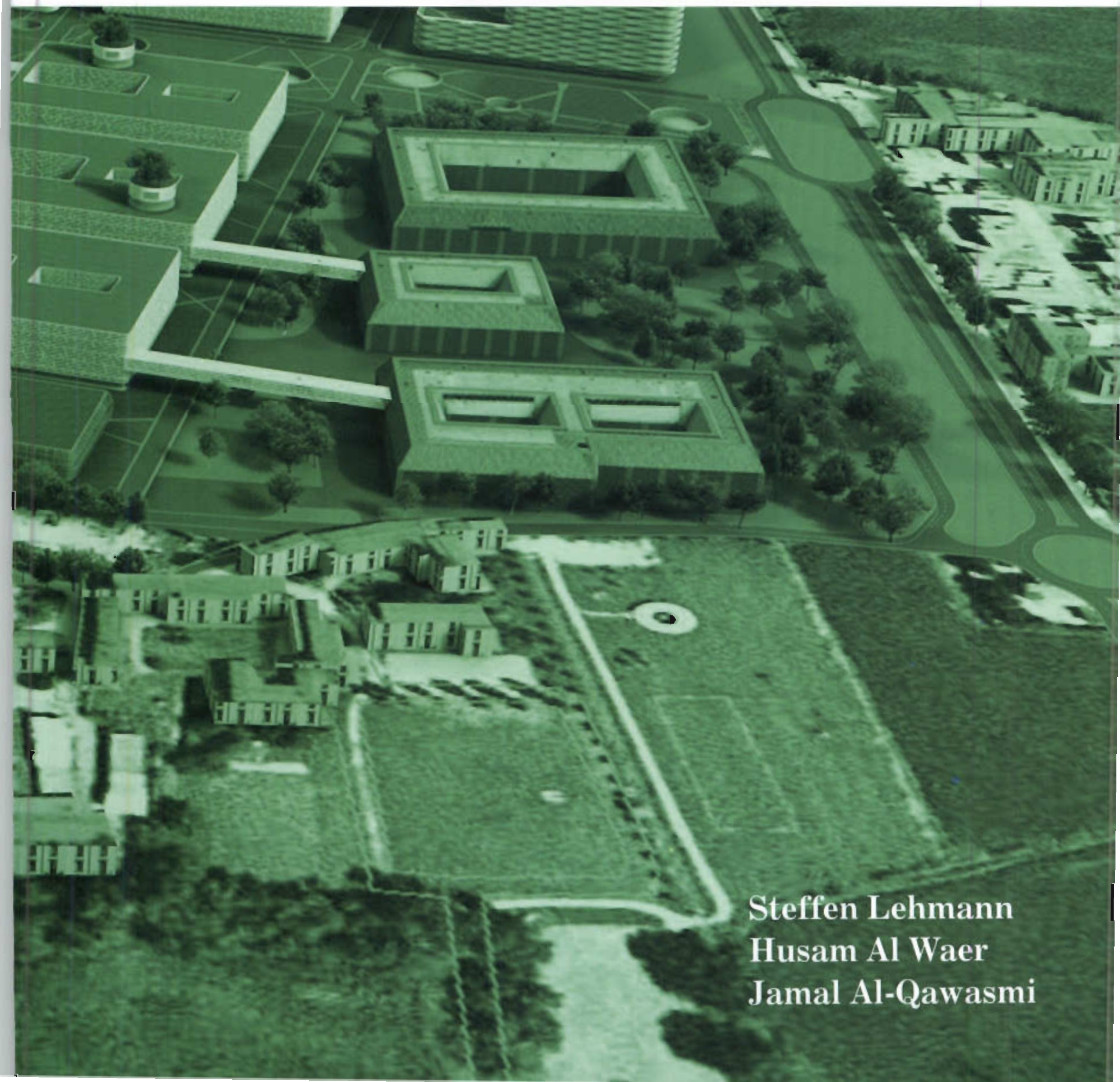
Sustainable Architecture & Urban Development

Vol IV



Steffen Lehmann
Husam Al Waer
Jamal Al-Qawasmi

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- أعدت دائرة المكتبة الوطنية بيانات الفهرسة والتصنيف الأولية
- يتحمل المؤلف كامل المسؤولية القانونية عن محتوى مصنفة ولا يعبر هذا المصنف عن دائرة المكتبة الوطنية أو أي جهة حكومية أخرى

Sustainable Architecture and Urban Development

Volume IV

Editors
Steffen Lehmann
Husam Al Waer
Jamal Al-Qawasmi

SAUD 2010
The Seventh International Conference of
The Center for the Study of Architecture in the Arab Region

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The Seventh international conference of CSAAR has been an enormous undertaking that would not have been possible without the efforts and cooperation of several people and organizations: conference organizing committee, international review committee, CSAAR advisory Board, Middle Sustainability Group (ESTEDAMA, Geddes Institute for Urban Research at The University of Dundee, and Energy Center at The University of Jordan.

The four-volume proceedings of the SAUD 2010 conference, titled Sustainable Architecture and Urban Development, have been made possible through the contributions of many. First, we want to thank all the authors that responded with their work to our Call for Participation. Without their effort and trust, this conference would not have been possible. We also would like to acknowledge the international review committee for their hard work and dedication at evaluating the numerous papers submitted. A special thank goes to the conference keynote speaker: Prof Dr Raymond J Cole.

We are particularly grateful to the United Nations Sustainable Building and Construction Initiatives (SBCI, UNEP), The International Council for Research and Innovation in Building & Construction (CIB) and The International Initiatives for a Sustainable Built Environment (iiSBE) for all the support they provide for the event. SAUD 2010 is one of the regional conferences taking place around the world in 2010 as a prelude to The World Conference on Sustainable Building, SB11 in Finland, that are all organized under the auspices of CIB, iiSBE and UNEP. Thanks also go to the UNESCO Chair for Sustainable Urban Development in Asia, Middle East and the Pacific; and to all other supporters and sponsors of SAUD 2010 for their generous financial contributions.

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Preface

The increasing urbanization of many parts of the world, coupled with globally critical issues, such as environmental pollution, increasing energy consumption, global warming, water and resources shortage and lack of waste recycling are resulting in major urban crises. In an effort to explore and map the challenges and opportunities of sustainable development, the Center for the Study of Architecture in the Arab Region (CSAAR) has collaborated with The University of Dundee, and the University of Jordan, to organize SAUD 2010, the 2nd International Conference on Sustainable Architecture and Urban Development. This conference was held from July 12 to 14, 2010 in the City of Amman, in Jordan.

The conference aimed to address issues related to best practices of sustainability in urban design, planning and development in the Arab region and elsewhere. Of particular interest for the conference organizers was to identify pathways to achieve urban sustainability in Arab cities. These cities are currently undergoing some of the fastest rates of change and development worldwide, and challenges to harmonize this rapid and sometimes even traumatic experience of change are significant. The rapid, often erratic, growth has not occurred without unwanted consequences in the built environment .

To engage meaningfully in the sustainable development debate, the conference organizers invited architectural practitioners, educators, university scholars and their counterparts in governments, municipalities and environmental design fields, to develop research in a number of thematic streams that encompass not only the spatial and physical aspects of the built environment, but also the social, economic, legislative, and ecological contexts and consequences .

More than six hundred authors from a diverse community of researchers responded with abstracts, and more than three hundred fifty of those submitted papers were submitted for blind peer review. The 128 papers that were selected for presentation at the conference come from a variety of architecture and urban development fields and have the potential for enhancing the interdisciplinary knowledge base by defining best practice of sustainable development. The critical nature of the subject has attracted authors from around the word and therefore the content of the publication provides a global perspective on the subject. This four-volume publication has been organized into twenty two chapters that correspond to the conference sessions: Sustainability Assessment & Buildings Performance; Sustainable Construction Materials & Technologies; Low Energy Architecture; Vernacular Architecture and Sustainability; Ecological, Social and Cultural Sensitivity; Urban sustainability and Low Carbon

Development; Sustainable Construction Materials & Technologies; Design with Nature; Ecological, Social and Cultural Sensitivity; Urban Design and Sustainability; Eco-Mobility: Sustainability in Transport; Cultural Heritage and Eco-Tourism; Sustainability Assessment Methods, Applications and Limitations; Urbanism in the Middle East; Sustainability in Arab Countries; Sustainable Renovation and Restoration; Sustainable Design Issues; Landscape and Ecological Sustainability; Retrofitting the City; Sustainable Housing and Neighborhoods; Sustainability in Developing Countries; and Reflections on Sustainability

The term Sustainability has become ubiquitous to every conference and paper today that it risks being reduced to an empty slogan. Therefore, the editors and co-conveners were keen to seek an intellectual discourse that would help to pin down the exact notion and meaning of the term's use .

The keynote speakers from Canada and Germany considered the diverse and broader context of sustainable urban development, while exploring a pedagogical approach to the integration of sustainability knowledge into teaching and research .

This international conference attracted much attention and recognition among professionals involved in sustainable urban development. Ideas expressed by authors range from empirical investigations to case studies and literature review of various issues related to sustainability of the built environment. In the following pages you will read a range of concepts and learn about researchers' findings. However, the four volumes cannot provide definitive answers and, as a result of the rapid change in the field, some of the claims made may seem quaint and outdated almost immediately after publication. Authors of the session papers responded with a wide and inspiring spectrum of possible positions. The papers suggest that the only constant may be change and the future of the built environment may depend on our ability to keep up with this rapid change and the development of new knowledge.

The Editors and Conference Conveners,
Amman, July 2010

Retrofitting the City

Mazzola's proposal for a "new" sustainable urbanism seeks to expose the contradictions underlying modernist architecture and the urban planning emerging from the 1933 CIAM Athens Charter. For far from being universally accepted, this paper reveals that at the time of its inception, a number of architects and planners suggested modernism was ripping architecture from society and reducing planning to little more than a debate about aesthetics which nobody understood. Indeed, rather than arguing about the aesthetics of the "functionalist" city, Mazolla's paper suggests that the modernist movement ought to have instead dedicated considerably more time and effort to working out how human settlements can evolve to meet social needs, customs and traditions in environments which are respectful of the past as well as the future.

This call for human scale settlements, equally respectful of tradition, culture and diversity, is also the message communicated by the other three papers on "retrofitting" from Bodurow, and Martin, Ozturk and Kokoula. Mirroring to some degree the ongoing debate about the legacy of modernism for today's "new" and "everyday" urbanism, they focus attention on how architects and planners can "shrink" the functional city and subject it a process of regeneration more intensely human in scale, culturally-specific and retrofitted in a way that not only meets social need, but which matches this to their environmental requirements.

Taking this form all four papers make significant contributions to what is currently understood and known about retrofitting the city and in particular, how to make it human in scale, culturally-specific, social and environmental. As such they echo many of the important debates currently taking place over the nature, shape form and content of everyday urbanism, not so much at the level of the block, or street, but within the culturally-specific context of the city's social needs and environmental requirements.

Mark Deakin
Edinburgh Napier University, UK

Proposal for a "New" Sustainable Urbanism of Mediterranean Basin

Ettore Maria Mazzola
The University of Notre Dame School of Architecture, Rome Studies, USA-Italy

Abstract

When we talk about urban development, we do run the risk to be attracted by the so-called "western world", just like what happens in Countries as China and Dubai.

The big business related to the multinationals' house building must not be ignored. The debate on "sustainability" is often about energetic buildings problems only, while the costs and the harmful effects of certain industrial solutions, presented as sustainable, are always forgotten.

How much does it cost all of this? And what does it mean to produce, to transport and to install those technologies, which are not possible to be realized on the day after the low-cost oil era?

The Mediterranean Basin presents a lot of solutions that have been set aside according to the 1933's Athens Charter. The authors of that document excluded from their "models" those one of many Mediterranean Countries – millennial craddle of urban culture – and simply defined "wrong". According to them those models were not respectful of the guidelines ("doctrinal points") of the new cities' town-planning, linked to the automobiles' addiction!

This paper has the purpose to launch a proposal for the recovery of the urban-architectural canons that preceded the Modernism era. The historical archives of Mediterranean cities are full of documents referring about the way they used to build until the advent of Modernism era. The knowledge of these rules could open new ways to operate a sustainable retraining of the cities, especially in the peripheral areas, devastated by the "urbanism of numbers", of zoning and of standards.

Keywords: *Retrofitting the Existing City, Sustainable Urban Design.*

1 Introduction

It is unanimously held that the birth of modernist architecture and urban planning dates from the 4th CIAM held in Athens in August 1933. The Charter that resulted, a result of its authors' wishes, especially of Le Corbusier, became a sort of "Bible" for architects and lawmakers. Thus cities of the whole world over came to lose any possible relationship with that healthy tradition that had determined their development for thousands of years before it.

That tradition, made up of monumental and "minor", noble and vernacular architecture, depending on climatic, orographical, cultural and religious situations, etc. ensured that every population developed a sort of architectural and urban planning "dialect". Over time it was able to refine itself until it was able to define the identity of places and skills of the people – and of entire communities – and be recognised as belonging to those places. By imposing a single and therefore depersonalising language of forms and proportions based on hypothetical mathematical models far removed from true human needs, we have ensured that the cities of the 20th century, and individual examples of architecture within them, have lost any possible relationship with people, trying to honour a presumably technological civilisation in an increasingly abstruse way.

Today, the result of imposing this modernist vision on the city should force us to consider the fact that the utopia of the so-called "functional city" has been a complete failure.

The socio-economic and ecological repercussions of that vision show that the dream of making the city functional and well-ordered was flawed by an ideology that was completely senseless.

On the other hand, it is hard to imagine why cities that have been "functional" for over two thousand years could no longer be considered fitting models. We probably should have been less radical in our reasoning, making allowances for cars to be used within cities, but there was certainly no need to make provision for heavy transport vehicles.

Nor can we accept that cities that have grown and expanded for two thousand years, respecting their delicate relationship with the countryside, as well as the need to have everything available, need to be re-planned to fit in with zoning requirements. The separation of functions, an increase in distances, thinking based on urban grids and absolute rules, basing all measurements on standard numbers rather than human sized dimensions, has led to large, costly and unsafe cities as never before. Today it is even more difficult to think of restoring the relationship between the city and the countryside, and between built-up areas and human beings within the city, simply because post-1933 regulations were based on those absolute certainties.

In Italy, several urban planning laws were based on these theories. Even today, laws such as nos. 1150/42, 167/62 and presidential decrees nos. 1404 and

1444/68 prevail. It is hard to think about changing things if those who legislate continue to think along the lines of those laws, and especially that ideology. We probably need to start rediscovering a series of norms, codes, and building regulations that existed before that wretched 1933, study them properly and understand how they can be adapted to contemporary life, as well cohabit with some recent norms that are worth taking into consideration, because, as Edmund Burke stated,

«A healthy civilisation is one which maintains the relationships with the present, the future and the past. When the past nourishes and supports time present and the future, a society is advanced».

2 Little Known Facts about the 4th C.I.A.M.

The 4th CIAM is unanimously recognised as the beginning of Modernism. What is not known, or at least not well known, are the details of what actually happened, how and when, and who drew up the "Athens Charter", which the entire urban planning and architectural sector hinges on today.

More information detailing those events might help us understand who was responsible for leading us to the current situation. Above all, however, it would help us consider whether it is right to continue on this path. Both modernists and lovers of tradition complain about the present situation. Many of them express their feelings and criticise things that do not function in the functionalist city but no one has been brave enough to document the history of the problem and name those who were responsible. Perhaps this is because they feared becoming objects of ridicule, or being condemned for having dared to question the sacred cows of our profession. I will attempt, therefore, to clear up things, in the hope that it will unite us in reviewing all the urban planning laws produced following that unfortunate "journey" in 1933!

On July 29th 1933, the steamer Patris I left from the port of Marseilles for Piraeus. It was not an ordinary journey, but a floating "charrette*" with a double

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* This term originated at the Paris École des Beaux-Arts in the 19th century. The French term *charrette* means "carriage" or "cart". Architecture students at the École des Beaux-Arts were very familiar with having to work hard, often until the last moment, on their project drawings ... even while they were travelling to school in horse drawn carriages ("*en charrette* ") to show their drawings to their professors. Later, the use of the word underwent a change and the way it is used now refers – especially among "traditional" architects –to the initial *full-immersion* phases of a collective design project. The term *charrette* has also been applied in the past to the cart that took condemned prisoners to the guillotine. In the 16th, 17th and 18th centuries, when travelling took a long time, the word *Charette* referred to long journeys in horse-drawn carriages during which statesmen and politicians took the opportunity to work together to resolve

purpose, both real and metaphoric. The first one was a Marseilles-Athens-Marseilles cruise, but the second was the quest for a more liveable city that was "functional and radiant".

The "journey" of the 4th International Congress of Modern Architecture "ferried" its participants towards the Greek shores, but also towards a functional city, in other words, also towards their discussions and the final Congress document, or the Charter.

That things had already been decided beforehand was only to be expected. The preparatory instructions for the congress issued as far back as 1931 read: "The Congress has chosen a materialistic-deductive method over an idealistic-inductive one, as the only possible basis for a collective activity and as a result to carry out the working Congress" (De Biagi, 1988). In addition, we would do well to remember that once on board, the participants found themselves having to discuss 33 different cities, using charts that had all been prepared on the basis of a single ideological perspective based on a predetermined method. It goes without saying that this interpretation, and thus the very strong criticism of the historic city, was merely a given that had to be ratified, so much so that in addition to the 33 "non functional" cities, a thirty-fourth, new city: the functional city was foreseen! (P.G. Gerosa, 1978).

Point 71 of the Charter confirms that «The cities included in the 4th CIAM all have the same characteristics of disorder and do not satisfy man's psychological and biological needs»**.

In short, as we will see, they wanted to demonstrate the validity of Le Corbusiere's theories from La Ville Contemporaine pour 3 Millions d'Habitants, (fig. 1) and the Plan Voisine (fig. 2) – which, once reinforced by the 4th CIAM, would be transformed by Le Corbusier himself into the Ville Radieuse of '35 – and which would be applied to the plans for Amsterdam and Barcelona during that period. The objective was to transform them into universal rules, that is rules that would be adopted for all future urban planning … to the great joy of the automobile industry (for example Voisine), which had already promoted those ideas … but this would never be assumed or even suggested by any architectural historian.

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a series of problems that they had set aside to discuss together. This meaning is closest to the way it is used in the world of architecture today.

The tables for the 33 cities were all drawn up using the same analytical criteria, the same scale and a unified system of colours and symbols. The *new plan for Amsterdam*, (which was already in the conclusive stages of planning), was their model (based, in turn, on Le Corbusier's previous theories). The instructions for different national groups were derived from this Dutch example, in order to make the material "*easily comparable and thus show it in a unified way*". *Directions for exhibiting The functional city, December 1931.*

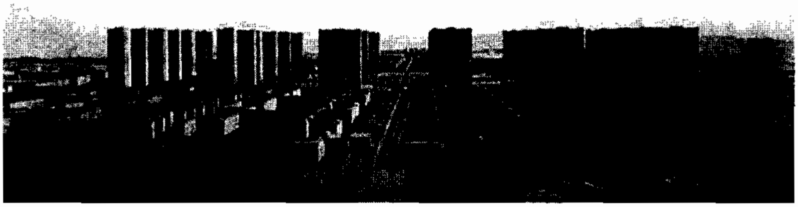

Figure 1: 1921-22 Le Corbusier, «La Ville contemporaine pour 3 millions d'habitants»

The "Final Resolutions" resulting from this work led to drafting the "Charter". The chapters dedicated to the Observations summarised the analytical work that had been carried out and, quite obviously, denounced the "ills of the contemporary city that had to be faced and resolved"; however, the paragraphs that followed looked at ways to "Il faut exiger" ("make a demand"), enunciating the principles that had to be followed in order to achieve a functional city. Right from its title, this was irrefutable dogma, which was presented as the dictatorial imposition of a presumably élite group of qualified thinkers.

Confirming the fact that they were looking to justify the judgements and decisions that had already been made, the Spanish G.A.T.E.P.A.C. (Grupo de Artistas y Técnicos Españoles para el Progreso de la Arquitectura Contemporánea) declared in "AC":

«The importance of the collected documents is extraordinary, perhaps even more so than the foundation material for the Frankfurt (The minimum dwelling) and Brussels (Rational Lot Development) Congresses. For the first time, we can carry out a comparative study of the historical evolution and current state of the world's principal cities. [...] The urban phenomenon is perfectly clear in these city plans. These are not merely splashes of colour and the outlines are not mere squiggles, whether agreeable or not; these plans are expressive, organic ones that can explain the vital phenomena of every city. The analyses of these plans, once complete, can confirm the urban planning theories of recent years for us».

And as it happens, among the Congress documents, the Barcelona plans presented by GATEPAC (fig. 3) were considered a sort of revelation, a true harbinger of the principles discussed and codified in Athens. The plan for "Future Barcelona" was seen by Le Corbusier as a "magnificent functional city", "a radiant and contemporary city, well positioned where it belongs, between the sea and the hills".

But it seems that not everything that happened during the Congress went according to plan. Part of the programme in Athens changed. For example, according to the original programme, the Congress delegates were to have crossed the Aegean Sea all together for three days ... but for some reason they ended up travelling in three separate groups, one towards the Cyclades Islands, another towards the Argosaronic and Peloponnese islands, and the third went to Delphi. Some critics have pointed out that this "separation" in the journey illustrates the diversity in view points, highlighting disagreements within the 4th CIAM. (Y. Simeoforidis, 1993).

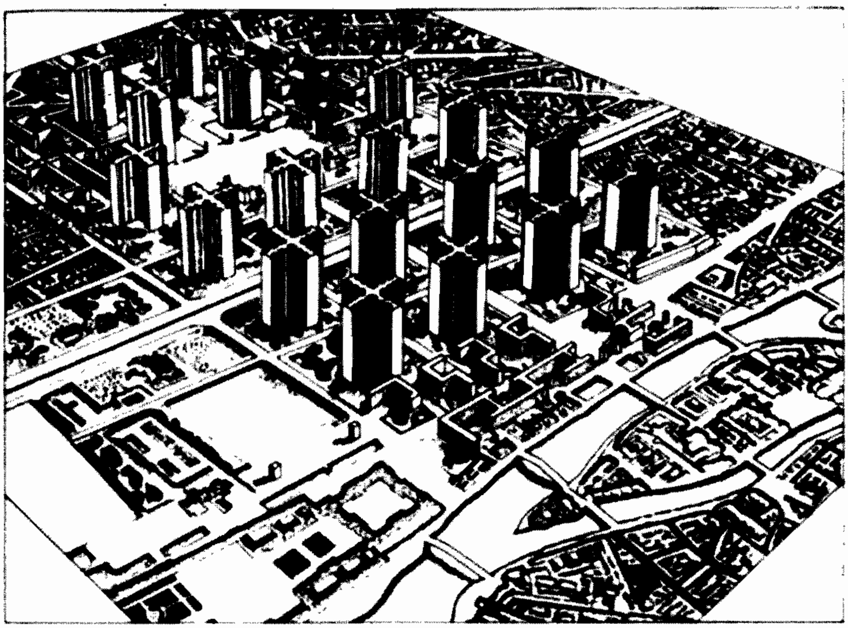

Figure 2: 1925 Exposition international des arts dècoratifs, Plan Voisin for Paris. The Plan Voisin called for a radical demolition and reconstruction intervention, involving 240 hectares in the centre of Paris. The area involved was located along an East - West axis between rue des Pyramides and the circular Champs Elysées square, Gare St. Lazare and rue de Rivoli. Residential buildings (immeubles-villas) were to be built on the site, with a commercial area along a secondary axis (northwards from the Seine) upon which cross-shaped skyscrapers would be located. Only a few "monuments" would be saved from demolition (the Louvre, Place Vendome) though often moved from their original location and surrounded by huge park areas.

During the return journey to Marseilles, the delegates are also supposed to have drafted a unified document on the FUNCTIONAL CITY that summarised the preliminary work and the outcome of the debate that had taken place. In accordance with the objective of the first CIAMs, the idea was to draft the document in a prescriptive form, with the objective of codifying and sharing the principles of urban planning and modern architecture, affirming the authoritative nature of the modernist point of view. But this did not go according to plan either, and this was because of the difficulty in "placating" those who were agitated because of the differences of opinion that surfaced during the Congress. This was confirmed by Giedion, the secretary himself. At the next Congress he said:

«There are two opposing directions within CIAM [...]. One of these chooses a prudent analysis of facts as a departure point and on this basis it tries to arrive at a new situation step by step. [...] The second one approaches the problem globally, with something similar to a bird's eye view, and it expresses itself with wide ranging designs that look forward. [...]» (S. Giedion, 1937).

We also know that at the beginning of the return journey, on board the Patris, after the first disagreements the Dutch CIAM president, Cornelis van Eesteren attempted to restore order and proceed to drafting a final document. He stated:

«Without decisions our work has no meaning. Decisions are the same as reports [...] Our reports are the most important thing. It would be better for the Congress to risk taking the wrong decision, rather than losing our way in endless analysis».

What was he referring to? From the words of his call to order it is clear that it had not been possible to come to an agreement.

During the outward journey, a commission had been elected to draft the final resolutions. At Athens, a questionnaire was distributed, divided into four functions (housing, free time, work, transport) with an additional part on the historic city. On departure for the return journey, the different country groups turned in their questionnaires. It was immediately clear that there was no single position, and thus on the penultimate day of the journey not one but three different versions of the concluding text were presented to the delegates. The "strange" coincidence of the number of versions and the aforementioned number of groups travelling in the Aegean Sea should be noted! The reasons for disagreement were mainly centred around issues of land ownership and land patterns (U. Ischia, 2006) (in other words the things that interest speculators) and historical heritage. On August 14th, at the end of the Congress, on arrival at the port of Marseilles, almost all the members of the Commission for the resolutions remained in the French city, except for Le Corbusier who left the group. After arriving at a compromise, a document entitled Communiqué du Congrès divisé en trois parties (P. De Biagi, 2005) was drawn up.

As confirmation of the divergences and difficulties, intense correspondence followed (P.G. Gerosa, 1978), between August and December '33, principally between Le Corbusier and Giedion, in which they mainly discussed the political dimensions of architects' work and their relationship with political authorities (the need to demand!).

Time passed and Le Corbusier wanted the resolutions to be presented at all costs. The letter that he wrote to Giedion on August 29th was the clearest proof that disagreement existed, the proof that everything that had been done was nothing more than an attempt to disguise Le Corbusier's own theories and present it as something that, in the public opinion, should seem the "consensual" result of group work and, by extension, the translation into urban planning of the "shared desire" of modern man! This letter is quite disrespectful, and shows the despotic side of Le Corbusier. Above all it demonstrates how he wanted (maybe because of his relationship with the automobile industry lobby) to make a breakthrough into political circles where decisions are made that turn into laws and urban planning codes:

«Listen to me, Giedion: I've been staring at reality for ten years. I know what the problem is, what makes people uneasy, where the brakes, the weaknesses and good intentions are. I know what we should aim at [...] whom we should refer to. Our 4th Congress is an event. That's all! [...] Decisions were taken on the last day and accepted by everyone. They're objective. This is the sensible thing: agreement on objective ideas. And it's ideas that we need to put in front of public opinion. This is what our Congress lives for. Otherwise it will perish! These objective ideas will be the truth from 1933 for everyone, in all countries.... We must not try to get out of it. We have responsibilities: architects await us, so do Mayors and ministers: in short, people who have responsibilities. You don't hold a Congress to say empty things, but to build [...] The time has come. Giedion, the world burns. There is need for certainties. We are the technicians of modern architecture [...] I ask that the resolutions be published. Their form isn't important to me» (P.G. Gerosa 1978).

Despite this, Le Corbusier published the volume in the name of the French CIAM Group entitled Urbanisme des CIAM. La Charte d'Aténe only in 1943, (or maybe 1941 or '42 according to some historians), ten years after the congress. In this way he made the statements of the 4th CIAM "his own", editing them, splitting them into 95 points, and conveniently commenting each one himself. The work that he had started and ardently fought for from the time of the Contemporary City in '21, could not have been reworked and codified by anyone else.

Our knowledge of the "way things happened" cannot help but cast a shadow on that presumed communion of thought that he tried to uphold. Then in 1957, a new publication followed, La Charte d'Aténes, whose only author was Le Corbusier ... As Pier Giorgio Gerosa astutely pointed out «The appeal of a collective text in the star's mythological orbit had already become a fact».

Unfortunately it was too late to cast doubt on the ideas in that document presented as the summary of common thought and desire. In the light of world-wide legislation after the 4th CIAM, and consequently the way in which architecture and urban planning are taught in universities – and put into practice by professionals the world over – we need to recognize in Le Corbusier the figure of an absolute monarch, a new "Sun King", who was able (despite the fact that he never earned a degree in architecture) to subordinate the population of the whole world to his ideal of the city and of architecture. The Empire of Modernism, with no recognisable territorial boundaries, can be held to be the largest empire that ever existed in human memory, and its leader, Le Corbusier, the man who was able to painlessly (if we leave out the psycho-social damage caused by his "functional city") impose his hegemony at a planetary level.

It is interesting to note that it was Le Corbusier himself who took the trouble to point out that

«the Charter was not the work of an individual but the conclusion reached by an elite group of builders who were passionately dedicated to the new art of building, armed with the certainty that the homes of men [...] should be re-examined [...] (Le Corbusier, 1950) ».

Widening the Charter's "intellectual origins" was useful to give the image of a collective and shared harmonious thought ... despite being limited to "an elite group of builders" regardless of the wishes of the "thoroughly ignorant" common mortals who would have then had to live in those cities.

As confirmation of the serious repercussions that the Charter had on urban planning all over the world, Sigfried Giedion said in his speech at the 6th CIAM held at Bridgwater in 1947:

«Today we know that the Athens Charter, which laid the foundation for modern urban planning in 1933, had a great influence on legislators (S. Giedion, 1951)».

The following statement of Le Corbusier can shed light on the bias inherent in the work done in '33:

«The Athens Charter opens all doors to modern day urban planning. It is an answer to the existing chaos of cities (Le Corbusier, 1951)».

Le Corbusier's rhetoric is evident from the statement he made (Le Corbusier, 1931), when it was decided to hold the 4th C.I.A.M. in Greece (initially, Moscow had been decided on). He held that holding the Congress in Athens did not mean that it would in any way have any relationship with the historic city as, "by statute", the CIAM did not mean to return to the past, or to plan and consider a city or architecture that were not "contemporary". Thus he wanted to negate that "past" for what it was.

The highly critical vision of the historical layout of the cities discussed by the Congress, starting with the chart presented by GATEPAC of Cerdà's Plan for Barcelona, shows that the historical urban grid was already considered extremely unhealthy, confused and harmful for the future city. The concluding chapters of the CIAM founding Congress at La Sarraz, and the Athens Charter, both dealing with "historical heritage" were explicit in declaring CIAM's refusal to «transfer to their works the creative principles of other epochs and the social structures of the past***». Besides, the theorists of Modernism insisted that it was necessary to "Annul history!" and use "Zeitgeist" (the Spirit of Time).

***From the concluding declaration of the founding meeting for CIAM at La Sarraz: «*The work of architects is [...] that of finding agreement with the great*

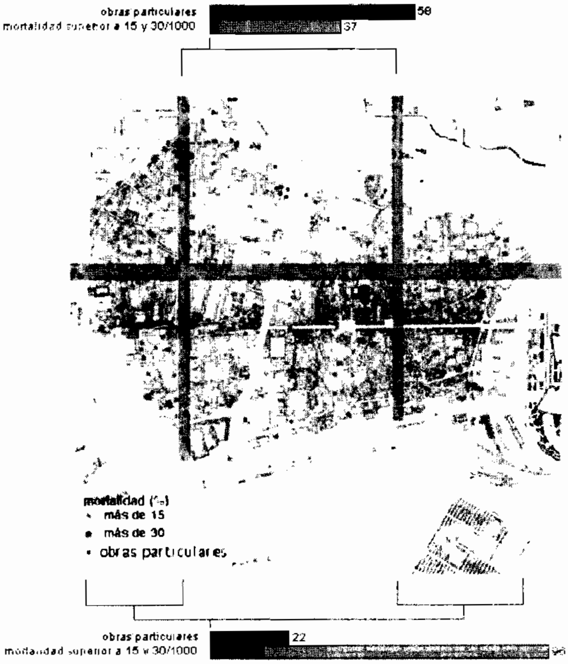

Figure 3: Chart presented by GATEPAC during the 4th C.I.A.M. - Barcelona at the beginning of the second half of the 19th century. This map specifically indicates the mortality index, and as such is a useful document to show the need for Engineer Ildefonso Cerdá's work in adding three roads to the original urban fabric. The addition of bar graphs to this table at the bottom (summary of data from the internal area) and the top (summary of data from the external area) made it possible to analyse the impact that the works proposed by the Catalan engineer (obviously) would have had from the health point of view.

3 A Few Final Considerations

My criticism is actually nothing new. Even at the '33 Congress, a person very close to Le Corbusier realised that they were proceeding towards a dead end. The CIAM's own members had no interest in listening to other architects who were working during those same years using a modern approach that respected tradition. But they might at least have taken into consideration these words of Fernand Léger, a French painter who was Le Corbusier's friend and a member of

events of the time and with the great objectives of the society they belong to and to create their works in conformity with them. Therefore they refuse to transfer to their works the creative principles of other epochs and the social structures of the past». Official Declaration, June 28th 1928 the friends of CIAM, in his DISCOURSE TO ARCHITECTS, in Athens that August of '33 he said:

«I think that your heroic epoch has ended [...] The clearing up effort is over. Stop, because you are going over the limit [...]An élite (group) has followed your heroic epoch. That is normal. You have built state-of-the-art houses for people Instead you want your ideas to spread... the term "urban planning" to overshadow the aesthetic problem". [...] "Town planning is social. You have entered a brand new field, where your pure and radical solutions will have to fight [...] Abandon this elegant and condescending minority [...] The small average man, the "city dweller" in other words, is dizzy [...] you have created an absolutely new architectural concept. But from an urban and social viewpoint, you have gone too fast. If you want to do urban planning, I believe you must forget that you are artists. Become "social" [...] there is a schism between your aesthetic conception accepted by a minority and your urban vision that is in trouble everywhere because the masses do not understand it, [...] you should have looked behind you: you would have seen that you have no followers [...] It is necessary that men like you carefully observe the men behind you and those at your side and who expect something, [...]. Put your maps/plans back in your pockets, walk down the street, listen to them breathe, make contact, lose yourself in the raw material, and walk in their dirt and dust ». (F. Léger, 1933)

Unfortunately these words came to nothing, because from that moment onwards, the way of thinking about architecture and urban planning changed forever for the sake of faut exiger!

4 The Proposal

The historical archives of all Italian cities, like those in every city or town in the Mediterranean area are packed with documents that can show how construction was done before the advent of Modernism. During the very same years when people were theorising about the "functional city" and creating new theories from nothing, many cities adopted more logical regulations in order to "survive" the advent of the automobile. Even large cities, for example Rome and Bari, approved very interesting Building Regulations. Many cities, especially in countries that bordered on the Mediterranean sea – which were left out of the cultural debate because they were considered "secondary" – managed to resist the advent of modernism for much longer, thanks to their "lack of importance". This condition of "cultural delay" (obviously with respect to the advent of Modernism) makes it possible for us to suppose that in those places pre-modern regulations and urban codes existed, including those passed recently which, as evolutionary logic would suggest, are the natural evolution of older or ancient ones.

More information about these regulations (from before '33 in Europe, while in North Africa and the Middle East they could date to the early '50s) could thus open up new avenues for urban renewal, especially in suburban areas devastated by urban planning based on numbers, zoning and standards.

Logical evolutionary continuity is a simple concept. Except for the annulment of history theorised by Modernist ideologists, all historical periods have made good use of their inheritance and gone on from there. This means that the historicist principle of cataloguing everything into compartments and putting a label with a date on it cannot be considered valid at all. On studying the representational arts we can see how works of the early Renaissance blend with those of the of the late Medieval period, and then with Mannerist and Baroque art, etc. No-one woke up one morning declaring "today I will create Baroque!" This natural passage from one "choice" to another, is even more applicable if we look to the principles that oversee the criterion of co-habitation within a society, so much so that many of the norms that the Italian Civil Code contains today can be traced back to the ancient ones of Roman Law. And this is just as valid for the laws that apply to the "ART OF BUILDING CITIES". Byzantine (Julian of Ascalon, 531-533) and Arab (Ibn Abd al-Hakam, 767–829; Ibn Dinar, 827; Ibn al-Rami a Tunisi, circa 1350) urban planning treatises do in fact exist, such as those studied by Besim Hakim (2001). If correctly studied they show how the whole history of urban planning in the cities of the Old Continent have never known a "dark age". Those documents allow us to establish how a series of norms from Roman Law were revised during the Byzantine period, only to be revised again by the Arabs, and finally return to Italy, or be exported to all Islamic countries, before merging with the architecture of Renaissance cities.

During every period, and respecting a series of general rules, all countries, and the regions and cities within them developed their own architectural and urban planning character based on their specific needs.

Before the annulment of history theorised at the beginning of the 20th century, no such break had ever existed.

The objective of our research is to historically reconstruct this "pathway" which had led from Rome towards Byzantium and the Middle East to later return to Italy that without a break. At a world level today, a large group of people from different disciplines have emerged, who agree on ideas for improving cities, making them "sustainable" and saving the planet from global warming. In Italy there is now a good group of persons who live in the various cities and who could do their share to help. Thanks also to the network, and to our relationships with many colleagues all over the world, we could take advantage of help from people in countries such as Greece, France, Spain and Portugal, as well as in Libya, Egypt and Lebanon. We want to bring teachers and architects from the different Mediterranean countries together in order to recover some of those Building Regulations, technical norms etc. from local archives and start working together to evaluate guidelines – or principles – that could enable every country according to its needs, customs and traditions, to work out plans to create sustainable modern cities, more respectful of human beings. Research of this type should have the participation of architects and urban planners (spirits free from the prejudice of the modernist matrix), historians of Roman and Byzantine law, historians of Arab and Islamic culture, urban sociologists, etc.

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Convergence of Intensity [Ci] or How to Purposely Shrink a City

Constance C. Bodurow, Jordan R.M. Martin
Lawrence Technological University

Abstract

Attempts to describe the current and envision the future condition and form of the shrinking city lie along a wide spectrum – from the pessimistic [city as an "unlimited vacuum"] visions of Landscape Urbanism to the optimistic [city as a place for "unlimited capacity"] projections of Hyper-Urbanism.

In our design research, we ask: What form would the post industrial city take if shrinkage were purposeful? What if cities such as Detroit or New Orleans abandoned the restrictive nostalgia of their expansive [and unsustainable] urban geographies and embraced the forces of intensity [or the intent to become intensive]? What if shrinkage came to be viewed as the ethical, valued, sustainable approach in contrast to the explosive, unchecked, eco-system shattering growth of the cities of the BRIC nations? What if communities proactively identified and designed for the "coming together" of population, energy, capacity, investment, blue, green + gray infrastructure and existing built form into a spatial convergence? The author defines this purposeful phenomenon of "re-sizing" the city based upon broadly defined density metrics as intensive convergence or a convergence of intensity [Ci].

