[xviii] Ibid, pvii
[xix] Rohn, Visual Dynamics, p4
[xx] Rohn, *Visual Dynamics*, p5, Plate 1
[xxi] Rohn, Visual Dynamics, p6
[xxii] Ibid, p106
[xxiii] Ibid,pI3-17
[xxiv] Cernuschi, Jackson Pollock, Meaning and Significance, p115
[xxv] Hobbs, Levin, Abstract Expressionism, The Formative Years, pl9
[xxvi] Siegel, Painting After Pollock, Structures of Influence, pl4
[xxvii] Hobbs, Levin, Abstract Expressionism. The Formative Years, pl4
[xxviii] Ibid,p24

[xxix] Ibid,pl3
[xxx] Arendt, The Human Condition, p189
[xxxi] Kernfeld, What to Listen for in Jazz, p130
[xxxii] Nisenson, Blue: The Murder of Jazz, p115
[xxxiii] Miller, The Tropic of Capricorn, p50
[xxxiv] Ibid,p74

Studio Work in Progress: Postcards from the Edge of Atlanta's I-20 East

Michael GAMBLE, Assistant Professor
Georgia Institute of Technology
College of Architecture
michael.gamble@arch.gatech.edu

In the concrete reality of today's world, places and spaces, place and non-places intertwine and tangle together.
Marc Augé, *Non-Places, Introduction to an Anthropology of Supermodernity*

Abstract:

Previous Masters Thesis research conducted by graduate students under my guidance was concerned with the assessment of residual urban sites in relation to suburban expansion. The tremendous influx of displaced commuters and capital into the redevelopment of Midtown and Downtown Atlanta was the impetus for this research. We constructed projects around such spaces as parking lots, brown-fields, newly inscribed 'special public interest' and 'community development' zones, and dysfunctional gaps in the city such as interstate viaducts and tunnels.[1]

The most recent Thesis research, completed in the Spring 2002, shifts away from investigations concerned with Atlanta's numerous urban centers, and moves out toward Atlanta's eastern suburban periphery. For all the prosperous professionals who have moved into the core city of Atlanta to escape traffic, the growth of the suburbs was 100 times greater than that of the city last year. The city, in fact, has grown little while the region around it has swelled. With 427,500 people, Atlanta today accounts for 13.3 percent of the metropolitan area's 3.2 million residents, while it made up 22.4 percent in 1980.[2] Over the next ten years, it is anticipated that the I-20 corridor from Atlanta, east to Madison, Georgia, will become the fastest growing sector of the Atlanta metropolitan area. The State of Georgia is finally involved in a number of initiatives which seriously assess issues related to sprawl - environmental, transportation, civic, and institutional, all related to our quality of life.

As Atlanta expands, small towns on the edge of the metropolitan area must act now to develop intelligent, comprehensive plans for future development, or risk consumption by pervasive growth. *The assessment of existing policies, the implementation of new planning strategies and architectural proposals that address the intertwining of traditional settlement patterns and contemporary modes of being is the focus of this current research.*

Organizations Involved

Over the last 3 years, several parties have come together to outline rules, regulations and visions for future growth in and around Covington, Georgia: The city of Covington; The Arnold Foundation, a funding source for redevelopment; the Community; HomeTown Neighborhoods, Inc, a developer working in concert with Duany/Plater-Zyberk to develop two new neighborhoods; and the Georgia Tech Architecture Program. Georgia Tech's relationship with Covington began 5 years ago in 1997 when Successful Community Partners, headed by the

Georgia Conservancy and Tech's Urban Design Workshop headed by Randall Roark, established the first in a series of workshops aimed at closely examining issues related small town and suburban expansion. The focus was the development of environmentally sound and socially progressive strategies which address future growth in small towns on Atlanta's periphery.[3] In the years following these initial workshops, The Arnold Foundation, a private organization based in Covington, purchased several large tracts of land in immediate proximity to the town's historic center. In the Fall of 2000, The City of Covington and the Arnold Foundation hired Duany/Plater-Zyberk to study future growth patterns in the general proximity of the center and generate designs for two new neighborhoods within a 10 minute walk of the town square. These two developments include 600 new houses, commercial and institutional buildings. Phase one is currently under construction. In the Summer of 2001, Georgia Tech was contacted and invited to participate in further assessment of Covington's future growth and asked to make proposals for sites as yet framed by other planning studies. This research, conducted with 11 graduate students from the architecture and urban design program, is concerned with a variety of very real issues that are not necessarily site specific, and address some of the inherent challenges facing many contemporary metropolitan areas.

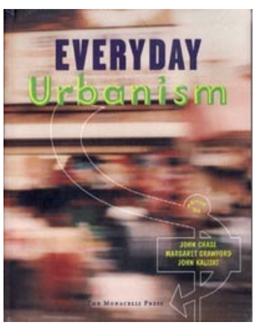
Notes on Covington

Covington, Georgia (pop. 12,000), situated 35 miles East of Atlanta, is under attack, literally, by Atlanta's pervasive sprawl. The original town plan consisted of 16 200' x 200' blocks organized around the town square. Prominent public buildings including a courthouse, bank, county offices and memorial sculptures create a profound 'small town' civic presence. Over time, Covington expanded to include two residential enclaves within walking distance of the square. Farms surround Covington even today, yet a buffer of strip style development pushes against the historic center and the fields. There are a number of voids in the historic center, once occupied by buildings, now occupied by cars. One-half mile away from the pedestrian town center running parallel to highway 287, is a myriad of big box retail and 'auto-centric' strip centers. The growth projected for Covington and Newton County over the next 10 years will permanently alter the community's physical, economic, community and lifestyle characteristics.

There are several very different scenarios confronting Covington over the next 20 years. As Atlanta continues to sprawl, Covington, like it's immediate neighbor to the West, Conyers, could very easily be absorbed by strip, *cul-de-sac* and other low-density developments. Regrettably, Conyers has become yet another poster child for poor planning and myopic development. Covington is on the cusp, and could very easily be absorbed, becoming yet another bedroom community of commuters and big box development, or worse another Conyers. While there have been occasional improvements, Covington has slowly eroded over the last 50 years. The streets, sidewalk and square are still intact, but the town lacks cohesiveness, both physically and socially. However, there are so many positive aspects - reasonably priced housing and affordable land; the potential to have many commercial and civic nodes linked by pedestrian and vehicular paths; walking, cycling and rail as a primary/secondary mode of transportation; dense woods and forests in close proximity to the town square; a reasonably sound watershed; and a commuter rail line, which links Atlanta to Augusta. There are excellent opportunities for experimental approaches to projects such as mixed uses, hybrid building types civic/institutional in-fill and adaptive re-use.

Theoretical Platform:
Introduction

For the first 7 weeks of thesis preparation, defined as "Critical Positions" all thesis students participate in an intensive reading exercise with a faculty member not engaged in studio teaching. Students explore a variety of general topics as a means to identifying a specific research trajectory. Typical to any thesis studio, each student develops a personal and particular line of inquiry, yet in the studio setting it is necessary to have some cohesive foundation from which to work. For the second half of the seminar, students shift into smaller group discussions with their specific thesis instructor. Using Atlanta and Covington as a reference, in my studio, we moved forward to address current issues concerned with the intertwining of traditional settlement patterns and contemporary modes of being. This continuing investigation includes cross media examinations of critical writing, literature, film and art, situating these issues within the larger realm of the history of ideas. We extended our reading and analysis to include the exploration of appropriate typologies and programs specific to each evolving individual line of inquiry. [4]



On Urbanism

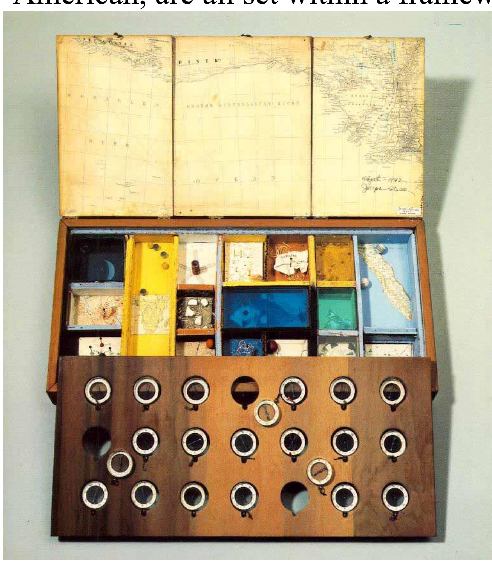
In the second part of the seminar, we began by investigating what Doug Kelbaugh has intelligently defined in "The Essential Common Place" as 'Three Paradigms for Urbanism.' Using source case studies and writings, aspects of 'New Urbanism', 'Everyday Urbanism' and 'Post Urbanism' were investigated throughout the first seminar. *"The three fundamental values described in the Introduction as underlying this book - community, sustainable order and human spirit - can be loosely assigned to these three paradigms. New Urbanism, with its emphasis on environmental values and ecological design, most fully embraces sustainable order. Everyday Urbanism is most aligned with community and Post Urbanism with the human spirit, especially freedom. "* Excerpts from <u>Suburban Nation: The Rise of Sprawl and the Decline of the American Dream</u>, <u>Everyday Urbanism</u> and <u>S,M,L,XL</u> were the source text for debates. Students worked independently or in small groups to unpack the texts and write synopses.

External sources and references regarding each type of urbanism were brought into the discussion primarily through student presentations and lectures. Students were asked to prepare 10 minute presentations on selected texts and projects and then allowed to engage in debate to test the positive and negative aspects of each paradigm. Debates and case studies were posted on the web for each discussion, and continue to be an excellent resource as students move deeper into their respective projects. Students positioned their work in relation to these debates at the outset, and moved into investigations of Covington with these arguments in mind. During reviews, in some instances, students refer to the information on the website to help make a point. This proved to be quite fruitful in the first phase of the studio.

On Narrative and Cross Programming

As design research, Architecture and Urban Design must always be an expression of a desire and an instrument of necessity. It is this double operation, the dialectic between utility and desire, which is an underlying theme in this research. Involving students in programming discussions strengthens their commitment to their own work while simultaneously helping developers, the county and community investigate the latent potential of vacant sites. Discussions with the various parties involved revealed a willingness to explore new building types, particularly as related to new forms of commerce and transportation. During the programming phase, students were asked to develop a series of Program Collages which specifically identified each and every component pertinent to continued architectural research as a series of scaled pictographs. The challenge was to outline all aspects of each evolving program, from the largest to the smallest space and begin generating a script which could be quickly edited and reconfigured to explore as many program alternatives as possible for a site.

What characterizes an urban situation is not a singular condition or name, but various actions, and with this a resistance to simple inventory. In the contemporary city, urban no longer refers to a particular form or place but to a specific class of spatial situations identified with a density of overlapping actions and characters, orders and scale relationships. This aggregation of scales – regional, metropolitan and local; of programs: political, economic, ideological, physical and functional; and characters: those complex social interrelationships which are inherently American, are all set within a framework conditioned by prior acts and future modifications.



Central to our argument is the construction of new programmatic narratives that seek to outline contemporary modes of existence. Attempts to conceptualize the contemporary city and all of its detritus with orders based solely on historic models limit more inventive readings of current situations. Conceiving of sites as a compilation of urban narratives, both literal and fictive, might propose, as J.B. Jackson suggests, stranger paths through the city.

Another key component of our research was a reassessment of single use building types. The term mixed use has been used in the past to denote a variety of programs implemented in one location. And yet we are beginning to see another approach, which can be defined as the creation more radical programmatic relationships in highly concentrated areas. The work of Joseph Cornell, the American assemblage artist , and some of the other surrealist *bricoleurs* is of particular interest, especially as a teaching tool. Similarly, Andre' Bretons "Free Union" is an excellent metaphor for free thinking about potential hybrid programs: (excerpt)

My wife whose shoulders are champagne
And fountains that curl from the heads of dolphins under the ice
My wife whose wrists are matches
Whose fingers are raffles holding the ace of hearts
Whose fingers are fresh cut hay

Cross programming, a staple of any successful urban environment, encourages invention, not tradition and potentially offers new possibilities, which suggest quality of life, economic and social benefits at multiple scales.

On Sustainabililty and Materiality

In the article "Eco-Effectiveness," William McDonough explains that strategies of sustainability go beyond environmentally friendly practices. "It engages the idea of an effective economy producing profits for companies in the business of making profits, while treating people fairly and well and respecting, or even celebrating, the natural world."[5] These notions take sustainability beyond a single issue approach, which might simply focus on energy efficiency. While his essay might read like a marketing brochure, selling sustainable architecture to corporate America, others refer to sustainability with a similar, expanded definition. The New Urbanists refer to it in their descriptions of smart city growth. In both cases, the definitions of the terms are such that they begin to implicate one another in such a way that an *either/or* restatement of the proposition is impossible. The apparently opposing sides actually co-exist, regardless of whether the scale is tipped or balanced. Sustainability, should, whenever possible, be implemented as it generally refers to a well designed, site sensitive built environment. Architects are obligated to use environmentally friendly products, and to site buildings in ways that are responsive to a given environment on obvious levels. Perhaps the design of buildings as ecological machines can become an exciting proposition – engaging the processes of each site (part of genius loci and context) and adding to the understanding of architecture as assembly and making.

Some Pertinent Projects:

Students are currently in the studio phase of the research. Throughout the review process, sites and programs were developed with future implementation in mind. In fact, most of the proposals are part of a larger, ambitious master plan for the town. The students are actively involved in discussions at the community level, and due to the nature of the research, are committed to expanding conceptions of how Covington could grow in the future.

Hybrid I: Assessing and Redesigning Parking Lots and Strips Centers

These projects are concerned with re-evaluating the strip, particularly in relation to the historic center. Walking north from the central square, the fabric of Covington very quickly erodes into single use occupancy buildings surrounded by asphalt. One look at the attached aerial photograph reveals the challenge: How can defunct strip shopping centers be reinvigorated? How can a greater density be sutured into an existing site? What are the economic and environmental parameters of such research. In Covington, a significant ecosystem meanders through all aspects of the place, from the strip through the center and on into the countryside. By increasing the density around these sites and addressing the mitigation of environmental conditions, can architects change public empathy toward the automobile, or will atrophy eventually set in to super sized suburban culture? One goal of this critical project is *to make the common uncommon, by seeking ways to* transform an ordinary strip development into a place, to make something ordinary, extraordinary.

Project One: Small Scale Big Box and Housing

What are the potential connections, (if any) between standard, suburban big box retail, parking, housing and a 200' x 200' city block on the edge of the historic center. Target, one of the more progressive retailers in the 'big box' corral is the anchor tenant in this exercise. In addition, 20 housing units will be included in this project. Convincing retailers to develop housing in concert with shopping facilities is at least now precedented.[6] As demographics change, and vehicular congestion coagulates, living in close contact to shopping will be imperative, even in the suburban landscape.

