International Journal of Architectural Research

Architecture
Planning
Built Environment Studies

An International Fully Refereed Journal
Published three times a year
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Chief Editor
Ashraf M. Salama

Includes
Regular Refereed Papers
Review and Trigger Articles

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International Journal of Architectural Research

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ArchNet International Journal of Architectural Research – Archnet-IJAR is the first of its kind; an interdisciplinary comprehensive scholarly journal of architecture, planning, and built environment studies, that is blind reviewed and published on the World Wide Web three times a year.

Objectives
Archnet-IJAR objective is to establish a bridge between theory and practice in the fields of architectural and design research, and urban planning and built environment studies. It reports on the latest research findings and innovative approaches for creating responsive environments, with special focus on architecture and planning in developing countries.

Archnet-IJAR is truly international and aims at strengthening ties between scholars from different parts of the world with contributors and readers reaching across geography, boundaries, and cultures.

Archnet-IJAR articles come from architects, interior designers, planners, and landscape architects, and from those working in these fields in academic institutions, universities, research centers, government agencies, and private practice.

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Archnet-IJAR addresses academics, practitioners, and students of architecture, planning and interior design. It addresses those who are interested in developing their understanding and enhancing their knowledge about how environments are designed, created, and used in physical, social, cultural, economic, and aesthetic terms. Archnet-IJAR content keeps readers up-to-date on the latest ideas, designs, and developments in built environment related fields.

Archnet-JAR publishes research studies, criticisms and evaluation studies, and critical analyses about the creation, use, and evaluation of different types of environments at the macro and micro scales. The journal includes original empirical research papers, analytical case studies, and high quality position papers. Three major areas are covered by Archnet-IJAR:

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Topics include – but not limited to: architectural pedagogy and design studio teaching practices; architectural technology and sustainable design; design methods and architectural theories; design and project programming; environment-behavior studies; information technology; Islamic architecture; computer applications and virtual environments; post occupancy and facility performance evaluation; and social and cultural factors in design.

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Topics include -- but not limited to: administrative and political factors contributing to the shaping of communities, cities and urban regions, community planning; sustainable urban conservation; environmental planning and eco
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**Critical Essays on Architectural and Planning Projects:**

Essays that cover the above topics; critically discussing projects in use; after they have been designed, built and occupied. Articles are preferred to utilize the case study approach as a critical method in built environment research.

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The Chief Editor is in charge of developing journal issues, seeking out resources and articles, establishing publishing strategies, coordinating the review process, and posting each issue and its articles online. Archnet-IJAR has two boards; advisory and editorial. The range of expertise of the boards that include the panel of referees –academics and professionals- ensures high quality scholarly papers and allows for a comprehensive academic review of contributions that span wide spectrum of issues, methods, theoretical approaches, and professional practice.

**Submission Process**

Unlike other printed Journals where contributors wait for periods that reach two or three years for their work to get published, the value of Archnet-IJAR as an online journal is that it eliminates the large lead time needed for publication. However, submission, referee, and publishing processes are strict and adhere to the following procedures:

Interested contributors contact the chief editor expressing interest, and submitting a summary of their paper. One page will do.

The chief editor consults with the advisory and editorial board members according to their relevant expertise.

Soon after receiving feedback from the referees, author(s) are contacted to submit their full papers.

When full papers are received, they will be forwarded to two editorial board members for blind review, according to the referee form.

The chief editor contacts the author(s) with the referee form filled by the reviewers. While papers will be blind reviewed, in exceptional cases author(s) will be asked to communicate directly with the reviewers.

Author(s) revise their papers as noted by the reviewers and re-submit their work to the chief editor.

Author(s) should make sure that their submissions should be free of jargon, clear, simple and to the point.

Papers will be published in the next issue according to the following schedule:

March 30th (publishing date): December 15th (deadline to receive papers after reviews)
July 30th (publishing date): April 15th (deadline to receive papers after reviews)
November 30th (publishing date): August 15th (deadline to receive papers after reviews)

Interested reviewers and members of the advisory board may submit their work for publication in Archnet-IJAR. Their work will go
through the same blind review process and will follow the preceding procedures.

**Notes to Contributors**

1. **Submission of Manuscripts**
   The language of the journal is English. All submissions will be online. One copy of the manuscript (in word document format) together with original figures and tables must be submitted to the editor: Ashraf Salama ijar@mit.edu
   The name, mailing address, position, affiliation, telephone, fax, and email of each author must be supplied in a cover letter attached to an email. All papers will be blind reviewed and assessed by at least two referees.

2. **Preparation of Manuscripts**
   **Layout**
   Manuscripts should be typed in double spacing on one side of A4 (21x29.7 cm) paper with reasonable margins (2.5 cm). All pages should be numbered consecutively.

   **Title page (page 1)**
   The first page of the manuscript must contain a concise and informative title; names, affiliations and addresses (including e-mail) of all authors, and identify the corresponding author (who will be responsible for correspondence and reviewing proofs). An abbreviated title of less than 50 characters (including letters and spaces) should also be suggested.

   **Title of paper, abstract and keywords (page 2)**
   Title of the paper should be written at the top of abstract without authors’ name. A concise and informative abstract must not exceed 300 words in length, should summarize the objective, methods and major findings of the paper. Keywords must be carefully selected to facilitate the readers’ search on Archnet Website, and should not exceed 5 key words.

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   **References**
   References in the text should give the surname of the author and the year of publication in brackets, for example, Rowe (1985) or (Rowe, 1985), followed by a, b,...when two or more references to work by one author are given for the same year. Page numbers should be given for quotes (Mitchell, 2003:33). At the end of the text the references should be listed in alphabetical order of authors’ names and in chronological order for each author. Initial and final page numbers of articles and papers should be given. The names of books and periodicals should be given in full, and the publisher and the city of publication should be given for books, conference proceedings, etc. Details of availability should be given for unpublished conference papers. Full references should also be given for legal judgments, bylaws and regulations, and government publications, etc. Examples of reference citation are given below.


3. Submission Process, Copyright, and Originality of Work

Proofs will be sent to the corresponding author for checking. Proofs should be returned within one week of receipt. Authors should correct typesetting errors only; they should not add any new material to the paper at proof stage.

Please read the submission process and procedures, and copyright notes under the general outline of the ARCHNET-IJAR.

All correspondence should be addressed to the chief editor.

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THE CASE FOR DAYLIGHTING IN ARCHITECTURE

Richard Barrett

Abstract
The paper discusses the reasons for using daylight in the design of architectural form and space. These reasons extend from those of a practical nature, including energy conservation, cost factors, and health and wellbeing, to those of a more intangible, aesthetic nature. Some historical precedents are offered as examples of projects in which designing to maximise daylighting was crucial in the mind of the architect. By contrast there is also discussion relating to the ‘the lost art’ of using natural lighting in architecture. Some of the reasons for this loss of conviction and expertise are considered. The place of national building codes and other statutory requirements is examined, as is the role of the architect and his/her relationship with other professionals involved in daylighting design in architecture.

Keywords
Natural lighting; daylighting; core-daylighting; form and space.

Introduction
In an earlier study conducted by the author (Barrett, 2003), the question of ‘core-daylighting’ was considered in reference to the natural lighting of spaces deeply within buildings - spaces that cannot readily be lit using conventional perimeter fenestration).

In considering this question, however, it was important firstly to step back from the process, and to look more broadly at the issue of daylighting per se, examining the issues, and establishing the case for ensuring quality natural lighting in architecture. There are a number of widely diverse reasons as to why this should be important. These range from pragmatic reasons, such as sustainability and energy conservation, running and maintenance costs for buildings, and the health and wellbeing of the building’s occupants, to the more aesthetic and poetic aspects of architecture, such as those espoused by Le Corbusier, Louis I Khan, and a few other architects. Along those lines, Lam (1992:10) suggests that “... when all buildings were designed around a single, fixed light source (the sun) the difference between great architecture
and mere building could be measured to a large degree by the skill with which that source was used. The shapes and sizes of rooms, and the materials and details in them, were determined largely by the appearance the room would take on when rendered by daylight."

An important consideration, therefore, and one that is later discussed in more detail in this paper, is the role of the architect as compared and contrasted with other professionals working in the field of daylighting, and the various tangential issues such as user satisfaction and comfort.

**The Case for Daylighting**

The history of daylighting in architecture is punctuated by major developments, such as the discovery of new structural systems which allowed larger openings, and hence better natural lighting. Arguably, however, the one single event which could be considered pivotal, but also detrimental to the role of daylighting in architecture, was the invention of fluorescent lighting in the mid 1930s. This gave the architect virtual carte blanche to design deep, windowless spaces, in which lighting levels were consistent no matter where an occupant was located. No longer was the building necessarily designed to take advantage of natural light, and architects were thus deprived of an important design element, one which their predecessors had considered so vital to the crafting of their architecture.

In spite of technological developments such as fluorescent lighting, there were a few twentieth century architects for whom there could be no compromise, and who recognised the crucial role played by natural lighting in their work. As long ago as 1964, for example, Professor S.E. Rasmussen, in a series of lectures to the Royal Institute of British Architects, stated that “… the same room can be made to give very different spatial impressions by the simple expedient of changing the size and location of its openings. Moving a window from the middle of a wall to a corner will utterly transform the entire character of the room.” He contended that daylight was “… fundamental in allowing us to experience architecture” (Rasmussen, 1964:187).

By way of illustration, Professor Rasmussen cites Le Corbusier’s Chapel at Ronchamp, which he considers to be a major shift in thinking by the architect. Le Corbusier’s earlier work he sees as employing strident, strong side lit spaces, but in the design of this chapel there is a new approach, in which “Le Corbusier has created a church interior … which has the emotional appeal that is based on the shadowed dimness constraints on their creativity. In reality, though, and as a consequence of this technological advancement, the art of using natural light in an architectural manner was rapidly lost to architects practising in the middle and second half of last century. Paradoxically, the new found freedom to design with ultimate flexibility did not, as might reasonably have been expected, give rise to better architecture. On the contrary, too many other considerations were being ignored, and above all a feeling of alienation was being experienced by the inhabitants of the new deep plan buildings.
of indirect lighting, in which form is only vaguely revealed” (Rasmussen, 1964:212-213). The architect’s subtle use of natural lighting is clearly seen in Figure 1, in which the roof appears almost detached from the walls, giving the interior something of an ethereal and spiritual appearance.

The architect Louis I Khan was another strong proponent of the use of daylight in architecture; for him natural light was something of a starting point, and as contended by Buttiker “… one of the most powerful aspects of Louis I Khan’s architectural space is his handling of natural light. Khan believed that architecture began with ‘the making of a room’, and that ‘a room is not a room without natural light’. The structure is a design in light. The vault, the dome, the arch, the column are structures relating to the character of light. Natural light gives mood to space by the nuances of light in the time of the day and the seasons of the year, as it enters and modifies the space” (Buttiker, 1994:10).

Khan sums up his own attitude in his statement that “… a space can never reach its place in architecture without natural light” (Buttiker, 1994:24).

Buttiker believes that later in Kahn’s career, daylight became more and more significant in his work. He developed increasingly sophisticated ways and means of manipulating light, and according to Buttiker the zenith of his achievement is shown in one particular example of his work, namely the Assembly Hall in Dhaka,
The Case for Daylighting in Architecture

Richard Barrett

Bangladesh (Figure 2).

Figure 2: Assembly Hall, Dhaka, Bangladesh, in which Khan manipulates natural lighting to enhance the building’s sculptural form (Source: Buttiker, 1994:179).

Possibly the most often cited example of Khan’s work with daylight, however, is the Kimbell Art Museum, Kimbell, Texas (1967-1972). In this building he designed ceiling mounted reflectors (Figure 3) which redirect light from an exterior roof aperture running the length of the buildings.

Ander also draws upon the words of these two leading exponents of daylight in architecture, firstly in quoting Le Corbusier - “I use light abundantly, as you may have suspected. Light for me is the fundamental basis of architecture. I compose with light.” And adding Khan’s quote that “… a room is not a room without natural light. Natural light gives the time of day and the mood of the seasons to enter. The choice of a structure is synonymous with the light which gives image to that space ... a plan of a building should read like a harmony of spaces in light” (Ander, 1995:(ix),6).

Figure 3: Daylighting of museums and galleries is not universally favoured by curators because of risk of UV damage to the exhibits. In the case of the Kimbell Art Museum, however, and in order to minimise this risk, Khan used perforated aluminium ceiling diffuser-reflectors to admit controlled levels of natural light (Source: Buttiker, 1994:179).

Another building in which daylight plays a hugely significant part is the Johnson Wax Building, Racine, Wisconsin (1950). The architect, Frank Lloyd Wright, carried out some bold experimentation with glass tubing to create ‘skylights’ to the main open plan office...
area (Figure 4). Architects, like all innovators, will sometimes push boundaries beyond the knowledge and techniques available at the time, and this can be said of this project. The level of technology failed to match Wright’s innovative thinking, and regrettably much of the tubing had to be replaced.

Architects who feel strongly about using natural light will sometimes describe it as being another ‘material’ with which to build. Ruck (1989) emphasises the important role played by daylight in the design of architecture, and she considers it to be as much a ‘material’ as the brick, steel, stone and concrete, of which the solid fabric of the building is made, and should not be considered an applied decoration.

Health, Wellbeing and Performance

Gallagher (1994) suggests that the Industrial Revolution made a significant difference to the way we lived. We changed from an agrarian, substantially outdoor way of life, to a more indoor, urban environment. She believes we adapted rapidly to this new lifestyle, in spite of millions of years of evolution which had seen us respond to the cycles of the earth and sun. Gallagher states, however, that environmentally minded scientists are now questioning what we traded off in order to live indoors, with artificial lighting, heating and cooling - a new world order structured as she says around economic rather than biological concerns. For the first time in our history we were no longer wakened by the dawn, and lulled to sleep by darkness.

The availability of daylight and its impact on the health and wellbeing of building users is generally nowadays acknowledged as fact, and writing some five years later Gallagher (1999) cites winter statistics for the north of the United States, pointing out the serious nature of an illness known as seasonal affective disorder (SAD). Six percent of New York residents suffer severe depression during winter, but as many as 50% of the residents suffer mild symptoms, including low energy, and disturbed eating and sleeping patterns. Gallagher believes that this behavioural problem has a specifically environmental cause: lack of light.
Ruck is also very specific on the issue of health and wellbeing of the occupants of buildings, and suggests that “… light can also be considered on physiological and biological grounds as being essential for the wellbeing of a building’s occupants owing to its non-visual effects such as brain stimulation and body orientation and balance. A good luminous environment therefore depends not only on environmental and task lighting design, but also on the spectral composition effects of the light on individuals. Great architects, including the designers of the Parthenon, the craftsmen of the Gothic cathedrals, and indeed certain twentieth-century architects, have understood the impact of natural light and its importance for putting human beings in touch with their environment” (Ruck, 1989:40-42).

It is no coincidence, therefore, that natural light has always played a key role in the design of certain building types, in particular where human emotional wellbeing could be an issue, including sacred and religious architecture. Stegers considers that “natural light… [has] a fundamental effect on the atmosphere of sacred spaces. Light and shadow determine the spatial qualities of a space … light can accentuate, direct attention, create an atmosphere of contemplation and composure, foster togetherness in prayer, or underline the solemnity or festiveness of an occasion” (Stegers, 2008:60).

Ruck discusses the issue of human biorhythms, and the importance to human wellbeing of maintaining the 24-hour pattern. The quality and quantity of natural light plays a central role in this, and she refers to evidence indicating that seasonal physiological and psychological problems can be caused by “the pattern of light changes in winter” (Ruck, 1989:47).

The author of this present paper visited Antarctica in the summer of 1978 as a member of the design team for the Scott Base re-building redevelopment. The continent experiences 24 hours of continuous daylight during the summer months, and it was interesting to note how people had adapted to this. The construction workers, for example, seemed to survive on far less sleep, and to work much longer shifts than normal. Hopkinson (1963) believes that both architects and the specialists they work with need to be very aware of this innate ability of human beings to adapt to environmental conditions. Whilst this may work to advantage in short term situations (such as those experienced by the Scott Base construction workers), psychological adaptation, where the person will slowly learn to tolerate conditions which he or she may have initially found to be less than ideal, may be damaging to health and wellbeing.

On this question of the ‘adaptability’ of human beings, Thomas (1996) makes an interesting point in regard to how we also adapt our physical environment. We do this in order to arrive at similar environmental conditions internally, regardless of external climatic conditions. He contrasts the English cob cottage with the Middle Eastern ‘doha’ house, both of which are constructed of earth. Both buildings, the cob cottage under overcast skies, and the doha house in bright and hot sunlight, have evolved to provide around 100 lux of light, whilst both have also dealt successfully with very differing external temperature conditions. There are, however, other considerations over and above lighting levels, and Ruck (1989) suggests that
visible light plays a much wider role than just that of stimulating ‘vision’. She believes it to have a profound effect on the whole human organism. This occurs through stimulation of the pineal gland, which is connected via the inner secretory system to the endocrine glands and the central nervous system. She cites research in this area carried out by Lewy et al (1980), and points to other research, in which the psychological effects of natural light have been explored. “The information our brain receives from the illuminated environment is an essential element shaping our moods, reactions and psychological wellbeing” (Hughes 1983). Plank and Schick (1974) summarise the effect of colour on non-visual processes in human beings. The potential effects include changes in mood and emotional state, muscular activity, rate of breathing, pulse rate, and blood pressure. In addition, MacLaughlin et al (1982) have concluded that the spectral character of natural sunlight has a profound effect on the photochemistry of 7-dehydrocholesterol in human skin and induces physiological and biochemical responses in humans” (Ruck, 1989:46). Specifically, this refers to the enhanced assimilation of previtamin D3 (MacLaughlin et al, 1982).

Ander (1995) and Hopkinson et al (1966) raise the issue of preference for daylight, as generally expressed by people in the workplace, and ponder why this should be the case. At the time of writing Hopkinson et al noted that there had been little research into the behavioural aspects, and they could only therefore surmise as to the reasons. The survey undertaken as part of the author’s Masters Thesis has indicated that many of the architect respondents felt issues such as exterior view and natural ventilation to be equally important to occupant wellbeing (Barrett, 2003). Hopkinson et al reflect that same view. Gallagher believes this whole area is ripe for extensive research when she states that “... equipped with good data on which, or how many, people are sensitive to lighting, spatial arrangements, noise, and other ordinary features of our surroundings, architects, office managers, doctors, and the rest of us will be better able to create more supportive, personalised environments” (Gallagher, 1994:18).

Gallagher considers that some findings in the area of environmental-behavioural (E-B) research are significant to the debate, and Cherulink (1993), a prominent E-B researcher, agrees. He is highly critical of many architects who he sees as taking an overly quantitative approach to the planning of buildings, whilst ignoring the real needs of the users, such as their need for natural light. “Over and over again I have seen architects skip over the theory and insight of an architectural program to go straight to the square footage listing - “how big do you want the room” is the concrete level at which they are comfortable ...” (Cherulink, 1993:7).

Gallagher (1999) and Day (1990), agree with this view, believing that architects are not sensitive to the fact that the ‘places’ they design have a direct bearing on the mood of the users. Both authors believe that architects generally have aesthetics uppermost in their minds when designing, and that the issue of daylighting is not taken seriously; “… in every aspect of environmental design we must recognise that whatever we do affects the human being, the surroundings, the spirit of places and the wider world. It has human, social, biological and ecological implications” (Gallagher, 1999:11).
Gallagher (1994) suggests that architects are starting to respond to the growing awareness of the importance of light to wellbeing, and she cites the New York Board of Education and their experimentation with classroom shape, as shown in Figure 5, “… rather than the traditional box, this version’s plan resembles a bisected square whose halves have been pushed in opposite directions; because it has eight corners and walls instead of four, the room allows for bay windows and a lot more light” (Gallagher, 1994:49).

Evans (1981) points out that the human organism works most effectively and productively when there are conditions of changing stimuli, and that by its very non-constant nature, daylight is an excellent vehicle for providing this - “... the trick in building lighting design is to find a way to provide reasonably subdued surface-brightness variations while at the same time providing some visual flexibility and stimuli. The proper introduction of daylight into the environment is the simplest and most effective way to provide these valuable variations” (Evans, 1981:21).

Evans also points out the importance of orientation, and the fact that human beings have an innate need to be able to relate, both physically and psychologically, to their surroundings. In making the case for orientation and the need for exterior views within buildings he uses the analogy of a passenger on board ship, and points out that the passenger is more likely to suffer sea sickness below decks, than if he or she has a view of the horizon, and that (although significantly milder in effect) the same holds true for people inside buildings. Lam (1992) and Ruck (1989) also emphasise that humans have a biological need for visual information, including aspects that can be related to the daylighting of buildings, such as orientation, contact with nature, awareness of the time of day, and of the weather. Evans (1981) cites research by others such as Ruys and Sommer, in which view to the outside has been shown to be as important as sun and daylight to the occupants of buildings. He also makes the important point that duration of stay in an interior non-daylit space has a significant bearing on acceptability to the occupant. The most extreme situation of unacceptability is the totally windowless environment, which, more than 30 years ago, Collins (1975) was researching at a time when the concept was very acceptable, with the main emphasis being to conserve energy. World oil prices were soaring, and for the first time in history attitudes towards energy consumption were being challenged. The crisis caused us to look carefully at how we designed our buildings, and so it was from this somewhat pragmatic background of ‘energy efficiency’ that her book was published in 1975 by the US Department of Commerce. Collins believed...
there was something equally important to the occupants of buildings; “... even though a windowless building might be the best solution for eliminating energy loss through windows, there is considerable evidence that this may not be very desirable for the people in the building” (Collins, 1975:2).

In the historical context of Collins’ study, her cautionary warnings not to overlook the comfort, behavioural and performance needs of the occupants of buildings must have seemed anachronistic to mainstream thinking of the time. She had been right to cry caution, however, as validated by other research, including that of Rangi and Osterhaus (1999) writing a quarter of a century later, where they point to clear evidence of risk to the health of people occupying windowless environments.

**Statutory Requirements and Codes**

The debate about daylighting and architecture from an historical perspective shows that since the Industrial Revolution the rate of change has been exponential, and far more so than at any other time in history. The period began with the development of iron, steel and glass as major construction materials, and then moved through the discovery of various technologies that allowed the interior environment to be controlled, and culminated in the mid-twentieth century energy crisis. There was now a need to rethink much that had gone before.

Mindset, however, is always a hard barrier to break through, and this event was no exception. The commercially orientated interests of developers and clients was the overbearing driving force behind much of the architecture built in New Zealand during the 1980s, and it was difficult for any architect wishing to address ‘green’ issues. In 1992, however, the New Zealand Building Code (NZBC) was adopted, and this has undoubtedly gone some way towards helping the change of mindset (NZBC, 1992, rev. 2004).

In spite of the code, however, property developers continue to look for loopholes, and the Building Industry Authority (BIA), the agency responsible for implementing the NZBC prior to 2004, regularly had to deal with situations in which interpretations were stretched beyond the point of acceptability. (The Department of Building and Housing (DBH), is the governmental body responsible for administering the NZBC since 2004. They have carried out various legal determinations which have tended to keep loophole seekers somewhat at bay).

The following is an e-mail correspondence which serves to illustrate the nature of problems being encountered by the BIA. The e-mail was received on 10 December 2001, from Ms Claire Benge, an architect employed by the BIA in Wellington, New Zealand. It was sent in response to the author’s enquiry about the NZBC, Section G7, and as to any changes to this regulation that may be being contemplated. Anecdotal information obtained by the author had suggested that some projects had been of concern to the BIA, in respect of the interpretation being taken by property developers and others.

Richard
That looks like an interesting subject, and we are very happy to help you as much as we can. As you probably know, clause G7 “natural light” requires not only natural light but also visual awareness of the
outside environment. The natural light requirement is quite low, being not less than 30 lux for level for 75% for the standard year. Both of these requirements are to ensure mental health, and there is a limit on application to housing, all people’s homes and early childhood centres.

One of our concerns at the moment is that developers try to get as many rooms as possible into buildings that are too deep. We receive a few queries about obtaining the awareness of the outside in deep architectural spaces through other rooms. These are sometimes for new buildings and sometimes for redevelopment of existing inner city buildings. The acceptable solution for G7 allows both natural light and visual awareness of the outside environment through another room. In practice we have interpreted this is being through a living space only. This is in order to maintain privacy, i.e. a bedroom can obtain natural light and visual awareness of the outside environment through a lounge or dining-room space because curtains can be drawn or shutters closed to provide privacy, but this does not work in reverse.

Some very convoluted plans are put to us with very little evidence that visual awareness of the outside environment is sufficient. These plans might be useful to you if we can find a way of making our correspondence available while maintaining confidentiality. If you are interested, let me know.

There has already been a ruling by the BIA about visual awareness of the outside environment, which may have cost the developer some money because the townhouses were sold as three room apartments when one did not comply with G7 and therefore strictly speaking was only a storeroom. The owners may be suing for the difference between the price of three and two-bedroom apartments.

We also have pressure from developers about the need in apartments for natural light and visual awareness of the outside environment in spaces that are likely to be used for studies, offices etc. We argue that any space that is large enough to place a bed in it is likely to be used as a bedroom at some stage of its life and therefore must have those requirements. This would have to be a space < 1.8 in either direction.

Claire Benge, Architect
Building Industry Authority
Wellington
New Zealand (Barrett, 2003).

Osterhaus and Donn (1998) compare and contrast attitudes towards daylighting and external views as apparent in a number of national building codes, including those of New Zealand, Australia, the United Kingdom, and, of particular significance, that of Germany. The fact that access to both natural light and views to the exterior are generally acknowledged as being important for health, wellbeing and worker productivity, appears not to be reflected in the codes of all countries. The authors point out that The New Zealand Building Code is quite unequivocal on the issue, in stating its objective “... to safeguard people from illness or loss of amenity due to isolation from natural light and the outside environment” (NZBC, 2004:Approved Document G7).

The authors also point out, however, that this is limited to habitable spaces, and does not include the majority of workplaces. The fact that the NZBC is a performance-based, non-prescriptive code, is also significant, and tends towards ‘liberal interpretation’ by property developers and the like. By contrast, in Germany the codes are very much more prescriptive, with strict requirements in regard to both external view and access to daylight. For example, although some exceptions are permitted, such as darkrooms and basement shops, bars and restaurants, there are strict requirements for the design of workplaces. The following
requirements serve as examples to illustrate the prescriptive nature of the German codes:

“In the Federal Republic of Germany, federal regulations for workplaces ... demand that each employee must have a view to the outside ... a window area of at least 1.25 m² (is required) for workspaces up to 5 metres deep, and a window area of at least 1.5 m² for rooms more than 5 metres deep. In addition, for rooms of up to 600 m² floor area, the total window area shall be at least 10 percent of the floor area, for rooms with a floor area of more than 600 m² the total window area shall be at least 60 m² plus one percent of the floor area. The window sill shall be located between 0.85 and 1.25 metres above the floor level of the room, and the transparent part of the window shall be at least one metre wide and at least 1.25 metres high“ (Osterhaus & Donn, 1998).

Perhaps not surprisingly, in a country where legislation ensures access for all workers to both natural light and exterior view, the code compliance requirements in Germany seem to largely negate the need for core-daylighting systems. Compulsion means that the solution is sought in the initial building planning, rather than in adding components retrospectively. “German office buildings generally have little depth. The most common configuration is a central corridor with offices on both sides. Rarely does the depth of the offices on either side exceed 5 metres” (Osterhaus & Donn, 1998).

Their paper concludes by suggesting that daylighting design should become an integral part of future lighting codes and standards, particularly in the design of offices and other workplaces.

Daylighting Design - The Role of the Architect

To conclude this paper, consideration will be given to the role of the architect, and the relationship between architect, building user, and other professionals working in the arena of daylighting. As with many issues in architectural design, the primary aim must be to meet the specific needs of users. At the basic level in considering what these needs may be, Evans (1981) believes there is failure, on the part of both architect and building owner, to examine and address specific visual task needs at the design stage. User needs, however, go much more deeply than the ability to carry out visual tasks, into considering the overall comfort, health and wellbeing of the building’s occupants. As discussed earlier, Gallagher (1999) and Cherulink (1993) believe that architects need to show more interest in the findings of environmental behavioural research, and to be more proactive in adopting some of the findings.

There is something of a grey area in all of this debate, however, and the question needs to be asked, “how far can the architect go in assessing and judging user needs, or is this the realm of another professional?” In answering this, and speaking from his standpoint as a lighting engineer and designer, Hopkinson (1963) is quite unequivocal in his view. He believes that establishing the needs, per se, of people, falls firmly within the arena of the psychologist, and that the architect’s role is to provide the environment necessary to meet these needs. He suggests that “the architect’s task of creating a favourable environment for living and working demands a study of the response of the human being to this environment. Such a study is new
as a science, though not as an art" (Hopkinson, 1963:3).

Cook (1997) believes that the understanding of daylighting techniques could well become an important aspect of the architect’s services, and that more clients are likely in the future to seek this form of expertise. Hopkinson (1963) also emphasises the important role played by the architect, though he sees it more as assimilating the engineer’s expertise into design solutions. Writing exactly one decade before the first oil crisis, Hopkinson suggests a more responsible and pro-active approach be taken by architects, and that the ‘seat of the pants’ approach must be underpinned by the more scientific expertise. “Lighting and glare, acoustics and noise, etc, ... are all matters to be studied by a new kind of specialist, although the application of the results of all these experimental studies lies with the architect” (Hopkinson, 1963:3).

Ander (1995) makes a strong plea to building design consultants to work cooperatively and for all disciplines to become involved at an early stage in the design process. This, he considers, gives the best chance for all aspects to be properly considered and integrated. In considering what the best approach might be to the successful integration of daylight in architectural design, Moore (1995) introduces the idea by suggesting that “...daylighting is the most recently discovered realm of architecture. Once inseparable from the practice of fine building design, lighting by natural means began to be regarded as anachronistic early in the twentieth century when electric lighting became both practical and economical. Instant, safe, predictable, and absolute, artificial lighting has tended to overwhelm building design since the Industrial Revolution. Electricity has also made possible constant illumination levels that do not reflect the natural rhythms and the unpredictable variations of each day’s new light” (Moore, 1995:(vii)).

Ander considers that there is an intimate relationship “between people, daylight and architectural form, with daylight being the ‘design variable’” (Ander, 1995:(vii)), and consequently the most significant element in determining the form and scale of the building, its orientation on the site, and the interior spaces, both in terms of the quality and character of those spaces, and in how the occupants respond to those spaces.

Selkowitz (1998) suggests that technological advances, such as more efficient types of glazing, will be insufficient to change mindset, and he believes that the process needs to be much more holistic in nature: “Daylighting is fundamentally a systems integration challenge, involving the building siting and orientation, fenestration design, lighting systems design, control systems selection, and ongoing maintenance” (Selkowitz, 1998:2).

Lam (1986) essentially agrees with this viewpoint, and he suggests that designing for sunlight involves careful architectural design in terms of both the planning and the geometric forms relative to the light available. He also suggests that an overall understanding is needed on the part of the designer, of the nature of light, and the methods of controlling light, and the ability to relate this to an architectural context. He cites the Cambridge University History Faculty building by James Stirling as an example of failure to address environmental concerns
(Figure 6). “Many of the best known architects have created dramatic toplighted sculptural statements that must have assumed sunless skies and then attempted to ameliorate the self imposed problems with technical solutions, sometimes with little success. One example is the fully glazed greenhouse ceiling/roof at the Cambridge University History Faculty building (James Stirling, 1967). This building is an environmental disaster, cold and drafty in winter and hot as an oven in summer” (Lam, 1986:142).

**Conclusion**

The importance of looking at the whole building cannot be over emphasised. Thomas (1996), much like Lam, and Baker and Steemers (2000), acknowledges what he terms “the most significant shift in thinking,” which is to consider the building in its entirety. This more holistic approach gives careful consideration to aspects such as the initial siting of the building, its eventual form, and the structure and materials used for construction and finishes. He considers...
that daylight has become important as a consideration in building design, to the extent that the design should “aim to provide enough light whenever the sun is above the horizon” (Thomas, 1996:6).

The best of intentions may not always come to fruition, however, and a whole range of conditions can sometimes conspire to make it very difficult to provide optimum natural lighting conditions deeply within a building. These ‘conditions’ might include a deeper than normal floor plan, or a less than ideal site, which, for example, may be heavily shaded by adjacent hilly terrain, tall trees or other buildings and structures. It is in this area that considerable work has been done over the past two decades, to develop a range of systems and methods to facilitate interior daylighting by redirection of natural light. This topic has been covered in some depth by the author in an earlier paper (Barrett, 2007), in which a range of these systems and methods is catalogued and discussed. These range from simple devices such as skylights and light shelves, through to more complex computerised sun-tracking mirror and prism systems (heliostats). Much of this innovative development has been carried out by Dr Paul Littlefair of the United Kingdom Building Research Establishment, and his research includes some historical precedents as illustrated by figure 7, indicating that light redirection is nothing new (Littlefair, 1996). This also throws out a challenge to architects, to think creatively about natural lighting of deep interior spaces, rather than take the easy alternative of relying on artificial illumination.

As architects we would also do well to acknowledge the inspiring legacy left to us by the likes of Khan, Le Corbusier, and others. We should also recognise that a few contemporary architects (such as Steven Holl, and Lord Norman Foster), have taken up the reins, and continue to work within the principle that “…light inspires us and can enliven space. There are few things as delightful as the ever changing presence of natural light in a building. Natural light tells us about the weather, the time of day,
and satisfies other deeply rooted psychological needs” (Egan & Olgyay, 2002:88).

References


**Richard Barrett**

Richard Barrett is a practising architect and a Senior Lecturer and former Chair of Research at the School of Architectural Studies, Christchurch Polytechnic Institute of Technology, Christchurch, New Zealand. He graduated from the School of Architecture, City of Leicester Polytechnic (UK) in 1971. In 2003 he was awarded a Master of Architecture degree (with Merit) by Victoria University of Wellington, New Zealand. His interest in the subject matter for his masters thesis, 'core-daylighting' (systems and methods for bringing natural light into deep architectural space where conventional methods such as windows and skylights cannot readily be used), was sparked during the early 1980s whilst working as architect for the redevelopment of New Zealand's Scott Base in Antarctica. Barrett visited the continent to monitor construction, and the experience of living in constant daylight, with no apparent diurnal-nocturnal rhythm to pace daily activities, led to an interest in the physical and physiological influence brought about by natural light (or its lack), and in particular the role played by architecture in this process. This culminated in his Masters thesis (Barrett, 2003) which examined the state of the art amongst New Zealand architects. He is an Associate Member of the New Zealand Institute of Architects, and committee member of the NZIA Canterbury/Westland Branch. He can be contacted at barrettr@cpit.ac.nz
CULTURAL PERSPECTIVE OF WAYFINDING BEHAVIOR-
EXPLORING THE SOCIO-SPATIAL VARIABLE IN THREE CHINESE
HOSPITALS CASE STUDIES

Yi Lu and Ruzica Bozovic-Stamenovic

Abstract
In the era of rapid economic growth, China is witnessing huge transformations of the built environment, accompanied by the problem of spatial disorientation in large scale buildings, such as hospitals and airports. In search of possible resolutions, we are looking into the relationship between wayfinding performance in hospital environments and the Chinese traditional spatial archetype. This study focuses on a few of the most characteristic properties of traditional Chinese architecture: the axially and openness. By having subjects carry out various wayfinding tasks in three urban hospitals that differ in terms of the degree of axially and openness, we examine how socio-spatial variables impact spatial navigation. The result supports the relationship between search performance and spatial properties described from a cultural point of view. It suggests that wayfinding performance could be affected by cultural characteristics immanent in the Chinese society. Acknowledging the deficiencies of this small-scale study we may want to restrict its relevance to inspiring further research in this direction. In the long term, we might expect new prospects leading to important implication for the future of hospital design.

Keywords
Wayfinding; socio-spatial variables; culture; Chinese hospital.

Introduction
From a theoretical point of view, wayfinding performance is the result of a two-way process between a person’s cognitive ability and his or her environment (Gaerling, Boeoek, & Lindberg, 1986; Gaerling & Evans, 1991; Golledge, 1999; Moore & Golledge, 1976) (see Figure 1). The environment suggests distinctions and relations, and the wayfinder makes path choices based on perceived environmental information, with the cognitive ability mediating between the two. A growing body of literature suggests various physical characteristics could facilitate wayfinding. The environment-behavior link is regarded as purely spatio-physical relations in most studies. However, the socio-spatial relations between the environment and wayfinder are also a critical part of the full understanding of wayfinding performance across cultures. Just as Lynch suggests, the systems of orientation used vary widely from one culture to another, from one landscape to another (Lynch, 1960).

In China, and maybe other countries with a rich indigenous culture, the wayfinding environment is much more inclusive. It incorporates both
the spatio-physical aspects expressed through planning and dimensions, but also other permanent features possibly perceived and understood through their cultural dimension. The assumption is based on two reasons. First, Chinese culture and philosophy such as Dao, Confucianism, and Feng-Shui profoundly and directly affect environmental cognition and spatial concepts, even in rapidly modernizing Chinese society. Second, the spatial parameters of Chinese culture have always had vast influences on layout, symbolism and understanding of spaces and settings even until now.