Detroit and New Orleans - two proud yet wounded cities whose patriarchal structures have failed them - portray the most exaggerated [and often cited] examples of the phenomenon of contemporary urban "shrinkage". These cities also provide the basis for investigation and intervention – initially Detroit, described here, with its stubborn defiance of normally reliable market forces. Both cities have high [sustainable] ground in their original urban form and settlement patterns, concentrations of population, and growing political will to "shrink" – though, in recent initiatives, these criteria alone have proved unsuccessful as a basis for purposeful shrinkage. Ci may provide a theoretical and practical way forward to a future, sustainable state.

During the summer of 2009, the authors engaged in a design research project in Detroit Michigan [an outgrowth of past and continued design research initiatives to envision a more equitable and sustainable city]. This example of the "place of research and the research of place" adds new theory to the discourse of re-sizing the shrinking city, and illustrates an application of Ci through a collaborative design process between the community and the academy.

The authors assert that in response to the well documented phenomenon of "shrinkage" of the post industrial city, that a new urban eco-system is required, one which takes advantage of the complex combinations of social, economic and environmental forces, while increasing flexibility and reducing susceptibility to their mercurial nature. This urbanistic and theoretical approach to the shrinking city disputes both extreme future visions put forward for both cities. The paper provides a brief background, describes our theoretical approach, design process, and an initial application of the Ci theory via formal urban design recommendations. Detroit serves as the context for the first application of Ci, but the authors believe that the design methodology is replicable and widely applicable to empower the purposeful shrinkage of cities across the globe.

Keywords: *architecture, density, spatial analysis, sustainability, urban design.*

1 Background

intense: adj. 1 of extreme force, degree, or strength: intense concentration

intensive: adj. 1 very thorough or vigorous 5 denoting a property measured in terms of intensity rather than extent.

intensity: n. 2 [chiefly Physics] the measurable amount of a property.

intent: 1 n. intention or purpose. adj. 1 determined to do. – attentively occupied with 2 showing earnest and eager attention.

converge: 1 come together from different directions so as eventually to meet. – come from different directions and meet at.

Cities are dynamic artifacts: they exist in a state of constant change. Shrinkage as an urban phenomenon has existed in the continuum of cities for millennia. Imperial Rome shrank from a peak of 1 million citizens to less than 100,000 by the Middle Ages. The British cities which led the Industrial Revolution – Glasgow, Liverpool and Manchester – peaked in population by 1900 and have been declining since (Rybczynski + Linneman, 1997). In the last decade, the concept of urban shrinkage has been reinterpreted in concert with the reality of a globalized social, economic and environmental context for urbanized regions. Two contemporary cities have often been paired [to the point of cliché] to describe the phenomenon of urban shrinkage: Detroit and New Orleans [NOLA]. Shrinkage has occurred, infamously, in Detroit over 50 years of slow attrition and in New Orleans via swift trauma over the course of a weekend. Globally, other post industrial cities have shrunk through failures of long trusted patriarchal structures, and the complex combinations of social, economic and environmental forces.

The phenomenon of the Post Industrial city was identified over thirty years ago (Perloff, 1980). Such cities are defined in economic and market terms – "the post-industrial city is...a continuation of the industrial city...a city in which traditional industry maintains a significant but decreasing share of economic activity, replaced as an engine of economic growth by the production of various types of services" (Shaw, 2001). The phenomenon of shrinkage, more often identified as a "problem" or "syndrome" as though a disease – is generally defined as "cities with population of 100,000 or more that have undergone population losses of greater than 10 percent in the last five decades (Wolf-Powers, 2007). The phenomenon was formalized by the well funded German Federal Cultural Foundation's "Shrinking Cities Project" [www.shrinkingcities.com], a project and traveling exhibition that claimed "classic urban design and city planning has come up against its limits" (Oswalt, 2004). The Shrinking Cities project engaged architects, academics and artists to provide perspectives on shrinkage. Featuring four cities - Detroit, Ivanovo, Manchester / Liverpool and Halle / Leipzig - each described an example of a specific strain of depopulation, with its own industrial raison d'être, and parallel strains of social unrest and cultural traditions forged from its deindustrializing crucible.

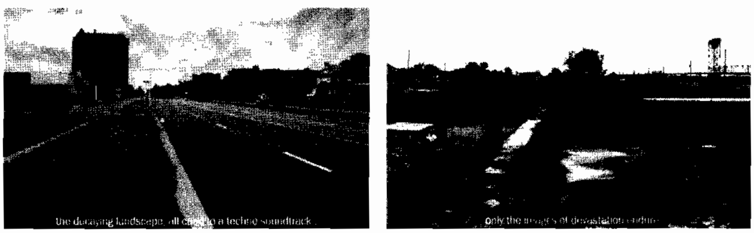


Figure 1: Globalized images: Detroit and NOLA as portrayed by the international media, art + design communities

While Detroit and NOLA - two proud yet wounded cities whose patriarchal structures have failed them – portray dramatic examples of the shrinking cities phenomenon [both experienced over 50% reduction of population], they share an urban condition with 370 other cities, largely in the western, developed world. Even so, an entire creative industry has emerged around a morbid fascination with the two cities. Detroit is predictably rendered in all the "usual suspects" of its globalized image: aerial views of abandoned auto factories and neighborhoods, the '67 riots/civil insurrection, deteriorating infrastructure, decaying landscapes and resilient citizens, all cued to a techno soundtrack. The results are formally compelling yet sentimental. A superficial, and image-based knowledge of place, no matter how well intentioned, is evident, and ultimately, it is only the images of devastation that endure. Over almost two decades, beginning with Camillo Vergara's now infamous photographs documenting, over time, the empty skyscrapers of downtown and deteriorating neighborhoods, a slew of designers have descended, motivated by the so called "blank slate" of Detroit's vast abandoned geography. Numerous architectural and urban design studios and charrettes have studied Detroit from Ann Arbor, LA, even Oslo, Norway. The influx will culminate [one hopes] with Time, Inc.'s year long scrutiny: Assignment Detroit (Carr, 2009).

Post-Katrina NOLA's traumatic shrinkage has been similarly portrayed in the media, and received even greater response from the design community. NOLA has received massive amounts of funding in support of design initiatives– in FY 2003 alone, the US federal government has provided $3.1 million in funding for urban planning University partnerships (http://www.oup.org/). A Google Search of "exhibitions on post-Katrina NOLA yielded 10,500,000 hits, including the United States Pavilion at the Venice Biennale, After the Flood: Building on Higher Ground. Since the art and design disciplines are not "first responders" after disaster, the author acknowledges the genuine human desire to contribute after such urban trauma. Indeed, the authors have personally participated in several such initiatives, including the AIA RUDC NOLA Charrette, Operation Comeback Field Inspections for the National Trust for Historic Preservation, a Detroit University based NOLA Field Studio, and Neighbors Helping Neighbors through the Ontario federal college system.

Despite all the attention of domestic and international intellectuals, unfortunately, precious few of the efforts result in truly relevant recommendations to prompt improvement in the urban and human condition. The nature of the attention, the ubiquitous streaming video and photography of deteriorated, abandoned landscapes, all of which document a moment in time for each shrinking city and produces, intended or not, a numbing affect, for both residents and the world that might offer productive input and assistance. Residents of Detroit have become so numbed, a local website developed "Assignment Detroit: The Drinking Game" as an understandably sarcastic reaction to the perennial media obsession with the city (http://dyspathy.com/).

This morbid fascination conceals a barely hidden agenda that Detroit and NOLA are expected to remain frozen in time — a devastated palette ripe for creation. What is needed is original and unsentimental commentary on imbalanced and unsustainable development and its social, environmental and economic impacts. In cities such as NOLA and Detroit, citizens want and expect fresh perspective that is contrary to and may point a way out of their current urban and regional condition. If the intent of such art and design interventions is to displace "classic" approaches, then surely, proposed interventions would address the issues facing the citizens of the city: housing, mobility, employment and providing for and raising children in a challenged economic climate and making recommendations which elegantly address the basics of self-determination, food production, and economic and environmental sustainability in the urban context. (Bodurow, 2007).

2 A Theoretical Approach

Urbanites are interested in the future of urban form. Fundamentally, cities should be the most desirable location for human habitation: beautiful, equitable and sustainable. The city and more to the point – the shrinking city – is an antithesis of this desirable urban condition – but no less a complex and ever changing entity. Attempts to describe the current and envision the future condition and form of the shrinking city lie along a wide spectrum. Most adopt a 20th century, capitalist notion of growth and regeneration: promoting growth as "good", inevitable, and accommodated and assimilated through technology. That growth will provide something – form, program, policy - to fill in the gaps of the post industrial city. Rollin Stanley, defined this at the 2005 UC Berkeley Conference on shrinking cities as "the dogma of growth" (Allweil, 2007).

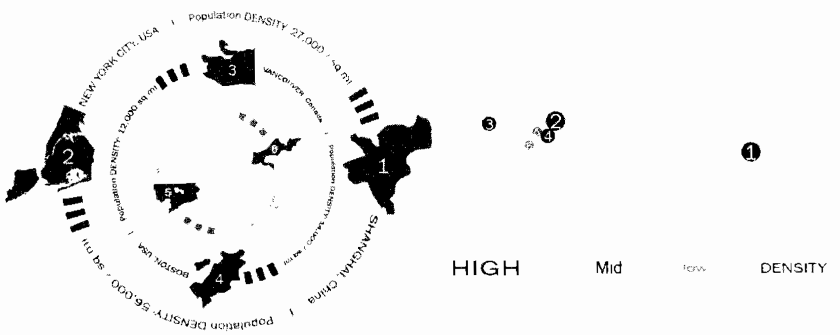


Figure 2:A spectrum of urban Density: population densities of:
LD [low density]: Regional Detroit, MI, USA and New Orleans, LA, USA
MD [mid Density]: Boston, MA, USA and Vancouver, CA
HD [High Density]: Shanghai, China and New York City, NY, USA

Much has been published in the post-modern era extolling the theoretical, conceptual and practical virtues of inherent urban density. Urbanists began the argument in the 1960s with incisive criticism of modernism and its impact on the physical and social fabric of North American cities (Jacobs 1961). After languishing during decades of unabated urban sprawl, a revived focus on the center city praised Manhattan's grid, resultant density at the scale of the block, and the desirable "culture of congestion" that it has generated (Koolhaas 1978). Contemporary urbanists have focused on the complexity of the city and have promoted density [especially in cities experiencing exponential growth] as a way to address contemporary global ecological and quality of life challenges (Maas

2005, 2007). More mainstream endorsements from industry and professional groups identify density as a viable alternative to sprawl, generating increased livability and sustainability in urban areas (McCown 2003). However, the majority of these theoreticians and practitioners have focused solely on the built environment, subsuming other metrics. Some have addressed the social aspect of density, noting the importance of documenting and integrating cultural and quality of life issues (Cruz, 2007) and concluding that "conceiving the city in terms of form is neither necessary nor sufficient to achieve the goals ascribed to the compact city. Instead, conceiving the city in terms of process holds more promise in attaining the elusive goal of a sustainable city" (Neuman, 2005).

Cities are not static artifacts – they exist in a state of constant change, and along a spectrum of urban density, growth, and contraction. For purposes of contrast, we highlight the extremes of current urban theory – the low density Landscape Urbanism approach and the Hyper-Density approach.

Unlimited Vacuum?

Proponents of landscape urbanism are pessimists in their approach to the shrinking city. Examining "the context of global capital, post Fordist models of production, and informal labor relations," Landscape urbanism asserts that "urbanization continues to decrease the density of North American settlements" (Waldheim 2006). With landscape as their principal "building block", they offer a vision which utilizes abandonment and decay as the primary assets of the shrinking city, making proposals for interventions that recommend large swathes be left fallow or turned over to natural forces. There is little recognition of existing residents and their daily activities, with the exception of "residual human use" such as the training of firefighters. (Waldheim, 2001). Similarly, the concept of "dross…emerges as a consequence of current rapid horizontal urbanization" and "accumulates in the wake of the socio- and spatio-economic processes of deindustrialization, post-Fordism, and technological innovation" (Berger, 2006). Again, the wasteland of the shrinking city becomes the valued asset, advocating the "designer to consider working in the margins rather than at the center." This approach is also supported by economists, who have defined the emerging post-industrial trans-national economy as "spatially dispersed, yet globally integrated." (Sassen, 1991)

Unlimited Capacity?

Proponents of hyper-density are optimists in their approach to the shrinking city. They promote the city as a place of unlimited development or "capacity", calling for "a new…city that continues to serve all demands while incorporating all desire. A city that increases our capacities within the current mass, as well as in the currently underused spaces". Further, "it will lead to a new programmatic 'skin" around the globe that probably will not only extend only horizontally but upwards and downwards as well." (Maas 2006). This notion of endless carpet of density across the globe – land, sky and sea – replicates the 20th century notion that growth is inevitable. That the city is about "the promotion of "consumerism and optimism over protectionism and pessimism" (Maas 2006). Unlike Landscape Urbanism, the hyper density approach relates to mid- and high-density cities, particularly those with explosive economic and population growth such as the major cities of the BRIC [Brazil, Russia, India, and China] nations.

Limited Intersections [the new geography]

The author proposes an alternative theoretical approach which is neither optimistic nor pessimistic, but ethical. Convergence of Intensity [Ci] is a value based approach which meditates the two ends of the density spectrum. Ci proposes specific criteria for the "re-sizing" of the post-industrial|shrinking city, arguing that balanced, sustainable, dense and urbane development is still possible.

The author's previous design research defined value densification as "a focus on investment and development in neighborhoods and districts where inhabitation, infrastructure, cultural and employment assets [and value] are in evidence" (Bodurow, 2006- 2009). A resultant project in collaboration with two regional Detroit communities – the Value Densification Community Mapping Project [VDCmp] – was developed to explore how aspects of the post-industrial city can be understood, communicated and leveraged in service of equity and sustainability and to use technology to reveal data about the city in order to convince community, political and economic leadership to embrace densification. The project focused on the creation of a unique multivariable digital interface that incorporates and merges components of several 4D visualization softwares to model physical and social density and value in three dimensions. The digital interface is currently in use, empowering the community through asset identification and creation of an accessible tool to assist in envisioning its environmental, social and economic future.

Value densification was conceived from an analysis of Detroit's development and spatial legacy and guided by a broader interpretation of value. In support of a design studio, the author has documented the growth and decline of Detroit's industrial spatial logic over 150 years, and the associated social, economic and environmental investment. This study revealed that while large swaths of abandonment existed, geographic foci could be identified through proximity to continued [expanded] "places of making" (Bodurow, 2006) and a broad and diverse interpretation of value that results from the investigation that subsumes the economic and elevates human [inhabitation], cultural [place] and infrastructure [ecosystem] value (Bodurow, 1991).

Expanding on the value densification methodology and interface, the author proposes Ci to further investigate the implications for urban form, contending that shrinkage should be purposeful. Detroit or New Orleans should abandon the restrictive nostalgia of their expansive [and unsustainable] urban geographies and embrace the forces of intensity. In this way, the negative stigmatism of shrinkage might come to be viewed as a valued and sustainable approach in contrast to the explosive, unchecked, eco-system shattering growth being experienced in the cities of the BRIC nations. These cities should proactively identify and design for the "coming together" of population, energy, capacity, investment, blue, green + gray infrastructure and existing built form into a spatial convergence. The author defines this purposeful phenomenon of "re-sizing" the city based upon broadly defined density metrics as a convergence of densities [intensity] intensive convergence or a convergence of intensity [Ci].

The fundamental question in "re-sizing" the shrinking city is: where and how will we sustainably redevelop [densify] and support resident populations with infrastructure, services and investment?

Since answers to this essential question have been dominated by capricious political, market, and/or social forces, the consistent description and application of metrics [criteria] are essential. Certainly, NOLA has experience with proposals of "concentrating investment in more populated parts of the city" (Luescher, Shetty, 2009). The Wallace Roberts & Todd [WRT] plan proposed rebuilding New Orleans as an archipelago of connected neighborhoods. WRT argued that the city should "shrink the footprint" by strategically rebuilding neighborhoods most likely to have a critical mass of returning residents. The plan met with citizen protest, and was ultimately abandoned. The state of Louisiana and the city went on to produce additional, competing plans (Saffron, 2006).

Both Detroit and NOLA provide the basis for investigation and intervention – initially Detroit, with its stubborn defiance of normally reliable market forces. Both have high [sustainable] ground in their original urban form and settlement patterns, concentrations of population, and growing political will to "shrink". Detroit might have grown [densified] within its "high" ground – within the Grand Boulevard – the city limits until 1927 when it sprawled, through annexation, to its present 140 square mile unsustainable form. NOLA might have stayed tight to the levies – its high ground, perhaps the effects of Katrina would have been mitigated. Both cities have concentrations of population – though these criteria alone – as evidenced by the reception given WRT's plan – has proven unsuccessful as a basis for purposeful shrinkage.

In response, the author asserts that a new urban eco-system is required, one that leverages the assets and the complex combinations of social, economic and environmental forces of the shrinking city, while increasing flexibility and reducing susceptibility to their mercurial nature. Ci identifies and purposely weights an expanded set of criteria for shrinkage:

population - shrinking cities such as Detroit and NOLA are often characterized by significant population loss. However, both cities have neighborhoods that are characterized by stable, even growing populations. Concentrations of inhabitation serve as a foundation criterion.

capacity – here defined specifically related to built form and density – both existing and potential. In particular, we refer to the "as of right" zoning build out envelopes – the density that market forces would generate in a growing city. Given the economic context of shrinking cities, often these conventional approaches to development are ignored in favor of densities that attract public and foundation sector subsidy.

energy – defined as "embodied energy" both in terms of civic ethic and built form. This is energy transformed into intent. Shrinking cities have layers of organizational energy – largely in the non-governmental [NGO] sector. Citizens, failed by both the public and private sectors, have increasingly turned to self reliance as a means of stabilization and regeneration. Shrinking cities generally have a legacy of both built and narrative heritage. Such energy assets are both formal – those designated by some governmental authority; and informal – those deemed significant by the citizens of the community [we make no value judgment about the primacy of either typology]. Concentrations of these diverse resources become the third criterion.

blue, green + gray [infrastructure] – shrinking cities are rich with physical and technological infrastructure that supported manufacturing and movement of goods and services and the associated human settlement. This infrastructure defines the natural and built ecosystem of the city. We employ an expansive interpretation of infrastructure as "blue, green and gray": green infrastructure describes both natural flora and fauna and their related habitats and also man-made landscape and greenway networks and the increasing emphasis and presence of criteria-rated buildings and neighborhoods. Blue infrastructure describes the watersheds, floodplains, wetlands, hydrology, etc. Gray infrastructure is entirely man-made, including highways, roads, rails, digital technology, etc. along with the environmental impacts generated by such.

investment – in both Detroit and NOLA, there exists a highly subsidized development economy. Detroit is literally "upside down" with market forces, with every project built over the last decade having received some sort of development subsidy – tax abatement, public or foundation investment. LISC has invested millions in Detroit (LISC, 2009), and the federal government billions (HUD, 2009) In NOLA, both leveraging private sector investment. These phenomena array themselves spatially. Concentrations of unconventional investment become the fifth criterion.

The convergence of these criteria forms an intersection and identifies the new geography for design intervention. Ci takes value densification to the next level – modeling the specific opportunities and employing urban design rationale to make formal recommendations based on these criteria to guide the future of urban form. Ci will lead to decisions about priorities around concentration of investment and development. This strategy implies a very different urban form than the post industrial/shrinking city has taken in the twentieth century, but perhaps a more sustainable state. A primary intent of this approach is to empower communities to take advantage of the shrinking cities phenomenon. Detroit and NOLA are not simply susceptible to continuing degenerative forces associated with them. Additionally, the Ci approach may prompt a new way of interpreting, illustrating and leveraging distinctly urban assets and, in doing so, positively influence future urban form.

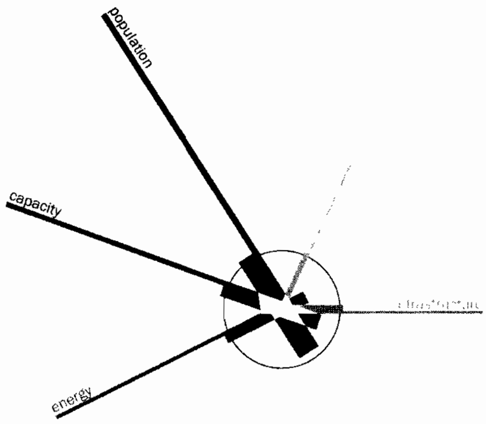
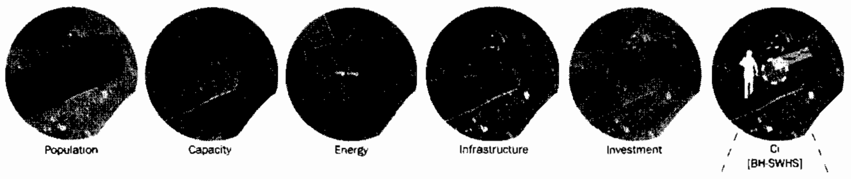


Figure 3: The new geography: Convergence of Intensity [Ci] – this diagram illustrates the primary metrics [criteria] implying a "coming together" of densities [intensities] into a spatial convergence.

3 A Contextual Design Process

The context of the authors' design research is Detroit, Michigan, USA. Specifically, we have worked in Southwest Detroit, a 12,450 acre, 19.45 square mile neighborhood located on the Detroit River, the international border with Canada and at the junction of major highway and rail infrastructure. Southwest Detroit is characterized by new immigration and population growth, a cogent cultural heritage, large employment centers, rich "blue, green and gray" infrastructure and cultural and historic sites. Southwest Detroit enjoys a vibrant commercial base and is served by highly skilled advocacy and longstanding, effective community-based development organizations, 25 of which recently organized under the umbrella organization of the Southwest Detroit Development Collaborative [SDDC].



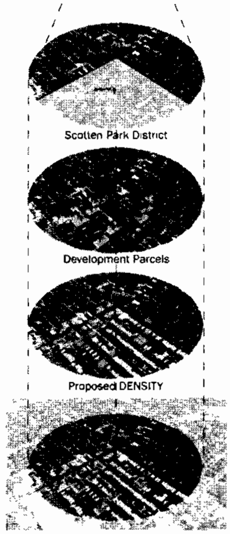


FIG. 4: Ci applied: Analysis Layering + Urban Design Rationale

Since summer 2007, the author has collaborated with the SDDC supported by LISC and AIA funding. This collaboration produced a multivariable 4D digital interface with 135+ data layers which "mapped" diverse attributes of human, organizational, physical and economic metrics. We are currently focusing on utilizing the resultant digital interface to conduct analysis in support of future Urban Design studies. By using data layers to construct what we call "analysis layerings", we prompted the community to identify additional layerings, and ultimately relevant and useful design work in support of community driven planning, design and development initiatives. This work has assisted in identifying unintended conflicts amongst various public and private development projects, and supporting specific initiatives as diverse as the placement of green infrastructure projects to marketing commercial corridors (Bodurow, 2009).

Formal [Urban Design] Recommendations

During summer of 2009, the authors initiated an initial application of the Ci theory via formal urban design recommendations. As an "example of architecture, urban design and related fields being part of the mix" [Luescher, Shetty, 2009] we applied the Ci theory and practice approach to re-sizing the shrinking city through a collaborative design process between the community and the academy. We engaged the community to identify potential Urban Design interventions and Development Opportunities. More than 23 initiatives are being contemplated and implemented in Southwest Detroit. We then conducted a Ci analysis to identify the intersection of various density metrics from the 135+ data layers in the existing digital interface. Authors selected specific metrics, illustrated with 3D extrusions at the scale of the parcel or Census block group, to vividly portray density:

population [density by block group];

energy [geographic locations of SDDC organizations and formal + informal cultural assets];

capacity ["as of right" zoning envelopes by parcel];

infrastructure [geographic locations of neighborhood parks and greenways and proposed Rail Link]; and

investment [business and employment density by block group].

The resultant analysis layering illustrates the new geography of convergence within ¼ mile of social, economic and environmental asset density in the Southwest Detroit neighborhood. Specifically, the convergence occurs in the Bagley Housing/Southwest Housing Solutions [BH/SWHS] neighborhood preservation plan area: a 1 acre area of Southwest Detroit. The community client selected one of BH/SWHS projects as a "beta test", since that organization, through Michigan State Housing Development Authority [MSHDA] subsidies, had built and were in the process of building, housing in this area.

In support of our work with BH/SWHS, we conducted an urban design study, including site visits and existing conditions documentation of the Scotten Park and Hubbard Communities study areas bounded by W. Vernor to the South, Toledo to the North, Junction to the West and 25th Street to the East. Informed by a digital model of existing built and proposed development for the study area, we identified all vacant parcels in the study area that were realistic for future development.

Further evidence of Detroit's highly subsidized development economy [MSHDA, etc.], our community client was not aware of the "as of right" zoning build out envelopes in the study area. We proposed to design and model the maximum density allowed under the current City of Detroit Zoning Ordinance. FIG 5 illustrates this MAX Zoning proposal, which is 55 units/acre – more than 6.5 times more dense, "as of right" than BH/SWHS's MSHDA application.

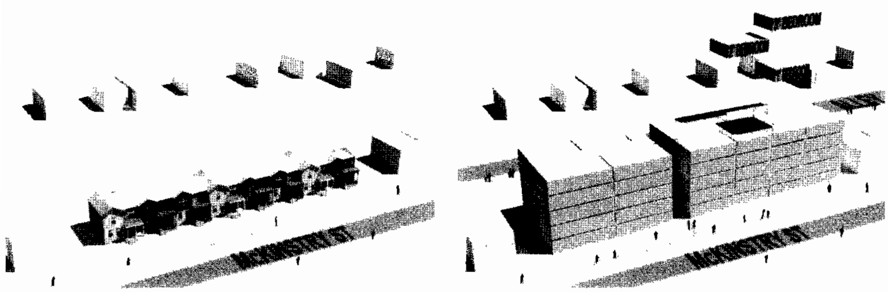


Figure. 5: min + MAX Zoning: BH/SWHS Scotten Park [8 units vs. 55 units/acre]

We developed and applied an urban design rationale, utilizing urban design principles to guide our density recommendations:

1 As of Right Zoning – the study area contains two zoning districts: R2 + B4. Each allows a maximum height of 35', with front and side setbacks from parcel lines based on existing built context.

2 Street Grid – three perimeter streets – W. Vernor, Junction, and Clark are four travel lanes each with widths that allow for more height and density – both formally and in terms of increased social density and pedestrian, motorized and non-motorized traffic. These perimeter streets also present the opportunity to continue the existing pattern of ground floor commercial. The Scotten Park study area has two sets of "one way pairs" with intermediate alleys. We targeted parcels on these "pairs" for increased residential density in keeping with the current pattern and character.

3 Circulation –proposed buildings are massed and sited to concentrate pedestrian traffic and entry along perimeter and residential street frontage and contain residential vehicular traffic and parking access via existing alleys.

4 Solar Orientation – the study area is ideally oriented with southern exposure. The proposed building massing reflects opportunities to maximize sunlight for residents and future green infrastructure.

5 Building Typology – two new typologies were recommended: Mixed Use [with Ground Floor, Commercial] and Apartment Residential in support of the MAX zoning scenario. Note that these higher density typologies are recommended for McKinstry and Uthes, and represent an alternative to BH/SWHS's

MSHDA application [e.g.: FIG 4 illustrates a proposed building yielding 55 units [15-3BR, 30-2BR, and 10-1BR] in comparison to 8-3BR townhouses on the same parcel]. For all typologies, 2+3 story buildings are assumed as "walk ups" and 4 or more story buildings include an elevator core.

6 Program – uses were driven by the community client and include residential and ground floor commercial [retail and services]. Opportunities for

GF Commercial were identified on the three perimeter streets. Higher density residential typologies were focused on interior parcels.

7 Public Realm – initial opportunities for green courtyards between and alongside residential buildings were identified.

The BH/SWHS Scotten Park Scenario 2: MAX Zoning, as of right, yielded an additional 30 development parcels. We designed and modeled 30 new residential buildings with 482,458 sf. of proposed residential density distributed among 488 total units [111 one bedroom units; 236 two bedroom units; and 141 three bedroom units] and 62,108 sf. of new commercial density in the study area.

This proposed density, if built, would essentially double the BH/SWHS real estate portfolio within walking distance of the convergence of densities illustrated in the Analysis Layering [FIG 4].

4 Conclusion/Next

Ci adds new theory to the discourse of re-sizing the shrinking city. Ci challenges extreme future visions for Detroit and NOLA: the pessimism of the low density approach of landscape urbanism and the optimism of the hyper-density proponents may provide a theoretical and practical way forward to a future, sustainable state.

While we have been encouraged by the results of the initial design process and its resultant formal recommendations, our work to date has motivated us to reflect upon, evaluate and enhance the Ci theoretical approach and design methodology. We plan to engage in this reflection while simultaneously continuing the collaborative design process between the community and the academy in Southwest Detroit to model the 20+ identified urban design and development opportunities using the Ci methodology. The authors are also investigating the use of parametric software to convert our "analysis layerings" into logic scripts in order to animate the convergence of densities at an urban scale in a more compelling manner. Our work to date has motivated us to enhance the Ci approach: how might we illustrate [animate?] the convergence of densities in a more compelling manner? What are the parallel metrics that might portray impact and benefit of increased density? Can we expand on the established methodologies for "carrying capacity"? We are researching "Swarm and Flock Urbansim" (Leach, 2009) and refining the interface and integrating Rhinoceros software into our 4D digital interface to better visualize, illustrate, analyze, and convey design direction for future urban form at the parcel scale.

In the Fall 2009 semester, the authors conducted a masters level seminar entitled DENSITY=GREEN: sustainable urbanism, density and spatial analysis. Participants researched, analyzed and visualized in 2D, 3D and/or 4D, parallel metrics that portray both the impacts and benefits of increased density in six cities representing the spectrum of urban density. This seminar also began to explore and expand upon the established methodologies for "carrying capacity"

(McHarg, 1969; Meadows et al 1972) to define a "tipping point" to human habitation in the urban context – a level at which the new eco-system created through built and population densities begins to negatively impact the natural environment and ecological capacity of an urbanized region. To further our "tipping point" research, we have applied for grant funding to support the creation of both formal and policy recommendations to encourage informed decision making and urban and architectural design around balancing the long term benefits and impacts of urban density. We hope to examine discreet sets of parallel or comparative metrics, including social, environmental, and economic to model the potentially positive and/or negative impacts of increased density, focusing on mixed use development, in three urbanized regions.

Detroit serves as the context for the first application of Ci, but authors believe that the design methodology is replicable and widely applicable to empower the purposeful shrinkage of other urbanized regions along the spectrum of urban density in cities across the globe.

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Urban Regeneration Process of Eskisehir/Turkey in the Context of Sustainable Development

Rengin Beceren Ozturk[1], Arzu Ispalar Cahantimur[1], Aysen Ozturk[2]
[1]*Department of Architecture, Uludag University, Turkey*
[2]*Department of Architecture, Osmangazi University, Turkey*

Abstract

The aim of the paper is to put stress on the importance and necessity of urban regeneration for sustainable development of cities. The concept of urban regeneration is undertaken as an integrated process for environmental, social and economic development of urban areas. For this aim, urban regeneration process in Eskisehir is explained via examples of implementations undertaken in different parts of the city. Eskisehir is one of the earliest and most industrialized cities in a developing country, Turkey. The urban regeneration examples explored in the scope of this paper are pioneer studies not only for conservation and revitalization of natural, industrial and historical heritage of the city, but also for the country. In spite of being parallel strands of urban policy of many countries, greater emphasis is given to achieving urban regeneration, especially in economical terms, rather than to sustainability. However, it should be considered that all urban regeneration examples contribute to sustainable development through the recycling of derelict land and buildings, reducing demand for peripheral development and facilitating the development of more compact cities (Urban Task Force, 2005). After examining the urban regeneration studies implemented in natural, industrial and historical heritage sites of the city in the context of environmental, social and economic sustainability; the paper discusses the achievements and the deficiencies of the studies in local and regional scales. The authors put stress on the leading role of local government in providing integrated approaches to land management policies and sustainable urban development.

Keywords: *urban regeneration, sustainable development, Eskisehir, Turkey.*

1 Introduction

The United Nations denotes that, harmonious urbanization has never been more important than it is in the urban century, with more than half of the world's population now living in urban areas (Ban Ki-moon, 2008). The high concentration of activities, objects and people in urban areas, and the flows between rural and urban areas, connote that cities are major contributors to environmental change at local, regional and global scales. They are also platforms for social differentiation, segregation and exclusion. As a consequence, everyday living in our contemporary society involves a high level of spatio-temporal change that is reflected in the social, cultural, economic and political contexts, especially between the relations of the society and the city. There are no simple answers to current urban and global environmental and socio-cultural problems, however, it is necessary to reconsider housing, building and town and country planning in a holistic environmental, social and political context. In the other words, sustainable urban development, of which basic requirement is the integration of social, environmental and economic development in an equitable and everlasting way should be achieved (Detr, 1999). Taking into account the ongoing consumption of open space for housing, retailing and industry, it is indicated that a sustainable urban development cannot be achieved without re-integrating derelict land into the property markets and encouraging development back to central urban locations (Rescue, 2003).

Healey, et.,al. (1992), define urban regeneration as an idea involving both the perception of city decline and the hope of renewal, reversing trends in order to find a new basis for economic growth and social well-being (Parkinson, 1989). In the Report of Urban Task Force, 2005, it is stated that urban regeneration has a crucial role in achieving sustainable development that offers people a better quality of life without compromising the quality of life of future generations. As indicated in the Report of Department for Communities and Local Government: London (2009), successful regeneration strengthens communities by creating new economic opportunities. In this report, regeneration is defined as the process of creating sustainable places where people want to live, work, and raise a family. Concerning the UK is one of the pioneering countries of the world for urban regeneration, the results of the theoretical studies and the implementations experienced throughout the country are handled as the determinant factors for explaining and evaluating urban regeneration process discussed in this study. On the other hand, a successful urban regeneration includes a vision for not only the urban area but its relations within the regional and national scales. Thus, national regeneration policies of Turkey are discussed before explaining Eskişehir case.

2 National Urban Regeneration Policies

Serious internal migration from rural to urban areas started with industrialization caused the urbanization phenomenon to become one of the basic problems of the country in all its aspects. Thus, a lack of healthy accommodation problem, which is typical for underdeveloped or developing countries, had arisen. Beginning from 1950s, illegal housing and squatter developments increased rapidly around large cities and the dwelling shortage doubled every year (Tapan, 1996). Towards the end of 1970s, as a result of the increasing demographic pressures on the urban territory, the squatter settlements which had originally been set up on the peripheral areas started to be included within the boundaries of the cities (Senyapılı, 1996). As a consequence, by the 1980s, the term of urban regeneration began to take place in the government's urbanization policies regarded as an essential tool in the renewal of squatter housing areas, especially those in city centers.

As Güzey (2009) states, the concept was carried to the local agenda via the Habitat II meeting held in Istanbul in 1996, and urban regeneration was introduced as a new local policy in the creation of safe cities, which will be sustained through national plans and reports. She determines the distinguishing characteristic of urban regeneration applications in Turkey, as their being regarded as a form of project-based housing supply, rather than a holistic re-structuring process that should be evaluated at an urban scale. Both, academicians and professionals who are well-informed about the real objectives of urban regeneration define this process in Turkey as 'market-oriented through government assistance'. They claim that decentralization and market-oriented privatization policies give power to the local authorities as economic formations over political formations and strengthen them nationwide, as well as local, for the purpose of urban re-structuring. The argument of these authorities is clinched by the body of the documents of the 73rd. Article of the Municipality Law (numbered 5393) which is about urban regeneration and development areas and Law (numbered 5366) about "Preservation of Historical and Cultural Immovable Goods through Renovation and Regeneration". The contents of both of these two Laws are not clear enough to determine the characteristics of the regeneration areas. What's more, there are no specifications neither about the scale and nature of the regeneration implementations, nor about the responsible actors of the process. The 73rd. Article of the Municipality Law eliminates the chance of public participation by giving all of the rights about the decisions of the regeneration processes. This means that urban regeneration in Turkey is far away from being sustainable with its missing dimensions of social equity and economic and environmental integrity.

On the other hand, in the last decade, having been understood the re-use potential of old industrial heritage properties, more attention has been drawn on conversion of them and successful studies implemented especially in big industrial cities like Istanbul, İzmir, Bursa. By the implementation of these examples offering spaces for adaptive uses, the concept of brownfield regeneration came into the national agenda. Some examples of the conversion of industrial buildings to cultural and commercial uses in these cities are as follows; conversion of the old Gunpowder Factory in Bakırköy, İstanbul to Yunus Emre Cultural Center, the old Tobacco Factory in Cibali, İstanbul to Kadir Has University, the Merinos textile factory in Bursa to Atatürk Cultural Center, the old fishhouse in İzmir to a shopping centre.

Although these examples of revitalization of old industrial sites involve both successful renewal of the physical fabric and the active economic use of the buildings together with their surroundings gained success in implementation, it is thought that an integrated sustainability approach was not included in any of the projects. The deficiency of the nationwide debates about sustainable development caused by lack of awareness of the concept could be designated as one of the most important reasons of this claim.

After summarizing the national urbanization policies in the context of urban regeneration process in a developing country, Turkey, urban regeneration process in Eskisehir- one of the earliest and most industrialized cities of the country- is explained via examples of implementations undertaken in different parts of the city. The urban regeneration examples explored in the scope of this paper are pioneer studies not only for conservation and revitalization of natural, industrial and historical heritage of the city, but also for the country.

3 Urban Transformation Process of Eskişehir

Being located in the Central Anatolia Region, on the west side of the capital city Ankara, Eskişehir is one of the fastest developing cities in Turkey (See Fig. 1). River Porsuk as a natural threshold; Ankara-İstanbul railway and Ankara-Bursa-Bilecik motorway as main transportation routes structure the linear urban form of the city along the east-west direction. Its facilities of transportation such as railroad system and motorway together with its fertile land suitable for agriculture, its rich mine resources and different kinds of energy resources give the city the opportunity to be effective in industrial development. Thus, Eskişehir is defined as the door of Central Anatolia opening to the West. On the other hand, two of the biggest universities in Turkey, Anadolu University and Osmangazi University, established in 1958 and 1970 respectively, redoubled the importance of the city as being an education centre. As a result of these affirmative conditions, the city has a continuous increase in population, from 706.009 inhabitants in 2000 to 723.000 in 2006 and 741.729 in 2008 (DIE Report). Today, principal industrial production of the city is mainly about, stone and soil products, cement and cement products, metal products, wood products, textile products, flour and floury products (EOSB Report).

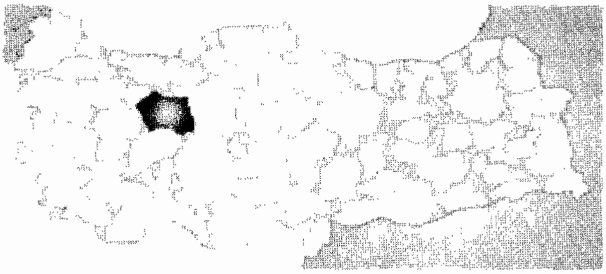

Figure 1. Location of Eskisehir in Turkey. (www.eskisehir-bld.gov.tr)

The change in the image of Eskişehir from a small agricultural town to a trade centre began at the beginning of the 18thcentury. Outer migrations caused by attractiveness of the productive Anatolian agriculture and developing meerschaum trade were the reasons of this change (Çakmak, 2008). With the establishment of the railway the development in agriculture, mining and industry of the city was accelerated, giving rise to a new city layout showing pre-industrial city characteristics. The most important development affecting the morphology of the city was the expansion of the residential areas to the north of the city where the railway station was located. At the beginning of the year 1923, the city was composed of three different districts which are; the residential area "Odunpazarı" in the south, on the mountain site as the main part of the city, two residential areas in the north, around the river Porsuk as secondary parts and another residential area having sparse population between these two parts of the city (Çakmak, 2008).