Project Two and Three: Piggybacking

The current condition in Covington along Hwy 287 is similar to small towns across the country. Commonly referred to as 'the strip' this area runs along the highway, only a few blocks from the urban center with large retail centers spread out along part of its length. Constructed adjacent to the train depot years after it was rendered defunct by the automobile, new interest in light rail creates a desire to reassess the strip in order to create more density close to the train station. There is no edge condition, the buildings have no relation to the street, and the scale is conducive only to vehicular traffic. Peppered along the edge of the parking lots are various smaller businesses - fast food restaurants, bank branches, video rental stores etc. In many instances these function as the de facto building edge, providing only symbolic mitigation between the street and the vastness of the parking lots. This in between area is ripe for speculation. What would happen if these established islands had a new program added above? What would happen if various new programs were inserted within the confines of the parking lot? How can points of densities begin to challenge the current landscape of the parking lots?

This investigation is concerned with three key issues: The assessment of existing strips and parking lots for future changes and uses; the development of a structural and spatial prototype which could be used on other sites; methods of increasing density by cross programming without drastically altering parking and vehicular patterns.

Hybrid II: Rail Transit Center/ Live/Work Housing

One component of Georgia's SmartGrowth initiative involves the renewal of the Atlanta-Augusta rail corridor. Covington benefits from its inclusion in this transportation network - a rail corridor of affluent small towns connected to metro Atlanta. GRTA is the state of Georgia

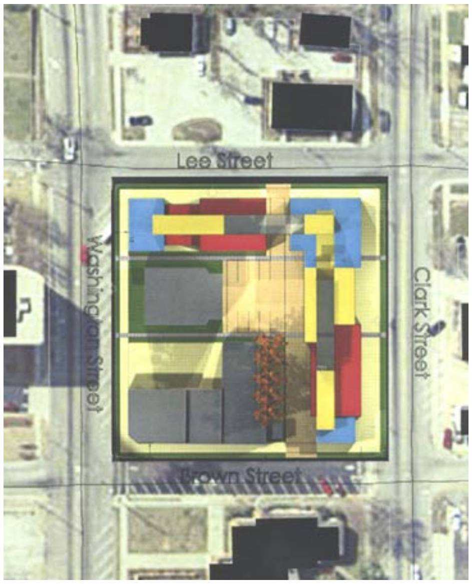
authority that works to provide transportation choices, improved air quality and better land use in order to enhance the quality of life and promote sustainable growth for all Georgians.
More specifically, GRTA works with those counties in Georgia that have been designated non attainment under the federal Clean Air Act standards. Currently, there are thirteen counties in the metropolitan Atlanta area that are non-attainment. .[7] Planned for implementation in phase two of the Georgia Regional Transit Passenger Rail Integration Plan, the Atlanta-Covington-Madison commuter rail corridor should be functioning by 2008.

With proposed future expansion into these small towns, Atlanta's growth is projected to maximize the Atlanta-Madison rail corridor for continued expansion. This system will create a virtual proximity for Covington creating viable alternatives for suburban living in Atlanta without the commuting deterrents. DPZ's analysis and proposal discusses the potential of a connector to Atlanta, but never investigates Covington's ability to accept this change. What

possibilities will it create? What conditions will it alter? How can it be used off the main lines and into the town centers? The proposal for this project is a direct result of these questions. How can this kind of infrastructure influence the transition of Atlanta's growth into traditional Covington. The program of this project will include: Rail spur from the main connector line into downtown Covington; Work/live hybrid units that allow easy access into Atlanta with the advantage of suburban living while accommodating the need for low cost housing; Retail development that intensifies the urban street condition; Parking Garage to promote pedestrian surfaces in the adjoining town square; and park that abuts the adjacent wetland.

Hybrid III: Neighborhood Telework Center, Chamber of Commerce, Design Center

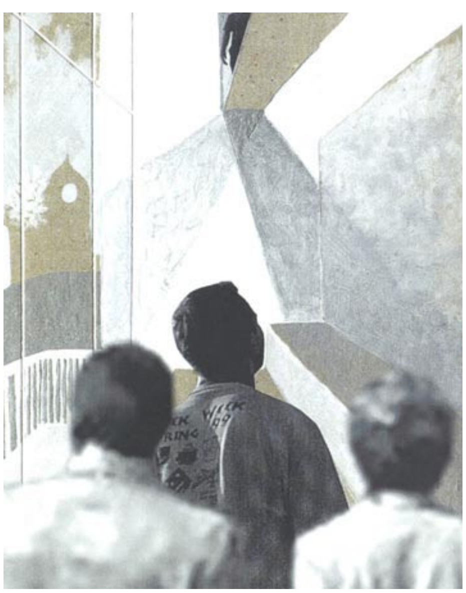
This proposal superimposes three distinct programs: The Covington Chamber of Commerce, A new Teleworking Center and a New Design Center. This new typology will bring together some key elements at play in the redefinition of Covington. Under future funding by the Arnold Foundation, the design center will serve as an integral addition to the Chamber of Commerce. As a progressive town on the Suburban periphery, Covington's move to create a telework center, a centrally located, walkable business center subsidized by private and public funds, will demonstrate how successful teleworking can be. Larger corporations are now understanding the benefits of employee telecommuting, and Atlanta's annual telecommuting day has demonstrated the real impact working from home or remote locations can have on Atlanta's



stifling rush hour traffic. During the summer of 2000, the Atlanta region ranked 4th worst in the country for bad air days. Between 1997 and 1999, Fulton County had the worst smog problem in the country outside of Los Angles, making Fulton's air pollution one of the worst in the US. In 2000, every region of Georgia violated the health based smog standards except coastal Georgia. According to the Georgia Public Interest Research Group (PIRG), the air is unhealthy somewhere in Georgia on one out of every two days.[8] To help combat metro Atlanta's increasing traffic problems, the Metro Atlanta Telecommuting Advisory Council (MATAC) is committed to demonstrating the positive impact of teleworking has on both traffic and pollution issues as well as employee recruiting, retention and productivity. MATAC says that widespread telework activity can accelerate Commuter Choice participation by metro Atlanta employers because when executives discover they can save money, improve employee performance, reduce absenteeism and turnover, and recruit quality employees.[9] This progressive facility will serve as a model for future development in neighboring counties.

An architecture that synthesizes both the private and public interest of its users will strengthen the downtown district of Covington. As Jane Jacob notes, a district must satisfy the multiple needs of its users. Currently Covington is threatened by its changing demographics and the surrounding retail strip centers. Previous attempts at revitalizing an urban center have been stereotypically focused on issues of nostalgia. Everyday space is the connective tissue that binds daily lives together, amorphous and so persuasive that it is difficult even to perceive. In spite of its ubiquity, everyday space is nearly invisible in the professional discourses of the city.[10]

Everyday life is organized by time as much as by space, structured around daily itineraries, with rhythms imposed by patterns of work and leisure, week and weekend, and the repetitious gestures of commuting and consumption.[11] The tension between modern architecture's quest for the conceptually pure and the plurality of the modern city defines the fundamental dilemma of twentieth-century urban design.[12]



Hybrid IV: New Community Center/Elderly Housing/Community Market

Covington needs a diversified recreational facility that responds to three major groups: the elderly (ages 55-up), Young adults (age 21-35) and youth (age 15-20). The immediate vicinity of Covington is composed of shops, offices, restaurants, abandoned factories and residents with no structures that address planned recreational activity. Through uniting many diversified genre of activity under one roof, it is possible to achieve a dialogue between social groups who would not necessarily interact and this housing of events would create a vehicle which could be driven towards social understanding amongst its users and ultimately, social unity. By overlapping programmatic elements intended for a diversified group of users (varying in age, race, class, day and/or night users, etc.), this proposal is concerned with a new type of community center. Programmatic types include an Art Gallery, Auditorium, Cafeteria, Community Market, Parking Lot, Computer Lab/ Learning Center, Conference Room, Exercise Room, Game Room all set within a Terraced Greenspace which is part of Covington's emerald necklace, a resuscitated ecosystem which flows through the town. In the world of the psychological, barriers between humans are formed in mind sets through differences in class, stations, wealth, self-conceit, etc. In the physical world these differences and barriers may take on the appearance of walls or vertical planes that block horizontal movement. More so, in a world combining the psychological and the physical, the metaphysical exists. This metaphysical world introduces a world of impenetrable and penetrable layers in space. One could see this evident in the interior and exterior design of the Kawasato-Mura Center. By using the program and formal architectural elements one could envision creating spaces that foster interaction between groups that would not necessarily intertwined on a regular basis. This stage from dialogue could be a possible solution for understanding one's self and other members of society.

Conclusions

Sprawl and unmitigated growth are a detriment to the quality of life in Metropolitan areas. Long commute times and higher and higher levels of pollution weigh heavily against the American Democratic ideals of mobility, freedom and personal liberty. Hundreds of communities are now working toward controlling runaway development by prescribing to the tenants of SmartGrowth. Indeed there are a litany of buzzwords surrounding new attitudes toward urban growth, and the risk is very real that 5 years from now our concerns for more efficient urban/suburban environments will have further succumbed to the perils of unchecked expansion. Anyone involved in the debate knows that change will only come slowly over a protracted period of time. In Atlanta, the Georgia Regional Transportation Authority is operating on a 25 year timeline. Changing public policy and perception is no easy task, and the implementation will prove extremely costly. But the challenge is real, and counter to trends in the academy over the last 10 years, students have the opportunity to begin embracing new ways of thinking about towns and cities that will have a direct impact on their, and their children's, futures. In fact, it may very well become vogue to read a planning or zoning document in the design studio! Perhaps this work will contribute to the debate, and help empower future designers to consider viable alternatives as small towns are confronted with the multvalent forces of the contemporary American city.

---

[1] See Design Work presented: *2 Projects: Another Atlantic Steel and the Contemporary Film Institute* and Reprogramming Midtown Atlanta : Excerpts from the Masters Project Studio published in the ACSA National Conference Proceedings, Baltimore, Maryland, March 2001.

[2] http://www.ganet.org/grta/nyt_11_21_99.html

[3] See Workshop Covington: Blueprints for Successful Communities , published by the Georgia Conservancy, November 1997.

[4] See my syllabus online at http://undertow.arch.gatech.edu/homepages/mgamble/mp2002.htm

[6] See Sienna Architectures acclaimed Zupan Market in Portland, Oregan

[7] http://www.grta.org/

[8] http://georgia.sierraclub.org/

[9] http://www.matac.org/

[10] Everyday Urbanism, edited by Margaret Crawford, John Chase and John Kaliski. New York: Monacelli Press, 1999. pp. 25.
[11] Ibid. p. 26.
[12] Ibid. p. 90.

The Mineral Springs of Virginia: Virginia's Lost Landscape

Brian KATEN
Landscape Architecture, Virginia Tech
bkaten@vt.edu

In his essay "The 19th Century Rural Landscape: the Courthouse, the Small College, the Mineral Springs, and the Country Store", John Brinkerhoff Jackson stated: *"One final southern landscape feature deserves much more study than it has so far received: the watering place or spa or mineral springs.[1]"* This paper presents the nineteenth century mineral springs as a particularly significant yet long neglected Virginia landscape. These mineral springs will be revealed as places of convergence and interest to landscape historians, historical landscape architects, preservationists, and contemporary designers interested in heritage landscapes, healing landscapes and tourism

The Virginia landscape has long been a place of particular interest to historians and designers alike. Its evolution, from the earliest English settlement at Jamestown through the plantation landscapes of the eighteenth and nineteenth centuries to contemporary sustainable communities is an important chapter in the making of a truly American landscape. Despite the richness of this story, it is incomplete. Beginning in the mid-eighteenth century and lasting into the early decades of the twentieth century, a significant Virginia landscape, the mineral springs, flourished and extended the influence of the physical and social "Virginia" landscape far beyond the Tidewater towns, and Plantations.

Public use of the springs began in the mid-eighteenth century. Many of the more prominent springs, including Hot Springs, Warm Springs, Sweet Springs and Rockbridge Alum Springs were frequented by Virginians and colonists from other states well before the revolutionary war. In 1747 George Washington noted in his *Journal of My Journey over the Mountains*, that "We this day called to see the fam'd Warm Springs." [2] In 1756 the warm springs at Bath (now Berkley Springs, West Virginia) were given to the state by Lord Fairfax to be "forever free to the public, for the welfare of suffering humanity". [3] Around the springs the town of Bath was platted and among the first to purchase a lot was George Washington. By 1770 the springs had become what Carl Bridenbaugh has called "a powerful democratizing agent" a place where "the planting aristocracy, Jefferson's sturdy yeomanry, and coonskin democrats of the back woods mingled…These resorts proved a potent factor in promoting colonial union and in nourishing nascent Americanism. They were the most significant intercolonial meeting places. At the spas representatives of the aristocracy of each colony meet in person…Some came back year after year; some made lifelong friends; some began protracted correspondence." [4]

The best description of the springs landscape is from the *The Springs of Virginia*, by Perceval Reniers: "The region of the Virginia Springs straddled the continental divide, sprawling through the long valleys and over the equally long ridges of the Alleghenies…[with] Warm Springs at the top and Grey Sulphur Springs at the bottom.

The central axis running between them would be about 75 miles long and the transverse axis, running cross county from the east to the west between Rockbridge Alum on the east and Blue Sulphur on the west, would be approximately the same….through the center lay the inner group, the fountains most strongly impregnated with minerals, heat, fashion, and fame - the Warm, the Hot, the White Sulphur, the Sweet, the Salt Sulphur, and the Red Sulphur. For the most part they were connected by good turnpike roads, and in order to make the circuit of the lot one had to cut back and forth across the mountains, up out of one valley and down into another, travelling in all about a hundred and seventy five miles."[5]

The springs were in many ways the edge of culture on the early American frontier. As the frontier moved west the springs in their mountain setting became important stops in the travels of early American nature writers and foreign travelers serving as a laboratory for exploring and presenting both the designed landscape and romantic "nature". The springs were often included along with other early tourist destinations such as Natural Bridge, Peaks of Otter, Weyer's Cave and Falling Springs in tours of Virginia's natural wonders[6] (fig. 1 and 2). In the *Narrative of a Tour in North America*, the English Barrister, Henry Tudor wrote in 1831: "I reached for the night, one of the fashionable Virginia watering places, called Sweet Spring…having a handsome and extensive sweep of verdant ground spread out in front, of the dimensions of a park. Nothing can exceed the romantic seclusion of this beautiful spot; of which the finely sheltered situation, and many natural advantages, render it a crowded and favorite resort during the summer months." (fig's. 3 and 4) Communion with nature at the springs would become an important activity in the early nineteenth century tourist landscape and a significant component of medically prescribed healing regimens for spring visitors. A medical regimen prescribed for a visitor to Red Sulphur Springs gives some indication of the importance of the landscape in the healing process.