Figure 1: The traditional wayfinding model composed of three parameters: wayfinding performance, the environmental variables of the setting and human cognitive ability. (Source: Authors).

This cultural dimension is reflected in the main principles of configurations, including axiality, cardinal orientation, and open spaces (Li, 2002; Lu & Bozovic-Stamenovic, 2004; Shen, 1994; Steinhardt & China House Gallery., 1984; Wheatley, 1971; Xu, 2000). The first distinguished feature is cardinal orientation and axially (Figure 2). It is shared by almost every city, resident house and public building. In China, this pattern appeared “in the plans of some of earliest cities, but even the smaller cities and towns usually exhibited the rule of cardinal axially and orientation” (Shen, 1994). In Chinese cities, the principal street running from south to north was of much greater significance than any venue running from east to west. In cities and settlements, the most important official buildings were ranged along this axis (Wheatley, 1971). This feature dominates layouts of almost all built environments, ranging from the Old City of Beijing to single residences.

The second obvious feature is the layout of courtyard (Figure 3). Buildings, usually rectangular in plan, were established around a courtyard or series of courtyards. Despite the different forms of individual buildings, the courtyard composition is the most common. Even compact houses of two or more floors will often be found to be planned around a small courtyard. This is to obtain the balance of yin and yang (Lee, 1989; Lung, 1978). Yin signifies the shadowy slopes, the cold and rainy season, and everything that is passive and female; Yang signifies the sunny slopes, warmth and dryness and everything that is active and male. According to yin-yang school, yin and yang are interdependent, for there is no yang without yin and no yin without yang.

This discourse suggests that the built environment may seem to be easily understood by the traditional Chinese due to the striking physical features that denote particular inherent spatial
patterns. Cultural conditions influence the environmental cognition of traditional spatial concepts, as well as traditional environments. Therefore, socio-spatial variables might impose an important constraint on wayfinding behavior, otherwise solely guided by universal spatial concepts and navigational rules. Hence, we assume that the environmental properties like axially and open spaces might be relevant for wayfinding in Chinese hospital layouts.

**Methods**

**Overview**
Various studies have already confirmed the influence of spatial characteristics on wayfinding and spatial cognition, though most of them focus on the spatio-physical link. As early as 1960, Lynch (1960) pointed out five elements – landmark, path, node, edge, and district – as important for the legibility of a city. Later, Gaerling and others (1983) pointed out three environmental variables could influence wayfinding: degree of differentiation, degree of visual access, and complexity of spatial layout. Similarly, Weisman (1979) believes that visual access to cues and landmarks, architectural difference, signs, and plan configuration are important factors likely influencing wayfinding behavior. O’Neill (1991) found both cognitive mapping and wayfinding performance increased when the ‘Inter-Connection Density’ decreased, which is defined by the average number of connections per choice in a floor plan. Later, Peponis and others used space syntax theory and methodology to examine
the spatial variables. The researchers reported that subjects’ searching patterns were strongly predicted by a space syntax measure of the accessibility of a particular space (Haq, 2003; Peponis, Zimring, & Choi, 1990).

These studies have brought attention to the various properties of the environment and techniques for their measurement. However, further discussions and investigation on environmental specificities from specific cultural perspectives are needed. Apparently, the hypothesis of this study could benefit from applying the theory and methods of space syntax (Hillier & Hanson, 1984). In this case space syntax will be used for analyzing particular spatial patterns which reflect, and could be recognized, quantitatively measured, and labeled as part of the wider cultural pattern (Hillier & Hanson, 1984).

**Settings**
The research was carried out in three complex urban hospitals in Nanjing, a major Chinese city. The selected hospitals are diverse in regard to their principles of configuration. One is to a great extent based on principles of traditional Chinese architecture, due to obvious axis running from south to north, and many open spaces in front of the main buildings (Figure 4). On the other hand, the second one has a strongly compact layout, with few characteristics of Chinese traditional buildings (Figure 5). The third hospital shows an in-between situation in respect to the previous ones. It also has some open spaces and an axis running from north to south. However,
these characteristics do not dominate spatial organization (Figure 6). It is assumed that these different layout principles could be of some relevance to wayfinding behavior in these three hospitals.

Figure 4: Floor plan and picture of General hospital, which has obvious characteristics of axially and open spaces. (Source: Authors).

Figure 5: Floor plan and picture of 81 Hospital; a compact layout, without open space. (Source: Authors).
Subjects
In these three settings, 31 participants carried out a variety of tasks related to wayfinding behavior and cognitive spatial understanding. The subjects were 17 male and 14 female college students aged 18 to 25. They were carefully screened so that none had visited a large hospital complex more than once in the 12 months prior to the study.

Procedures
The subjects were individually met on campus and led to one of the hospitals. Every participant carried out two wayfinding tasks, an open exploration of the setting, and a directed search for certain destinations within it (1).

For the open exploration, the subjects were led to the main entry point of the hospital and were asked to freely explore the ground floor of the complex. They were instructed to learn about its layout and locations as best as they could, so that they would be able to carry out specific search within the environment later. They were instructed not to talk to anyone but to try and fulfill their tasks only from the environmental information, including signage received from the actual setting. The subjects were followed by a researcher, and search paths were recorded on the plans of the hospitals.

After the completion of the open search phase, subjects were asked to perform directed searches for specific locations. As before, subjects were allowed to proceed as they wanted and to read any signs that were available, but were prohibited from asking questions. The directed search paths were recorded on the plans of the hospitals.
Environmental Variables
In order to systematically analyze the tracking records, we first looked into the layout of selected hospitals applying methods from the space syntax theory. We assumed that the environmental properties, axially and open space, reflect cultural parameters, and are critical for wayfinding performance, as they are easily understood by people from this particular culture. Hence, the environmental properties of axially and open spaces were selected as being important for predicting Chinese people’s wayfinding performance, in this case, of local hospitals.

In terms of technique of space syntax, the layout of axially can be reflected in the environmental variable of integration. The spaces located along the axes have higher integration values than the others, due to their easy access. The measure of integration, or its reciprocal, segregation, is expressed by Real Relative Asymmetry or RRA value. This value is obtained by the analysis of a graph representing the number of changes in direction between one axial line or space to all other lines or spaces, in a given building.

On the other hand, the open spaces can be defined in terms of the environmental variable of visual access. The existence of open spaces could increase the degree to which other spaces could be seen from a given space. The measure of ‘visual access’ is established by a trained observer who stood in particular nodes of various hospitals and estimated how many other decision nodes he could identify.

Behavioral Variables
As discussed above, this study considered two kinds of behavioral variables: use of lines and nodes in the two tasks, open exploration and directed search, and redundant nodes use in directed search. The total frequency of use of each axial line and each node was counted for statistical purposes. It was calculated from the times of total use of each unit by the 31 subjects during their exploration within the setting. For the purposes of such computation, the backtrackings other than those which covered a considerable length were ignored in this study.

For each directed search task, the shortest topological route was determined. The nodes that lie on such routes were called ‘path node’. More than on use of these path nodes and use of other nodes were considered as redundant use. It is important because it gives a measure of wayfinding difficulty. Redundant node use was calculated from subjects’ performance in directed search. In terms of the environment, this provides an important value of attraction for any node and space, and in cognitive terms this provides a sense of environmental understanding.

Results
The data set includes both environmental variables, which are analyzed from a cultural point of view, and behavioral variables, which are obtained from the recorded search tracks of the subjects in three hospitals. Basic information about the respondents, such as age, sex and background were also collected.

Open search and environmental variables
In order to discover whether the pattern of integration or visual access was relevant to the way in which the buildings were searched, we
studied the correlation between the degree of integration of different axial spaces and the frequency of use of each space by the 31 subjects during the open search (Figure 7). For the purposes of such computation we ignored backtrackings, other than those covering a considerable length from one corridor junction, or end point, to another.

During open search period, the correlations between integration value and frequency of use of each axial line turned out to be quite strong, whether we consider integration with respect to the circulation system only (Pearson’s correlation \( r = 0.789, 0.766, 0.716, p < 0.001 \) in General, Nanjing, 81 Hospital receptively) or with all rooms on the main floor, including those only available to staff (\( r = 0.643, 0.545, 0.671, p < 0.001 \) in General, Nanjing, 81 Hospital receptively).

Similarly, the correlations of usage of decision nodes to node integration value were also high, both when we consider integration with respect to the circulation system only (\( r = 0.747, 0.784, 0.736, p < 0.001 \) in General, Nanjing, 81 Hospital receptively) and with all rooms on the main floor, including those only available to staff (\( r = 0.651, 0.594, 0.586, p < 0.001 \) in General, Nanjing, 81 Hospital receptively).

A preliminary inspection indicates that both the line use and node use were relevant to the integration value of each unit. However, as we expected, the correlation value was higher when the integration value is obtained with respect to the circulation system than that obtained with respect to all rooms on the main floor. For example, the correlation value between line integration value and frequency

![Diagram](https://example.com/diagram.png)

*Figure 7: The left figure represents the network of basic choice nodes defined within the circulation system in General Hospital. The right figure represents the recorded tracks of the subjects who searched the hospital. Some nodes and spaces are more frequently visited by subjects than others. (Each thin line represents the tracks of three people. Some minor deviation was ignored in this figure.) (Source: Authors).*
of line use in General hospital is 0.789 with respect to circulation system only, while the value decreases to 0.643 with respect to all rooms including some restricted areas.

During the open search period, the correlation between visual access value and the frequency of use of each decision node were also significant. Hospital 81 has an r-value of 0.659, p<0.05, while the values of General hospital and Nanjing hospital are 0.631, 0.565, p<0.05 respectively.

Finally, the mathematical analysis confirmed that the multi-co-linearity was not clear; there is no high (r=0.80 or greater) inter-correlations between the independent variables of node integration value and node visual access value. This result indicates the feasibility of multiple regression analysis.

In accordance with the mathematical analysis, an interaction term comprises all independent variables, which yields significant correlations with frequency of node use. This was used in the multiple regression analysis. To our surprise, the two independent variables entered into the regression, node integration value and node visual access value, yielded an adjusted R-squared value of 0.670, 0.675, and 0.597 (p<0.05) in General Hospital, Nanjing Hospital and 81 Hospital respectively.

**Directed Search and Environmental Variables**

In the phase of directed search, the way we analyzed behavioral data was as follows: each search path was transcribed as a set of decision nodes. For each task, we determined what was the path, or the set of paths, that could lead to the destination with the shortest metric distance. The nodes used in excess of this shortest path were defined as redundant.

The correlations between frequency of redundant use of each node and integration and visual access were calculated. It was found that there is a statistically significant correlation between the redundant frequency of node use and the degree of integration of that node with respect to the circulation system only (r=0.606, 0.625, and 0.545, p<0.05 in General Hospital, Nanjing Hospital and 81 Hospital respectively).

On the other hand, the correlation between the average frequency of redundant use of each node and its degree of visual access was not significant in General Hospital and Nanjing Hospital, though there is still a consistent trend. However, this correlation remains significant (r=0.620, p<0.05) in the case of 81 Hospital.

**Discussion**

In the open search, the combination of the integration value and visual access value of a given node determines to a great degree of the variation of the use of this node. It suggests that open exploration in a hospital was bias toward some spaces more than towards others, in proportion to their degree of integration and visual access. It seems that the results suggest the existence of search pattern which is highly dependent on specifiable and measurable qualities related to environmental properties of axiality and open spaces.

In the directed search, the redundant search for particular destinations is also biased so that more integrated or more easily observed nodes are more frequently traversed, almost irrespective of what the point of origin or destination may be. Those subjects, who did not reach their
destination efficiently, seemed to walk more along integrated spaces. On the other hand, in the 81 Hospital, subjects seemed to still heavily rely on the degree of visual access. Perhaps the difficulty in developing configurational knowledge in the early exploration causes the subjects to become more dependent on visual cues in the directed search.

The empirical results favor a more comprehensive wayfinding model, involving four kinds of parameters. The first is the cultural properties of the built environment which could be understood as system of abstract relational patterns. The second parameter is the observed search and wayfinding paths recorded in the tracking, which have been shown not only to be correlated to the pattern of axially and open spaces, but also to display specific regularities which could be predicted according to parameters of the specific culture. The third is the Chinese culture, which tries to maintain the harmony of the human and nature. Culture has great influence on the building configuration and the people’s cognitive ability, and hence is of great significance for the wayfinding performance. The fourth is human’s cognitive ability, including some navigation rules which seem to mediate the relationship of the above three variables. The relationships between them are summarized in Figure 8.

![Figure 8: The wayfinding model composed of four parameters: wayfinding performance, the configurational variables of the setting, human cognitive ability, and a cultural dimension. (Source: Authors).](image)
Our research findings imply that there is a relationship between the cultural aspects of environmental variables and our subjects’ wayfinding performance in these hospitals. The cultural parameter may impose stress on the environmental cue selection and wayfinding performances of our subjects in the settings. One environment may be well-understood because it conforms to a stereotype already constructed by the wayfinder even when it is visited for the first time. Alternatively, one environment may be regarded as disorderly by a person if it has no physical features that match one’s own generic recognizable spatial pattern.

**Conclusion**

Based on this study, we may suggest that in the mind of our subjects, there was a certain spatial pattern used to identify and to structure the environment. These environmental properties were identified as integration and openness or visual accessibility; the combination of integration value and openness value of a given space appears relevant to the frequency of use of this space during the phase of open search and directed search. It indicates that the environment-behavior link might be more than pure spatio-physical relations.

If the abovementioned points are true, we can draw some important design applications. Designers should redirect their attentions from an exclusive focus on universal wayfinding principles, to one that also considers the cultural aspects of spatial concepts. By integrating proper attention to the latter, we can create environment to facilitate wayfinding and better match the inherent cultural preferences of the users.

Some limitations of this study and recommendations for future research follow. First, it is certain that even in the context of Chinese culture the cultural properties of environment could not be simplified and expressed thorough axiality and open spaces only. In fact, much more research is certainly needed to identify all important Chinese cultural aspects of wayfinding. Second, the environmental properties of open spaces discussed in this study still need further investigation and application using a stricter methodology. Third, further works should be aimed at a computational model and wayfinding rules set to predict human wayfinding performances as discussed above. It is beyond the scope of this research to discuss how wayfinding rules can interface with computational navigation models in the future. Ultimately, further wayfinding studies would examine the role of the socio-spatial dimension in different cultures or countries, using either space syntax methods or other innovative research methods.

**Notes**

(1) These methods were known from previous research done by Peponis (Peponis, et al., 1990).
(2) This value is also used earlier by Peponis (Peponis, et al., 1990) and later Haq (Haq & Zimring, 2003).

Source of illustrations: Yi Lu.

**References**


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Yi Lu is a PhD student in the department of architecture, Georgia Institute of Technology, USA. He received his bachelor degree of architecture in 2002 from Southeast University, China and his master degree of architecture in 2005 from National University of Singapore. He has practiced in large architectural firm DP Architects in Singapore. His projects include single family houses, public housings, and large commercial complexes. He is interested in several research areas: spatial syntax, architectural theory, environmental behavior studies, and GIS. After joining the PhD program in Gatech, he has worked in two research projects: 1) web-walking on campus, which studies how the physical attributes of paths influence people’s walking behavior in corporate campuses. 2) Visibility Analysis in built environment, which explores the effect of visibility structure of environment on people’s perception, movement and distribution within the environment, by developing new measures of visibility analysis in GIS platform.

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THE SPATIALITY OF VEILING - MUSLIM WOMEN LIVING PRACTICES IN MINNESOTA HOMES

Samaneh Vahaji and Tasoulla Hadjiyanni

Abstract
Although much controversy surrounds the Muslim veiling tradition, little has been studied about how immigrant Muslim veiled women navigate the practice of veiling while living in western-type houses. Through interviews with ten Muslim veiled women in Minnesota, this study explores the relationship between veiling and domestic environments. The findings point to both dress and interior spaces as being forms of enclosure, one being mobile (dress), that help women construct their cultural and religious identity while providing them with privacy, protection, and a sense of control. Residing in typical, suburban American homes however, the women we interviewed experienced difficulties being unveiled in one of the few places where the veil can come off. Designers who are cognizant of cultural differences in housing needs can create homes that support various ways of living, that is, culturally sensitive housing.

Keywords
Housing; women; Muslim; culture; identity.

Introduction
Both dress and space have been positioned as markers of cultural identity, ones endowed with social meaning (Eicher, 1995; Low and Lawrence-Zúñiga, 2003). Limited research however, has focused on exploring the relationship between these two cultural expressions. Questions such as: “How does space relate to dress?”, “What are the implications of this relationship for spaces, like domestic environments?”, and “Which other cultural traditions and practices are impacted in the process?” warrant further exploration. Answers to these questions attain special significance under conditions of displacement when a group’s cultural practices are altered or implicated into the web of social changes that accommodates migration (Bammer, 1994). Asking these questions from within the domestic domain, the site of many cultural practices and traditions, is even more adamant as research shows that not being able to practice one’s traditions negatively impacts displaced peoples’ mental, emotional, and physical well-being (Adler, 1995; Papadopoulos, Lees, Lay and Gebrehiwot, 2004). Designers who are sensitive to the intertwining of cultural identity
definitions can better respond to the diverse needs of users by creating culturally sensitive housing, housing that supports various ways of living (Hadjiyanni, 2005, 2007).

Migrants of Middle Eastern origin, many of whom are Muslims, are among the millions of people who move in search of a better life. With Middle East studies being a relatively under-developed area (by comparison with other area studies disciplines) (Waines, 1982), expanding our understanding of the issues faced by displaced Middle Easterners can contribute to the knowledge of disciplines from anthropology to architecture. Complicating the picture further are studies of Middle Eastern women, which have been biased due to western perceptions of their status and role (McDougall, 1983). Attributed by many to Islam and Islamic Law, Muslim women’s lives are examined narrowly, by foregoing for example the investigation of how factors other than religion might impact their practices and viewpoints (Keddie, 2002).

Although multiple ‘voices in architectural education’ have called for more research and education around cultural differences from an architectural perspective (Dutton, 1991), according to Tom Fisher “architects talk a lot about the benefits of good design for people’s lives, but we do very little to quantify those benefits or to document their effects” (1996, p.42). Exploring how the built environment relates to cultural identity and the practice of traditions is especially important at a time when diversity is inherently embedded in the American cultural landscape. Such an exploration though attains further dimensions when entrenched into the study of traditions surrounded by controversy. It is probably safe to say that, particularly since 9/11, no other form of dress is as controversial as the veiling of Muslim women.

Through interviews then, with ten Middle Eastern Muslim veiled women (mohajabe) in their Minnesota homes, this study is a systematic inquiry into their beliefs and accompanying housing needs, aiming to start a dialogue around ways to apply this knowledge to architectural practice. The paper begins with a discussion of the veiling tradition and the controversy that surrounds it; continues with the study’s methodology and sample description, and then delves into the analysis of the findings, highlighting why these ten women are veiled and how they navigate the practice of veiling in their homes’ spatial reality. The paper concludes with culturally sensitive design solutions and directions for future research. Undertaking a study of the veil’s spatiality can be construed as arguing ‘for’ the veil and as advocating for an architecture that is supportive of a tradition that many consider a means of keeping women subservient to men. Therefore, prior to proceeding any further, it is imperative to state that taking a stand is beyond the scope of this paper. Instead, veiling is used as an example of the issues designers must be cognizant of if they are to respond to the similarities and differences that constitute cultural identity definitions (Hall, 2000).

**Background: The Veiling Tradition**

Although it is one of Islam’s oldest traditions, veiling, or the hijab, is engulfed in controversy. The paradox behind the hijab is that on the one hand it is perhaps the most recognizable and identifiable outward sign of being a Muslim, while on the other hand, it is seen by many as a
form of social oppression. What is difficult about
the hijab is the intertwining of the grounds on
which either camp stands—the reasons behind
those who are ‘for’ it and those ‘against’ it are
tied into a web that is hard to untangle. Caught
in the debate are everyone, from scholars,
policy makers, educators, and designers to
common people from all over the world. Therefore, before delving deeper into exploring
the spatial implications of veiling, we must have
an understanding of the deep roots behind this
debate.

Queen Rania of Jordan, one of the Middle East’s
most well-known ambassadors and an advocate
for women’s rights, summarizes the debate
and points to the veil’s religious associations:
“For many, the hijab represents modesty, piety
and devotion to God, and I truly respect that.
But the hijab should not be used as means of
applying social pressure on people” (TIME,
2007). Veiling’s ties to Islam are partly behind
its negative perceptions by westerners, which
go back to colonial attitudes that launched
discourses around the veil as oppressive and
backward versus as an affirmation of cultural
identity and a form of resistance to colonization/
westernization forces (El Guindi, 1999; Bullock,
2002; Thangarajah, 2003; Scott, 2007).

Accentuating the controversy is the question of
how much one should be covered to be a good
Muslim. The different and diverse interpretations
of the Quranic verse shown below are often
the cause of trouble as ‘covering’ translations
range from a woman’s hair (through a scarf like
the hijab, prevalent in countries like Iran) to a
woman’s whole body (like the Afghan burka).

And say to the believing women, that they cast down
their eyes and guard their private parts, and reveal
not their adornment save such as is outward; and
let them cast down their veils over their bosoms, and
not reveal their adornment save to their husbands, or
their fathers, or their husbands’ fathers, or their sons, or
their husbands’ sons, or their brothers, or their brothers’
sons, or their sisters’ sons, or their women, or what their
right hands own, or such men as attend them, not
having sexual desires, or children who have not yet
attained knowledge of women’s private parts; nor let
them stamp their feet, so that their hidden ornament
may be known. And turn altogether to Allah, O you
believers, happily so you will prosper (Quran, 24:31).

As dictated above, devoted Muslim women
can be unveiled in the presence of only a few
men—in all other cases where men are present,
they must be veiled. With homes being among
the few places where the veil can come off,
domestic environments that account for the
spatial implications of veiling can support veiled
women’s well-being.

The Veil, Privacy, and Muslim Architecture

Questions around veiling are inherently framed
within the context of privacy and Muslim
architecture. Defined by Altman as “selective
control of access to the self or to one’s group”
(1975, p.18), understandings of privacy become
more ambiguous when applied to groups like
Arabs. Here, privacy is relational and public and
it concerns primarily women and the family.
According to El Guindi: “For women it is both a
right and an exclusive privilege, and is reflected
in dress, space, architecture and proxemic
behavior” (1999, p.82).

In spite of its wide regional diversity, the residential
architecture of the Middle East supports the
privacy needs of the veiling tradition, or rather,
women’s ability to be unveiled when at home,
through physical manifestations like plans and
spatial arrangements that nurture gender separation. In order for men and women to socialize separately, Arab-Islamic settlements, both traditional and modern, are most often divided into two segments: the male quarter (majlis) and the family living area, the domain of women, which includes the living room, bedrooms, bathrooms, kitchen, storage areas, etc. Further ensuring privacy are characteristics like each space boosting its own separate entrance and washroom. Outdoor spaces are also enmeshed in this dialogue of public and private by taking the form of enclosed courtyards that being placed behind an impenetrable wall, give women the privacy needed to be outdoors without wearing the hijab (Howell & Tentokali, 1989; Rowe, 1989).

Apart from the overall house layout, constructing privacy extends to details like the misaligning of the doorways of neighboring houses, which are positioned so as when the doors are open, views into the other house are not possible (Rowe, 1989). Similarly, windows into the street are limited or they are architecturally treated so again, views into them are restricted. A common technique of controlling views into the house via the windows is the mashrabiyya, lattice woodwork screens, which guard families’ and women’s right to privacy, that is, the right ‘to see’ but not ‘be seen.’

Of particular relevance to this study are the parallels between the veil and the mashrabiyya as noted by El Guindi who states that: “In many ways, veiling resembles a mashrabiyya; but whereas mashrabiyya is stationary, veiling is mobile, carrying women’s privacy to public spaces” (1999, p.95). Indeed, El Guindi extols the veil’s “dynamic flexibility” and “ability for spontaneous manipulation and instant changing of form” (1999, p.97). She explains: “The faculty it offers of pull down to uncover or pull up to cover provides the wearer with the advantage of instant maneuvering” (1999, p.97). Further links between the veil and the mashrabiyya are brought to light by Kenzari’s and Elsheshtawy’s eloquent interpretation of these two cultural expressions as “crystallizations of transparency” (2003, p.24). Extrapolating their argument to spatiality, the authors premise is that “transparency is a property of a process rather than a material (2003, p.24) dependent on things like the position of the viewer. ‘Unveiling’ then, is as much about the power of a woman to lift the veil as it is about the spatial restrictions or barriers she may encounter in the process. Building off these discourses, this paper will further explore the relationship between the veil and domestic spaces by going beyond two-dimensional elements like the mashrabiyya to examine the three-dimensional abilities of these two cultural expressions to construct a sense of privacy, protection, and control. As we will see, in displacement, the dialectic between the veil and domestic spaces is closely tied to the lack of privacy.

**Study’s Purpose and Methodology**

Data for this paper were collected as part of the University of Minnesota’s Undergraduate Research Opportunity Program (UROP) in the fall of 2007. Ten interviews were conducted with Muslim veiled women (mohajabe) in their homes with the purpose of exploring how mohajabe Muslim women relate to their domestic environments, the place where the hijab can come off. With the interviewer being a Muslim
veiled woman herself, the study overcomes the common concern surrounding Middle Eastern studies of male researchers being disconnected from the female perspective (Keddie, 2002). On the other hand, one can easily argue that speaking to one of their own some women might have felt uncomfortable expressing views that could have been perceived as anti-veiling. Cognizant of this limitation and of the fact that the small sample is not representative of all Muslim women, the paper heavily relies on the experiences shared by the interviewees, seeing them as a starting point for getting a closer and deeper understanding of their viewpoints and needs.

Interviewees were asked to describe things like what the hijab means to them; how they use their current house and any concerns they might have; traditions they value and wish to pass down to their children; and their ideal housing conditions. Demographic characteristics were also collected along with plans of the homes and interior/exterior photographs.

**Sample Description**

Identified through contacts within the Muslim community of Middle-Eastern origin, the ten women interviewed were of diverse ages, educational backgrounds, income levels, and years in the U.S. Their ages ranged from 20 to 43 years old, the average being 29; all but one were/had received higher education; and their incomes ranged from less than $20,000 to over $100,000, with the average falling in the $50,000 to $60,000 income category. All women were married and their family sizes ranged from two to five people, with the average being three people. Five of the interviewees had no children, while the rest had between one and three children.

In terms of their occupation, one was a stay-at-home mom, three were working full-time, and six were university students. Reflecting the temporal dimensions of the veil’s spatial implications, the time these women spent in their houses varied greatly—on average, excluding sleep time, the full-time workers spent about four hours inside their houses; students 10 hours, and the stay-home mom about 15 hours. Activities they engaged in while at home included cleaning, cooking, reading/studying, socializing, and watching television.

Eight of the ten interviewees lived in houses they owned while the other two rented, devoting more than 30 percent of their income on house payments or rent. Five resided in single-family detached homes, three in townhouses, and two in apartments with an average of three bedrooms and two bathrooms. All but one of the women interviewed lived in the suburbs of the Minneapolis/St. Paul area.

Most of the women (seven) were from Iran, one was from Palestine, one from Iraq, and one from the U.S. Those born outside the U.S. have lived in the country from a minimum of three to 24 years, with the average being 11 years. Their close connections to their homeland were evidenced by their frequent trips (either every year or every-other year) and the fact that four plan to go back after finishing their studies (another four plan to stay in the U.S. and two are unsure about their future plans).

All women wore the scarf-type of hijab which covers a woman’s hair and, depending on the length, some of the body. Seven started wearing the veil when younger than 10, two between 11-14, and one between 26-29 years of age. All have family members who also wear
the veil and their parents/social expectations had an influence on their choice to be veiled. However, they also added that when they could think for themselves, they realized that they still wanted to keep the hijab on for its advantages and therefore, all women want to pass the hijab dress code down to their children.

**Discussion - Practicing Veiling in Minnesota Homes**

When introducing themselves to us, in addition to mentioning their name and educational level, most of the women we interviewed highlighted the fact that they were Muslims. Having set the frame around which the interview would be structured, these women ensured that we knew the importance of religion in shaping and forming their activities and lives. Communicating their Muslim identity was also very important to all of our interviewees (in a scale of 1 to 5, the average was 4.7), who employed many forms of cultural expression in the process—be those decorating with framed verses of the Quran to praying five times a day (Figure 1). As our aim was to explore the spatial implications of veiling, we begin by elaborating on the reasons our interviewees cited for wearing the veil.

**Reasons for Veiling**

Showcasing her religion was one of the main reasons this 25 year-old woman chose to wear the hijab:

“I think I am special. My confidence has been raised to the sky because of wearing the veil. I am getting closer to God. It makes me a woman on a mission. It represents my religion. I know I am being watched and I need to behave nicely.”

Others, saw the opportunity to stand out in public as the key to acting as ambassadors for their cultural and religious groups because,
as one interviewee stated: “We are the most misunderstood ethnic and religious group, and media portrayal of our lives and identities are unfairly negative and full of lies.” Another felt that she “wanted to reveal the true identity of Muslim people because everybody needs to know Muslims are good, and they need to trust us, because we are honest and trust worthy.”

For this woman, wearing the veil meant abiding by her religious beliefs as the hijab was a marker of her religious identity: “Sometimes I think I like not to wear it, but I can’t because it’s not comfortable for me. It’s not comfortable because I feel so guilty about it in terms of doing something wrong for the religion. Maybe it’s a joke that I feel comfortable.”

Similar reasoning was expressed by a 24 year-old college student: “I love to show others that I am different. Hijab is one of the things that are in the Quran and we believe things that are in Quran are for our own good.”

Particularly intriguing to anyone studying space, what it means and how it is constructed, are the links between the veil and protection. As elaborated by this 42 year-old woman: “It’s a covering, it defines my religion, it covers me from everybody else.” A 22 year-old further explained: “It shows my identity and shows my boundary for strangers not to enter and gives me a kind of security that I could not otherwise find.”

Also fascinating is a perception of veiling that stands opposite to western conceptions of ‘covering’—by covering themselves, some women felt that they actually show more of themselves, and most importantly, they allow others to focus on what really matters. This paradox, ‘covering as a means to show more,’ sounds uneasy to the western mind where ‘covering’ implies that something is hidden. A 43 year-old professor related that wearing the hijab increases the value of women in the eyes of men, helping them be recognized for their achievements. While describing what the hijab meant for her, she said: “It means that I can be respected for my intelligence and intellectual abilities and not for my body image. To me, it’s a sanctuary and female independence.”

Lastly, another dimension of veiling that is often misunderstood by the veil’s opponents is its association with freedom and ‘less to worry about.’ According to a 27 year-old from Iran: “The hijab means a lot. It is a part of my identity. If I am forced to take it off, it will be very hard for me to function. It doesn’t limit me as a woman, I can function and do my daily activities. If I am going to work or to school, I don’t need to worry about how I look as far as my sexuality and body image goes in people’s minds. It is as if I am wearing ‘privacy’ while in public.”

Veiling then, is the purposive act of ‘building’ a ‘wall’ around one’s body that ensures a woman’s privacy. Acting as a means of control, the veil becomes the vehicle through which Muslim women negotiate between the self they show to others and their private self. Conceiving of the veil as a ‘boundary’ speaks to the veil’s spatiality and its ability to foster a sense of enclosure, one that engenders comfort, safety, security, and a sense of freedom, while forming and positioning a woman’s religious and cultural identity. Incidentally, all of these dimensions of meaning are also associated with domestic environments (Hayward, 1977; Moore, 2000), and therefore, the parallels between the two types of spatial constructors are beginning to
become evident. Below, we will delve deeper into exploring how domestic spaces impact the process of navigating between identities and between what it means to be veiled and unveiled.

**Domestic Implications of Veiling**

When asked what home means to her, a 27 year-old mother of two said: “It is somewhere safe, where I can be comfortable. I can breathe without anybody countering me. I am in control of everything.” She paused and then added: “It’s my territory.” Another interviewee elaborated: “Home means a lot. Of course, it’s a place to relax and keep your privacy, a place for gathering, fun, and family activities. It’s a place to express your likes... sense of style; because you are the master of the house, you have your freedom. You can do anything you want.” These meanings of home were jeopardized though when domestic interior and exterior spaces were not supportive of the veiling tradition.

Meeting their privacy needs was among the reasons many interviewees cited for liking their house—from the fact that spatial division allowed for gender separation during gatherings to the large windows that enriched the interiors with natural views and sunlight while blocking neighbors’ views into the home. On the opposite end, the difficulties some encountered due to living in the U.S. related to homes not supporting their privacy needs. These difficulties were exacerbated by temporal factors like the fact that half of our interviewees spent much of the day in the home, often caring for children, caring for the home by cooking and cleaning, socializing, but also reading and working on the computer. All of the women noted that privacy in the home was extremely important to them and it extended to both outsiders and family members. As a 27 year-old who has lived in the U.S. for a little over six years explained:

“Privacy is important because living in America [means] there are [still] certain norms that you need to practice. Because when I am home, I can truly be who I am, I need to have privacy to maintain who I am. So, provide spaces at home where I can be who I am, dress however I want and talk about whatever I want.”

Among the spatial implications of privacy, the open plans prevalent in new construction are probably the design characteristic of their homes that most interviewees had trouble with. The typical open-plan kitchens for example, created difficulties for some women as they had to keep their hijabs on when guests were over, making cooking and serving male guests both dangerous and uncomfortable (Figure 2). This situation was even more stressful due to the fact that most of our interviewees preferred to provide all the food during social gatherings. Characteristics of cooking spaces they felt would account for comfort and privacy included enclosed kitchens, even if it meant separating the kitchen from the dining room with a curtain.

Apart from spatial division and placement, the size of spaces also impacted some of our interviewees’ activities in the home. When guests visit, typically, gender separation rules take effect. Having two large separate spaces to accommodate the two groups is ideal for a pleasant gathering. If the house does not allow for complete separation, then women and men will end up creating their own circles in one large space, which implies though that
all women will have to remain veiled during the socializing hours.

Spatial divisions must extend to both the horizontal and vertical directions. Having two stories, with the bedrooms upstairs and the kitchen/dining/living room downstairs, was preferable to some women as most often, the second floor is not accessed by guests. According to a 22 year-old, “Bedrooms upstairs are easy and provide a space to take off your hijab and breath.” In such cases though, an unveiled woman should be able to access all needed spaces. The placement of the staircase must then enable her to go to the second floor without being seen both from inside and outside the house. In typical American homes however, openness guides the design of entry areas and staircases are in many cases located by the front entrance. This is contrary to Islamic spatiality that conceives of the entrance, the threshold, as marking the transition from the public to the private domain and as having religious significance. According to Eliade (1959, p.25), the threshold is “the limit, the boundary, the frontier that distinguishes and opposes two worlds – and at the same time paradoxical place where those worlds communicate, where passage from the profane to the sacred becomes possible.” A 27 year-old mother of two explained the limitations she encounters because of her lack of control of the threshold:
“Something else that I don’t like is that if someone knocks on the door, I have to walk in front of the door in order to go upstairs and wear my scarf, and they can see me while I go upstairs. So, what’s the point if they can see me? I wish I had a door with a little eye.....There is an issue with American houses....In Saudi Arabia, there is a different door for guests so that they can’t go through the house. Let’s say I have some guests and I want to sneak out, I can’t because they will see me” (Figure 3 & 4).

Figure 3: Accessing the stair has no privacy due to sidelights of main entrance (Source: Authors).

Figure 4: Floor Plan of the house (Source: Authors).
Connections to the outdoors were additional factors that impacted the well-being of some of the women we spoke with. All of them liked having big windows that allowed for sunlight and natural views. However, to maintain their privacy when unveiled, eight of our interviewees relied primarily on curtains or blinds that darkened the interiors and cut off all outside views. Solutions to this problem include using opaque glass; ensuring that windows are not aligned and do not face those of neighboring homes; spacing houses further apart (enough to prevent views into another home); and using greenery to screen views.

Many of our interviewees also valued private backyards—when asked about characteristics of their houses back in their home countries which they would like their house in the U.S. to have, most mentioned enclosed backyards. These are domestic open spaces where veiled women can take off their hijabs and enjoy the feeling of sunlight and wind in the privacy of their own home. According to a 22 year-old, in her house in Iran: “We had a hayat [backyard] that had tall walls all around and we had a hoze [traditional pool with a low level fountain] and a variety of trees.” The semi-private green spaces surrounding typical American suburban homes can transform into private backyards by means of tall walls or fences and dense plants as well as techniques such as keeping backyards from facing each other and...
placing homes as further apart as possible. Similar programmatic requirements can carry over into porches, additional outdoor spaces that can account for privacy from the gaze of outsiders, the wish of a 43 year-old who explained that: “When I sit on my porch, I have to wear the hijab and that is very uncomfortable. I’m in my home and I am fully dressed!” (Figure 5).