With the beginning of the Republican Period, an important transformation process experienced in the physical, political and economic structure of the city began with the rapid industrial development (Çelikkanat, 1973). Several factories located in two frontiers of the city, producing flour, tile, timber and furniture were established. The first group of factories including flour factory and tile factories were located around the railway station and its ateliers at the south-west of the city. At the south-east of the city, the sugar factory was established in the military region which includes the plane maintanence ateliers (Çakmak, 2008). Industrial buildings filled the empty places between the residential areas. In 1980, the buildings of Anadolu University were carried to another place called as Yunus Emre Campus and the boundaries of this campus were broaden rapidly. At the same time, the second university of the city, Osmangazi University was established in Meşelik Campus. Today, Eskişehir is an important industrial and education city with its great contribution to the industrial production of Turkey and facilities for university students.

As experienced in most of the industrial cities in the world, Eskişehir has been undergoing a rapid deterioration process. Character of the downtown residential area began to change from housing to the central business district including new urban functions. This was another reason for dispersion of residential areas to the periphery of the city occupying the greenfield areas. On the other hand, expansion of the boundaries of the university campus to the North of the industrial area accelerated the dispersion of the residential areas towards this side of the city. This development process that the city had undergone caused the problem of locational obsolescence for the industrial buildings. Over time, urban pattern of the city around the industrial buildings changed to a residential form and in terms of the accessibility to infrastructure, the location became obsolete for the activities for which they were constructed. The functional obsolescence was also a matter of substance for these industrial buildings because of the attributes of their surrounding area. Difficulties of access as a result of narrow streets and traffic congestion and inadequate parking can be mentioned as the reason of functional obsolescence as well as unsuitable physical conditions of the buildings for contemporary production methods. Once being attraction places of the city, these industrial areas began to be abandoned and left to deteriorate as the result of economic obsolescence and a new industrial zone located in the south of the city. As a consequence, it can be said that, everyday living in our contemporary society involves a high level of spatio-temporal change that is reflected in the social, cultural, economic and political contexts, especially between the relations of the society and the city.

4 Urban Regeneration Implementations in Eskişehir

The actions of the city's mayors have been very effective in managing urban development of the city since 1984. The preparation of municipal plans controlling development and construction within the city's borders, the preparation of conservation plans for traditional housing areas, improvements in the city's infrastructure, including the sanitation system, the gas pipeline network, sewage treatment facilities, the transportation system and cleaning up the Porsuk River, were all undertaken during this period.

Today, mission of the municipality is to provide access for all the inhabitants of Eskişehir to the social, cultural, economic and urban development features of the city and to build up community consciousness. Thus, vision of the municipality is to develop plans and projects for sustainable urban development of the city. Authorities of the local government developed strategies in order to provide a vital and secure urban life, a successful transport network, sportive, recreational and entertainment opportunities for everybody, intense economic activities (webpage of the municipality). The principal aim of the local government is to achieve sustainability of the city in terms of urban, socio-cultural and economic development with a holistic approach.

It is indicated by the researchers that local governments are particularly relevant to people's daily lives as they manage the infrastructure and services that directly influence quality of life (Satterthwaite, 2009). Satterthwaite (2009) supports this statement and thinks that, mayors who have influence in urban centres, also influence the form of the city's current and future development, including its success in attracting new investment. He adds that these mayors are also likely to influence the form and extent of the urban centre's physical expansion by the extent of their commitment to managing land use. The mayor of Eskişehir, Prof. Dr. Büyükerşen has been the mayor of the city since 1999. Having a common sense and high level of awareness about sustainability, he has been influencing the development of the city in a positive way. In spite of the limited income of the municipality many successful regeneration studies implemented under his leadership. The selected flagship projects are presented briefly in this section.

Rehabilitation and Sanizitation of the River Porsuk: After 1960s urban and industrial waste caused pollution of the river so that it was declared as one of the dirtiest rivers of Europe in 2002. What's more it was a great threat for its near environment for water flood. The Metropolitan Municipality of Eskişehir undertook the rehabilitation and sanizitation studies of the river together with the studies to strengthen the bridges over the river against natural disasters. On the other hand, 24 new bridges were built and arrangements about waterborne traffic were made in order to improve the transportation possibilities of the city (See Fig. 2)

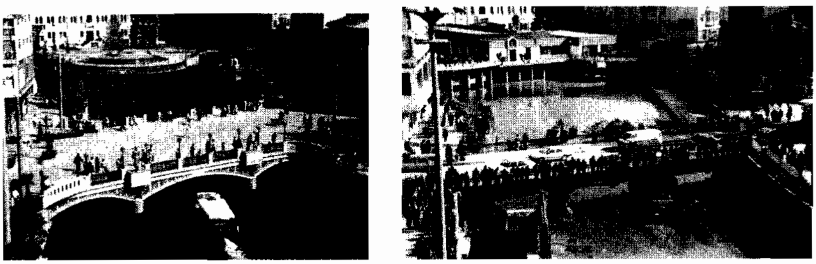

Figure.2. The River Porsuk before and after the rehabilitation studies (www.eskisehir-bld.gov.tr)

Rehabilitation of Dip Bazaar(Çukur Çarşı): A small natural island in the middle of the river Porsuk which had been used as a fish market for lots of years was converted to an urban park with playgrounds for children, cycle and walking paths and a big amount of green space (See Fig. 3)

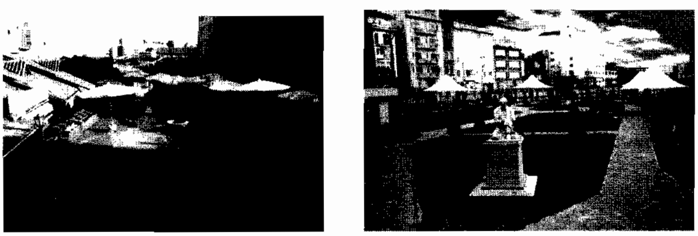

Figure.3. The Dip Bazaar before and after the rehabilitation studies (www.eskisehir-bld.gov.tr)

Conservation and Redevelopment of Odunpazarı Traditional Area: The traditional houses in the "Odunpazarı", the first settlement area of Eskişehir were renovated and restorated. These houses were converted to either cultural buildings like museum, library, children theatre, or touristic buildings like guest houses and restaurants. This project is the Pioneer one for cultural heritage conservation studies in the city (See Fig. 4). Restoration of the building which served as a headquarter during the Turkish War of Independence, and its new usage as a museum has a special value for conservation and transmission of historical heritage (See Fig. 5).

Figure. 4 Traditional Houses in Odunpazarı after restoration studies (www.eskisehir-bld.gov.tr)

Figure. 5. The Headquarter Building before and after its restoration (www.eskisehir-bld.gov.tr)

Conversion of the old Slaughterhouse to a Complex for Restaurants: The old slaughterhouse had been vacant for about three years and the Municipality decided to convert it to a complex for restaurants serving different kinds of meals after the rehabilitation studies. This complex is an alternative entertainment place for the inhabitants of the city with wide green areas surrounding.

Conversion of the Market Hall Building to Cultural Centre: The market hall of the city moved from the city centre to a more accessible location on a suburban industrial area and the old building of the market hall left to deteriorate. The physical structure of the old building was conserved and rehabilitated so as to give spatial opportunity for new uses. With the dynamic leadership of the municipality, the building and its surroundings were converted to a cultural centre named "The Market Hall Youth Centre" (Haller Gençlik Merkezi). This cultural centre includes, a public theatre, a theatre for children, an ice rink and many commercial and entertainment units and restaurants. The case of "The Market Hall Youth Centre" can be represented as a flagship Project acting as a magnet for further developments. Locating on the transport axis of the university and the city centre, it provides a suitable physical and social environment attracting the young people and the residents (See Fig. 6).

Figure.6. The Market Hall Building before and after its restoration (www.eskisehir-bld.gov.tr)

The common specific objectives of these urban regeneration cases in Eskişehir can be listed as follows;

- raising the quality of urban life is the main objective in all of the cases,
- providing new businesses for the local community,
- providing a variety of spaces for social activities, especially for the young population of the city,
- promoting the cultural and touristic potential of the city,
- contributing to the development of new residential areas in healthy conditions around their surroundings,
- achieving easement of access, acquiring a good public transport supported by tramlines of the city,
- emphasizing the importance of re-use of traditional materials which were used especially in the old industrial buildings, in order to conserve and promote the heritage value of these sites.

5 Evaluation of Urban Regeneration Cases in Terms of Sustainable Development

The urban regeneration examples explored in the scope of this paper are pioneer studies for conservation and revitalization of industrial and historical heritage of Eskişehir. As stated before, in spite of being parallel strands of urban policy of many countries, greater emphasis is given to achieving urban regeneration, especially in economical terms, rather than to sustainability. However, all urban regeneration examples contribute to sustainable development through the recycling of derelict land and buildings, reducing demand for peripheral development and facilitating the development of more compact cities (Urban Task Force, 2005).

As stated before, without a comprehensive urban regeneration framework that will define a vision for not only the urban area but its relations within the regional and national scales, the scope of an urban development procedure is limited (Roberts and Sykes, 2004). Thus, a holistic approach including socio-cultural, economic and environmental components of urban regeneration process is inevitable. The following principles determined by the researchers should be considered when evaluating the urban regeneration studies (Turok, 2004; Roberts and Sykes, 2004; Hall, 1997 qtd in Carter, 2004):

Economic transformation: increasing job opportunities, improving the distribution of wealth, developing abilities, increasing local property taxes, linking local to city and regional development, attracting inward investment.

Social transformation: improving the quality of life and social relations, improving the access to housing through developing health, education and other public services, decreasing the crime rates, overcoming stigmatization and social exclusion.

Governance: re-organizing decision-making mechanisms within a democratic understanding, increasing the number of participation spaces, considering different expectations; emphasis on region-wide partnerships, emphasis on horizontal and vertical linkages within and between institutions.

Physical transformation: solving the problem of physical deterioration with new land and property requirements.

Environmental quality and sustainable development: urban regeneration should promote the balanced development and management of the economy, society and the environment.

Nonetheless, it would be better to monitor the urban regeneration process throughout its life cycle, in order to develop more practical strategies to achieve sustainable development. At this point, it will be explanatory to evaluate the studies in terms of economic, social and environmental sustainability objectives.

When considered in the context of economic sustainability, adapting new uses to old buildings without demolishing them and the reuse of the original structural elements could be regarded as minimising waste production. Secondly, keeping the operational costs low by providing developments with renewable energy power sources and minimum source consumption is necessary. However, because of the deficiency of sustainability agenda during the construction years of the cases, it can be estimated that sufficient importance hadn't been given to reduce energy or minimise waste consciously during the construction phase. There are no passive or active ecological systems to generate energy in these regeneration cases. The heat isolation systems used in the construction, reconstruction or restoration of the buildings are the only contributory factors for minimising heating and conditioning costs of the new enterprises. The third supporter of efficient and competitive businesses is high quality of urban and architectural design. When compared with the former conditions of the sites, it can be stated that after having been adapted to new uses, all of them provide urban spaces having much better environmental quality. Appropriate transport infrastructure providing connectivity of the new businesses to the city is another necessity for economic sustainability. The railway and the tramline provide good public transport links between the sites and the city centre and also to the university campus.

When considered in the context of social sustainability; the urban regeneration studies in Eskişehir provide community buildings and open space for social interaction besides offering a mix of retail spaces. What's more, including two multifunctional halls, two theatres and a cinema hall, The Market Hall Youth Centre provide suitable spaces for educational seminars and community training in any subject. Provision of these kinds of services helps the local community to develop social capital and also avoid social exclusion in the city. A variety of public transport alternatives provide good access for the users of these sites including children, teenagers, people with disabilities and older people. However there are some difficulties for the disabled people to use the inside of the buildings.

Environmental sustainability requires the prudent use of natural resources together with the protection of ecosystems and biodiversity (Williams and Dair, 2007). In fact, traditional Turkish building construction systems and building materials meet the environmental sustainability objectives. Traditional building materials, timber and brick have the properties of renewable materials and low energy inputs. However they are not being used as much as they had been in the past. The use of these traditional building materials during the rehabilitation, reconstruction or restoration processes of the old industrial buildings was the only attempt in favour of environmental sustainability. Infrastructure for an effective public transport is also provided for all of the cases, and it is an important necessity to meet the objectives of minimising the use of resources and pollution.

6 Concluding Remarks

In the context of this study, examples of urban regeneration studies including natural, historical and industrial heritage sites from Eskişehir are described and their contribution to the sustainable development of the city is discussed. First of all, urban development process of Eskişehir together with its socio-cultural, economic and industrial dimensions is explained. Then the selected urban regeneration cases are presented and this presentation is supported by the evaluation of them in terms of economic, social and environmental sustainability objectives. It is found out that the presented urban regeneration studies in Eskişehir partially meet the objectives of the sustainable development components, however in an unconscious way. It can be concluded that, urban regeneration studies in favour of community are important and effective tools for urban sustainability. However, it is clear that, more benefits can be gained, if a holistic and participative approach is used and sustainability criteria are considered in deciding, planning and implementation stages of the projects.

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Retrofitting Addis Ababa: Compromising Rapid Urban Growth and Sustainability

Xenia Kokoula
Swiss Federal Institute of Technology (ETH), Zurich

Abstract

The socio-spatial processes initiated by unrestrained urban growth in so-called third world cities present a significant challenge both to researchers and designers, albeit in different terms. Whereas the first have gained a significant insight into social, economical and political conditions, which produce these urban spatialities, the latter are usually left to struggle with a considerable development pressure, conflicting interests and the urgent needs of an ever growing population. In the light of these social, political and environmental problems even the most well-meant design proposals may have either little impact or even negative side effects on the livelihoods of the urban dwellers.

Focusing on a neighbourhood of Addis Ababa, Ethiopia, the present paper outlines a case-specific methodology of planning interventions. Firstly, it is acknowledged that the complex host of social, environmental and infrastructural deficits should be dealt with in different scales. Urban design, situated between the disciplines of architecture and planning, can prove adequate in undertaking this task of retrofitting the city in order to respond to the needs of a growing population. A combination of state-driven, communal and private initiatives, following flexible design guidelines could compromise the pressure for a denser and multifunctional urban environment, without sacrificing environmental and social sustainability. This aim, however, cannot be achieved solely through spatial design; a participatory strategy, involving all social agents should be developed. The design of new urban environment, more sustainable, denser, and sufficiently connected to infrastructural networks is considered to be a process that responds and reacts to a strategy of implementation.

Keywords: *sustainability, infrastructure, social agents, participation*

1 Context

1.1 Addis Ababa: City and Challenges

According to the 2007 Ethiopian census, the population in Addis Ababa is 2.8 million, growing with an annual rate of 2.1% (Summary and Statistical Report, 2008). These officially acknowledged numbers are significantly lower than estimations of several non-governmental organizations, which speak of a population of 4 million, an annual growth rate of 8%, and anticipate no less than the tripling of the population by 2024 (Ethiopia, Addis Ababa, 2008). On all accounts, the Ethiopian capital has to face a significant urban growth in the years to come.

Several empirical studies relate housing shortage, informal housing, urban poverty, and deficiency of infrastructure to this rapid urban growth (Shiferaw, 2005). Indeed, even though the term slum is only reluctantly used by locals, images of dilapidated housing units, expanding informal settlements, and overcrowding are in accordance with estimations that about 80% of the population lives in slums (Addissie, 2007).

It is generally acknowledged that uncontrolled urban expansion can undermine social and environmental sustainability. Scholarly research may not necessarily refer to the Ethiopian context but brings up very similar concerns. Davis (2006) points out that environmental crises are endemic in impoverished, yet ever-growing urban territories. In a parallel examination of issues of social justice and sustainability Harvey (2000) insists that these concern several territorial scales at the same time. The larger phenomena of air, soil and water pollution are as crucial for the livelihoods of the population, as the challenges of the household scale (lack of sanitation, indoor air quality), and both are closely related to the scarcity of basic infrastructures. According to Cambell, priorities should be reassessed so that the usually neglected household scale can be addressed together with the urban and the territorial scale (Cambell, 1989). The present paper further pursues his argument in seeking urban design strategies to deal with this host of environmental and social problems.

1.2 The Site

Situated in the district of Bole, around Mike Leyland Street, the site of this case study presents challenges common to many other urban neighborhoods, which were once in the periphery, but within a few decades became part of a booming city centre (fig. 1).

Figure 1: Addis ababa, city borders, sprawl, and intervention site

It is a socially mixed residential area, where formal and informal structures coexist. Different typologies, ranging from single-family housing, cluster housing to lower class tenements can be found. Accordingly, also the age, construction quality, and infrastructural provisions of the buildings vary, but are generally substandard. Some newly built high-rise structures bear evidence to the quick transformation of the neighborhood from a residential area with one- or two-storey buildings into a central urban zone facing significant developmental pressure (fig. 2).

While the aforementioned description could equally apply to several urban regions, there are some critical local particularities in Addis Ababa, which must be taken into account. A first complication arises from the fact that the land in Ethiopia is state-owned and can only be leased.

Figure 2: Existing street front, Mike Leyland Street, Bole, Addis Ababa

This land policy originates from the socialist regime, which came into power in 1975, and has largely remained unchanged (Berry, 2004). Although it initially aimed at reducing poverty, it has since resulted in a severely limited security of tenure, and has often led to the disregard of the public participation (Mai, 2006). According to UNHABITAT report of 2008, relocations of low-income population have been a common policy in order to make land available for private investment (Ethiopia, Addis Ababa, 2008).

In the site in question, the developmental pressure and raise of land values is intensified by the active support of the authorities. The government-sponsored Local Development Plan (LDP) encourages gentrification (Mulugeta, 2005) by setting a minimum height requirement of five stories for the plots along Mike Leyland street. Unlike private investors, the vast majority of local residents cannot afford meeting this requirement. Thus the fear of forced relocation in the sprawling edges of the city is shared among residents of all income groups.

Such a development based on private investment would eradicate the substandard, low-income, and informal housing of the area. However, it would further contribute to sprawl, as the more affordable outskirts of the city would most probably accommodate the population in their expanding slums, without in the least improving the hazardous housing conditions. Pursuing at the same time socio-spatial and environmental concerns, we seek an alternative development plan, which would respect the existing social structure and involve all social agents.

2 Theoretical Framework

Terminology coming from the western urban planning discourse should be further clarified, before being applied in a very different context. Here the terms participation and sustainability will be shortly discussed in an attempt to define a context-based content.

2.1 Participation

Participation as a tool of urban design has been widely used and misused throughout previous decades (Arnstein, 1996). However, there seems to be a significant potential for participatory processes following models that do not come from the American and European experience, but from the Ethiopian culture itself.

There are mainly two kinds of local structures that form the base of a context-oriented participatory strategy; the official, administrative ones and the equally significant, unofficial, traditional ones. The administrative divisions of kebele (a dwellers' association of a neighborhood scale) and wereda (an administrative unit equivalent to a district) have the advantage of being directly connected to the centralized decision making centers (Berry, 2004). While traditional social structures have less immediate access to the central authorities, their role in regulating the everyday life is so important that they should not be ignored. Idir, the burial network, and equub, the savings collectives, have a wide appeal in the Ethiopian society (it is believed that every Ethiopian regardless of income, religion or national origin belongs to a certain idir) and are traditional forms of collecting and redistributing surpluses within the community. While the idir savings are mainly used for burial ceremonies of the community members, equub resources can finance a variety of projects (also neighborhood development projects) on the basis of consent. Together with the elders' councils (shimagile), these institutions have established relations of communication and solidarity in the Ethiopian society throughout the years. Thus they could be effectively engaged in a participatory discourse on the urban environment.

2.2 Sustainability

While trying to establish such a discourse, it is crucial to discuss the much contested and ubiquitous term sustainability. Its initial definition attaches equal importance to environmental, financial and social issues (Larsen, 2009); however, the latter have been often neglected, as the sustaining of capital production relationships and their environmental impact seemed to dominate the sustainability discourse (Harvey, 1996).

Studying the Ethiopian Capital, it seems that social and environmental challenges are interconnected in several complex ways. The inadequate housing conditions, the deficient social and physical infrastructures, urban poverty and sprawl can be considered as different sides of the same problem. Several, mainly empirical remarks strengthen this argument. Informal housing dwellers in Addis Ababa are often forced to move away from the places where they generate their income and squat in the periphery, because they lack both the financial means and the technological know-how to increase the inner city density. Apart from posing an immediate threat to their livelihoods and social networks, this inner city gentrification process has significant environmental consequences. The resulting sprawl, combined with the lack of efficient means of transport, has been most commonly associated with air pollution. Moreover, inadequacy or complete absence of basic infrastructures presents at the same time a considerable public health risk (of which the urban poor are most affected) and an environmental hazard. Poorly maintained water supply, to name just one of the many urgent infrastructural challenges, endangers the health of slum dwellers with limited accessibility to health facilities, as much as it deteriorates the city's rivers and soil on a larger scale (Ethiopia, Addis Ababa, 2008). The aforementioned examples would justify the use of the term sustainability to describe an environmentally sound and socially just development, which has to take into account different territorial scales.

3 Intervention Methodology

3.1 A Double Process

Taking into account the environmental consequences of urban sprawl, the social hazards of gentrification, as well as the housing shortage and the infrastructural inadequacy, it is generally accepted that modernization and densification of the existing urban fabric in Addis Ababa is a necessity (Angelil & Hebel, 2009). Especially in the case study in question, the task of the designer is one of retrofitting the existing city in order to accommodate growth, while creating an environmentally sustainable urban environment and respecting the existing socio-spatial structures. This aim can be achieved through a participatory process that acknowledges the various interests and mediates between social agents. It is only to be expected that such a project would be faced with several challenges, which can only be tackled through a constant exchange, support, and insight coming from the local community.

As traditional design tools and methodologies can only partly address these issues, the design of a site specific, step-by-step process of implementation should be developed. The strategy involved could be defined as a double process, where the design of the spatial product (sustainable, deriving from the existing) and the social process of its materialization (participatory, involving all social agents) is considered an entity.

3.2 Social Agents

Among the stakeholders that should be represented in this process are the state and city authorities, the private investors, the local communities, and the residents, each having an own vision of the area. If the declared aim of the two first is clearly reflected in the LDP, the wishes and aspirations of the latter are much harder to decipher, them being a highly heterogeneous group of people. Interviews conducted in situ reveal that the wish for improved infrastructure as well as the fear of forced relocation is shared across class distinctions.

Following a study of formal and informal urban functions and development tendencies, the different qualities of space are identified and categorized into groups. Spaces that provide access are apt for the building of a new infrastructural grid; high value plots are suited for private investment; spaces which bear significance for the community are optimal for accommodating communal activities. Thus the potential to respond to existing needs while improving the working and living conditions of the residents can be mapped (fig. 3). Roughly sketched appears here a strategy that should involve several types of intervention: state-driven public, cooperative-based communal and private interventions are necessary in order to account for all stakeholders.

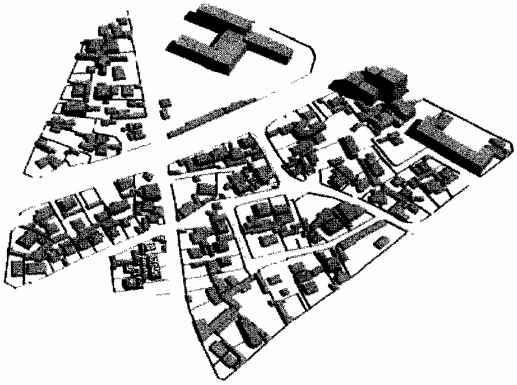

Figure 3: Existing urban fabric

3.3 State-Driven Public Intervention

3.3.1 Design

The modernization of infrastructural networks, in order to prevent further degradation of the urban environment is considered here as a task of the administration. After studying the urban typologies of cluster, compound and block, a network of secondary accesses for pedestrians and light traffic (donkeys, motorbikes) is integrated in the existing urban fabric and sidewalks are built along the existing streets. The infrastructural provision networks (water, sanitation and electricity) are built along these new linear public spaces, thus enhancing the public character of infrastructure.

Apart from improving access to public spaces and infrastructural networks, this decision acknowledges the importance of formal and informal open-air activities that take place on the main and secondary streets and allows them to expand on the inner part of the blocks. The surface of these much needed linear public spaces is maximized by partly elevating the new paths above the ground level. Thus several activities (informal trade, textile processing) can take place in a variety of public spaces such as ramps and staircases.

Rather than replacing the existing urban fabric with a new one this design intervention aims at altering and retrofitting it. Through the redefinition of property borders, a backbone is created, which passes through and connects existing lots and compounds with public spaces and urban voids (fig. 4).

3.3.2 Implementation

In order to obtain the legal right of intervening in the required area, the authorities could apply a process of eminent domain and equivalent compensation, under the condition that the current residents are able to keep their properties and businesses. Existing structures would thus be exempt from demolition, so as to avoid unnecessary relocation. In most cases, this would mean that only a part of a plot is transferred to the authorities and the property borders are redefined.

This implementation process is not expected to remain unchallenged. Since the establishment of minimum height requirements in the area the built fabric is constantly changing, and many informal temporary constructions are being built as a response to the fear of eviction. These are on one hand considered as a source of income, if rented as shops, and on the other hand, would increase compensation costs, in the case of relocation. In order to deal with this situation, a top-down participatory process based on consultation should be initiated. This would inform and update the design process, while it is being implemented.

In this process, existing urban voids adjacent to the main and secondary streets turn out to be high value plots for investment, as they have access to the new infrastructure provisions. These vacant plots already being state's property can be leased to private investors, thus contributing to the financing of the public investments. As part of the deal, housing development should be encouraged in order to address the problem of severe housing shortage in the Ethiopian capital.

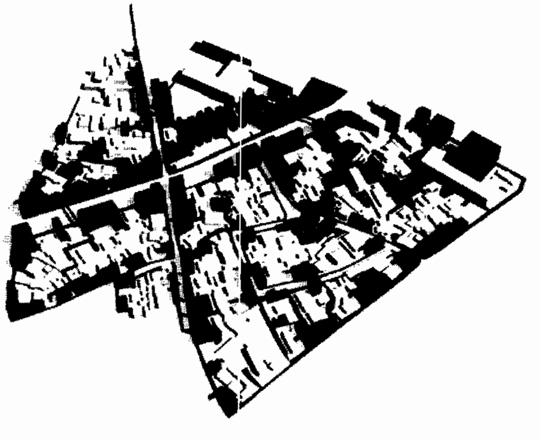

Figure 4: Public interventions.

3.4 Cooperative-based Communal Interventions

3.4.1 Design

The juxtaposition of the existing fabric with the new access paths results in a redefinition of uses and property borders. Land previously on the inner side of clusters or compounds would now tap directly into the infrastructural networks. Hence much needed communal space can be created. Medium-rise facilities accommodating social infrastructure (school, kebele centre, health facilities) are being designed there (fig. 5).

The location of these facilities in walking distance from the places, where the community lives, minimizes transport and makes them accessible to a larger part of the population. Thus the design not only responds to existing needs, but is a considerable step towards sustainability as well. Environmental concerns of a smaller scale, for instance, ensuring good lighting and ventilation conditions not only for the new communal buildings, but also for the existing adjacent residential ones, can be resolved through a set of simple zoning and design guidelines. These would define the minimum distances between volumes, while taking into account case-specific requirements for open space.

3.4.2 Implementation

In contrast to the state-driven process of the public interventions, a combination of a bottom-up and a top-down process is required for the communal ones. The heads of the traditional residents' associations (shimagile, equub), who are directly elected from the members, can be engaged as their delegates in the implementation process. They would give voice to the needs and aspirations of the population and negotiate directly with the local municipal authorities (kebele, wereda).

The implementation of this step of the process would be subsidized by municipal authorities as well as the resources of the residents' association. This funding plan would only be possible if the new facilities are planned on a local cooperating base and are met with broad consent. The communal interventions represent a further step in the overall process, in which spatial design and its materialization directly influence each other.

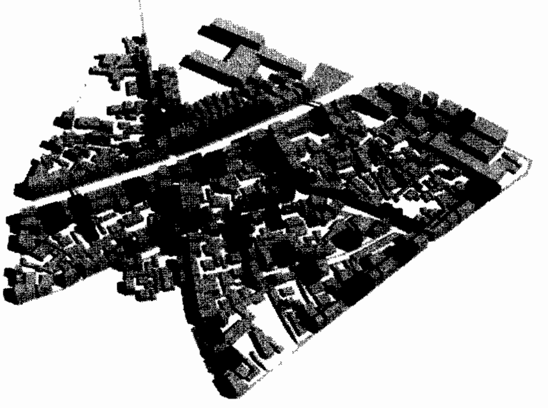

Figure 5: Communal interventions.

3.5 Private Interventions

3.5.1 Design

In accordance with this scheme, individual homeowners are expected to participate in the process of densification, through rebuilding, enlarging, or adding a second floor to their house and through connecting to the new water, electricity and sanitation networks (fig.5). The role of the designer is not to define the outcome of this densification process with any precision; rather it is reduced to setting flexible design guidelines and suggesting possible plan typologies. Minimum distances, maximum heights, and floor area ratio values would be defined, in order to ensure good lighting and ventilation. These guidelines would also respect the indispensable open private space for social and household activities (such as the processing of food ingredients or brewing coffee).

As far as the plan typology design is concerned, it is based on observations made in situ as well as reports of the housing sector in Addis Ababa (Situation Analysis of Informal Settlements, 2007). The new available space would first of all accommodate the needs of the current residents, who live in conditions of severe overcrowding, and if needed, their home-based commercial activities. However due to the existing demand for housing the creation of leasable space is also anticipated. This space is designed following the existing cluster housing typology, in which strong neighborhood relations of solidarity have been documented. A common yard, shared by existing and new housing units becomes the backbone of this typology.

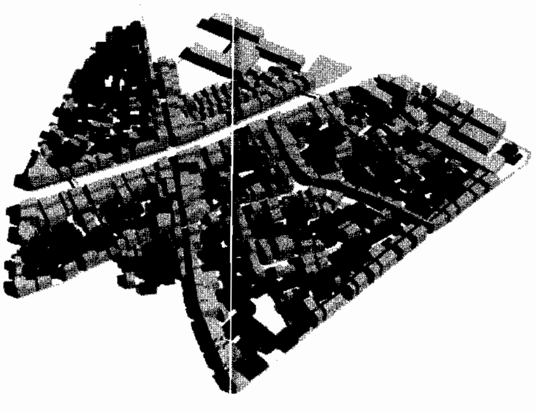

Figure 6: Private interventions.

3.5.2 Implementation

Such a bottom-up, small-scale process of urban renewal has little to do with the top-down grand housing program that the city authorities have launched in 2004 and where residents are completely underrepresented (Addissie, 2007). Instead of large state and private investments, this process would require local, kebele-based technical support and funding, while further financial expenses can be partly covered by the equub savings system. This would enable private homeowners to meet the requirements for a denser, better equipped and therefore more sustainable urban environment.

Taking into account the housing shortage, the overcrowding and the constant influx of population, there is no doubt that the residents, given the opportunity, would willingly create additional built space. However, this would be a long term process and a certain amount of informal building activities is highly predictable. That is a further, crucial reason to make sure that the design guidelines are versatile enough and able to adjust to the constant change of the urban fabric.

3.6 Challenges

By taking into account all stakeholders, this step-by-step process of retrofitting the existing urban fabric seeks to address several of the most common issues faced by designers, such as the financing difficulties, the local resistance and the challenge of the adaptation to future needs.

The central administration can gather the necessary resources through the leasing of unused land. Eventually more leasable space can become available through the subdivision of existing plots. These resources should not be solely managed from the state, but should be redistributed among the local authorities. These would then be involved in the communal and the private-driven implementation processes as well. Thus the funding of these phases would not rely exclusively on the limited resources of the local social networks (equub and idir).

Social consent might be even more crucial for the success of the whole process, than securing financial resources. Both the design guidelines and the suggestions for an implementation seek to be flexible enough so as to respect the wishes and aspirations of all the social agents involved. As a consequence, a precise spatial outcome cannot be designed; traditional architectural design techniques are used in order to visualise several potential situations (fig. 7) and not an end-product.

Accordingly the designer's visions of potential outcomes of this process are by no means conceived as fixed or finalized. Apart from programmatic requirements, space typologies and minimum space limitations, few other design decisions are imposed on the social groups that will live, work or invest in this space. Future, unpredicted needs and uses that may arise as the city grows, will not be incompatible with an established, inflexible urban fabric.

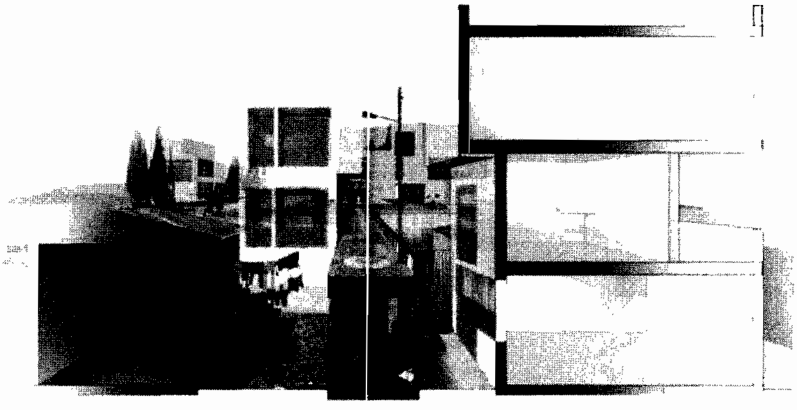

Figure 7: Potential coexistence of new infrastructure, new communal facilities and the existing residential buildings.

4 Conclusions

The design-implementation process outlined here seeks to encourage densification as a sustainable alternative to uncontrolled squatting and urban sprawl, while at the same time it sets certain limits to it. It addresses environmental challenges in the city scale by avoiding sprawl, the neighborhood scale by improving social and physical nfrastructure and the household scale by deriving from existing structures while improving housing conditions.

Summarizing the aims of this process, the accommodation of a growing number of residents and facilities in the additional built mass is not a goal per se, but is achieved through the creation of a highly heterogeneous, sustainable and resilient urban environment, where all social agents are represented. It should be stressed that these aims are not considered as the final results that will be achieved after the successful end of the intervention. On the contrary, they underpin the whole process throughout its course. They create and at the same time they are sustained by conditions of negotiating between public and private realms and between stakeholders with conflicting interests and needs.

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Sustainable Housing and Neighborhoods

Urban Geometry, Indoor Thermal Comfort and Cooling Load: An Empirical Study on High-Density Tropical Housing

Kam Shing Leung and Koen Steemers
Department of Architecture, University of Cambridge, UK

Abstract

This paper contributes to climate-responsive design in contemporary tropical cities by identifying the urban geometric features that influence the environmental performance of high-density housing. The indoor thermal conditions and electricity consumption of 275 households in Singaporean public housing were surveyed. Their geometric and radiant properties were concurrently studied with graphical analyses and computer simulations.

Simulated solar irradiation on façade, flat orientation and urban-form prototype are found to be significantly correlated with perceived indoor thermal comfort while the vertical position and the average sky view factor of flats are shown to be insignificant. Direct but not diffuse solar irradiation on the windows of major rooms is shown to be significantly correlated with perceived sunlight and daytime thermal comfort. Respondents in west-facing flats generally reported greater daytime and night-time thermal discomfort and these flats consumed 33% more electricity than the average. Respondents in a tall tower cluster perceived greater night-time indoor thermal comfort and air circulation, whereas those in a cluster of shorter block forming semi-open courtyards perceived indoor air circulation and greater electricity consumption.

Furthermore, based on the findings that perceived air circulation has a stronger effect than perceived sunlight on indoor thermal comfort and 70% of occupancy time was from 7pm to 7am when there is no sunlight, it is suggested that enhancing wind should be prioritised over reducing sunlight if the two objectives cannot be reconciled in the hot and humid climate.

***Keywords**: high-density housing, climate-responsive design, indoor thermal comfort, cooling load, hot and humid, urban form.*

1 Research Objective

Passive cooling is a major strategy for reducing energy consumption in tropical housing since air-conditioning accounts for a significant portion of energy consumption in residential buildings (Joseph C. Lam, 1996). It is often achieved by enhancing air circulation and reducing solar heat gain in dwelling units through façade design. In high-density housing where considerable urban obstruction exists, passive cooling potential is also influenced by the geometry of adjacent buildings. Due to their size and proximity, adjacent buildings modify the amount of sunlight and wind that individual flats are subject to. The presence of multiple dwelling units in a single building also means that the environmental condition of flats in different vertical positions or orientations can vary significantly. Therefore, the urban geometry becomes an indispensable component in evaluating the indoor thermal environment in high-density housing.

Two common approaches are adopted to study the above effects. First, simulations are performed to understand the effect of urban morphological variations on wind and solar radiation. For example, Kubota et al (2008) performed wind tunnel test on the models of 22 real residential building clusters in Japan and demonstrated the negative correlation between site coverage and urban air ventilation potential. Ng et al (in Bay and Ong, 2006) applied computer simulation programs and wind tunnel test to demonstrate the favourable effects of height variations on the air exchange and daylight access of individual flats. Leung and Steemers (2009) developed a RADIANCE-based simulation technique based on Perez et al (1993) and Compagnon (2004) to identify the common urban morphological variations that affect the amount and distribution of solar irradiation on high-density housing clusters. These studies, however, only revealed the microclimatic conditions between buildings or on building facades. It is not certain whether and how these differences would influence the indoor thermal environment and the cooling load of buildings.

Second, empirical studies have been performed to understand the thermal sensation, electricity consumption and other environmental perceptions of people living in flats that are subject to different urban environment. Wong et al. (2002) studied the thermal and wind sensations of 257 residents in Singaporean public housing and suggested that thermal sensations vary between residents living in flats with different sizes and vertical positions. Lucas Souza et al. (2004) studied the electricity consumption of 20 low-rise buildings in an urban context and suggested that the orientation and the sky view factor (SVF) of their adjacent street canyons had an effect on electricity consumption. However, results from these studies were not statistically tested and the opposing effects of wind and solar radiation were not analysed.

This paper therefore aims to confirm whether and how exposure to different urban geometries affects the indoor thermal environment and cooling load of a flat. The ultimate goal is to identify the urban-form prototypes and physical design strategies that are favourable to the indoor thermal comfort and cooling energy conservation of high-density housing in the hot and humid climate.

2 Methodology

2.1 Survey design

The survey was conducted in four building groups in two Singaporean new towns as shown in Figure 1, which offered 3041 prospective households for the survey. These building groups were selected to maximise variations in urban geometry while minimising other design variations. To determine the effect of the urban form, efforts were made to select building groups in which the façade and layout of dwelling units are similar within each group.

A mail survey was conducted in July 2009 with the questionnaire refined based on a pilot study and comments from environmental design professionals in Singapore. Control questions were built into the questionnaire to ensure the authenticity of responses. A total of 275 valid returns were received, among which 215 sets of useful information concerning electricity consumption and 263 sets concerning perceived indoor thermal conditions were obtained. Respondents represented a largely equal gender split and covered the full range of ages and income groups on aggregate and within each building group.