> "If the weather and other circumstances admit, rise about 6, throw your cloak on your shoulders, visit the spring, take a small-sized tumbler of water, move about at a brisk walk; drink again at 7, and once more at half -past 7; breakfast at 8. After breakfast , if you can command a carriage, take a drive, otherwise a slow ride on horse-back until 10. From 10 to 12, enjoy yourself in conversation or other mode most agreeable to you -- eat no luncheon --at 12 take a glass of water, at 1 take another. From 12 to 1 take exercise at ten pins, quiots, billiards; dine at 2; amuse yourself in social intercourse until 5. Take a drive, ride, or walk until 6 -- drink a glass of water; exercise until 7 -- take a cracker and a cup of black tea. If you are a dancer, you may enjoy it, but in moderation, until 9-quaff a glass of water from the Spring, and retire to your room."[7]

By the time of the American Civil war the Virginia springs were perhaps the most important social landscape in the south. People came from throughout the south each summer to travel the springs circuit in western Virginia. Peregrine Prolix noted in 1834 that: "This tour, taken during the 'season' (the summer), lasted for as many weeks -- or months -- as the pocketbook could bear and became a fixture in the social life of the antebellum south. Thousands of visitors came annually, not only from Virginia but from

Louisiana, the Carolinas, and the other states of the Deep South." [8] Charlene Lewis has stated that "Each Summer, more elite whites congregated at these resorts than anywhere else in the south….The Virginia Springs formed a key part of the extensive and elaborate world of southern elite…Virginia springs shaped elite society throughout the south".[9] In 1838 Captain Frederick Marryat noted of White Sulphur Springs that: "…all the first old Virginia and Carolina families, many of them descendents of the old cavaliers, were at the springs when I arrived there; certainly I must say that I never was at any watering place in England where the company was so good and so select."[10]

The springs also served as meeting places of a wide variety of thought and social intercourse. Peregrin Prolix writing of an 1834 visit to White Sulphur Springs described the political and social mix: "from the east you have consolidationists, tariffites and philanthropists; from the middle, professors, chemical analysts and letter writers, from the west, gentlemen who can squat lower, jump higher, dive deeper, and come out drier than all creation besides, and from the south, nullifiers, union men, political economists, and statesmen; and from all quarters functionaries of all ranks , ex-candidates for all functions, and the gay agreeable and handsome of both sexes who come together at the White Sulphur to see and be seen, to chat, to Laugh and dance… "[11] The social mix was just as great in 1847 when John S. Skinner, writing of White Sulphur Springs for the New York Tribune observed: " The company here is increasing hourly. The last three days have added 150, and what is remarkable, they come from 14 states and Territories…" The springs were also as Charlene Lewis notes "places where southern women found rare freedom and power".[12] The landscape played a central role in the exercise of that freedom. Relieved from the their responsibilities on the plantations, "women happily spent entire days outside – strolling, hiking, climbing, riding, fishing, picnicking, and playing lawn games."[13] Young people of both genders could enjoy rare unsupervised outings and excursions in the spring's landscapes. Included were "romantick rides an walks as well as fishing trips"[14]

Throughout the nineteenth century the springs were important places in the developing American recreational landscape. Henry Lawrence has stated that the springs "were the first recreation resorts on the continent".[15] In the north, resort towns developed around many of the early spas but in Virginia the springs, clearly influenced by the plantation landscapes of the south, developed into a distinctive landscape compositions often comprised of a modest hotel flanked by cottages or "rows" of guest rooms whose arrangement enclosed a central park-like greenspace. (fig's. 5, 6, and 7) Porte Crayon's 1855 description of Rockbridge Alum Springs captures this distinctive springs composition: "…the lawn, enclosed by a semicircle of cottages, partially shaded with trees, its green carpet dotted with groups of gayly dressed visitors, presents a pleasing and animated picture."[16] The larger landscape composition at the springs included channelized streams, spring houses, bath houses, gazebos, bowling alleys, ballrooms, pavilions for music and games, a pond, icehouses, privies, and walks and gardens. The refinements that many of the springs achieved were noted by Porte Crayon who noted in 1855 that "Fauquier Sulphur Springs… surpasses all others in the extent, elegance, and costliness of its improvements. The buildings, of brick covered with slate, form a semicircle, inclosing a handsome park. These grounds are ornamented with fountains and enlivened by herds of fallow deer." [17](fig. 8) The manicured landscapes of the springs and the surrounding wilderness were more than aesthetic presentations. Each day visitors engaged those landscapes through prescribed medical regimens, social gatherings and excursions, and solitary hikes and strolls. To be in the landscape and to experience its richness was a critical component of the visitor's experience.

The Virginia springs would influence the design and development of springs across the United States from White Sulphur Springs in Ohio to Paso de Robles Hot Spring in San Luis Obispo County California developed by D.D. Blackburn in 1857. Henry Lawrence reveals that: "Mr. Blackburn had been born in Virginia but grew up 10 miles from Yellow Springs and 45 miles from White Sulphur Springs in Ohio. His resort…began with a small hotel flanked by rows of cottages on three sides with detached buildings containing parlors, billiard rooms, dining halls and bathhouses."[18] The influence of the spring's landscapes, however, would be wide ranging. According to Lawrence, The spring resorts in the mountains west of Charlottesville were "the most direct descendants of the Jeffersonian design [of the University of Virginia's 'academical village'] and would become an important link in the American campus design tradition[19] (fig. 9). Their influence on later landscape compositions such as the twentieth century motor court and motel design is also readily apparent.

Over 80 Virginia mineral springs have been identified. The defining features of a significant number of those landscapes are intact. Today, in a time of increased interest in heritage landscapes, healing landscapes, and tourism, they are an extraordinary resource for interpretation and rehabilitation. A Springs Tour again seems to be a possibility following the success of the recently developed automobile tours of Virginia's Civil War landscape: The Virginia Civil War Trails. The Trails' brochure includes five automobile tours including a Shenandoah Valley tour.[20] The landscape of the Shenandoah Valley Tour includes nearly all of the present day Virginia springs sites located west of the Blue Ridge Mountains. Extending the tour 30 miles to the south and west add all of the remaining significant spring sites. The expanded tour could easily be connected to the nearby West Virginia Springs Tour that includes Sweet, Salt Sulphur, Red Sulphur, White Sulphur, and Blue Sulphur Springs among others. The resultant tour would be a significant and meaningful overlay to the Civil War Trails tour. During the civil war many of the springs served as military hospitals. After the war the springs again served as retreats for the former aristocracy and southern military elite. Prominent among the spring's tour would be Yellow Sulphur Springs between Christiansburg and Blacksburg Virginia (fig. 10). Here Roderick Lewis has noted that "After the civil war quite a number of the prominent ex-soldiers would gather at the Yellow Sulphur Springs Resort. General Pierre Beauregard …was often a summer guest. Another prominent guest was General Jubal Early.[21] Early and others meeting at Yellow Sulphur following the Civil War would reconstitute the Southern Historical Society and significantly influence the development of the social and physical landscape of the American south for the next century.

The Virginia Mineral Springs are a significant part of the story of a developing nation and the defining event of that young nation's history. They deserve to again take their rightful place as Virginia landscapes of historical importance, regional and national influence, and economic potential.

Fig. 1. Natural Bridge, from Edward Beyer's Album of Virginia, 1857. Special Collections Department, University Libraries, Virginia Tech.

Fig. 2. Falling Springs, from Edward Beyer's Album of Virginia, 1857. Special Collections Department, University Libraries, Virginia Tech.

Fig. 3. Sweet Springs Hotel, Photo by author.

Fig. 4. Sweet Springs Cottage Row and Central Lawn. Photo by author.

Figure 5. Capon Springs, Photo by author.

Figure 6. Yellow Sulphur Springs Hotel, Photo by Author.

Figure 7. "Memphis Row", Yellow Sulphur Springs. Photo by author.

Figure 8. Fauquier White Sulphur Springs, from Edward Beyer's Album of Virginia, 1857. Special Collections Department, University Libraries, Virginia Tech.

Figure 9. Montgomery White Sulphur Springs, from Edward Beyer's Album of Virginia, 1857. Special Collections Department, University Libraries, Virginia Tech.

Figure 10. Yellow Sulphur Springs. Photo by author.

[1] John Brinckerhoff Jackson, Landscape in Sight: Looking at America (New Have: Yale University Press, 1997), 148.

[2], Michael P. Branch and Daniel J. Philippon, eds. *The Height of Our Mountains: Nature Writing from Virginia's Blue Ridge Mountains and Shenandoah Valley* (Baltimore: Johns Hopkins University Press, 1998), 93.

[3] Carl Bridenbaugh, *Baths and Watering Places of Colonial America* (Williamsburg: Virginia, 1946), 160.

[4] Bridenbaugh, *Baths and Watering Places,* 181.

[5] Perceval Reniers, *The Springs of Virginia: Life Love and Death at the Waters 1775-1900* (Chapel Hill: University of North Carolina Press, 1941), 26.

[6] Will Sarvis, "Turnpike Tourism in Western Virginia, 1830-1860", *Virginia Cavalcade* (Winter 1999): 19.

[7] William Burke *The Mineral Springs of Virginia*, Quoted in John W. Dumont, *Red Sulphur Springs Background Survey Report* (J.W. Dumont, 1987), 28.

[8] Quoted in John W. Dumont, *Red Sulphur Springs Background Survey Report* (J.W. Dumont, 1987), 15.

[9] Charlene Marie Lewis, "Ladies and Gentlemen on Display: Planter Society at the Virginia Springs, 1790-1860". (Ph. D. diss., University of Virginia, 1997), ii-iii.

[10] Robert Conte, *The History of the Greenbrier, America's Resort* (Charleston, West Virginia: Pictorial Histories Publishing Co., 1989), 206.

[11] Conte, *The History of the Greenbrier*, 202.

[12] Lewis "Ladies and Gentlemen on Display", iii.

[13] Charlene Marie Lewis, *Ladies and Gentleman on Display: Planter Society at the Virginia Springs, 1790-1860* (Charlottesville; University of Virginia Press, 2001), 130.

[14] Charlene Marie Lewis, *Ladies and Gentleman on Display: Planter Society at the Virginia Springs, 1790-1860*, 148-9.

[15] Henry W. Lawrence, "Southern Spas; Source of the American Resort Tradition". *Landscape*, vol.27, no. 2, (1983) p. 2.

[16] Porte Crayon, "Virginia Illustrated", *Harper's New Monthly Magazine* no. LVII (Feb. 1855, vol. X), 80.

[17] Porte Crayon, "Virginia Illustrated", 123.

[18] Lawrence, "Southern Spas; Source of the American Resort Tradition", 11.

[19] Lawrence, "Southern Spas; Source of the American Resort Tradition", 6.

[20] See the Virginia Civil War Trails Brochure published by Virginia Civil War Trails, Richmond, Virginia 1997.

[21] Roderick Lewis Lucas, *A Valley and Its People* (Blacksburg, Virginia; Southern Printing Company, 1975), 84.

Promoting Sustainable Development Through Participatory Design in a Small Town: Mebane, North Carolina: 2nd Phase

Zeynep TOKER (North Carolina State University)
Umut TOKER (North Carolina State University)
Fatih A. RIFKI (North Carolina State University) fatih_rifki@ncsu.edu

1. Introduction

The goal of this project is to generate appropriate design guidelines and implementation strategies for development in key locations of downtown Mebane, North Carolina. One of the main objectives of the project is to enhance community participation in this process. The appropriate goal setting technique in this regard is chosen as charrette process, i.e., the rapid pace at which the design is finalized with a guiding principle: consensus (Sanoff, 2000).

The charrette process is planned in three phases. In the first phase, objectives and strategies were determined based on the identified problems. The second phase elaborates on design implications of these strategies. Finally, in the third phase the appropriate design guidelines will be generated for the development of downtown Mebane. Following the first phase of the process, which was presented in the ARCC spring 2001 conference, second phase is prepared, illuminating the third phase.

2. Charrette process as a technique

The charrette process is a goal setting technique by way of collecting local knowledge as a compliment to professional knowledge. Therefore, it is a collaborative exchange of ideas and information between the public and the professionals on a specific problem or a project related to built environment, or a decision concerning the future of society (Sanoff, 2000). Since there are many disciplines involved in the formation, improvement and development of physical environment and the society occupying it is diverse, numerous disciplines are expected to be involved and cooperating in the charrette Process. Thus, it is inherently an interdisciplinary problem solving approach.

The distinguishing characteristics of charrettes are:

- group involvement,
- development of a product,
- time limitations,
- commitment to reaching consensus (Gollattschek & Richburg, 1981).

Regarding the group involvement criterion, the primary concern is that people, who are directly or indirectly affected by the development decisions, participate in the process (Smith & Hester, 1982). Therefore, there are two main objectives of the charrette process. The first is to gain the unified support of a representative cross section of citizens affected. This is necessary because of the inevitable need of their endorsement when it is time to implement these decisions.

Second, the charrette process is aimed at securing the support of the power structure that will commit the necessary resources for implementation (Sanoff, 2000). Therefore, in addition to professionals' involvement in the process, support from citizens and from the power structure is indispensable for a successful implementation of the decisions developed through the charrette process.

Development of a product is the second criterion in the charrette process. In order to achieve this aim, it is necessary that there is an identifiable problem to discuss to begin with. For identifying the problem and generating solutions, user participation is inevitable in the charrette process. Moreover, involvement of professionals from within and outside the community is another dimension that helps to come up with a product at the end of the process (Sanoff, 2000, Smith & Hester, 1982). In addition to all of these, one of the major constituents is commitment to put recommendations into action.

As the third criterion time limitations should be considered in the charrette process. On one hand, the success of a charrette process is dependent on the implementation period. Ideally, the charrette process maximizes participation over a 3-5 day framework. This is a structured schedule but an open process for participation (Sanoff, 2000, Smith & Hester, 1982). In a charrette, design solutions are developed by planning intensively in a compressed period of time while working against deadlines to resolve differences (Cramer & Wehking, 1973). Three major mechanisms are used during this process. First, idea generation requires a reciprocal knowledge transfer among all affected parties. Second, decision-making requires a dialogic discourse ideas presented of. Finally, problem solving provides recommendations and proposals as process outcomes (Sanoff, 2000).