Closing Comments

Through interviews with ten mohajabe women this study explored the spatial implications of the veil. The findings show parallels between the veil and domestic environments as both serve as spatial enclosures that construct a woman’s identity and provide women with privacy, protection, and a sense of control. The veil’s spatiality takes the form of a flexible, portable, or mobile enclosure, it is ‘a house on the move,’ one that endows women with the privacy they need while in public spaces. Homes, on the other hand, places where women can be unveiled, are complementary forms of enclosure that enable Muslim women to navigate between a public and a more private self, reconciling in the process tradition and modernity.

What was fascinating in this study was witnessing how a seemingly ‘fixed’ space, like a domestic environment that is determined by fixed walls, floors, and ceilings, attained in the hands of these women ‘moldable’ qualities. Much like the veil, a home’s spatiality was maneuvered by women to meet their privacy needs. A space typically devoted to the dining room was transformed into a sitting area for guests so that the woman could cook unveiled in an open-plan kitchen; curtains were pulled down when needed for privacy (Figure 6); plants and other trees screened views between homes of neighbors (Figure 7).

In their three-dimensionality then, residential spaces are much like the veil: dynamic, flexible, and adaptable forms that can be, to some extent, creatively manipulated and molded to meet Islamic societal expectations. Through both the veil and domestic spaces, the Muslim women we spoke with navigate between varying degrees of privacy, between being veiled and unveiled, as well as between roles
such as being safekeepers of tradition and modern gender definitions.

At the same time though, some of these mohajabe women found themselves in a residential architecture that was often unsupportive of their particular needs. The open kitchens prevalent in mainstream American suburban housing prevented some from cooking unveiled, making cooking dangerous and uncomfortable. Similarly, the open plans of the homes limited their movements when male guests were visiting, forcing them to be veiled while inside their own residences. Women also felt restricted from using outdoor spaces like yards and porches due to the fact that they had to be veiled. The difficulties they faced contradicted with the idea of home as a place “where you can do anything you want,” creating stress in their lives.

Culturally sensitive solutions that support the veiling tradition include closed-off and separated kitchens; separate spaces for men and women to socialize; deeper and further apart houses that provide more privacy; plans that separate the intimate areas such as bedrooms and restrooms by means of hallways and floor levels, allowing women to move around and perform their tasks while having unrelated male guests over; locating stairs so that women can access the upper level without
being seen; windows that screen views into/and from the houses of neighbors; and outdoor spaces that are private.

As the paper stated from the beginning, the veil is engulfed in controversy. Completing this study automatically makes the authors part of the debate: Are the proposed culturally sensitive solutions about the women's right to 'see' and 'not be seen' or are they about seclusion and subordination? Adopting these solutions engages designers in discourses where they must defend their decisions around religious choices and social standings in a secular country like the U.S. How far should designers go when responding to the needs of users? Where do they draw the line between respecting a cultural tradition and all its implications and positioning their designs in the future?

In closing, reflecting on modernization processes that change boundaries between nations and cultures, one cannot help but wonder if veiling as a cultural and religious identity constructor will be a part of the past. In our sample, aside from the women’s dress, we did not witness traditional gender roles among the families we interviewed. In the households we visited, both men and women cooked and helped with household tasks, such as cooking and cleaning and many of the veiled women we spoke to were professionals and financially independent. The dress’ ties to religion and identity though, signal that it might be a long-lasting practice. The implications then of this study for architects and interior designers include asking questions about how to increase awareness about cultural aspects of space and how to help contribute to the diversity of experiences that enrich our world and support well-being. Future research can further explore the needs of many other ethnic and minority groups. In the meantime, design educators can spread the word about cultural differences, offering courses in which students can familiarize themselves with the particularities surrounding the lives of religious, cultural, and ethnic minority groups. Thinking about how to work toward culturally sensitive designs is a start.

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Notes

1. The 2000 U.S. census shows 283,225 people as having been born in Iran. The same census also states that in 2000, 18 percent of the total population aged 5 and over, or 47.0 million people, reported they spoke a language other than English at home, 600,000 of them speaking Arabic.
2. See Waines (1982) for an excellent description of Islamic law and all that it entails.

3. As the paper’s focus is the spatiality of veiling, it is beyond the scope of the paper to elaborate on the veiling debate. For a thorough discussion see Bullock (2002), El Guindi (1999), and Scott (2007).

3. Fashion designers, like Miuccia Prada, who is searching for ways to gain “more power for women,” argue for the “Muslimification” of fashion: “In the end, we designers are really just looking for a new way to dress...The super-exposure of nudity seems not to have given much happiness to women” (Betts, 2006). What western architects and interior designers can learn from the veiling tradition remains to be seen.

4. Although the paper focuses on veiled Muslim women, it should be noted that Islam prescribes that men also cover themselves and dress modestly. Here is the verse in the Quran: “Say to the believing men, that they cast down their eyes and guard their private parts; that is purer for them. Allah is aware of the things they work” (Quran, 24:30).

6. In the U.S., veiling is not regulated and therefore, the paper’s references to veiling are a reflection of a woman’s right to choose. However, the political manifestations of veiling vary tremendously in both western and Muslim countries. While in Turkey, a Muslim nation, female government employees are prohibited from wearing headscarves and veils, in countries like Saudi Arabia, all women must be fully veiled when in public spaces. Among western nations, in 2004, the French government instituted a ban on the wearing of ‘conspicuous signs’ of religious affiliation in public schools, which to many, is aimed at Muslim girls wearing headscarves, criticized as another way by which France is failing to integrate its former colonial subjects as full citizens (Scott, 2007).

7. For a detailed description of women’s role as keepers of the Muslim religious rituals in the home see Mazumdar & Mazumdar (2004).

8. Although all of our interviewees feel comfortable with the veil even though they stand out in public, other studies showed that standing out amounted to racial abuse by non-Muslims (Franks, 2000).

9. The idea of the veil as protection is evident in films like Eva Mulvad’s ‘Enemies of Happiness,’ which documents Malalai Joya’s campaign for Afghanistan’s National Assembly. Here, both Malalai and the Danish filmmakers relied on the burka for their safety in the public.

10. Let’s keep in mind that as veiled women are always covered when outdoors in public areas, the only place they can feel the sun and wind is in the privacy of their home.

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Samaneh Vahaji, an Iranian living in Minneapolis since 2003, is a Masters of Architecture student at the University of Minnesota. She holds a Bachelor of Design in architecture from the same university. Being a Muslim, veiled woman herself, Ms. Vahaji is interested in devising ways by which to integrate cultural aspects of space in architectural practice.

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USE OF STABILISED EARTH IN THE CONSTRUCTION OF LOW COST SUSTAINABLE HOUSING IN AFRICA – AN ENERGY SOLUTION IN THE ERA OF CLIMATE CHANGE

Mohammad Sharif Zami and Angela Lee

Abstract
Stabilised earth is an alternative building material which is significantly cheaper than using conventional brick and concrete, and is also environmentally sustainable. Earth has been used as a construction material in every continent and in every age. It is one of the oldest building materials. The use of earth on site as a building material saves manufacturing cost, time, energy, environmental pollution and transportation cost. Most African countries do not have any well structured and effective program to address the global agenda of sustainability through the use of appropriate construction materials. In order to demonstrate stabilized earth as a sustainable appropriate construction material, the experiences and practices of using earth construction can be studied and harnessed from other subcontinents to demonstrate the dynamism of this material suitable for low cost house construction in the African subcontinent. This paper aims to identify and highlight potentiality of stabilized earth construction in the solution of low cost housing crisis in Africa and justify the use of this appropriate construction material is an energy solution in the era of climate change.

Keywords
Earth construction; sustainability; climate change; low cost housing.

Introduction
Cities in the third world have, since the 1950’s, experienced unprecedented growth in terms of spatial development and population increase; urban population increase has particularly been high due to rural-urban migration (Dwyer et al, 1981, 33). The urban population alone in Zimbabwe increased from 27 in 1992 to 42 in 2002 (Chakwizira & Kuchena, 2004). Unfortunately, third world cities were never planned for these magnitudes of growth in population influx, nor do they in reality have the required jobs and facilities to support such expansion (Srinivas, 1999). Urban facilities, especially housing, have failed to meet the demand of the rural poor who migrated to urban areas (Kamete, 2006). According to UN Habitat (1996), housing shortage in African cities ranges from 33% to 90%. According to the South African census report of 1996, 1,049,686 households lived in informal dwellings. UN Habitat (1996) also estimates that approximately 60% of the African population reside in shantytowns, slums and uncontrolled settlements. A solution has to be found to provide sustainable low cost housing for the above stated squatter's
and shack’s inhabitants which is ‘eco’-friendly and will preserve the environment for future generations; because climate change has been described as one of the most important environmental issues facing world today. There has been increasing consensus that this is attributable to human activity, which has been recognised and reflected by governments worldwide through implementation of various pieces of legislation.

A critical literature review method was adopted in this study to investigate how the use of stabilised earth in the construction of low cost sustainable urban housing in Africa can reduce carbon dioxide emission and contribute towards the solution to climate change. The paper begins with demystifying climate change and its influence on mankind including its environment. The paper critically analyses the benefits and drawbacks of earth construction in general and empirical evidence of environmental benefits in particular.

**Climate Change**

Climate change is fast rising up the international agenda, driven by growing scientific and political consensus that it is the greatest environmental threat and challenges of modern times. Governments, businesses, and the wider society are affected and all have a role to play in tackling it. This emergent need is evident around the world through the many international agreements such as the Kyoto Protocol, European agreements such as the European Emissions Trading Scheme and European directive on the energy performance of buildings (EPBD), and national measures such as the United Kingdom’s Climate Change Programme (UKCCP) and Climate Change Levy (CCL). According to Oxford Reference Online (2001), the terms “Climate Change” and “Global Warming” refer to an increase in the average temperature of the earth, primarily because of the rise in concentration of various greenhouse gases in the atmosphere. The phenomenon of climate change includes both global and regional changes. The main cause of concern is the great increase in carbon dioxide released by the burning of fossil fuels around the world. Various other gases also contribute to the climate change which includes Methane, Nitrous Oxide, Chlorofluorocarbons, Hydro fluorocarbons and Sulphur Hexafluoride. Collectively these greenhouse gases contribute towards the enhanced greenhouse effect (Oxford Reference Online, 2001).

According to king (2005), it is often reported that scientists themselves cannot agree whether climate change is really happening, as the climate had changed naturally before, whether it is influenced by human activities and whether, even if both things are true, it really matters. However, the majority of credible scientific opinion is clear on all three points. There is inevitably much that remains uncertain in the science, given the enormous complexity of the earth and climate systems themselves, but equally a good deal of science is well-established. However, beyond any reasonable doubt the sceptics are wrong, climate change is a real and present danger and mankind is driving the process through combustion of fossil fuels (King, 2005).

Al Gore (2006) explained that out of a study of 928 (10% sample) peer reviewed scientific studies dealing with climate change in scientific
journals during the past 10 years, there are zero disagreeing with the scientific consensus that green house gas pollution has caused most of the warming of the last 50 years. Subsequently, Al Gore (2006) believed there is a “misconception that there is disagreement about the science, deliberately created by a relatively small group of people, who’s principle objective was found to be to reposition global warming as theory rather than fact”. Upton Sinclair once stated that ‘it is difficult to get a man to understand something when his salary depends on his not understanding it’ (cited by Al Gore, 2006).

According to Edwards (2005, p3), fifty percent of all resources consumed across the planet is used in construction, making it one of the least sustainable industries in the world and the World Health Organisation estimated in 2003 that global warming was causing 150000 deaths a year. Edwards (2005, p9) also stated that by 2050 it is anticipated that the human race will have four times the environmental impact it had in 2000 (based on a 2 percent annual economic growth and a global population of 10 billion). The EU estimates that air pollution from traffic is the second biggest killer in Europe, leading to 60000 deaths a year from bronchitis, asthma and heart disease (European Environment Agency, 2001). According to Edwards (2005, p22), buildings are big users of raw materials and the environmental capital locked in them is enormous, as is the waste footprint:-

- Materials: - 60% of all resources globally are used for construction (roads, buildings, etc.).
- Energy: - nearly 50% of energy generated is used to heat, light and ventilate buildings and a further 3% to construct them.
- Water: - 50% of water used globally is for sanitation and other uses in buildings.
- Land: - 80% of prime agricultural land lost to farming is used for building purposes and much of the remainder has been lost through flooding due to global warming.
- Timber: - 60% of global timber products end up in building construction and nearly 90% of hardwoods.

Therefore, environmental damage resulting from current construction practices is clear, thus, it is imperative that environmental damage in the form of Global Warming needs to be addressed if we want to avoid disaster.

Consequences of Climate Change

The impacts of climate change, as identified by the IPCC (1995) include changes to human health and the environments, as well as the global and regional economy, therefore creating social and commercial costs to office based companies. Windell (2007) explains that the key consequences will depend on timescale, short term changes – between now and 2020 – will be no more than inconvenient, however in the long term there will be profound issues which will entail social, economic and political unrest. Al Gore (2006) explains that, “the most vulnerable part of the earth’s ecological system is its atmosphere, the composition of which is now changing”, and this is due to a small set of factors.

IPCC (2007) explain that ‘warming of the climate system is unequivocal, as is now evident from observations of increases in global average air temperature and ocean temperatures, widespread melting of snow and ice, and rising global average sea level’. The Carbon Trust
(2005) describes the ‘most clear, prominent and consistent indicator’ as the retreat of mountain glaciers (Fig 1). According to Al Gore (2006), “40% of all people in the world get their drinking water from rivers and spring systems that are fed more than half by the melt water of the glaciers and within the next half century those 40% of people on earth are going to face a very serious shortage because of this continued melting”.

Climate change is a moral issue in all societies all over the world. If people and businesses worldwide continue to allow climate change to occur it is deeply un-ethical, as scientific studies have demonstrated the seriousness of the crisis we face. Climate change is therefore a critical business issue for commercial office companies today in the modern world. Such businesses significantly contribute to energy use and carbon emissions, however, through implementation of different measures driven by legislation there are many opportunities to make savings. These savings are both financial and reduction of the detrimental effect they have upon the environment.

Al Gore (2006) also explains that, “global warming paradoxically causes not only more flooding but also more droughts. Severe droughts occur at the same time as other areas are flooded. One of the reasons for this has to do with the fact that global warming not only increases precipitation worldwide but it also relocates that precipitation”. Hunter, CEO of IAG, Australia’s largest insurance company explains that “there has been almost a linear increase in catastrophes occurring since global temperatures started rising in the early 1970’s (Al Gore, 2006). Table 1 shows the recent effects and trends as aforementioned and an assessment of human influence on the trend and the likelihood of future trend (IPCC, 2007). According to Carbon Trust (2005), the potentially sensitive switch point areas concerning a number of the phenomenon in Table 1, in which local effects may trigger larger-scale changes. However, melting of the Arctic ice may have already reached a tipping point that could trigger severe weather changes around the world.
Use of Stabilized Earth in the Construction of Low Cost Sustainable Housing in Africa: An Energy Solution in the Era of Climate Changes

MOHAMMAD SHARIF ZAMI AND ANGELA LEE

Phenomenon and direction of trend | Likelihood that trend occurred in late 20th century (post 1960) | Likelihood of a human contribution to observed trend | Likelihood of future trends based on projections for 21st century
--- | --- | --- | ---
Warmer and fewer cold days and nights over most land areas. | Very likely | Likely | Virtually certain
Warmer and more frequent hot days and nights over most land areas. | Very likely | Likely (nights) | Virtually certain
Warm spells/heat waves. Frequency increases over most areas. | Likely | More likely than not | Very likely
Heavy precipitation events. Frequency increases over most areas. | Likely | More likely than not | Very likely
Area affected by droughts increases | Likely in many regions since 1970's | More likely than not | Likely
Intense tropical cyclone activity increases | Likely in some regions since 1970 | More likely than not | Likely
Increased incidence of extreme high sea level | Likely | More likely than not | Likely

Table 1: Recent trends, assessment of human influence on trend, and projection for extreme weather events. (Source: IPCC, 2007).

Conventional Brick Manufacturing Industry and Carbon Dioxide Emission

According to Allinson and Hall (2007), it is estimated that the construction and the operation of buildings is responsible for around half of all global Carbon Dioxide emissions, thereby contributing the largest single source attributable to climate change. Besides, Africa needs millions of affordable houses for the majority of its population. The conventional construction of low cost houses utilizes factory manufactured ceramic brick in Africa.

Majority of these brick manufacturing industries uses wood to burn the brick. A few industries use coal for burning the brick. This contributes deforestation in most of the African countries. Fig 2 shows a typical and very common view of brick manufacturing industries in most of the African countries. During the process of burning, large amount of Carbon Dioxide and other gases are emitted to atmosphere and an enormous amount of waste is generated (Barbosa et al, 2007). If a two bed roomed low cost house needs three thousand bricks and Africa needs millions of housing units, it can be
imagined how much wood is needed to burn all these bricks. According to Barbosa et al (2007, p30), the use of unburned earth in construction will contribute to reduce energy consume, Carbon Dioxide emission, amount of residues and desertification process.

The BBC Climate Website (2007) explain that in order to stabilise climate change all together, emissions would have to be reduced around 70% globally and one of the main problems with Carbon Dioxide is the length of time it remains in the atmosphere as it can take about 100 years for it to disperse, targets set out by the Kyoto Protocol are nowhere near this. Therefore, all that can be done is to reduce the effects of climate change. Even if the concentration of all GHGs and aerosols had been kept constant at 2000 levels, a further warming of about 0.1 degree centigrade per decade would be expected according to emission scenarios (IPCC, 2007).

The Advantages of Earth Construction

Today approximately 30 percent of the world’s population lives in earth houses (Roaf, 2004). If these dwellings had been built in so-called modern materials like aluminium, plastic, or concrete we would have been far closer to a global ecological breakdown (Minke, 2001). According to Easton (1998), Rammed Earth construction is a cheap way of providing shelter since earth is an abundant resource. A simple mechanism is used with semiskilled labor. It is environmentally friendly, since no firing is required; hence conservation of wood, coal
and electricity. Easton’s statement proves that, the aspect of sustainability and environmental conservation of low cost housing is supported by the use of earth as a construction material. Stabilized rammed earth materials have low embodied energy content because approximately 95% of the raw materials are unfired and are locally available (Allinson and Hall, 2007). Frescura (1981) writes, “in addition to its political, economic, social and ecological advantages, earth has great cultural and architectural importance.” Construction in earth has the uniqueness of manifesting the cultural heritage of any people and encouraging the continued use of the material helps to maintain and preserve the craftsmanship and cultural values embedded in earth building. However, when using earth as a low cost construction material for housing we should not assume that all housing problem will disappear. The advantages of a mastery of earth construction are multiple and complementary and are as follows:

1. Appropriate use of material considerably reduces construction cost (Lal, 1995; Zami & Lee et al, 2007) and hence stimulates the economy. Earth construction allows appreciable economies to avoid excessive expenditure of energy.

2. Earth construction products have the potential to reduce energy used in production by 80-90%, with efficiency increasing with scale of production (Morton, 2007).

3. Earth is easy to work with using simple tools and less skill. So, it encourages and facilitates self-help and community participation in house building (Kateregga, 1983).

4. It is strong in compression and so makes good walls and can also be made strong in shear and tension through additives and reinforcement (Lal, 1995, p119).

5. The higher the ratio of non-manufactured local materials the lower the ratio of man-made energy. Earth is nature’s product (Lal, 1995, p119); it requires no energy to produce, it saves man-made energy, it is labor intensive, and it is in plentiful supply and enduring. Rammed earth walls are ideally suited for passive solar construction. Contrary to popular belief, earth provides the natural comforts of balanced temperatures, humidity and noise control (Alphonse et al, 1985).

6. Earth has such a low rate of thermal conductivity (it’s actually near zero); warmth takes almost 12 hours to work its way through a 300mm thick wall. The half-day rate of heat transfer makes the material a perfect substance for providing thermal mass in passive solar construction (Cassell, 1993). The sun’s warmth will actually be reaching the interior of the house during the cold hours of the night, yet the walls insulate the interior from summer temperatures (Kateregga et al, 1983).

7. According to Lal (1995, p119), earth construction provides excellent heat insulation, so the interior space is cooler in summer and hotter in winter than a building made of conventional building material such as, concrete and brick. Due to this property, earth constructions are suitable in tropical and sub-tropical climatic condition.

8. According to Cassell (1993), besides insulating and storing heat, rammed earth also allows
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more air exchange than does any comparable material. A rammed earth house breathes without suffering any significant heat loss. This is especially important today because the interior of houses are 5 to 7 times more polluted than the outside.

9. Earth materials ability to regulate indoor air humidity is highly significant in creating healthy indoor climate, especially in relation to Asthma, where UK has some of the highest rates of in the world (Howieson, 2005).

10. Earth is a good noise absorbent which is a desirable quality in house design (Kateregga, 1983)

11. According to Morton (2007), earth bricks and blocks can substitute for concrete blocks in most internal applications, where it is not suitable for external use due to the severe climatic reasons.

12. The thick walls also provide a feeling of security which goes beyond their warmth and strength. Moreover, putting metal grills on window and door openings can make a house fortress. The compression strength of rammed earth is higher than that of a concrete wall of similar thickness (Houben & Guillaud, 1989) thus making a rammed earth building nearly as durable as a bomb shelter.

13. A rammed earth wall is about 40 percent cheaper to build than a standard stud wall, including labor (Cassell, 1993). Rammed earth is not just an economy construction technique it results in some of the most pleasant, comfortable, and energy-efficient buildings available at any price (Zami & Lee, 2007). Using tinted stucco, the pise builder can finish his house in almost any color or architectural style (Houben & Guillaud, 1989).

14. According to Morton (2007), earth brick can be produced with minimal investment in new plant and processes. Earth bricks can follow the standard fired brick manufacturing process, but are removed from the cycle before firing.

15. Since this natural material can be used locally with reduced transport costs (Kateregga et al, 1983) and without secondary industrial transformation.

16. Earth building can be seen as a means of creating employment (Zami & Lee, 2007).

17. Given basic guidance, building designers could easily incorporate it (earth construction techniques) into current building design (Morton, 2007).

18. Earth is very good in fire resistance (Alphonse et al, 1985).

The use of earth with an innovative approach would apply well to the African context considering that the modern earth construction technology reflects all the above advantages. In the light of all the above advantages and benefits of earth construction it can be posited that, earth construction is sustainable solution to low cost housing crisis in Africa. Earth, as a construction material (mixed with a certain amount of clay), has a low ecological impact (Minke, 1984). Earth building methods are highly refined and developed in un-industrialised countries, and interest is growing in Europe (Roaf et al, 2004). Roaf et al (2004) also listed the arguments in favour of earth constructions as a strategy for the future: -
1. They are based on resources available in practically unlimited quantities in most places.

2. Only low energy inputs are required in the building process, approximately 1-3 percent of that used in similar concrete buildings (Berge, 2001).

3. Earth houses are long lasting if built correctly, and when the house is scrapped the earth returns to its original state without any degrading of quality.

4. Earth houses are labour intensive rather than cost intensive.

The Disadvantages of Earth Construction

According to above description earth construction is advantageous, but there are some drawbacks of earth construction technology which makes it sometime unpopular amongst professionals, clients, and decision makers. According to Dunlap (1993), a significant problem associated with the construction of earthen buildings is the lack of standard criteria to evaluate the finished product. For conventional brick and concrete block houses, there are specifications and methods of tests for evaluating nearly every item of construction material that goes into the house from gypsum sheathing to roofing shingles. It is very rare to find such specifications for adobe blocks or rammed earth walls in African countries. This certainly serves as a deterrent to potential owners of earth homes. More importantly, it deters the lending institutions from investing money in such a home when they have no guarantee that the structure will be standing halfway through the life of the loan.

According to Cassell (1993), the two historical disadvantages to rammed earth has been water damage and labor intensity. The Australians have solved the water damage by spraying the wall with a transparent plastic Ideal for wall cleaning with a hose or damp sponge. Labor intensity has been solved by the use of gasoline and pneumatic powered tamping devices (Beyond 2000). Selma Robinson, a magazine writer, in her article “Houses Dirt Cheap” states, “And if the houses of Pise de terre are scarce, architects and builders who know about this type of construction are scarcer still. The low cost of Pise de terre construction work may, paradoxically, tend to limit its acceptance. There is very little money to be made from it by contractors and the skilled building trades. Even the architects, collecting their customary percentage on total cost, made less on this type of building” (Robinson, 1939). Kateregga (1983) listed the following weaknesses of earth (unstabilised) in building construction:

1. It has extremely low tensile strength (Blondet & Aguilar, 2007) and its poor and very low load bearing capacity makes it unsuitable for supporting heavy roofs from large span building.

2. It has a very high moisture (water) absorption ratio which also contributes to its structural failure.

3. Earth has a low binding strength for its particles and this contributes to its low compression strength.

4. Earth has a very high shrinkage/ swelling ratio resulting in major structural cracks when exposed to different weather conditions.
5. It has a low resistance to wear and tear, less durable and calling for frequent repairs and maintenance when used in building construction works.

Beside the above weaknesses, Lal (1995, p119) stated some more weaknesses of earth construction. These are as follows:

6. It is eroded easily by water, which makes it use difficult in areas with high rainfall or possibilities of flooding.

7. It is susceptible to mechanical damage. Rodents can easily make hole in mud walls and under the floor, thieves can dig their way into the house.

8. Mud does not grip wood properly, so gaps often develop around wooden doors and windows in mud walls.

9. Mud houses behave poorly in the event of earthquakes.

Most of the above weaknesses are derived and mentioned from the experience of unstabilised earth construction. Most of the disadvantages associated with mud houses can be overcome by suitable improvements in design and technology, such as soil stabilisation, appropriate architecture, and improvement in structural techniques (Lal, 1995, p120). Problem of earth wall erosion by rain and flood water, rodents making hole in wall and floor, and poor performance during earthquake can be solved by making the earth stabilised. Vernacular earthen houses located in seismic areas are at risk because of their inherent structural vulnerability, and it is possible to provide reinforcement to earthen buildings in order to improve their structural performance and to prevent their collapse during earthquakes (Blondet & Aguilar, 2007).

**Environmental Benefits of Stabilised Earth Construction in Low Cost Housing**

The above sections analysed the benefits and drawbacks of stabilised earth construction in general and it is notable that the drawbacks of earth construction can be addressed positively if earth is stabilised. This section is going to analyse critically the existing literature particularly on the environmental benefits of stabilised earth in the construction of low cost urban housing.

According to Maini (2005), some studies have shown that, in the Indian context, building a square metre of masonry with CSEB (compressed stabilised earth block) consumes 5 times less energy than a square metre of wire cut bricks masonry and 15 times less than country fired bricks. Maini (2005) also stated that the compressed stabilised earth blocks (CSEB) are more eco-friendly than fired bricks and their manufacture consumes less energy and pollute less than fired bricks.

**Energy consumption**

<table>
<thead>
<tr>
<th>Consumption</th>
<th>Energy per Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire cut bricks</td>
<td>4.9 times less</td>
</tr>
<tr>
<td>Country fired bricks</td>
<td>15.1 times less</td>
</tr>
</tbody>
</table>

**Pollution emission**

<table>
<thead>
<tr>
<th>Emission</th>
<th>Pollution per Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire cut bricks</td>
<td>2.4 times less</td>
</tr>
<tr>
<td>Country fired bricks</td>
<td>7.9 times less</td>
</tr>
</tbody>
</table>

Table 2 shows a comparative analysis of energy consumption and carbon dioxide emission of four types of building material. According to the numerical data shown in Table 2, CSEB
consume the lowest energy and lowest carbon dioxide emission if compared with Wire Cut Bricks, Country Fired Bricks, and the Concrete blocks.

<table>
<thead>
<tr>
<th>Product and thickness</th>
<th>Number of units (Per square metre)</th>
<th>Energy consumption (MJ per square metre)</th>
<th>Carbon dioxide emission (Kg per square metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSEB - 24 cm</td>
<td>40</td>
<td>110</td>
<td>16</td>
</tr>
<tr>
<td>Wire Cut Bricks - 22 cm</td>
<td>87</td>
<td>539</td>
<td>39</td>
</tr>
<tr>
<td>Country Fired Bricks - 22 cm</td>
<td>112</td>
<td>1657</td>
<td>126</td>
</tr>
<tr>
<td>Concrete blocks - 20 cm</td>
<td>20</td>
<td>235</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 2: A comparative analysis of energy consumption and carbon dioxide emission of four types of building material. (Source: Maini, 2005.)

According to Vroomen (2007), there are two important aspects playing a role in the ecological impact of a construction technique, and they are as follows:
- The energy required to construct a house and
- The carbon dioxide emission resulting from the total process.

In order to be able to assess the performances of the construction materials on the above aspects, a computation is made in Vroomen’s (2007) research and to make the computations as transparent as possible, the values that were applied in different construction materials are given in Table 3.

<table>
<thead>
<tr>
<th>Product</th>
<th>Energy required in MJ / Kg</th>
<th>Carbon dioxide emission in Kg carbon dioxide per Kg material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum (NBVG, Herpen)</td>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td>Cement (Adobemachne)</td>
<td>4.8</td>
<td>1.25</td>
</tr>
<tr>
<td>Soil (Adobemachne)</td>
<td>0.028</td>
<td>0</td>
</tr>
<tr>
<td>Fired bricks (Houben)</td>
<td>3.16</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Table 3: The characteristics of the materials as applied in the computation. (Source: Vroomen, 2007).
The resulting totals are given in Table 4. The complete computation with all sources is added to the CDrom.

<table>
<thead>
<tr>
<th></th>
<th>Adobe</th>
<th>CSEB</th>
<th>Fired brick</th>
<th>Hollow concrete blocks (HCB)</th>
<th>Gypsum stabilised earth wall in sections</th>
<th>Gypsum stabilised earth massive blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy required (MJ/ fu)</strong></td>
<td>36</td>
<td>233</td>
<td>1026</td>
<td>390</td>
<td>191</td>
<td>161</td>
</tr>
<tr>
<td><strong>Carbon dioxide emission (Kg/ fu)</strong></td>
<td>0</td>
<td>55</td>
<td>118</td>
<td>98</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4: The totals of the environmental computation. (Source: Vroomen, 2007).

Vroomen (2007) identified the following conclusions on the energy requirement and carbon dioxide emission from the above tables:

- The energy requirement of Gypsum Stabilised Earth is about half of the energy requirements of HCB.

- Adobe is indisputable the most environment friendly material.

- The firing of bricks is a very energy consuming process.

- Both cement stabilized products (CSEB and HCB) cause a large carbon dioxide emission. Due to their lower Wet Compressive Strength and high amount of gypsum required, the CSEB is no better alternative than HCB.

- A lot of carbon dioxide is released in the production of fired bricks.

- The release of carbon dioxide is almost nil in the production of Gypsum Stabilised Earth walls.

**Conclusions**

It is notable from this paper that there has been increasing levels of Carbon Dioxide and other greenhouse gases in the earth’s atmosphere over recent years causing the climate to change, which will in some way affect every individual person worldwide. Besides, it is evident that earth construction is environmentally sustainable compare to the conventional (fired brick, concrete, etc.) building materials and would be appropriate in the case of low cost house construction in Africa. Promotion and implementation of earth as an alternative low cost urban house construction material is worthwhile and significantly helpful in achieving environmental sustainability (less carbon dioxide emission and less energy used). It is also notable from this paper that stabilisation of earth doesn’t only mean the cement stabilisation. Gypsum is also one of the stabilisers which are discussed in this paper proved to be more environmentally sustainable than the cement stabilised earth. It is possible to use un-stabilised raw earth as
rammed earth or compressed earth blocks; this paper described why the stabilised form is more suitable for the African situation in terms of overcoming the drawbacks of earth construction, by-laws and housing standards. The only challenge that prevents earth becoming the preferred choice of building material amongst the general population is the acceptability of this material by that same population. An awareness and understanding by people to environmental issues such as air pollution, deforestation, land degradation, climate change and energy conservation would help them change their attitudes and views towards earth building. Besides, in earth construction individuals and community as a whole can easily participate in building their own homes in affordable ways addressing their moral obligation to climate change.

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NATURAL VENTILATION: A PASSIVE DESIGN STRATEGY IN DESIGNING HOTEL LOBBIES - CASES FROM TROPICAL MALAYSIA

Abdul Malik Abdul Rahman and Muna Hanim Abdul Samad

Abstract
When the Malaysian government increased electricity tariff by up to 12% in early 2006 and also another increase in early July 2008, most commercial buildings were affected by the move. The hardest hit would be the hotel industry as they are among the economic frontiers of the nation. Already burdened with the rigorous efforts of filling their rooms with guests, they now have to re-strategize to sustain business. Energy bills to pay for cooling have always been the biggest burden. Cooling the air is an intangible and a never-ending wasteful activity. Cold room for food is on for 24 hours for obvious reasons. To overcome this, one strategy was considered to be part and parcel of the overall building design so as to contribute to the reduction of the high dependency of energy consumption for cooling. The challenge here is to reduce electricity consumption without compromising the comfort of the guests and also reduce the overhead costs to give a more competitive edge in hotel room rates. Among other passive design elements this paper considers two natural ventilation occurrences and locations that can be relied upon for Malaysian hotel designs.

Keywords
Natural ventilation; hotel lobbies; land and sea breeze; prevailing winds of valleys.

Introduction
In Malaysia, as in other parts of the world, the success of the tourism industry depended very much on the success of the hotel industry. The star ratings (two-, three-, four- and five stars) would indicate the kind of services provided by the hotels. It also indicates the levels of comfort that can be experienced, namely, material comfort, activities and facility conveniences and also thermal comfort. The hot humid climate of Malaysia necessitates the use of all kinds of mechanical systems to cool the surroundings. To feel comfortable one has to be under shade and experiencing ample air movement concurrently (Abdul Malek, 1994). Discomfort would set in when one element is missing. When being exposed under the tropical sun one would experience the stifling heat unless the wind is of ample velocity (normally > 2m/s) to rid off the radiant heat. When under shade an air velocity of 1m/s is sufficient. At night time (i.e. with no sun) the surrounding areas needed ample wind to get rid off the high relative humidity. Otherwise the high humidity in the air gives stickiness to the human skin and this is a discomfort. It is unfortunate that the tropical
climate in Malaysia is described as hot and humid and has no reference to wind. This means that the much desired wind in Malaysia for natural thermal comfort cannot be depended upon because of its characteristic behavior in that it is unpredictable, multidirectional and erratic i.e. when there is wind the velocity may not be of the required speed. As a result air conditioning, fan and misting fountain were resorted to. These then add to running cost especially where air-conditioning takes up nearly 70% of the electricity bill in most hotel buildings (Buttgen, J., A personal conversation with the General Manager, Copthorne Hotel, Penang, Malaysia, June 2003). This is not the right move as productivity of the staff would be affected. Steps should be taken towards energy efficiency in all activities.

Only two natural phenomena (Abdul Malek, 2004) can be identified to provide ample air velocities which can have an influence in the design of buildings. They are normally experienced at locations (i) by the beach, geographically termed as land and sea breezes and (ii) the prevailing winds of the hill slopes. Generally, Western tourists would flocked to Malaysia, among other activities, was to bask under the Malaysian sun. A typical and habitual behavior was that after sightseeing tours they would bask in the sun by the beaches. So for the same reason as most other hotels in other parts of the world, most hotel locations would be along the fringes of attractive beaches.

An increase in the cost of electricity tariffs up to 12% in May 2006 for commercial activities, including hotel industry (News Straits Times, May 2006), the increase in petrol price and another hike in electricity tariff (News Straits Times, July 2008), have compelled almost those in business activities to brace themselves to be frugal. A General Manager of a particular hotel in Penang resorted to switching off air conditioning for one hour at the administrative section in order to save energy (Buttgen, J., A personal conversation with the General Manager, Copthorne Hotel, Penang, Malaysia, June 2003). This is not the right move as productivity of the staff would be affected. Steps should be taken towards energy efficiency in all activities. The normal approach would be proposed to be as listed below:

a. Incorporate as many passive design elements in the building layout, fabric and envelope. This should be the first line of strategy as apart from initial construction costs there would not be any running cost after implementation.

b. Gradually change all obsolete electrical appliances, equipment and installations. To change all at once would be too drastic on the budget and furthermore the problem of disposing immediately or storage with all the replaced appliances, equipment and installation may arise.

c. Set up an energy management program and form an energy management committee. The leader is to report energy issues to the board of directors. Energy issues has to be in the agenda all the time to be as center stage otherwise the exercise towards energy efficiency without compromising comfort would be futile.

d. Finally, when budget allows, installing the photovoltaic system would be a wise move as once installed no further running cost would be incurred. The energy obtained is free from the sun. The advantage is that it is maintenance-free except for the topping up of battery fluid.
It can last for at least thirty years and very friendly to the environment. It is clean energy.

The hypothesis is that temperature discomfort can be alleviated by higher air velocity. Higher air velocities in tropical Malaysia are normally found in two locations (Abdul Malek, 2004), namely (i) the perpetual wind of hill-slopes and (ii) the land and sea breeze. Thus this investigation is of an exploratory nature to verify the hypothesis.

**Methodology and Field Investigation**

The passive element here is to make full use of the wind both from the land and sea breezes phenomenon and the prevailing wind from the hill slopes. Two locations of hotels were identified to represent the situations, namely, one located by the sea and the other perched on top of a small hill. The study limits itself to the hotel lobby as this would be ideal for natural cross ventilation. Hotel rooms are normally single opening for security and privacy and would not be appropriate to be experimented upon. Furthermore there are more people at the hotel lobby than at their own individual rooms.