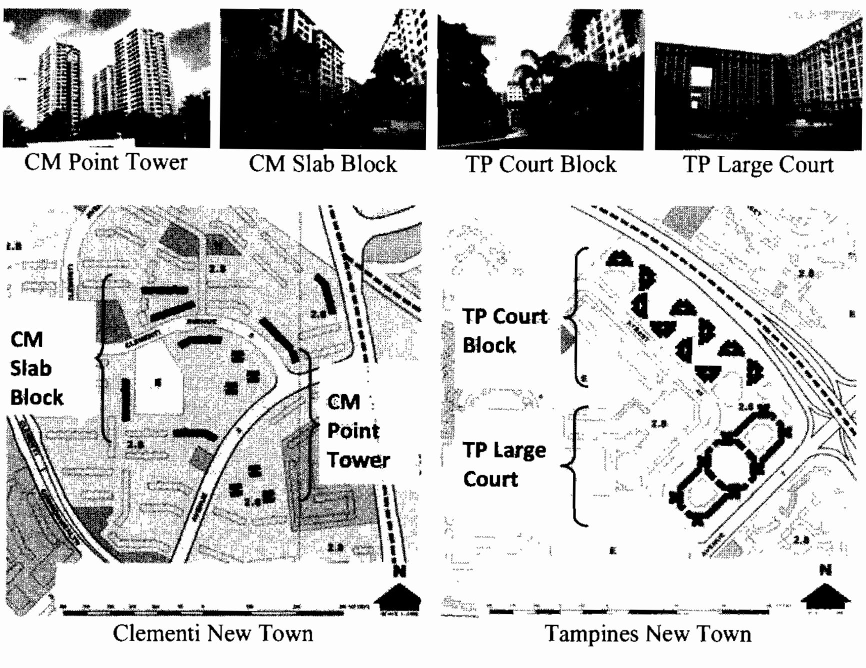


Figure 1: The four building groups selected for the survey (Source of base maps: *Master Plan 2003*, Urban Redevelopment Authority, Singapore)

Dependent variables

Daytime thermal comfort, night-time thermal comfort and average electricity consumptions are the three major dependent variables. Based on the seven-point Bedford scale (Auliciems, 1981) that has been widely used in thermal comfort study, respondents were asked to express their general perception in their flats assuming that no mechanical cooling was used. They were also requested to write down their monthly electricity consumption in kWh from January to June based on the values printed on their June utility bill. The flat type-specific national average electricity consumption was also requested. The authenticity of survey responses was validated by the agreement between this number and the values provided by the utility company.

Independent variables

Three sets of independent variables were used to correlate with the above dependent variables. The first set included the physical attributes of flats, which were based on the graphical studies of building plans and computer simulations on the solar irradiation on building facades. The second set was obtained from the survey and included occupant's perceptions on environmental factors that are related to thermal comfort. The third set included control variables that relate to neither the urban geometry nor the thermal environment but bear theoretical relationships with household electricity consumption. These variables were obtained from both the survey and the study of relevant building plans. Table 1 lists out all variables that were investigated in the study.

Table 1: Dependent, independent and control variables in the study

<table>
<tr><th>Dependent
(from survey)</th><th>Independent set 1
(from graphical analysis and computer simulation)</th><th>Independent set 2
(from survey)</th></tr>
<tr><td rowspan="3">▪ Daytime thermal comfort
▪ Night-time thermal comfort
▪ Average monthly electricity consumption</td><td rowspan="3">▪ Orientation
▪ Vertical location
▪ Weighted-average sky view factor (SVF) of windows
▪ Solar irradiation on major windows per floor area</td><td>▪ Perceived sunlight
▪ Perceived air circulation
▪ Perceived humidity</td></tr>
<tr><td>Control variables
(from survey)</td></tr>
<tr><td>▪ Occupancy hours
▪ Flat size
▪ Household income</td></tr>
</table>

2.2 Preparation for statistical analyses

Identify control variables

In order of the strength of the correlation, occupancy period (in terms of person-hours in a normal weekday), flat size and monthly household income were found to correlate significantly with the electricity consumption of flats. Regression analyses showed that these control factors account for approximately 38% of variations in electricity consumption

The average electricity consumption data were found to deviate from normal distribution. After logarithmic transformation, the electricity consumption data were shown to exhibit normal distributions for both the whole data set and the data sets of individual building groups. Further test on the transformed data also showed that all the assumptions of parametric tests were met. Therefore, parametric tests were applied to correlation analyses between electricity consumption and interval-level variables.

Perceived daytime/night-time thermal comfort, sunlight, air circulation and humidity were expressed based on preference scales. These are ordinal measurements and therefore non-parametric tests were applied to correlation analyses involving these variables.

Calculation of solar irradiation and sky view factor

Studies on the effect of solar irradiation and sky view factor were focused on CM Point Tower and TP Court Block. They were selected for their homogeneity in façade design and flat layouts, which helped reveal the sole effect of urban geometry. Since the effect of urban geometry is the research focus, design details such as window openings, façade motifs and sun-shading devices were not included in the computer model. RADIANCE, a computer programme developed by the Lawrence Berkeley Laboratory and had been widely used in lighting- and solar radiation-related studies, was used to simulate the amount of solar radiation that enters major rooms (i.e. living rooms, dining rooms and bedrooms). "Virtual pyranomenters" were assigned to the mid-points of the windows of these major uses. The amount of direct and diffuse solar irradiation that reaches the window was then estimated by multiplying the solar irradiance by the corresponding window size.

The hourly simulations of solar irradiation on the 120 surveyed flats in CM Point Tower and TP Court Block for a six-month period were beyond the available computing power. An aggregate sky was therefore constructed to represent the total solar radiation from the sky during the six-month period. Such method had previously been adopted in the PRECis and SOLURBAN projects (Compagnon, 2004). The tailoring of the method for this particular study can be found in Leung and Steemers (2009). Hourly variations in direct and diffuse solar radiation during the surveyed period were obtained from the Typical Meteorological Year (TMY) Data obtained from the US Department of Energy website (U.S. Department of Energy, 2008). They were adjusted to match the actual monthly global solar radiation values that were available from the Department of Geography of the National University of Singapore (Roth, n.d.) in order to resemble the actual sky condition.

The sky view factors (SVF) of major windows in a flat were also calculated with RADIANCE simulations by assuming a uniform sky. They were given by the ratio of solar irradiation on a point with the presence of urban obstructions to that without obstructions (Compagnon, 2004).

3 Findings

Research findings are reported under four groups of correlation analyses that aim to reveal the potential effect of the following parameters on the perceived daytime/night thermal comfort and the electricity consumption of flats:

1. Solar irradiation on major windows – Section 3.1;
2. Simple geometric measurements (i.e. flat orientation, vertical position and average sky view factor) – Section 3.2;
3. Urban-form prototypes (i.e. point towers, slab blocks, large courtyards and lower blocks forming semi-courtyards) – Section 3.3; and
4. Perceived indoor environmental factors (sunlight, air circulation, humidity) – Section 3.4.

3.1 Effect of solar irradiation on thermal comfort and electricity consumption

Effect on daytime and night-time thermal comfort

In theory, greater solar irradiation on windows leads to a hotter indoor thermal environment and higher cooling load. In a high-density urban setting, however, a higher level of solar irradiation may also represent less urban obstruction and therefore a greater exposure to wind that moderates the indoor thermal environment. This study therefore attempts to ascertain whether solar irradiation on the windows provides a good indicator for the impact of urban geometry on indoor thermal comfort.

Solar radiation through windows was shown to have by far the largest effect on solar heat gain as compared to heat conduction through opaque walls or the window glass (Lam et al., 1993). Therefore, solar irradiation on a flat was defined as the amount of solar irradiation on the windows of major rooms per floor area in this study.

As tabulated in Table 2, non-parametric tests on both CM Point Tower and TP Court Block show that direct solar irradiation on windows possesses large and significant correlations with daytime thermal comfort and perceived sunlight, while diffuse solar irradiation does not exhibit such relationship. Although the total amount of diffuse solar irradiation on building façades is much higher than that of the direct component in Singapore, the direct component alone serves as a better indicator for the effect of solar heat gain. It is believed to be because direct irradiation is intensively received by individual flats during a shorter period of time while diffuse irradiation is more evenly received throughout the day. Also, since the sun is a point source that follows a particular sun path, direct irradiation on different flats varies more noticeably and therefore its heating effect is more acute and perceivable.

As for the correlation between night-time thermal sensation and solar irradiation on windows, a medium size effect was found in TP Court Block but no significant result was found in CM Point Tower. The lack of effect on the latter is believed to be due to the cooling effect of wind, which is supported by findings to be described in sections 3.3 and 3.4.

Table 2: Correlations between solar irradiation on windows of major uses vs. thermal sensations and sunlight perceptions

		CM Point Tower			TP Court Block		
		Thermal comfort during day time	Thermal comfort during night time	Perceived sunlight	Thermal comfort during day time	Thermal comfort during night time	Perceived sunlight
direct solar irradiation per floor area	Correlation Coefficient	.328**	.188	.417**	.390**	.257*	.389**
	Sig. (1-tailed)	.005	.075	.000	.001	.024	.001
diffuse solar irradiation per floor area	Correlation Coefficient	.024	-.086	-.034	.080	.058	.112
	Sig. (1-tailed)	.429	.258	.398	.271	.330	.197
direct & diffuse solar irradiation per floor area	Correlation Coefficient	.185	.020	.135	.226*	.148	.263*
	Sig. (1-tailed)	.079	.438	.152	.041	.130	.021

* Significant at .05 level (1-tailed) ** Significant at .01 level (1-tailed)

Effect on electricity consumption

Parametric correlation analyses were conducted between solar irradiation on major windows (direct, diffuse and direct-plus-diffuse) and average electricity consumption of a flat. No significant correlation was found for two possible reasons. First, the significant effect of solar irradiation were mainly found in day time when most occupants were not at home and only 10% of air-conditioning usage occurred (based on survey results). Therefore, the day-time thermal discomfort due to sunlight was not translated to higher air-conditioning usage. Second, non-climatic factors such as occupants' habit on the use of air-conditioners and the efficiency of the machines weakened the link between air-conditioning usage and electricity consumption. It further masked the overall correlation between solar irradiation and electricity consumption.

3.2 Relationships between simple geometrical measurements, indoor thermal environment and electricity consumption

3.2.1 Effects of flat orientation

Flat orientation was the orientation that the principal façade of a flat faces. The principal façade was defined as the façade with the largest window area of major rooms, with the exception of CM Point Tower in which the four corner units were defined as facing northeast, southeast, southwest and northwest. Flat orientations were grouped into eight categories, which were defined by dividing the azimuth into 8 equal sectors with their mid-points pointing towards due north (N), northeast (NE), east (E) etc. It is worth noticing that all west-facing flats in

TP Court Block and TP Large Court are exclusively installed with horizontal sun-shading device. Therefore, any adverse effect of west-facing on indoor thermal comfort is likely to be even greater if no sun-shading device is installed.

Effect on daytime and night-time thermal comfort

Figure 2 shows the daytime and night-time thermal comfort of respondents living in flats that face different orientations. A noticeably higher thermal discomfort was found in west-facing flats both in day time and at night. In addition, a relatively low thermal discomfort of respondents living in flats facing south and southeast was expressed in day time. A marginally lower night-time thermal discomfort was also expressed by respondents living in flats facing south, southeast, and northeast.

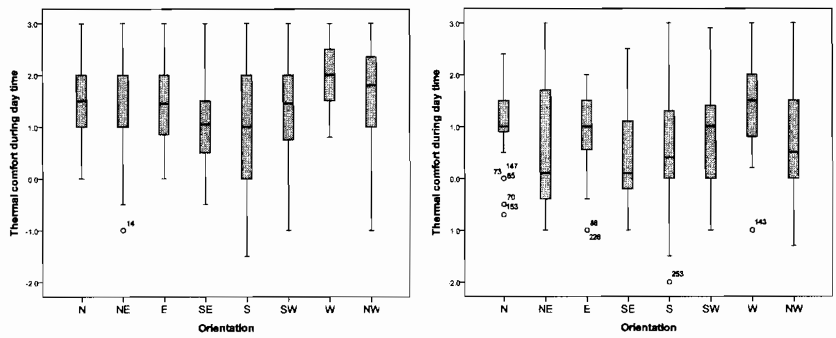


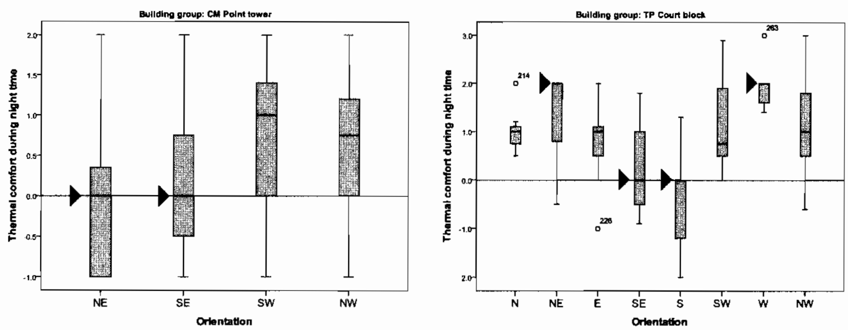
Figure 2: Thermal comfort of respondents in flats facing different orientations – all building groups (left: daytime; right: night-time)

Based on results from non-parametric tests, daytime thermal comfort was shown to be significantly affected by the orientation of the flat, $H(7)=17.9$, $p<.05$. However, post-hoc analyses showed that the significant differences were only found when the high thermal discomfort in west-facing flats was compared with the low thermal discomfort in south- and southeast-facing flats. While west-facing flats are shown to be significantly hotter than south- and southeast-facing flats, their thermal environments are not significantly different from the average condition.

The night-time thermal comfort was also shown to be significantly affected by flat orientation, $H(7)=18.0$, $p<.05$. In this case, post-hoc analyses showed that west-facing flats were perceived as significantly hotter than the average condition. However, south- and southeast-facing flats (the two coolest orientation groups) were only shown to be cooler than west-facing flats but not the average condition.

Difference between CM Point Tower and TP Court Block

Separate analyses on CM Point Tower and TP Court Block reaffirmed some of the above findings. In CM Point Tower, respondents living in west-facing flats (NW and SW) expressed a significantly higher daytime and night-time thermal comfort than other respondents as shown in Figure 3. The same difference was also observed in TP Court Block. However, the lower thermal discomfort in south-facing flats was only found in TP Court Block but not CM Point Tower. In CM Point Tower, no significant difference was found between the thermal comfort in south-facing flats and north-facing flats either in day time or at night. In TP Court Block, on the contrary, noticeably lower thermal discomfort was generally found in south- and southeast-facing flats, which is likely to be attributable to the combined effect of lower solar irradiation and higher air circulation. The survey was performed in July when the sun crossed the sky vault on the north. South-facing flats were therefore subject to less solar heat gain than their north-facing counterparts. In addition, the prevailing wind direction is south/southeast in July in Singapore (Meteorological Services Division, 2009), which enhances the cooling potential of south-facing flats by natural ventilation. The lack of effect in CM Point Tower is believed to be due to the availability of east- and west-facing side windows, which moderated the difference in the thermal environment between north-facing and south-facing flats by facilitating effective cross-ventilation.



▶ median value

Figure 3: Night-time thermal comfort in flats facing different orientations (left: CM Point Tower; right: TP Court Block)

Effect of electricity consumption

Parametric tests showed that there are significant differences in average monthly electricity consumption (when controlled for non-built form related factors) between flats facing different orientations, $F(7,207)=3.009$, $p<.05$. However, post-hoc study shows that the effect of flat orientation was statistically significant only when the two extremes were compared. As shown in Figure 4 on the left, west- and east-facing flats tend to consume more electricity while south- and southwest-facing flats tend to consume less. Comparing to the mean monthly electricity consumption of all flats with non-built form related factors controlled (370kWh), west-facing flats consumed 122kWh (33%) more electricity per month on average. As mentioned in 3.2.1, additional sun-shading devices had already been installed exclusively for west-facing flats in two building groups, without which the effect of west-facing is expected to further increase. The high electricity consumption in west-facing flats is likely to be due to the combined effect of the lack of prevailing wind throughout the year and the strong solar radiation from the west in the afternoon. With the building thermal mass, the effect of the latter is carried on to the evening when most household members return home and air conditioning is more likely to be used.

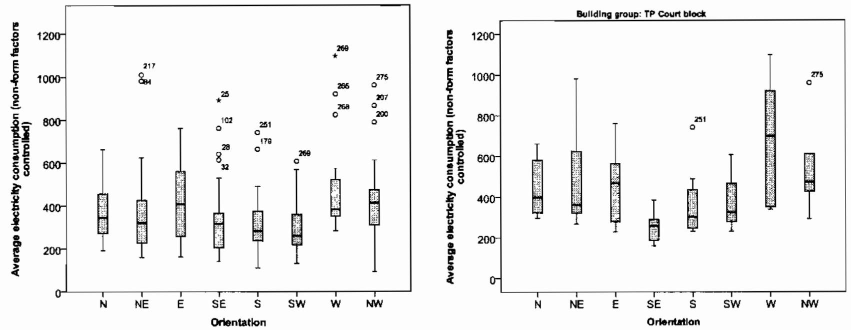


Figure 4: Average electricity consumption controlled for non-built form related factors (kWh) vs. flat orientation (left: all building g groups; right: TP Court Block)

Difference between CM Point Tower and TP Court Block

The significantly higher electricity consumption of west-facing flats was found in TP Court Block but not CM Point Tower. In CM Point Tower, parametric tests showed that there is no significant difference in average electricity consumption between flats facing different orientations, $F(3,48)=.562$, n.s. even though nearly half of the flats have windows facing due west. This is believed to be due to superior air circulation in those flats and therefore relatively moderate median thermal discomfort (approx. +1 in CM Point Tower versus approx. +2 in TP Court Block) that led to less cooling energy consumption. On the contrary, difference in electricity consumption between west-facing flats and other flats is more apparent in TP Court Block as shown in Figure 4 on the right. The larger difference is believed to be due to the particularly low air circulation in TP Court Block, which did not allow the daytime solar heat gain to dissipate effectively in the evening when the air conditioning was most intensively used.

3.2.2 Effect of vertical position and sky view factor

To investigate whether these two simple geometric descriptors can be used to assess the impact of urban geometry on the indoor thermal environment, correlation analyses were performed on 110 combinations between simple geometric descriptors, building groups, environmental performance indicators and orientation groups as listed in Table 3. CM Point Tower was separately studied because it is substantially taller and more exposed to the sky than other three building groups. Any significant result may represent the difference between CM Point Tower and other building groups instead of the geometric descriptors under investigation.

Table 3: 110 scenarios tested for significant correlations between simple geometric descriptors and environmental performance indicators

Simple geometric descriptors	Environmental performance indicators	Building group	Orientation groups
▪ Vertical position ▪ Sky view factor	▪ Daytime thermal comfort ▪ Night-time thermal comfort ▪ Perceived sunlight ▪ Perceived air circulation ▪ Average electricity consumption	▪ All groups except CM Point Tower ▪ CM Point Tower ▪ TP Court Block	▪ On aggregate ▪ On the 8 individual orientation groups*

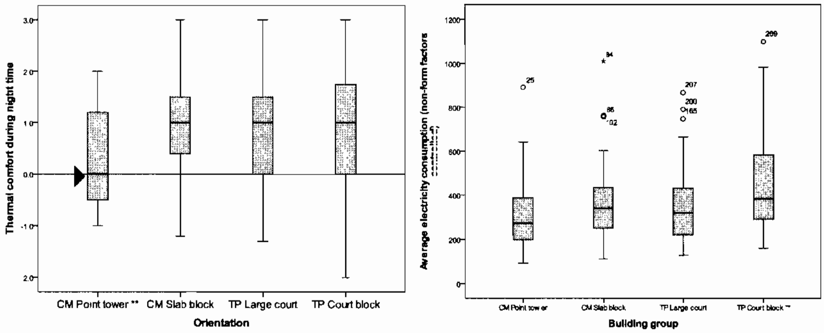
* applied to "all group except CM Point Tower" only. Flats in other two building groups were not test due to the small number of flats facing each orientation.

A series of correlation analyses showed that neither the vertical position nor the sky view factor of flats had consistent effects on the indoor thermal environment or other environmental perceptions. Among the 110 scenarios, only three statistically significant correlations were found. Without strong theoretical reason for distinguishing them from the rest, these correlations offer little predictive power to future assessments. It shows that neither the vertical position of flats nor the sky view factor serves as a good indicator for the indoor thermal environment or cooling load of a flat in a high-density tropical context.

3.3 Comparison between building groups representing different urban-form prototypes

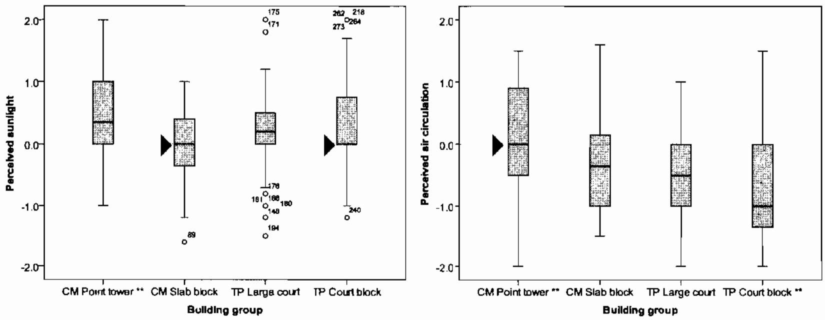
The survey found noticeable differences between the four groups in night-time thermal comfort, electricity consumption, perceived sunlight and perceived air circulation. At the same time, no noticeable differences were found in daytime thermal comfort and humidity. As shown in figures 5 and 6, CM Point Tower differs from other building groups by having a noticeably lower night-time thermal discomfort, higher perceived sunlight and higher perceived air circulation. TP Court Block, on the other hand, is shown to have a noticeably lower perceived air circulation and higher electricity consumption (by 23%). All these differences were found to be statistically significant. The distinctive morphological characteristics of each building groups provide plausible reasons for the differences in environmental conditions, which will be further explored in Section 4.

Further comparisons between the figures suggest that both night-time thermal comfort and electricity consumption exhibit stronger links with perceived air circulation than perceived sunlight. Respondents in CM Point Tower expressed higher perceptions to both sunlight and air circulation, and on aggregate they generally felt cooler. On the other hand, respondents in TP Court Block perceived similar amount of sunlight but less air circulation, and on aggregate they consume significantly more electricity. The ultimate indoor thermal comfort and electricity consumption therefore appear to be more influenced by perceived air circulation than by perceived sunlight.



▶ median value

Figure 5: Night-time thermal comfort (left) and average electricity consumption (controlled for non-built form related factors) (right) in different building groups



▶ median value

Figure 6: Perceived sunlight (left) and air circulation (right) in different building groups

3.4 Relationship between perceived environmental factors, thermal comfort and electricity consumption

As shown in previous sections, variations in urban geometry often result in opposing effects on sunlight and air circulation in terms of their effects on indoor thermal environment. To understand the relative effect of these environmental factors, correlation analyses were performed to compare the effects of perceived sunlight, air circulation and humidity on daytime thermal comfort, night-time thermal comfort and average electricity consumption. Daytime thermal comfort (the higher, the hotter) was found to be correlated negatively with perceived air circulation (σ = -0.49) and positively with perceived sunlight (σ = 0.19) and perceived humidity (σ = 0.55). On the other hand, night-time thermal comfort was found to be correlated negatively with perceived air circulation ($\sigma = -0.43$) and positively with perceived humidity ($\sigma = 0.47$). In both cases, the effects of air circulation and humidity were comparable and were much larger than sunlight, which agrees reasonably well with the relative effects of these environmental factors on thermal comfort as observed in a laboratory setting (Fanger, 1972).

For electricity consumption, none of the three environmental factors on indoor thermal comfort showed any significant effect. On the other hand, daytime and night-time thermal comfort respectively possess weak ($\sigma = 0.16$) and strong ($\sigma = 0.64$) correlations with electricity consumption. It implies that optimising one environmental factor alone is unlikely to result in cooling energy conservation. It also suggests that optimizing night-time rather than daytime indoor thermal comfort is more crucial to cooling energy conservation in the hot and humid climate.

4 Discussions and Conclusions

Design implications of findings

The study contributes to the knowledge of climate-responsive design for contemporary tropical cities by identifying the urban geometric features that influence the indoor thermal environment and cooling load of high-density housing in the hot and humid climate. Both flat orientation and direct solar irradiation on windows of major rooms per floor area were shown to be effective indicators for the resulting indoor thermal comfort. While it is generally true that higher thermal discomfort was reported if the flat faced west or received more solar radiation, the strength of the effect depends the level of perceived air circulation. The correlation between direct solar irradiation and night-time thermal comfort, together with the significantly higher electricity consumption of west-facing flats, was only found in TP Court Block but not CM Point Tower. This is believed to be attributable to the superior air circulation of flats in CM Point Tower, which moderated or even outweighed the adverse effect of solar heat gain.

Furthermore, between the four surveyed building groups that represent distinctive urban-form prototypes, there are significant differences in night-time thermal comfort, perceived sunlight, perceived air circulation and the electricity consumption of flats. For example, CM Point Tower is characterised by its great building height (25 storeys) and low site coverage (Figure 1), which creates an urban geometry with higher exposure to wind and sunlight. Each flat also has its windows of major rooms facing two orientations, which facilitates cross-ventilation (Figure 7). These physical attributes have possibly resulted in a superior night-time thermal comfort level whilst retaining an average daytime thermal comfort level. It suggests that the favourable effect of higher exposure to wind outweighed the adverse effect of higher exposure to sunlight. Building clusters that have a high building height and low site coverage like CM Point

Tower potentially offer a climate-responsive prototype for high-density housing in the hot and humid climate.

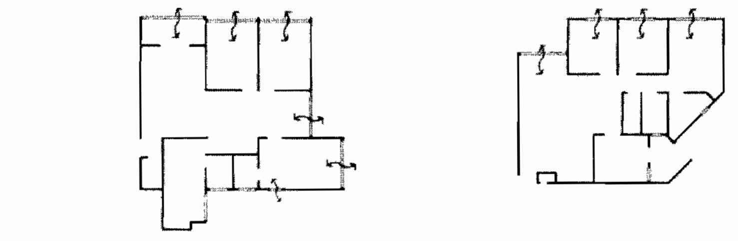


Figure 7: Ventilation potential of typical flats in CM Point Tower and TP Court Block (blue arrow: windows in major rooms)

TP Court Block, on the contrary, has a low height profile (10 storeys) and a more enclosed urban form (Figure 1). Each flat also has low cross-ventilation potential since all major windows face the same orientation (Figure 7). Respondents in this building group perceived significantly weaker air circulation and an average level of sunlight. At the same time, they were generally found to have higher air-conditioning usage and average electricity consumption (23% higher than average). This suggests that building clusters with semi-enclosed open space and mono-directional windows in each flat like TP Court Block potentially consume greater cooling energy in high-density housing in the hot and humid climate.

The significance of air circulation over sunlight becomes even more apparent when the pattern of occupancy is considered. Based on the survey result, 71% of occupancy hours are found between 7pm to 7am when no sunlight is available. Therefore, the mere consideration of reducing solar irradiation on building facades does not benefit the indoor thermal environment at the most critical time. Maximising wind potential, on the contrary, can enhance the indoor thermal comfort in the evening when most people are at home and air-conditioners are actively used.

Despite their relationships with the exposure of a flat to the ambient climate in theory, the vertical position of flats and the average sky view factors of windows are found to be poor indicators of perceived indoor thermal conditions and electricity consumption. It is therefore not advisable to use these descriptors to evaluate the indoor thermal environment of high-density tropical housing. On the other hand, simulated direct solar irradiation on major windows was found to correlate significantly with daytime thermal comfort and perceived sunlight, and was shown to correlate much stronger than direct-plus-diffuse irradiation. Therefore, simulated direct solar irradiation provides an adequate indicator for evaluating the effect of an urban or building design on solar heat gain in the conceptual design stage.

Limitation of the research

Numerous assumptions and approximations have been made in both simulating solar irradiation on windows and evaluating the environmental conditions in a flat. Major ones include the use of TMY weather data to approximate the actual distribution of sky radiance, the use of solar irradiation on windows to approximate the effect of solar heat gain, and the use of respondents' perception to represent the levels of sunlight, air circulation and humidity inside a flat. Nonetheless, significant findings in this study show good agreements with theoretical relationships, which give confidence to the validity of the research method. First, simulated solar irradiation based on the aggregate sky was shown to have significant effects on the indoor thermal comfort and perceived sunlight of respondents. Second, good agreements were found between the theoretical and empirical effects of sunlight, air circulation and humidity on thermal comfort. It is particular revealing that perceived sunlight was found to be significantly correlated with daytime but not night-time thermal comfort, which would occur only if respondents distinguished their daytime thermal comfort (question 2) and night-time thermal comfort (question 3) carefully when they responded. Third, solar irradiation is both a simulated and a perceived quantity in this study but air circulation is only represented by respondents' perceptions. The validity of using perceived air circulation to represent the actual indoor wind environment should be further investigated.

Further research

Based on the above discussion, two apparent follow-up research questions emerge. First, air circulation assessments in this study were solely based on residents' perceptions. Wind tunnel tests and/or computational fluid dynamics modelling can be employed to ascertain the urban geometric features that are favourable to indoor air circulation. Second, the actual design feature that causes the inferior air circulation in TP Court Block should be identified. The low air circulation in TP Court Block can be attributable to either its enclosed urban form or its mono-directional windows, or both. Singling out the design feature that causes the inferior air circulation will inform better design for high-density housing in the hot and humid climate.

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Designing a Dwelling Unit in Tripoli – Libya by Using Sustainable Architectural Principles

Aisha A. Almansuri, Steve Curwell, David Dowdle
University of Salford, UK

Abstract

The modern urban built environment is considered the most energy consuming sector as new forms of construction and services have been applied without complete understanding of their side affects. Therefore, buildings are now dependant mostly on the mechanical equipment to provide comfort. As a consequence, this has led to, firstly, many ecological problems such as the over and misuse of the energy resources, pollution and associated ill-health. Secondly, design without consideration of the local climatic conditions, which can also contributes to loss of identity related specifically to every climatic region, resulting in buildings having the same features all around the world regardless of the cultural, social and physical differences.

In Libya, issues related to this subject are neglected or rarely studied. This paper, therefore, aims to highlight some architectural solutions that contribute to reducing building's energy consumption as well as creating an architecture related to the local environment and place.

It provides an overview of the general architecture principles and a study of the components of environmental design and the architectural treatment for this climatic zone. A model of a house for Libyan family life will be shown in order to give an idea of the application of some sustainable architectural principles taking into consideration the physical, cultural and social differences.

Keywords: *Architectural design, Housing, Hot regions, Sustainable architecture, Tripoli- Libya.*

1 Introduction

Based on the frightening facts that are emerging about global warming and the other effects of fossil fuel burning, it is generally accepted that buildings of the future should be in better harmony with their environment and should integrate the local influences of the specific climatic regions they are built in. Prior to the modern era, architects and builders had little else other than local materials and natural resources.

Contemporary architecture reveals its similarity in almost every part of the world without any consideration to regional characteristics, in contrast to vernacular architecture which is almost climatically appropriate, where architects and builders traditionally had to design with respect to nature, local climate and materials. They designed their buildings carefully taking in consideration thermal properties of materials and the availability of local resources.

This paper presents passive climatic solutions in vernacular and contemporary architecture. In Addition, it provides the principles of sustainable building design and the applications of these principles in designing a dwelling unit in Tripoli- Libya.

2 Sustainable Architecture

The concept of sustainable architecture appeared more or less at the same time as the evolution of the concept of sustainable development. Cofaigh et al., (1996) described sustainable building as those buildings that have minimal detrimental effects on the natural environment, on their immediate surroundings and on the wider regional and global setting. On the other hand, Sherlock (1991: 293) emphasises reductions in the consumption of energy as a step towards sustainability, and argues that the best way for this is "...to reduce our need to travel ... to live in compact cities where everything is close at hand". McDonough (2000) stated that sustainable design is the conception and understanding of environmentally sensitive and responsible expression as a part of the evolving matrix of nature. Roaf et al., (2005) defined the eco-house as a house that is closely connected to the site, society, climate, region and planet.

Accordingly, sustainable architecture can be defined as an architecture that meets human needs and has minimum impact on the natural environment. It is a planned effort at designing a built environment that is energy and ecologically considerate both internally and externally.

Housing has a greater influence upon global and social harmony than any other building type. The importance of the home as a starting point for successful communities has been emphasises by many authors such as Edwards (2000: 7) who stated that "...living in harmony with the environment has become an essential component of the design of homes and neighbourhoods in the third millennium". Gilkinson and Sexton (2007:2) cited the definitions from the sustainable housing project of the British Broadcasting Company (BBC) as

"Sustainable housing is a form of affordable housing that also incorporates environmentally friendly and community based practices. It attempts to reduce the negative impact that homes can have on the environment through choosing better building materials and environmental designs". Furthermore, in Hilary Armstrong's interpretation of sustainable housing "...housing is sustainable if everyone has the opportunity of access to a home that is decent; if it promotes social cohesion, well-being and self-dependence" (Edwards 2000: 2).

To achieve sustainable housing in any society, a central role should be given to the importance of sustainable housing. The home as a family unit addresses three different dimensions of well-being, economic development, social welfare and environmental welfare Figure 1.

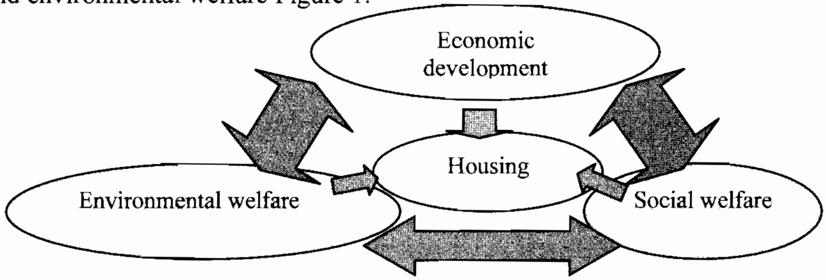


Figure1: the three dimensions of sustainable housing (Source: Almansuri et al., 2009)

2.1 Sustainable housing design and environmental welfare

McMullan (2002:2) identifies that 'the built environment is formed by buildings and structures that humans construct in the natural environment'. The impact of contemporary buildings has been highlighted by Enertia Building Systems (2006) as building is the second largest industry in the world after agriculture, and the pollution from heating and cooling of buildings cause the main damage to the environment and grow to be greater than that from cars. The environmental quality of the housing conditions of the residents and residential activities on the ecological system are the major concerns of a sustainable environmental perspective (Emhmed, 2005).

2.2 Sustainable housing design and social and culture welfare

Sustainable communities need to allow families to invest long periods of time in their neighbourhood (Edwards, 2000: 25). The cultural sustainability of housing can be associated to the preservation of housing heritage. The adaptation of residents to the natural habitat, how it changes with time and the progression of technology all reflect the physical form of housing. Therefore, the physical form becomes a part of culture itself. The arrangement of housing's internal spaces is an outcome of socio-cultural values, customs and practices as well as enhanced by housing legislation and roles. While the external forms of housing are the result of the availability of building resources, the climatic conditions, the construction capability of the residents and the aesthetics of specific communities over specific periods of time (Chiu, 2004: 5).

To achieve a sustainable and balanced society in housing requires a number of issues to be addressed such as social exclusion, crime and employment opportunities, as well as the usual priorities of energy and environmental performance. The transformation of a culture and the cultural identity of a place represent the lifestyle of a people, as well as the aesthetic and the artistic dimensions of culture. The conservation of residential buildings for aesthetic and heritage values enhances the continuation of a culture (Emhmed, 2005).

2.3 Sustainable housing from an economic perspective

Chiu (2004) stated that there are two fundamentals for housing to be economically sustainable:

1- The benefits to housing providers and producers must be more than or equal to the costs of housing production given the housing demand levels; and
2- The production and consumption processes must be within the environmental capacity to provide and absorb, given the mitigating technology.

The first relates to the operation of the housing sector and the ability of housing consumers to afford quality housing. The second refers to the recognition of the environmental gains and costs of housing activities. To enhance environmentally friendly consumption behaviour, it is essential to understand the central role of affordability, value and habits. Also to mitigate the environmental impact of housing activities and their implication for the financial viability of housing projects, it is important to know the development of technology, building materials and housing designs. (Chiu, 2004: 4).

3 Principles of the Sustainable Architecture

Sustainable design techniques are becoming increasingly important in building design. It should include all kinds of activities and processes that increase the capacity of people or the environment to meet human needs and improve the quality of human life. Many studies have been conducted on the principles of sustainable architecture. Almansuri et al., (2008) and Almansuri et al., (2009B) have summarised the main principles of sustainable architecture as follows;

- **Respect of the user's socio-cultural values**. The variety in architectural form can be seen as a result of a host of social, cultural, economic, physical, and technological variables (Rapaport, 1969);
- **Adapting the climatic conditions**. Sustainable buildings should respect and benefits from local climatic conditions and adapt to the daily and seasonal climatic changes;

- **Energy conservation**. Buildings consume energy not only in their operation, for heating, lighting and cooling, but also in their construction. Construction often requires large amounts of energy for processes ranging from moving earth to welding. Also transportation of the materials used in buildings.
- **The use of local materials**. Using the provided local material will significantly contribute in respecting and enhancing the environmental issues.
- **Respect the location (site conditions)**. It is essential to consider that the building design and construction will not have a major effect on the site topography and the surrounding architectural style.
- **Water efficiency.** As water consumption is a serious ecological concern nowadays, it is very important to consider regulating its use and reuse inside and outside buildings.
- **The use of natural light and ventilation**. Building and window design that utilizes natural light and ventilation will lead to conserving electrical lighting energy, shaving peak electric loads, and reducing cooling and heating energy consumption.
- **The studied use of colours**. Colours have physiological and psychological impacts on the human body and in addition to its aesthetic values, it plays a significant role in reducing and reflecting the solar radiation on the external walls.
- **Treatments for ecological problems such as noise pollution**. Noise is like light in its effect on psychological human health, accordingly buildings should be protected from noise sources.

3.1 Principles of sustainable housing

Emhmed (2005) added to these general principles of sustainable architecture other sustainable design principles to housing, summarised as follows;

- The dwellings should be compact for less land use; to reduce motorised travel; effective thermal resistance for good microclimatic performance and efficient use of infrastructure and the protection of agricultural land.
- Compact form to provide high density, low-rise buildings.
- Dwelling should be flexible and adaptable to allow for future changes in family organisation.
- Spaces in the dwelling should be multi use at different times of the day.

3.2 Passive design techniques

Many references sets the basic passive solar design techniques, for instance, U.S. Department of Energy (2004), Christensen (1994) stated that there are three basic types of passive solar design; direct gain, indirect gain, and isolated gain, and some others give two other types; composite and combined. All of these types explained by Christensen, (1994), Evans (2007) and Roaf et al., (2002) as follows:

- Direct heat gain

South facing glass admits solar energy into the house where it strikes directly and indirectly thermal mass materials in the house such as masonry floors and walls Figures 2, 3.