On the other hand, there are time limitation problems during the process for evaluating the outcomes of several steps, which will inform the following steps in the process. Therefore, it is necessary to plan the program in such a way that these time limitations are considered.

It is possible to see the charrette process as the initial organizing step for a longer implementation period. Thus, there are some basic strategies to follow during this critical process in order to develop consciousness and willingness among the participants to achieve a consensus. Perception of a common goal and sense of urgency are two complementary strategies in this regard. Representations of all the components of a community should be involved for developing a sense of full participation. At the same time, the process should be designed in such a way that a sense of individual contribution to the process should be also maintained (Sanoff, 2000). Charrette should help resolve conflicts and to redirect the energy toward common concerns (Smith & Hester, 1982).

Although these basic strategies and mechanisms are present in most charrettes, there are differences and hence several categories of the charrette process (Sanoff, 2000). First, educational charrettes generally address an architectural or urban design problem serving community issues. They end up with schematic representation of the solution ideas. The process usually involves university students and their instructors. Second, leadership forums, retreats, focus groups are forums for citizen activists, elected officials and nonprofit developers. These informal forums are used to define local problems; help list the relevant issues and test some alternatives appropriate for the problems. The third category is traditional problem solving charrette, which involves practicing professionals and participating citizens, and focuses on producing solutions to a well-defined problem.

For example, the outcome maybe a plan of a building or a park that is necessary for the community. Finally, interdisciplinary team charrette involves a holistic approach that deals with issues such as economic development, affordable housing, neighborhood crime and transportation. Teams of eight to twelve practicing professionals come together for this comprehensive task.

3. Case of Mebane, North Carolina

In light of the above charrette categories, the charrette proces of Mebane, may be regarded as an educational charrette because of its connection to North Carolina State University's College of Design, as well as a traditional problem solving charrette because of its ultimate aim, which is to generate a design solution.

In Mebane charrette, the area of concern was predetermined, as the downtown area. The main objective was to identify alternatives for the development patterns of downtown Mebane that would promote sustainability. Therefore, the charrette process was designed in such a way that, the citizens were able to define the problems in the study area and propose several objectives together with relevant strategies.

The charrette process in Mebane had the main objectives found in most charrette processes. Participation of citizens from a cross section of the society and involvement of power structure were guaranteed. However, this charrette was the first step of a three-step process, which includes idea generation, decision making, and problems solving.

In the first step, problems were defined and ideas were generated by the participants. At the end of the first charrette, all the goals and strategies, which were developed and ranked by the participants, were listed (Figure 1). Based on these goals and strategies, several proposals were visualized in order to increase the awareness during the decision making process. Visual understanding of these goals and strategies is crucial for the charrette process, since it will increase the understanding of the participants about the design implications of their decisions.

GOALS AND STRATEGIES

1. Attract people to downtown
- More restaurants
- New uses (education & entertainment)
- Adaptive re-use (White Furniture Company)
- Shops: specialty/antiques
- "Town square" area
- New grocery store in downtown
- Conversion of post office to library
- More landscaping
- Pedestrian crossing at railroad
- Diagonal parking
- Small educational center in downtown

2. Retain character/history of Mebane
- Façade improvements
- Adaptive re-use (White Furniture Company)
- Focus on existing buildings
- Designed open spaces
- A train station
- More landscaping
- Pedestrian crossing at railroad

3. More people living in downtown
- Shops downstairs – flats upstairs
- Focus on existing buildings

4. Make streets more attractive to pedestrians
- More landscaping
- Move electric wires underground
- "Town square" area
- Repaired sidewalks
- Improve street lights

5. Mixed-use in downtown
- Improve street lights
- Shops downstairs – flats upstairs
- Develop White Furniture as business incubator
- Focus on existing buildings

6. Improve ways to get to Mebane
- A train station
- Pedestrian crossing at railroad
- Repaired sidewalks

7. Economic development
- New grocery store in downtown
- A train station

8. Fill the empty spaces/spots
- Façade improvements

Figure 1. The list of goals and strategies.

Therefore, the first charrette for idea generation continues with the second step, decision-making. In this step, there are some design implications generated in light of the goals and strategies identified in the first charrette. That is, participants have the opportunity to visualize the design implications of the solutions they propose in the first charrette.

In the first charette the participants individually matched the most important three goals with three strategies. Therefore, among all of the goals and strategies generated by the participants, the ranking was achieved according to their perspectives. Regarding this ranking of the goals and strategies achieved in the first charrette, the design professionals prepare the visual representations of the primarily chosen solutions by the participants. Two major alternatives are developed. First, locating an educational complex, and transforming the surrounding environment into a recreational outdoor space are demonstrated through digitally edited photographs (Figure 2, Figure 3). Second, re-use of the White Furniture Company building as a recreational center is visualized with its surrounding potential outdoor areas (Figure 4).

Figure 2.An educational complex near White Furniture Company Building (before and after).

Figure 3. Open spaces surrounding the educational complex (before and after).

Figure 4. An open space near White Furniture Company Building (before and after).

Although these alterations implemented in the specific locations of downtown Mebane, the general concerns, such as attracting more people to downtown, retaining its historical character, making the streets more attractive to pedestrians, and increasing the number of people living in downtown are the guiding ideas of all proposals. Moreover, the underlying principles in all of the design implications are drawn from the strategies that were identified in the first charrette. Several of these principles are adaptive re-use, more landscaping, addition of new uses, underground electric wires, and designed open spaces.

The final step, problem solving will be designed to make sure that participants have an equitable role in the formation of the final decision. There will be few design alternatives in the third charrette, based on the reactions about the design implications in the second step. Thus, the result of this three-step process will be based on the ideas and preference of participants, and the expertise of the professionals.

4. Conclusion: Evaluation of the process

Establishing critical awareness for the current condition and development alternatives among the residents of Mebane is one of the potentially successful aspects of this process. Although the details of Mebane Charrette process are explained in the paper covering the first phase (Rifki et al, 2001), some aspects are still notable at this stage. There are several achievements, which are specific to this project. First, the ongoing planning process carried by the county planner was a complementary project because of its lack of concentration on the downtown. Second, the regular meetings with the county planner helped to arrange a meeting for the charrette process. People are informed about the project and the content of the charrette meeting. Besides, these regular meetings provided a certain amount of time, which is already designated to discuss the future of their city by the residents of Mebane. Third, the involvement of local newspaper was beneficial. The charrette process, and the concluding remarks of the first phase were published in the local newspaper. This provided awareness for the residents, who did not take part in the process.

The mixed formation of groups in the Mebane Charrette to include residents and government officials at the same time provided well-adjusted discussions among them. By the presence of one government official and four residents in the groups the problem of dominancy is eliminated. Furthermore, with the existence of one member of design team in each of the groups decreased the problem of dominant personality in Mebane Charrette.

However, there are some limitations of the technique due to its inherent features. The number of participants is limited because of feasibility concerns (Smith & Hester, 1982). Besides, it is never guaranteed that the minority groups are represented (Hester, 1994).

The generalizability of this effort as a case study is limited as it is in any charrette project because of the specific characteristics of each town and participant group, which are the major identifiers of the outcome of the process. However, as a technique for goal setting, charrette process works efficiently to help generate design guidelines. Moreover, case study provides limited basis for scientific generalization. Although the findings of case studies are generalizable to theory, they are not generalizable to population because the study itself does not represent a sample (Yin, 1989). Consequently, the results and guidelines are specific to this project, even though the implementation of charrette process for goal setting and generating design guidelines is generalizable.

References

Cramer, H. L., Wehking, R. J. (1973) Charrette The Planning Process, Washington, D.C.: Bureau of Elementary and Secondary Education.

Gollattschek, J. F., Richburg, J. R. (1981) The Charrette as a Group Decision-Making Process for Community-Based Institutions, in Community Services Catalyst, v11, n1, 22-25.

Rifki, F. A., Toker, U., Toker, Z. (2001) “Making A Small Town Livable: Promoting Sustainability Through a New Urbanist Approach in Mebane North Carolina” in Proceedings of the Architectural Research Centers Consortium Spring 2001 Research Conference at Virginia Tech., 44-48.

Sanoff, H. (2000) Community Participation Methods in Design and Planning, New York, Chichester, Weinheim, Brisbane, Singapore, Toronto: John Wiley & Sons, Inc.

Smith, F., Hester, R. (1982) Community Goal Setting, Stroudsburg, Pennsylvania: Hutchinson Ross Publishing Company.

Yin, R. K. (1989) Case Study Research, Newbury Park, CA: Sage Publications.

On the Nature of Walking and Learning Pedestrian Environments

Jody ROSENBLATT NADERI, RLA
College of Architecture, Texas A&M University
jrnaderi@archone.tamu.edu

Students	Barani Raman, candidate Master's of Computer Science, 2002 Memory Grober, candidate Master's of Landscape Architecture Rui Zhang, candidate Master's of Landscape Architecture, 2003 Marc Zak, candidate Bachelor's of Landscape Architecture, 2002 Peiwen Yu, candidate Master's of Landscape Architecture, 2002 and 25 Students from Bachelor's of Landscape Architecture, LAND 318 studio, fall 2002, class of 2004
Advisors	Dr. Michael Manser, P.Eng., Texas Transportation Institute Dr. Vic Sierpina, University of Texas Medical Branch, Galveston Professor Nancy Volkman, Department of L.A.U.P., TAMU Rabbi Sam Karff, School of Public Health, University of Texas Geni Bahar, P.Eng. Itrans Consulting, Montreal, Quebec

Abstract:
This phase of a one-year urban design research project focuses on the question of how to measure variables that impact walking for health, spiritual renewal and commuting and how to design to encourage pedestrians to walk. The results of this phase of the research project contribute to (1) identification of significant environmental variables to which pedestrians respond, (2) the creation of a video and still imagery archive of ranked pedestrian spatial sequences, and (3) a data base for pedestrian design . The research project is attached to a landscape architecture design studio at Texas A&M University. A multi-disciplinary team of graduate students oversees the literature research, the technical video and graphic support and the development of software technology. A videographic data base of a variety of pedestrian spatial sequences, with both qualitative and quantitative attributes has emerged as a result of the research to date. The case studies used in the research are specific pedestrian routes that the students selected based upon their everyday experience of commuting, health and spiritual renewal walks.

Purpose of the Research
Leaders in the health community are now recognizing that our best hope for reducing obesity and associated health risks, one of the most challenging health risks we face (Wycoff, 2001), may be through enticing people to walk (Williamson, 1999). While the psychological and physiological benefits of walking have been thoroughly documented (Anshel, 1996; Kramer at al., 1999; Ulrich, in Marcus and Barnes, 1999), the spiritual or phenomenological benefits of walking are coming under investigation as well, witness the worldwide labyrinth movement (Verditas, URL here), and research into the neurological mechanisms of meditative exercise (Kamei, et al., 2000). Certainly the consensus across a wide spectrum of disciplines is that it is vital to create and support a safe and pleasant walking environment that is easily accessible and useful in the daily life of people.

While observers such as Alan Jacobs (1993) bring a rich perspective to the question of what constitutes great streets, researchers are just beginning to test design theories in a systematic manner, such as Isaacs' work testing pedestrian preferences relative to the "Urban Picturesque

Theory," or Cervero and Radisch's study comparing walking patterns in post-war and traditional street car suburbs in the Bay Area (Cervero and Radisch, 1996).

Land use relationships, distance between origin and destination and community design can set up the physical parameters which will meet the criteria long observed by transportation planners. The Federal Highway Administration has just completed a Best Practices Design Guide for Designing Sidewalks and Trails for Access which recommends allowing "mixed use developments with higher densities so that trip distances are decreased and walking is promoted as a mode of transportation" (FHWA. 2001) While this document was driven by a need to assist State Transportation Departments to comply with the requirements of Title II of the Americans with Disabilities Act, the Guide is intended to be used to design and construct pedestrian facilities with an aim to accommodating disabled users. This emphasis, while admirable, only addresses a part of the need to encourage walking. It is not just that a ramp is there that will encourage the able-bodied to walk. The complexities that surround pedestrian preferences relate not only to the nature of their reason for walking (i.e. walking for pleasure, for health or for commuting) but also to a holistic environmental design that sets up the sensual framework around a positive experience of walking.

For several years, the urban design and city planning community in the U.S. have been struggling with the conundrum of the walking environment in a car-dominated landscape. Many designers have entered the discipline of infrastructure planning and design, however many of these same designers are working within an engineering paradigm that does not fully recognize human experience as part of the design equation. In a close look at the negative aspects of the suburban world, Michael Southworth notes the complexities of the design matrix: "We need to pay more attention to the real tradition of places . . . In urban design that tradition includes fundamental environmental qualities such as scale, grain, transparency, the relation between buildings and streets, connectedness, and access to daily needs."(Southworth 1997) However, the decisions that affect the pedestrian realm within transportation are not led by the landscape architectural, urban design, planning or architectural community; they are led by the engineering profession.

Transportation engineers and traffic planners have produced a large body of work pertaining to pedestrian/bike/automobile interaction, demographic/behavioral models, and street design as well. Walking safety and crossing interactions with cars are now identified as areas within the transportation engineering industry that have high research interest (Miller et al., 2000). The work within the industry and the design guidelines that emerge are struggling with numbers of members who are faced with "having to accommodate the pedestrian" (AASHTO 2000) in communities developed around the automobile. Needless to say, the tools that the engineers are using to understand how to design for the pedestrian are the same ones used for designing for the car: level of service (based on how many units can get through a given space within a given time) (Seneviratne and Morrall, 1985) (Mori and Tsukaguchi, 1987); congestion management (Dixon, 1996) (Sarkar, 1993); utilization forecasting technologies (Botma, 1995) (Schwartz, Porter, Suhrbier, Moe and Wilkinson, 1999). Transportation industry researchers are acknowledging that alternative approaches to pedestrian research might result in more relevant data for safety and human factors (Khisty, 1994). It is the sensual experience of the pedestrian that contains the option for spiritual renewal and health improvement in this mode of travel.