Two hotel lobbies are chosen for the experiment because most hotel lobbies in Malaysia have high ceilings and therefore big volumes of air. In city hotels air-conditioning is resorted to for thermal comfort because to have an open design concept would not be suitable due to several factors such as noise pollution, dusts and thermal discomfort from outdoor heat islands. Hill hotels and beach hotels can therefore explore to make full use of the hypothesis mentioned above with the intention to reduce dependence on energy consumption from conventional electric supply (i.e. sourced from burning the fossil fuels). The hotel industry would benefit a lot from reducing its running cost because its occupancy rate fluctuates seasonally. Low occupancy rates would reduce the profitability gap and with low running costs would make the profitability gap even better in times of high occupancy.

So designing hotel lobbies to adapt and capitalize on good natural ventilation would help hill hotels and beach hotels to enhance not only their profitability and at the same time saves the environment. Using good natural ventilation means less dependence on conventional electric supply, a process that depletes the fossil fuel.

To seek hotels perched up on hill slopes was not an easy task to do because most hotels would rather be located near beaches. Beaches are popular with tourists from the temperate and cold countries. In Malaysia, not many are on hills but most can be found on mountains tops. Mountain locations do not pose any problems with heat thermal discomfort. The cool temperature is usually most welcome by the locals. So a hotel on a hill slope in this investigation was identified not for comparison with all hill hotels but taken as an exploratory investigation to verify the hypothesis that hill slopes locations can make full use of the air velocity into designing of buildings. Several beach hotels are also located by the seaside but only one particular hotel was investigated because of the same scale and size of building mass with the other two hotels adjacent to it both left and right. The adjacent hotel on the right side of the experimented hotel i.e. the Copthorne Hotel has its lobby totally enclosed and air-conditioned throughout and this was found to be energy inefficient. It was also observed that even when there were only
two or three staffs behind the counter the air-conditioning was still switched on all the time. Unlike the hotel under investigation where the lobby has no air-conditioning at all but depended solely on the natural behavior of the outdoor climate. This is an ideal building to be investigated as it took consideration of the land and sea breeze thermal behavior and incorporated in its design.

The objective was to determine whether the average natural air velocity can reduce thermal discomfort at hotel lobbies so as to depend less on air conditioning to be designated as one of the best practices. The climatic elements of air velocity, air temperature and relative humidity are measured by means of respective sensors and the data was logged into a BABUC environmental data logger which was then transferred into a computer for further analysis. This reading was carried out for a period of one week to give an average picture of the indoor environment’s climatic performance. One week is deemed as adequate to give some indications of the indoor climate. This one-week reading is a typical week which does not represent the rainy season as worst case condition. The challenge here is to provide reasonable comfortable atmosphere during hot seasons. Malaysia does not have four seasons unlike other countries up north and south. The hot humid characteristics of the Malaysian climate need to be compensated by generous winds. Malaysia does not have generous winds to rely on. The characteristics of wind conditions in Malaysia are that they are unpredictable. By observation and experience it was identified that only two geographical settings would provide promising wind conditions that can be utilized and incorporated in the building designs, namely the land and sea breeze and the prevailing wind of hill slopes.

The Land and Sea Breeze
A hotel at Batu Feringghi, Penang is by the side of a beach facing the Malacca Straits. It was chosen as representative of the land and sea breeze situation. The arrow in the diagrammatic cross section as shown in Figure 1 indicates natural ventilation. The land and sea breeze phenomenon is termed because of the different surface masses meeting at a junction. Land is denser than the sea and therefore during daytime it is heated more rapidly than the sea. Heated land would create a zone of low pressure as the hot air rises to the above atmosphere. This low pressure is then filled up with relatively cooler air from above the sea mass by the process known as thermo-siphon and is referred to as the sea breeze since the breeze comes from the sea. At night time the reverse is known as the land breeze because again land being the denser surface would release heat absorbed during the day rapidly than the sea thus becomes cooler than the sea.

The top right picture shows the hotel lobby looking towards the sea. The sea is located at the far end behind the two betel nut trees at the background. The location of the BABUC environmental data logger is also shown as indicated in white arrow (bottom left). The BABUC environmental data logger comprised of sensor probes for air temperature (dry), relative humidity, hot wire probe for detecting air velocity. Care was taken in setting up the environmental data logger so that the probes were measuring the climatic elements under shaded environment and away from the sun
rays. The readings were taken every fifteen minutes interval continuous twenty four hours for one week to find an average pattern of the indoor climate.

The Prevailing Winds of Hill Slopes
A hotel at Bukit Jambul, Penang perched up on top on a small hill was chosen to represent the test case for a hill slope with a prevailing wind condition. The arrows in the diagrammatic cross
section as shown in Figure 2 below indicate natural ventilation. The hill slope’s prevailing wind phenomenon is termed because of the thermal properties of air mass being warm or cool. Warm air mass would rise up due to its low density, and cool air, usually occurring in the evenings and into the night would be heavier than warm air and would therefore slide along the slopes of the hill to the bottom of the valley. This process creates air movement that can be tapped for use in buildings built along ridges of hills or along hill slopes.

Figure 2: Diagrammatic cross section of hotel. (Source: Authors).

Discussion

The hypothesis is that capitalizing on the natural ventilation helps to reduce the cost of monthly bills for cooling the hotel interiors to provide comfort for the hotel guests and local occupants. The two experiments carried out in the previous section showed that by identifying and understanding the natural behavior of wind in tropical Malaysia, the hotel industry can employ the idea of using predictable wind conditions to reduce the business overheads. In Malaysia only two locations were identified as having more predictable wind conditions than any other parts of Malaysia. Though it cannot be totally relied upon for 100% all the time but identifying where such locations are, would help to influence the hotel designs for new buildings and, while for existing ones renovations can be done to retrofit the idea. Land and sea breeze and prevailing winds of hill slopes are the two locations that provide predictable wind conditions. Other parts of Malaysia such as the country lowlands interior and urban settings would describe the wind condition as unpredictable, multi-directional with erratic wind speeds.

The Standard Effective Temperature is a temperature indicator as it takes the considerations of other climatic elements and not just relying on the air temperature alone. From here graphs were created to help interpret the thermal performances of the hotel lobbies. In the graphs are four lines representing average one week readings, the relative humidity (%), air temperature (0C) and air velocity (m/s). The fourth line is the standard effective temperature (0C) which is also the skin temperature. It is the result of the interaction of the three basic...
climatic elements, namely the air temperature, the air velocity and the relative humidity. The discussions that can be derived from these two graphs are as follows (Graph 1):

Figure 3: (Top left): The main entrance glass door and wall (Top middle): Hotel lobby and atrium (Top right): The panoramic view to the sea and Penang bridge (Bottom left): Top end of the atrium allowing for daylight. (Bottom right): The BABUC environmental data logger measuring air temperature, air velocity and relative humidity. (Source: Authors).
Graph 1: Average readings for (above) Beach hotel and (bottom) Hill hotel. (Source: Authors).

1. Both the investigations showed that the SET are below the air temperature averaging 10°C-1.5°C. When it comes to thermal comfort a 10°C drop would make a significant difference in comfort and also in the reduction of energy consumption. This saves a lot of energy monthly bills.

2. There is somehow a general mirror image between the SET and the air velocity, especially from 12.00 noon to 6.00 pm for the beach hotel and from 8.00 am to 3.00 pm for the hill hotel. This means that when there is wind the temperature of a particular space will drop. But the indoor climatic behavior differs during the evening. Without the presence of wind the temperature still drops simply because there is no sun to heat any air mass.

3. Both the SETs falls within the Malaysian Thermal Comfort zone, i.e., within 240°C to 280°C (Abdul Shukor, 1993). The SET of the beach hotel seemed to be on the higher side within the comfort zone and for the hill hotel was more towards the mid-section of the comfort zone. Since the period of measurement was taken at different weeks it is highly likely that the week taken for the beach hotel was experiencing higher air temperatures. Nevertheless it is important to note that both are within the stipulated comfort zone and that air velocity was the determinant factor to bring down warm temperatures.

**Conclusion**

The above investigations showed the hypothesis has been verified. Architects and other building professionals are to take heed that these proven findings specifically at these two geographical locations and phenomena, wind can influence the building design of hotel lobbies. A 7 to 8-day period for measurement at 15 minutes interval was taken as reference just to check on the consistency for worst case conditions. The worst case condition for a tropical climate is usually during the hotter parts of a typical day. There has been no base reference for the number of days for measuring in tropical climates especially in the Equatorial climate of Malaysia because any typical day would be described as either hot or wet. So one year reading seems unnecessary.
Most hotel lobbies in Malaysia were cooled by air-conditioning. Apart from the cold rooms to keep food fresh, air conditioning has been one source of high energy consumption in a typical hotel. These two hotels under investigation were wise enough to design their lobbies capitalizing on natural ventilation. Air-conditioned hotel lobbies normally would set their temperature indoors at 22°C. The designed outside air temperature for air-conditioners was set at 33°C by mechanical engineers of air-conditioners. The lower the temperature set at the air-con unit the more energy is consumed to extract the moisture from the outside air before releasing the dry cold air into the interiors (Ismail, M.R., 2000). Therefore the best practice is to reduce the gap between the outdoor temperature and the indoor temperature. Twenty-two degrees centigrade is far too low and the difference between outside air temperature and indoor temperature is too wide. Sometimes this can be wasteful when there were not many people around the hotel lobby and the whole air volume of the lobby was cooled unnecessarily.

At times when there is equilibrium in temperature there may not be any wind at all (calm situation). Discomfort would then set in and this situation is common to all hotels in Malaysia. When this happens it is highly recommended that electrical fans may be needed to achieve comfort level thereby obliterating the dependency on air-conditioning. Between fans and air-conditioning, fans are much cheaper to operate. Reduction in energy consumption means overheads are less and thereby pose more competitive in the hotel industry.

References


CONCEPTUALIZING THE PRINCIPLES OF EMERGENT URBANISM

Mathieu Hélie

Abstract
This article is the product of reflections on the consequences of the latest discoveries in complexity science upon the practice of urban design. Its intent is to establish a foundation for a new debate in urban design, which is trapped in production processes inherited from a failed ideology, modernism, but has had no scientific alternative until the last decade. It will not argue over the superiority of one urban design morphology over another, the debate that many urban designers are engaged in, but make the counter-intuitive claim that urban design morphology is an unimportant determinant of the life and sustainability of a city, and that the relevant determinant is the process through which the city is grown. From the starting point that spontaneous city growth is absolutely necessary for sustainability, techniques to produce large-scale geometric order are reintroduced that respect this condition and produce order out of the random actions of large numbers of individuals, a phenomenon known as emergence. With this insight, urban design is explained as the selection of urban growth processes that emerge desirable patterns.

Keywords
Complexity; emergence, morphology, fractals; sustainability.

Introduction
This article is the product of reflections on the consequences of the latest discoveries in complexity science upon the practice of urban design. Its intent is to establish a foundation for a new debate in urban design, which is trapped in production processes inherited from a failed ideology, modernism, but has had no scientific alternative until the last decade. It will not argue over the superiority of one urban design morphology over another, the debate that many urban designers are engaged in, but make the counter-intuitive claim that urban design morphology is an unimportant determinant of the life and sustainability of a city, and that the relevant determinant is the process through which the city is grown. This implies a computational science approach, and the references drawn are from the computational schools of the three relevant scientific fields; the process morphology of Christopher Alexander, the computational physics of Stephen Wolfram, and the “Austrian” school of economics and sociology theorized by Friedrich A. von Hayek (amongst others). By conceptualizing the city and urbanism as a system that generates
morphology, instead of pure morphology, a systems analysis approach is applied that demystifies modernism, the organic traditional city, and the sustainable future city.

The Journey to Emergence

Of the different domains of design, urban design is an oddity. While the design of a machine can be traced to a definite, deliberate act of invention, and even the design of buildings (architecture) is rooted in known production processes, the design of cities was never seriously attempted until well after cities had become a normal, ordinary aspect of civilized living, and while the design of machines and buildings was a conscious effort to solve a particular problem or set of problems, cities appeared in the landscape spontaneously and without conscious effort. This casts doubt over the efficacy of urban design. The designers of machines and buildings know fully how the processes that realize their design operate, and this knowledge allows them to predictably conceive the form they are designing. Urban designers do not enjoy such a certainty.

How is it possible for what is obviously a human artifact to arise as if by an act of nature? The theory of a spontaneous order provides an explanation. According to Friedrich A. von Hayek (Hayek, 1973) a spontaneous order arises when multiple actors spontaneously adopt a set of actions that provides them with a competitive advantage, and this behavior creates a pattern that is self-sustaining, attracting more actors and growing the pattern. This takes place without any of the actors being conscious of the creation of this pattern at an individual level. The spontaneous order is a by-product of individuals acting in pursuit of some other end.

In this way cities appear as agglomerations of individually initiated buildings along natural paths of movement, which originally do not require any act of production as dirt paths suffice. As the construction of individual buildings continues the most intensely used natural paths of movement acquire an importance that makes them unbuildable and these paths eventually form the familiar “organic” pattern of streets seen in medieval cities. This process still takes place today in areas where government is weak or dysfunctional, notably in Africa where urban planning often consists of catching up to spontaneous settlement, and in the infamous squatter slums that have proliferated in the 20th century. Figure 1 shows a transect of the spontaneous urbanization process in the exurbs of Mexico City.

As urbanization becomes denser, the increasing proximity of concurrent, competing individual interests causes conflicts between the inhabitants of the emerging town. Individuals build out their properties in such a way that it interferes with others, for example by blocking paths or views. These acts threaten the sustainability of the spontaneous order, and to resolve this situation the parties involved appeal to the same judges that rule on matters of justice. These judges, again according to Hayek, are required to restore and preserve the spontaneous order with their rulings. These rulings provide the first building regulations and, when government authority becomes powerful enough to do so, are compiled into comprehensive building codes to be applied wherever the force of that government extends. (Hakim, 2001).
The compiled building codes are later brought by colonists to create new settlements, reproducing the morphology across multiple towns but each time in a pattern that is adapted to the local context, physical and social. Early town planning efforts are attempts at regularizing the building codes in order to plan for long-term organization of cities, but maintain the spontaneous production process. Most notably the rapid urbanization of New York City was accomplished by very simple rules on the size of blocks laid out in the 1811 Commissioners Plan for New York. Unlike the experience of urbanization in previous centuries, where urban growth was slow and often stagnant, the urbanization of New York took place in a time of rapid social and economic changes, and the city government had to invent building codes involving issues that never could arise in a pre-capitalist society: first the tenement, then the skyscraper, and ultimately, the automobile.

Modernism: The Replacement of the Spontaneous Order

Architects and urban planners of the early 20th century, confident in the techniques of engineering and industrial production, believed that the spontaneous city had become irrational and had to be replaced with a new design fully integrating new industrial technology. The Swiss architect Le Corbusier is famous for designing a complete city around the automobile and building models of his design, as shown in figure 2. In so doing he adopted a process of urbanization that was completely planned hierarchically, applying the processes familiar to architects at the scale of an entire city. He also ridiculed the morphology of spontaneous cities as being the product of donkey-paths.

Although the architectural program of high-rise living of Le Corbusier was discovered to be a colossal failure, the modernist process of development replaced spontaneous urbanization in the industrialized world. The housing subdivision substituted adequately for the high-rise tower block, providing affordable housing in large numbers to a war-impoverished society. This production process is still in force today, separating cities into three distinct zones: residential subdivisions, industrial and office clusters, and commercial strips.

Modern city planning has been successful at its stated objective, producing a city designed specifically around automobile use, yet it was immediately and has been perpetually the target of criticisms. Most significantly the vocabulary of these criticisms had to be invented in order to spell out the critics’ thoughts because the type of deficiency they were observing had never been seen. Words like placeless or cookie-cutter were invoked but fell on the deaf ears of urban planners who were trained in
Cartesian processes and industrial production techniques.

The most devastating criticism of modernist urban planning came in the form of a sociological study and personal defense of the spontaneous city, the book Death and Life of Great American Cities by Jane Jacobs (Jacobs, 1961). In it she described in great details how the functions of a spontaneous city related and supported each other. Her concluding chapter, the kind of problem a city is, is still the most relevant. In it she attacks the scientific foundations of urban planning at a paradigmatic level, and claims that the methodology of the life sciences, at the time undergoing the revolution created by the discovery of DNA, is the correct approach to producing cities.

Death and Life of Great American Cities has been adopted by contemporary urban planners as a textbook for urbandity. Its descriptions of the characteristics of a city are now the models upon which new developments are planned. The old urban development of housing subdivisions and office parks is being substituted for the new urban development that has streets, short blocks, and mixed uses, just as Jacobs had described to be characteristic of life in the city. A major difference between Jane Jacobs’ preferred city and the new urban plans remains. The layout of mixed uses is organized and planned in the same process as Le Corbusier planned his city designs. The scientific suggestions of Jacobs have been ignored.

**The Discovery of Emergence and Complexity Science**

Since Jacobs published her attack on planning science molecular biology has made great technological achievements and provided countless insights into the morphology of life. In parallel the computer revolution has transformed the technology of every human activity, including that of design. But the computer revolution brought along some paradigm-altering discoveries along with its powerful technology. In geometry, the sudden abundance of computing power made it possible for Benoit Mandelbrot to investigate recursive functions and his discovery, fractal geometry, generated a universe of patterns that occurred in many aspects of the physical universe as well as living organisms (Mandelbrot, 1986).

Some thinkers saw that the life sciences were part of a much more general scientific domain. They formed the Santa Fe Institute and under...
the label complexity studied not only organisms but also groups of organisms, weather systems, abstract computational systems and social systems. This research formed a body of theory called complexity science that has resulted in the creation of similar research institutes in many other places, including some centers dedicated specifically to urban complexity.

Their scientific revolution culminated in two major treatises within the last decade, both from physicists practicing in a field of complexity. The first was A New Kind of Science by computer scientist and mathematician Stephen Wolfram (Wolfram, 2002), where he presents an alternative scientific method necessary to explore the type of processes that traditional science has failed to explain, elaborating a theory of the universe as a computational rule system instead of a mathematical system. The second was The Nature of Order (Alexander, 2004) by architect Christopher Alexander, where he presents a theory of morphogenesis for both natural physical phenomena and human productions.

**A Definition of Emergence**

To define what is meant by emergence we will use the abstract computational system upon which Wolfram bases his theories, the cellular automaton. Each cell in a row is an actor, making a decision on its next action based on its state and the states of its direct neighbors. All cells share the same rule set to determine how to do this, that is to say all cells will act the same way with the same context. In this way each row is the product of the actions of the cells in a previous row, forming a feedback loop. The patterns of these rows are not in themselves interesting, but when collected in a sequence and displayed as a two-dimensional matrix, they develop complex structures in this dimension, as shown in figure 3.

The same general principle underlies all other emergent processes. In a biological organism a single cell multiplies into exponentially greater numbers of cells that share the same DNA rules. These cells create structures in a higher dimension, tissues and organs, which form the entire organism. In the insect world complex nests such as termite colonies emerge from the instinctual behavior of individual termites. And in urbanization, buildings form into shopping streets, industrial quarters and residential neighborhoods, each of which forming a gradient with no obvious boundaries and overlapping into one another as a single whole system, the city.

Figure 3: The 30th rule of all possible rules of one-dimensional cellular automata produces a chaotic fractal when displayed as a two-dimensional matrix, but most other rules do not create complex two-dimensional structures. The first line of the matrix is a single cell that multiplies into three cells in the second line in accordance with the transformation rules pictured below the matrix. This process is reiterated for the change from the second to the third line, and so on. All the information necessary to create structures of this complexity is contained within the rules and the matrix-generating process. (Wolfram, 2002).
The Qualities of an Emergent City

The adoption of mass-production processes, or development, in substitution for spontaneous urban growth in the mid-20th century created for the first time a phenomenon of alienation between the inhabitants and their environment. While the physical features of spontaneous cities could be traced to complex histories of families, businesses, and organizations, the physical features of planned cities owe their origin only to the act of planning and speculation. This has severe consequences towards the sustainability of place as there will not grow any particular attachment by the residents, their presence there being only a temporary economic necessity and not the outcome of their life’s growth. Mass-production of the environment left people as nothing more than consumers of cities where they used to be their creators. A building culture was replaced with a development industry, leaving the landscape culture-less and with no particular sense of identity. This took place despite the evidence that a building which has a unique history and has been fitted to someone’s life, as opposed to speculatively produced, generates market value for that property. (Alexander, 1975) This is why, although the demolition of so-called “slums” to replace them with modern housing projects created a great deal of opposition against urban renewal programs, the demolition of the housing projects later on did not lead to a popular preservationist opposition. They were not the physical expression of any culture.

In addition to cultural patterns, spontaneous settlements also have a peculiar morphology that has not successfully been imitated by modern growth processes. Spontaneous settlement processes give individuals full freedom to determine the boundaries of their properties. Spontaneous settlement is one where total randomness in building configuration is allowed, with no pre-determined property lines acting as artificial boundaries. Buildings and building lots as such acquire general configurations comparable to cell structure in living tissues, unique sizes and boundaries that are purely adapted to the context in which they were defined. In the absence of abstract property boundaries, property rights are bounded by real physical limits such as a neighbor’s wall. (Hakim, 2007).

Very attractive spontaneous cities, sometimes labeled “historic” cities, feature a specific pattern of the urban tissue to complement the previous two qualities. It consists of similar vernacular buildings that appear very simple when considered individually, but produce a visually fascinating landscape when considered as a whole. This is a form of fractal geometry. In mathematics a fractal is a geometric object of infinite scale that is defined recursively, as an equation or computation that feeds back on itself. For example the Sierpinski triangle is defined by three triangles taking the place of one triangle as in figure 4.

In addition to its remarkable similarity to natural phenomena, this form of geometric order informs us of a very important law in geometry: a feedback loop that is fed through the same function will produce an ordered but unpredictable geometric pattern out of any random input.

The Mandelbrot Set is a much more interesting fractal that is defined as a simple recursive
mathematical equation, yet requires a computation to visualize in its full complexity. When computing how many cycles of feedback it takes for the equation to escape to infinity for specific coordinates, figure 5 is the outcome.

This tells us why cities of vernacular buildings have such appealing geometric properties at the large scale, despite being often shabby and improvised at the scale of individual buildings. Shanties made of scrap metal and tarp look rough at the scale of the material, but because multiple shanties share their construction process despite originating from random conditions they form an ordered geometric pattern with its specific “texture”. The same law applies at other scales of feedback, for example the production of a door. Whether the input for one door is larger, taller, wider than another door, if the same production process is employed the two doors will contribute to the overall fractal order of the urban space. This law has been employed not only in traditional and spontaneous cities, but also for modern urban planning initiatives.
In the New York City neighborhood of Times Square the structure of billboard advertisements is defined by a building code that determines their configuration in relation to the configuration of the building. The outcome is a unique tissue of advertisement billboards that has become more characteristic of the neighborhood than the buildings themselves, which are not produced by a shared feedback function.

**Fundamentals of Urban Complexity**

Christopher Alexander showed in *A City is not a Tree* (Alexander, 1965) that social and economic networks formed complex semi-lattice patterns, but that people who observed them limited their descriptions to a simple mathematical tree of segregated parts and sub-parts, eliminating connections in the process. (Figure 6 compares the structure of a tree and semi-lattice.) In attempting to plan for urban structure, a single human mind, without a supporting computational process, falls back on tree structures to maintain conceptual control of the plan, thus computing below spontaneous urban complexity, a phenomenon that is consistent with Wolfram’s theory of computational irreducibility of complex systems. (Computational irreducibility states that the only accurate description of a complex system is the system itself and that no abstraction or reduction to a simpler process is possible.) Nikos A. Salingaros later detailed the laws of urban networks in *Theory of the Urban Web*. (Salingaros, 1998) Network connections form between nodes that are complementary, and therefore the complexity of networks depends on an increasing diversity of nodes. Salingaros describes the urban web as a system that is perpetually moving and growing, and in order to do this the urban tissue has to grow and move with it. Consider for example the smallest social network, the family. Debate over accessory units or “granny flats” has intensified as normal aging has forced the elderly out of their neighborhoods and into retirement complexes, while at the other end of the network young adults entering higher education or the labor market vanish from a subdivision, leaving a large homogeneous group of empty-nesters occupying what was once an area full of children, and often forcing school closures (a clear instance of unsustainability).

![Figure 6: A comparison of a tree pattern on the left and a semi-lattice pattern on the right. The tree structure is made of groups and sub-groups that can be manipulated separately from others. The semi-lattice pattern is purely random without distinct sub-parts. (Source: Author).](image)
modern apartments with adequate sanitary conditions. To the authorities’ befuddlement some of the residents later returned to live in the slum in order to once again enjoy the rich social networks that had not factored in the design of the modern apartments and neighborhoods, demonstrating that the modern neighborhoods were less socially sustainable than the slums.

In commercial networks, space syntax research (Hillier, 1996), using a method for ranking nodes of semi-lattice networks, has shown that shops spontaneously organize around the multiple scales of centrality of the urban grid at its whole, creating not only commercial centers but a hierarchy of commercial centers that starts with sporadic local shops along neighborhood centers and goes all the way to a central business district located in the global center of the spatial network. The distribution of shops is therefore a probabilistic function of centrality in the urban grid. Because the information necessary to know one’s place in the hierarchy of large urban grids exceeds what is available at the design stage, and because any act of extension or transformation of the grid changes the optimal paths between any two random points of the city, it is only possible to create a distribution of use through a feedback process that begins with the grid’s real traffic and unfolds in time.

The Built Equilibrium

Although they may appear to be random, new buildings and developments do not arise randomly. They are programmed when the individuals who inhabit a particular place determine that the current building set no longer provides an acceptable solution to environmental conditions, some resulting from external events but some being the outcome of the process of urban growth itself. It is these contextual conditions that fluctuate randomly and throw the equilibrium of the building set out of balance. In order to restore this equilibrium there will be movement of the urban tissue by the addition or subtraction of a building or other structure. In this way an urban tissue is a system that fluctuates chaotically, but it does so in response to random events in order to restore its equilibrium.

This explains why spontaneous cities achieve a natural, “organic” morphology that art historians have had so much difficulty to describe. Every step in the movement of a spontaneous city is a local adaptation in space and time that is proportional to the length of the feedback loops and the scale of the disequilibrium. For spontaneous cities in societies that experience little change the feedback loops are short and the scale of disequilibrium small, and so the urban tissue will grow by adding sometimes as little as one room at a time to a building. Societies experiencing rapid change will produce very large additions to the urban tissue. For example, the skyscraper index correlates the construction of very tall buildings with economic boom-times, and their completion with economic busts. The physical presence of a skyscraper is thus the representation of a major disequilibrium that had to be resolved. (Thornton, 2005) The morphology of this change is fractal in a similar way that the movement of a stock market is, a pattern that Mandelbrot has studied, the result of a process that changes in proportion to its scale. In general we can describe the property of a city to adapt to change as a form of time-complexity, where the problems to be solved
by the system at one point in time are different from those to be solved at a later point in time. The shorter the time-span between urban tissue transformations, meaning the shorter the feedback loops of urban growth, the closer to equilibrium the urban tissue will be at any particular point in time.

Modern urban plans do not include a dimension of time, and so cannot enable the creation of new networks either internally or externally. They determine an end-state whose objective is to restore a built equilibrium through a large, often highly speculative single effort. They accomplish this by creating a large-scale node on existing networks. In order for such a plan to be attempted the state of disequilibrium in the built environment must have grown large enough to justify the immense expense of the new plan. This is why development will concentrate very large numbers of the same building program in one place, whether it is a cluster of 1000 identical single-family homes or a regional shopping mall, just like the skyscraper concentrates multiple identical floors in one place. Demand for these buildings has become so urgent that they can find a buyer despite the absence of local networks, the standardized building plan, or the monotonous setting. This is not as problematic for large cities for which a single subdivision is only a small share of the total urban fabric, but for smaller towns the same project can double the size of the urban fabric and overshoot the built equilibrium into an opposite and severe disequilibrium.

The mixed-used real estate development has attempted to recreate the sustainable features of the spontaneous city by imitating the morphology of sustainable local economic networks. It has not reintroduced the time dimension in economic network growth. Often this has resulted in a commercial sector that serves not the local neighborhood but the larger region first, consistent with the commercial sector being a product of large-scale economic network disequilibrium. In other developments the commercial sectors have struggled and been kept alive through subsidies from residential development, another instance of unsustainability.

The sustainability of any natural system is its ability to renew itself for changing circumstances, restoring its equilibrium with the environment. An emergent city possesses this ability through a very responsive urban tissue that can restructure itself whenever necessary (much like cell growth in multicellular organisms). Modern planning has interfered with this process insidiously, sometimes going as far as banning urban tissue change after the initial design for fear that change would cause the system to break down, while in reality change is what keeps the system stable. This contradiction has been the principal cause of failure in modern cities.

**How Emergent Urbanism Works**

In a traditional spontaneous city, 100% of the surface is initially a network structure, open land. From this surface the best paths are selected to fit the networks that are emerging, and the leftover space is progressively built upon. Starting with a completely open, fully-connected land structure, the city's design can consist of a purely negative process by placing constraints on construction over important paths. In this way the street structure and hierarchy becomes an evolved structure that matches the history of its
networks, and the placement of buildings and uses is also an evolved structure that matches the flows of movement. Over time these paths are paved and upgraded, and important junctions of paths become the central open space of the city. The central square of a spontaneous town can be explained as the remainder of a fractal process of subtraction, with the most underused part of the spatial network being removed at each additional step of feedback until no further network subtractions are possible. With the circulation of people optimized, the remaining space is augmented with street furniture specifically designed for crowds, such as benches, transit stops, billboards, kiosks and so on.

An emergent city similarly begins with a network structure, although one that is much more sophisticated than open land. In modern design the typical asphalt street produces a network that is suited particularly to automobile networks, but also has the unfortunate side-effect of cutting pedestrian networks that normally enjoy the entire surface in a spontaneous city. As a remedy these streets are equipped with sidewalks that are often narrow and unpleasant (if not dangerous) to walk, an effort at translating strict traffic control methods to the pedestrian. It is not surprising that pedestrians are so rare in modern cities, but some efforts have shown that pedestrian networks can emerge from modern design. One example is the three-story deck of the La Défense business city in Paris (shown in figure 7), which contains parking but also regional rail and subway links, as well as being an open pedestrian surface. At the ends of this network structure a generative process of spontaneous development creates the actual networks of the city. As evidenced by the crowds present on that surface and the abundance of neighborhood shops the pedestrian networks function quite well. What is more surprising is that the automobile networks are underused and some parking structures empty, despite the neighborhood having been conceived for the automobile.

Figure 7: The “pedestrian slab” style of design was blamed for the failure of modernist urban planning projects, but at La Défense the slab is a working structure. The developer adopted spontaneous building development instead of applying the complete architectural plan, enabling the formation of a dense local economy. (Source: Author).

Because of the high costs and other complexities involved in producing networks for modern transportation systems it is not possible to practice a purely negative and subtractive process of street formation. However the network structure must still be an evolved structure that is produced with feedback from lot development instead of building an entire grid before it has been decided what size of lot is needed. Most importantly all forms of movement must be in balance in
the street design so that one type of network structure does not cut another and prevent the network formation process. (Salingaros, 1998).

**The Cultivation of a Spontaneous City**

Once a network structure is in place the process of network formation can begin.

Wiki systems have shown that the simple freedom to create does not necessarily produce networks unless there also exists a simple interface to this network. The World Wide Web provided a system of linked websites that could spontaneously produce an encyclopedia for many years before the Wikipedia system catalyzed the distributed knowledge of millions of people into an exponentially growing and internally coherent system. The creation of crowd-catalyzing systems has since been named “crowdsourcing.” Translating crowdsourcing principles to planning processes, Alexander described in The Oregon Experiment how an institution could directly support the spontaneous development of its city by providing designers and managers to assist individuals and realize the program that the individual users have in mind. (Alexander, 1975).

With the initiative for developing new building programs left deliberately undefined and in the hands of the individuals and organizations that develop the socio-economic networks of the city, there remains the issue of producing a geometrically coherent landscape that is harmonious and distinctive. This is accomplished with shared generative processes, (Alexander, 2004) and particularly the nesting of generative processes into one another (also known as a shape grammar or form language), as shown in figure 8. No matter what configurations of space are required by any individual building program, if this configuration is realized physically by the same building process as for any other random configuration then the two realized buildings will share symmetric properties and the result will be a harmonious geometric order. This has been employed in many instances by the regulation of construction materials, which creates a geometric order at the scale of texture, but it also applies for any other scale of geometry, as

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**Figure 8.** Three volumes are randomly defined in space without relation to each other. When a shared feedback function is applied to transform these volumes the volumes become related by these transformations. The function in this case is: 1 – Cut out the top corners to half the volume’s height, 2 – Raise the center of the roof. (Source: Author).
evidenced by the geometric order created by the advertisements in Times Square.

By defining construction processes instead of fixed building designs it is possible to plan for future growth without eliminating spontaneous growth and feedback. A developer that is initiating a program of emergent urbanism can therefore prepare for construction in advance of any projects having been determined. Building high-technology structures is a complex art that requires significant expertise and a skilled workforce. The developer that creates adaptive building processes that can be used to generate and realize building plans easily and rapidly will provide the same spontaneity as squatter settlements achieve.

As evidenced by the popularity of historic towns of Europe and particularly the Mediterranean as tourist destinations there is enormous demand for and profit to be made from cities that adopt the geometry of emergent cities. For this to work however the development and banking industries must be persuaded of the effectiveness of process design as opposed to master planning, and the municipal authorities must be willing to approve urban design with no fixed configuration. (Alexander, 2004). Political issues also create a significant obstacle. The long approval processes that one must go through to develop a new city or neighborhood have significantly increased the length of the feedback loops and favored large-scale development as well as made small communities less competitive. Even when long review or public consultation processes can be avoided, a development has to comply with weighty subdivision and building codes that consume time to absorb and understand, and in so doing contribute to lengthening the feedback loops and making the urban tissue less adaptive and less sustainable.

The Urgency of Emergent Urbanism

The recent disappearance of speculative real-estate financing makes “development” in the conventional sense an enterprise that fewer cities can continue. Many cities have been left with financial deficits along with new subdivisions in a state of arrested development, where “ghost grids” are occupied by only a handful of homes. In the developing world urbanization is either proceeding at an unprecedented scale, enticing municipal authorities to develop skyscraper suburbs, or has spun completely out of control to produce shantytowns. A middle ground must be found that can result in a sustainable human habitat.

The existence of low-density suburbs has been normal for all cities in history. These suburbs had socio-economic networks that were less dense and diverse but just as complex as those of urban centers. The pattern of suburban sprawl, characterized by housing subdivisions, office and industrial parks, and commercial strips, has little in common with those traditional suburbs. Life in suburban sprawl involves frequent and extensive automobile trips, which traditionally was not possible, that correspond in length to the scale of network development and feedback loops. Automobile dependency was not as noticeable when sprawl development was grafted onto an existing spontaneous city, and it was thus possible to live partially urban lifestyles, taking advantage of the local networks in a “central business district”, while retiring every night to a house in a “dormitory” suburb such as
the one in figure 9. In many places there are no such urban centers left or they have become insignificant in size compared to sprawl areas. Traditional suburbs were not so dependent on urban centers, they provided a complete living environment within a small area, and as they grew denser they eventually offered a greater range of lifestyles that made them indistinguishable from urban centers. Sprawl development has not followed this time pattern. The conclusion is that sprawl is not characterized by a low-density pattern of urbanization but is, far from it, an enormous increase in the scale of the urban web and the process of urban tissue growth. This has been shown by the negative consequences of density increases in Los Angeles, the model of sprawl development, where increased population densities, instead of reducing automobile use, have exacerbated the automobile dependency of sprawl. (Eidlin, 2005).

American-style sprawl, characterized by the housing subdivision, has provided no space for local pedestrian networks to form on top of its disconnected pedestrian structure. Sidewalks are built but they pale in comparison to the freedom and comfort of movement enjoyed in traditional cities where the entire street belonged to pedestrians. Since no space was left over for spontaneous urban growth to take place over time, and municipal zoning or community associations have made it impossible for spontaneous growth other than housing to take place, American-style sprawl deals two critical blows to local network growth. It should therefore be no surprise that subdivision-suburbs have been criticized for their anti-social properties. In a completely different style, Asian-type construction of large clusters of high-rise residential buildings connected to mass transit, although fitting the requirement for density many urban planners insist upon, shares more with the housing subdivision than the spontaneously dense city. It is a tree-like structure of repetitive housing programs that does not grow its own internal networks. Such development can also be tolerable when connected to spontaneous cities in the same fashion that American-style sprawl did, but as more of the spontaneous tissue is removed whole to be replaced with such clusters the drawbacks of sprawl appear.