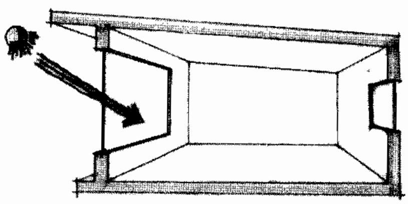


Figure 2 direct heat gain in winter

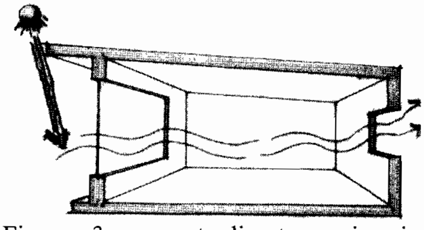


Figure 3 prevent direct sunrise in summer

- Indirect heat gain

In indirect gain system, thermal mass is located between the sun and the living space. The thermal mass absorbs the sunlight that strikes it and transfers it to the living space by conduction. There are two types of indirect gain systems:

- Thermal storage wall systems (The Michell-Trombe wall Figures 4, 5 Evans (2007) explained that 'Trombe wall' or 'ventilated accumulator wall' achieves a favourable modification of the outdoor conditions in a series of steps, using different thermal properties of glass, surface absorbance and thermal mass in following layers of the construction.
- Roof pond systems, using water pipes in the roof to heat water in morning and distribute heat in the night Figure 6.

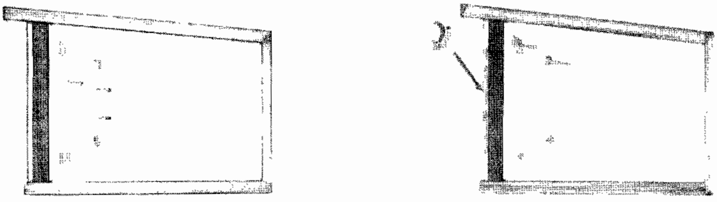
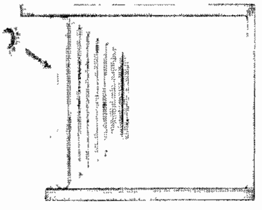


Figure 4 using the storage wall with close or open windows when necessarily



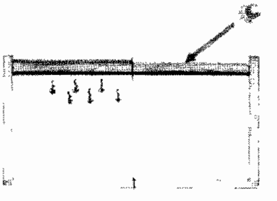


Figure 5 using the Water pipes wall as thermal storage wall

Figure 6 using the water pipes in roof as thermal storage roof

- Isolated system

Isolated gain system has its integral parts separate from the main living area of a house. Examples are a sunroom (solar green house) and a convective loop through an air collector to a storage system in the house Figures 7. It employs a combination of direct gain and indirect gain system features.

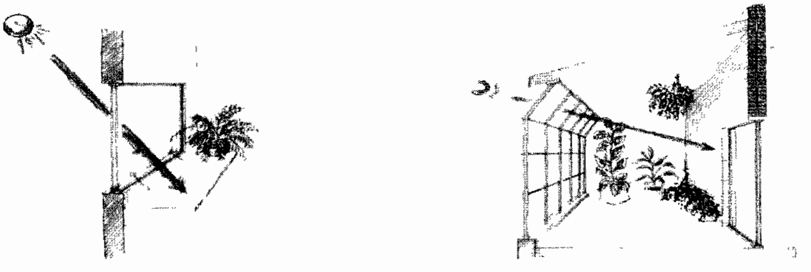


Figure 7 direct heat gain to sunroom + indirect heat gain to living room

Combined system:

This system is more flexible than others because it depends on mixing more than one type Figure 8.

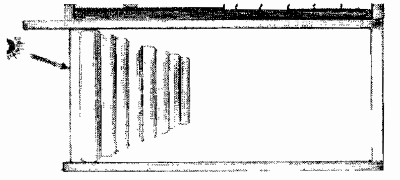


Figure 8 :using trombe wall and water pipe roof in the same time

Composite system:

This kind depends on using one of the previous systems in addition to using mechanical systems to increase the benefits; it can be by mixing passive and active systems.

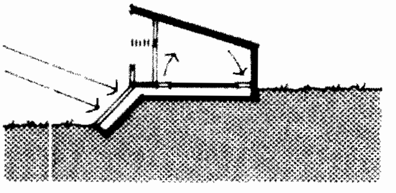


Figure 9: using direct heat gain and solar collector Source: Ebrahem (1987)

Source of Figures (2 to 8) the author after Panchyk (1984)

4 Tripoli- Location and Climate

Tripoli is located in Libya in the Mediterranean Sea. It is situated to the north of the Equator, at longitude 32.56 degree, and latitude 13.15 degrees east of Greenwich as shown in Figure 10 (Amer, 2007).

The weather in coastal region is characterised as hot, humid in the summer season and warm, rainy in the winter season (Shawesh, 2000).

The average humidity in this region is 58% to 65%, which in some years may increase in the summer June to the end of August (Emhemed, 2005).

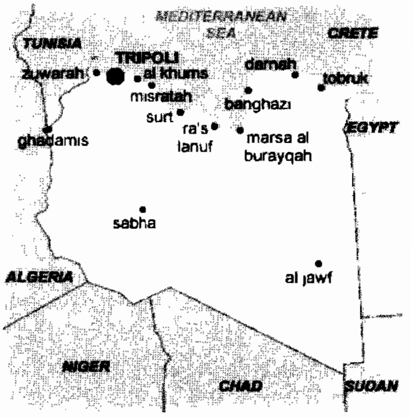


Figure 10 Tripoli's location in Libya

The average temperature in Tripoli ranges from 30°C in summer to 8°C in winter and in the desert summer temperatures rise to over 50°C, but daytime winter temperatures range between 15 and 20°C, falling below zero at night (Arab.net 2002). The geography and climatic characteristics of Libya have had a direct effect on housing and urban patterns. This requires special treatment to prevent undesired heat within external and internal housing spaces. In addition to climatic issues, socio-cultural issues have been the main factor dominating the Libyan housing design, the next part explains the importance of these factories in shaping Libyan housing.

4.1 Socio-cultural issues in Libyan society

Religion and socio-cultural values in Libya play a very important role in controlling and directing the behaviour of people within internal and external spaces. Many authors such as (Daza 1986, Shawesh 2000, Emhemed 2005, and Amer 2007) have raised the main Libyan socio-culture factors as follows;

- Privacy in Libyan society is a priority consideration within housing spaces.
- The separations age and sex and guests have long determined the roles played within the family.
- The extended family and elderly people have special and high status in the society.
- The way of life of the Libyan people has many aspects that should be considered in external and internal spaces.
- The way of preparing meals in the kitchen, the need to have storage places and the way of serving food to guests and family members requires more internal spaces.
- Safety and security are priorities to Libyan life.

Although all of these factors are well addressed in the Libyan local traditional architecture, most of them do not exist in contemporary houses. Emhmed (2005) explained that the effect of religion and social interaction on local architecture can be observed in two ways; Islamic religious teaching encourages privacy and modesty, and courtyard houses fulfilled this condition by providing an inward-looking house.

As stated previously the cultural sustainability of housing can be related to the preservation of housing heritage. On the other hand, although contemporary houses have lack of attention to socio-cultural demands and the accepted standards of life, it possesses many advantages such as more comfort, flexibility, privacy, area and possibilities to use new technology. Amer (2007) summarised the advantages of both house types in Table1.

The opinions of residents and professionals in Tripoli in terms of future housing design have been investigated by Amer (2007) and Almansuri et al., (2009A+B). They identified recommendations for new house design as follows:

- The design should be suitable for geographic location and reflect the local identity and social-culture aspects;
- Combining the advantage of the traditional and contemporary designs;

- Take the courtyard concept as an essential element in design taking in consideration (using appropriate building materials, good proportion, appropriate position, provide movable cover to avoid excess summer heat and winter rain, also, solarium house can be a good solution and a courtyard can be used as a solarium when using moveable covered windows);
- Flexibility and harmony suitable for modern furniture;
- Avoid large windows and provide balconies to provide shading, and for privacy reason, a big part of the palcony can be covered by musharbia.
- Use local building materials with modern technology and new insulation materials;
- Use light colours, which reflect the sun-rays;
- Avoid high rise building;
- The contribution of users in the design process is important to fill the gap between designers and users; and
- Pay attention to economic factors and cost of materials.

Table 1: Advantages of the courtyard and current houses

Advantages of the courtyard	Advantages of contemporary houses
- It provides air movement ventilation; - It provides natural light and shaded area; - It provides the privacy. particularly from streets, neighbours and visitors compared with contemporary housing; - It is a quiet place, which offers good protection against the passage of heat and the street noise; - It is a space for family gathering after sunset, it is also used as area for activities during wedding and meeting friends; - It allows to children greater safety in terms of their playing areas, where their mother can easily watch them; and - It provides a good relationship within extended families.	- They offer different spaces for varied functions such as Arabic and western salons; - The superior quality of finishing; - The good arrangement of interior space; - More privacy is offered in terms of separation between brothers and sisters; - There is greater potential for future extension and adoption than in traditional housing; - They are more structurally stable.

4.2 Housing and building laws in Tripoli

To design a dwelling unit in Tripoli, it is important to understand the building laws in this area, Emhmed (2005) clarified that the main components of planning and building legislation that affect housing projects in Libya are land use, streets' width, building height, site coverage and zoning regulations. He translated the Libyan planning and building Act 1969 into English. In this paper, the codes related to private housing that affect the model design are summarized as follows;

Modern legislation requires housing units to stand separate from one another across a specified minimum distance. Buildings should have the following dimensions:

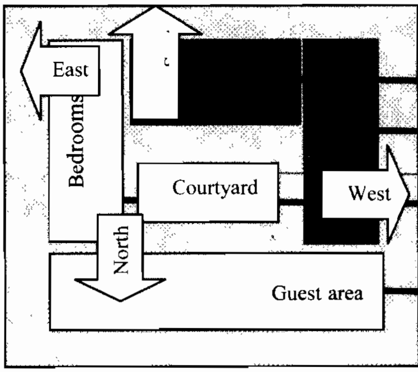
- Yards and setback requirements; The Libyan Planning and Building Act 1969 illustrates the different distances of these setback requirements (front, side and rear), particularly in residential areas, according to the land-use and density of the area as determined in the master plan (the designed model located in zone R2 – single-family residential district -low density, $500m^2$ land area).
- Building height limits and number of storeys; maximum number of storeys, according to zoning type area.
- The thickness of the external walls should not be less than 25 cm on the ground floor and 20 cm for the upper floors; and the thickness of the internal walls inside the flats should not be less than 20 cm.

4.3 The application of sustainable methods in private dwellings in Tripoli

From the previous discussion about the new housing design recommendations, this part will provide a model architectural design for a single Libyan family house to meet the following contents;

- Family size more than 6 persons (The average number of Libyan family) ;
- The land area is about $500m^2$ (suggested by the building laws - council);
- Respect the building laws in Tripoli;
- The model will not seek to provide a detailed design (form and elevations), it is to provide a flexible, applicable aide which can be amended and adapted according to site location, users needs and the creativity of the architect.

Next figures show the model design that includes the main sustainable houses principles for Libyan families in Tripoli. It incorporates vernacular solutions with new technology. More detailed discussion shows in section 4.3.1



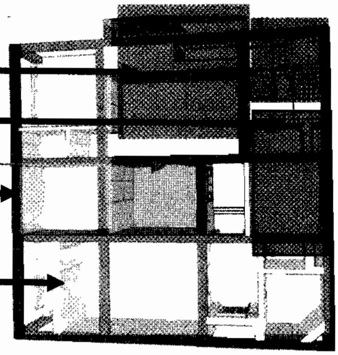


Figure11: explains the main design concepts Figur12: the construction method

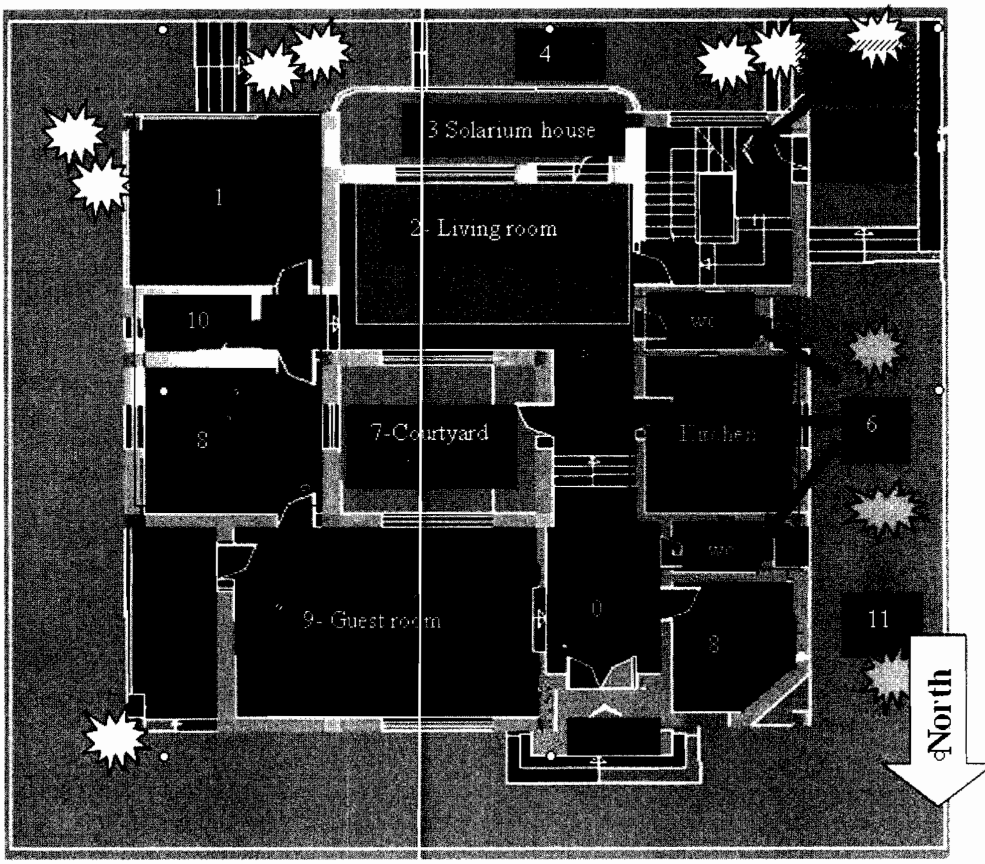


Figure 13: Ground floor plan - explains the functions and design concept

Key:
1. Terrace can be change to room in future
2. Living room, has axes to the green house and the courtyard
3. Solarium house space as an extra space to living room
4. Rain water storage
5. Staircase entrance to the family area, basement and the first floor
6. Kitchen and toilets gathered and located in the west side
7. Courtyard in the centre of the house
8. These spaces can be used for Arabic salon guest room, guest bedroom or as an office, also in future when the family leave the first floor for the son or for rent, it can be used as a bed rooms
9. Guest area can be furnitured by western salon and dining room
10. This space can be used as an extra toilet or storage area
11. Car parking can be located in the West and shaded by trees

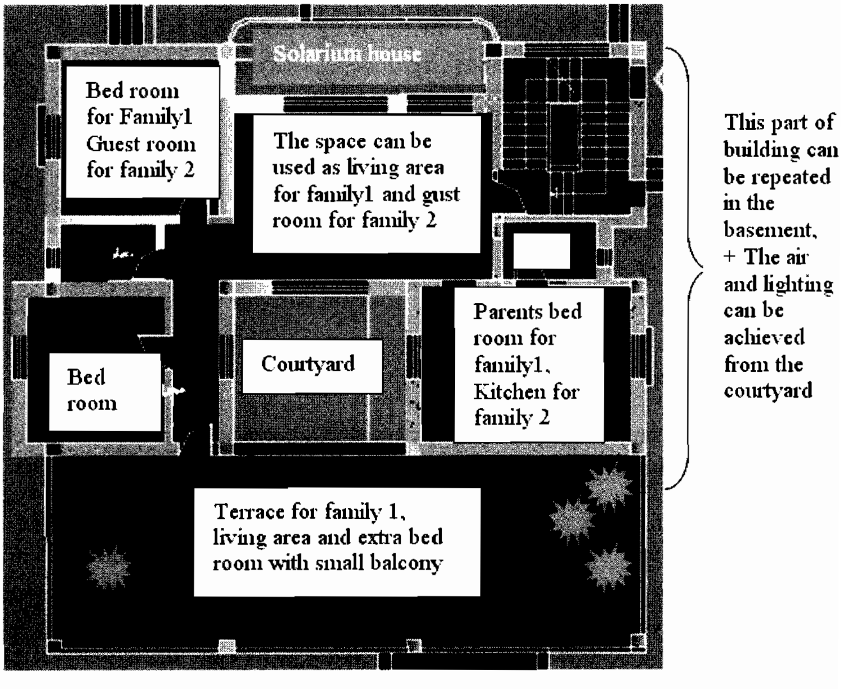


Figure 14 first floor plan and it can be basement plan – explains the flexibility in using the floor for the main family 1 and split it when use it by a new family2.

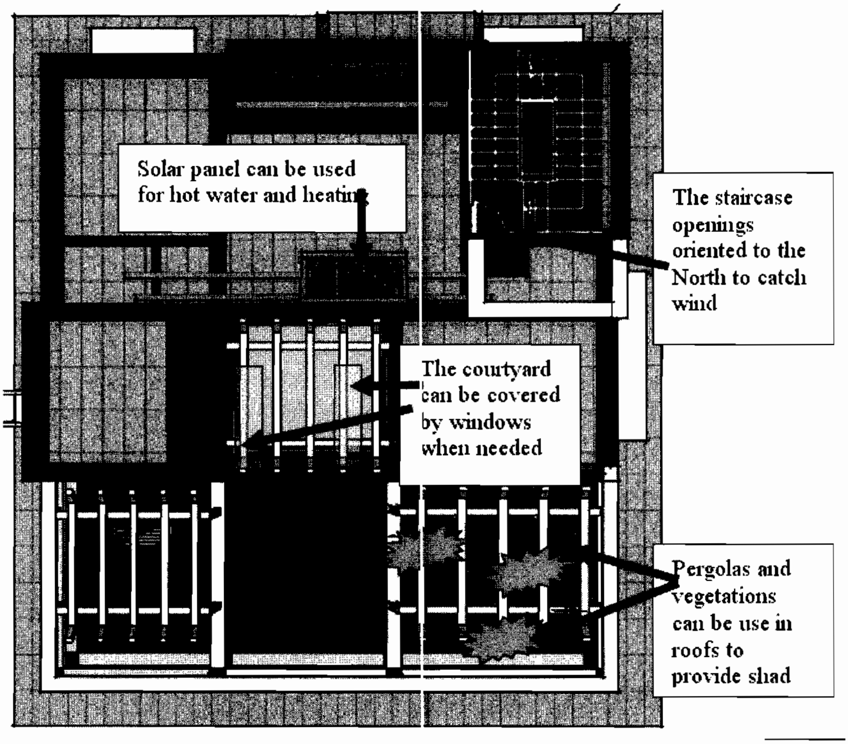


Figure 15 shows the roof plan with an explanation of the main features.

4.3.1 Design concepts discussion-how the design meets the criteria

According to the information given in the previous section, and the criteria of sustainable housing, the model concept is designed to meet these criteria in following ways;

Respect of the user's socio-cultural values; to respect the social culture, the design provides privacy, safety, flexibility and future extension, were the internal spaces have been designed according to its functions, it divided into three main group zones (guest, family and surface zones) (Figure 11, 13 and 14). The model offers the required number of spaces with adequate areas. Basement is used as one of the solutions that can provide extra spaces (It can be used for daily life, work or storage). In addition to that, its constant thermal comfort (Figures 14, 17). Choosing simple construction method can help in reducing cost (Figure 12).

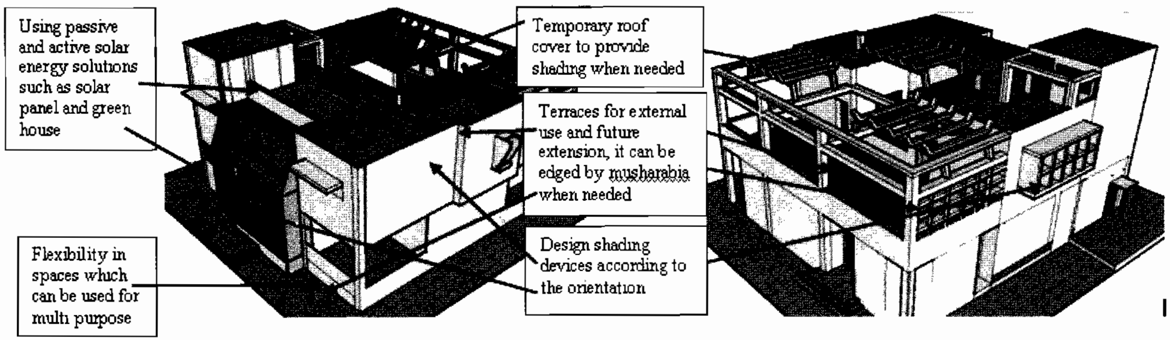


Figure 16: perspectives shows the main external features in the designed model

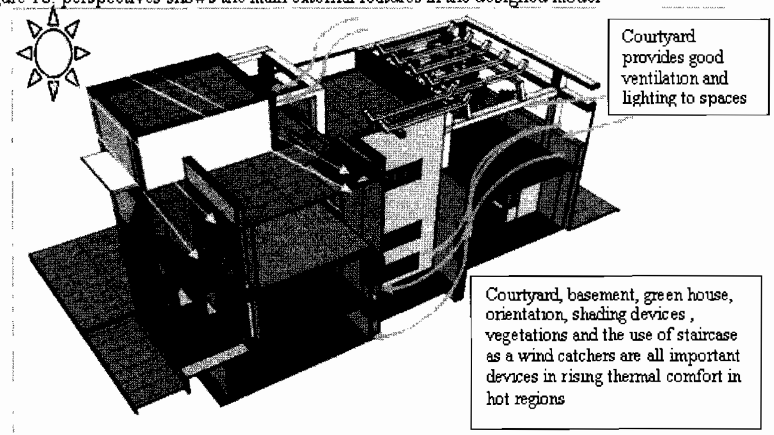


Figure 17: sectional perspectives shows the relation between the courtyard and other functions

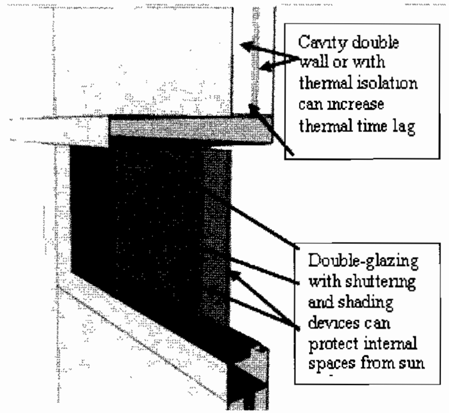


Figure 18: shows external wall and windows design

Adapting the climatic conditions; As mentioned before that Tripoli needs cooling more than heating, accordingly the main points is to prevent heat temperature to inter the spaces, providing shading and cross ventilation by the following strategies;

- Orienting the spaces to the best orientation. Living room and guest room can be in the north or south (living room is preferred to locate in the south because it can have a solarium house which help in moderate internal temperature). Bed rooms should be located in the east to receive direct sun in the morning while family are not using this rooms, services can be located in the West (Figure 11);
- Provide shading by using trees and shading devices- (vertical shading devices in the East, Horizontal one in South and combined of vertical and horizontal one can be located in the West (Figure 16);
- The thickness of walls which increase time lag or use cavity walls or one of the techniques presented earlier and using double glassing windows with a suitable thickness;
- Use solarium house concept to provide a good environment and prevent a direct heat gain to the living area (Figures 13, 16, and 17);
- Landscape design can help in provide shading by using trees especially in the East side (Figures 13, 14, and 15);
- Use the concept of the courtyard to provide cool air (Figures 13, 17).
- Use the staircase as wind catcher by orient the openings towards the North side (Figures 15, 17).
- Using *musharabia* in balconies or where necessary to provide privacy, shading and allow cross air (Figure 15).
- To reflect direct sunrise, the best shape of roofs can be curved or bitched and if it is not suitable, roofs should be shaded by shading devices or trees;
- Choose the appropriate design and materials with thermal insulation in walls, roofs and windows (Figure 18);

Energy conservation; In addition to the previous climatic strategies, energy consumption can be reduced by the following strategies;

- Using active solar energy (solar tracker) for hot water and heating spaces (Figures 15);
- Provide good lighting by good windows orientation and size, also choose appropriate internal colour and light colour in the external surfaces;
- Using passive design techniques such as solarium house (Figure 16 and 17);
- Using the provided local material

Respect the location (site conditions); Respect the site location, shape, geography and style by respecting building laws, and using simple structure that can not harm the site features (Figure12);

The use of natural light and ventilation; the model designed to receive natural light and ventilation and the courtyard helps to increase the amount of lighting were the windows in external surfaces includes shading devices and *musharabia* (Figures 14, 16,17 and 18).

Water efficiency; to reserve water, the model provides ground storage for rainwater (Figure 13), also gather the services in one side for water supply and sewerage, and recycle the used water in gardens (Figures 11 and 13).
The studied use of colours; the model suggested using bright colours in both external walls and roofs. For the interior surfaces the choices can be left to the residents.

Reduce noise pollution; can be by trees and spaces orientation also by using sound insulation.

Flexibility; the model offers flexible design by the possibility to add spaces when need it (for example using big terraces which can be changed to rooms). Possibility for future extension (a part of the house can be used for new family or for rent). To achieve flexibility, the position of the staircase should have access to inside and outside of the house (Figure 13).

5 Conclusion and Future Research

Relationships between man and the natural environment are reflected in housing forms. These forms present a clear identity to a culture, particularly in the early periods when man has a strong connection directly with natural resources.

To be successful in sustainable housing design, the architectural designer should play role in reducing the impact of buildings on the environment. They must consider energy efficient design strategies in the early design stage and should not rely on using simplified analysis, synthesis techniques, and historical examples. Also, building energy simulations are becoming more common in the design of buildings, architects should use it in the early design stage.

The modifications of the indoor conditions in buildings can be achieved by the use of the characteristics of the building skin, building materials, cross-ventilation and the use of available technologies. These demonstrate the potential of the building design to modify the internal conditions through strategies of natural conditioning.

This paper presents; First, the main principles of sustainable housing design with passive design techniques, second, an overview of the case study conditions and the third, the application of sustainable methods in private dwellings in Tripoli. The suggested design did not give a detailed form and elevations, it is a concept design shows the possibilities of designing a dwelling unit taking in consecration most of sustainable housing principles. Accordingly, a suggested concept design aimed to provide flexible guideline and applicable aides which can be amended according to site location, users needs and the creativity of the architect. The house shows how traditional values can be incorporated into a contemporary design that meets current needs for modern live in Libya.

For future studies, more quantified information to evaluate the inside thermal comfort and energy consumption can be achieved by testing this model using special software such as ECOTECT which be suggested for future studies.

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Convolution Dwelling System as Alternative Solution for Housing Issues in Urban Area of Bandung, Indonesia

Hafiz Amirrol, Komang Tria Parabawati and Achmad Tardiyana
Department of Architecture, Institut Teknologi Bandung (ITB), Indonesia

Abstract

In approaching urban housing issues, particularly in Indonesia, questions regarding multiple political-social-economy-cultural paradigms are inevitable. These paradigms often come together with the complex problems in housing condition, especially when it involves the marginalized urban poor. This paper discusses the potential of a new approach in housing design, which we call as the Convolution Dwelling System. This design experiment, conducted as part of the studio exercise for the Master's Program in Architecture Design at Institut Teknologi Bandung (ITB), respond to the site, which is located at the area of Industri Dalam, Bandung, West Java, Indonesia. The Convolution Dwelling System is hoped to provide alternative design solutions in offering flexible yet individually unique housing designs that would be able to accommodate densification within a controlled and sustainable environment. The design strategies formulated from the research were also seen as potential scheme that would resist generic housing developments that are often associated with urban sprawl as well as to approach the design problem within the idea of community based development. This paper is hoped to disseminate the overall design process and thinking behind the research to contribute in providing alternatives housing design scheme for a more sustainable urban dwelling.

Keywords: *Convolution Dwelling System, compact urban neighbourhood, marginalized urban poor, self-helped housing, community based design process, urban sprawl control.*

1 Housing Dilemma in Indonesia

Indonesia is a unique mix of contradictory conditions. From its difficult politics to economic situations, to its complex social and cultural compositions, and to its rich and vast geographical conditions, Indonesia provides us – architects and designers, with questions to response to these complex paradigms in its real contextual condition. The questions of housing and urbanization in Indonesia is more than simply a matter of providing shelter for households, but should also aim in creating environments that corresponds to the need for human dignity and that facilitates and enriches the daily practices of human life. The physical formation of Indonesia's housing and urbanism development that is happening now is a reflection from those wide spectrum conditions of the society itself. From luxury housing of the elitist and the rich, to well-organized mass housing located at housing estates intended for the middle-upper income level of the society, to the emergence of low-cost housing and semi-permanent housing which grow 'spontaneously', normally at slum or non-planned areas of the city, which housed the lower income society – these conditions proved that the development of housing and settlements cannot be seen simply in terms of their physical aspects – but also to tackle the questions of cultural, social and economic paradigm of the people.

Looking at the condition of the Indonesian society today, there is a wide spectrum in representing the wide spread of living conditions, especially if we view it from the aspect of social-cultural and social-economic of the whole nation. These social-cultural conditions, if being looked at a more detailed point of view, always involve the conditions of social relationship, conditions of value and belief systems and right to the conditions of cultural practice and living habits. These values are always being coupled with its dynamic social-economic conditions, which involve the level of income, ability to sustain economically, as well as their access to sources of income. All of these conditions normally happened in an uneven distribution of wealth and lifestyle practice. The development of housing and settlements in Indonesia, as well as those happening at most developing countries, are still at the transition condition (Lim, 2001). The state of the society, which is very heterogenic, whether in terms of socio-cultural, or socio-economy demanded a more mature and cautious act in the whole process of policy-making, planning and design thinking, and right until the act of implementation. These conditions are being seen as both potentials and constraints.

The cumulative effect from these issues is the formation of slum area in the city. Slums, random expansion, inefficiency and uncontrollable high-density sprawl presently characterize many Indonesian cities. This had caused segregated zones, which relate to the problems of poor socio-economic and living conditions, especially for the marginalized urban poor. Hyper densification on urban areas, conditions of sprawl, rapid urbanization and transmigration process pose significant challenges to urban design and housing practices. From the analysis, it can be said that slums in Indonesia are the product of failed policies, bad governance, corruption, inappropriate regulations, dysfunctional land markets, unresponsive financial systems, and a fundamental lack of political will (Darwis, 2002). Slums and squatter settlement exist because poor people cannot afford the housing provided by the formal land and housing markets. In our case, these formal land and housing markets were not even being provided properly, thus these low income households can only afford to build, buy or rent dwellings of relatively small size and of very low quality living environment (Figure 1). However, studies has shown that slums are in fact often highly organized both spatially and socially, that their dwellers often participate in the urban economy, that they are culturally diverse and dynamic, and that their residents are always highly motivated to improve their living quality. (UNESCAP, 2008)

Figure 1: Slums and squatter settlements in Indonesia.

The provision of adequate affordable housing for the lower income society has not been fully met yet by the government due to the problems of limited land especially in urban areas. The government has always been trying to find solutions to this problem of hyper-densification by providing vertical housings, which are provided parallel with their version of housing policies. Most housing policies in Indonesian cities attempted to address the proper and legal housing shortage, particularly for the low-income population, but did not succeed as they were being addressed through an escapist, non-holistic and almost naïve point of view. The principle ruling of the housing policy was to serve the people. Its general objective was to take care of the low-income families by providing sufficient numbers and living environment for them to live in. High-density urban housing is being defined as flats, or locally known as *rumah susun* (stacked housing), and is generally classified into two types; fully owned flats (*rusunami*) and rented flats (*rusunawa*). These dwelling systems include residential buildings and its neighbourhood as well as its public areas, infrastructure services, public facilities and amenities, and also the articulation of that neighbourhood in their urban settings. These policies seem to be comprehensive enough in providing solutions to the current housing problems in Indonesia. However, in reality, due to lack of wise design application, the policies failed to be applied in real contextualized situation, thus leaving the housing problems to be unresolved, at least at the most minimum standard. What are being offered today are duplication of generic housing models that are not only failed to provide conducive living environment, but sometime are creating more problems, especially social, cultural and psychological problems.

In responding to these questions and issues for the new housing design proposal, we try to approach these conditions beyond formal, quick fix solution and emerged into a practice where housing, urbanism and landscape designs are treated as a model of connective, scalar and temporal operations through which the urban condition is conceived and engaged as a complex and processual ecology. The area of our site, Industri Dalam, Bandung is the perfect site in examining these generative housing issues in urban areas. Its instability and dynamism offer opportunities for architects, urban designers and landscape architects to look beyond products and venture into a more sophisticated process that hopefully will reveal the hidden potentialities of housing settlements of the urban poor. Through the manifold identification of various paradigms in daily life, generating alternative design solutions would offer a sustainable and fair living condition for this marginalized society. This analysis on the condition of the site is hoped to provide a guiding framework in determining strategies and thinking process in the search of this alternative design scheme.

2 Proposed Site: Industry Dalam, Bandung

Bandung is located in the province of West Java and is one of Indonesia's cities with a rapid growth rate. This is indicated by the existence of large-scale economic activities with large capital such as industrial activities, communication facilities, and comprehensive transportation networks in supporting social mobility, facilities for education and religion practice as well as adequate health facilities (Figure 2). These conditions had forced Bandung to develop as a city that should provide decent living, working and playing environments to all of its inhabitants due to the accelerating density growth. The Sundanese people formed the majority of the original community in the area of West Java. Generally, the Sundanese community is known to practice the culture of communality with strong family values. These are due to the common cultural practice of communality, which is locally known as 'guyub' and 'rereongan' (Sumardjo, 2009). 'Guyub' is a traditiona Sundanese social practice of gathering around to socialize within the community of an area. 'Rereongan' is the culture of sharing within the community that strengthen and compliment the social practice of 'guyub'. The common gathering activity that is being practice usually involves creative activities such as producing arts and crafts, gardening and farming, or other recreational activities, and all these are usually being done at a common open space of the village. However lately, these precious cultural practices of the Sundanese people seems to be left out and forgotten in the current hectic, demanding and high density city life.

POPULATION BREAKDOWN

CURRENT TOTAL POPULATION
1,050

MALE
420

FEMALE
630

ELDERLY (over 65 years old)
100

CHILDREN (below 12 years old)
300

BIRTH RATE (per annum)
7%

DEATH RATE (per annum)
3%

TRANSMIGRATION RATE (per annum)
1.6%

POPULATION GROWTH RATE (per annum)
5.5%

JOBLESS RATE
52%

POPULATION GROWTH

POPULATION GROWTH (comparison between Jakarta and Bandung)

YEAR	JAKARTA	BANDUNG
1950	1,516,000	511,000
1955	2,067,000	679,000
1960	2,818,000	902,000
1965	3,501,000	1,086,000
1970	4,215,000	1,265,000
1975	5,219,000	1,493,000
1980	6,519,000	1,774,000
1985	7,357,000	2,090,000
1990	8,246,000	2,460,000
1995	9,786,000	2,896,000
2000	11,748,000	3,448,000
2005	14,020,000	4,126,000
Average Growth	+ 1,375,416 per 5 years	+ 413,236 per 5 years

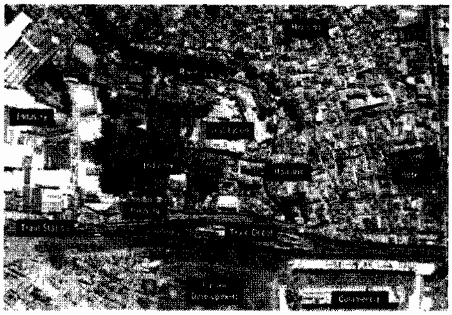

Figure 2: Population Data and Context of Industri Dalam, Bandung.

Industri Dalam is situated smack in the middle of the city of Bandung. It is surrounded by many strong forces that emerged through unprecedented population and city growth, i.e. uncontrolled slum areas with serious urban sprawling condition, industrial areas, transportation lines such as railway tracks and train stations, hotels, commercial areas, markets, etc. and all these are products of transitions from integration to segregation of city components and city life. The mostly 'spontaneous' structures found around the site are always being seen as 'illegal' and unfit for the rapid urban development for the city of Bandung, which is worryingly being controlled by the capitalistic policy of the city. This policy had caused many poor people in the urban area not being able to afford the housing provided by the formal land and housing market, thus creating 'alternative' dwelling types which are slums and squatter settlements. To many policy makers, slums should be demolished because they are believed to embody many negative influences such as diseases, crime, political unrest and other social problems. This design proposal is trying to respond to the current and future need of the site, which will be discussed in Topic 4.

Social sustainability is the main priority in designing this proposal. Non-gentrification approaches will ensure a balance new development, leaving no displacement for the existing dwellers of the slum area, and to eliminate marginalization, the whole process of relocating them was planned carefully to reflect the whole idea of the Convolution Dwelling System. The convoluting organization of the housing units, where each unit were organized in the form of continuous clusters, connected with corridors and public spaces were resemblance of the spatial organization structure of the original urban village. By implementing convoluting spatial organization, density of the housing development may be increased but at the same time has successfully avoided uncontrollable sprawling growth. This method proved to reduce environmental degradation of the area, since compact urban neighbourhoods were created in a self-sustaining way, thus promising economic sustainability for the whole new neighbourhoods

3 Reflection of Design Process and Theoretical Framework

As part of the studio work in our Master's Program, the design of affordable housing in Industri Dalam attempts to expose students to the real situation concerning the housing condition especially affordable urban housing in the form of high-density housing. Through the understanding of real condition of the shortage of housing experienced by the urban poor, students are hoped to creatively and sensitively propose an appropriate new housing scheme in the area of Industri Dalam. Understanding and improving the socio-cultural and socio-economic sustainability of the site, and providing design strategies and guidelines with the right metrics, allow some wider issues to be tackled. The vision is about how we plan the place and develop it to move forward. This is the real challenge for planners, policy makers, designers and developers to think differently about places and its making process. From this principle of contextualism and social-cultural sustainability of Industri Dalam, students of the design studio were encouraged to see the whole design process based on a synoptic method. This way, rational strategies or synectic approaches could be realized and transformed into a reflexive program for the urban intervention. This research and design project makes use of a multiple sources of evidence and so a mixed-methodology is adopted. It combines heuristic reasoning and participatory observation approaches as well as qualitative and quantitative strategies.

The intention of the project is to expose students to spatial planning and design issues, with special emphasis on social and cultural phenomena in producing alternative models relevant to contemporary and future housing solutions and urban forms. By zeroing into the components of place making as complete entities in themselves, the hidden dimensions of the site could be appreciated. What is introduced in the design studio is a way of thinking, a way of approaching problems by identifying them rather than inventing them. Only then does one look for specific data that are needed in order to solve the problems. Also important is the logic of the argument - how the various sections of the study work together and are linked to the main problem. In this process of identifying problems and solutions, students were guided to categorizing and analyzing typology characters of existing built forms. This is with the aim of giving birth to fresh ideas which will have a strong characteristic in its design approach - a type of specific architecture and urban form with strong cultural elements which may not be able to be represented elsewhere. Aldo Rossi (1984) suggests this principle of using typology studies as an analytical moment of architecture, and it has become a guiding tool for students to understand local culture and context in the production of their individual design proposal.