The question our research studio asked is what exactly constitutes an environment that is not only pedestrian-friendly, but proactively encourages walking in the context of public health, safety and welfare. We are trying to answer the question of what constitutes a successful walking environment within a transportation corridor. What are the underlying physiological/cognitive/social forces affecting pedestrian behavior? Researchers have been modeling pedestrian movement since the 1970's; for instance, Helbing et al. (2001) models pedestrian behavior based on Lewin's (1951) theory of optimal personal space, and provides predictive and prescriptive guidelines for improved pedestrian flow efficiency. As a mathematician, his work describes quantifiable patterns of movement along corridors, through hallways, within intersections. His models allow introduction of physical barriers that affect the flow of the pedestrians. Assuming fluid dynamics as a metaphor for his observations, Helbing makes an admirable although weak attempt to jump the divide between math and architecture and suggest ways to increase efficiency of movement through an intersection so that pooling will not occur. Collaboration with this type of research is advantageous to our studies, although there is limited direct application to the design of pedestrian facilities because of the oversimplification of the sensuous nature of the human being. Gibson (1958) and later cognitive psychologists describe the complex interactions between perception, cognition, and locomotion.

The literature review gave us an overview of physical, psycho-physiological and aesthetic theory that led us to spatial sequence design inquiry into the nature of walking on three platforms: commuter walking, walking for health and walking for spiritual renewal. Bringing these diverse bodies of knowledge together into the design studio require an imaging tool powerful and versatile enough to represent diverse pedestrian environments. Bishop's (2001) investigation into the validity of subject response to virtual environments provides cautious optimism that such a tool may be used to test human response to the landscape.

It was clear to us at this point, that transportation and health industries would naturally turn to urban design and landscape architecture for research contributions on aesthetic and sensuous assessment of pedestrian environment. From a design communication perspective, the use of multi-media in generating first an accurate representation of the nature of pedestrian environments and then developing design proposals in collaboration with the medical and transportation communities has exceptional value. The issue in large part was how to bridge the gap to conduct our inquiry using technology that could communicate sequential space determinants in a manner that could be quantified without losing a sense of the holistic nature of the pedestrian experience.

In the design of pedestrian spatial sequences that are integrated within transportation corridors, we are dealing with a treacherous and dangerous environment. Developing a research and design tool in the form of a Pedestrian Simulation Laboratory was initiated at Texas A&M University last year. This research contributes to the PEDSIM validation phase at TTI as researchers struggle with the accuracy of simulated data versus field realities (Naderi, Raman 2001). During our research, we generated data comparing representations with field assessment to begin to determine the magnitude of the difference between field and simulated environments that will further the research associated with the PEDSIM as well as give other designers insights into representation technologies that might be more appropriate for urban design use.

Kevin Lynch pointed out that designers are always faced with the dilemma of how to communicate a simple spatial sequence using traditional architectural communication graphics and technology (Lynch 1976). Thiel went so far as to develop a notation, somewhat like ballet choreographers use, to communicate sequential space. (Thiel, 1961) Videography and advances in simulated animation technology now have greater potential as both a design and design communication tool. Our research will ultimately provide designers with technological tools that facilitate communication and exploration of sequential spatial design proposals.

Because people walk for different reasons, we divided the investigations into three categories of inquiry: health walks, walks for spiritual renewal and commuting walks. The health walk and the walk for spiritual renewal were both loops and circuits with similar environmental variables. The spiritual renewal walk meandered more and included options for sitting individually and in groups. We offer detail explanation of the three modes of walking that designers are most often trying to encourage or at least accommodate on sidewalks and trails within transportation corridors.

A representative health walk was selected as a target landscape (Fig. 1 – 1.d). Health walks are an important part of many public and semi-public spaces. Witness the circuit markers and mall walkers clubs found at many large shopping centers. Natural elements such as distant mountains and vegetation are cited by various researchers as factors assisting in patient recovery (Ulrich et al, 1991b: Ulrich and Addams, 1981). Health clubs have implemented circuits outside and inside buildings as have community centers, recreational parks, etc. Environmental variables are very controlled inside but offer clues as to how to design sidewalks for healing walks. Pedestrian accident statistics indicate high incidences in early morning and late evening. People are much more difficult to see at this time of day, commuting vehicular traffic can tend to be very focused on their ultimate destination and it is before and after work that many people who walk for health around a circuit in their neighborhood are experiencing crashes. Many of the longer distance walkers and runners use the travel way of the vehicles rather than the concrete sidewalk for many reasons including resiliency, evenness, unrestricted width. Health walk for health purposes whether preventive or curative, are becoming more and more prevalent. Access to idealized health club circuits or parks is not always available and streets will be used as an alternative.

A representative spiritual renewal walking environment was selected as a second target spatial sequence (Fig.1 – 1.g.). The pedestrian seeking spiritual renewal is specifically seeking a pedestrian experience that removes one from everyday spatio-temporal dimensions. Barrie theorizes that the world's great sacred paths have certain elements in common: an entry point that establishes a point of decision as to whether or not to begin the journey, a sequence of defined spaces, places, or events long a path that grows increasingly more sacred, a manipulation of scale, distance, and time along the path, which creates the impression that the journey is longer and thereby more eventful than it actually is; a consistent ordering of constructive and space-forming elements and materials, and overall a legible architectural language. These criteria were reflected in the design and assessment criteria used by subjects while evaluating sequences that were defined as spiritually renewing walks.

The issue in selecting spiritual paths for us was that people often step into the world outside their home or work seeking reflection and renewal, taking "paths represent the willful leaving of one place and a journey to another . . .. "the way is always directed from the known to the unknown." (Norburg-Schulz in Barrie 1996). A legible path sequence not only orients one physiologically, but psychologically and spiritually as well. Traditionally it has symbolized a going forth from the known to the unknown, the content of which is still present today." (Barrie) The sacred path has been modeled by theorists and historians as a “sequence [that] acts as a marker of the sacred ground, as protection for the uninitiated, and as a trial to be endured for those seeking the divine. Walking along the path and the attainment of the sacred place repeats the sacred act enacted by the god in illo tempore or mythological time . . . the process is often contradictory, being simultaneously easy and hard, clear and obscured, close and distant.” (Barrie, 1996). The contemplative path of the Zen Buddhist tea garden also seeks removal from the daily world. Walking the path to the tea house, like walking a labyrinth, is a ritual of attention: “In the wabi tea ceremony…the path led guests through a succession of detailed views—from a formal entrance to a series of twists and turns past a washbasin and lantern to a path of stepping stones . . . stones, bridges, and turns were intentionally included to slow guest down, to encourage them to leave worldly concerns at the garden gate...to enter the tea garden is to remove oneself from the world beyond, focus on the immediate, appreciate the smallest details of life, and remind oneself of the essentials. To the Zen mind, all else is illusion.” (Bibb, 1991)

A representative commuting walk facility was selected (Fig. 1 – 1.a.) The commuter is typically following a path from A to B trying to get somewhere as opposed to being along the way. The standards for commuting are usually to move people through as quickly and without interruption as possible. Much of the transportation research in planning and design is based on accommodating pedestrians at Levels of Service that address capacity and flow as opposed to experience. Pedestrian sequences that included multi-modal transfer stations or were in an employment or school district were identified as having a lot of commuting traffic.

Hypothesis

Our primary hypothesis is that great pedestrian environments with specific physical attributes or combinations of attributes can actually encourage people to walk for health, spiritual renewal and/or commuting purposes. There are several assumptions behind our research at this point:

1. Attributes of pedestrian environments can be disaggregated and evaluated
2. Pedestrian experience uses all senses but visual perception is primary
3. Environmental expectations of a walk are shaped by the purpose of that walk

Method

The first step was to understand what makes up pedestrian spatial sequences and how people respond to common elements when they are walking for different purposes. An attribute list was developed using research by Jacobs, Bigelow, Lynch and personal interviews that attempted to define elements that were common to all pedestrian spatial sequence experiences. Value scales were then attached to each attribute. Quantifiable value scales were determined using previous research in design considerations of pedestrian environmental simulators (Naderi, Raman 2001). This preliminary attributes list and associated values was taken into the field and used by researchers to evaluate a series of pedestrian spatial sequences.

Spatial sequences were evaluated both on site and using video representation employing a fixed set of attributes using the same range of values. The spatial attributes that were evaluated were: walkable, sittable, length of the walk, width of the walk, accessibility from parking, slope, surface resilience, surface traction, handicap access, amenities, security, crossing safety, greenery, marked entry, focal points, adjacent built areas, noise level and adjacent land use.
At the end of the attribute form, the student was asked to judge overall whether the spatial sequence was “great”, “adequate” or “bad”.

In theory, manipulation of the attributes will affect human behavior in the space. Ultimately, we can design to target landscapes. The big stumbling block in testing pedestrian spatial thresholds in simulation is how closely representations of spatial sequences really depict field conditions. In the Naderi and Raman research, the effort is underway to define the nature of the pedestrian experience and understand what needs to be simulated to accurately reflect the environmental variables which affect the pedestrian (Naderi 2002). Lynch, Appleyard, Thiel and others have discussed the limitations of videography as a device for illustrating sequential analysis and design proposals. To address the complexity of this issue, we asked student researchers to evaluate spatial sequences using comparative research methods:

1. on-site evaluation of a pedestrian spatial sequence;
2. evaluation of a life-size scale (1:1) video of the same sequence;
3. evaluation of a 1:1 videographic representation of a sequence by others;
4. evaluation of the difference of perception between a video of their site and on-site experience; and,
5. evaluation of 1:1 videographic representation while walking on a treadmill

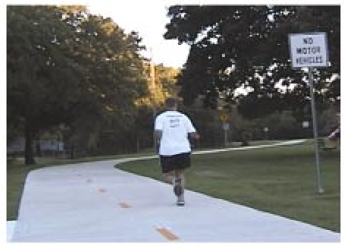
The results of their evaluations helped define the level of validity around the use of remote data by comparing the performance evaluations of spatial sequences between the field, the video representation in a stationary position and the affectiveness of the treadmill on enhancing the realism of the video representation. This was done by asking researchers to answer a questionnaire after assessing both a field condition and a 1:1 scale video display of the same sequence in the lab (Fig. 1 – 1.b., 1.e., 1.h.). The questions we asked them were as follows: Did you find that the onsite conditions were easier or harder to assess than the conditions shown on the films that you evaluated? Did the pedestrian environment seem less pleasant, about the same or more pleasant on video? When you saw the film of your site, did you feel the same about the space as you did when you were on site? Were there any significant changes between the film of your site and your actual site and what were they? The last question specifically addressed using the video representation in conjunction with operating a treadmill. Because we are currently developing a Pedestrian Simulator (PEDSIM), it was important to determine the affect of physically moving while assessing a pedestrian spatial sequence using remote imaging.

The students in the design studio were then asked to design a spatial sequence associated with a new hospital complex being proposed by McGill University Health Center in Montreal Canada. The students selected sites that were integral with the McGill University Health Center proposal for a large-scale hospital project. The students selected sites that they designed and modeled using 3D hard models and plans. The designs reflected a natural emphasis on health, as they were part of the hospital complex (Fig. 1 – 1.f.). Commuter walks and walks for spiritual reflection were also designed (Fig. 1 – 1.c., 1.i.). The clients from Montreal were thrilled by the variety of ideas from the students.

The data generated from the site evaluations is currently being analyzed. A software tool named the Pedestrian Learner is under development that utilizes the data base to assess pedestrian design proposals. The Pedestrian Learner is a intelligent decision making software that makes use of the Machine Learning algorithm called Decision Tree for its decision making process. The decision tree is a hierarchical decision structure in which each node in the tree specifies a test for some attribute instance and each branch descending from the node corresponds to one of the possible value of the attribute. The main advantage of the Pedestrian Learner however is to predict the extent of the intended change on the usability of the environment. For example the learner might be used to predict if we add more trees to the road with less sittable space, it is still an adequate pedestrian environment. The pedestrian Learner database draws directly from the data input of the students and other researchers working with the attributes form.

Step 1. Representative spatial sequences were used to establish the limits of the design inquiry.

1.a. Commuter walk



1.d. Health walk

1.g. Spiritual renewal walk

Step 2. Spatial evaluations in the field were compared with video presentations of the same sites in the lab.

1.b. Still image from student videography: commuter walk

1.e. Still image from student videography: health walk

1.h. Still image from student videography: spiritual renewal walk

Step 3. Students designed walks that respond to spatial sequence research.

1.c. Student model of commuuter walk, proposal for McGill University project.

1.f. Student model of health walk, proposal for McGill University project.

1.i. Student model of spiritual renewal walk, proposal for McGill University project.

Figure 1: Studio Research-Design Sequence

Findings
We are still evaluating the environmental variables assessed by fall studio. At this point in the study, we observe: (1) spatial sequences rated in the field received overall higher ratings than the same spatial sequences rated from videographic representation; (2) evaluations appeared to cluster – e.g. variables generated similar responses; and (3) all sites selected by the students were rated as either "great" or "adequate". As a result additional "bad" sites had to be documented by the graduate students to develop a useable range.

Our original assumptions which underpinned the hypothesis were found to not be completely true. Our three assumptions were:

1. Attributes of pedestrian environments can be disaggregated and evaluated
2. Pedestrian experience uses all senses but visual perception is primary
3. Environmental expectations of a walk are shaped by the purpose of that walk

We found that the attributes of the pedestrian environments could be disaggregated but there were instances in the comparison between the video and in-situ evaluations where the students identifed a lack of "genius loci" in the video imaging. They identified the walking experience depicted in the video as a "less pleasant" experience due to a loss of a sense of context. Thus there appears to be an experience of the whole which is itself a complex environmental variable. Pedestrian experiences were dramatically affected by the presence of a highly ranked negative experience of one of the senses, then this overrides all other considerations including visual quality. As an example, at a spiritual walk site, a heavy odour from fried chicken was identified as a single attribute which made the site a "bad" site overall.
Of the three experiences, walking for spiritual renewal appears to be the most complex in terms of the relationship between the sensory perception, the mental state of the walker and the physical spatial sequence. Heschel indicates that the marking of time may be the most significant part of the spiritual "walk"; the walk exists more in a temporal dimension than in the physical dimension.

We asked the students to write a short essay identifying positive and negative attributes of the walk they studied in the field. Positive attributes identified by the students included "contrasting patterns of light and shadow in sequence", "smell", "sounds", "overall sense of peace…." These attributes clearly indicated that factors other than visual variables significantly contribute to the pedestrian experience. Negative attributes included "lack of natural light", "lack of maintenance", "feeling of insecurity," and "no sense of enclosure". From these observations and others, we will refine the attributes list for the next phase of the research. The data is currently being routed into the development considerations for the Pedestrian Simulator and the Pedestrian Learner.

The complexity of the walking environment experience was confirmed in the designs developed for the McGill University Hospital Center. Even though the design brief for the studio project asked that the student pick one or the other of the three types of walking environments to develop, a minority did so. Most of the designers created multi-purpose spaces for the health campus in Montreal. This positive finding indicated the complexity of the design inquiry into walking experiences in pedestrian spatial sequence designs.