The proliferation of slums in developing countries has been most severe where attempts at deliberate urban planning have been most intense. One model is the city of Brasilia, which is world famous as a gargantuan attempt at landscape architecture under the principles of modernism. The large-scale architectural structure of Brasilia has become complemented by spontaneous suburbs, favelas, which
represent a complete opposite of the planning process of the government-dominated urban center. This is by itself a very clear demonstration of the concept of built equilibrium as the most ambitious attempt at deliberate urban planning has sustained itself only with one of the most unplanned forms of urbanization to balance it. Initiatives to normalize squatter settlements have been successful at improving living conditions, but they only reduce hardship after the fact. In order to prevent slums from appearing, spontaneous urban design for new cities must be adopted by the authorities. This same spontaneous urban design must replace sprawl.

**Urbanism as a Science**

Wolfram explained the scientific constraints of complexity science by proposing that any computation that demonstrates complex behavior is computationally irreducible, meaning that there is no other process or mathematical formula that can describe the behavior and predict outcomes in fewer computations than the process itself. For linear processes common in mechanical systems it is possible to predict action using known physical equations, and engineering of mechanical systems relies on this predictability. But, once again according to Wolfram, insisting on using predictable processes deprives us of processes that are truly complex. This explains why modern processes in planning and building cities have resulted in an inferior environment than the urbanity that was produced by spontaneous, evolved processes. It is also why Alexander introduced The Process of Creating Life by insisting that modern Cartesian processes had to be replaced with generative processes. (Alexander, 2004).

Wolfram’s new scientific method, whose intent is to discover complex emergence, relies on explicit simulation of large numbers of different rules in the same process class to substitute for natural evolution. This means that it is not necessary to wait for a spontaneous order adapted to modern conditions to manifest itself naturally, that instead we can search for one scientifically. In Wolfram’s system visualization and algorithmic search through the output patterns identify the rules which generate emergent complexity. This of course means a limit in predictability that has long been familiar in the social sciences, that only the general pattern of a process can be known from its rules and that no precise prediction can be computed. Computational irreducibility means that full knowledge is required of the input in order to compute the output. We cannot possibly centralize all the information that motivates all individuals who create a city (Hayek, 1945), and so we must accept that only patterns are predictable and not specific form.

What is possible with a methodology of explicit process simulation is to compare the quality of one process to another and find patterns that were not designed or engineered into the process (emergent patterns). Some of these patterns may be beneficial, in which case a wondrous new discovery will have been made, and some patterns may be undesirable. For instance, had modern American municipalities seen how their planning rules would result in the proliferation of surface parking lots in their urban core, these processes may not have been adopted.
Being random, we cannot know why and when socio-economic networks will form. All that we can simulate is how they will form. In order to achieve this we will need to study urban morphology as a morphogenetic process, and create the computational tools to make simulations of these processes possible. By understanding the how of morphogenetic processes through simulation, we can design and build cities that produce complex order.

**Conclusion: the Art of the Space between Spaces**

If architecture is the art of space, when then is urbanism? We know from the material evidence of historic cities that it is possible to create geometric order at enormous scale. However attempts by architects to design at such scale have met with failure because of either economic or social constraints. Where urban design has succeeded was as a small sector in the context of a much larger, pre-existing urban areas. The act of design was not upon the city but upon a small part of its tissue.

The question urban design must answer is how to connect random urban tissue transformations together into an ordered whole. Of greatest importance has been the design of the tissue of public space, roads, parking and transportation structures between buildings which itself is not fixed but is always being transformed by the addition of new buildings requiring connection. Maintaining functional order in such a tissue has been achieved in the 20th century by excessively over-supplying parking space, with terrible consequences on pedestrian connectivity and visual order. Inevitably this connective tissue, the structure that is the city’s central purpose for existing, is a space that has no boundary in either space or time. The difference between architecture and urbanism is therefore not a change in scale, where a large enough design becomes urban design, but a change in dimension. With a working design in the urban dimension, any attempt at architecture, no matter how large or small, contributes to urban order.

With the additional insights provided by fractal geometry it becomes possible to conceive of spontaneous urban growth as a form of landscape art. For reasons of economic scarcity individual building architecture may remain constrained in materials and craftsmanship, but by carefully defining rules for urban growth it is possible to create very complex geometric order at the large scale. The drawback is that it cannot be a predictable geometric order the way that architecture is typically understood, but a geometric order that will adopt a predictable pattern in response to an unpredictable input that is local conditions and individual actions. Emergence thus limits what class of landscape art it is possible to achieve, but makes the class that is achievable an order of magnitude more powerful than what has so far been attempted.

The confusion of building and planning processes has produced a modern urban landscape that is often generic if not chaotic. Large-scale planning efforts to create a harmonious environment have come at the expense of network formation. The adoption of emergent processes instead will reduce this chaos and gradually produce a random fractal, the definitive outcome of a shared feedback function, onto a healing landscape.
sustainable city cannot be attained otherwise.

References


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ARCHITECTONICS - A SYSTEM OF EXPLORING ARCHITECTURAL FORMS IN SPATIAL CATEGORIES

Andrzej M. Niezabitowski

Abstract
Comparative researches based on visual analyses of different architectural objects enable separation of the small number of basic recurrent units defining spatial aspects of architectural form independently of when and in which cultural circle the object was created. These basic units of spatial structure can be termed spatial universals. Using them in accordance with some basic and universal rules of assembling into larger wholes makes possible creating any spatial objects as well as transforming them into different ones. At the same time words of natural languages contained in dictionaries give us important clues how people think about space. Another important clues are included in some recent theories of perception. All these findings taken together have been the basis to create the system of notions and terms regarding space in architecture. It is founded on basic and universal spatial elements (units) and rules of their composing into larger wholes. The paper is the trial of presenting such a notional system which was termed architectonics (or morphotectonics). Basic notions enabling description and analysis of spatial structure of any architectural object have been introduced. Fundamental spatial units have been also distinguished based on the principle of hierarchical structure – from elementary ones, through more and more complex up to largest ones playing decisive role in defining the whole architectural object. Basic spatial morphological features called also cardinal ones have been differentiated. Primary kinds of articulation have been discussed dealing with the empty space (internal or external), line, surface and volume and their elementary units had been distinguished. Besides morphological features characterizing composing elements the rules of their assembling have been specified, which have been termed syntax or relational features, characterizing spatial wholes composed of elements. Both morphological and syntax features may be treated quantitatively or measured by means of introduced coefficients. The presented system of notions as well as the quantitative approach should enable objective description and analysis of the built environment which is the necessary condition of research dealing with relations between man and his behavior and the environment, if these researches have to fulfill such elementary scientific criteria as repeatability, verifiability, internal and external validity and inter-subjective communication. The presented methodological proposal is addressed in particular to research on perception and cognition of the built environment and people’s reactions to it, such as evaluations, associations and emotions. It could be also useful in historical research carried both in comparative and systematic perspective, as well as in environmental aesthetics where comparing the new object with existing surrounding is of crucial importance. For the reason of limited place the paper is restricted only to presenting the system itself, while applications should be the subject of different publications.

Keywords
Architecture; space; system; description; analysis.
**Introduction - Initial Assumptions**

The comparative research dealing with the manners of shaping the built environment in different cultural circles and historical periods carried on from different cognitive perspectives and, based on different methodological assumptions, provides sufficient materials to formulate the hypothesis that in theoretically unlimited variety of spatial forms generated anywhere and at any time, there are some common elements of basic character – recurrent and generally employed. It includes, in particular, the spatial systems (layouts and arrangements) of architectural objects, their main composing elements and their features, as well as the manners of gathering these elements into larger wholes. These recurrent basic units, invariable and not dependant on time and place in which they were generated, may be termed spatial universals. This notion is analogical to language universals, being a relevant component of contemporary psycholinguistic concepts (Wierzbicka, 1996). A similar idea is also present in some recent concepts of architectural theory, mainly based on phenomenological approach (Thiis-Evensen, 1988), separating some basic units called “archetypes” or “primitives”. Although these findings have not been proved by empirical methods, nevertheless could be of some value for theoretical considerations. The concept of “primitives” has a long tradition reaching in its roots ancient ideas of Plato and Pythagoras and continued in many later theoretical treatises. Such units are, in some way, metahistorical and meta-cultural. Since all living processes of human beings always proceed with an environment of definite spatial structure, its recognition is one of the basic cognitive activities enabling adaptation and survival. On certain phase of human species evolution the specific human ability to create the space of environment appeared – the production and transformation of artificial spatial systems like buildings, structures, settlements, villages, cities, towns, etc., which, being the products of man, have to be comprehensible for him, reflecting the structure of his cognitive possibilities.

The recurrence of some basic manners of space shaping seems to support the next hypothesis, according to which there exists one universal spatial system common to all people as a sort of universal spatial “language”. According to the currently dominating approach to many human competences, such a system would be universal, biologically qualified characteristic of human species, as well as being the component element of our genetic equipment like language qualifications. To put it in a different way – every human being possesses the innate ability to create elementary spatial objects, understanding other already existing ones and availing them as the tools. This ability seems to be the biological basis for natural, unconscious and free assimilation of spatial elements, their features and the rules of their composing into larger wholes by small children, as well as for conscious intentional processes of learning and creating space at the later stage of personal development. Owing to this ability, we are not only able to perceive space, but we are also able to think about it, create its representations, and speak about it. According to some contemporary linguistic theories, spatial notions are more fundamental than other notions expressed in given language (Maciejewski, 1996) which could be the strong premise of the previously presented hypothesis.
Nevertheless the construction of such hypotheses is not the goal of these considerations. They rather show the author’s view on space in architecture. Regardless of its truthfulness the possibility of the construction of the spatial notions system in architecture appears to be of great importance to architectural research and theory. It seems also reasonable to find it perceptually and cognitively and exploit the analogies to language systems, which serves as the source of inspiration and pattern. The subject of the present considerations will be first of all investigating spatial objects in architecture, and in particular looking for some cognitive units of universal character. The basis of this search is the supposition that the ways of shaping space by man are determined not only by traditionally acknowledged premises of technology, function and culture having changeable character, but also by perceptual and cognitive abilities of man, which – as being biologically qualified or innate – are, as a rule, stable and universal. For this reason the recognition of the universal rules of shaping space can have important meaning, not only theoretical, but also practical, because it should lead to better fitting of created spatial structures to the structure of man’s psyche.

The main goal of researches on morphology of architectural space carried on for many years from that specific perspective (Niezabitowski, 1979, 1995, 2002) was searching for spatial universals and creating fundamentals of the universal spatial system which is common to most architectural objects, while simultaneously being reflected in human languages which in turn reflects human thinking. This approach was mainly inspired by some recent concepts developed in the frames of psycho-linguistics (Kurcz, 2000). The method of research is based on comparative visual analysis of architectural objects created in several of the biggest cultural circles of Europe, Asia and America as well as in the most important historical epochs (of the pre-historical period, ancient times, medieval period, and modern times). The basic research material were photographs of about 500 architectural objects of different historical periods and cultural circles contained in well known basic books on history of world architecture, “Key Monuments of the History of Architecture” (A. Frazer, H. Millon, 1965). This material was subjected to visual analyses and comparisons in order to separate fundamental, recurrent elements defining spatial systems of architectural objects, their characterizing features and relations between composing elements. So the primary method used in this research can be classified as observation, since it is planed, systematic and directed to specific goal. To achieve this objective the special research tool previously termed morphotectonics (Niezabitowski, 1979) enabling description and comparison of spatial systems in architecture was created. The primary premise of creating this system was fulfilling the basic scientific criteria which are well known and widely accepted in many scientific disciplines, like objectivity, inter-subjective communication, internal validity, external validity, generalization, recurrence of results, etc.

Since some basic ideas of the concepts presented in the paper were inspired by linguistics and particularly psycholinguistics, some of the introduced terms and notions were also borrowed form this disciplines (like for example morpheme or formant) (Berko Gleason, Bernstein Ratner, 2005). Others are well known and widely used within the area of architectural theory and practice. However, of
special importance are notions and terms taken from the famous “Roget’s English Thesaurus”. This unique dictionary of English language was constructed not on the usual way of putting words in alphabetical order, but was based on classifying them according to some principal ideas being foundations of thinking about the world. So in the class of space we can find about 130 spatial categories, each of them including from several to tens of words, so that the total amount reaches about 7 thousands terms regarding space and spatial objects. If we assume that there is a connection between language and thinking which is the basic thesis of psycholinguistics (Kurcz, 2000), we can also built the hypothesis that analyzing natural languages gives us important clues as to people’s ways of thinking about space in general and architectural space in particular. Moreover, there is no scientific evidence that people really think about space using strict mathematical notions and definitions. These statements taken together could be the basic premises of building the notional system possible to employ in describing, analyzing, comparing and systematizing spatial objects in architecture. Findings of visual spatial analyses were confronted with notions regarding space taken from the above mentioned dictionary and combined together to form the presented descriptive/analytical tool. Some of its elements are also supported by recent theories of visual perception, like Marr’s computational theory, and Biederman’s Recognition by Components theory. The whole proposition should be treated as theoretical concept which needs empirical verification. But this can not be the subject of the small sketch like the presented paper. Finally it has to be noted that some important attempts of systematization of architectural forms were already successfully made by other authors (F.D.K. Ching, 1993, R. H. Clark & M. Pause, 1996, W. J. Mitchell, 1994). Some of them are more oriented at teaching which does not mean that they do not fulfill scientific criteria, while others are more readily implemented in architectural research.

**Basic Notions and Definitions of Architectonics**

**Architectural object as the spatial system**

To keep the necessary scientific discipline we will begin with the basic statement that every architectural object can be considered as the spatial system. The method of system analysis proved to be particularly useful for investigating highly complex objects, so its application to architecture should be well founded. The general definition of a system must be descriptive and based on the enumeration of its main elements. So every system:

1) is an ordered and cohesive set of components, creating the whole which is different from components itself,

2) every component is characterized by the set of features,

3) all components are connected by the set of relations, which is called structure of the system,

4) every component remains in specific relation to the whole system, or serves particular function in it; the set of these relations (or functions) is called organization of the system,
5) every system as the whole remains in definite state, defined by the set of features which are constant in the chosen period of time, 6) some system undergo the processes of changes, or modifications, which means (among other things) that one can make different operations on the system components. Some of these notions can be used in description, analysis and comparison of architectural objects.

Adapting the system approach to architectural objects one can say that they can be considered as the sets of spatial elements connected with each other in such a way, that the observer can visually perceive them as the orderly and cohesive whole. This requires some additional explanations dealing with the manner of our perception of the surrounding world. Since a considerable part of information coming to our mind from the external environment is transmitted through the sense of vision; we could say that our perception of space is mainly visual. This does not mean that we could neglect the role of other senses, but still their role in the perception of space is only ancillary. Therefore, regardless of the unquestionable importance of such senses as touching, smelling, hearing or kinesthetic stressed especially by phenomenological approach (This Evensen, 1988) we can treat the perception of spatial objects as mainly visual. This means deliberate simplification, omitting such important visual features as color and texture. Not considering these visual features was motivated by the tendency to increase clarity and intelligibility of the argument as well as by restricted frames of this paper. The above definition of spatial system complies also with the Gestalt laws of visual perception.

So the proposed architectonics is a system of notions reflecting both our mental skills and common experiences with space and spatial objects, based on acquired knowledge which we gain through perception and cognition. These three elements are also reflected in languages. To return to the analogy with language system we should differentiate between two main components of the architectonics:

1) Morphology - considering spatial elements of the system and its features, 2) syntax – investigating spatial relations between elements themselves, as well as between elements and the whole.

**The spatial morphology of architectural object**

Every spatial system (or architectural object) contains a definite number of spatial elements and units of different kinds. To explain and define these basic notions we should use the method of reduction and ask the basic question: what are the smallest and already not divisible visually perceived parts of the spatial system, being something like the “particles” of chemical compound, or – using rather the comparison with language which seems much appropriate – the “characters” of visual space? It will be convenient to understand by the elementary spatial unit of architectural object the smallest visually perceived and clearly defined three dimensional part of it being either independent whole or a part of the bigger whole. This unit, being the smallest visually discernible physical component of the object, is not always relevant for the perception of the whole and not necessarily influencing its integrity, will be called voxel (volumetric element) (Mitchell, 1994). It is
a kind of spatial point, being physically a very small lump of given building material. They could be compared to characters or phones in language.

We can take the somewhat abstract assumption, that its shape is more or less spherical or cubic, while its dimension is defined by the ability of people’s normal eye resolution. So voxel is a material point which we are able to perceive visually. For this reason it may also be named visual point. As abstract as they may appear, voxels are not virtual ideas but concrete material things, exemplified by such real objects like vertexes of the cube or another solid, or small amount of pigment on the surface, etc. For this reason, voxels can assemble with each other in the process of accretion or agglutination, which results in creating bigger parts, being able to divide space into different regions, which can be named morphemes. There are three basic manners of assembling voxels: 1) grouping them one after the other in such a way, that they form a single free line, which we will call the visual line, 2) grouping them in such a way, that they form a single free surface, which can be called visual surface, 3) grouping them in such manner, that they create visual volume, which we can call visual solid. We can give them one common name of basic visual elements or visels. Watching any architectural object we can easily recognize such components like points, lines, surfaces and solids, so we tend (consciously or not) to interpret this object as composed of visels. While voxels and visels still seem to be rather purely theoretical concepts based on visual perception but not very useful in practice of spatial analysis, morphemes are much more concrete three dimensional units of spatial system, able to define its visual character (Niezabitowski, 2004). Morphemes are generated as the products of the process of spatial articulation, which means that, in the most general sense, location the definite portions of building material in particular places. The particular building material will be given the generalized term substance. In that meaning, it must have such physical features, as solid state of aggregation, resistance to forces, hardness, and durability (Gibson, 1979). The result of the featured process is a division of formerly homogenous universal space into substantially differentiated parts: full space and empty space. We can say that architectural space is a set of full and empty places which are always complementary and never exist separately (at least in terrestrial conditions). This also means that space is not substantially continuous – or that it is articulated. Putting all these statements together we could name them the “rule of general articulation”, which is the first rule of spatial definition. The division of space means introducing boundaries between parts of a given subject, which separate one part from the other, or separate particular parts from the rest of space. Every morpheme is a defined spatial region limited by the outer line or surface called boundary, which surrounds it from all directions. Putting this in categories of Gestalt theory of perception, one can say that morphemes are the figures, while the whole spatial system plays the role of ground. The space inside the boundary may be called interior. Such an approach is parallel to the Gestalt notion of figure and its contour, which is nothing other than the physical and visual boundary. The interior of the morpheme can be either filled with substance (or full) or remain the empty space. So morphemes are either the portions of substance or the empty spaces
between them. Correspondingly we can say that about full morphemes - massives and empty morphemes – vacuons.

In other words, massives are the positive spaces (filled with substance), while vacuons are negative spaces (devoid of substance). For example capitals, shafts or bases of columns are massives (positive spaces), while channels hollowed within the solid shaft are vacuons (negative spaces). Morphemes as the smallest parts being able to divide space could be compared to syllables. Adding morphemes to each other leads to the creation of bigger components of spatial system, which can be considered as independent and self sufficient, relevantly influencing the integrity of the spatial system and its wholeness. Such parts will be called formants. They may be considered as counterparts of words in language. The examples of formants could be windows, portals, cornices, eaves, columns, pilasters, etc.

To explain this notion, let’s take the example of window, as the complete whole, called formant. Such an element, playing the independent role in the whole building, consists of many smaller, dependent parts, like frames, wings, panes, mullions, glazing bars, window sills etc, which are not reducible to smaller visually and spatially relevant components. Such parts may be called morphemes. In the most general sense, they can be regarded as architectural details, which is a traditional, well known and widely used architectural notion. Since formants consist of morphemes, they may be considered as subsystems of the whole spatial system. Just like morphemes, formants can also be interpreted as figures, while the whole spatial system plays the role of a ground.

Every morpheme or formant can be characterized by the set of spatial features, which can also be called distinctive features. By this notion, we will understand definite physical properties defining the way in which the morpheme or formant spreads in the space, distinguishing it from other elements. The part of architectonics investigating features of the elements of spatial system may be called spatial morphology.

As we have previously noted, in practice, formants are the well known building elements like windows, doors, balconies, oriels, cornices, socles, etc. One can divide formants into: 1) primary formants, which are the main parts, deciding about features of the whole system, and 2) secondary formants, being the subordinated parts, deciding about the features of the primary formants. Whether the given formant is primary or secondary depends on: a) its localization in the system, b) its dimensions, and finally c) its spatial function in the system. Primary formants are components of the system localized in spatially important places, possessing relatively large dimensions and fulfilling the most important spatial functions in the system. The important places within the spatial system are: whole external boundary or its visually perceived parts like contour as the whole, its upper part, its lower part, its sides and vertexes. Other important places of the system are: places within the silhouette, like main vertical or horizontal divisions, primary and secondary axes and visual center. Important spatial functions are: accentuation of the above mentioned important places, filling, separating, and connecting. The function of accentuating means that these places are marked by introducing to them spatial elements
attracting our attention. Accentuating of the whole contour may be called framing, upper part of the contour - crowning (or resting), lower part of the contour – underlining (or supporting), sides of the contour – flanking. Correspondingly, the framing elements may be named frames, elements accentuating upper parts - crowns, lower parts – bases and side parts – flanks. The function of filling resolves to contain one object within another and may also be called nesting. Separating is a more complex function since it depends on substantiality. If the given components are vacuons (or empty elements), separating them is possible only by using a full element (or massive), while connection is possible only by using an empty element (or vacuo). On the contrary, if the given formants are massives (or full elements) their separating is possible only by using an empty element (or vacuo), while connecting them is possible by using a full element (or massive). This rule, being one of the most fundamental principals of spatial articulation, may be named the rule of connecting and separating spatial regions, which is the second rule of spatial definition. On the formants we can make some basic system operations. The most relevant of them are: addition, subtracting, division, substituting, replacing. All of them are articulating operations which lead to generation of the spatial systems, representing different degrees of complexity.

So the concept of spatial function leads us to the third level of assembling spatial units - the set of formants (both primary and secondary formants), which could be treated as the counterpart of sentence in linguistics. It will be termed tecton. It is a more complex system than that of formant, containing more elements which are bound by complex relations. The example of this unit may be the façade of the building or another big part of it like inner wall with a complex system of composing elements. This analogy to linguistics would be incomplete if we did not differentiate the highest, fourth level of assembling spatial elements being the counterpart of text. It is the building as a whole, the edifice or volumen, which should be treated as the most complicated spatial system, being the subject of our analysis. Of course, we could continue this way of thinking and take into account also much more complex spatial systems like parts of cities, cities as a whole, etc. But for the clarity of analysis, we will restrict the scope of it only to the above mentioned levels. Summing up, we have introduced five spatial units enabling spatial analysis on five different levels. On the first level such units are voxels and/or visels, on the second - morphemes, on the third – formants, on the fourth – tectons, and finally on the fifth – edifices or volumens (whole buildings). Decomposition of larger wholes into smaller parts seems to be in accordance with some of the recent theories of visual perception like Marr’s computational theory (Marr, Nishihara, 1978) and, in particular, with Biederman’s Recognition –by – Components theory (Biederman, 1987). The latter describes the way in which this process of decomposition or parsing the visual field into segments is usually performed, founding on edges extracting through detecting differences between luminance, texture and color of surfaces, as well as recognizing regions of acute concavity. Another support of the concept of main components of the visual area is provided by the empirical data and conclusions from recent researches on the activity of human eyes during the visual process (Keul, Hutzler, Frauscher, Voigt, 2005).
Morphology of spatial systems investigates three spatial features regarding both spatial units being parts of the whole structure (morphemes, formants, and tectons) and the whole structure (volumens). The set of these features, which we will call cardinal features, contains: 1) shape, 2) dimension, 3) directivity.

Ad 1) The shape of the component (or the whole set) may be described by six specific aspects of this cardinal feature: 1.1) dimensionality, 1.2) geometrical quality, 1.3) curvature, 1.4) flexure, 1.5) convexity, 1.6) articulation.

Ad 1.1. Dimensionality of the component or the whole system is the aspect of shape, being the particular case of proportions of its basic dimensions (length, width, height). When one, two or all three dimensions are so small that they do not play a relevant perceptual role and for that reason may be omitted, we will differentiate the following modalities of dimensionality: punctual, linear, superficial, solid. It is obvious that these notions cannot be treated literally according to geometrical definitions. They are based on the common perceptual interpretations of visual data flowing in from the environment. These data are compared with our knowledge about geometrical objects like points, lines, surfaces and solids stored in our mind, and then categorized correspondingly on the basis of resemblance. So when all three dimensions of a single object (width, length and height) are so small that they could be omitted, we can interpret it as point and can talk about punctual articulation (Plate I, Fig. 1, 2). The example could be the handle or another very small detail, only faintly noticeable so that it can be easily interpreted as a point. When two dimensions of a single object (for example length and width) are very small, while the third is so big and clearly noticeable that it can be regarded as dominating, we can interpret it as line and talk about linearity (Plate I, Fig. 4). The example could be the mast, very slender column, bar, stick, rod, rope, string, etc. When one dimension (for example width) of the object is very small, while the remaining two (length and height) are so big, that can be treated as dominating – we can interpret it as surface and talk about superficiality (Plate I, Fig. 5). The example could be the single free standing wall, screen, curtain etc. Finally, when all three dimensions of the object are big and clearly noticeable, though none of them is clearly dominating – we can interpret it as solid and say about solidity (Plate I, Fig. 6). The example could be the building of any type. It is difficult to measure dimensionality because it involves the question of the visual perception of proportions. Practical measures could be established either by arbitrary assumptions, what seems to be an inappropriate solution, or by empirical study, which has not been done yet.

Ad 1.2. Geometrical quality is the aspect of shape based on the possibility of describing it by means of the basic notions and figures of Euclidean geometry. This should not be confused with regularity, although in some cases it seems to be convenient since it gives some possibility of simplification of the form, which is close to the Gestalt notion of Pragnantz, or a good form. (Plate II, Fig. 1-4). The opposite of this feature is non-geometric quality. This concepts should be implied in terms of empirical research in visual perception rather than in mathematical notions of structural information theory (van der Helm, Leeuwenberg, 1996) since the results of the former are not always
in accordance with the latter (Olivers, Chater, Watson, 2004). The measure of geometrical quality is the coefficient of geometrical quality, which could be defined as the ratio of the number of geometrically shaped components (Gp) to the total number of parts composing the system (Ap), Cgeom = Gp/Ap (it may also be expressed in percentage). A more detailed description should investigate the number of different geometrical types of figures (like triangles, semicircles, rectangles, etc.) applied in particular morphemes or their parts. Of course, also the notion of geometry (like the previously discussed notion of dimensionality) should not be treated literally, but rather intuitively. There is a great variety of very complex shapes which are geometrical in the strict sense of the word, but perceptually they are not recognized as such since this interpretation is too difficult for our mind. In terms of the Gestalt theory of perception they are not good Gestalts, since they contain too much information to process. So in using the term “geometrical quality,” we will understand it rather in the manner pointed out by Irving Biederman’s theory of Recognition by Components (Biederman, 1987). According to this theory, people perceive all spatial objects reducing them to different combinations of 36 simple geometric volumes (geons), so it is also possible to interpret all architectural objects and their parts in this way. It seems to be especially promising in regards to the most important of the previously differentiated spatial units, like formants and tectons which decide on spatial definition of any architectural object.

Ad 1.3. Curvature is the aspect of the object’s shape which needs to consist of at least one curved line or surface (it refers to contour, silhouette or solid). The opposite of this feature is non curvature (Plate III, Fig. 1-4). The measure of curvature is the coefficient of curvature being the ratio of the number of curved lines or surfaces (Cp) appearing in particular formants to the total number of lines or surfaces (Ap) employed in the system, Ccur = Cp/Ap (may be also expressed in percents). It is also possible to measure the total length of curved and straight lines, and count the ratio of the first ones to the second ones, or measure the total area of curved and flat surfaces, calculating their ratio.

Ad 1.4. Break or flexure is the aspect of shape referring to the fact that the outer surface of the object possesses at least one sharp edge or its contour possesses at least one vertex. The opposite of this feature is oval quality (Plate IV, Fig. 1-4). The measure of flexure is the coefficient of flexure, which could be defined as the number of sharp edges and/or vertexes. Break is often one of the possibilities to mark the border between adjoining spatial components.

Ad.1.5. Convexity is the aspect of shape pertaining to the fact that it is impossible to find such a tangent to the contour (or outer surface) which could cut this contour (or outer surface). The opposite of convexity is concavity. To define these features in perceptual terms we can say, that convexity is the case in which projecting parts appear, while concavity means employing recessed parts (Plate V, Fig.). Of course, we can encounter also mixed cases, in which both convex (projecting) and concave (recessed) parts appear in the same object. The measure of convexity is the coefficient of convexity, defined as the ratio of the area of outer surface covered by projections (Aproj) to the area of the whole outer surface of the object (Asurf), Cconv = Aproj/ Asurf. Correspondingly, the measure of
concavity is the coefficient of concavity, defined as the ratio of the outer surface area covered by recessions (Arec) to the whole area of the outer surface Asurf, Crec = Arec/Asurf. Both may also be expressed in percentage of total outer surface. In practice, normal visual perception of the outer surface means usually the perceived silhouette of the object. The notion of convexity with its counterpart concavity seems to be the key morphological concept since it is based on the ideas of emptiness and fullness, or – to put it in a different way – on the idea of spatial articulation. In the strict sense concavity is the lack of material (substance) in a given part or region of the object. Thanks to the presence of such regions it is possible to distinguish between different morphemes or formants, or to define where the one morpheme finishes and the next begins. The border between different adjoining parts often puts on the form of concave or convex region (Stamps, 2000). As previously noted, another kind of border is break (edge). These remarks lead us to another important notion of morphology, which is the articulation of space.

Ad 1.6 Articulation is the aspect of the shape related to the division of the space by disposing definite portions of material in it. We can differentiate four basic kinds (or aspects) of spatial articulation: 1.6.1) articulation of empty space (or free articulation), 1.6.2) articulation of line, 1.6.3) articulation of the surface (planar, superficial or tied articulation), 1.6.4) articulation of full (solid) space (or tectonics) (Plate VI, Fig. 1-6).

Ad 1.6.1) We can differentiate five main modalities of the empty space articulation, which are strictly connected with dimensionality:

1.6.1.1) punctual articulation (Plate VII, Fig.1D), when empty space is divided by punctual components (which is rather purely theoretical case in three dimensional space, but may be real on two dimensional plain; example – lumps of material on the wall surface), 1.6.1.2) linear articulation, when empty space is divided by linear components (example – the structure made of rods, like in geodetic domes) (Plate VII, Fig. 1C, Fig.4) 1.6.1.3) superficial articulation, when empty space is divided by superficial components (example – structure made of slabs, like in most usual buildings of different type) (Plate VII, Fig.1B, Fig.4), 1.6.1.4) solid articulation, when empty space is divided by solid components (example – the structure made of very thick, massive columns, like in the Egyptian temples or different massive blocks like in Sydney Opera) (Plate VII, Fig.1A, Fig.2) 1.6.1.5) mixed articulation, when empty space is divided by components of different dimensionality (Plate VII, Fig.5). In the last case we can count the number of all main components and the number of particular parts of different dimensionality (punctual, linear, superficial or solid) and express their participation in the whole in percents, using correspondingly the coefficients of punctual articulation (Cpunct = x % of punctual components), linearity (Clin = x % of linear components), superficiality (Csuperfic = x % of superficial components) and solidity (Csolid = X % of solid components).

Ad 1.6.2. Articulation of line is based on dividing it into different segments. There are two basic kinds of line articulation: 1) continuous (without intervals), 2) discontinuous (with intervals). In the first case, the line is divided by vertexes or points of bending and segments can have different shapes, lengths and directions. In the second
case, when the intervals appear, the segments can also be differentiated on the basis of shape, length and direction, but additional parameter has to be taken into account – namely the length of the interval. There are many possibilities of classification of different kinds of articulated lines, but it is not possible to present them here, so we will restrict ourselves only to the above mentioned two-fold division.

Ad 1.6.3) We can distinguish seven basic units of superficial (or tied) articulation: folds, offsets, ridges, furrows, pockets, pinnacles, openings (Plate VIII a and b). Folds and offsets are both concave and convex formations, and the main difference between them is that folds are curved, while offsets – not curved. There are a lot of examples presenting folds like undulating walls of many baroque architectural objects, wavy ceilings and vaults, etc. (Plate VIII a, Fig.1, 2). Also, offsets are a very popular way of shaping building surfaces, both walls and roofs (for example shed roofs) (Plate VIII a, Fig.3, 4). Ridges are elongated convex formations (e.g. pilasters, attached columns) (Plate VIII a, Fig.5, 6), while furrows are their opposite - elongated but convex (Plate VIII a, Fig.7, 8). Pinnacles are convex formations of punctual character (fleurop, crocket, tenon) (Plate VIII b, Fig.3, 4) while pockets, being their reverse, are punctual but concave (e.g. niches, conches, cavities, recesses) (Plate VIII b, Fig.1, 2) Openings are the two dimensional perforations in the continuous surface, and their different types depend on shapes and dimensions. There are numerous examples of this unit all over the world like windows, doors, gates, door-ways, portals, etc. (Plate VIII b, Fig.5, 6). In all cases of articulation discussed above, we can measure them by counting the percentage of total surface covered by the specific units.

Ad 1.6.4) We will differentiate three basic kinds of the full space (solid) articulation, also referred to as tectonic articulation: 1.6.4.1. positive articulation (“convex solid” or “block”), 1.6.4.2. negative articulation (“concave solid” or “syncline”), 1.6.4.3) internal articulation (“inner solid” or “cave”) (Plate IX). Positive articulation of the solid (“convex solid”) is based on the units (tectons) which we will call blocks. Depending on their dimensionality and directivity we can differentiate the following kinds of blocks: punctual block (relatively small mass with all three dimensions close to each other, e.g. small house, kiosk, etc.), linear standing block (large mass whose height is clearly bigger than the remaining two dimensions, e.g. post, column, tower, etc.), linear lying block (large mass, which length is distinctly bigger, than the remaining two dimensions, e.g. beam, elongated block of flats, etc.), superficial standing block (large mass, whose height and length are big, while thickness is relatively small, e.g. screen, thin wall standing alone, etc.), superficial lying block (large mass whose length and width are big, while height is relatively small, e.g. lying slab or plateau, etc.), and massive block (large mass, whose all three dimensions are big and similar, e.g. massive volume, big cubic edifice, etc). Negative articulation of the solid (“concave solid”) is based on the units (tectons), which we will call synclines. Perceptually, they can be interpreted as empty spaces (vacuons) engraved in full mass and opened from above. Depending on their dimensions and directivity, we can differentiate the following kinds of synclines: punctual syncline, linear standing syncline, linear lying syncline, superficial standing syncline, superficial lying syncline, and
solid syncline. Internal articulation of the solid is based on units (tectons) which we will call caves. Depending on their dimensionality and directivity we can differentiate the following kinds of caves: punctual cave (room), linear standing cave (shaft), linear lying cave, superficial standing cave, superficial lying cave, and solid cave.

Ad 2) Dimension is the cardinal feature denominated in several different ways or possessing different aspects. Its first aspect is linear, defined as the interval measured on the straight line between two most distant points of contour or outer surface. It may pertain to particular dimensions in vertical direction (height) or in horizontal dimensions (width, length). The second aspect is related to the surface and defined as an area, while the third aspect pertains to the volume of the solid. Another aspect of dimension is its ratio to the dimensions of its surroundings, which may be described as relative dimension or scale. Finally, we can say about the ratio of the one of three basic dimensions (for example height) to another (let’s say width), which is usually called proportion.

Ad 3) Directivity is the cardinal feature which defines dominating directions of spreading the component (or the whole system) in space. Within the frame of reference appointed by the earth’s environment we can differentiate the following aspects of directivity:

3.1. verticality, 3.2. horizontality, 3.3. obliquity, 3.4. no-directivity (Plate X). We should differentiate between the directivity of the whole system and directivity of particular components. So the whole object can be vertical, while its composing elements are horizontal and reversed. We can also encounter two other cases: horizontal objects consisting of horizontal parts and vertical objects composed of vertical parts. In each case we can define the auxiliary coefficients like the ratio of the number of vertical/ horizontal morphemes/ formants to the number of all morphemes/ formants. Each of four main aspects of directivity of the whole object can be measured by specific coefficients. Correspondingly, we can measure the verticality/ horizontality of the whole using coefficient being the ratio of the greatest height to the greatest horizontal dimension (width or length), and obliquity by defining the angle of inclination to the horizontal direction. When none of the main directions is dominating, we can speak of no-directivity. Another way of measuring this feature is, for example in case of verticality, counting the ratio of the number of vertical elements (morphemes, formants, tectons) to the number of all elements, or ratio of the total length of vertical elements to the total length of all elements. The same pertains to the remaining modalities of directivity.

The spatial syntax of architectural object

Beside cardinal features spatial objects composed of formants (or formants composed of morphemes, if they are considered as sub-systems) are characterized also by syntax features of two main kinds: 1) constitutive features and 2) topographical features. Constitutive features define the general quantitative properties related to the distribution of components, while topographical features define detailed spatial relations between formants or the way of its spreading in space.
Ad 1) Constitutive features include two main aspects: 1.1) complexity, and 1.2) differentiation (Plate XI, Fig.1, 2). Complexity is the constitutive feature which defines the number of main components. One can differentiate three levels of complexity (or modalities of this feature): small, average and high (Plate XI, Fig.1,3,4). Differentiation is the constitutive feature defining the number of different kinds or classes of main components. One may distinguish three levels of differentiation (or modalities of this feature): small, average and high (Plate XI, Fig.2, 5, 6).