In searching for innovative solutions in revealing and exploiting the potential of these issues, housing design must be seen as a process, rather than creating formal assumption based on previous rules of thumb or general theories. The problems of dwelling in this area are supposed to be treated equally with the problem of those previously mentioned problems of socio-economic paradigms.

Not only the physical condition of this housing area shall be explored, but also certainly, the most important point of view is to understand the psychological and thinking behaviour of the society that has made up the area as what it is today. These basic thinking and behavioural issues of dwelling will be the guiding path in selecting, reducing, summarizing and developing problems and issues into potential, innovative and localized design solutions. To be able to understand the way of thinking of the dwellers of this area, a strong community based movement is being seen as the most suitable approach in searching for alternative solutions which hopefully will benefit the users, surrounding environment as well as a long lasting tool for capacity building (Ferry, 2009). This community-based movement is to assimilate designers (students) with the various stakeholders of the site in a simulation-based approach in the process of understanding the conditions and problems of Industri Dalam.

Probably the best intervention is not only creative design, but also a self-helped, conscientious program is most needed in securing a better and fair living environment for the marginalized urban poor community. The primary aim of this scheme is to establish the continuity of localized culture in the development of contemporary housing design scheme together with a contemporary yet regionalist urban form. Even within the context of globalization, the surface of urban life of Industri Dalam is still embedded in indigenous meanings, which include collective memories, spirit of togetherness as well as the traditional practice of Sundanese culture. If we want to reconstruct or reconnect the historical rupture of local cultural tradition created by westernization, it is necessary for us to understand the cultural forces that have established design principles behind the creation of their indigenous built form, which then can be translated in the modern context (Zubir & Amirrol, 2007). The aim is not to replicate but to transform and assimilate what have been done in the past into something compatible with the values and aspiration we hold today. By understanding the process that has contributed in moulding existing and previous cultural artefacts is not to deny present day realities, but to re-establish a continuity of traditionalism within the context of modernity.

4 The Convolution Strategy and Its Process

The Convolution Dwelling Strategy is an alternative design strategy in approaching the various problems of Industri Dalam. The idea is to create a spatial organization of housing units in a continuous and convoluted form, where the basic reasoning in the application of this new dwelling concept originates from the basic problems of high-density urban dwelling, which are uncontrollable sprawl and the madness repetition and rigidity of vertical dwellings. Urban sprawl has always been an ongoing issue, which had caused the following problems of decline in social capital, negative impacts on land and water quality and quantity, creating a car dependant community, reduction of public open spaces, higher pollution rate and gentrification issues. To response to the demand of hyper density, most development programs have resorted to generic, naïve type of vertical developments that are common in today's urban landscape. These kind of vertical development had also caused problems, which include the problem of decreasing social interaction between dwellers as a result from isolated community, the issues of cultural practice, safety and psychological, lack of personalization due to its rigid and uncreative configurations and design, as well as the problem of escalating development cost (Clarke, 2008). The convoluting method offers alternative since its built form morphology provides modular organization of a complete and sustainable neighbourhood.

In creating a robust neighbourhood, both empirical and parametric based behavioural analyses were conducted to improve the connectivity, networks and configurations of built forms of the proposal (Figure 3). By introducing strong paths as the primary circulation route, connecting dwelling clusters, nodes and public spaces within the site have proved to increase the quality of the site's value of integration and connectivity. This was done by modifying the already available internal route of the site and try to reconnect them with conditions that are seems to be appropriate in achieving the permeable quality of the new design scheme. The modification approaches are as follows:

1. Improving accessibility (Mean Value of Integration) by means of adding new networks and re-sizing and upgrading of existing routes.

2. Retaining low accessibility at selected areas to encourage spontaneous interaction and surprises.

3. Restructuring the hierarchy of road and connectivity networks that are visible to optimize the value of the site.

4. Improving accessibility between proposed site and its surrounding.

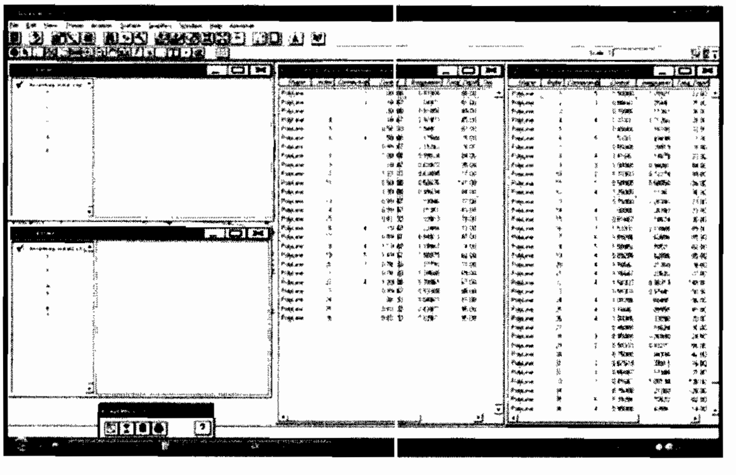

Figure 3: Measuring accessibility through urban parametric analysis.

The modified connectivity route allows for the implementation of our concept in integrating modern yet regionalist dwelling system that will encourage and allow the spirit of 'guyub'. A clear direction in structuring the connectivity of the area helps in creating a self-sustaining compact neighbourhood, and this design approach is a response from the locality of the site itself. From the modified routes, existing infrastructural nodes such as water sources, washing facilities and garbage disposal facilities that have played important roles in the community's daily activities were selected, improved and upgraded as important nodes in the revitalization processes as they had already created important sense of place for the area in terms of practice of everyday life, as well as generator for the place. The marked nodes will be the early point of reference in determining the whole planning configurations based on the process of spatial assemblage (Figure 4).

4.1 Alun-alun as Place Making Strategy

Alun-alun is a Javanese architectural term for the central open space common to all villages, towns and cities in the island of Java in Indonesia. Alun-alun is one of the most strategic public spaces to encourage social interaction (Santoso, 2008). Currently, there are eight active spots on the site where social activities happen almost on a daily basis. These informal gathering spaces are potential nodes for the revitalization development, where these nodes were to be retained and upgraded into lively communal spaces. Memory plays an important role in our decision to adapt this strategy, as we believe that the sense of place or genius loci of the site is all about the sense of belonging by the current dwellers. The memory of being together and building the village 20 years ago will always be something that cannot be erased even with a total make over of the area.

4.2 Networked Dwelling System

The whole new master plan is designed to create permeability for the site. This is again a design strategy to encourage social interaction and networking in creating a dwelling system that care about each other and towards their surrounding environment. The convoluted and interconnected housing units, infrastructural nodes, communal spaces and access points are also strategies to allow flexible mode of use in anticipating future density growth, economic status and also act as important mitigation plan during the event of disaster. These consolidated urban and housing components are hoped to provide a better living system for the users. We are seeing the design of this housing proposal as an ongoing process, not as a finite product designed by the architects. To implement the idea of this ongoing process of development and flexibility of change, the non-structural building skins (exterior and interior) can be easily change by later intervention by the users themselves. Infill panels such as window frames, wall panels, ventilation panels, etc. were designed as modular units, thus allowing them to be altered based on future needs.

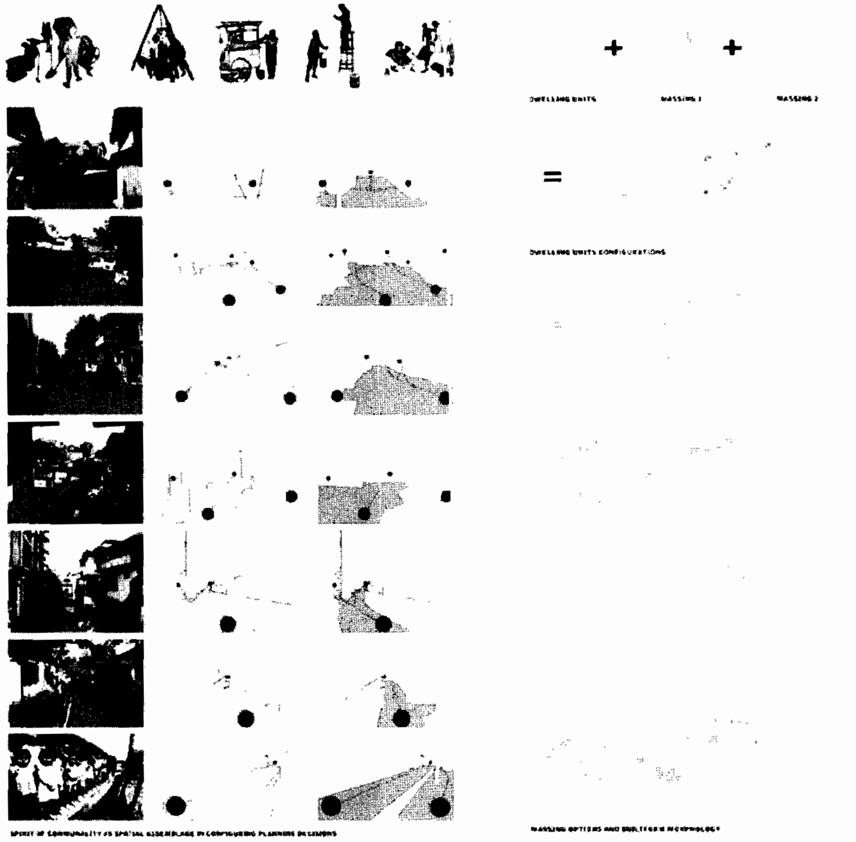

Figure 4: Spatial assemblage and built form morphology.

However, these changes are being limited only within a controlled and allowable perimeter, pre-determined and planned by the architects. This is to control and prevent unwanted growth of the units that may results to structural problems as well as other planning problems such as layout configurations, uniformity and ventilation flow. The idea of the massing layout and clusters configurations is to create a spatial quality where high-density dwelling can still be appreciated with a decent quality of open and green space. Each layer of the higher units will have access as if they are still at the ground level. This will allow people to meander around the neighbourhood without having to feel that they are being separated by the multi-layered building structure, and will also allow a more permeable collective dwelling system. Simultaneity, continuity and ephemerally characterize the flowing public spaces, therefore is an assemblage of the different dwelling clusters. This strategy is hoped to preserve the spirit of communality, or better known as 'guyub', which have existed in the current collective dwelling lifestyle of the society, even their dwelling units will be transformed almost vertically.

4.3 Phasing Plans

The development staging plans are as follow:

4.3.1 Stage 1

1) construction of structural nodes for new Convolution Dwelling System, 2) river improvement, 3) drainage and water reticulation system improvement, 4) public toilets construction.

4.3.2 Stage 2

1) rehabilitation of identified existing dwelling units, 2) kitchen, toilet and water supply improvement, 3) construction of new Convolution Dwelling units.

4.3.3 Stage 3

1) relocation into new Convolution Dwelling units, 2) demolishing works for identified unfit dwelling units, 3) construction for other public facilities and infrastructures, 4) pathways, drainage, landscaping and beautification works.

4.3.4 Stage 4

1) Rehabilitation of identified existing structure for adaptive re-use purposes
2) Advance improvement programs,
3) Waste management and implementation for sustainable dwelling system, 4) socialization of planning, design and construction concepts/ methods to the end-users and community leaders.

4.4 Easy to Understand Designs and Process in Promoting Social Cohesion

In responding to the needs of the community, as well as to participate them in the study, design and implementation process of this revitalization initiative for the Convolution Dwelling proposal, we believe that easy to understand designs and processes are the most efficient strategies in promoting social cohesion within the structure of the community. We believe that designs should be easy - does not require high and sophisticated tools and technology, simple and user-friendly. This concept is part of our effort in holistically tackle the issues in housing problems when it involves the urban poor community, thus celebrating their rights for them to know what their future house will look like. The scheme also encourage the community to practice their housing rights by choosing their own preferences, within a design driven controlled condition. However, architects and designers should still have the power in determining planning and control regulations. This process is a social negotiation in celebrating human's unique aspiration, thus leading to design solutions that should be easily assembled by the community themselves to encourage the spirit of *gotong royong* (working together).

This approach summarizes the whole observation of, and theories about Industri Dalam and its users as a self-organizing entity (Figure 5). In seeing the significant contribution of the local community in building this specific character of Industri Dalam, one must see housing design as an ongoing process that will evolve through participation of the community itself. Housing and urbanity is contextual, both spatially and temporally, and is always in the making. Options in place making are not ready made, but are always morphing. Choices are not between what is already there, but are about anticipating, adapting, and combining what the current and future keeps on offering. To understand something as complex as this site, where urban poor and rapid development co-exist at the same time, we must seek what s common in its many manifestations and constant in its transformations. Therefore, by learning to see environment in terms of change, we also learn to understand the ways in which we organize ourselves as agents acting upon it. This concept is a resemblance to John Habraken's approach in designing the housing units by proposing the separation of 'support' or base building from the 'infill' or interior fit-out in residential construction as a means of giving inhabitants a meaningful participative role in the design process (Habraken, 1998) (Figure 6). This approach also borrows some principles from the Structuralism's concept of participatory design process, thus leaving some room for incompleteness for future intervention from the users themselves.

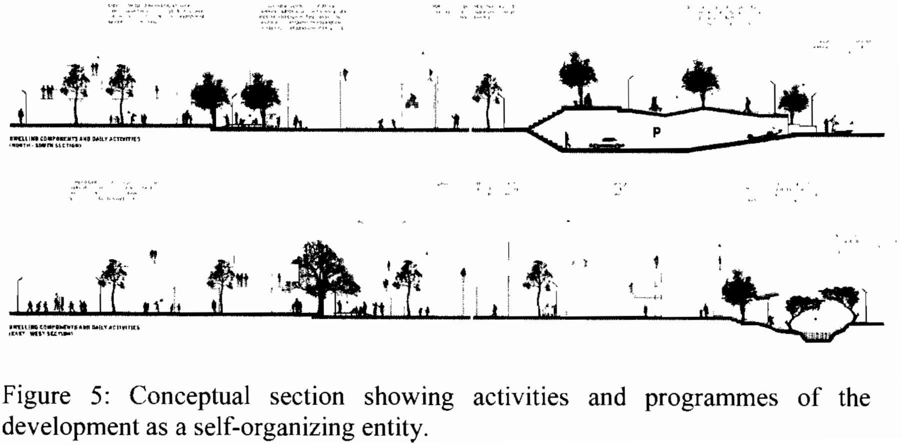

Figure 5: Conceptual section showing activities and programmes of the development as a self-organizing entity.

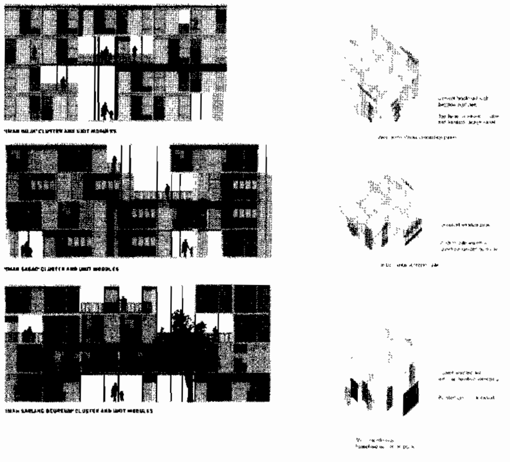

Figure 6: Unit modules with easy construction for infill panels.

Figure 7: Overall view of the Convolution Dwelling.

5 Conclusion

The Convolution Dwelling System proposed for the area of Industri Dalam focuses on the role of the dwelling places in influencing urban form and all of its components and paradigms (Figure 7). This in particular considers the drivers of change that would affect cultural and economic sustainability and influence social housing development. Most modern cities have traditionally bought into the notion of social-cultural-economies agglomeration; the idea of similar and sharing of resources, living habits and mutual benefits. This similar idea is also being applied in the design of our proposal, resulting in a spatial cluster of dwelling system that conveys layered interactions of cultural, commercial and social habitation. The key attribute and justification for this agglomeration is the increase of density and demands of the city itself. By increasing the density of the area into a more organized dwelling system, environmental degradation will be reduced at the regional scale, and will also help in the economic upgrading of the community, since the proposal opt for a comprehensive and self-organizing living system. The convoluting structural systems that are flexible enough for the dwellers to extend their housing units according to their future needs are also answers to control unwanted housing growth that are currently happening in most housing slums in Indonesia.

In the years to come, Indonesian cities and townships will face a major overhaul of its condition and surrounding, be it infrastructures, planning systems, built form typologies, housing types, as well as extensions and annexations. New ones will be built, and things might not be good as in the 1980s and early 1990s, when things are still 'fresh' and not chaotic as what exist now. But urban infrastructures and good housing are what Indonesian cities will demand, so these cities will get these new urbanism infrastructures either slowly or quickly, but surely eventually (Nas, 2007). Population growth, urban migration, economic growth, tourism demand, and the whole modernization process will demand that. Important decisions are to be made by every layer of society, with a clear conscience that is very important to shape the future urban civilization and lifestyle. These decisions must undergo intensive processes, and the proposals generated and discussed above from the idea of manipulating the existing cultural practice of communality or 'guyub' may work as catalyst for new sustainable dwelling system intervention. This concept imposes order and demand certain behaviours and discipline. It will also create new types of dwelling typologies, urban spaces and usage, with different possibilities to relate to existing spaces and socio-cultural context.

From the understanding of these concepts and design processes, a research based studio unit is seen as a laboratory to execute research on these new possibilities of urban studies. It is hoped that our effort in this design research exercise can validate the possibilities of projecting a new typology of housing design alternative that is derived from the source of localized norms i.e., from the spirit of 'guyub' and the practice of everyday life, thus stimulating the wide myriad of housing design interest in generating interesting new design schemes. As a studio exercise structured to expose students and researchers to the real condition of urbanism in Bandung, this process of analyzing, understanding, designing and re-evaluating the problems of the context helped the studio participants in nurturing critical design thinking in the overall process, thus creating potential design schemes that could contribute academically or in the scale of a real project to the improvement of the housing and urbanism development of Bandung and Indonesia.

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Appropriate Technology for Housing in Sudan: Evaluation of Selected Innovative Building Materials and Technologies

Akram Elkhalifa[1], Amal Balila[2]
[1] *Faculty of Architecture, University of Khartoum (Sudan), University of Camerino (Italy)*
[2] *Faculty of Architecture, University of Khartoum, Sudan*

Abstract

Similar to many developing countries, Sudan is experiencing high and rapid urbanization rates. The urban population of the country, as percentage of total population, increased from 6.8% in 1950 to 40.8% in 2005 and estimated to be 74% by 2050 (UN, 2008b). Wars, conflicts, natural disasters and escaping vulnerability are among the leading forces to the rapid growth in urbanization rates in Sudan. Among many other urban agglomerations problems, the provision of adequate and affordable housing forms the greatest challenge for governments and concerned parties. Housing in the Sudan comprises, on average, of more than 47% of the individuals' income.

The National Fund for Housing and Rehabilitation (NFHR) has been established according to a presidential decision in 2008 in an attempt to solve the problems of Housing in Sudan. In search for adequate and affordable housing based on appropriate local building materials and technologies, the NFHR devoted much of it resources to address the problems of the housing sector in Sudan. Research institutes, professional associations and practitioners were invited to give their suggestions and recommendations. Some demonstration models were developed to show the appropriateness of each technology and the extent of its affordability.

The purpose of this study is to carry out a comparative analysis between some of these different technologies in terms of economical and environmental contexts to fulfill the sustainability development requirements. The level of suitability of these demonstrative models to the Sudan will be addressed and discussed.

***Keywords**: Sudan, Housing, Building Materials, Building Technology, Sustainable Development*

1 Introduction

The world's total population in 1950 was estimated at 2.5 billion, it is expected to triple by the year 2010 reaching 6.9 billion. The last few decades have brought a world that is far more urbanized with a much higher proportion living in large cities and metropolitan areas (UNCHS, 1996). The World Urban population has been estimated to be about 50% in 2010 (UN, 2008b). Between 2007 and 2050, the population living in urban areas is projected to gain 3.1 billion, passing from 3.3 billion in 2007 to 6.4 billion 2050. By midcentury the world urban population will likely be the same size as the world's total population in 2004 (UN, 2008a).

The urban population of the least developed countries (LDCs) has increased from 0.8 billion in 1975 to 2.3 billion in 2005 and expected to be 2.9 billion in 2015. The urban population of the LDCs represents more than two third of the urban population in the world.

Sudan, as one of the least developed countries (LDCs) (UNDP, 2008) , has experienced rapid urbanization rate during the last few decades. The total population of the country increased from 9.1 million in 1950 (UN, 2008b) to 39.1 million in 2008 (CBS, 2008). The urban population of the country- as percentage of total population- increased from 6.8% in 1950 to 40.8% in 2005 and estimated to be 74% by 2050. The inhabitants of Khartoum, the largest city in the country, increased from 0.9 million in 1975 (UN, 2008a) to 5.2 million in 2008 (CBS, 2008) and expected to reach 7.9 million by the year 2025. The share of the city in the total population in the country increased from 2% in 1950to 13.5% in 2008, and the city accommodates more than one fourth of the urban population of the country (UN, 2008b) & (CBS, 2008) . The city has been ranked as the 214^{th} , 53^{rd} , 44^{th} among the world's urban agglomerations having 1 million inhabitants for the years 1975, 2007, and 2025 respectively (UN, 2008a).

The increase of the inhabitant of the globe and its urban population calls for more construction activities especially for housing. In developing countries, in general, the rate of construction is far below the demand for shelter, infrastructure and other amenities.

Many factors such as demographic growth, shifts from rural to urban areas, natural and human-made resource depletion, and significant changes in expectations and life styles, all combine in their various ways to erode the viability of traditional approaches to shelter provision. But many approaches to shelter provision developed over the past 50 years require capital, equipment, or skills that are inaccessible to the majority. Between the declining viability of traditional solutions and the inaccessibility of many modern alternatives, sustainable architecture defines an approach that seeks to bridge this gap (Norton, 1999).

In search for resolving the problems of housing in Sudan, the government launched in March 2008 the national project for housing and rehabilitation "Shelter for all". Under this project came the establishment of the National Fund for Housing and Rehabilitation (NFHR). The search for economically affordable materials and alternative technologies is of the concerns of the NFHR. Different materials and building technologies have been introduced to the NFHR as being convenient for housing in Sudan. These alternative materials and technologies need to be evaluated to assess their appropriateness to Sudan in terms of economical affordability, environmental impact and performance, and applicability.

The purpose of this paper is to evaluate some of these alternatives and put them into comparison. The results of this analysis will help the NFHR in the decision making regarding the most appropriate alternatives to adopt and disseminate.

2 Building materials and Sustainability in Developing Countries

There is a direct link between construction activities and human settlements development. In this context, the supply of building materials is a key factor in the construction sector's response to the needs of human settlements (UNCHS, 1986). Due to the increasing demand for construction activities, the demand for building materials and components increased accordingly. The importance of the building materials stems from the fact that it constitutes the single largest input to construction, accounting for 50 to 80 per cent of its total value (UNCHS, 1986) & (Planning Commission (India), 2002). High costs of construction in developing countries are attributed, among some other factors, to the insufficient production and limited output, low quality, and high costs of building materials beside the employment of inappropriate technologies in construction (UNCHS, 1986).

Sustainable construction can be defined as that which considers the economy and efficiency of resources or even eliminating possible negative impacts caused to the environment and its users. There are several alternative choices of constructive systems, materials, and available technologies. It is of great importance to get to know their real characteristics, their performance and possible impacts. It is through this knowledge that one opts for the best solutions and thus reaches good sustainability levels in the products of building site (Marques & Salgado, 2007).

Turin (1973) categorized the construction industry in developing countries into four levels based on the different levels of technology used, these levels are; the international modern, the national modern, the national conventionally, and the traditional. The traditional sector relies extensively on the locally-produced building materials while the international level relies on the imported materials.

The imports of building materials dominate the list of problems of building materials in developing countries. Besides, many developing countries depend, to a large extent, on imported construction skills and machinery. The reliance on imported materials is attributed to the low competitiveness of the locally-produced materials with imported materials. Insufficient production and limited output, low quality, and high costs are common characteristics of the locally produced materials in developing countries. The employment of inappropriate technologies being used in the production of building materials is responsible for the limited output and range of indigenous materials. Moreover, the limited ability of the traditional sector to make bulk purchases of inputs and limited access to capital and credits justify the small scale production of the sector (UNCHS, 1986).

Norton (1999) provided a list of criteria for the assessment of sustainable architecture. The criteria includes: the use of locally available materials and resources, socio-economic affordability, response to the local climate, durability, and potentials to be locally replicated. Therefore, the development of the locally-produced materials could have a significant impact on the building sector in developing countries. However, and for this purpose, developments in production capacity and technological capabilities are perquisites. Technological development in the production of building materials accompanies the sustainable development of construction methods and techniques.

The dependence on local capabilities has its economical impacts as stated by (Hillebrandt, 1999) that the use of simple technologies, local materials and little capital equipment is appropriate for developing countries. In Sudan, many researches were performed in search for low-cost local building materials for housing. For instance, when taking the history of earth architecture in Sudan as an example, a research was carried out in 1964 by prof. Ahmed Abdel Rahman Elagib (Adam & Alagib, 2001), his research focused on the earth, especially the rammed earth because of its easy fabrication and simplicity. Other important findings were obtained from a PhD research done in the United Kingdom by Dr. Alfadil Ali Adam. His findings were very important, because he classified the Sudan soil into groups; draw a proper map that showed his classification and the proper soil mixture that can be applicable in each part of Sudan. His findings were a base for many and also to future researches in the earth architecture in Sudan. However, these research efforts were limited, isolated, and lack coordination and collaboration between different stakeholders.

3 National Fund for Housing and Rehabilitation in Sudan (NFHR)

3.1 Background

In March 2008, the president of Sudan launched the national project for housing and rehabilitation "Shelter for all". The president adopted the provision of housing for the residents of the entire country within all the income class groups.

The main objective of the project is the implementation of comprehensive renaissance in the urban environment and achievement of sound physical planning fulfilling the best utilization of land. Besides, the project is concerned with the provision of adequate, affordable, and comfortable housing for the middle and low income population. For the purpose of achieving the goals of the project, the National Fund for Housing and Rehabilitation was established. The main objectives of the NFHR are to:

- Contribute to the process of urban planning and the setting of strategies through the cooperation with other authorities at the national and states levels.
- Coordinate and cooperate with funds for housing and rehabilitation on the states levels.
- Contribute in obtaining loans and grants in the area of the Fund's work.
- Encourage financing for housing and rehabilitation on national and states levels.
- Contribute to the development of building research and the application of local materials in construction and building.
- Reduce the construction costs through refunding of taxes and duties imposed on cement and iron.

A committee, headed by the Minister of Finance and National Economy, is formed to manage the Fund, run its affairs, and exercise the powers which enable it to achieve its goals. The Secretary-General of the NFHR is the chief executive officer of the fund, and responsible for running the financial and administrative affairs of the fund beside the implementation of policies decided by the directors of the fund.

3.2 NFHR Projects: A Search for Alternative Building Materials and Technologies

The correct choice of the materials to be used in construction has to happen in a conscious way, considering the distance of its production, its thermal and acoustic performance, its cost, the operation and maintenance easiness. (Marques & Salgado, 2007). Technologies that are appropriate at a national level must also be segregated from those that are appropriate for local consumption. This would distinguish technologies that need to go into macro-industrial production from those suited to micro-enterprise. Appropriate technologies are those that respond to the local environment, resources and economic needs. The development of new materials and technologies needs also to take into account the fact that the majority of the population is poor with very limited investment capacity (du Plessis, 2002).

As part of its objectives to reduce construction costs for housing, the NFHR invited contractors, building materials suppliers, and building technologies providers to build demo houses in the green valley in Khartoum. A couple of different materials and technologies had been presented (table 1). The objective of these demo houses was to help the NFHR adopting a list of alternative materials and technologies which proof to be affordable and adequate for the housing of middle and low income population. The engineers at the NFHR performed the economical comparison between these alternative technologies. The methodology followed in the economical analysis was based on cost information provided by different contractors. The alternative materials and technologies introduced to the NFHR focused on four components of the house building. These components are: walls, roofs, floors, and doors and windows. The subject study will focus on the materials and technologies employed in the walls and roofing since they represent the highest share in the construction cost beside their significance in terms of environmental performance.

Table (1): List of alternative building materials and technologies introduced to the NFHR

Walls	**Roofs**	**Floors**
Red Brick	Concrete (Conventional)	Plain Concrete
Cement Blocks	Pre-Cast Concrete	Cement Tiles
Stabilized Soil Blocks	Jack Arch	Ceramic Tiles
Hollow Red Blocks	Sandwich Panel	
Stone Blocks	Steel Sheet Roofing	**Doors &Windows**
3D Panel	Onduline	Locally Manufactured Steel Ds & Ws
Light Concrete	Corrugated Iron Sheets	Imported Steel Ds & Ws
	PVC Roofing	

4 Evaluation of the Thermal Performance of Selected Building Materials for Housing

Referring to the Köppen climate classification and according to the geographical location of Sudan (between latitudes 3.5°N south and 22°N north) Sudan is classified as an arid hot and dry climate. In Sudan, given its climate characteristics, blocking solar radiation and minimizing solar gains are among the main design criteria to be met for a totally environmental-building. Therefore, from an environmental point of view and energy uses, avoiding heat gains is preferable. Walls and roofs are the important elements of the building envelope that are directly affected by the solar radiation, which is responsible of a big amount of heat gains in buildings. The minimization of heat gains can be obtained through the selecting of appropriate materials for each element of the building envelope. While the maximum amount of heat gains is attributed to the building skin which consists of the materials. Therefore, focusing on building materials selection is of a great importance and should be put into consideration from the early stages of the design process. According to Moon (2007), there are efforts to create buildings that do not require external energy to heat, cool, or power them. Thus materials with low embodied and operating energy are considered environment-friendly and meet the sustainable construction criteria.

The following analysis focuses on the effect of using different materials used in walls and roofs on the internal environment of the building in term of thermal performance. For the wall materials, the most common materials used in buildings are selected. While for the roofing materials, the cost is also considered in the selection by including, into the analysis, the materials that have the highest and lowest costs. The selection of alternative materials is based on cost comparative analysis results carried by the engineers at the NFHR. The analysis results are shown in table (2):

Table (2): Cost comparison and ranking of alternative building materials and technologies for walls and roofs introduced to the NFHR

Walls	**Cost in SDG (Ranking)**	**Roofs**	**Cost in SDG (Ranking)**
Red Brick	16,170 (5)	Concrete	9,590 (8)
Cement Blocks	15,545 (4)	Pre-Cast Concrete	6,440(6)
Stabilized Soil Blocks (SSBs)	17,295 (6)	Jack Arch	7,700 (7)
Hollow Red Blocks	14,445 (2)	Sandwich Panel	6,300 (5)
Stone Blocks	15,195(3)	Steel Sheet Roofing	4,200 (3)
3D Panel	18,645 (7)	Onduline	4,900(4)
Light Concrete	11,725 (1)	Corrugated Iron Sheets (CISs)	3,850 (2)
		PVC Roofing	2,800 (1)

For the purpose of analyzing the appropriateness of the suggested building materials and technologies, sets of alternatives (materials and technologies) have been selected interchangeably. The objective of the underlying analysis is to evaluate the thermal performance of the selected alternatives and their implications on the internal environment.

One of the most effective means of reducing a building's reliance on external grid power is to reduce energy use as a whole. Increasing reliance on natural lighting and passive heating and cooling are some of the most effective ways of reducing energy consumption in a building. Heating and cooling buildings contribute to more energy usage than any other aspect of a buildings use. Consequently, the choice of building materials is one of the most important aspects that determine the performance of a building and thus its level of sustainability (Moon, 2007). This paper adopts the following criteria to compare the performance of different materials recommended to the NFHR. The criteria are based on the amount of energy that the building needs to perform well:

a) **The annual energy Loads:** The amount of annual energy that is needed to cool one square meter of the building (Wh/m^2)to be within the comfort band (18°C to 26 °C)

b) **Passive Comfort:** The total number of hours which the building enjoys in the thermal comfort level from the total number of hours of the year.

c) **Heat gains:** The amount of heat gained by the building in the hottest day in the year (20th of May).

d) **Passive breakdown of heat gains:** Amount, as percentage, of heat gains and losses attributed to different ways of heat gains and losses.

In all cases, the materials for floors, doors and windows are assumed to be similar. The selected materials for the underlying analysis include:

- **Walls:** (a) Red Brick, (b) Cement Blocks, (c) Stabilized Soil Blocks (SSBs)
- **Roof:** (a) Concrete, (b) Jack Arch, (c) Corrugated Iron Sheets (CISs), and (d) PVC

According to the materials and technologies applied, two roof shapes are considered in the analysis; flat roofs for concrete, CISs, and PVC while vaulted roof is applied for the Jack Arch. The total number of alternatives evaluated is 12. Another important aspect to consider for the corrugated iron sheets roof is the possibility of adding ceiling by employing a traditional technology for ceiling (by using timber boards). The ceiling improves the performance of the roof significantly.

The analysis is performed using the Ecotect software which belongs to Autodesk Corporation. Ecotect is a programme that analyzes buildings designs as three dimensional models (3D) to simulate how they will perform and operate. Ecotect gives architects and engineers the opportunity to study their buildings energy performance from the earliest stages of the design to see how their buildings will operate. The Ecotect software has many environmental tools which are used to analyze many environmental design principles such as thermal, solar, shading and lighting. Ecotect is one of the programmes that assist on estimating, managing, and controlling buildings energy. The analysis employs the same house plan for the analysis of the 12 alternatives. The total built area of the house is $70m^2$ consisting of two bedrooms and veranda (figure 1).

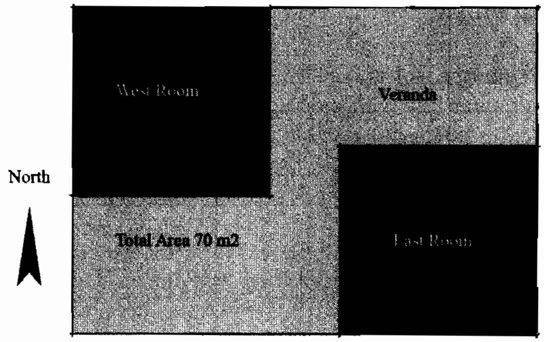

Figure (1): The house plan used in the analysis

The following table gives information regarding the properties of the materials used such as their layers, thermal conductivity, and thermal decrement.

Table (3): Properties of the materials selected for the analysis

Element	Materials	Layers	Section	U-Value W/m²K	Thermal Decrement (0-1)
Walls	Red Brick	1.Plaster Building (Molded Dry) 2. Brick Masonry Medium 3. Plaster Building (Molded Dry)		2.64	0.70
	Cement Blocks	1.Plaster Building (Molded Dry) 2. Cement Blocks, 3.Plaster Building (Molded Dry)		3.93	0.98
	Stabilized Soil Blocks	1. Soil (Avg. Props) 2. Plaster Building (Molded Dry)		2.00	0.42
Roofs	Conerete	1.Concrete 2.Plaster Building (Molded Dry)		1.09	0.74
	Jaek Arch (Brick Roof)	1. Plaster 2. Brick 3. Iron 4. Plaster		2.98	0.63
	Corrugated Iron Sheets without ceiling	1. Zinc		5.62	0.98
	Corrugated Iron Sheets with ceiling	1. Zinc 2. Air Gap 3. Timber		2.33	0.07
	PVC	1.Polyvinylchloride		2.16	0.99

4.1 The Annual Energy

The total annual energy that is needed to control the internal environment of the building by using mechanical cooling systems to be in the comfort band, gives an indication of which materials combinations (combinations of the roof and the walls materials and also the roof shape), are the best and lead to use the minimum amount of energy to cool the house and raise its performance all over the year.

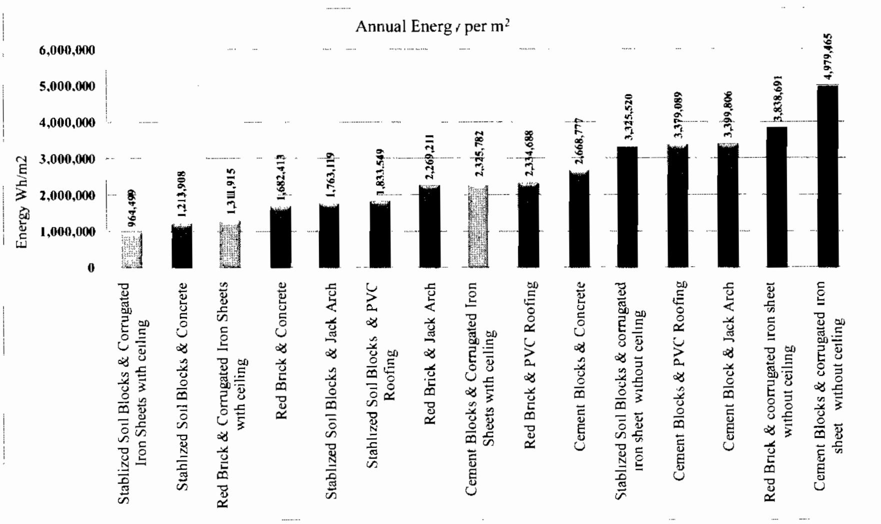

Figure (2): Annual Energy that is needed to cool the house

Figure (2), shows the amount of total energy that the house needs to be within the comfort band all over the year. The graph illustrates that the SSBs in walls, when combined with different materials for roofing, perform well. Meanwhile, cement blocks with any type of roofing system and materials need an amount of total energy more than any other combination. For roofing materials and technologies, on the other hand, the corrugated iron sheets (with a false ceiling) and concrete show the best performance. However, if the corrugated iron sheets roof is used without a false ceiling, it comes at the end of the list with all wall materials. This imply that corrugated iron sheets as roofing system can be successful and give good results if it is used with a false ceiling (yellow bars in fig 2), while if it is used without any kind of false ceiling it will be the worst type of roofing system and it will lead to use more energy in order to raise the performance and the quality of living conditions inside the house. The minimum amount of energy required is associated with using a combination of stabilized soil blocks for walls and corrugated iron sheets with a false ceiling as a roofing system. The maximum amount of energy required is accompanied with the combination of cement blocks and corrugated iron sheets without the false ceiling for walls and roof respectively (red bars in fig 2).

4.2 Passive Comfort

The total number of hours that the building enjoys in the comfort band compared to the total number of hours of the year (8760 hours in one year), gives an indication of how the building is performing passively with the environment and the amount of time that the house will be in need for mechanical cooling.