Conclusion
Over the next few semesters, we will continue to gather video and site assessment data for pedestrian environments, including high accident sites, great streets, sacred paths and healing

walks. Using this data, we will build the knowledge base for the Learner and develop the virtuosity of the Pedestrian Simulator.

Broad categories of future inquiry include the mind-body continuum. Walking as aerobic exercise has been studied in terms of enhanced cardiovascular health, stress reduction, and improved cognitive performance. Is there a connection between movement and brain wave activity, which in turn affects cognitive, emotional and physiological functions? Can we learn more about this body/mind interaction and how we might design our city streets to encourage healthier mental state? Anthropological, religious and spiritual perspectives that call for design guidelines to integrate 'the sacred' in our homes, streets, and towns enrich the discussion of pedestrian well-being. Can this research tease out the emotional or cognitive effects of symbolic elements in the urban landscape? Is there a relaxation effect human being experience from traveling through a symbolic landscape? Is it measurable?

Our interest started with the idea that design matters and that the health and safety of pedestrians can be directly affected by the design results of our transportation corridors. We have begun investigation into quantifying elements which directly contribute to the perception of whether walking is desirable or not. Walking has become a number one public health concern, as so much disease is associated with overweight and obesity, weak cardiovascular conditions and the like. The health industry is becoming rapidly cognizant of the fact that walking environments are not readily available to most urban dwellers in the west and that their lifestyles may no longer permit a continuation of the lack of proper pedestrian facilities. It is the health community in fact that is calling on the architectural and landscape architectural community to consider appropriate design of walking facilities in our articulation of our cityscapes.

Research and Bibliographic References

American Association of State Highway and Transportation Officials (AASHTO). 1995. A Policy on Geometric Design of Highways and Streets 1994. Washington, D.C.: American Association of State Highway and Transportation Officials.

Anshel, M., 1996, Effect of chronic aerobic exercise and progressive relaxation on motor performance and affect, Behavioral Medicine, Winter 96, 21 (4), 86-197

Appleyard, D., 1965, Motion, sequence and the city, in Kepes, G. (ed), The nature and art of motion, George Braziller, Inc., New York

Barrie, Thomas, 1996, Spiritual Path, Sacred Place: Myth, ritual, and meaning in architecture, Shambala Books, Boston and London

Bib, Elizabeth, 1991, In the Japanese garden, Starwood Publishing, Washington, D.C.

Bigelow, J. "Determination of a Suburban Pedestrian Facility Level of Rating Scale." University of Virginia, Charlottesville, 1999.

Bishop, I., Wherrett, J., Miller, D., 2001, Assessment of path choices on a country walk using a virtual environment, Landscape and Urban Planning, 52 (4), 225-237

Brannon, L. and Fiest, J., 2000, Health Psychology: an introduction to behavior and health; Wadsworth, Bemont, CA.

Cervero, R. and Radisch, C., 1996, Travel choices in pedestrian versus automobile oriented neighborhoods, Transport Policy, 3 (3), 127-141.

Dixon, L.B. Bicycld and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems. In Transportation Research Record 1538, TRB, National Research Council, Washington, D.C., 1996, pp. 1-9.

Fruin, J.J.1971.Pedestrian Planning and Design. Metropolitan Association of Urban Designers and Environmental Planners, Inc.
Fruin, J.J. 1971. Designing for Pedestrians: A Level-of-Service Concept. *HRB,* Vol.308, pp. 1-15.
Haklay, M., O'Sullivan, D., Thurstain-Goodwin, M. Schelhorn, T., 2001, So go downtown: simulating pedestrian movement in town centers, Environment and Planning B; Planning and Design, 20001/05. 28 (3), 343-359
Hancock, T., 1993, The evolution, impact and significance of the healthy cities/healthy communities movement, Journal of Public Health Policy, Spring; 14 (1): 5 – 18
Hall, E.T. 1966. The Hidden Dimension. Garden City, NY: Doubleday & Company, Inc.
Helbing, D., Molnar, P., Farkas, I., Bolay, K., 2001, Self organizing pedestrian movement , Environment and Planning B: Planning and Design, 28, 361 – 383
Huchingson, R.D. 1981. New Horizons for Human Factors in Design. New York, NY: McGraw-Hill.
Isaacs, Raymond, 2,000, The urban picturesque: an aesthetic experience of urban pedestrian places, Journal of Urban Design, 5 (2), 145-181
Jackson, J.B. 1984. Discovering the Vernacular Landscape. New Haven: Yale University.
Jacobs, A., 1993, Great Streets, MIT Press
James, J.G. 1950. The Perception of the Visual World. Boston: Houghton Mifflin.
Kaplan, R., Kaplan, S. and Ryan, R., 1998, With People in Mind, Island Press, Washington, D.C.
Khisty, C.J. Evaluation of Pedestrian Facilities: Beyond the Level-of-Service Concept. In Transportation Research Record 1438, TRB, National Research Council, Washington, D.C., 1994, pp. 45-50.
Kundera, M. 1991. Immortality. New York: Grove Weidenfeld.
Kamei, T., Toriumi, Y., Kimura, H., Ohno, S., Kumano, H., Kimura, K., 2000, Decrease in serum cortisol during yoga exercise is correlated with alpha wave activation, Perceptual and Motor Skills, 90, 1027-1032
Kramer, Arthur F; Hahn, Sowon; Cohen, Neal J; Banich, Marie T.McAuley, Edward; Harrison, Catherine R; Chason, Julie; Vakil, Eli; Bardell, Lynn; Boileau, Richard A; Colcombe, Angela, 1999, Ageing, fitness and neurocognitive function; Nature. 400(6743), 418-419
Lynch, Kevin. Managing the Sense of a Region. MIT Press. 1976
Maring, G.E. 1972. Pedestrian Travel Characteristics. Highway Research Record, Vol.406, pp. 14-20.
Miller, John S., J. A. Bigelow, and N. J. Garber " Calibrating Pedestrian Level-of-Service metrics with 3-D Visualization
Mori, M., and H. Tsukaguchi. A New Method for Evaluation of Level of Service in Pedestrian Facilities.
Transportation Research A, Vol. 21, No. 3, 1987, pp. 223-234.
Naderi and Raman, "Design Considerations in Simulating Pedestrian Environments", TRB Conference, 2002.
National Cooperative Highway Research Program (NCHRP). 2000. Implementation of the AASHTO Strategic Highway Plan, "Initial Draft of a Compendium of Strategies. NCHRP Project 17-18(3).
Older, S.J. 1968. Movement of Pedestrians on Footways in Shopping Streets. Traffic Engineering and Control, August 1968, pp. 160-163.
Palmer, J., Hoffman, R., 2001, Rating reliability and representation validity in scenic landscape assessments, Landscape and Urban Planning, 54, 149-161

Sarkar, S. Determination of Service Levels for Pedestrians, with European Examples. In Transportation Research Record 1405, TRB, National Research Council, Washington, D.C., 1993, pp. 35-42.

Schwartz, W.L., C.D. Porter, G.C. Payne, J.H. Suhrbrier, P.C. Moe, and W.L. Wilkinson III. Guidebook on Methods to Estimate Non-Motorized Travel: Supporting Documentation. FHWA-RD-98-166. FHWA, U.S. Department of Transportation, McLean, Va. 1999.

Seneviratne, P.N., and J.F. Morrall, Level of Service on Pedestrian Faciliities, Transportation Quarterly, Vol.39. No. 1, 1985, pp. 109-123.

Sitte, C. The Art of Building Cities, trans. Charles T. Stewart, Reinhold, New York, 1945 (orig. 1889)

Southworth, M., 1997, Walkable suburbs, Journal of the American Planning Association, 63(1), 28-44

Surgeon General's Call for Action "Toward a National Action Plan on Overweight and Obesity: The Surgeon General's Initiatives, HHS NEWS, U.S. Department of Health and Human Services. http://www.surgeongeneral.gov/todo/pressreleases/obesitypressrelease.htm. 2001

Thiel,P., "A Sequence-Experience Notation," Town Planning Review, Vol. 32, No. 1 (April 1961)

Transportation Research Board. 1985. Highway Capacity Manual, Special Report No. 209. Transportation Research Board.

Untermann, R.K. 1984. Accomodating the Pedestrian. New York: Van Nostrand Reinhold Company, Inc.

Ulrich, R. S., Effects of gardens on health outcomes: theory and research, 1999, in Marcus, C.C. and Barnes, M. (Ed), Healing Gardens, New York: Wiley, pp. 27-86

William.H. Whyte, The Social Life of Small Urban Spaces, 1980, Conservation Foundation, Washington, D.C.

The architecture of complex objects: computers, aircraft, buildings, bridges, landscapes, towns

Stéphane HANROT
Ecole d'Architecture de Marseille Luminy (France)
stephane.hanrot@wanadoo.fr

Abstract:

Architecture seems to be currently torn between two extreme movements: one tending to limit it to buildings only, in a sort of protectionism, the other tending towards widening of its scope. Previously, we referred to the architecture of gardens and to naval architecture. Now, we also speak of software architecture, aeronautical architecture, and molecular architecture. In fact, it seems that these apparently opposed, paradoxical movements are two manifestations of one same process. What is this process? In this article, it is suggested that we are witnessing the emergence of architecture's specificity among the different disciplines that concern complex objects/systems and their design.

The purpose of this article is to provide clarification of this question.

1. Introduction

Nowadays, it is clearly obvious that the range of architectural objects, which some people consider should be limited to buildings, is in the process of being widened. Previously, one spoke of the architecture of gardens and of naval architecture. Now, we also speak of software architecture [Deschaintre,1998], aeronautical architecture [Rechtin,1991], molecular architecture [Mesplède,2000], financial architecture [CAE,1999] and even defence architecture [ADAM,1999].

This widening was recognized and theorized in the early 1990s by H. Rechtin, an engineer and professor of aeronautics. Rechtin showed that the specific nature of the architect's "art" – i.e., the capacity to "architecture" or to "architect" things – was also valid for all complex systems that have to be designed and that, for new fields of engineering, this art was required in order to get beyond the dead ends of their traditional methods [Rechtin,1991&1996]. This need led to the emergence of the first software architects, mechanical architects, etc.

This paper proposes to examine the consequences of this development for the architectural discipline[1]. It is accepted that, as a discipline, architecture has at least five characteristic fields.

The first field, its principal subject, is that of "architectural objects and their architecture". Here, the term architecture[2] is used in the "generic" sense of "*Principle of organization of a set of objects*" [Imbs,1979].

The second is an activity, "architectural practice", which establishes architecture as "an art", i.e., the capacity to "architect" objects in a situation where they are created or modified. The verb "to architect" is taken to mean "*to construct and arrange something as an organized whole; to give an architectural character to something" [Imbs,1979]* - one dictionary definition is as follows: "*to architect: to design (a building) - as architect" [Oxford,1987]*.

The third is the branch of knowledge formed by "architectural knowledge" (or "architectural expertise") concerning objects and practice, knowledge that is considered to include the "science of architecture".

The fourth is the activity of "architectural research", which develops, in particular, this science.

---

[1] Where "discipline" is defined as "a branch of knowledge, a field of activity, a subject of teaching and study" [French Academy,1990].

[2] One should not be surprised at the use of the word "architecture" in a sense different to that of the classic architectural discipline. This word is polysemic, i.e., it has several meanings. This was shown in a previous work that analyzed definitions given by architects and by dictionaries [Hanrot,1998].

The fifth is also an activity, “teaching“, which passes on this knowledge or expertise to students, leads them to the experience of architectural objects, and initiates them in practice and in research.

Starting from this basis, we shall see that we can classify traditional and new architectural objects in a consistent manner. Among these, buildings, gardens, public spaces, infrastructures, landscape and town form a particular ensemble that determines the living space of man and society. These everyday objects are easy to distinguish from aeronautical, marine or information systems objects, to mention just a few examples.

This classification shall be presented in its principle, and we shall use it to answer the question that we are concerned with, viz.: what are the consequences, in other fields of the discipline, of the widening of the field of architectural objects?

2. The widened field of architectural objects

A building is composed of a large number of parts (storeys, rooms, floors, ceilings, walls, bricks, etc.) that define forms and spaces. It also belongs to a context which may be urban, peri-urban, rural, or natural. It performs several functions: use, comfort, cultural, mechanical, constructional, thermal, etc. Its lifetime starts with its design brief and then its actual design, its construction, and its use up until its destruction. It has an architecture that is recognized in the composition of its different parts and the ordering of its forms and spaces in order to perform its multiple functions, in the urban, peri-urban, rural or natural contexts in which it is located, throughout its lifetime, which may be up to several thousand years.

In a previous work [Hanrot,2000], it was shown that aircraft, software and buildings all have a large number of parts, they all perform a large number of functions, and they all belong to a context. Therefore one may recognize architecture within them.

The architecture of an aeroplane is expressed by the composition of its different parts (fuselage, wings, engines) and sub-parts, and by the coordination of the different functions that it must perform in the air and on land, throughout a lifetime of around twenty years.

The architecture of software may be understood as the composition of its various parts (modules, procedures, etc.) and sub-parts, that enable it to perform its different functions in the domestic or professional contexts in which it could be installed, throughout a lifetime that may be very long.

House of the Australian architect, Peter Stutchburry

All these objects that have an architecture belong to the field of architectural objects. The factor that they all have in common is that they are complex objects that form systems[3]. This leads us to a generic definition of the architecture of complex objects that is more precise than that of Imbs quoted above: *architecture is a principle of composition of the parts of a complex object/system as a whole, which allows and coordinates the accomplishment of the system's various functions in the context(s) to which it belongs, throughout its lifetime.*

However, buildings, aircraft, and software applications are different objects. A building belongs to the world of things that can be directly perceived by man, as is an aircraft, but not a software application. A building is fixed in its context, while aircraft are mobile. A building has interior or exterior forms and habitable spaces, as has an aircraft, but not a software application. A building plays a part in the daily living conditions of man and society. It has a comprehensive character and a lasting quality that are not envisaged in either aeronautics or information systems. Lastly, buildings are constructed in situ - which is not true for aeronautics or for information systems. Other differences could be pointed out, but these are particularly characteristic. Therefore the question is: are there other complex objects that distinguish themselves from aircraft and computers in the same way as the building does?

The Airbus Beluga, with its astonishing architecture

Affinities and differences:

In previous works [*opus cit.*], I showed that civil engineering structures, roads and public spaces, infrastructures, garden and parks, large-scale landscaping and towns are complex objects which, like buildings, are part of the space and forms of man's living environment. Just like buildings, they distinguish themselves from objects such as aircraft or software applications by their physical materiality and by the fact that they are fixed in their context and setting.