Ad 2) The set of topographical features contains: 2.1. orderliness, 2.2. inclusiveness, 2.3. substantiality, 2.4. configuration, 2.5. zoning.

Ad 2.1) Orderliness is the topographical feature of the system which defines the rules of arrangement of main components. The number of these rules determines the level of orderliness. When no clear rule of arrangement is possible to detect we can talk about state of chaos (Plate XII, Fig.1 A). This concept seems to be very close or even analogical to the notion of regularity, so the previous remarks on this subject relate to it (see the discussion on geometrical quality). One can differentiate three levels of orderliness: small, average and high (Plate XII, Fig.1, 2, 3) Orderliness of the system may be based on: grouping of main components possessing equal cardinal features (shape, dimension, directivity) which may be called cardinal orderliness (Plate XII, Fig.2) or arrangement of the main components according to the definite relations, which may be called relational orderliness. This kind of orderliness takes into account the following spatial relations between main parts: distance, direction, angle and sequence. When both cardinal and relational orderliness occur in the object, we may talk about complete orderliness (Plate XII, Fig.3, 4).

Ad 2.2) Inclusiveness is the topographical feature defining the outside-inside relations between morphemes/ formants. Depending on this relationship, one can differentiate the following modalities of inclusiveness: separation, penetration and containing (Plate XIII, Fig.1). Separation takes place when neighboring spatial regions have no fragment in common (Plate XIII, Fig.2). Penetration, on the contrary, means that regions have some common spatial fragments, or one of them is at least partly surrounded by the other (Plate XIII, Fig.3). Finally, containing is the state in which one region is nested in another, being surrounded by it from all sides (Plate XIII, Fig.4).

Ad 2.3) Substantiality is the topographical feature defining the presence or absence of material in particular fragment of space. One can distinguish two reciprocally bound features being different aspects of substantiality: 2.3.1 consistency (or density), 2.3.2. continuity (or closure).

Ad 2.3.1) Consistency (or density) is the topographical feature defining relative intervals between formant (Plate XIV). Depending on this, we can distinguish three levels or different states of consistency: distance, proximity and adhesion. This concept corresponds with the notion of spatial contiguity which is well known in research on perception of visual patterns although interpreted in different ways (Olivers N.L, Chater D, Watson D. G, 2004). When the interval between two components is equal or bigger than the sum of their biggest dimensions
(which ranges), one can say that they are distant. When the interval between them is smaller than this sum but bigger than 0 one can refer to their proximity, and when the distance is equal 0 one can refer to adhesion. One can measure the level of this feature using the coefficient of consistency icons, which is the ratio of the mean distance between morphemes (formants, tectons) to the mean of their dimensions. A good example of this feature could be the interior of an Egyptian temple with its thick pillars and relatively narrow spaces between them, or the interior of the Taj Mahal shrine in Agra demonstrating the same phenomenon. Adhesion may depend on the number of points in which the adjoining morphemes (or formants) meet with each other and on the total area of the common surface.

Ad 2.3.2) Continuity (or closure) is the topographical feature, defining the substantial character of borders, or the presence of full or empty fragments in them (Plate XV). We can distinguish three levels of continuity: small, average and high. The measure of this feature is the coefficient of continuity $C_{cont}$ being the ratio of the sum of the length, area or volume of empty spaces in the border to the total length to the area or volume of the whole border (depending on its dimensionality). The illustration of three levels of continuity may be as follows: the frame (small continuity, low degree of closure), the raster or the perforated wall (average continuity, average degree of closure) and the full wall without openings (high level of continuity and high degree of closure).

Ad 2.4) Configuration is the topographical feature of the system defining the spatial arrangement of its main parts in the whole and the relations between them. We should underline that configuration has two different, though sometimes bound aspects. The first one is connected with the outer spatial structure of the whole mass, regarded as the full solid and investigated from outside, the second one – with the inner structure of the same mass, regarded as the hollow, empty solid and perceived from inside. The first one consists mainly of massives or at least they are perceived as massives, no matter if their inside is hollowed or not. The second, on the contrary, consists mainly of vacuons or is perceived as mainly empty space, or a set of reciprocally bound empty spaces, regardless of the presence of some massive elements.

To make a clear distinction between these aspects, we have to discuss the previously introduced notion of tectons and tectonics. So the first aspect of this notion means the massive (or perceived as massive) primary formants, decisively influencing the spatial structure of the whole system investigated from outside. The second aspect of tectons means the biggest interior empty spaces defining the inner structure of the hollowed mass. So examples of massive tectons are wing pavilions, cupolas, towers, wings, roofs, or other big projected and massive parts of the building, while the examples of empty tectons are big halls, saloons, lobbies, interiors of stair cases or other interior vast rooms of buildings. As tectons are the biggest macro-formants (primary formants) defining the shape of the whole mass from outside or inside, to be able to denominate the reciprocal spatial relations between them we have to introduce the tool for coordinating them. This tool will be called the spatial skeleton. This is the set of inner lines located in such a way that in each section
they are in equal distance from the outer boundary.

Division of the whole object to components corresponds with Marr’s concept of extracting parts of the visual form. His proposal contains several steps: extracting contour, finding regions of deep concavity and label both convex and concave sections, finding segmentation points, dividing contour by segmentation points, finding component axis, and finally relating axes. (Marr, Nishihara, 1978). Such a set of lines as a kind of spatial axis, may be considered as the substitute of the real shape so it may be easily analyzed, described and compared. We can differentiate two component elements of a spatial skeleton (or axis), trunks and branches, though some systems have only trunks, while others, only branches. We can also find systems without a skeleton, in which it is reduced only to one point. The elements of skeletons may be of closed or open character. On this basis, we can build the complete taxonomy of spatial arrangements presented in Plate XVI a. (some examples of it are presented in Plate XVI b).

Despite the aspects of syntax discussed above, we should also take into account that spatial syntax is the process of assembling spatial units in spatial groups of different kinds. Thus, we can distinguish three basic kinds of grouping: assembling in rows, assembling in layers, and piling up. Assembling units in rows means grouping them along a particular line spreading in one direction, and at the same time putting them in proximity. As the result the group spreads only in one direction. Assembling in layers is based on grouping units along lines multiplied several times so that each line adheres closely to the neighboring one. As a result, the group spreads in two directions. Piling up means putting one layer on another one in the third dimension – height.

Ad 2.5) Zoning is the topographical feature defining the location (or position) of the formants in the whole system. One can differentiate the following positions: front, back, left, center, right, upper, lower. Describing and analyzing the system in this respect, we should enumerate the number of macro-formants (primary formants) located in particular zones.

It seems convenient to gather all the differentiated features in Spatial Features Inventory, which forms a kind of taxonomy (Niezabitowski, 2004). It consists of three main parts containing three main kinds of features: cardinal (morphological), constitutive and topographical (syntactic) (respectively Tables 1 – 3), which are set together from the most general to the most detailed ones starting from descriptive categories, through their aspects and ending on modalities (or sub-modalities) of aspects.

General Comments on the Procedure of Spatial Analysis

The complete and detailed description and analysis of spatial architectural system based on notions and terms introduced in the above deliberations is the process containing several stages, which should follow in the strict succession. The first question we have to answer deals with what is to be our main subject of interest: whether the analysis should deal only with chosen parts of the object or the object as the whole. If the answer to the second question is affirmative, we have to decide whether we
want to describe the object’s exterior or interior, which implies a completely different descriptive and analytical situation. Suppose we decided to examine the whole object from outside. In such case, we should take into account that what we usually see from one fixed point of view is only the part of the whole outer surface of the object, which could be named its shell. To gain the complete outlook of the whole, we should either walk around the building and above it (which is usually impossible in practice), or examine its photos (drawings) taken from different perspectives and points of view.

Regardless of what is the source of our information, we should notice that the shell is usually divided into three relatively independent but still bounded parts: walls, roof and floor. The latter is observable only from inside, so in this case we can omit it, and focus attention only on outer walls and roof. Next, since we decided to describe and analyze the object from outside, we have to examine the articulation of the outer surfaces and then the articulation of the solid. Analysis of articulation of the surfaces is the process in which we differentiate the biggest components of the outer surface of the walls localized in important places of it, or macro-formants (like cornices, eaves, socles, pilasters, bounded columns, windows, portals, balconies, porticos, loggias etc.). Correspondingly, analysis of the articulation of solid is the process of differentiation of the biggest components of it or tectons, like breaks, projections, wings, towers, turrets, roofs, cupolas, etc. To summarize this first stadium, we can say that its essence is the recognition and enumeration of the main components of the system, which means establishing its contents and defining the degree of its complexity.

The second stadium of description and analysis deals with shapes, dimensions, directivity, position and articulation of the main formative components enumerated in the first stadium. In describing them, we use all of the previously introduced notions as well as measures, which allow us to express the features of components in a quantitative manner.

**Conclusions**

Every scientific discipline begins its development from description, measuring, analysis, comparison and systematization of basic phenomena. The science of architecture, which unlike architecture itself is a rather young discipline, should work the same. If we accept this position, the attempt to create the new sub-discipline within the range of positive architectural theory (Lang, 1987), exploring spatial aspects of architectural form and laws of its shaping will be well-founded. It can help us to understand better not only architecture as such, but also comprehend man, who creates and uses it. The above deliberations are the trial of the notional system creation, enabling exploration of spatial phenomena in architecture in a way which fulfils the basic criteria of science. Such a system of notions, as well as the possibility of quantification of spatial phenomena, is the prerequisite of scientific exploration of architectural form which is not only the matter of aesthetics but also the matter of spatial morphology. This system could be implemented in research of architectural psychology, especially the perception and cognition of the built environment, as well as environmental aesthetics. On this basis, we can expect possibilities of prediction of human
reactions and appraisals of it which should be of crucial importance for shaping the built environment of high quality.

Plate I. Shape of the morphemes. Aspect: dimensionality

<table>
<thead>
<tr>
<th>Fig. 1. Dimensionality (punctual, linear, superficial, solid)</th>
<th>Fig. 2. Dimensionality (mixed)</th>
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<tbody>
<tr>
<td>Fig. 3. Punctual dimensionality</td>
<td>Fig. 4. Linear dimensionality</td>
</tr>
<tr>
<td>Fig. 5. Superficial dimensionality</td>
<td>Fig. 6. Solid dimensionality</td>
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</tbody>
</table>
Plate II. Shape of the morphemes. Aspect: geometrical quality

Fig. 1. Geometrical quality (scheme)

Fig. 2. Non-geometrical quality (scheme)

Fig. 3. Geometrical quality

Fig. 4. Non-geometrical quality
Plate III. Shape of the morphemes. Aspect: curvature

Fig. 1. Curvature (scheme)

Fig. 2. Non curvature (scheme)

Fig. 3. Curvature

Fig. 4. Non curvature
Plate IV. Shape of the morphemes. Aspect: flexure

Fig. 1. Flexure (scheme)
Fig. 2. Oval quality (scheme)
Fig. 3. Flexure
Fig. 4. Oval quality
Plate V. Shape. Aspect: convexity

Fig. 1. Convexity (scheme)

Fig. 2. Concavity (scheme)

Fig. 3. Convexity

Fig. 4. Concavity
### Plate VI. Shape. Aspect: articulation

<table>
<thead>
<tr>
<th>Fig. 1. Articulation of empty space</th>
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<tr>
<td>Fig. 2. Articulation of empty space</td>
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<tr>
<td>Fig. 3. Articulation of surface</td>
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<td>Fig. 4. Articulation of surface</td>
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<tr>
<td>Fig. 5. Articulation of solid (tectonics)</td>
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<td>Fig. 6. Articulation of solid (tectonics)</td>
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**Plate VII. Articulation of empty space. Four basic modalities**

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<tr>
<td><strong>A.</strong> Solid articulation</td>
<td><strong>B.</strong> Superficial articulation</td>
</tr>
<tr>
<td><strong>C.</strong> Linear articulation</td>
<td><strong>D.</strong> Punctual articulation</td>
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</tbody>
</table>

**Fig. 1. Modalities of space articulation**

**Fig. 2. Space articulated by solid elements**

**Fig. 3. Space articulated by surface elements**

**Fig. 4. Space articulated by linear elements**

**Fig. 5. Space articulated by mixed elements**
<table>
<thead>
<tr>
<th>Plate VIII. (a) Articulation of surface. Basic units.</th>
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<tr>
<td><img src="image1" alt="Fig.1. Folds (scheme)" /></td>
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<td><img src="image2" alt="Fig.2. Folds" /></td>
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<td><img src="image3" alt="Fig.3. Offsets (scheme)" /></td>
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<td><img src="image4" alt="Fig.4. Offsets" /></td>
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<td><img src="image5" alt="Fig.5. Ridges" /></td>
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<td><img src="image6" alt="Fig.6. Ridges" /></td>
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<td><img src="image7" alt="Fig.7. Furrows (scheme)" /></td>
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<td><img src="image8" alt="Fig.8. Furrows" /></td>
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Plate VIII (b). Articulation of surface. Basic units (cont’d)

Fig. 1. Pockets (scheme)

Fig. 2. Pockets

Fig. 3. Pinnacles (scheme)

Fig. 4. Pinnacles

Fig. 5. Openings (scheme)

Fig. 6. Openings
Plate IX. Shape. Articulation of solids (tectonic articulation) depending on dimensionality

A - positive articulation ("convex solid" or "block")
BP - punctual block, BLS - linear standing block, BLL - linear lying block,
BPS - superficial standing block, BPL - superficial lying block, BB - massive block

B - negative articulation ("concave solid" or "syncline")
NP - punctual syncline, NLS - linear standing syncline, NLL - linear lying syncline,
NPS - superficial standing syncline, NPL - superficial lying syncline, NB - solid syncline

C - internal articulation ("inner solid" or "cave")
KP - punctual cave, KLS - linear standing cave, KLL - linear lying cave,
KPS - superficial standing cave, KPL - superficial lying cave, KB - solid cave
Plate X. Directivity.

Fig.1. Different types of directivity
A. Verticality
B. Horizontality
C. Obliquity
D. No-directivity

Fig.2. Verticality

Fig.3. Horizontality

Fig.4. Obliquity
Plate XI. Syntax features. Aspect: constitutive features (complexity and differentiation)

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Fig. 1. Different levels of complexity

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<th>Fig. 3. Small level of complexity</th>
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<th>Fig. 4. High level of complexity</th>
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<th>Fig. 2. Different levels of differentiation</th>
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<th>Fig. 5. Low level of differentiation</th>
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<tr>
<th>Fig. 6. Average level f differentiation</th>
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Fig. 3. Small level of complexity
Fig. 4. High level of complexity
Fig. 5. Low level of differentiation
Fig. 6. Average level of differentiation
Plate XII. Topographical features. Orderliness.

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<tr>
<td><img src="image1.png" alt="Diagram A" /></td>
<td><img src="image2.png" alt="Diagram B" /></td>
<td><img src="image3.png" alt="Diagram C" /></td>
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**Fig.1.** Different types of orderliness

![Diagram D](image4.png)

**Fig.2.** Cardinal orderliness

![Diagram E](image5.png)

**Fig.3.** Complete orderliness: cardinal and relational

![Diagram F](image6.png)

**Fig.4.** Complete orderliness: cardinal and relational
Plate XII. Orderliness (cont’d)

Fig. 1. Different states of orderliness
A – lack of orderliness (chaos)
B – state of orderliness

Fig. 2. Small level of orderliness

Fig. 3. Average level of orderliness

Fig. 4. High level of orderliness
Plate XIII. Topographical features. Inclusiveness

Fig.1. A, B – separation, C – penetration, D – containing (nesting)

Fig.2. Separation

Fig.3. Penetration

Fig.4. Containing (nesting)
Plate XIV. Topographical features. Aspect: Substantiality. Modality: consistency (density)

Fig.1.
A – distance
B, C – proximity
D - adhesion

Fig.2. Distance

Fig.3. Proximity

Fig.4. Adhesion
### Plate XV. Continuity (closure/openness)

| Fig. 1. Low level of continuity |
| Fig. 2. Average level of continuity |
| Fig. 3. High level of continuity |
| Fig. 4. Average level of continuity |
| Fig. 5. High level of continuity |
| Fig. 6. High level of continuity |
Plate XVI. (a) Configuration – syntactic taxonomy based on visual skeleton
Plate XVI (b). Configuration. Different types.

Fig. 1. Trunk and branches

Fig. 2. Trunk and branches

Fig. 3. Ring skeleton

Fig. 4. Skeleton consisted only with branches

Fig. 5. Configuration without skeleton

Fig. 6. Skeleton consisted only with trunk
Architectonics - A System of Exploring Architectural Forms in Spatial Categories.

ANDRZEJ M. NIEZABITOWSKI


References

Andrzej M. Niezabitowski

Andrzej M. Niezabitowski is a Professor of Architecture at the Silesian University of Technology in Gliwice, Poland. He holds a masters degree in architecture and urban planning from Cracow University of
Technology, Poland (1968), and Ph.D. in technical sciences from Silesian University of Technology in Gliwice, Poland (1973). He has got the D.Sc. degree in technical sciences from Wroclaw University of Technology, Poland (1983), and was appointed as assistant professor at the Division of History of Architecture in the Faculty of Architecture, Silesian University of Technology (1984). He was nominated as the associated professor in the Department of History and Theory of Architecture in the Faculty of Architecture Silesian Technical University (1991) and elected the Head of this Department (till now). He has got the title of Professor in technical sciences from the President of Polish Republic (1996), and was nominated as the Full Professor by the Minister of Science and Higher Education (1999). In the period from 1993 – 1999 Prof. Niezabitowski was the Dean of the Faculty of Architecture in Silesian University of Technology. In that period he was also the coordinator of two international research projects granted by EU. The main subjects of his scientific interests is the theory of architecture, especially the spatial morphology of architecture, perception and cognition of architecture, and the history of modern architecture. He published 2 books, about 60 articles in scientific journals in Poland and abroad, and several articles and papers in conferences proceedings. Chosen titles of publications: Study of residential environment and psychological needs., Some ideas on the evaluation of architectural work. Theoretical basis of architectural criticism., The Visual Perception of Spatial Structure of the Built Environment – Basic Descriptive Categories., Visual Character of the Built Environment as a Tool for the Description, Analysis and Comparison of Architectural Objects. He has received several foreign scholarships, among others from Spanish Government (in Escuela Technica Superior de Barcelona, Spain), Cambridge University (UK), Eindhoven University of Technology (The Netherlands). He is the member of IAPS, and the Head of the Committee of Architecture and Urban Planning Polish Academy of Sciences (division in Katowice, Poland). He can be contacted at andrzej.niezabitowski@pols.pl
While design practices are generally seen as a major driver for shaping debates and trends in architecture and urbanism, architectural discourse is typically shaped by discussions in books, journal articles, short essays, and reviews of design trends or critiques of buildings or design competitions. In many cases however, critical essays may have the power to communicate ideas and concepts in a concise manner while books can still be seen by some academics or many practitioners as lacking the capacity to communicate the same ideas or concepts effectively. Whether or not one would agree with this view is a different issue. Yet, as a reaction to such a view it is possible to see book reviews playing the role of short essays or articles which enable readers to grasp the message a book author is trying to convey—yet in a short and quick way. In person-environment research—as part of contemporary architectural discourse—book reviews are important as they provide significant slices of larger arguments, but enable readers to...
classify, categorize, and relate those arguments to other discourses on theories of architecture and urbanism, and thereby comprehending the full spectrum of issues introduced through a specific period of time.

As part of a specialist subject (elective) on Socio-Behavioral and Cultural Factors in Architecture and Urban Design, which I teach to architecture students at Queen’s University Belfast, a book review assignment was delivered. The course aims at introducing students to cultural, social, and psychological issues in architectural and urban design, and their value to successful design practices. It provides an overview and analysis of the literature and major scholars, researchers, and practitioners. An integral component of the course is an intensive discussion of issues that pertain to ways in which information about socio-cultural factors and environment-behaviour knowledge can be applied to design projects. In more specific terms, the objectives of the course therefore encompass: 1) To increase students’ sensitivity to the built environment and to break any habits of taking the environment for granted; 2) To acquaint students with particular knowledge of a variety of environments including residential, work, learning, and urban environments. Since our societies are in a continuous process of transformation, we must engage in sound future design that would involve the systematic examination of the relationship between culture, behaviour, and the environment; 3) To enhance students’ understanding of the core concepts regarding human-environment relations and how these concepts vary by different cultures and sub-cultures, 4) To develop students critical thinking abilities about the role of the built form in fostering, enhancing, or inhibiting cultural behaviours and attitudes.

In this article, I discuss the notion of reviews and book reviews, outline the assignment delivered to architecture students at Queen’s University Belfast, then present selected students’ reviews. While this article is simply a presentation of students’ work, the ultimate objective is to offer a package of ideas and concepts generated in the literature of person-environment interaction as viewed by the students. This is coupled with students’ articulations of and reflections on how the merits and demerits of those ideas and the way in which they relate to such ideas in their reviews. While this article does not reflect on students’ work and does not have a conclusion, it calls for a database that is exclusively dedicated to reviewed books on person-environment interactions, which could be published online on the web of one of the societies or associations concerned with people-environment interactions including EDRA-Environmental Design Research Association and IAPS-International Association of People-Environments Studies.

The Notion of Reviews and Book Reviews

A review is a critical appraisal of a text, event, exhibition, object or product, or phenomenon. Reviews can consider books, articles, entire genres or fields of literature, architecture, art, fashion, restaurants, policies, exhibitions, performances, and many other forms (UNC, 2009). Essentially, a review makes an argument or a polemic. The most important element of a review is that it is a commentary, not merely a summary or summary of a thrust of a book. It allows the reviewer-student to enter into dialogue and debate with the work’s creator.
Typically, a reviewer provides an agreement of disagreement while identifying exemplary elements or deficiencies in its knowledge and the message it attempts to convey. Also, a reviewer should state his/her opinion of the work in question, and that statement will probably resemble other types of academic writing, with a thesis statement, supporting body paragraphs, and a conclusion.

In general terms, reviews are brief. In newspapers and academic journals, they rarely exceed 1000 words, although a reviewer may encounter lengthier assignments and extended commentaries as required for publishing. In either case, reviews need to be short and snappy and to the point. While book reviews may vary in tone, subject, interest, and style, there are a number of common features that can be exemplified as stated by the writing center of University of North Carolina-Chapel Hill (UNC, 2009). However, they are dependent on whether the review is developed for learning, professional, or marketing purposes.

1. A review is typically expected to offer the reader a concise summary of the content. This includes a relevant description of the topic as well as its overall perspective, argument, or purpose.

2. A review offers a critical assessment of the content. This involves the reviewer’s reactions to the work under review: what strikes the reviewer as noteworthy, whether or not it was effective or persuasive, and how it enhanced the reviewer’s understanding of the issues at hand.

3. In addition to analyzing the work, a review often suggests whether or not the audience would appreciate it.

In educational and learning terms, the book review is assigned to develop analytical skills. First, the student reviewer has to depict the content, regardless of the type of content whether it is research-based, or position-based. In the subsequent narration the goal of the book reviewer is to discuss the content of the book and provide generic analysis of what he or she had read, and deduce if the author managed to reveal the core, whether he or she kept to the thesis or properly achieved the purpose of the book. Additionally, the reviewer is to speculate on the topic him or herself.

Generally, the objective of a book review is to communicate the ideas and sensations experienced by the book reviewer to the review reader, while analyzing the content. This involves elaborating to the reader on what the precise meanings of the ideas that the author presumed to convey, or what did the reviewer experienced during the reading. In informing the third party of the events, the book reviewer, then, may be considered as a reporter, who informs the third party of the events; the book reviewer is an analyst, who makes judgments based on their own experience. Thus, developing book reviews requires some special skills, as well as obliges with some precise responsibilities. Not only is a professional obliged to read and scrutinize the text, but he or she must also realize concealed, implied meanings the author hinted about (Wikipedia, 2009). Skilled book reviewers’ explanations make the reader feel this “that is just what I thought” sensation (Wikipedia, 2009). In a book review, the main points of the book being reviewed must be expressed. Then, the
book reviewer has to decide upon the validity of the author's arguments. The reviewer is responsible for judging the work by asking if the writer or author has succeeded in persuading the audience, or if his or her justifications were insufficient and weak. As such, the reviewer here judges the adequacy of the book’s topic in relation to the content.

**The Book Review Assignment to Architecture Students, Queen’s University Belfast**

The assignment given to architecture students on book reviews was part of the course work required for the elective Socio-Behavioral and Cultural Factors in Architecture and Urban Design where eighteen students were enrolled. The delivery of the exercise was undertaken at two steps; the first is book identification and discussion, and the second is conducting the review. The selection of the book was based on students’ interest but constrained by the relation to one or more of the topics covered in the subject matters of the course. Each student selected a book then a class discussion was undertaken to debate the reasons for book selection as a pre-exercise activity.

In conducting the reviews, students were asked to develop their reviews based on strict format for consistency purposes. Students were required to offer the basic information about the book following these headings reviewer/student name; Book title; author(s) / editor(s); edition / print; year of publication; city of publication; publisher; number of pages; ISBN; paperback/Hardback; cover Image: and review text. A number of criteria were given to the students for developing their reviews; these can be exemplified as follows:

**Length:** The length of the review should be in the range of 1200 – 1600 words (references are not included).

**Content:** The review must systematically include the following:

- **Introduction to the subject matter and what is happening in the area that the book addresses.**
- **Context:** For the review to be accessible to as many readers as possible a review needs to contain something about the context in which the book is written. If the book is new, how does it fit into current thinking on the subject? If the book is more than 10 years old, how does it fit into the main stream thinking in the time it was written?
- **Audience:** Who is the intended audience? Does the book address that audience? Does it make clear any pre-requisites there are for reading it?
- **Contribution:** What is the state of knowledge in this subject and how does this book add, change or break new ground in our knowledge of this subject?
- **Discussion:** A discussion of contents (including personal interpretation of the issues and concepts). As well, the discussion would involve: the strengths and weaknesses of the book; comments on author’s style and presentation; Are the contents, index, glossary and bibliography adequate? Whether the author’s aims have been met and presented clearly in the book?
Production: Are there any particular problems with the form of the book? Are there a substantial number of errors (typographical or other) or errors in the technical matter?

Conclusion: Would the book be of interest to colleagues? What is your overall assessment of the book? What are its best and worst features? Would it be recommended to others? Is it worth purchasing or recommending to a library?

A total of eighteen books on person-environment interactions were reviewed and those selected here were the best reviews which were marked based on the criteria given to the students. The selected books are:

- 1960: The Image of the City—Kevin Lynch, reviewed by Jennifer Montgomery
- 1962: The Death and Life of Great American Cities—Jane Jacobs, reviewed by Michael Dowds
- 1973: Defensible Space—Oscar Newman, reviewed by David Montgomery
- 1974: Psychology for Architects—David Canter, reviewed by David Rushe
- 1976: People Space: The Making and Breaking of Human Boundaries—Norman Ashcraft and Albert E. Scheflen, reviewed by Christopher Bell
- 1980: Meaning and Behaviour in the Built Environment—Geoffrey Broadbent, Tomas Llorens, and Richard Blunt (eds.), reviewed by Leanne Courtney
- 1982: Environmental Psychology in Building Design—John Brebner, reviewed by Ryan Ward
- 1997-2000: Architecture and Identity, Responses to Cultural and Technological Change—Chris Abel, reviewed by Lyndsey Magowan
- 2001: The Language of Space—Bryan Lawson, reviewed by Ronan White

The book review assignment is seen as one of the components that contribute to the achievement of learning outcomes of this course that can be exemplified by demonstrating the following:

- Awareness of how people respond to different environmental settings
- Understanding of theories and methods that clarify relationships between people and environments
- Ability to extract implications for planning and design from cultural and behavioral information
- Awareness of outstanding projects awarded for addressing cultural and societal needs

References

The Image of the City
Review by Jennifer Montgomery
The Image of the City
Kevin Lynch
1960
Cambridge, Massachusetts, USA
MIT Press
181 pages
ISBN 13 9 78 0 262 62001 7
Paperback

“What does the city’s form actually mean to the people who live there?” Lynch discusses and analyses the theory of the environmental image, and the effect of an individuals’ perception of the city, in relation to emotional security, orientation and personal growth. He distinguishes the composition of the urban setting into paths, edges, districts, nodes and landmarks, all of which are interrelated with both positive and negative consequences. These visual attributes allow residents to develop ‘mental maps’ of their surroundings, which was materialised on paper through interview processes in Boston, Jersey City and Los Angeles. Examples of these insightful maps, drawings and descriptions are included within the book content. He then proceeds to discuss the city form and the importance of developing clearer environmental images of our surrounding landscapes, “if the environment is visibly organised and sharply identified, then the citizen can inform it with his own meanings and connections. Then it will become a true place, remarkable and unmistakable.”

At the time of publishing, questions were beginning to appear concerning the development of city landscapes and their relevance to cultural and economical conditions. However, this publication, ‘The Image of the City’ served as an innovative text during the context in which it was developed, and remains relevant to current urban design and city planning principles.

Originally aimed at city planners the book should, at the present time, appeal to a wider range of professions; urban designers, architects, planners and the general city dwelling public.

Topics are analysed within this text which, during the 1960’s, were not otherwise discussed, it wasn’t until the 1980’s with the publication of ‘The Architecture of the City’ or ‘People in Cities: The Urban Environment and its Effects’ that similar topics were approached and questioned, analysing the effects of personal experiences and memory on the environmental image and vice versa. However neither of these examples provides a concise explanation to which the city can be understood and observed.

Lynch begins the book with a general discussion and explanation of the environmental image, describing the city as an object which is perceived, and recognising that the image continually changes, or shifts, “On different occasions and for different people, the sequences are reversed, interrupted, abandoned, cut across. It is seen in all lights and all weathers.” An individual creates and bears their own personal image of the city, depending on many factors such as gender, culture, occupation or familiarity. The
importance of a vivid environmental image in personal orientation, which is created and produced through a combination of immediate surrounding sensation and the memory of past experience, is identified throughout the book, “let the mishap of disorientation occur, and the sense of anxiety and even terror that accompanies it reveals to us how closely it is linked to our sense of balance and well-being.” Ultimately the environmental image is analysed by Lynch into three components: identity, structure and meaning.

Three American cities are then studied to gain a first hand understanding of the role of environmental images in urban lives. “Boston is unique in character among American cities, being both vivid in form and full of locational difficulties. Jersey City was chosen for its apparent formlessness, for what seemed, on first observation, to be its extremely low order of imageability. Los Angeles, on the other hand, is a new city, of an utterly different scale, and with a gridiron plan in its central area.” Interestingly Lynch states that there is not one city throughout America that could be considered a great example of urban design. Two basic forms of analysis were carried out within each city – lengthy interviews with a small sample of city residents and systematic field reconnaissance by trained observers. Lynch admits that the samples of city residents may be biased, although “rich in suggestion”, unfortunately forcing the reader to immediately question the content. The methods by which people shape images are intriguing, often recalling spaces and elements through a journey they have completed, confusion and disorientation appear constant, occurring at similar points for different individuals. Throughout these journeys, typically from home to workplace, it is evident that the environmental image nearer the home is clearer, vivid and more detailed, providing more interest and pleasure for the individual, as they approach their workplace this image becomes greyer, more abstract, unclear and conceptual.

Lynch moves on to classify the city into five elements: paths, edges, districts, nodes and landmarks.

Paths “are the channels along which the observer customarily, occasionally, or potentially moves.” Edges “are the linear elements not used or considered as paths by the observer.”

Districts “are the medium-to-large sections of the city, conceived of as having two dimensional extent, which the observer mentally enters “inside of”, and which are recognisable as having some common, identifying character.”

Nodes “are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is travelling.” and;

Landmarks “are another type of point reference, but in this case the observer does not enter within them, they are external.”

Each of the elements converse and respond to one another, forming an interesting pattern within the cityscape, this weaving of components is then utilised to form individual environmental images. The elements do not simply resonate with positive effects; they can also conflict and destroy themselves, ultimately they all operate together, in a context.
When discussing the future of the environmental image, Lynch examines cases outside America, which proves more interesting for a European reader, as the examples become identifiable. The crucial development of stronger images is discussed on an international level, including further examination of the city elements. Including interesting analysis of the ‘edge’, “An edge may be more than simply a dominant barrier if some visual or motion penetration is allowed through it... It becomes a seam rather than a barrier, a line of exchange along which two areas are sewn together.’ Form qualities for future urban design are distinguished: singularity, form simplicity, continuity, dominance, clarity of joint, directional difference, visual scope, motion awareness, time series and names and meanings. All of which should work together in the creation of identity and structure, “Thus a region would be unmistakable which had a simple form, a continuity of building type and use, which was singular in the city, sharply bounded, clearly jointed to a neighbouring region and visually concave.” Here Lynch is prescriptively trying to establish the ideal conditions for the creation of a perfect environmental image, this may not be applicable to the present, however, it is a potentially interesting topic of research during initial design stages.

The principal of this concept is to weave the separate elements of the city together to form a sense of “interconnectedness” at any level or in any direction.

The ideal approach to future design, with the aim of a powerful city image, is then established, considering the problems posed by “discovering and preserving the strong images, solving perpetual difficulties, and, above all, drawing out the structure and identity latent in the confusion.” Lynch states that we need an environment which is “not simply well organised, but poetic and symbolic as well. It should speak of the individuals and their complex society, of their aspirations and their historical tradition, of the natural setting, and of the complicated functions and movements of the city world. But clarity of structure and vividness of identity are first steps to the development of strong symbols. By appearing as a remarkable and well-knit place, the city could provide a ground for clustering and organisation of these meanings and associations.”

Lynch satisfies his original aims, but the process is unfortunately inefficiently arranged, general discussions and examples of mental maps and personal navigation are placed in the appendixes at the end, as opposed to an introduction to the general topic at the start. However, the arrangement of the body of the book is effective, clearly establishing discussion topics within the page margins and following a stimulating order.

Overall, Lynch describes the visual attributes of cities with impressive clarity, arranging the firsthand information in a readable and effective manner. The text facilitates the formation of a creative design perspective at a
city level, useful whether you are submerged in a design project or simply walking around your environment and observing the elements. Whilst progressing through the text the reader begins to apply the concepts and theories to their personal surroundings, pinpointing landmarks, nodes and districts.

Lynch’s approach to the discussion is somewhat romantic, continuously linking observations to individual experiences and memory and examining how this affects personal intensity of life. It is the manner with which he links practical surveillance and theoretical existences that result in a powerful text.

Once the reader progresses past the unusual layout and somewhat dated language the truly human content, which tackles urban design, personal actuality, city composition and individual perceptions, becomes apparent. This then provides motivation for further investigation of the topics covered; perhaps an examination of the extent to which city forms can heighten the observers’ attention and enrich their experiences and existence.

Ultimately I would recommend this book to both my colleagues and anyone with an interest in the subject of creating communities, whether it is read to understand a specific element or for personal interest I feel it will prove useful at some point in their careers, particularly the comprehension of the five city elements which proposes a clear understanding of the city “ingredients”. It will prove equally useful in encouraging the reader to look at their city, town or general surroundings – an education in seeing, which is equally important as the reshaping of what is seen.

**References**


**The Death and Life of Great American Cities**

**Review by Michael Dowds**

The Death and Life of Great American Cities

Jane Jacobs

First Edition

1962

London, United Kingdom

Jonathan Cape Publishers

448 pages

ISBN 9780679600473

Hardback

My attention was first drawn to Jane Jacobs, and her book ‘The Death and Life of Great American Cities’ after reading an essay entitled ‘The Open City’. It was written by Richard Sennett and appeared in the book ‘The Endless City’, produced by the Urban Age Project and first published by Phaidon in 2007. The book looks at the situation of cities around the world (in 2007) and Richard Sennett’s essay looks in particular at what kind of architectural forms might promote the experience of time ... abet social relationships that endure through being given the opportunity to evolve and mutate. Describing his three strategies for doing so, he gives full credit to Jacobs as the philosophical base of his work. The themes Sennett describes are so current and important in contemporary discussions regarding urbanism that I was surprised to find that Jacobs' book ‘The Death
and Life of Great American Cities’ was first published almost four decades ago (1962). I was equally astonished by the correlation between the urban issues faced in 1960’s American cities, and those encountered in today’s ‘globalised’ world.

Reading Jacobs’ book in 2008, it is difficult to fully appreciate its radical nature given the context that it was written in. In the late 1950’s and early 60’s great urban centres were not seen as the desirable places of excitement, opportunity and experience that they are today. Although it has always been a strain in American thought, Jeffersonianesque philosophies regarding society and cities may have been experiencing somewhat of a revival in post World War 2 America. This is particularly interesting considering the emergence of ideas surrounding greater social awareness like FDR’s ‘New Deal’ and Michael Harrington’s 1962 ‘The Other America: Poverty in the United States’. The unprecedented growth of the middle classes and the accompanying consumer boom, combined with a greater sense of social responsibility lead to the rather schizophrenic urban model of suburban sprawl and inner-city renewal. This was the ‘can-do’ baby boom period, the mantra was out with the old, in with the new.