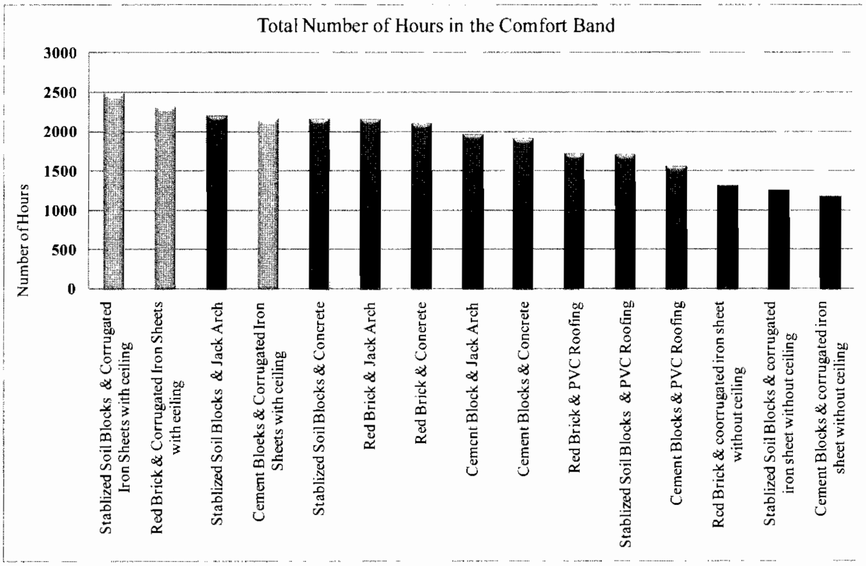

Figure (3): Total number of hours inside the comfort band from the total hours of the year for each alternative

The graph on figure (3) indicates that the building enjoys the highest amount of time in comfort band by combining stabilized soil blocks for walls and corrugated iron sheets (with a false ceiling) in the roof. The total number of hours, inside the comfort band, is estimated to be about 2500 hours, meaning that the building enjoys 28.4 % of the total number of hours all over the year in the comfort band without any mechanical cooling or heating. The minimum number of hours in the comfort band is experienced through the combination of cement blocks in the walls and corrugated iron sheets (without a false ceiling) in the roof. Similarly, the PVC roofing system, with all walls materials, falls at the end of the list with about (17-19%) of time in passive comfort.

4.3 Heat gains:

The amount of heat gains in the hottest day of the year (in May 20th) gives an indication of the performance of different material in terms of gaining heat. The graph in figure (4) shows heat gains and losses in the hottest day of the year (20th of May). Similar to the results of the analysis provided in (section 3.1), the stabilized soil blocks top the list in terms of best performance. While the cement blocks for walls tail the list. The combination of SSBs and corrugated iron sheets (with false ceiling) gives the best results in this regards, meanwhile the combination of cement blocks and jack arch gives the worse results. However, the brick, as a main material in the jack arch, tends to gain and losses heat slowly.

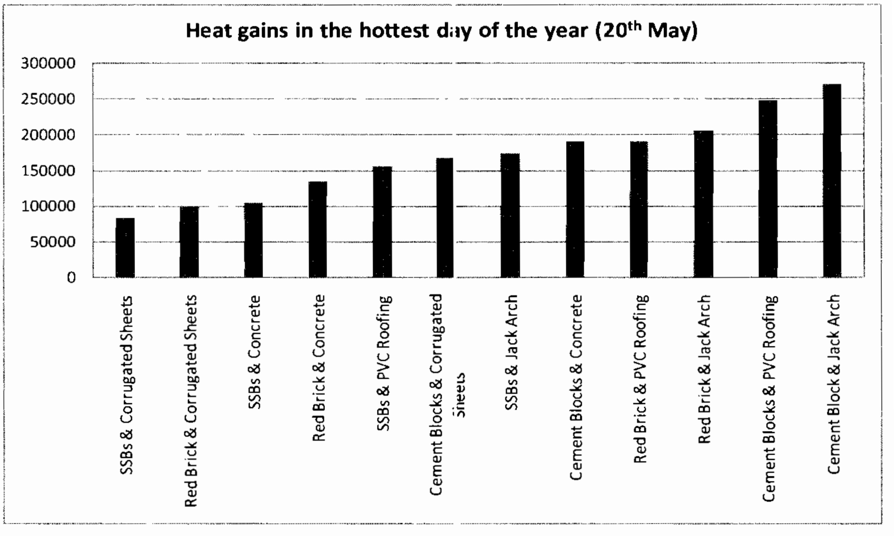

Figure (4): The amount of heat gains (wh) by different materials in the hottest day of the year for each alternative

4.4 Passive Breakdown of Heat Gains and Losses

Passive breakdown of heat gains and losses gives an indication of gains and losses attributed to different ways by which the building interact with the solar heat. The building usually gains and losses heat through its fabric (external building materials), by conduction and solair (gains due to indirect solar exposure), otherwise known as the Sol-Air temperature. These heat gains are caused by the molecular excitation within the building materials when exposed to solar radiation. The total amount of the heat gains or losses by both ways is the role of the materials of the external surface (especially walls and roof), and here comes the main role that the materials selection plays. The building also gains and losses heat by ventilation, occupancy, internal equipments that generate heat, direct solar radiation through glazed surfaces and also from the surrounding buildings. The breakdown of heat gains and losses by different combinations for walls and roofs is shown in figure (5).

Figure (5) shows that the heat gains by all parts of the house and factors (the fabric, solar, ventilation, users, lighting and equipment, and the surroundings). It shows the heat gains associated with different combinations of materials for walls and roofs where the total heat gains by the material is the summation of the heat gains by the fabric and the solair. Accordingly, the minimum amount of heat gains, (about 45%) of the total gains occurs when using the corrugated iron sheets with the false ceiling for the roof and the stabilized soil blocks for walls. Also when the same system of corrugated iron sheets is used with red bricks in walls; it gains about 56% of the total gains. The maximum amount of heat gains is obtained when red brick is used for walls and combined with corrugated iron sheets without ceiling for roofing (about 84.5% of the total gains).

The graph clears that the building, mainly and in most cases, gains heat, through its fabric and the solair. However, the heat gains attributed to ventilation is higher than that to solair when using a combination of SSBs for walls and corrugated iron sheets for roofing. Additionally, and in most cases, the heat gains attributed to the fabric are the highest except when the corrugated iron sheets and PVC are used for roofing without a false ceiling, where the maximum heat gains are attributed to the solair.

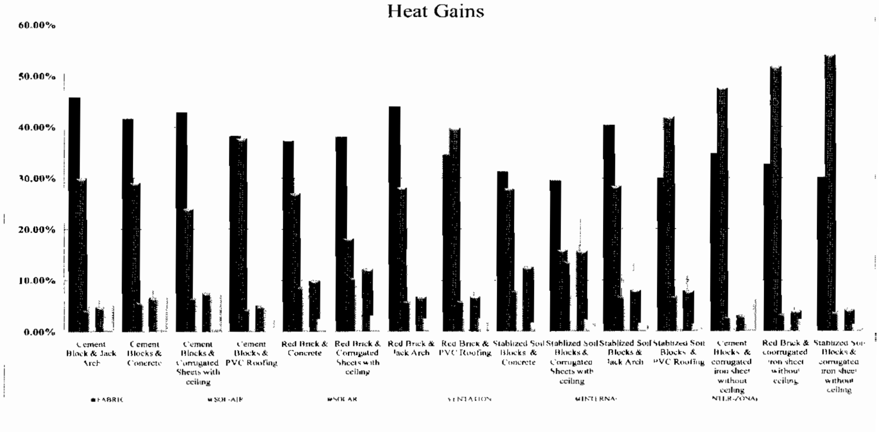

Figure (5): Passive breakdown for heat gains for different alternatives

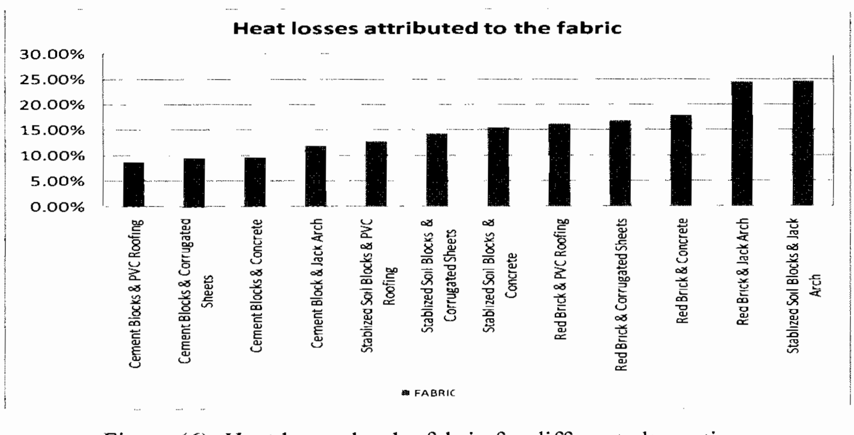

Figure (6): Heat losses by the fabric for different alternatives

Figure (6) above shows the amount of heat losses attributed to different ways through which the building gets rid of heat. In this regard, brick as a material, in all combinations for both walls and roofs, appears to be the best material in terms of loosing heat through the fabric. While the cement blocks tend to have small percentage of heat loss attributed to the fabric. In all combinations options between walls and roofing materials, most of the heat losses are attributed to the inter-zonal factor.

5 Conclusions and Recommendations

The search for adequate and sustainable housing, in general, should include, besides cost, other sustainable construction requirements such as environmental impact, thermal performance, and availability of the building materials. The selection of materials for walls and roofs, which have the highest share in the cost of housing beside their importance to the thermal performance of buildings, is crucial. The selection of materials involves manifold factors such as durability, maintenance, operation, ..etc. These factors are beyond the scope of this analysis.

The authors highlighted the performance of different combinations of selected materials in terms of annual energy required, passive comfort, heat gains, and passive breakdown of heat gains and losses. The analysis results presented in this paper conclude that corrugated iron sheets in roofing perform well with all wall materials if false ceiling is used. On the other hand, cement blocks tend to be inappropriate in terms of thermal performance. Therefore, this conclusion should be considered when selecting cement blocks for walls construction. Alternative design solutions could be presented in this regard (i.e, false ceiling). The analysis approach should be extended to all possible alternatives for walls and roofs in order to get a more comprehensive and in depth sight on the technologies introduced to the NFHR. To recapitulate, the NFHR needs to consider more factors, beside the cost, in the selection of the alternative materials or technologies to adopt. The following recommendations might help the NFHR in developing its own criteria for the selection of materials and building technologies to be employed in its schemes that meet the sustainable construction requirements:

- Establish an assessment tool to analyze the performance of different building materials i.e., Leadership in Energy & Environmental Design (LEED);
- Introduce the application of recycled materials and encourage the use of materials which are recyclable;
- Choose appropriate methods of construction in term of energy and resources efficiency;
- Establish collaborative research projects with research institutes and universities;

- Analyze the application of innovative building materials and technologies to assess their appropriateness to the Sudan and transfer these technologies whenever possible.
- Adoption and dissemination of appropriate building technologies;
- Establish workshops and training programs to share the knowledge of successful and appropriate technologies;
- Open contact channels with similar bodies abroad and nongovernmental organizations (NGOs) to benefit from their experience;
- Invite the private sector, individual architects, and contractors to participate in the NFHR schemes;
- Provide direct and indirect access to finance for the low and middle income population.

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Quality of Life of Residents in Urban Neighbourhoods of Penang, Malaysia

Abdul Ghani Salleh, Nurwati Badarulzaman
Universiti Sains Malaysia, Malaysia

Abstract

Research in quality of life indicates that there are many factors in the neighbourhood that contribute to residents' quality of life through neighbourhood satisfaction. Examples of these factors are environment, safety, public facilities and housing satisfaction. Many studies have shown that satisfaction with neighbourhood features affect residents' quality of life. Residential neighbourhood satisfaction is an important indicator of housing neighbourhood quality which affects individuals' quality of life. This paper presents an empirical analysis of social, economic and physical features of urban neighbourhoods that contribute to overall satisfaction of with the neighbourhood which in turn affects positively the overall feelings toward life. Data for the study come from primary source collected through a personal interview technique. Field surveys were conducted in 2008. A sample of 100 households was randomly selected using systematic sampling procedure from households living in middle income residential neighbouhoods in Penang, Malaysia. Data were analysed using descriptive statistics. Descriptive statistics generated frequencies and percentages of respondent characteristics and mean scores of satisfaction. The findings of the study indicate the residents were generally satisfied with overall quality of life. However, the satisfaction level was low for public transport, political activities and cost of living from physical, social and economic aspects respectively.

***Keywords**: quality of life, neighbourhood quality, residential satisfaction.*

1 Introduction

Quality of life is 'individual's overall satisfaction with life (Schumaker et al., 1990). Many studies have shown that satisfaction with neighbourhood features affect residents' quality of life (life satisfaction). An involvement of community in urban neighbourhoods is an essential ingredient of sustainable housing which affects their quality of life (Choguill, 2007). A study in Malaysia has shown that residential neighborhood satisfaction is an important indicator of housing quality and condition which affects individuals' quality of life. It determines the way they respond to their residential neighbourhood and environment (Abdul Ghani, 2008).

Satisfaction with social, economic and physical features of the neighbourhood tend to contribute to overall satisfaction of with the neighbourhood (neighbourhood satisfaction), which in turn affects positively the overall feelings toward life (life satisfaction). The empirical evidence which support neighbourhood quality or neighbourhood satisfaction can be broken down into 17 components in three categories as cited in Sirgy and Cornwell (2002):

Physical Features:

- Satisfaction with homes and yards.
- Satisfaction with landscape in the neighbourhood.
- Satisfaction with street lighting in the neighbourhood.
- Satisfaction with nearness to the neighbourhood facilities.
- Satisfaction with crowding and noise level in the neighbourhood.
- Satisfaction with quality of environment in the neighbourhood.

Social Features:

- Satisfaction with integration with neighbours.
- Satisfaction with outdoor play space.
- Satisfaction with people living in the neighbourhood.
- Satisfaction with ties with people in the community.
- Satisfaction with crime in the neighbourhood.
- Satisfaction with race relations in the community.
- Satisfaction with sense of privacy at home.

Economic Features:

- Satisfaction with home value in the neighbourhood.
- Satisfaction with cost of living in the community.
- Satisfaction with socio-economic status of the neighbourhood.
- Satisfaction with the neighbourhood improvement.

According to Sirgy and Cornwell (2002), satisfaction with neighbourhood physical features as indicated above contributes significantly to one's satisfaction about the housing and neighbourhood. Similarly, according to them, satisfaction with neighbourhood social features and economic features significantly affect life satisfaction through one's overall feelings of these neighbourhood features.

Research in quality of life indicates that there are many factors in the neighbourhood that contributes to residents' quality of life through neighbourhood satisfaction. Examples of these factors are environment, safety, public facilities and housing satisfaction (Lee and Guest, 1983). Studies by Campbell, Converse and Rodgers (1976) and Sirgy et al. (2000) indicate that neighbourhood satisfaction is a significant predictor of life satisfaction. As stated above, satisfaction effects of the neighbourhood physical, social and economic features play a very important role in neighbourhood satisfaction which determines life satisfaction. Firstly, satisfaction with housing, street lighting and noise level in the neighbourhood are among the main neighbourhood physical features affecting neighbourhood quality (Dahmann, 1983; Miller at el. (1980) and Bones, Bonaiuto Ercolani, 1991). Secondly, satisfaction with integration with neighbours, people living in the neighbourhood and race relations are among the main social features affecting the neighbourhood quality (Ahlbrandt and Cunningham, 1979; Campbell, Converse and Rodgers, 1976 and Miller at el., 1980). Lastly, satisfaction with home value, cost of living in the community and socio-economic status of the neighbourhood are the main economic features affecting the neighbourhood quality (Galster, 1987 and Lu, 1999). Thus, it can be hypothesised that neighbourhood features, such as physical, social and economic features affect life satisfaction as indicated in Figure 1.

2 Data Analysis

Data for the study come from primary source collected through a personal interview technique. Using this technique, set questions were asked by the interviewers to elicit information from the respondents. Structured questions were used in preparing the questionnaire for the survey. To avoid bias resulting from questionnaire design, the questions were constructed in such a way that they were direct, simple and familiar to the respondents. Nevertheless, some explanations by the interviewers were expected to clarify certain points so that certain level of consistency could be achieved in the interview.

The questionnaire is divided into five sections as follows:

a) Household information

b) House ownership information

c) Level of satisfaction with physical aspects of life

d) Level of satisfaction with social aspects of life

e) Level of satisfaction with economic aspects of life

The level of satisfaction of housing is measured in a five-point Likert scale ranging from "1" for very unsatisfied, "2" for unsatisfied, "3" for neutral, "4" for satisfied and "5" for very satisfied. Using the mean values of the scale, 3 is considered to be the midpoint. Thus, any value above 3 is considered somewhat satisfied but of lower level. Similarly with any value below 3, it is considered to unsatisfied but of lower level.

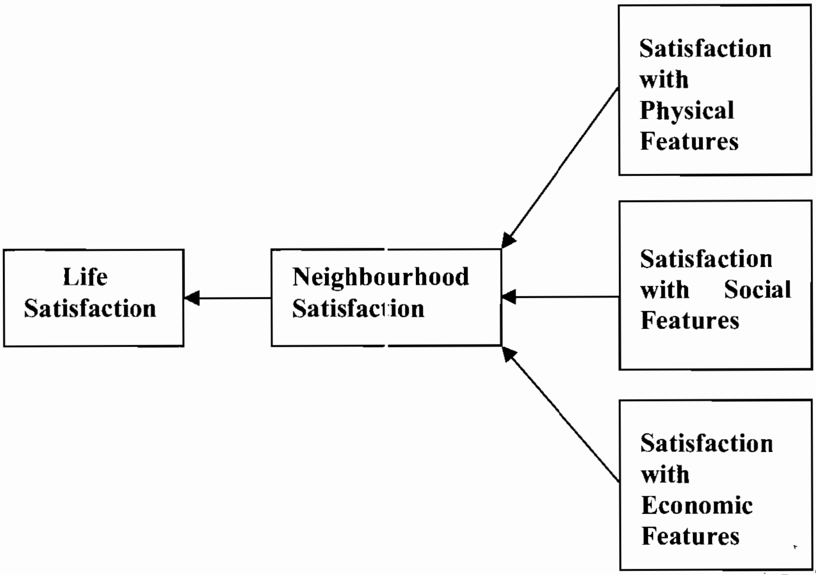

Figure 1: Neighbourhood Features Affect Life Satisfaction

Field surveys were conducted in 2008. A sample of 100 households was randomly selected using systematic sampling procedure from households living in urban neighbourhods of N-Park, Taman Pesara Indah, Island Glades, Taman Brown and Taman Sri Nibong in Penang, Malaysia. Penang is one of the most developed states in the country with a population of 1.5 million and urbanization rate of 80%. Data were analysed using descriptive statistics. Descriptive statistics generated frequencies and percentages of respondent characteristics and mean scores of satisfaction.

2.1 Household Characteristics

The population in urban neighbourhoods of Penang comprises households of multi-ethnic backgrounds with 20% of the households were Malays, 57% Chinese, 19% Indians and 4% others. The heads of household were relatively young with a large percentage of them in the age bracket of 31-40 (44%) and 80% of them had married. Their average income levels were mostly between RM 3,500-RM 4,400 per month (USD 1,080-USD 1,358).

In terms of housing tenancy, the residents were generally house owners with 74% of them owned their houses, while 24% of them rented their houses. The houses in the study area were recently built within less than 5 years of age (46%).

2.2 Satisfaction with Overall Quality of Life

The residents were generally satisfied with overall quality of life with 56% of the respondents indicated this category, while 44% of them expressed their feelings otherwise. They expressed their satisfaction with three main aspects of neighbourhood features, i.e. physical, social and economic as discussed below.

2.2.1 Satisfaction with Physical Aspect of Life

In this section, satisfaction with physical features is discussed based on the level of satisfaction of the residents. The residents have expressed their satisfaction with the neighbourhood physical features, such as dwelling units, housing area, environment, education and health facilities, public and recreational facilities and public transport. They have expressed their satisfaction more with the dwelling units, housing area and educational and health facilities (mean scores of 3.56-3.65) than their neighbourhood environment, public and recreational facilities (mean scores of 3.35-3.46). On the other hand, the mean score for public transport is 2.84 which indicate their dissatisfaction with the service (Table 1).

Table 1: Satisfaction with Physical Aspect of Life

Physical Features	Level of Satisfaction
Dwelling units	3.65
Housing area	3.56
Environment	3.35
Education	3.62
Health	3.60
Public facilities	3.39
Recreational facilities	3.46
Public transport	2.84

2.2.2 Satisfaction with Social Aspect of Life

The residents have expressed their satisfaction with the neighbourhood social features, such as interaction with neighbours, social interaction, ethnic relation, public safety, religious facilities and political activities. They have expressed their satisfaction more with social interaction with a mean score of 3.56 than their interaction with neighbours, ethnic relation, public safety and religious facilities (mean scores of 3.14 - 3.46). On the other hand, the mean score for political activities is 2.93 which indicate their dissatisfaction with the political interference in the community (Table 2).

Table 2: Satisfaction with Social Aspect of Life

Social Features	Level of Satisfaction
Interaction with neighbors	3.30
Social interaction	3.56
Ethnic relation	3.46
Public safety	3.14
Religious facilities	3.45
Political activities	2.93

2.2.3 Satisfaction with Economic Aspect of Life

The residents have expressed their satisfaction with the neighbourhood economic features, such as employment, income, work place, cost of living and home value. They have expressed their satisfaction more with employment with a mean score of 3.60, than their income, work place and neighbourhood home value (mean scores of 3.32-3.39). On the other hand, the mean score for cost of living in the neighbourhood is 2.71 which indicate their dissatisfaction with the rising cost of living in their neighbourhoods (Table 3).

Table 3: Satisfaction with Economic Aspect of Life

Economic Features	Level of Satisfaction
Employment	3.60
Income	3.39
Work place	3.37
Cost of living	2.71
House value	3.32

2.3 Relationship between Household Characteristics and Life Satisfaction

Life satisfaction is mainly influenced by household backgrounds and characteristics of the respondents. Using Pearson Chi-Square analysis, there is a significant relationship between life satisfaction from physical, social and economic aspects with household characteristics, such as ethnic background, age, education and income. However, life satisfaction of the respondents from social aspect is not very much influenced by their educational background. This implies that social aspect of life satisfaction is an important indicator of quality of life as expressed by the respondents irrespective of their educational background.

3 Conclusion

In general, the residents in urban neighbourhoods of Penang are generally satisfied with physical, social and economic aspect of life. However, there are variable levels of satisfaction for some features. The residents are particularly dissatisfied with public transportation services, political activities and cost of living in their neighbourhoods. Besides that, they are also concerned about their safety which would affect their quality of life.

The policy implications of the findings of the study indicate that the development of new urban neighbourhoods in developing countries, like Malaysia, needs to address the above problems, such as public infrastructure and transportation, cost of living and negative influence of political activities in order to achieve liveable environment and a good quality of life. The cost of living is generally influenced by regional and national factors. However, the development of new urban neighbourhoods should not burden the residents with high living costs and the lack of good infrastructure and community facilities. Therefore, sustainable neighbourhood development policies should take into account residents' own assessment of their local condition.

Acknowledgements

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The Village Building

Britt Sørlie
Department of Architectural Design, History and Technology; Faculty of Architecture and Fine Art; NTNU; Norway

Abstract

Sprawl as a result of growing cities or as part of rural settlements in the districts needs be addressed in relation to *sustainable development.* A concept for a new typology was developed by Mathias Harang in collaboration, as an entry to an open international ideas competition in 2007. A typical Norwegian valley was twisted to an urban melting pot for 5000 people, with sustainable potentials. The project was called the *Village Building.* It confronted the sometimes superficial environmental debate, by rearranging known built parameters and challenging low and widespread built fabric in the countryside.

Connections between settlement patterns, building form and the use of resources are essential in the research on the *Village Building*, where the aim is to gain more knowledge about this development strategy, and to see if and to what degree this way of thinking could work. The project is investigated in a Norwegian context, but might be applicable to different areas and climates around the world.

One of the investigations executed in the research involves a comparison of the compact strategy of the *Village Building* to the scattered settlement pattern of the Norwegian municipality of Hol, with about the same population. *Sustainable development* is used analytically through the tripartite understanding of the term into ecological, social and economical sustainability. Explicitly defined presuppositions of each category in relation to the *Village Building* are tested against the municipality of Hol.

Keywords: *competition entry, compact development strategy, megastructure, public infrastructure, sustainable development.*

1 Introduction

1.1 Settlement patterns and sustainability

Climate change is a great challenge of our time, and from an architectural and planning point of view, it is essential to look at how the built environment and development patterns contribute and respond to this. Very often the climate debate revolves around how new technology can solve environmental problems, not so much how structural premises can be changed to reduce energy demand and to free more land for food production. A focus on how the organization of built fabric affects the environment is in this respect crucial. As research on energy consumption shows, cities have bigger sustainable potentials than more scattered developments, because of more efficient possibilities concerning transport, infrastructure and buildings due to smaller distances and more compact structures (Centre for Strategic Urban Research, 2009). On the other hand, cities and megacities are surrounded by different sized areas of urban sprawl, where the distances to the city centre increases. The result is a greater need for transport, and poorer living qualities in the outskirts. Another problem is that big cities convert a lot of cropland to nonfarm uses and that food must be transported over long distances. Cities require a concentration of food, water, energy, and materials that nature cannot provide. Collecting these masses of materials and later dispersing them in the form of garbage, sewage and pollutants in the air and water is challenging (Brown, 2009). Large urban areas with little or no infrastructure grow rapidly, and especially in developing countries. In the book *Planet of the slums* (Davis, 2006) the following statistics are brought to attention:

"In 1950 there were 86 cities in the world with the population of more than one million; today there are 400, and by 2015 there will be at least 550. The global countryside, …, has reached its maximum population and will begin to shrink after 2020. As a result, cities will account for virtually all future world population growth, which is expected to peak at about 10 billion in 2050. Ninety-five percent of this final builtout of humanity will occur in the urban areas of developing countries, whose population will double to nearly four billion over the next generation".

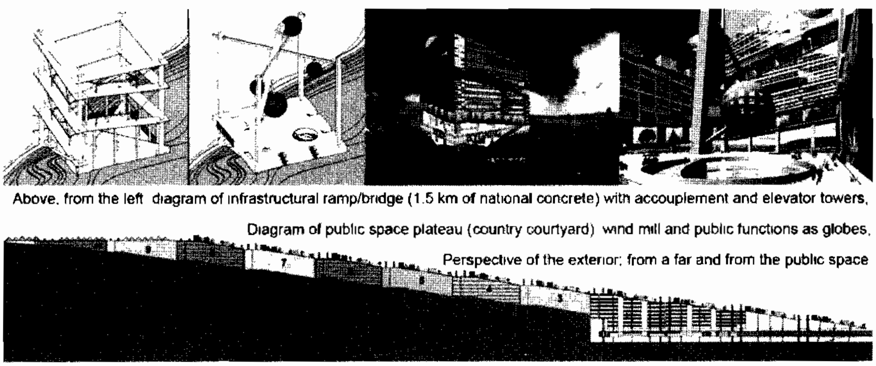
But sprawl also develops from another starting point; from more sparsely populated areas where primary industries, farms, are the historical core settlements. In Norway and in Scandinavia this kind of sprawled areas do not have very dense centres, and new developments tend to be either dense-low or scattered-low. The result has some similarities to the outskirts of cities, but in most cases with more natural resources nearby. Norway has the lowest population density in Europe (Statistics Norway, 2009) and centralization happens in a much smaller scale and speed than described above. Politically it is a goal to uphold settlement in the districts, even though scattered settlement patterns with low density are resource demanding, and even more so when the tendency is that more and more people do not want to live in the countryside, due to lack of job-opportunities and social services. Even though a rich country like Norway can hand out subsidies to uphold a good standard for these communities, it is essential to look into how and how much resource that are used compared to more dense developments. This is an issue also applicable to other sprawled areas around the world.

1.2 A new typology in architecture as a possible sustainable planning strategy

Sprawl as a result of growing cities or as part of rural settlements in the districts needs be addressed in relation to *sustainable development*, and in my ongoing research this is done through a competition proposal that represents a compact development strategy for a population of about 5000 people in the countryside. The proposal is called the *Village Building* and lies somewhere in-between the city and the countryside, with a fixed size that provide for natural and cultivated areas around it; laying the foundation of local food production. It represents a new typology; a decentralisation strategy on a national level, but a limited centralisation strategy on a local level. The title of the research is "The *Village Building*; a new typology in architecture as a possible sustainable planning strategy".

The *Village Building* is investigated in a Norwegian context, but not at a particular site. In a wider perspective, this entity could also be seen in relation to the Norwegian third world aid, relevant in areas of catastrophe, war and poverty. If the *Village Building* was calculated to cost two billion NOK (28 million dollar), the Norwegian Government Pension fund (http://www.regjeringen.no) would correspond to about one thousand *Village Buildings*, for all together ten million people. Low-tech versions of the *Village Building*, in relation to water supply, electricity and global communication, would be able to offer completely other qualities than barracks, tents and prefab houses.

2 The Village Building



Above, from the left: diagram of infrastructural ramp/bridge (1.5 km of national concrete) with accouplement and elevator towers,
Diagram of public space plateau (country courtyard): wind mill and public functions as globes,
Perspective of the exterior: from a far and from the public space

Figure 1: illustrations from the competition entry.

2.1 A competition proposal

Autumn 2006, *Blilyst* in collaboration with *Creative Troenderlag, the Ministry of local government and regional development in Norway, the Housing Bank* and *the Foundation for Design and Architecture in Norway* announced an open ideas competition called *Modern living solutions in the countryside*. The aim of the competition was to find living solutions that included social community and that exploited the advantages of the countryside like nature, light and space. 64 entries were handed in, in 2007.

An entry that got a second prize was the project with the motto ECOBOX 130x120x110 (Figure 1), by Mathias Ha‑ang in collaboration with myself and others. The numbers in the motto describes the borders of the project as a prism with an area of 130 metres by 120 metres, and with the height of 110 metres. ECOBOX refer to smaller environmental friendly projects gathered in an official Norwegian database with the same name (http://www.arkitektur.no/?nid=84523).

This project, the *Village Building*, was atypical in relation to the other entries as it represented a new typology. The proposition combined rural and urban qualities, in an iconographic diagram in a compact form, and challenged low and sprawled settlements in the countryside. The idea was based on organizing the built fabric of a typical Norwegian valley in a new way, through a public concrete bridge of one and a half kilometres or ramp that was twisted into a complete village community. If the ramp or bridge is unfolded (ill. at the bottom of figure 1), one can imagine the village centre in the bottom of the valley with a public square, public facilities, offices and trade; the valleyside with housing areas consisting of both singular houses and apartment blocks; and on top a mountain hotel and cottages. In this way the ramp becomes the public road that climbs up the valley and ends at the mountain, where all technical infrastructures are included.

The structure consists of a hierarchy of public and private parts as in an ordinary city. The public ramp creates a three dimensional structure with several different sites that can be developed by different developers, and can in this manner be compared to a conventional public road network (ill. top left, figure 1). The ramp revolves around a public square on top of a three story plateau at the base, where farming facilities, parking areas, a public transport station, shopping areas and public services are located. Inside the space of the cube four globosity buildings containing common and public functions are situated (second ill. top left, figure 1).

The project implied that changing known parameters could lead to less need for energy, advantages for public services and community, contrasting sprawl, and to developments that are more robust in relation to extreme weather. The *Village Building* is multifunctional, and the location would determine its program; the extent of housing, commercial buildings, service buildings, industry, and holiday homes will therefore vary. The strategy presupposed that nothing new was to be developed within a three kilometre radius.

From the jury report (Modern Living solutions on the Countryside, 2007):

"ECOBOX 130x120x110 is innovative in a big and completely different perspective than any of the other answers. The presentation is to the point, and the jury admires the way they approach the very fundament of the competition – and picks on the stereotype romantic image of life in the countryside. The *Village Building* connects business, tourism and ecology in a mega grasp, not without references to the metabolists. Closer parallels go to the Norwegian oil-industry and its enormous technological innovations which have not been used/exploited in Norwegian architecture. The project answers the programs request about the innovative, about the difference (or the lack of difference) between city and countryside, and about reputation and branding in a surprising and brave way"

Autumn 2007, the project for the *Village Building* was selected by a different jury in relation to the Oslo triennial for a publication in Arkitektur N called *B-sides*. This publication was related to the theme of the triennial, *culture of risk*, where ten innovative and/or experimental projects were selected from important competitions in Norway from the last eight years. These projects were typically not winners in the original competition, but second or third, and was meant to represent different ways of taking risk; in relation to program, choice of site, economy, politics, urbanism, form, new ways of living, use of unknown technology etc.

2.2 Research question

The aim of the research is to gain more knowledge about the *Village Building* and to find if and to what degree this way of thinking could work.

A question was launched by the editors, when the project was published in Arkitektur N in 2007; "Is the *Village Building* a horror vision of the countryside or a real possibility for a political experiment in the districts?" This question is interesting because it seeks to illuminate social, cultural and political aspects of the proposal, which also is the part of the research question where the term *sustainable development* is included: Is the *Village Building* a sustainable alternative for future development?

Three objectives have been put forward: 1) to evaluate social qualities related to the *Village Building*; 2) to evaluate area use, energy use and economy related to the *Village Building*; 3) to develop the *Village Building* further as an exhibition, and evaluate responses.

3 Theoretical framework

3.1 Historical and contemporary context

Some aspects behind the idea of the *Village Building* can be found in historical projects. It definitively has some similarities to the unrealised projects (paper-projects) proposed by the *Mega structure* movement in the 50-ties and 60-ties (Banham, 1976), which were not just project of a certain size as the name suggests, but also about the way differen elements such as public infrastructure and buildings were organized. Banham defines the *Megastructure* as "a big building with a flexible structure where several different elements could contain all activities in an urban life, and expand unlimited". The *Megastructure* movement in the 60-ties was a reaction and correction of the ideals of modernism.

In the competition entry the *Unitè d'Habitation* by Corbusier was used in the photo-collages illustrating the vertical sites of the *Village Building*, both because of its convenient section with views from two sides in the apartments but also as a critique and further development of this concept that in its time was presented as a "vertical village" (Sbriglio, 2004). One of the essential differences between the *Village Building* and the *Unitè d'Habitation* is the borders between public and private areas. Compared to contemporary "Eco-architecture", this is also essential because most such projects are about single buildings or several buildings organized in conventional ways.

3.2 Sustainable development

The term *sustainable development* is central in the research question which covers several aspects of a society; it can be interpreted in different directions, and is also the subject in a contemporary and comprehensive discourse.

The term *sustainable development* was first coined by the Brundtland Commission in 1987 (WCED, 1987) as to "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainability is often divided into three categories that depend and influence each other; ecological-, social- and economical sustainability. This understanding origin from the *triple bottom line* model developed by John Elkington in 1994 (Elkington, 1999), to further clarify the concept of sustainability as a tool in decision making. This model has however been criticised because it suggests that each category are equally depending on each other. Another critique is that the economical system tends to have a more important and bigger role than the other two in a neo-liberal marked economy. The *Nested System Model* (McGregor, 2006) is another understanding that implies that the ecological system is fundamental for both the social and economical system, and not the other way around.

3.3 Methodology

In architectural research where the built environment is the object of study, it is not unusual to use a mix of methods (Groat and Wang, 2002), due to technical, esthetical and functional aspects of physical form and the fact that it affects society and nature on different levels. In a process of developing a project in architecture, information and knowledge are gathered from many different disciplines; social studies, human studies, art, natural science, technology and engineering; to further be manifested as physical form. A "reality" is constructed from given presuppositions; both from personal knowledge, tacit knowledge (Polanyi, 1966) and from external requirements, limitations, needs and wishes. The outcome of this process can be described as holistic, meaning that the *whole is more than the sum of its* parts (defined by Jan Smuts in 1926). In the research on the *Village Building* a multi-method approach is used, maybe not very different from the process described above, where detailed knowledge of everything is not obtained but where connections are made from different elements by knowing something about them. The approach seeks to catch aspects with different character of a phenomenon to get more knowledge of a complex and multi-faceted project, guided by the research question.

To be able to illuminate the aspects put forward in the research question, interpretations of historical material leads to interpretations and constructed arguments about the future. Overall this attitude corresponds to a constructivist approach, where it is argued that "worlds" or "realities" do not exist out-there to be discover, but that these are created or constructed through processes (Gubrium and Holstein, 1997). The research is open ended and absolute conclusions are not drawn. This will give readers with different background a possibility to interpret the findings that are presented, and to make different conclusions (Flyberg, 2006). If the *Village Building* is a good or bad idea, sustainable or not, can be evaluated differently, even though the outcome of the research gives insight in aspects that work as a foundation for evaluations, and hopefully open up new approaches in the discussions on settlement patterns and the use of resources.

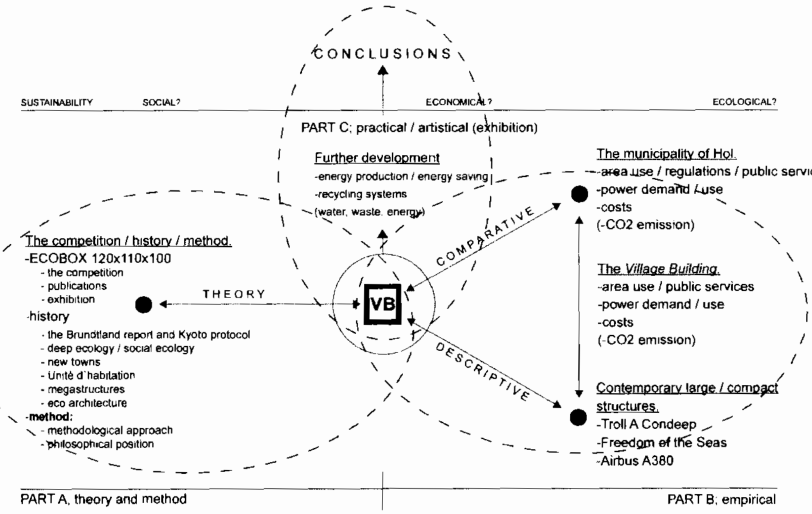


Figure 2: Research design.

3.3.1 Research design

The research design (Figure 2) illustrates how this research is divided into three parts (A,B and C). These parts are first of all connected by the cube that the *Village Building* (VB) constitutes (120 by 130 by 100 metres), which works as a structuring prism placing limitations on the different investigations through out the research. In part A the *Village Building* is put in a theoretical and historical context. The research question is put forward, the methodological approach accounted for and the term *sustainable development* introduced and interpreted explicitly as presuppositions in relation to the *Village Building*. In part B the presuppositions presented in part A are used to sort and control the gathering of empirical material in different cases. This material is in turn discussed in relation to the presuppositions. In part C the *Village Building* is elaborated within its conceptual frame, as an exhibition. To explore which systems of construction, water, sewage, garbage and energy supply that are suitable for the concept; on a basic level, is part of this process. It is also a goal that proposals by different architects (students) should be placed within the public infrastructural frame of the *Village Building*, so that the intended diversity of architectural interpretations and expressions appears. A description of the process, with a report on reactions towards the project, is included in this part of the research, and will give a new representation of the project in addition to the text produced. Part C has a practical and artistic character in some aspects and this part employs methods used by architects, through design (Research by Design), whereas the main part of the research employs well known qualitative methods used in social and human science.

Part A and B illuminates the issues put forward in the first and second objectives described above (evaluations of social qualities, area use, energy use and economy), while part C illuminates the third (further development).

3.3.2 Sustainable development as an analytical tool

It is important to describe how the term *sustainable development* is used in the research and what meaning it is given.