However, there are differences between buildings, civil engineering structures, roads, landscape and towns. A building and a city do not have the same lifetimes. The lasting qualities of a garden and a civil engineering structure are also different: one develops and changes through the growth of the plants that make it up, while the other changes only very slowly.

However, these differences are minor in relation to the links that relate these different objects. In fact, some of these objects may be considered parts of another.

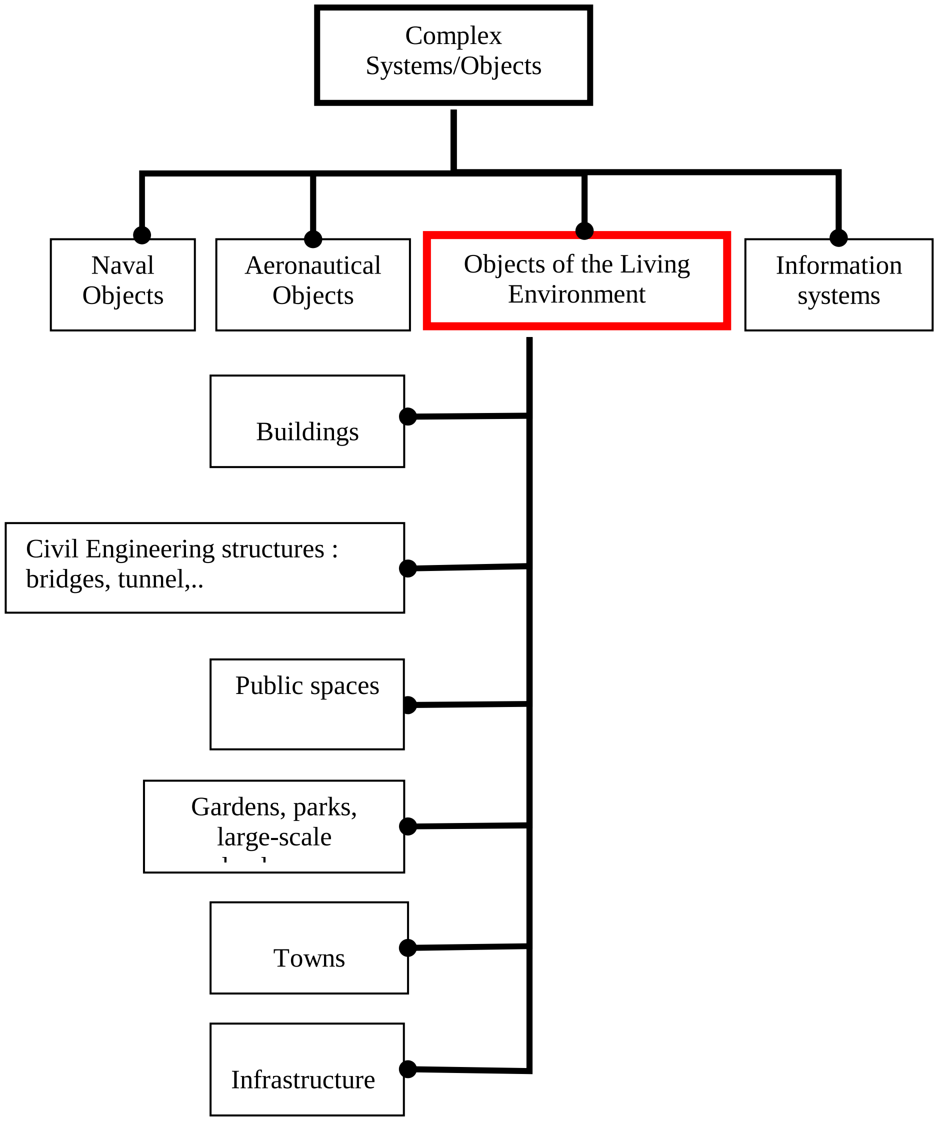
Conversely, this “other“ object forms the whole to which the first belongs. Thus, a building can be part of a town. The town is the whole to which it belongs. The town forms a part of the building's

[3] A system is composed of an object, or structure, and a function. Here, reference is made to definitions given firstly by Von Bertalanffy ("Théorie générale des systèmes" L. von Bertalanffy, Dunod ed., Paris, ISBN 210 001841 8, 1993) and then by J.L. Lemoigne (“Théorie du système général”, J.L. Lemoigne, PUF, 1976).

context, the other parts being the site itself with its climatic factors, its users, etc. A garden (such as an atrium garden) can be placed within a building, and a building (such as a summerhouse, a greenhouse or a café) can be placed in a park. A civil engineering structure or a planted embankment may be parts of a road. A town is a whole composed of buildings, gardens, infrastructures[4], etc.

Is it possible to find similar relationships between an aircraft and a building, or between a software application and a town? Obviously not. An aircraft may be housed in a hangar, but it is not a part of a hangar. It is a vehicle that is a “user-occupant“. A software application in itself may not be considered a physical part of a town, although it may contribute to a town's functions, e.g. a software application for regulating urban traffic.

Fig–1: Classification of architectural objects.



[4] Speaking of American roads, F.L.Wright wrote: “Year by year, as new, more and more enormous roads systems are added, they are constructed more and more magnificently. I predict that roads will soon also be architecture – as they fully deserve it: great architecture”. (from French translation of “Autobiography”, Frank Lloyd Wright 1943, Editions de la Passion, Paris, ISBN 2-906229-33-4, 1998).

Objects of the living environment:

These common characters and interrelations define a quite uniform field of objects that make up man's living environment and are built by him. Each of them is ordered by an architecture and contributes to the general architecture of this living environment. Therefore it is appropriate to group them together in one class in order to distinguish them from the others. Let us call this class the constructed things, edifices or “objects of the living environment"[5]. This corresponds to the definition of architecture[6] proposed by J. Fleming, H. Honour and N. Pevsner in their dictionary of architecture [Penguin,1998].

Taxonomy (systematic classification):

As shown in the attached graph, we may draw up a taxonomy (or systematic classification) of architectural objects in the form of a generalization/specialization tree. The complex object/system forms the generic class of architectural objects.

From there, a first level of specialization can be established in which we distinguish “objects of the living environment“ from other objects such as ships, aircraft or computers.

The objects of the living environment themselves have sub-classes. These include: buildings, civil engineering structures, roads, infrastructures, gardens and parks, large-scale landscaping and the town.

3. Architectural practice as activity and as process:

Widening of the field of architectural objects to complex systems in general inevitably leads to questioning on the different practices in architecture and on their correspondences. So what do the architect of a building, the architect of an aircraft and the architect of a software package[7] have in common? Is it the fact that they "architect[8]" in the same way in these different fields?

Taking the architecture of buildings as a paradigm, H. Rechtin [*opus cit.*] shows why notions of architecture and architectural practice can be now extended to the different complex systems produced in contemporary engineering.

In order to “architect“ or “architecture“ complex systems, the architect uses heuristic methods to examine ill-defined problems related to these systems.

According to Rechtin, heuristic methods[9] are more efficient than purely "prescriptive" standardized methods that consist in copying reference models. For the latter limit creativity and innovation, even if they sometimes make work easier. Heuristic methods are also more efficient than “rational“ or “procedural“ methods, whose step-by-step development is well-known. Although,

---

[5] In this sense, an “object of the living environment“ is an object that belongs in a fixed manner to a context or setting and is characterized by forms and spaces that make up the human and social living environment. It thereby performs, to varying degrees of success, several functions (relating to various aspects: social, use, comfort, aesthetics, symbolic, economic, technical, etc.). Any “objects of the living environment“, as a complex system, is presumed to have an architecture. This architecture lasts for varying lengths of time throughout the existence of the “objects of the living environment“ and places it in a historical continuum.

[6] Architecture: "The art and science of designing structures and their surroundings in keeping with aesthetic, functional or other criteria. The distinction made between architecture and building, e.g. by Ruskin, is no longer accepted. Architecture is now understood as encompassing the totality of the designed environment, including buildings, urban spaces and landscape." [Penguin Dictionary of Architecture & Landscape Architecture,1998]

[7]Practically every edition of the French newspaper "Le Monde" contains an advertisement for a position as information systems architect or multimedia architect. It is interesting to note that Bill Gates calls himself Microsoft's "chief software architect"! In information technology, architecture is a reality since the 1970s.

[8] Rechtin and Maier used the verb "to architect", or more precisely, the form "architecting", which is translated into French as "*architecturer*".

[9] An heuristic rule is a rule that guides the designer's action in the resolution of such problems. For example, people often mistakenly believe that a design scheme is devised from the general level to the particular, from the whole to the parts, or from the overall scale to the precise scale. However, in reality, the design scheme is developed and re-adjusted as the designer goes repeatedly back and forth between the two levels/scales. Therefore one must not hesitate to change scale and to reconsider the whole on the basis of the parts.

here again, the latter may be useful for a well-defined sub-problem. Heuristic methods are not only suitable for dealing with the problem in itself. They also take into account the context of political, social and financial decisions in which the design project develops.

In the field of objects of the living environment:

Rechtin's proposal is not without questioning of the architect's skills and area of competence. These are usually specified by adding another word before or after "architect" to designate the architect's particular field of specialization. Thus, one says architect-town planner for the architect who works on urban matters, or landscape architect for one who specializes in gardens, parks and large-scale landscaping. In France, one does not speak of a "building architect", which is a qualification or area of competence by default, although one speaks of the “civil engineering structure architect“ or "architect-engineer". Until the early 20th century, the architect who worked on roads design was called an “*architecte-voyer*“ [literally "highway architect" or "streets architect"]. This person held an extremely important position in the local municipal administration of cities[10]. In any case, the use of the generic term "architect" by building designers in France is rather improper.

There are common threads of practices and knowledge that run between the different classes of objects, and it is not rare for architects or groups of architects to have dual qualifications or areas of competence. One can be an architect-town planner and building architect, or a landscape architect and architect-town planner. However, specialization is very often necessary, since each field of practice requires specific know-how and knowledge.

Taxonomy:

As shown in the attached diagram, the architects of complex systems/objects form the generic class of practicians. From there, a first level of specialization may be established in which one distinguishes the architects of “objects of the living environment“ from other architects such as naval architects, aeronautical architects or information systems architects.

Architects of “objects of the living environment“ are themselves divided into fields of specialization: building architect, civil engineering architect, roads architect, infrastructures architect, landscape architect (gardens, parks and large-scale landscaping) and architect-town planner.

4. Architectural knowledge:

The fields of knowledge on objects and practices may be common at a certain level generalization and also specific, according to whether we are concerned with particular objects. The knowledge of an architect who designs civil engineering structures and that of an architect who designs buildings are quite similar. However, such knowledge is much further removed from the software architect's particular knowledge, and the gap of difference to be bridged between one type of knowledge and the other is very wide. However, this difference would be much greater between any given architectural knowledge and the technical knowledge of fluid dynamics or of cancer pathology in medicine.

Taxonomy:

Knowledge concerning architectural practices and objects is composed of branches and sub-branches. Knowledge concerning complex systems/objects and design practices forms the generic knowledge.

[10] Such positions still exist in the municipal departments of the City of Paris.

From there, differentiated branches of knowledge may be established for architecture and the practice of “objects of the living environment“ and for the other types of architecture (naval, aeronautical, information systems).

Knowledge concerning the architecture of such objects and their practices is divided into its own fields of specialization: building, civil engineering structures, roads, infrastructure, landscape architecture (gardens, parks and large-scale landscaping) and town.

5. **Research as an activity:**

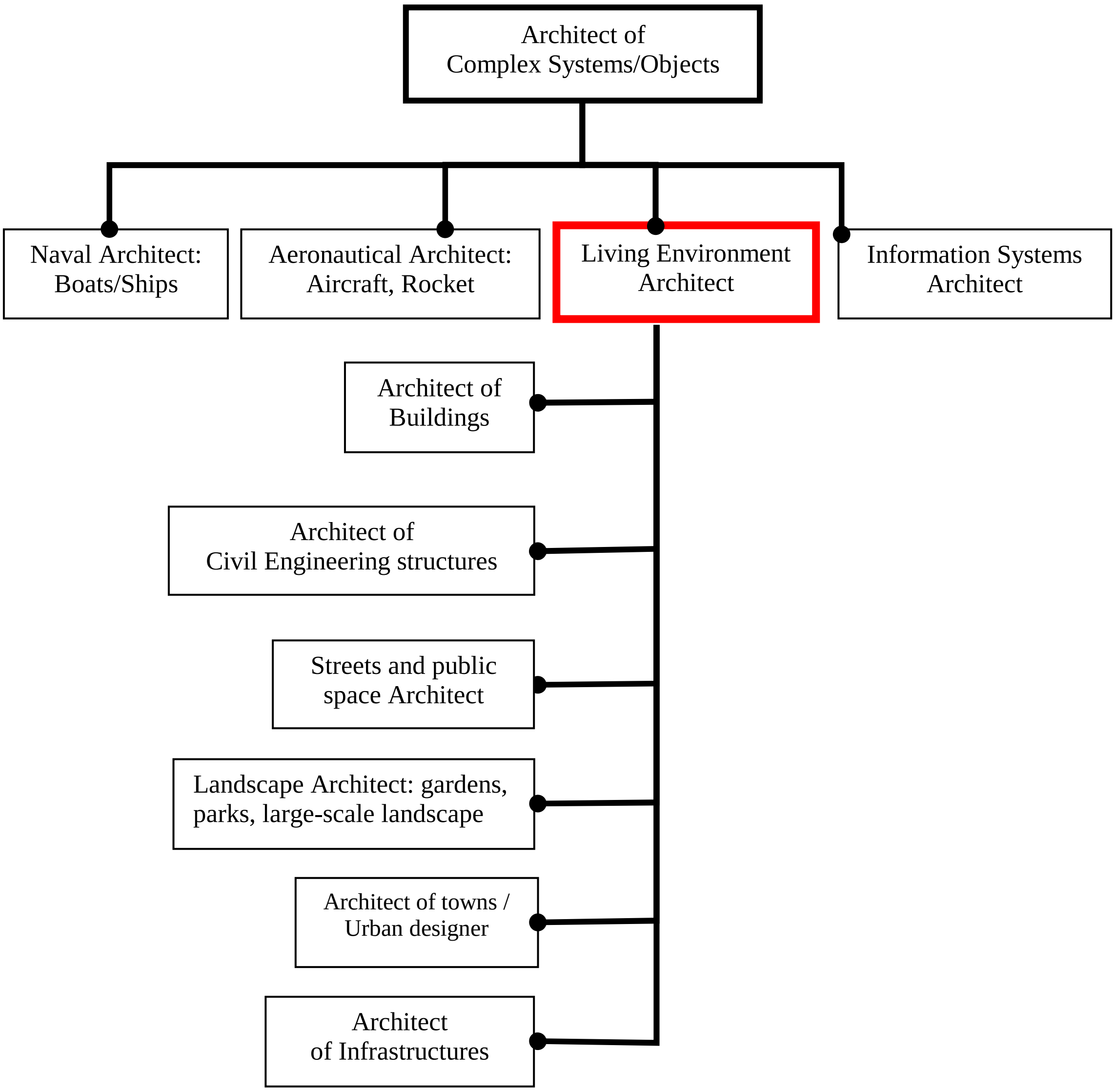
Research is an activity that aims to understand architecture and to form knowledge of architectural objects and practice. Naturally, the prime subject of study of research is the architectural object. How can we describe and understand architectural objects and particularly their architecture? What are the types and how is their great diversity organized? What are their models? How do they interact with the user/occupant and with society? How can the idea of architectural scale or architectural synthesis be conveyed?