Given the freedom granted by the newly ubiquitous automobile, the aspirant middle classes deserted city neighbourhoods for the space, privacy, security and all-round improved standard of living available in the vast tree lined suburbs. At the same time, inner-city slums would be cleared and replaced with high-quality, high-density and high-rise apartments set amidst civic parkland, giving to those in the lower socio-economic brackets of society the benefits of proximity to nature and abundance of space available to the rich (mostly white) inhabitants of the idealic suburbs. This was at least the thinking, one might say zeitgeist, of the time.

Jacobs dissents from this view and is unrelentingly frank in doing so. She traces the phenomenon of urban renewal back to the works of Ebenezer Howard. Working as an English court reporter in late 19th century London, Howard despised, and rightly so Jacobs admits, the squalid conditions of the city. He envisaged something different, that is the ‘Garden City’. Jacobs scathingly describes it as being based on the English country estate model, except with the manor house replaced by a community centre and work provided by factories hidden behind a screen of trees. She saw this as being not only urban planning, but a model for a paternalistic political and economic social system. Jacobs then goes on to describe how this vision of urbanism links directly to that of the Modernist movement, she cites Le Corbusier’s Plan Voisin as an example par excellence of what she calls the ‘Radiant City’. This is the basis upon which many inner-city urban renewal schemes, what became known as the projects, were created. From Chicago to Boston to Philadelphia and New York City, Jacobs describes examples of slum clearance and their replacement with high-rise, high-density and low footprint apartment blocks set amidst open space. She then proceeds to describe and explain the problems caused by these “socially minded” schemes, problems like crime, social disenfranchisement and perpetual poverty. A paragraph in the book that describes the response a social worker in the East Harlem projects received when she asked why residents
wanted to remove a particularly despised lawn, describes the problem succinctly:

“Nobody cared what we wanted when they built this place. They threw our houses down and pushed us here and pushed our friends somewhere else. We don’t have a place around here to get a cup of coffee or a newspaper even, or borrow fifty cents.”


Jacobs then contrasts this with what she feels to be a well constituted neighbourhood and uses as example her own, Greenwich Village (NYC), The Back-Of-The-Yards (Chicago) and the North-End (Boston). She continues to use these as examples throughout the book. She describes successful neighbourhoods and cities as being those that are untidy, highly complex, surprising, favour walking, biking and public transport and above all are diverse. She describes how a high degree of diversity of people (economic, cultural, ethnic, age, income, etc.) and buildings (size, age, use, etc.) set in an environment that encourages social interaction, is the fundamental basis of city life. That is the chance encounter, the unexpected discovery and innovation, she explains that these things occur in diverse and highly pedestrianised neighbourhoods because of what she called the eyes on the street. That is the passive surveillance afforded to streets that have a great number of users, increasing security and encouraging further visitors to the street. Although the work is highly insightful throughout, this is perhaps one of the two most outstanding contributions.

The other relates to finance and its impact on the city. Jacobs describes how the system of the time, by sorting the elements of society (residential, industrial, age, income and thus de facto ethnicity) combined with a national mortgage lending system, had led to a situation where finance was restricted to a particular ideology rather than ability to repay. In effect, people living in what were considered slum areas by city planners could not get finance to improve their living standards in a piecemeal and ‘organic’ way. Money would only be granted to ‘catastrophic’ projects. That is, slum clearance and radiant city rebuild.

On a more cynical note, Jacobs describes how the politics of finance affect the city. Naturally, always wishing to increase their tax revenue, governing authorities would have a motive for slum displacement. That is, clearing the area and replacing it with land uses (more residential or other) that would garner greater tax reprints. For slums are by their nature money receivers rather than generators.

From this discussion, Jacobs proposes an alternative vision of urban renewal, what she calls “unsluming”. It is not a catastrophic intervention by the state, but more an aid to naturally occurring unsluming processes. Her proposal is sophisticated and involves financing reforms, planning reforms and political will, a brief summary would not do it justice and so I will refrain from trying to give one. I mention political will in particular as the methods she advocates are piecemeal and subtle, as such they would inherently lack the public relations impact of ‘big’ urban regeneration projects. Politicians willing to forego short-term electoral gain for long-term societal gain are few on the ground. Thus, in some ways, it is as ideological as the radiant city or garden city approaches that she so apheres.
I am aware of the significant impact that Jane Jacobs, and this book in particular, has had on urban planning discourse and our understanding of cities. However, the aforementioned is one of several related criticisms that could be made of the book. The criticisms are not necessarily of what is discussed, but of what is not. Jacobs makes the assumption that suburban development is the result of poor urban planning strategies rather than a genuine lifestyle choice. Such an assertion is unscientific, but it would not be inherently flawed had she considered or given acknowledgment to the counter argument and explained why she felt it was wrong. This I felt was a flaw apparent throughout the book, that is assertions were made, then backed-up with selected examples but no consideration of counter arguments or examples that did not fit the trend were given. Supplementary to this, little if any quantitative data was given and there were circumstances where this would have been useful.

That is not to say that the contents of the book were wrong, simply that the arguments could have been framed in a more ‘scientific’ manner. However, the writing style of Jacobs is engaging and witty. Some daming critiques warrant genuine laughter, which is a tall order for a book addressing arguably mundane issues like urban planning. This may go some way to explaining why some of the things that I have identified as problems are present. The contents of the arguments though sophisticated and subtle are wholly accessible. One would not need to have had an education in urban planning or architecture to appreciate and enjoy the main thrust of the book, though some background knowledge, particularly on Le Corbusier and the Modern movement may be helpful.

This is certainly a book I would recommend to my architect colleagues as the matter-of-fact approach to Jacobs’ arguments is a refreshing departure from the more poetic styles that subsequent texts addressing similar issues have taken. Jacobs sets out her stall clearly, concisely and in such a way that the reader can then use her point of view to assess the urban environment around them.

References

Personal Space, The Behavioural Basis of Design
Review by Andrew David Graham
Personal Space, The Behavioural Basis of Design
Robert Sommer
First edition
1969
Englewood Cliffs, New Jersey, USA
Prentice Hall, Inc.
177 pages
Paperback

The investigation of human spatial behaviour and the effect which space, buildings and the arrangement of environment has on the individual is still a very important topic in today’s society. Much discussion has occurred recently regarding social interaction in the world of virtual reality and multi player game simulations.
As recently as August 2008 a complete issue of ‘Space and Culture’ was devoted to the investigation of interaction in the virtual world. Also, within architecture, many points argued by Sommer have still not been applied by the majority and only the few consider the effects of the environment on the behaviour of the individual in the design process. This book, although written in 1969 when the study of how design affects behaviour was just beginning to emerge, is still as relevant to all who would seek to create space where social interaction, whether virtual or physical, takes place. This is highlighted in the fact that the book has been republished this year by Bosko Books with an updated introduction to address the current situation within environmental design.

The book itself is considered as one of the key texts on user centred design in regards to the built environment and since its original publication, it has stimulated a lot of research into interpersonal and social interaction in various spaces and configurations.

Sommer’s investigation into human special behaviour began when working at a mental hospital in Canada. The hospital had a catalogue of design defects including poor lighting, long corridors and poor ventilation. In an effort to improve the quality of the environment, Sommer endeavoured to investigate the relationship between architecture and behaviour in hospital environments but found a lack of information available on the subject.

“It is interesting to know that more is known about animal than about human special behaviour.” Sommer began to investigate human spatial behaviour of how patients interacted with each other under the current conditions in the hospital. The nature of his research was ground breaking at the time as much of the research up to that point in social psychological theory, took place in controlled labs, overlooking the physical conditions under which interaction takes place. The findings were published in Sociometry in 1959 and this new avenue of investigation opened up the subject of social psychology to other fields such as architecture, interior design etc. This research work culminated in the writing of the book which is the subject of this book review; Personal Space, The behavioural basis of design.

The book itself is divided into two parts. The first section lays the foundation to the book, where Sommer explains the various theories of environmental design, how users interact in space and with each other. The theories are interwoven with statistics and research which do not overwhelm the reader, but add weight and authenticity. Sommer covers topics such as privacy, territoriality, and personal space, how each relate to each other and how they become manifest in the physical environment through user behaviour.

Sommer calls on the writings and knowledge of many anthropologists, such as Edward T. Hall, and sociologists, such as Erving Goffmann, to help explain the various points he raises in these chapters. Sommer makes use of much research, not only from his own personal investigation, but from various other sources.

The second half of the book explores various man made “environmental systems” including schools, prisons and student accommodation. In many ways, I am of the opinion that the
The author stops short, as he does not offer specific design solutions for each example. Perhaps this is due to the nature of my education as an architecture student, where one always wants facts, statistics, the door width, the required thickness of the wall, the ideal dimensions of the table and the optimum colour palate. The author rebukes this method of thinking and has made a conscientious decision to stay clear of creating rigid “formulated detailed laws” as each building should be a separate case study as each geographical, social and cultural setting will have different outcomes and different user requirements. Instead of a long list of best practices and data banks the author liberates the designer by equipping the reader with the tools and the means by which one can “objectively and validly” obtain data through research specific to each individual design.

The author has made this book very accessible to all by not overcomplicating the book with extensive statistics and he has also employed an accessible language which can be easily understood. The author claims that the book is not intended exclusively for architects, designers or city planners, although many of the chapters are “aimed in their direction”. Sommer implies in his writing that the book is for all who help shape our buildings, social spaces and private space whether that be the janitor, the nurse on night duty, the patient or the architect. The book is certainly not aimed exclusively at experts in the field of environmental psychology, but instead is aimed at those on the periphery of the subject in an effort to engage and help the reader consider the user requirements and the effect of spatial design on the individual.

“Knowledge about man’s immediate environment, the hollows within his shelters that he calls offices, classrooms, corridors and hospital ward is as important as knowledge about outer space and under sea life. For too long we have accepted physical forms and administrative arrangements based upon outdated views of human activity.”

In our profession, there is still a great need to abandon the presupposition of what each building type requires. Much of the design work is undertaken without the consideration of how people actually engage with the space, and how the space affects the individual. All too often our designs are based on our opinions and our preconceptions. We place ourselves in the place of the end user and design based on our values, our goals, our ideals and do not consider the vast range of users, which will inhabit and interact in the space. There is a need to remove ourselves, our opinions and our utopias from the design equation and instead factor in the requirements and the needs of the end users.

“Frank Lloyd Wright put forth the doctrine that form follows function, which became a useful antidote to needless ornamentation. Yet it is curious that most of the concern with functionalism has been focused upon form rather than function. It is as if the structure itself-harmony with the site, the integrity of the materials, the cohesiveness f the separate units, has become the function. Relatively little emphasis is placed on the activities taking place within the structure.”

Sommer goes on to argue that we so often analyse buildings based on a glossy print, void of any human life or reference. The idea that
we create three dimensional sculpture in order for it to be catalogued, marvelled and admired through a two dimensional media is absurd. The success of our architecture cannot be measured solely by its aesthetic appeal. The flavour of the month architecture will change, but whether a building will endure depends on how it engages with the end user and the quality of the environment that it creates. For the sake of our profession and the sake of our society we must engage in research of user requirements, we must research how the buildings we design affect the building occupants. We must learn from our mistakes and the errors of others in order to ensure that we produce the best design solutions. Considering how users react with the environment, not as a series of individual items, such as desks or chairs, but as an ecosystem, as a whole.

One may become slightly disillusioned when reading this book at various points. The author continually refers to how people interact with space and objects within space, how users prefer a certain chair for example, or a certain place at a table, a certain size of desk. However the point is continually made that users will adapt to their situations, they will grow accustomed and will often not question the environments in which they are placed. One example is of how patients will adapt to a new spatial arrangement within a hospital lounge, or how students will use their bed as a study space if the provided desk is inadequate. One wonders from time to time in the book if the author is voiding his own argument. All these fears are expelled however in the final paragraph in the closing words of the book which serve as a rallying cry to designers everywhere to consider the social and psychological impact of the spaces we create.

“Good design becomes a meaningless tautology if we consider that man will be reshaped to fit whatever environment he creates. The long range question is not so much what sort of environment we want, but what sort of man we want.”

Design shapes people not just buildings; it shapes the atmosphere in which we live; it shapes who we are and who we become. As architects we do not just build structures or spaces. We create the fabric on which life is lived, the fabric on which people interact and socialise. We must strive to undertake more research on an individual design basis, to insure that individual needs of the user and goals of society are met. As a profession we must design holistically and not only consider the physical requirements, but also the physiological impact of the spaces and spatial arrangements we create.

In my opinion this book is very useful as an introduction to the subject of personal space, environmental psychology and the behavioural basis of design. The author engages the reader in a very interesting and valuable subject and communicates in such a way that the subject can be easily understood. The book is well structured and contains a helpful index and detailed footnotes. I would recommend this book to anyone involved in design of spaces and to anyone who has a general interest in anthropology.

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Defensible Space
Review by David Montgomery
Defensible Space
Oscar Newman
2nd edition
1973
London, United Kingdom
Architectural Press
264 pages
ISBN: 0 85139 136 2
Hardback

Defensible space broadly examines how human perception of the built environment can affect one’s behaviour. The book attacks current ideas and methods at the time of urban and residential design, focusing on exploring a link between how the breakdown of reading and practicing of instinctual social and cultural symbols, such as thresholds and defined spaces absent in much modernist architecture, can increase crime rates and social malaise in residential areas.

The book was written at a time when there was an emergence of opposition towards the mainstream thinking throughout the 1950s and 60s of modernist planners such as Robert Moses, Head of New York City Planning in the mid 20th Century, who favoured such policies as urban renewal. Governments across the world that had implemented en masse urban renewal programs containing high rise residential schemes were realising the problematic consequences associated with them. The infamous scheme at Pruitt-Igoe in St Louis, when demolished in 1972 due to the local authority’s inability to control crime and anti social behaviour was heralded as the death of modernism. Urban theorists and writers such as Elizabeth Wood and Jane Jacobs argued the social problems caused by such radical changes to a cities urban makeup and were focusing on ideas of maintaining neighbourhoods, intimacy of communities and increasing diversity of use and smallness of scale. Newman’s Defensible Space builds on the ideas of Jacobs in her book The Death and Life of Great American Cities using statistical data to examine a correlation between poor physical design in new residential projects and crime rates within the area they are situated.

Defensible Space is aimed at a broad audience. While initially intended for housing developers, architects, city authorities and the police the manuscript was rewritten as the author wanted to appeal to a wider readership such as residents and associations wishing to implement defensible space schemes in their neighbourhoods. The book encompasses a wide range of subjects such as architecture, law, psychology and sociology as well as theoretical and technical concepts. However Newman has made much effort to describe issues in a thorough and balanced manner which not only facilitates the general reader but avoids over generalizing in areas of social class or ethnic background which is an attractive option to many to explain increases in crime rates.
When it was first published, the state of knowledge in the areas of crime prevention through urban design and in architectural psychology in general was quite small. However it was not completely alien. W. Russell Ellis states the book “met a felt need among some architects and law enforcement... has been gloriously reviewed in the New York Times and Wall Street Journal. Since the 1970s much work has been published in the area of architectural and environmental psychology. However Newman’s work, focusing on crime prevention through physical design, can be considered as the first major comprehensive study in this area of environmental psychology that uses statistical data to back up his own theories and contribute to theorists before him. The work also contributed to the creation of a new sub discipline in criminology that has come to be called Crime Prevention through Environmental Design. Indeed his work is held in such high regard that it is contributing to public policy in the United States. The US Department of Housing and Urban Design (HUD) along with Newman produced a Casebook in 1996 of projects using defensible space as an example for planners and architects. Even today Defensible Space is impacting Architectural Education as Byron Mikellides states that Defensible Space is the “most referenced book by UK Architecture Students studying this field” . The book also contributed to the work of Alice Coleman in her Book Utopia on Trial. However Coleman created a lot of controversy and apparently failed to understand the full concept of Defensible Space. Mikellides quotes Newman himself as saying “Utopia on Trial does not pay sufficient attention to social factors interacting with the physical as causes of housing dysfunction” Newman makes a strong argument for his concept of defensible space early in the book making it clear to his audience what it is. He identifies clearly the problems with the current methods of urban planning and residential design; the anonymity of the city and the destruction of community and the affect this has on increasing crime rates before explaining how defensible space works through a number of mechanisms to exploit the physical design of the built environment in such a way as to empower residents, increase their sense of territoriality, provide opportunities for surveillance and create pride in their community. Newman stresses the importance of community action throughout the book as the most important aspect of defensible space as he states “When people begin to protect themselves as individuals and not as a community the battle against crime is effectively lost”.

While these views have been seen since by some as narrow minded in approach, a threat to personal privacy and individual autonomy and the creation of gated communities within a modern city context, Newman does not come across this way in his style of writing and tone nor does he propose such ideas. The confusion over his work can be seen as a criticism of targeting it to too wide an audience who may not fully understand the concepts he is proposing. He links his ideas to basic human psychological concepts of influencing space through subtle measures of reading thresholds, determining feelings of public and private space and quality of design. Such measures can be seen in precedent typologies such as the terraced house. These practices, if operated through the physical design of the built environment
from an individual level, to a community level allows individuals to come together to increase a sense of territoriality and provide natural surveillance. It offers a way for the community to effectively police itself passively and in fact is not threatening to personal privacy but actually upholds it.

For thousands of years' defence influenced decisions on orientation and arrangement of buildings among small communities of people willing to deter intruders. Grouping buildings together or locating beside a river or on a hill are all collective decisions to create a defensible space. This need to feel safe is instinctual and is as valid today as it was in the past.

The author is able to compare real residential projects in order to support his claims referring to clear graphical material such as photographs, plans, sections and sketches throughout the book which complements the in depth and balanced discussion of the subject.

His attack on high rise residential towers and preference for three storey walk up apartments seems very justified given the crime statistics for both types. However he is able to link these back to social issues regarding anonymity, territoriality and surveillance which are influenced by the physical design of the buildings. He does not lose sight of his initial arguments and keeps clarity of vision.

The author shows a very open minded approach in touching on broader social and political issues related to crime and housing, and unlike Coleman, realises that the physical design of the urban environment is not the sole contributor. He makes the point that decision making is limited to vulnerable members of our society namely the poor as government agencies decide the design of their residential projects.

A large variety of statistical data is referred to at various intervals throughout the text and the author goes to great lengths in explaining and interpreting it. There is poor graphical representation of statistics and typographical errors that make referring to it confusing, but there is a very comprehensive methodology within the appendix of the book which could be used as a basis for conducting similar research into this subject area.

While the author was able to support his theories in general throughout the book using statistical data there are some discrepancies in his discussion of modifying existing environments to make them more defensible. The author was able to provide practical examples of areas in need of modification but no results from the modifications themselves making the exercise quite irrelevant to the reader.

I think however that the author was able to meet his aims in providing statistical information regarding how the physical design of the built environment affects social issues of territoriality, natural surveillance, civic pride and the effects this has on crime rates and social malaise. Thus he justifies a need for defensible space practice within architecture and urban design. A summary and series of recommendations are provided at the end which could be used as series of design principles for planners and architects interested in this area.

Overall this book is excellent in that it provides a strong theoretical basis of information for referral
and a thorough methodology for carrying out statistical analysis into the issues of urban design and crime. This book would be of use to students of architecture as an introduction to the concepts of defensible space and defensible space practice. It could be referred to during similar studies of the urban environment and its influence on crime in a thesis project. However it also serves in discussing and providing examples into basic designs of threshold and public and private spaces which could be employed in studio projects. I would also recommend this book to others interested in the more general field of environmental psychology and think it is worth while purchasing or having in university libraries.

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Psychology for Architects
Review by David Rushe
Psychology for Architects
David Canter
Series Editor: Henry J. Cowan
First edition
1974
Essex, United Kingdom
Applied Science Publishers Ltd
165 pages
ISBN: 0 85334 590 2
Hardback

The book that I have chosen to look at for the book review is Psychology for Architects, which was written by Professor David Canter, then of the University of Surrey England.

The book, published in 1974, and from the outset Canter states that this book is not “a detailed account of the research which psychologists have undertaken in order to assist design”, the book attempts to inform the reader about human beings’ interaction with the environment and the effects on architecture and comes to comprehend the behavioural and mental processes of human beings and their interrelation with architectural approaches. This is achieved by the use of examples of wide-ranging psychological processes such as Gestalt’s Pragnanz (Figure Ground) Theory, Steven’s Power Law to Machiavellian musings. The book aims at introducing the reader to a number of areas, but in a manner that is accessible and that can be easily understood for the casual reader.

Professor Canter developed environmental psychology, and set up the Journal of Environmental Psychology, which he still edits. The Theory of Place, which he developed in the 1970’s, has become one of the underlying themes of research in this area. He is currently working in the School of Psychology at the University of Liverpool.

The book, written in the 1970’s, is an attempt to correlate the basic elements intrinsic to psychology and how they can inform architect’s decision in building and place design. The discipline of “environmental psychology started in the 1960s when problems and options of humanity’s future had gained importance due
to increasing industrialisation”. The division of the individual in relation to the built environment had changed, Canter displays this widening gap by looking at an office block and shows how the view of the built object differs greatly from the finance group financing the project and “whose concern will be the economic viability of the project” the development company who are “more concerned with the ease of letting offices” and at the bottom of the pile is the group referred to as ‘the building users.’

The change in societal values and quality of life, along with the rapid industrialisation and capitalistic attitude amongst some towards the built environment and its injuriousness to the user, were issues that many involved in the emergence of environmental psychology such as Robert Sommer (Professor of Psychology Emeritus at the University of California, Davis author of Personal Space: The Behavioral Basis of Design 1969) Leanne Rivlin (Originator of the Environmental Psychology Doctoral Program, CUNY Graduate Center author of Environmental Psychology: Man and His Physical Setting 1970) and Professor Canter to name but a few.

Professor Canter states from the offset that “this is not a textbook”, it is instead a book which might be read in conjunction with a textbook. His aim for the book is to communicate the basic principles of psychological concepts to help inform design decisions. Canter attempts not to “take an unfair advantage of the ignorance” of his intended readers – lay-people, by choosing “material without the help of a generally accepted viewpoint to assist with this selection.” Instead he wishes the book to have a general and open-ended approach that will allow the reader “to consider the issues for themselves and try to discover other viewpoints.” Ultimately, Professor Canter is aiming his book at everyone from the trained psychologist to the architect and most notably, the layman by counteracting “using specific terminology (some would say, jargon) without being fully prepared to explain its meaning to the layman.”

The format of the book is broken into ten chapters covering different topics, with each chapter acting as an introduction to the main thinking behind psychological theories and what Canter does in each chapter is to draw a parallel between these and architecture.

Canter first discusses the topic of research and how through research, one can develop a catalogue of information from which one can reference. “The strength of science lies in the fact results are built upon one another” and that just like the architect has a number of design aspirations he wishes to investigate, a “research worker has a number of assumptions which he is trying to test”. From here Carter explains the ideas of reliability and validity and how the “methods for controlling the variables” are important in conducting research, with issues such as age, sex and skill sets are paramount. Canter believes that architects must have some understanding of psychology so that their interests in design concepts can “influence the course of psychological research”.

Canter then introduces the reader to the area of perceptual judgements and how they relate to context effects. Within this frame, Canter introduces the issues of one’s perception on a given context that can differ “according to the social situation we see them”. The main area incorporated into the theme if contextual
effects is that of sensations, as in directly relating to one of our five senses.

If one is to conduct an investigation into this realm, one must be aware that “these descriptions can be shown to be inaccurate because no sense organ could be influenced by a group of people.”

He looks at the importance of Gestalt’s Pragnanz (Figure Ground) theory and how seeing objects in terms of figures on a ground as “an important contribution to our understanding of perception.” The importance of Gestalt helps the reader grasp the concept of perception and how this can be informed in other aspects, such as perception of scale, space and even attention play “an important role in perception and needs to be taken into account of when considering the design of actual environments.”

The uniqueness of perceptual judgements is that its reference to context and what is familiar to the user it can help inform an architectural language that is based on precedent, “rules, often of proportions, in perception which determine what form or combination of forms will be beautiful.”

In Chapter 4, Canter looks at the role of learning in the role of psychology and architecture. He deals with this in the main, by dealing with the cognitive map topic. In doing this, he mentions the “place learners led by Tolman and the response learners by Hull.” Canter speaks of the ability of a user to draw a “mental map” to locate certain disciplines, regardless of the circumstances, much like the rat.

Developing this theory of learning, Canter delves into the areas of schedules of reinforcement, transfer of training and experience and how these can help create a cognitive map for the inhabitant of the building. The use of visual cues to trigger a familiarity with the built environment, Canter believes, can encourage healthy use and understanding of a building for the users. Canter does “not mean that architects should only produce buildings similar to those which already exist”, instead use precedent, context and what is familiar to help inform the language of the proposed design.

Canter speaks mostly on children’s development in this chapter and of the role of development next, and how “almost all aspects of behaviour can be shown to relate to age”. Canter speaks of the role of the environment in creating an upstanding new generation that can integrate into society to maintain order, he highlights that “some aspects of behaviour are learned and that they develop through the interaction with the environment.”

Formal operations, as Canter quips, are directly related to aspects of Jean Piaget’s Adaption, whereby “the person assimilates aspects of the environment... or accommodates those structures in order to incorporate some novel aspect of the surroundings.”

In looking further at the idea of development, Canter points out that sensori-motor intelligence is intrinsic to perceptual development and how one can understand and use an environment. Canter points out that architects must consider the user’s needs, even at different ages to further help their development as they are likely to demand different things at different stages of their development.
In Chapter 6, we are introduced to the area of underlying dimensions, and how through questionnaire analysis, albeit through a points marking system or textual preference means, we can deduce the success or failure of an environment that can then inform how we can improve in the future.

This form of investigation is very efficient, however as Canter points out, “one problem which arises... when applying it in architecture... to deal with when buildings other than private homes are to be considered.” It results in the designer having to make “some generalisations that at least refer to groups of users if not to the whole population of users.” However that said, the use of underlying dimensions by means of factor analysis, can help construct an understanding of the environment via user feedback and allow for a greater understanding of said environment.

What is important about the opening of Chapter 7 is that Canter points out “one of the strongest arguments which laymen feel they can bring to bear against the possibility of a scientific psychology is that everyone is different.”

The area is one that cannot really be pinned down, no formula to cater for all can be written, instead Carter speaks of the users differences in the form of age, sex and class—field dependence (“an individual’s ability to distinguish stimuli from the context in which they are presented”), cognitive complexity, extraversion and neuroticism and creativity and intelligence.

While this subject is somewhat broad, Carter points out that the architect “can then consider a broad range of potential users and behaviours in his building and not make the common assumption that most people are similar to himself.” The use of space is where Canter takes us next, and here he speaks of territorial behaviour and how “these social mechanisms usually take the form of defence of specific areas or territory.” He looks at the location of space, and how something like the location of a bench or structural column, can determine “relationships people take up in respect to other people.” This then feeds into the area of interpersonal distance, and how “if eye contact and head movement do influence interaction it might be expected that the angle of the two people from one another was important.”

Canter concludes that these individual elements relate to human territoriality and as such, when added up, are innocent in small behavioural contexts. However he does point out that “beyond these interpersonal distances is much more problematic.”

In Chapter 9, Canter talks about the organisation and defines it to be “whenever two or more people need to work together in order to achieve some common goal then we have an organisation.”

He looks at the various level of organisation, from two people to a large group where one person delegates, to a situation where larger groups come together and share knowledge and information in multi-disciplinary work. “It is thus apparent that it is difficult to study organisations without considering communication”. He says that adaptability, stability and identifiability are all key ingredients for a building to survive, but the most important aspect of this is satisfaction.
of workers.

The satisfaction of workers includes many aspects from self-fulfilment to financial reward and to the overall role within the organisation. It is important to acknowledge these fields as “the structure of communications within the organisation and the satisfaction of the members which motivates them to continue to be members” and see the long-term success of the organisation.

Canter concludes overall by making two standout relevant statements, he concludes that “psychology could have a profound influences both for the form of our buildings and for the way of life which they delineate.”

Having read the book, I found that it does give me an insight to the role of psychology within the built environment, and the references he makes to architecture at the end of each chapter maintain that thematic link. Since reading the book, I feel that I now have a good platform to start from should I wish to further my knowledge on the subject of environmental psychology. Canter makes many references to the work and theories of others, Bromley, Mowrer, Hull, Gestalt, and Altman to name a few. The book provides an excellent appendix at the back of the book, with all references documented with author and book titles allowing the reader to seek out knowledge from highly regarded sources. The effort on Canter’s part to remove the ‘jargon’ from psychology worked as the book’s content is accessible, however there were some occasions where I felt that I did need to take Canter’s advice and read this “in conjunction with a textbook.” Overall, I would recommend this book to a fellow student of architecture interested in getting a basic knowledge of the subject. I would also recommend it to the lay-person for a highly topical conversation piece at a dinner evening. “This is as it should be. Buildings are for people. People build them, use them, administer them and pass them by.”

People Space: The Making and Breaking of Human Boundaries
Review by Christopher Bell
People Space : The Making and Breaking of Human Boundaries
Norman Ashcraft and Albert E. Scheffen
First Edition
1976
New York, USA
Anchor Press
185 Pages
ISBN: 0-385-11229-7
Paperback

This book explores the concepts of human behaviour in space, with particular focus on how behaviour and cultural backgrounds and attitudes impact the use of space and the results of these impacts. The text investigates subjects, such as territories, privacy and crowding, that are important phenomena within the field of environmental psychology. Environmental psychology can be defined as “the science that deals with the psychological study of human behavior as it relates to the everyday physical environment.” (Salama, 2009)

The book, written in 1976, builds upon the authors’ collaborative research starting in 1970. Collaborative research between the fields of psychology, sociology, and anthropology were common at this time as identified by Stokols
when he states, “the 1970’s were a time in which researchers from several different fields came together to forge new theoretical and methodological approaches to the study of environment and behaviour” (Stokols, 1995). The book deals specifically with phenomena, considered as behavioural activities, which can be positioned within the field of environmental psychology. Environmental psychology had emerged recently to the publication of this book, focusing attention on human behaviour and environment. “Proshansky, Ittelson, and Rivlin (1970) presented the emerging field of environmental psychology in their first published volume, titled Environmental Psychology: Man and His Physical Setting” (Bonnes, Bonaiuto, 2002).

This book was written during a period of significant research in the field of environmental psychology as, “hundreds of experimental studies on topics such as crowding, personal space, territoriality, environmental cognition, and environmental stress were conducted during the 1970’s,” (Stokols, 1995) and whilst aligning itself with the mainstream thinking at the time, it also gives rise to considerations of the implications of behaviour in terms of repercussions, such as violence and urban crowding. How such implications can be addressed through the design of the built environment has been a central focus in the continuing development of environmental psychology.

No pre-requisites for reading the text have been identified. The content of the text, i.e. the exploration of personal space and social interaction based on specific research, suggests those closely associated with environmental psychology to be the intended audience. In contrast to this, the style of the text, i.e. the method in which the research has been communicated, suggests a much wider scope for the intended audience, encouraging transdisciplinary consideration of the information.

Positioning the text within current knowledge of the subject leads to a view of this text as basic in nature, almost stating observations about the selected elements of human behaviour. Such concepts are long established and knowledge in this subject area has greatly advanced since this book was written. However, positioning the text within its context gives rise to the significance of the content. Although the phenomena explored in the text had been identified and discussed prior to this book being published, as indicated by the authors’ references to other research material, this text considers these phenomena in an alternative way, emphasising the links between human culture and behaviour and the built environment.

A strong awareness of the research methodology is evident and openly discussed on a number of occasions, with the authors noting the importance of objective observation along with questionnaires and interviews. In the context of the research being carried out during the 1970’s and the emergence of new research methodologies, this reinforces the conclusions in the text by defining its scope and identifying its limitations.

The authors state in the preface that “the present collaboration is not just another effort to summarize research findings, as important as that may be” (Ashcraft, Schefflen, 1976) and it is interesting to consider this in relation to the volume of similar research studies at this time.
The use of pertinent examples to elaborate on the research and observations of the authors makes the text accessible and communicates the application of the research in a descriptive manner, permitting a degree of reader interpretation but more importantly stimulating thought regarding further application. This style, combined with clearly defined and relevant contents, index, notes and bibliography provides a rich source of information on the subject.

The aim of the book is to explore “how people use space in various contexts, how this use is repeated and replicated at various points of interaction, whether in an open public space or in the confines of one’s home, and how this use is repeated and replicated from the level of the typical conversational settings to the layouts of rooms, houses, neighbourhoods and cities” (Ashcraft, Schefflen, 1976).

This aim has been met through a systematic consideration of the various elements identified by the authors’. The book has been divided into two sections, the first relating to using space and the second relating to repercussions. Within this framework the authors’ identify and draw conclusions from their research as to how people use space and, through specific case studies and examples, clearly link these to the situations of rooms, houses, neighbourhoods and cities.

A strong awareness of the research methodology is evident and openly discussed on a number of occasions, with the authors noting the importance of objective observation along with questionnaires and interviews. In the context of the research being carried out during the 1970’s and the emergence of new research methodologies. This reinforces the conclusions in the text by defining its scope and identifying its limitations. The authors’ suggestion that “in fact, walls and other built structures are extensions of the much older rules of human interaction,” aligns itself with Robert Bechtel’s later statement, “there is no such thing as the design of space, only behaviour is enclosed by architecture.” This is a central theme in the authors’ approach to the subject matter, as they discuss and explore, firstly the elements of human behaviour and then its consequent impact on spaces.

A further important and clearly developed consideration is that of how measurements affect culture, identifying the underlying measurement principles that define our perceptions of spaces. This consideration links through to a rather interesting discussion arising in appendix B of the comprehensive notes on the text, which is particularly relevant to architects. The authors query the suitability of placing units of measurement on human behavioural activities, noting the numerous variations of uses in relation to culture and behaviour. This discussion reflects the peremptory nature of the text, as it underpins some key phenomena of environmental psychology while, at the same time, prompting further investigation and consideration of these elements as they relate to design.

The simple design and graphic layout of the book is well suited to the content, providing a clear structure to the text and illustrations. The text contains very few typographical errors and errors in the technical matter are not evident.

This book provides a clearly structured consideration of how people use space, forming
an introductory basis for the ongoing research in the field of environmental psychology. Although the content is not entirely contextually relevant, I would suggest that it would be of interest to my colleagues in the field of architecture. The subject matter is one that has an ongoing influence on architects as they consider the design of spaces for human occupancy. The use of examples, especially of the situation of the family on the beach, which is referred to in a number of the topics, describing ‘real life’ situations, makes the findings and conclusions more tangible and more readily applicable to the reader. I would recommend this book to others as a basic exploration of the human use of space, which concludes and illustrates some of the core concepts of behavioural factors in design. This is a text which is not worth purchasing but that should be available in a library catalogue.

References


Architecture for People: Explorations in a New Humane Environment. Review by Matthew Stewart

Architecture for People: Explorations in a New Humane Environment.
Byron Mikellides, Editor
Contributors
1980
London, United Kingdom
Studio Vista
192 pages
ISBN 0 289 70865 6
Hardback

Often criticized for their lack of responsibility to context, social factors and the way we live in buildings, architects have a responsibility to the people who use their buildings. The built environment is not just a backdrop to life and human activities but influence how we behave and live in our environments. As designers we need to be aware of the social consequences of what is built and realise the need to understand ‘humane individuals’ as well as how human behaviour relates to everyday built form.

The necessity of designers to understand human behaviour and human needs in buildings birthed the study of architectural psychology or alternatively environmental psychology or environmental perception. Mainstream psychology or sociology was considered to be uninspiring or irrelevant to the practice of
architecture and so in March 1969 in the House of Black Dell at Dalandui in Scotland the first conference of Architectural Psychology was held and the presentations were published by the RIBA and edited by David Canter in 1974. Research has grown rapidly seeking to understand human behaviour in relation to the built environment and how to better design with people in mind to make happier and healthier places for people to live in.

‘Architecture for People’ was first published in January 1980. The study of Architectural Psychology was approaching its 10th year of research; this book may be considered young in relation to current research. The book was compiled at a period when modern architecture had been strongly criticized for its lack of response to human need. Carl-Axel wrote “technical-economic and solely functional aspects have been allowed to dominate.” The book is a timely response to the character of architecture at the time when designers committed themselves to functionalism with new materials and cost effective solutions which resulted in many modern buildings proving impossible to use effectively. Architecture was failing to respond to human need and to provide comfortable pleasant environments. This was particularly significant at the time and was one of the first books to raise concern and awareness for the need to understand human behaviour for the practice of architecture. The book follows a period which witnessed a move towards an understanding of social psychology and personal space with such notable and influential titles as ‘The Psychology of Interpersonal behaviour’ by Michael Argyle published in 1967, ‘Behaviour in Public Places’ by Ervin Goffman published 1963 and ‘The Image of the City’ by Kevin Lynch published in 1960. The book sits comfortably in an area of specialised knowledge in architectural psychology which began in the 1970’s with notable titles as ‘Psychology for Architects’ by David Canter published 1974 and ‘Perception of the Visual Environment’ by Neil Prak’s published 1977. Architecture for People is one of the first books to take social psychology into the field of architectural Psychology.

‘Architecture for People’ has an intended audience of all people practicing or studying in the discipline of architecture. The book is directed towards architects and constantly challenges the designer’s preconceived ideas of suitability and quality of design for users. The book is intended to promote self evaluation in the way we respond to human needs and encourage designers to ask if their buildings are suited to users’ needs as well as they think they are. The book would also be an important part of architectural education and particularly relevant to students studying how to design and seeking to develop a person philosophy and an increased awareness of responsibility to the humane environment.

The contribution of ‘Architecture for People’ was considered pioneering early in the subject of architectural psychology. The book is edited by Byron Mikellides, Senior lecturer in Environmental and Social Psychology at Oxford Brooks University. Mikellides was one of the pioneer researchers of the new discipline of architecture psychology since 1968. He has lectured extensively in Europe and the United States and still publishes on this area of research today. Mikellides book ‘Architecture for People’ along with another highly regarded book ‘Colour
of Architecture’ have greatly contributed to the subject of architectural psychology and are still referred to in research papers published today.

The book was constructed by Byron Mikellides by inviting different authors and researchers from around the world, each a specialist in various areas including architectural psychology, biology and aesthetics as well as the practice of architecture. Each considered leaders in their area of architectural thought bring an international perspective on the subject. A balance is struck between chapters of theory and practical experience but each read as an individual essay contribute to the wider vision of this book.

The book begins with a critical tone of current architectural design thinking and sets a pace of optimism for the topic which when fully explored will endeavour to improve the quality of design in our build environment. As Mikellides establishes this challenge suggesting “we could do better than we have been doing so far in making our homes, our cities, our biosphere worthy of man in all his biological, social and cultural peculiarities.”

From the outset the book questions the way designers draw assumptions on various aspects of human design requirements and psychology decisions made on the behalf of the users. Through a playful technique of presenting 10 statements and obvious conclusions on factors affecting the user behaviour the reader is lead into a false confidence in their ability to make architectural psychological conclusions. The 10 statements are again presented along with researched conclusions and largely contrasts the original assumptions confirmed by the reader. This clever introduction reveals the importance of architectural psychology to the reader and promotes the self evaluation by humbling the reader to acknowledge the necessity of understanding the reality of behaviour rather than unsupported conclusions.

Considering the context of when this book was written, author Bruce Allsop continues to set the tone by condemning the social utilitarianism and functionalism of the 1950’s architecture quoting “its seems that socialism without art, when applied to buildings does not satisfy basic needs.” This move towards a more poetic architecture that considers human needs at an emotional and sensual level however is not left unanswered. Nicholar K. Humphrey a prominent young scientist from the Department of Animal Behaviour, University of Cambridge offers scientific observations to be drawn from the stimulation and enjoyment of the natural environment and how the brain forms the foundation for aesthetic perception. From a different perspective the emotion of ‘pleasantness’ is addressed from urban aesthetics where rhythm, patterns and balance and harmony present a theoretical model to understand how these urban environment characteristics stimulate the brain and its ability to respond emotionally.

I am very much encouraged by the idea this book promotes, the poetic side of architecture as art and pays homage to emotional stimulus while maturely acknowledges the conflict architects face between art and life. Robert Maguire observes the problem that architects face between choosing the values of art as the architect or the values of the user when compromise has to be met. We do well to be
reminded by Rikard Kuller that “a sensitive and thoughtful treatment of sensory characteristics is an important ingredient for the user of architecture, who not only sees the front of a building as an illustration but literally enters into it, takes possession of and lives behind it.” I commend this statement supporting the view to look beyond the image of architecture and consider the quality of the environment and how it betters the experience for the user.

The book’s fundamental tenet of considering architecture and the users highlights the importance of this topic in architectural education. “Most of our architectural schools are geared towards turning out the occasional genius—the future master of the new style—the next generation of tastemaker. His competence in addressing his client’s needs is given secondary importance.”

The book promotes the study of this field for architecture students and I would further agree that it benefits education and has become an important part of architectural curriculums to the present day. However the book offers a token of encouragement through Walter Segal, “There is in Britain a wealth of talent and vital energy which if properly tapped can produce astonishing results from its people.” It suggests architectural psychology key to releasing this talent in architecture.

As the book tries to cover many different topics and perhaps seeks to cover too much in the mere collection of essays, the chapters are interesting when read individually but many of the issues are overlapped by authors due to the nature of the editorial script. Some essays meander from the topic of architectural psychology and don’t greatly contribute to the understanding if the overall text.

I would recommend this book to my student colleagues but perhaps to be read in conjunction with other titles in line with the most recent research on the topic of architectural psychology. However Byron Mikellides seeks to raise awareness of the importance of architectural psychology and to encourage self evaluation about considering user needs as well as own agenda in creating a piece of art. The book is successful in emphasising the importance of improving the quality of the humane environment though understanding architectural psychology.

References


Meaning and Behaviour in the Built Environment
Review by Leanne Courtney
Meaning and Behaviour in the Built Environment
Editors: Geoffrey Broadbent, Tomas Llorens, and Richard Blunt
First edition
1980
Bath, Avon, United Kingdom
The Pitman Press
372 pages
ISBN: 0 471 27708 8
Hardback
The subject matter studied by Broadbent et al (1980) is that of Meaning & Behaviour in the Built Environment. This book is one of two devoted to this study. The study of meaning as Broadbent et al (1980) state relates to the built environment and its relation to “...all those other things in life which people attach significance and value – including their purposes, their conceptions, their ideas and beliefs.”

What is happening in the area that the book addresses is that there is a gap in communication between the architect and the layperson about the interpretation of meaning in the built environment. This popular misconception was studied by Hershberger (1972) who compared responses by architects, architectural students and non-architects. He concluded that “if architects are to communicate successfully their intentions to laymen they need to restructure architectural education so that architects do not have their own set of meanings.” The book also highlights that although there has been a rapid progression in the study of meaning and behaviour in the built environment. There is an ongoing need for study in this area and due to the fact that the field is so extensive there is a need for researches to impose limitations on this area of study.

The editors of this book include Geoffrey Broadbent, Richard Blunt and Tomas Llorens. Broadbent was a key figure in architectural education and research. His dissatisfaction with various developments in architecture had led to the context in which this book is written. This book was published in 1980.

At the time of publication Broadbent et al (1980) highlight that problem is apparent in the “struggle for theory” in the studies presented throughout the book.

This book is twenty eight years old. At this time, the mainstream thinking of architecture and the rationale behind the publication of this book was to encourage and develop architecture which carries relevant meaning.

The target audience is those architects and environmental psychologist wishing to encourage architecture with meaning. The author addresses the audience continuously throughout the literature making clear pre-requisites for reading the book. Broadbent et al (1980) state “the study of meaning as Eco Succinctly put it in (1973) is the study of logic of culture.” Hence to study the meaning and behaviour in the built environment an understanding of the logic of culture is required as Broadbent et al (1980) state that “Culture is man’s medium... it has developed mechanisms which have given man the experience of constancy in the face of change.” Furthermore Broadbent et al (1980) stipulate that it is fundamental to understand that the studies which are contained within the book do not or do not intend to present a representative picture of the literature it samples. In addition the authors denotes that the division of the papers in the volume should be considered as largely speculative, as the majority of the theoretical suggestions that link up (or go) beyond those advanced in the fourth section.

The state of knowledge in this subject is that architecture needs meaning to survive. In order to sustain meaning in architecture it is necessary to research best practices in this area. The book offers an awareness of environmental psychology
and the built environment and a collection of studies. However it could be argued that it contributes little to the development of the field as it contains collections of studies which could be found elsewhere therefore what does this volume offer to the study of meaning of the built environment? Osterberg (1982) states in review of the volume “Having read Broadbent’s closing comments it is difficult to understand why this anthology could not have greater relevance for the reader.” Furthermore Osteberg suggests “If the collection were concise, meaningful, and critical to the development of the field, then this volume would be useful for all those teaching and researching in the area.”

The contents of this book are divided into four sections presenting material from a wide range of publications in the study of environmental psychology in the built environment. Section one deals with the prototypes of empirical science. This section summarizes individual concepts of the built environment. Section two and three focus on the applications of specific theoretical categories of a more specific and complex character than those within the field of personal construct theory. Both section two and three consider structure relative to the relationship between human behaviour and built environment. Section four focuses on discussion of theoretical problems. This section is the largest of the four, however as the authors suggest it is not representative relative to the proportion of papers within the environmental psychology as a whole. Section five is a historical account of architecture psychology which dates to 1927.

The ordering of the papers within the book is as Broadbent et al (1980) affirms “…to manifest a certain progression in the argument.” This ordering enables one who may have not have a background in the psychology of environment to progressively build an understanding of the issues and concepts presented in the study of meaning and behaviour in the built environment.

As one advances through the book the author poses a number of questions to the reader which initiates the author to ponder on the key concepts and issues related to the built environment. A personal interpretation of the issues and concepts within this book is that there is a need for meaning in architecture and an interpretation of an environment is based on an individual’s perspective thus will affect and formulate behaviours within the built environment.

The strengths of this book is that the studies presented within the documentation use a wide range of data collection, research techniques, methodologies and analysis techniques. Varying from subjective to objective studies particularly with reference to the study of “the correlation of objective façade measurements with subjective facades ratings.”

At the beginning of each study Broadbent et al offer a clear description on the methodology of the experiments carried out in the study. Furthermore, the authors critically point out the flaws of the study methods and throughout the book reaffirm the studies which are not representative. The authors concisely draw conclusions at end of each study as to the findings of that study. The book presents a range of studies which offer a sound basis for others to advance further in these areas.
However the weaknesses of the book are that the studies are not representative as mentioned previously. Another weakness of this book to pioneers in the study of architecture and meaning is the year in which it was published as more recent research could be retrieved. Furthermore this book contains no glossary.

The authors' style would lead one to question whether the book looks at the field from an external point of view as was the author’s intentions from the beginning, Broadbent et al (1980) state, “This volume sets out to look at the field from an external point of view, with the hope of revealing a hidden pattern, or argument, which probably would have not been revealed with sufficient clarity from within the field itself.” Broadbent et al (1980) appear too attached to the studies by use of the words “I” and “me” throughout the book, this method of writing makes the literature appear very subjective.

The contents are concise, clearly stating the author, title and page number of each study. On examination of the index this proved to be a valuable resource.

This style of writing makes clear the purpose of the each of the studies and questions that require answers. The book contains no glossary. The bibliography is found at the end of each study rather than the end of the book, given that each study was carried out by different researches this placement is appropriate.

This book aims to reveal a hidden pattern or argument for meaning and behaviour in the built environment. There is an apparent “struggle for theory” however this aim may be difficult to achieve given “that such meanings may or may not be held in common by those who experience architecture; indeed, that fundamental differences in human experience will cause fundamental differences in the meanings people attribute to their environments.”

In conclusion, this book would be highly recommended to colleagues as they would benefit from its knowledge. The book would also be resourceful for researchers as it provides detailed methodologies of previous research in this area. Overall assessment of this book is that the authors took a holistic approach to exploring meaning and behaviour as they examined various different environments and the direct effect it had upon the individual. The best features of the book include: the layout, the comparison of different research, and the valid opinions examined. The worst features include the exclusion of a glossary, and the fact that the authors stipulate that the book does not provide “...a representative picture of the literature it samples.”

I would recommend to others and it would be worth purchasing to a library in the hope that it would create an interest for future research in this area. As Broadbent et al (1980) state “The curtains are hardly drawn on the vast amount of research which could be done in this area.”

References


The Meaning of the Built Environment: A Nonverbal Communication Approach Review by Timothy Williams

The Meaning of the Built Environment: A Nonverbal Communication Approach
Amos Rapoport
1982
Tucson, Arizona, USA
The University of Arizona Press
253 pages
ISBN: 0-8165-1176-4
Paperback

The meanings which buildings, their contents, and their inhabitants convey had been neglected for many years until this book was completed in 1980 and originally published in 1982. This was due to an attempt to be more ‘scientific’ in previous research which led to the neglect of the ‘soft’ aspects of environmental meaning.

“In what ways and on what basis do people react to environments?”

Attitudes towards the built environment can be seen as self-evident on the basis of how you feel about them and what you like and dislike about them. This is the main aspect of the book, in which Rapoport calls “man-environment studies”, that discusses the nature of such mechanisms that link people to their environments.

Rapoport discusses how humans react to the meaning the environments have for them and aspects of functions that give an understanding of how environments work. He describes “meaning is not something apart from function but itself a most important aspect of function”.

The argument of this book hinges on the main distinction of the “meaning for whom?” What meaning does the built environment have for architects and designers? What meaning communicates to the public or inhabitants and users?. Perceptual and associated aspects of the environment are discussed. Rapoport goes on to describe architects and designers as perceptual thinkers, whereas the public, the users react to environments in associational terms that are culture specific and hence culturally variable with the aspect of personalization. Within the book, Rapoport is more concerned with what and how meaning conveys messages to the users of the of man-environment interaction, which to the date of publication was undiscovered and is of central importance to explore for the success of this subject area.

Originally aimed at architects, this book can appeal to wider professions such as city planners and urban designers. Due to the simple layered approach set out by the author, this book can appeal to the general public who is interested in self-assessing questions of perception within this field.

Jurgen Ruesch and Weldon Kee’s, Nonverbal Communication Notes on the Visual Perception of Human Relations, published in 1959 was one of the first books to concentrate on the pragmatics and stresses of visual cues and observations. It also was a starting point in the discussion of
how physical environmental arrangements of settings influence social interaction and expresses various identities. Due to the book being published prior to most of the research carried out with the field, the book lacks some of the theoretical and methodological complexity of more recent work.

A ‘framework’ of thinking is set out to demonstrate some of the working process towards a particular way of approaching problems. How one thinks and what one considers is direct and simple way for us to understand the meaning of the built environment. Based on an early modified ‘neuro-cultural’ model by Ekman and Friesen, 1969b; Ekman, 1972, Rapoport, develops his own approach avoiding problems presented by symbolic approaches found in Ekman’s model.

Rapoport uses a nonverbal communication approach that has been least tested within this field, which is a simpler and direct approach that provides relatively easy observation and interpretation that has developed in other fields such as psychology and anthropology. The author describes environments to “provide cues for behaviour”. The behaviour aspect of the cues thus helps us understand the meaning of that particular environment. A set of three distinctions of cues that is set out within the book gives us guidance within the observation, recording and analysis of that environment. Firstly, fixed feature elements that are basically fixed or that change rarely slowly such as walls, ceilings and floors and that generally communicate much less than the other distinctions. Secondly, semi-fixed feature elements that change quickly and easily, that are under control of the users, communicating meaning, relating to personalization. Thirdly and finally, non-fixed feature elements related to the behaviour of that environment such as spatial relations, body language, movement, facial expressions, eye contact and so on.

Rapoport states that the environment is encoded with information and thus needs to be decoded. Considering Perceptual and associated aspects. Perceptual being noticeable differences drawing attention to themselves through contrast of different environments. Associated aspects being, the decoding of the meaning of the relevant elements and behaviour patterns, in relation to culture, context and situation. One begins to observe and understand the environment, a catalogue of cues start to appear. Then it is straightforward to identify a set of noticeable differences between the environmental examples and make inferences about them. Rapoport stresses about effectiveness of the meaning of the environment depend on redundancy and clarity. A definition of the location, the expected functions of behaviour will give location of people in social space and therefore give meaning. What I found within the analysis and descriptions is how easy it seems. Using one’s senses and thinking about what you perceive, read and observe the environment and making social inferences, provides clarity in the understanding of non-verbal communication.

The meaning of the built environment clearly depends on the broadest possible samples in space and time on all cultures, forms and periods. Meaning can also be seen as part of the culture and context of the environment. Throughout the book, Rapoport uses an extensive use of examples to discuss the subject area clearly. The examples uses are of are own
time and western culture, with cross referencing examples from more exotic cultures. There also can be seen a comparison between traditional and modern contexts. Rapoport puts his method into action into two subject areas, small scale and urban examples. Within small scale examples, the author looks at the importance of spatial organisation that communicates on a semi-fixed level that shows patterns and relationships. Within urban examples, he looks at the level of homogeneity and heterogeneity of an environment to determine the meaning and character.

The extensive use of examples, are very useful throughout this book, however some of the examples given can be hard to relate to in certain circumstances where a different culture or religion is given. This may be due to the reader from another culture who has no knowledge or experience of that culture described. Looking back on the examples used there is a cluttered amount of images within my head that sometimes can amount to confusion.

Rapoport within this book has achieved his goal to set out this approach as clear as possible to relate and bring together previously unrelated findings and facts. The author has first been specific due to the simplistic and direct approach that non-verbal communication has to offer. It is thus simple and straightforward to use. The use of cross-culture examination adds to the clarity and strengthens the effectiveness of decoding characteristics of fixed, semi-fixed and non-fixed elements and cues can quickly be discovered and understood. A general approach to the method of communication can be seen which relates to that of all products of human culture and that is easily referenced.

This is a book at the time of publication filled a significant gap within the field of the meaning of the built environment and that of essential reading. I would ultimately recommend this book to both my colleagues and anyone interested with this field. It has a clear and simplified approach that can be easily understood by anyone. The book opens up questions within my mind about perception of things, something that we architects may take for granted due to the self-evident nature of any environment. We architects find ourselves looking too much to the context of the modern movement which had seen an attack on the users meaning. We need to step back, consider a non-verbal communication approach to each project and implement to prove successful architecture.

Environmental Psychology in Building Design
Review by Ryan Ward
Environmental Psychology in Building Design
John Brebner
First edition
1982
Essex, London, United Kingdom
Applied Science Publishers Ltd
211 Pages
Hardback

The author of Environmental Psychology in Building Design, John Brebner, is a psychologist at the Department of Psychology, University of Adelaide, South Australia. He has written this book as a psychologist, aimed at people within the design discipline, with the hope of drawing attention to psychological factors and
their impact in the effectiveness of the built environment. The book, published in 1982 by Applied Science Publishers Ltd, Essex, was part of a series called Architectural Science Series, which looked at the application of the physical sciences to architectural design. However, Brebner’s book, like several other books in the series, for example, Sound, Man and Building by Prof Schaudinischky, was different because it was concerned with social science and design. However Brebner’s book was to take a further step by merging both the applications of social and physical science to architectural design within one book. As Henry J. Cowan states in his foreword, “Dr Brebner’s book is therefore particularly welcome because it combines, as far as I know for the first time, the application of physiological and psychological principles to architectural design.” The book, now sixteen years old, was clearly bringing together for the first time, two principles which in the real world are connected, yet until this book had been considered separate in the design world. However, as stated in the book, at the time science had not advanced enough to answer many of the points he brings up in the book, but it asks questions which we as designers must answer to satisfy users and their environment.

It is evident from the book’s title, Environmental Psychology in Building Design, and indeed throughout the book, that Brebner has aimed his work at a specific audience. In Henry J. Cowan’s foreword he makes a note to the audience, ‘Few architects today doubt the relevance of physiology and psychology to their work’. I felt it was clear throughout that the book was aimed at people within the design industry and more specifically design within the built environment, for example, architects and members of the architectural design team, such as planners, engineers and surveyors. He also mentions that he hopes the book will help forge interactions between people within different fields of study. As a psychologist, he was setting out to put across his area of expertise to members of a completely different profession, whilst also bearing in mind that we all have a collective goal; that is to maximise design and function throughout the built environment to the satisfaction of the people using them.

I do not believe that Environmental Psychology in Building Design broke any new ground when it was written in 1982, however I do feel that by trying to merge both physical and social science within one book, Brebner was trying to bring together different areas of research within the built environment and make people from separate fields come together and use their collective knowledge to gain a greater overall understanding of how we use the built environment.

The book begins by looking at the issue of ergonomics and human cycles; anthropometrics, types of movement and the frequencies of body functions. Brebner makes the point that there is a lack of up to date data available to designers within this field, particularly as there is no such thing as an average person. Brebner looks through the differences in gender, country of origin and general ethnicity and how these need to be accounted for throughout the design process. Although an understanding of these factors will not overcome all problems within a building, he does suggest that it will minimise general mistakes and risks in a design, giving many examples, such as a chair and a desk, and the relationship between heights of
arms, legs and movement of a user at a specific height of desk.

Brebner then goes on to look at psychological factors, and how we as people arrive at our individual interpretation of the world. Brebner talks about our long term memory and short term memory and how these affect our perception of the environment we live in. Although it is only a brief overview of how we store memory, it is an interesting topic, which Brebner backs up with two very simple yet stimulating picture exercises. I feel the use of these exercises is an effective way of bringing a theory based topic into the minds of a more visual profession, such as an architect.

Because vision is the principal source of information about the world around us, the scope and limitations of this system, according to Brebner, are key factors for ergonomics, general lighting and visual performance within a building. To understand their effects he gives us some details on the structure of the eye. We then move on to illumination, and he makes the point that illumination cannot be taken as a single variable, but it is linked to the workings of the eye among other variables, such as the variability in peoples vision. These topics all come under the heading of ambient conditions. Brebner also mentions the effects of temperature and humidity, explaining how an individual’s performance deteriorates if he or she has to increase, conserve or lose heat. Noise is the last issue within this topic, making the issue that noise is unwanted sound, yet psychologically it makes no difference, as the process of hearing both are the same. Brebner makes the point that the key with ergonomics is to “reduce the effects of noise and to maintain effective sound communication.”

Throughout the book, Brebner constantly refers to the working environment, and in the next chapter examines the workable environment in detail. This chapter is primarily concerned with ergonomics and general elements within a working environment. Brebner examines objects like keyboards, switches, levers and handles, as well as looking at postures. He also investigates how ergonomics can affect spaces and how people use such spaces, by examining how individuals move through a building, for example, through a corridor.

Brebner finally focuses on how interactions between people and objects within a built environment shape the human behaviour that occurs there. I feel this is the first area in the book where ergonomics and environmental psychology merge, as he states that the interaction between people within a space needs to be borne in mind as much as the arrangement of objects and spaces. As Brebner is a psychologist I had expected these points to be picked up on a lot earlier in the book, whereas initially the main focus seemed to be on the discipline of ergonomics.

Early in the book, Brebner occasionally uses diagrams, pictorial experiments and photographs to back up his arguments. As he was aiming the book at a mainly visual profession, that is, designers, I feel it is one of the strongest elements of the book. I do feel however, that Brebner could have continued this throughout the book. Overall I found the book relatively easy to read, and I liked Brebner’s direct approach with his writing and his constant use of examples to place his thoughts into a built reality.
I believe this book is an interesting read for any architecture student, and certainly one I would recommend to my fellow classmates. However, I feel that if people are looking for answers to questions they have regarding ergonomics or behavioural factors, this particular book may not provide the answers they are looking for. Brebner constantly asks intriguing questions and makes statements within the issues, yet he has no conclusions to the points raised. I certainly feel this book could be of value to any student of design, be it architecture or any other form, as it is a book that makes you consider, and indeed reconsider, your own preconceptions on the role ergonomics and environmental psychology can play within the built environment.

**Architecture and Identity, Responses to Cultural and Technological Change**

Review by Lyndsey Magowan

Architecture and Identity, Responses to Cultural and Technological Change

Chris Abel

Second edition

1997 (1st.) 2000

Oxford, United Kingdom

Architectural Press: An imprint of Butterworth-Heinemann

261 pages

ISBN: 0750642467

Paperback

The book is compiled of a series of theoretical discussions and case studies, which reflect the author’s mode of thinking at the time of writing. There are recurrent themes throughout the book; these include, identity, analogical thinking and the use of metaphors in architecture. The author is concerned with understanding and explaining the complexities of architecture, often visiting various parts of the world in search of answers and asking new questions, which have led to invaluable insights. His commitment to increase the responsiveness of architecture is evident throughout. This book provides an informative insight into the technological advances and the global perspective on the changing nature of modern architecture.

First published in 1997 with the second edition in 2000, it is a recent book in which the author discusses his ideas on diverse issues such as history, technology, philosophy, science and environment.

Abel refuses to be constrained by any single analogy or line of thinking and clearly demonstrates the importance of the advances of technology in architecture design. He engages the reader about diverse ideas spanning a range of topics.

The book is aimed at architects, developers, planners and students. Abel has strong views concerning the way in which architecture schools are run and states that, “more radical educational and administrative solutions will be required to bring architecture schools into line with industry and practice”. He goes on to stress the importance of links with industry and practice, and strongly believes more is needed to better equip the graduates with the interdisciplinary skills required.

In his essay about bio-tech architecture he explains how it uses smart technologies to achieve a dynamic, interactive relationship between a building, its users and its environment. Although very informative, it was difficult to understand and grasp the concept.
The essays presented cover an unusual range of topics and contain substantial undertones of the “state-of-the art” of architectural theory at the time. He has tested his ideas against a vast range of cultural and geographical situations across both developed and developing world. Through the book he further explores and adds to diverse ideas.

When discussing ‘Decentralization’ in the chapter entitled, ‘Urban chaos or self-organization’, Abel explains that the major forces of urbanisation in recent years have meant defragmentation of the traditional city form into a dispersed pattern. This breakdown of form stems from “fundamental changes in technology, income levels, family status and consumer taste.” He provides further insight and explanation into difficult theories and shows a well-travelled appreciation of images and pictures from all over the world and also evidence of extensive research, which applies on a global scale.

In general the book was well structured and formatted. I liked the way the book was broken down into three parts. Part one focused on new ideas in science and technology and the chapters aimed to increase our awareness and understanding of the complexities of human behaviour. Part two was a combination of essays concerning architectural theory, criticism and analogical reasoning. Part three contained essays which were concerned with issues on a larger cultural and global scale, for example, ‘Globalization and localization’. The index and bibliography were more than adequate and I found them useful and informative. However, one point of contention is that there does not seem to be an obvious flow or connection between each chapter; each chapter taking on a different topic.

Generally, the language used by Abel requires the reader to have prior knowledge of architecture to fully appreciate the dense and detailed analysis of information. Many of the chapters require a more in depth philosophical understanding of his architectural premise.

In part one, he creates a particular interest in how the bio-tech architecture workshop was created in response to the isolation, complacency and lack of vision which generally governs architectural education everywhere. We gain a greater understanding how to equip students with the use of responsive technologies which can be used to design buildings specific for place, purpose and climate.

Throughout, he articulates clearly how the language analogy in architecture is used to extend our knowledge. Analogies and metaphors are used as, “creative tools to instigate thought and structure research.”

In referring to architecture as a language, he portrays it as a “voyage of discovery into the unfamiliar territory of architectural meaning.” He further demonstrates how architecture is multidisciplinary and often hard to define and highlights the problem when analogies are taken too literally, and stresses the importance of striking a balance between reasoning and criticism.

At times I found his style of writing quite difficult to follow for example when he relates back to Darwin and his theories of evolution. Nonetheless, I did find some of his concepts enlightening in particular his comparison of Hans Scharoun’s
Philharmonie and Mies Van der Rohe’s National Gallery, each as language of organic and classical architecture respectively. He compares the two buildings as crossing between “different worlds of reality”. Each building is a masterpiece of its own kind but Scharoun’s concert hall is better appreciated from the interior whereas Van der Rohe’s is better appreciated from the outside. He states that when we compare one building with another, “we compare distinct languages...each offering a different interpretation of reality”.

When discussing new attitudes towards the integration of modern architecture with the natural environment, Abel describes Renzo Piano’s work as a good example of how he “integrates advanced technology into historical settings in his urban renovation projects.” He strikes a successful balance between technology and nature, achieving contemporary design as well as integration with culture and tradition.

I feel the author’s aims have been met through his writing as he effectively conveys meaning especially through his understanding of the use of metaphors. Metaphors are commonly used in architecture criticism, and the intent is “to make full use of the emotional responses that words can arouse, so as to enrich the description of a building.” I feel he provides a way to increase the meaning and responsiveness of architecture through his intellectual approach and his persuasive yet assertive writing.

Abel claims that the most successful examples in contemporary architecture are those that “abstract from the past what is still relevant today...by a process of analogy, project a vision of the futures out of the present.” It is clear that there is an emergent interest in architectural identity. This recurrent theme in the use of analogies represents the function of architecture and the formation of personal and social identities. Abel states that the principal metaphors used are “architecture as a language” and “architecture as space” but now more recently “architecture as identity”. He proceeds to give examples of various writers analysing their ideas of which have stressed the importance of the ability to act with architecture in a personal way. Writers include, Amos Rapaport, John Turner, David Appleyard and Clare Cooper Marcuse. Abel states that “some of the most dramatic evidence of the complex relations between architecture and human identity may be found in processes of cultural exchange.” He provides colonial architecture as an example as he explains how this is a process where people recreate familiar environments in “alien locations”, in doing so they retain part of their identity. He describes architecture as “a way of being” and therefore use it as a way in which we know ourselves.

Analogies and metaphors are used extensively through his writing, he refuses to be constrained by any single analogy or line of thinking. The essays, which comprise the book, make it a manageable read. I only came across one spelling mistake/misprint, when describing Jan Kaplicky’s project for a semi-underground museum integrating modern architecture with the natural environment and how it “makes effective use of proven energy-saving techniques, tucking the glass-roofed structure neatly into the base of the hill.”

In conclusion, Abel describes the architect’s role as needing to empathise with people and
place in which they live in order to ‘give form’ to that identity. In the final essay on ‘Asian urban futures’, he interprets the ideas and concepts of four accomplished architect-planners. This provides an informative and enlightening discussion on how they hold similar yet differing approaches on development planning and urbanization. Abel states that their approach is “a composite of western and eastern ideas and values, reflecting a continuous process of cross-cultural exchange.”

The best feature of the book is the format as it is a manageable read: divided into parts. It is well illustrated with photos and drawings and has a helpful appendix and bibliography. There are notes and references for every chapter, which is helpful. The worst feature is that many of the chapters require a more in depth philosophical knowledge and a glossary to explain some of the key terminology. Overall, I feel it was an informative and interesting read, which I would recommend to my colleagues.

Finally, I feel that Abel is successful in providing an up to date knowledge on various issues concerning architects and designers today. He conveys this on a global perspective. He demonstrates a wealth of experience and knowledge and through his style of writing one can sense he is passionate about his ideas and wants to convey these effectively to the reader through his persuasive writing.

**The Language of Space**

**Review by Ronan White**

The Language of Space
Bryan Lawson
First edition
2001
Oxford, United Kingdom
Architectural Press: An imprint of Butterworth-Heinemann
246 pages
ISBN: 0 7506 5246 2
Paperback

The Language of Space is a discussion of human psychology and architecture. It deals with the practical and fundamental principles within architectural design, and places much emphasis on how architects need to have more interest in the building occupants rather than the building itself. The following quotation emphasises the importance of such thinking, “We shape our buildings, and afterwards our buildings shape us” (Churchill 1943, as quoted in; Lawson, B., The Language of Space, Architectural Press, 2001, pg 194).

Although written by an architect the book often criticises architects, and how they need to get their buildings nearer to people’s needs than they often do. In one particular chapter it even indicates that the origins of legal disputes between neighbours are a result of the work undertaken by architects and planners.

The Language of Space was first published in 2001. In relation to the subject of human psychology and architecture it is a relatively new publication, as the majority of books within this subject area having been written
around the 1960’s when criticism of the modern architecture began. One could argue that the current thinking on the subject has not changed greatly since 2001, although when compared to the 1960’s publications, architectural trends and styles have certainly changed, today architecture is not only about the surface appearance, although it is about people and context, as The Language of Space discusses.

Analysis of The Language of Space would indicate that its intended audience is students. Not only is it written in a language that can be easily understood, although throughout the book the author often refers to architectural schools, students and the work they have undertaken. Within chapter eight (Space and Time), the author also discusses how students of architecture often aim to work out what their tutor wants them to do, and he believes that in doing so, the students thinking of architecture can become remote from how people behave in a building. A student as the intended audience is expected, as the author is Dean of the Faculty of Architectural Studies at Sheffield University.

One could also argue that as the book is written in the non architectural jargon, it would be quite suitable for a lay person, (a person from a non architectural background) to understand. One example of how the complex terms are broken down would be in Chapter four (Ways of Perceiving Space), where the author refers to the air traffic controller to describe redundancy in architecture.

In addition, The Language of Space would be a recommended book for practicing architects/professionals to analyse, it would certainly increase their understanding of space, and give them a different approach on design, thus with an outcome of better designed buildings.

As I got into depths of the book I began to realise that the issues being discussed were common knowledge on how humans respect each other in space. When I say common knowledge, I mean this in relation to our behavioural manner in space everyday. We actually do perform in space as the book describes, although we never realise. I can clearly say that since reading this book it has broke new ground in my knowledge of this subject; not only have I began analysing my behavioural manner, although I have began analysing the behavioural manner of others also. As it is my ambition to become an architect, understanding human behaviour is the key to organise and structure space. “I take the stand that buildings are not primarily art, technical or investment objects, but social objects” (Markus, T., 1993).

The contents of the book are very well broken down, with chapters, sub-chapters, illustrations and diagrams which in my opinion give the reader a greater understanding of the particular discussion.

The chapters in the Language of space vary in relation to what they discuss. The earlier chapters place greater emphasis on understanding human psychology whereas the later chapters begin to relate this to architecture.

Throughout the book, the author speaks to the reader in a very personal manner. In one particular chapter he discusses how he would rather describe this topic face to face with the reader, or in a lecture, rather than write the book.
He also describes in this personal manner, how the book was rewritten and redrafted several times. Although only a minor weakness, I felt its drafting to be slightly confusing in relation chapters overlapping. Or how the author would start to describe a particular topic, and then indicate that he will look at it in greater depth in a chapter to follow. If a take an example of behavioural setting, this reappears as a sub-chapter within both chapters one and two, although in Chapter six (Proxemics), it is discussed again in relation to furniture, and how furniture can restrict the occupant’s ability to create the behavioural setting needed to undertake the task involved.

Before reading particular chapters I had preconceived ideas of its discussion from the title, although these ideas often turn out to be incorrect. An example of which is discussed in chapter two (Space and the Human Dimension). Within this chapter the author discusses identity. I automatically assumed that this would relate to how each individual has their own identity and this does not change. Although I soon came to discover that spaces created within architecture changes one’s identity, and how architects can control the identity of others. The author uses an example of a waiter and how he changes his identity from the dining room to the kitchen.

In chapter eight (Space and Time), the author discusses how architects usually have a design approach that ‘form follows function’. He indicates that the problems associated with such approach are that architects do not understand function as well as they think. The author expresses that a good first step in changing design theories would be to take an approach of function following form, although I feel this approach will take time to evolve. This aspect and indeed other aspects that the book addresses are becoming increasingly evident in recent architectural designs. Europe in particular, with a large emphasis on context, and creating spaces that respond to our behavioural needs. One such recent example would be the Universita Bocconi, Milan, (by Grafton Architects Dublin), which received world building of the year at the first ever World Architecture Festival 2008; “It seems locked into place” (Stern, R., 2008, the chairman of the super jury). Although one could argue who was on the jury, was it persons from the architectural profession or people who actually use the building? I can inform you that it was persons from the profession; do I need to say more?

This leads me to discuss a topic in chapter one (Space as a Language). A section in this chapter focuses on how architects establish a jargon and communicate in a different language to that of a lay person. Even if the Jury at the World Architecture Festival had consisted of architects and lay persons, would they have been able to reach a unanimous decision through using this architectural jargon, or would the architects have had to adopt a different language that others could understand.

Apart from the minor overlapping issue which I discussed earlier, the book is extremely well formatted, the subsections within each chapter help break down the content therefore making the book more legible. In addition there are a range of diagrams and pictures within the book which are very useful tools to achieve a better understanding of the topics.
All in all I thoroughly enjoyed the content of book and I have no doubt that it will be of benefit to me in my architectural career.

Not only would I recommend The Language of Space to architectural minds like my colleagues, although I also recommend it to the non architecture mind (a lay person) to read. In doing so the lay person could understand the jargon used by architects, and therefore be able to become more involved in the design process, thus the outcome: a better designed building. In addition it would also help the non architectural mind realise that there is more to architecture than what is seen from the external appearance.

**References**


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Ashraf Salama holds B.Sc., M.Sc. and Ph.D. degrees in Architecture. He is Professor of Architecture currently holds a Reader in Architecture position at Queen’s University Belfast, Northern Ireland, United Kingdom. He taught and conducted research at Qatar University (2006-2008), was Associate Professor at KFUPM (2004-06), and was the Director of Consulting at Adams Group Architects in Charlotte, North Carolina, USA (2001-04). He is licensed architect in Egypt received his training at Al Azhar University in Egypt and North Carolina State University, Raleigh, USA. Salama chaired the Department of Architecture, Misr International University in Cairo (1996-01). He has published numerous papers and authored and co-edited five books on Architectural Education: Designing the Design Studio (USA), Human Factors in Environmental Design (Egypt), Architectural Education Today: Cross Cultural Perspectives (Switzerland), Architecture as Language of Peace (Italy), and recently, Design Studio Pedagogy: Horizons for the Future (United Kingdom). He is member of the scientific boards of several intl. journals including Open House International, Time Based Architecture International, and the Chief Editor of “Archnet-IJAR.” He can be reached by email at asalama@gmail.com or ijar@mit.edu.