Obviously, these questions are asked differently, according to whether one is studying the architecture of computers or the architecture of buildings. And it is obvious that the specialized knowledge identified for some is not relevant to others. However, at a certain level of generalization, certain knowledge is transposable and common to all, as shown by H. Rechtin.

Research also examines the genesis of these objects and the practice that governs them. How can we explain the detailed ways and means of practice? What role does the architect play with respect to the other players involved in the design process? How can we define the idea of the design process and the action of "architecting"?

The answer to all these questions is found in the study of objects and practices, by devising architectural theories and by developing applications that interest architects in their position as practicians, for all types of complex objects.

Fig–2: Taxonomy of architects and architectural practices.



Taxonomy:

Architectural researchers can place their subjects of study on different levels. They are “fundamental“ researchers and in this case they develop theories of the architecture of complex systems/objects and practices as generic entities.

They can also place their attempted formalization and production of knowledge at a first level of specialization, that of objects and practices of the architects of “objects of the living environment“, naval architects, aeronautical architects or information systems architects. It is then a matter of forming the knowledge specific to a branch and identifying its relation to more general theories of complex systems and their design.

Lastly, researchers can place themselves on a more precise level of specialization, specific to certain classes of objects or of practices of the architects of buildings, civil engineering structures, roads, infrastructures, landscape (gardens and parks, large-scale landscaping), and towns.

6. **Teaching:**

The fifth field, “teaching“, is intrinsic to the idea of discipline. Teaching is mainly provided in public schools of architecture, and also in universities and schools of engineering[11].

Training for architecture and for practice:

According to our taxonomy, training courses in the architecture of objects should have use of a common corpus (or body of knowledge) in order to open up to fields of specialization according to the types of objects chosen. In France, the fragmentation of training courses between the different schools and the university does not facilitate this sort of coordination. Rather, it leads to promoting various interest groups and cliques, starting from the teaching stage.

One could ask whether combined training courses could be provided on the architecture of “objects of the living environment“ and the architectures of other complex objects, such as information systems or aeronautics. Specialization is often necessary, according to the type of built object, and it is all the more necessary from one complex system to another. It is very unlikely that someone could be both a building architect and an information systems architect or aeronautical architect of a high standard. However, a body of fundamental knowledge and skills is shared by them all. Therefore it would be useful and interesting to compare the teaching developed in each field of architecture, particularly as regards the architect's standing in relation to the engineer[12].

Taxonomy:

Teaching, with its curriculum and its concerns, may be considered as analogous to the taxonomy of objects. One may therefore identify teachings that are generic or specific, to varying degrees, with respect to architectural objects and practices:

- Teaching on the architecture of complex systems/objects and on practices, as generic entities, would be far from an operational, hands-on practice. However, it would provide access to the fundamental knowledge of architecture shared by all fields. It would also provide overall understanding of the discipline.
- Teaching on the first level of specialization of objects and practices of the architects of “objects of the living environment“, naval architects, aeronautical architects or information system architects is therefore aimed at a specific branch. The student information systems architect needs to match knowledge on the architecture of computer networks and of software applications. This is part of the student's general training. Similarly, the student architect of the living environment must match the knowledge and interrelations between the architecture of buildings, civil engineering structures, landscape, infrastructures and the town.
- Teaching on the specific objects, practices and knowledges of the operational field at which the student architect aims - i.e. to certain families of objects or practices of architects who design buildings, civil engineering structures, roads, infrastructures, landscaping (gardens and parks, large-scale landscaping) and towns - takes on a specialized form. The other objects of the field of “the living environment“ are then seen as forming the context of the studied object. For the architect who specializes in building, the town and the landscape are seen as forming this context.

[11] In France, for example, UTC (Université Technique de Compiègne) awards an "Information Systems Architect" diploma, with a course provided by IMI (Institut du Management de l'Information, created by UTC and located in Paris).

[12] Rechtin establishes architecture as both an art and a science, and he proposes detailed means for validating heuristics, and also teaching curriculae. For, once architectural practice in new fields of engineering is recognized, its knowledge must be structured and teaching courses must be provided that shorten the learning curves that are usually involved in professional experience.

7. **Branches of the architectural discipline:**

Starting from the reasoned taxonomy (or systematic classification) of architectural objects, it was successively shown above how we can match taxonomies of architectural practices, knowledge, research and teachings. Since the five fields of the discipline can be consistently matched in a single classification tree, we may speak justifiably of different branches and sub-branches of the architectural discipline, which are attached to a common trunk composed of the architecture of complex systems/objects. This classification tree takes the architectural object as a discriminant criterion. It is illustrated in the attached diagram and shall be interpreted as follows:

The architecture of complex systems is the generic class.

From there, a first level of specialization, establishing different branches, can be established in which one distinguishes the architecture of "objects of the living environment" from other types of architecture, viz. naval, aeronautical or information systems architecture[13].

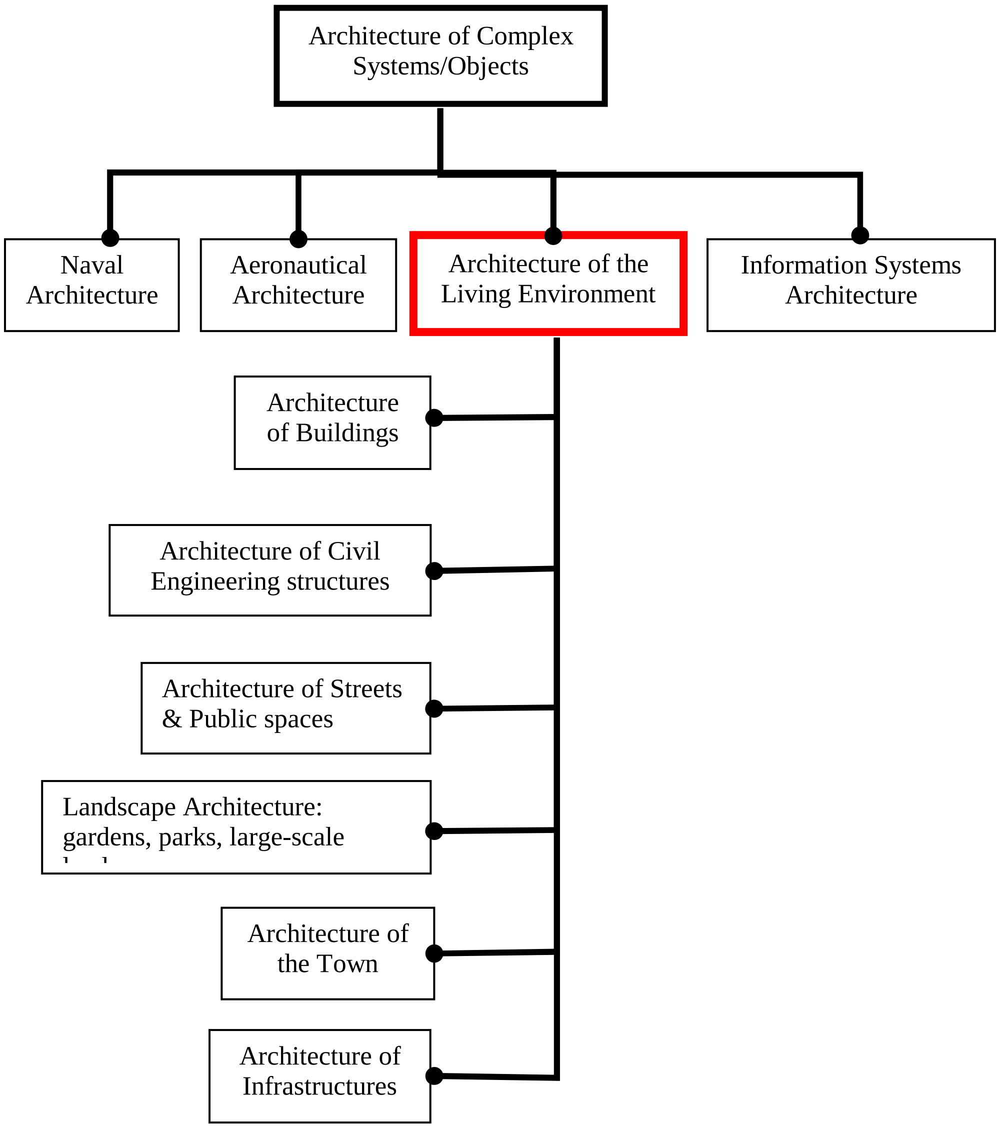
The architecture of such objects itself has sub-classes. Five of the same rank appear relevant: the architecture of buildings and civil engineering structures, of roads, of infrastructures, of gardens and parks, of large-scale landscaping and the town[14].

---

[13] This recognition of a wide field of architectural objects does not devalue the idea of architecture, as some purist architects may fear. On the contrary, it makes it possible to establish architecture as a fundamental principle that may consist of many facets or may be specialized, according to the objects in question.

[14] Some may oppose this classification, saying that it may bring to a head the conflict with urban planning by stating that the town has an architecture. Others have proposed this idea before me ("L'architecture de la ville", A. Rossi, Paris, ed. de l'Equerre 1966), ("Architecture, vocabulaire de" J.M. Pérouse de Montclos, Imprimerie Nationale ed., Paris, 2nd edition, 1989). If Cerda invented the discipline of urban planning at the end of the 19th century, he did so in order to objectivize knowledge on the functions of the town and the multiple systems that make it up, and also the processes of its development. The town, as a complex system, can be "architected" through its forms and spaces, even if this is not done with the same spatio-temporal means and methods as for a building.

Fig–3 - Taxonomy of branches of the architecture of complex objects and systems.



8. **Conclusion.**

The initial aim of this paper was to assess the consequences of the widening of the field of architectural objects currently observed in the discipline's other fields, viz.: practice, knowledge, research and teaching.

We have seen that the widened field of architectural objects can be organized in a tree structure. Then it was shown that this organization was reproducible in each of the other fields of the discipline. Consequently, we saw that this organization in a tree structure, of which architectural objects are the discriminant criterion, reflected new branches and sub-branches of the architectural discipline.

Evidently, this consequence can be viewed in a negative or positive light.

The negative view may be that of players in the traditional fields of architecture - and particularly building - who may fear a devaluation or a blurring of their professional title and of their social role as an architect. Rather than being an unsavoury form of protectionism, such an attitude would be the result of confusion that is common in these circles, which consists in assimilating architecture to a real object and particularly to a building. For indeed, people often refer to building by saying “this architecture“ or "this piece of architecture". Let us promote architecture as an ordering principle that

can be applied to different complex objects, and we will thereby remove the confusion, in order to adopt a positive perspective.

The positive vision is to recognize the new branches of architecture (which is inevitable, since they exist already) and to consider their advantages.

Firstly, architects of traditional fields have nothing to lose through this widening of the scope of architecture, since their place is not being taken by anything else. These new branches of the discipline do not replace the old ones - they complement them. The direct benefit gained by the traditional branch of the architectural profession and its architects is the recognition of the architect's competence and usefulness in fields other than building construction.

The most general benefit is that architecture acquires a stronger base, since it becomes involved in more fields of engineering and of creative design. It may then be approached on different levels of generalization and of specialization, and provides new problematic fields for its research and new resources for its teaching.

Without being unreasonably over-optimistic, the architectural discipline thus organized can become a focus for reflection that will be of major interest for all fields concerned with complex objects and their design.

9. **Bibliography**

[Adam,1999] “La nouvelle Architecture de sécurité en europe“, B.Adam, D.David, A.Dumoulin, B.Georges, E.Remacle, GRIP-Edition complexe ed., ISBN 2-87027-715-6, Brussels, 1999.

[CAE,1999] “Architecture financière internationale“, Conseil d'Analyse Economique, La documentation Française, ISBN: 2-11-004367-9, Paris,1999.

[Deschaintre,1998] "Informatique de gestion: Architecture logicielle, développement d'applications“, E.Deschaintre et C. Fischer, Col Techniplus, Casteilla ed., ISBN: 2-7135-1902-0, Paris, 1998.

[Hanrot,2000] “L’idée d’architecture“. Article published in the review “Le carré bleu“, N° 3/4- 2000, ISSN 0008 6878, Paris, December 2000.

[Hanrot,2001-a] “Proposition de modèles pour l’Analyse de l’architecture“. Article presented in AISE/IASSP-ENAU Sidi Bou Saïd International Semiotics Seminar, at ENAU (National School of Architecture & Town Planning), Tunis, 23 - 24 May, 2001.

[Hanrot,2001-b] "A la recherche de l’architecture: essai sur la discipline et la recherche architecturales": to be published by Harmattan in November 2001.

[Imbs,1979] "Trésor de la langue française", Paul Imbs et alii, CNRS ed, ISBN 2-222-0283-1, 1979.

[Mesplède,2000] “Architecture Moléculaire, chimie organique“, J.Mesplède, Bréal ed., ISBN: 2-84291-410-4, Rosny-sous-bois, 2000.

[Oxford,1987] "The Australian Concise Oxford Dictionary", Georges W. Turner, Melbourne Oxford University Press, Melbourne, ISBN: 019 5546 19 9, 1987.

[Penguin,1998] "The Penguin Dictionary of Architecture and Landscape Architecture", John Fleming, Hugh Honour, Nikolaus Pevsner, Penguin Group, New York, 1998.

[Rechtin,1991] "Systems Architecting - Creating and Building Complex Systems", Eberhardt Rechtin, Prentice Hall 1991 ISBN 0-13-880345-5.

[Rechtin,1996] "The Art of Systems Architecting (Systems Engineering Series)" Eberhardt Rechtin, Mark W. Maier; Hardcover.