Presuppositions of ecological-, social- and economical sustainability related to the *Village Building* are made explicit, which are statements discussed and tested in relation to parts of the empirical material in the research. The term *sustainable development* is in this way used as an analytical tool where the presuppositions create a concrete context for the *Village Building* (De Jong and Van Der Voordt, 2005). The three categories are used with an understanding that the ecological dimension is the carrier of the social and economical aspects. Behind all the presuppositions lies an understanding that the political will or political state within a community defines what sustainability means, and determines a possible outcome for development at a given time of power.

In the following, one of the investigations in part B is presented, where a focus lies on sustainability related to environmental aspects through energy demand and area use.

4 A comparative study of the *Village Building* and a scattered settlement pattern

The investigation aimed to find and compare resources related to two different building patterns; represented by the *Village Building* and the municipality of Hol in Norway. Quantifiable material for the *Village Building* and the municipality of Hol was gathered when possible, and further discussed and evaluated in a conclusion. As described above, three categories for *sustainable development* organizes the material, where the part addressing ecological sustainability was prioritized because this factor was considered fundamental in this investigation, which the other two parts relates to.

The municipality of Hol is a community with about the same number of people (4422 in 2010. Statistics Norway) as estimated for the *Village Building*. This municipality is defined as a National-park-municipality; with Geilo as one of five rural settlements in Norway defined as a National-park-village (status given in 2008), and has a scattered settlement pattern. The National-park-village concept is part of a pilot-project through the *Directorate for Nature Management*, where communities that are important gateways to National Parks are selected. These communities are required to develop plans with focus on environmental concerns.

In relation to the massive development of cottages and holiday homes connected to the mountain areas and skiing resorts in Hol, it is interesting to find how this special focus on environmental concerns are approached especially regarding area use and energy demand. The trend so far is to develop relatively dense-low areas or zones for cottage development; where traditional architectural expressions are pursued. With new or non-traditional premises, this kind of development becomes in total something different than the traditional, and occupies large areas.

The challenges of Hol are to keep local people from moving from the municipality, and to handle new developments related to holiday homes and tourism; both in a sustainable manner.

4.1 The *Village Building* related to ecological sustainability

Area use and building form are important factors for the presuppositions behind the idea of the *Village Building*, related to ecological sustainability. Firstly, this includes an understanding that sprawled building patterns occupies more square meters to both infrastructure and building than the *Village Building*, and will therefore demand more transport (and emission) and make rational collective systems or solutions (for example for infrastructure) more difficult. The strategy for the *Village Building* has better opportunities to provide for living areas and biotopes of animals, which often are divided by roads and buildings into small areas cutting through animal corridors; endangering species. The strategy will also maintain cultural and natural landscapes better, and give the inhabitants the opportunity for food production and to experience nature. Secondly, the energy demand in the *Village Building* will be much lower per person than within a sprawled development because of the reduction of external walls, which can be even further reduced by making the public space inside the cube a tempered zone. The energy demand per person will also be reduced because square meters per person are less than typical settlements in the countryside.

Factors compared to the municipality of Hol included footprints of infrastructure and buildings, and energy use/demand.

4.2 The *Village Building* related to social sustainability

The defined presuppositions behind the idea of the *Village Building* related to social sustainability illuminates social services and public places: The *Village Building* indicates that a sparsely populated area with a sprawled settlement pattern can be a social problem due to lack of public space and community, mediocre quality of public and private services because they are divided into very small units, long distances and fewer attractive job opportunities. The *Village Building* gathers all these functions in one place, with a small footprint, for a small population in the countryside. The *Village Building* proposes centralization for a rural settlement, with farming facilities and a public square at its base. It is a suggestion of how to revitalize settlements in the countryside in an environment friendly way, and to make it attractive also for young people who now live in the cities. The project can also be seen as a critic to suburban areas that has some of the same characteristics as described for scattered settlement patterns in the countryside; but without as good access to the natural environment and the possibilities for food production.

Factors compared to the municipality of Hol included outdoor public space, schools and kindergartens, and healthcare services.

4.3 The *Village Building* related to economical sustainability

Defined presuppositions behind the idea of the *Village Building* regarding economical sustainability: The *Village Building* is a concept to revitalize the Norwegian countryside in a concentrated form, which requires fewer locations for public services, such as healthcare and schools and a smaller network of roads and infrastructure, than a traditional development strategy for the districts. Usually this strategy is either dense-low or sprawled-low. Construction, maintenance and operation of the *Village Building* are more rational than in a widespread building pattern, and will therefore cost less.

4.4 Results

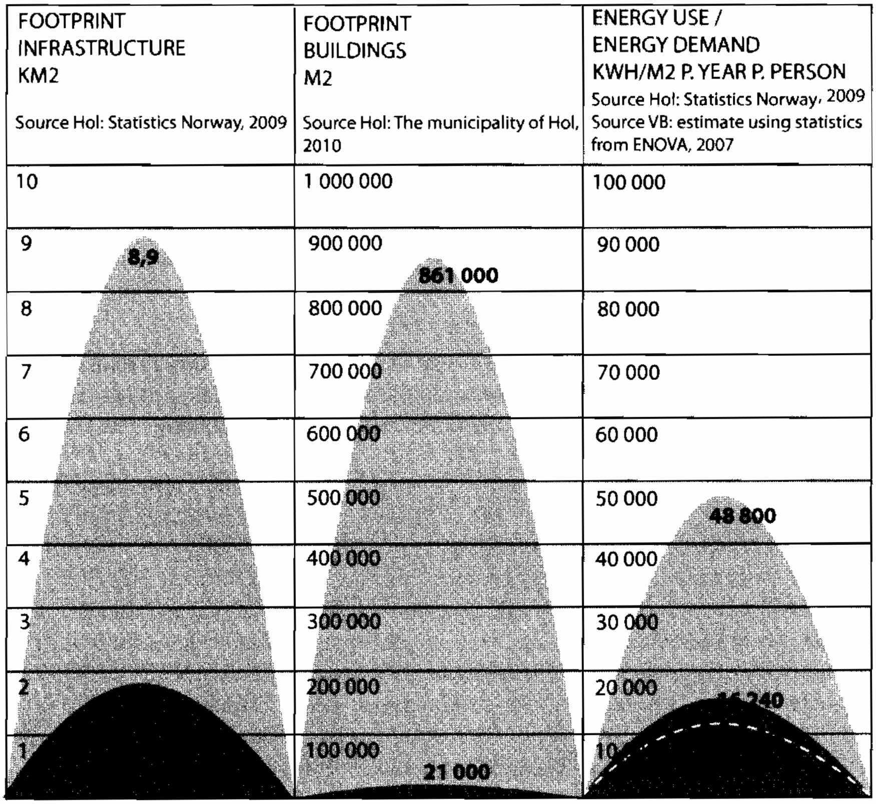


Figure 3: Comparison of area use and energy use/demand in the Village Building and the municipality of Hol. Light grey: values of Hol; dark grey: values of the Village Building.

The municipality of Hol reports (Municipality plan of Hol 2000-2012, p. 7) that they are getting more dependent on other income; such as transfers (subsidies) from the state, and that the tax income covers a continuously less share of their operating expenses. This indicates that the economical development is not sustainable, and questions the strategy the municipality have to strengthen the economical freedom.

There are no defined outdoor public squares or meeting places in Hol. The *Village Building* is built up around a public space, and this strengthens the presupposition related to social sustainability regarding lack of urban space in communities with scattered settlement. Even so, it is difficult to say if this is a problem for the people living in Hol since they have a lot of other types of space where they can meet, be social and to perform different kinds of activities. An urban public space might not be desired, and as long as there is no such space, there are no distances to measure either. However, there are plans for this kind of space in the village of Geilo.

Regarding the social services, it is also true that the schools, kindergartens and health care services are divided into smaller units in the municipality of Hol than in the *Village Building*. If wanting to uphold the settlement pattern in Hol, it seems like a good idea to have several schools and other services in the districts, so that the travel distances do not get too long. Most of the public services though are located in Geilo or Hol (the most densely populated nodes in Hol), which gives a certain travel distance anyway. For the schools of only 20 to 60 children, it is also a question of the quality these children are offered. For small entities as this the quality depends on few people and teachers. This is also the case for the many small kindergartens and healthcare services.

It is clear that the presuppositions related to the *Village Building* on ecological sustainability are true for the factors compared to the municipality of Hol. The footprint of infrastructure (calculated within the same area) is five times less for the situation with the *Village Building*, 40 times less regarding the footprint of buildings (!), and the energy use/demand about 4 times less in the *Village Building*. The reduction of resources used in the *Village Building* is distinctive in relation to areas and energy, and therefore resources saved for other purposes such as food production, natural habitats and landscapes (Figure 3). For the ongoing development related to tourism, this result should be thought-provoking if the municipality aims for a more sustainable development. The municipality-plan states that Hol aims to increase energy efficiency and reduce the growth of energy-demand. In the Energy-plan for Hol (Energy plan of Hol 2003-2013, p. 4) it is further stated that "...a kWh saved is far better for the environment than a new kWh produced, and that all new energy-demand as a result of development of housing and industry must be seen as an environmental strain. Even in Norway...It is this new development (related to tourism) that constitutes the most important potential for the influence the municipality can have on a more sustainable energy-development. To release potentials in the existing built fabric and businesses takes a very long time and is more expensive than to influence new developments".

The municipality encourages sprawled development patterns because this is regarded most sustainable for the community; to uphold settlements in the districts. Even so, it is recognized that such developments will cause big interference and a change in vegetation and landscapes that will displace existing grass and plant species and therefore biodiversity as a result of roads and other infrastructure; especially cottages as they are built today (Municipality plan of Hol 2000-2012, p. 18). This contradiction or paradox seems to be handled by the municipality by trying to hold back areas, but at the same time give them up bit by bit to developers, over time, because the pressure and need for these developments are required in the community and also a main priority. But as the numbers in this study show, it could be a good idea to have a stronger overall plan regarding resources linked to area use and energy. The municipality recognises the problems regarding both area use and energy use, but it seems that their main goals and strategies work in a direction where these problems just increase. One can assume that this also is the case on a national level, because Hol follows national guidelines regarding *sustainable development* (http://www.regjeringen.no). New premises do not necessarily trigger off new solutions; but continuing "development as usual" will also cause new and unexpected problems. Birkeland (Birkeland, 2008) might be on to a similar problem when stating that "our tools still focus attention on symptoms, such as pollution, waste and climate change, rather than on tracing problems to their sources in systems design and correcting these root causes. (…). Our tools turn designers into apprentices of past practices. Moreover, like Sorcerer's Apprentice, we are too busy keeping up with "tools of the trade" to question their real efficacy. (…). Our basic approach to institutional and physical design and practice must change".

The area occupied by holiday houses in Hol is about 5,5 km2 gross area or 1,7 times bigger than the area occupied by regular homes. In the investigation where footprints of buildings were compared to the *Village Building*, this area was left out because it belongs to a visiting population. If it is taken into account, the *Village Building* occupies 65 times less area than buildings in Hol. This draws the attention beyond the question of how much area one person needs, to the question of the necessity of a second home. The transportation between the two homes is also an additional stress to the environment. For a rich country like Norway, where oil is the main contributor to wealth, it might be an idea to rethink the use of resources; especially if the government continues to claim to be one of the best countries in the world concerning environmental issues. For the ongoing development of secondary homes in Hol, it could at least be an opportunity to develop something new in a more sustainable manner.

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Between Country and Town: New Concepts in Sustainable Rural Housing

Neil Burford, Joseph Thurrott, Alex Pearson
University of Dundee, Scotland, UK

Abstract

One of the results of the UK's housing policies over the past 50 years has been the proliferation of private, suburban housing estates. These are based around similar lifestyle models, low-quality spatial planning solutions and short-term, low-cost construction technologies. This practice disregards regionally distinct cultural and climatic contexts across the UK. It is widely recognized that standardised approaches to house building have been responsible for the poor quality place-making evident in suburban type countryside housing estates. These new developments lack the intrinsic sense of identity and richness that has historically given rural settlements their unique character and quality. Moreover, the communities that result from this type of development are intrinsically unsustainable; proliferating high-carbon lifestyles. The suburbanisation of rural Britain appears to have no end considering the UK government's target of building up to 290,500 new homes per year to achieve the goal of 3million new homes by 2020. It is now critically important that alternative, more sustainable, low-carbon housing models are envisaged which can be used as the basis for the conceptualization and development of more appropriate forms of housing that will inherently support new types of sustainable communities. This will inevitably require a step change in thinking to the provision, design and technology of new-build private housing in the UK. The following paper explores four strategies for a new sustainable development of low energy houses in a traditional village in rural Scotland. Anchoring, Court, Street, and Croft encapsulate these principles in four new models for the design of more sustainable housing in the Scottish countryside.

Keywords: *Zero-Carbon, Housing, Sustainable, Community, Rural, Suburban*

1 Rural Housing Context in Scotland

1.1 Housing Requirement in Scotland

UK Government targets aim to provide a significant increase in private and social housing over the next five years (Moya, 2009). The predicted population increase and shift from the social sector to private home ownership in Scotland along with the need to replace existing poor quality, inflexible post-war housing and the requirement to meet impending technical standards aimed at reducing the carbon footprint of new development, are the main reasons for the increased housing requirement. The other major factors that contribute to the problem are the increasing waiting lists of people in sub-standard accommodation, an ageing population and the need for affordable home ownership for young couples and families. In Scotland the majority of this new housing will be absorbed within new communities on Strategic Land Allocations associated with existing major towns and cities. However, there is a significant proportion of housing to be provided in rural areas to help support and bolster the rural economy.

1.2 Problems of Suburban Housing

Over the last two decades the majority of new housing has been provided by the commercial sector, resulting in developer-led standardised suburban housing estates on green field sites (Figure 1). There is a concern that the commercial sector's response to the Government's new housing targets will continue this trend. It is widely recognised that this approach has been responsible for poor quality spatial planning and uncontrolled sprawl that results when farm land becomes available for purchase (Anon, Scottish Office 1994). The form of these developments is driven by the need to provide each house with an individual plot of land with front, back and side gardens. Plots are organised around road layouts with loop systems and cul-de-sacs based on the primacy of the automobile. The resulting density is not urban or rural; rather, it sits somewhere in between: a no-man's-land of poor, ill defined thresholds and ambiguous spaces (Bates, 2007).

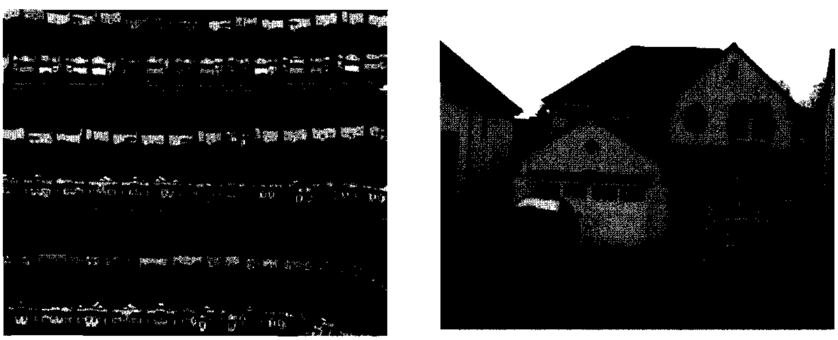

Figure 1. Typical developer suburban housing.

A principle concern with suburban housing has been the way in which new developments of this type respond to their context. In 2001, Scotland launched its first national policy on architecture and planning: 'Designing Places', intended to help raise standards of urban and rural development (Cowan, 2001). A key principle of the policy has been to ensure that new housing design considers the local vernacular (Figure 2). The Scottish Government's Directorate for the Built Environment stated that the way in which the new built environment can respond to issues of national and local identity and to its built heritage should form an important part of Scotland's policy on architecture. This has subsequently been reinforced in various Planning Advice Notes (Anon, PAN 72: PAN 44). However, the way in which this policy has been addressed and the resulting quality of the architecture produced has been widely criticised. In particular, it is recognised that this form of regional design control has led to a narrow interpretation of the historic built environment based solely upon a visual survey of prevalent historic materials and forms (Maudlin, 2009). This has tended to produce a neo-traditional domestic architecture that safeguards the memory of a specific time and culture (Figure 3) (Naismith, 1985). The resulting developments demonstrate little of the culture and values of contemporary society or how the architecture responds positively to a contemporary context. To date, little account has been taken of new pressing environmental legislation, changes in construction practice and the changing demographics of housing (Sheerin, 1990). The question of addressing the need for distinct and appropriate character in place-making is one which needs an alternative approach: based not on a visual aesthetic interpretation of historical form; but rather, one where the form results from a deeper understanding of the underlying cultural, environmental and economic drivers and their distinct regional differences (Bain, 2008). The appropriateness of the resulting architecture should be measured against a broader framework – where it is considered in relation to its contribution to generating intrinsically sustainable communities – rather than a superficial visual aesthetic response (Anon, Firm Foundations, 2007).

Figure 2. Black House: Scottish vernacular architecture of the Western Isles.

Figure 3. Poundbury, England: an example of neo-vernacular new town planning.

1.3 Zero-Carbon Housing Context

Passive and active design strategies are used in the development of low energy houses. Although the basic ideologies of conserving energy are widely known, research and development in various countries have led to different interpretations of the low energy house (Hastings & Wall, 2007). National Labels across the globe have been created to standardise and promote best practice in low energy demand housing such as Passivhaus (Germany), Minergie (Austria / Switzerland), LEED (United States/Canada) and Code for Sustainable Homes (UK). The UK Government has established the need to take action towards developing zero carbon homes and aimed to make all new homes zero carbon by 2016 (Anon, 2006). The Code for sustainable Homes (CSH) sets the parameters and national standards for the practice of low energy and zero carbon housing. The CSH system works by creating levels (1-6). The higher the CSH Level achieved, the more energy efficient the house, with CSH Level 6 being zero carbon. Achieving a CSH Level is dependent on how many points a proposal earns with criteria ranging from technical considerations to more community centred issues. CSH level 5 and 6 solutions such as the Sigma House (Figure 4), the Lighthouse (Figure 5) and Prince Charles' Natural House (Figure 6), are currently being developed and tested at the UK's Building Research Establishment. However, the vast majority of new housing throughout the rest of the UK is presently built to CSH Level 3, making the proposed achievement of CSH Level 6 by 2016 questionable (Jury, 2009).

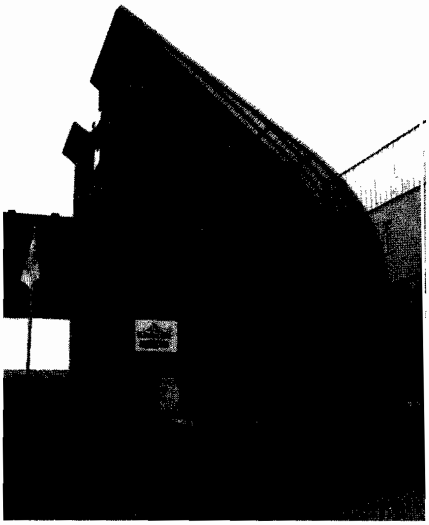

Figure 4. Lighthouse.

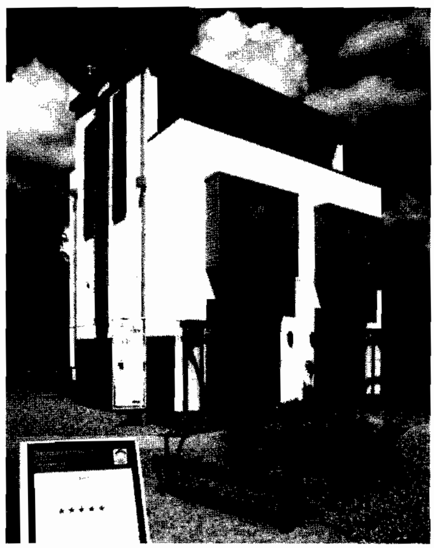

Figure 5. Sigma House.

Figure 6. Prince's Foundation Eco House.

1.4 The Need for Alternative Rural Development Models

The relationship between new suburban developments and existing rural communities is often a parasitic one. The majority of new development caters to the needs of the commuter; hence, they contribute little towards the economy of the countryside. The promulgation of high carbon, mono-cultural, commuter lifestyles invariably leads to a shift in demographics within existing rural communities (Barker, 1999). These issues have lead to strong arguments against the development of new housing in existing rural areas whilst reinforcing a view that rural development is simply unsustainable (Young, 2010). Specific factors against rural development include:

- Historic rural communities are low-density whereas contemporary sustainable practices rely on higher density developments.
- Modern society values leisure time as opposed to the notion of self-sufficiency. Hence, traditional farming is out of step with contemporary aspirations.
- Business development within rural communities is remote from markets with inherent supply chain issues.
- People living in disparate rural communities desire the same level of amenities as their urban counterparts; however, the provision of services to these communities is a greater burden on the environment.
- Most newcomers to rural areas usually have a romantic view of the countryside but this is often at odds with the realities of rural life.

Historically, the majority of Scotland's population lived and worked in rural areas and it is only comparatively recently that there has been a shift towards an urban culture where the majority of people live and work in cities. This change has resulted in a gradual decline in traditional rural settlements. However, the advent of new communication technologies and the development of more specialised forms of industry and agriculture can provide opportunities to revitalise rural areas, stimulate new economies and develop new cultures in line with the Scottish Sustainable Communities Initiative (Neil, 2010: Anon, SSCI, 2008). To address these opportunities there needs to be more strategic and qualitative thinking at planning (Macro), architectural (Intermediate) and technological (Micro) levels. This means that the desire to create more sustainable, economical and qualitative approaches to living coupled to the more stringent requirements of new place-making and energy legislation cannot be met by existing suburban development models. Therefore, more diverse communities will require alternative forms of housing of all tenures with mixed land uses and economies to realise their full potential (Richards, 1994: Cousins, 2009: Levitt, 2010). Although this problem is not limited to Scotland, the uniqueness of the Scottish context arguably requires special attention and if dealt with appropriately could form a model for thinking and development elsewhere. The principle problems in housing that need to be addressed are:

- Macro: inflexible pattern book urban layouts that fail to respond adequately to specific physical and social contexts;
- Intermediate: house typologies that are out of context with existing settlements and changing lifestyles;
- Micro: construction and energy practices based on cost as opposed to the promotion of healthy, sustainable communities.

2 Research Context

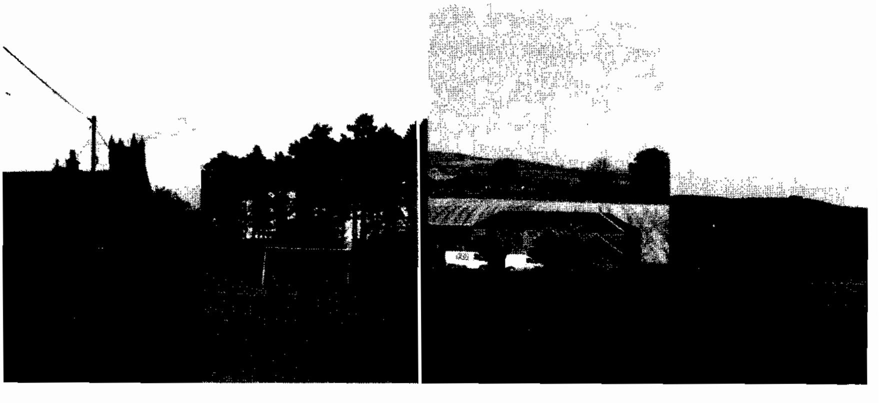

Figure 7. Meigle: site character.

2.1 Location and Political background

The village of Meigle is a classic example of a Scottish rural settlement (Figure 7). The site for the research is an area of farmland adjacent to the village which was the subject of a rejected planning development application submitted by a volume house builder in 2007 (Figure 8).

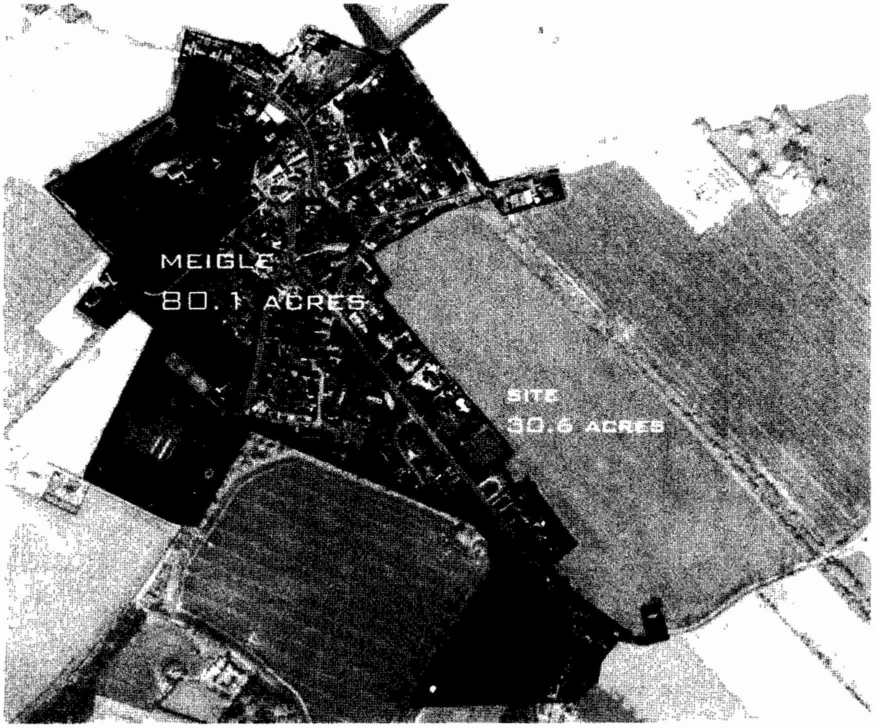

Figure 8. Meigle site plan.

The application had been rejected on the grounds that the development would have had a lasting, detrimental effect due to the anonymous suburban nature of the proposal. However, the community council is not averse to increasing the population of the village as they recognise the importance of new development to secure the economic future and vitality of the community. Hence, the Meigle Profile, an informative guide for planners and developers, was produced to help guide decisions on current and future developments in and around the village. The primary aim of the document is to allow Meigle to continue to change and grow, but in a manner that would be in sympathy with its own particular identity. The Meigle Profile became the catalyst for the Rural design scenarios outlined in the pages to follow.

2.2 Research Methodology

The aim of the research is to explore, through analytical and qualitative studies, a design based approach for the development of alternative strategies for sustainable low-energy housing development. The research was undertaken by the Macro-Micro Masters Unit of the University of Dundee School of Architecture and was based on methodologies established by the RIBA/CABE in their study of future housing predictions 'Housing Futures 2024' (Worthington, 2004). The aim of the study is to develop potential scenarios for future rural housing development responding to current and future Scottish policy frameworks. The objective of the research is to stimulate the debate around the provision of appropriate models of rural development. Operating from the Macro scale to the Micro scale and incorporating One Planet Living principles, the scope of the research was wide ranging; encompassing occupant lifestyle patterns, energy generation and conservation, food supply, waste-management and construction systems and urban planning strategies (Francis & Wheeler, 2006). The net result was four distinct design proposals for new typologies of rural development. Analysis was carried out under the following key subjects of study: Society, Townscape, Density and Character.

3 Rural Design Scenarios

3.1 Anchoring

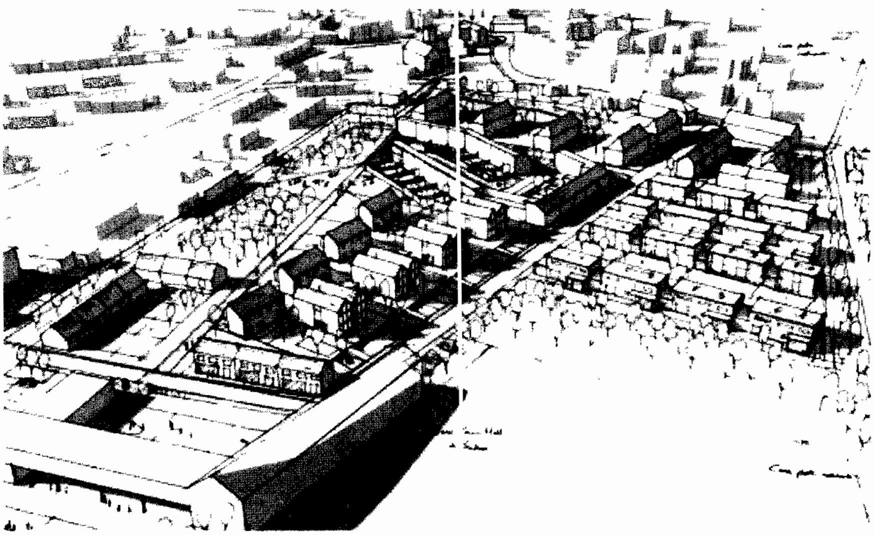

Figure 9. Scenario 1: Anchoring. Master plan, aerial view.

Anchoring reconciles the suburban dream of house and private garden with more traditional urban town planning concepts (Figure 9) (Krier, 1984, 1993, 1998). It incorporates higher densities than suburban counterparts through tightly defined and closely controlled spaces which reflect the character of the existing village. The new development anchors itself to the existing village through infrastructure, programme and built form. This is achieved by extending and repairing historical roads and pathways, developing mixed-use housing clusters and controlling external spaces. Varied identities, spatial scales and materiality reflect the richness of the existing village. Two main routes – one pedestrian, the other vehicular are used to organise the house clusters. The proposed school and community hall create a civic termination to the development, reinforcing social links with the village. Hierarchies of courtyards, pedestrian links, mews and gardens are clearly zoned to aid way-finding, a known problem with suburban layouts. The housing typologies vary across the site with rows, semi-detached, detached villas and retail, creating a diverse mix of tenure. These absorb new construction and energy strategies using simple associative vernacular forms. Open green spaces and deciduous tree plantations serve as wildlife corridors and connect with existing pedestrian path networks. A SUDS pond and associated channels along pathways filter grey water. Septic tanks and reed bed pools are used to treat black water. Combined heat and power is provided from biogas harvested from farm waste. Sustainable construction materials are employed throughout.

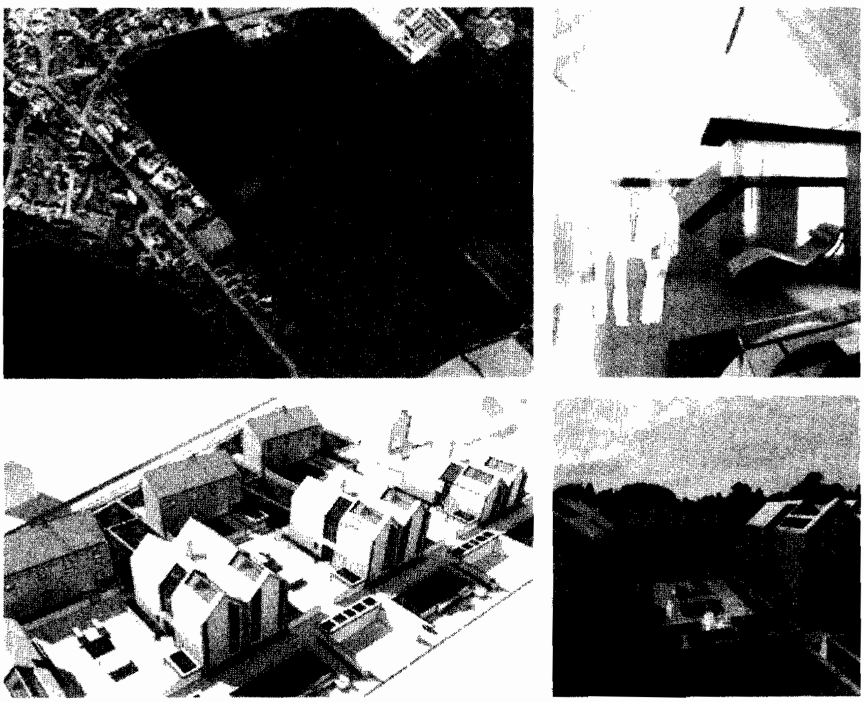

Figure 10. Scenario 1: Anchoring. Site plan and perspectives.

3.2 Court

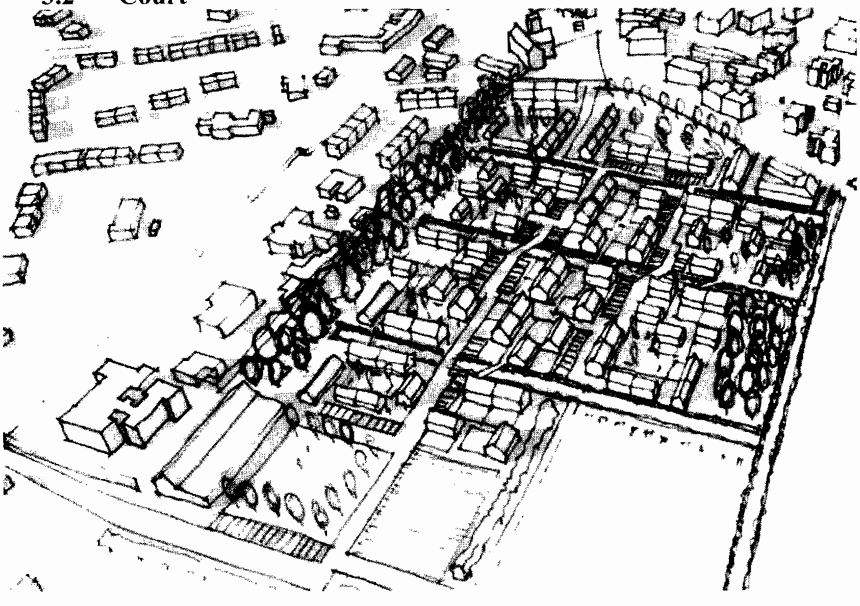

Figure 11. Scenario 2: Court. Master plan, aerial view.

Court is based on a cluster of 12 houses grouped around a number of interwoven public spaces to create a community unit (Figure 11). Each cluster is derived from Christopher Alexander's rules pertaining to the maximum number of people that can have a conversation around a table, thus engendering a recognizable social scale and order (Alexander, 1977). The eight courts that make up the development each have unique spatial organisations to give individual identity to clusters and variety to the masterplan. The sequence of open, contained and shared spaces introduces a hierarchy of ownership. Inter-cluster interaction is encouraged by placing different community facilities within each court. The courts are embedded within a hierarchal Cartesian matt of streets, paths and waterways. Streets incorporate shared pedestrian and vehicular surfaces giving access to parking bays adjacent to fully pedestrian courts. Landscaped waterways running perpendicular to the streets, serve as pedestrian connections between courts as well as inhabitable green spaces for services, SUDS and wildlife. Diversity is created by varying the housing typologies using single and two-storey detached and semi detached units surrounding each court. Each house has a specific relationship to the court, responding to urban, human scales and passive environmental considerations. Energy strategies at the community scale are based on wood fuel CHP from local forestry and suppliers. Individual houses utilise sustainable, low-energy technologies and materials. (Figure 12).

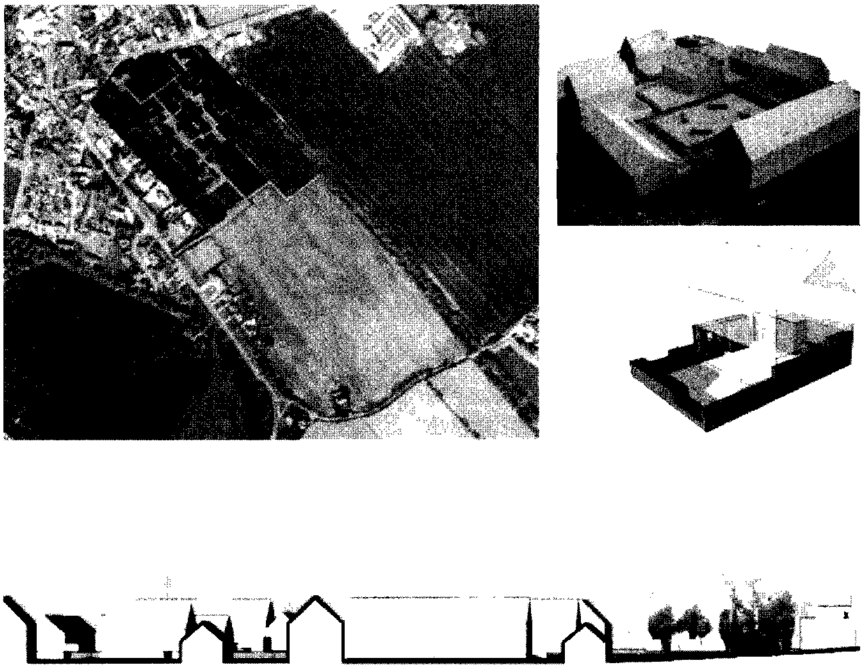

Figure 12. Scenario 2: Court. Site plan, models and section.

3.3 Street

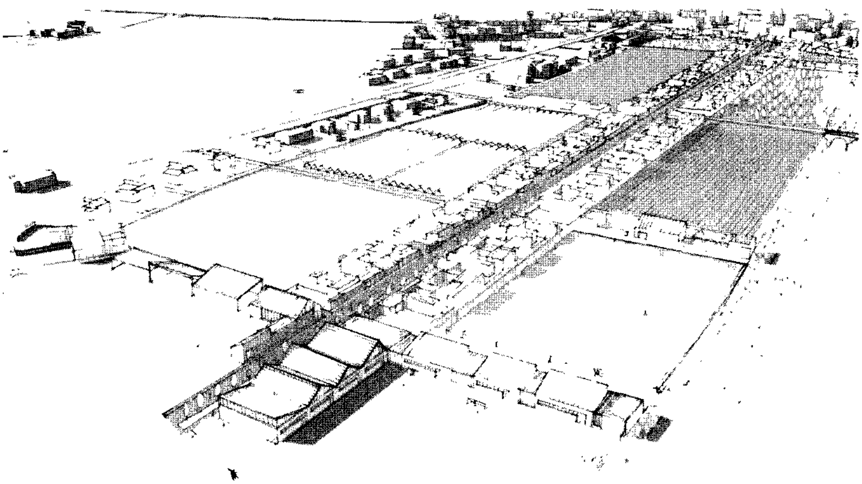

Figure 13. Scenario 3: Street. Master plan, aerial view.

The medians of street, wall and field respond to the rural context by interweaving the relationships between farming and contemporary living (Figure 13). The design is derived from principles established in Borneo Sporenburg, Amsterdam and offers a vision of urban living tuned to an aspiration by many to live in the countryside (Cousins, 2008). Reminiscent of the existing Victorian extension to the village, the street forms a spine along which sits a matt of densely built infrastructure driven unremittingly across the site. The houses form a solid wall along the street and field boundaries. These walls are punctured by tightly controlled and defined external courtyards and patios around which the main social spaces of the houses are arranged. The social spaces of each house have a fluid relationship with the main external spaces: street, field or patio. Houses and patios vary in scale depending on family sizes, giving richness and variety to the street. The limited palette of materials, in particular the brown brick which is associated with the red ochre colour of the fields, brings uniformity and order to the built infrastructure which is pierced at varying intervals by community parks and orchards. These civic spaces also collect perpendicular pedestrian routes that link into key nodes within the village and core path networks. The lateral path network defines a strict grid for the small-scale subsistence farming plots. A farmers market to the south of the site provides an outlet for local produce whilst stimulating cultural exchange between the existing village and the new development (Figure 14).

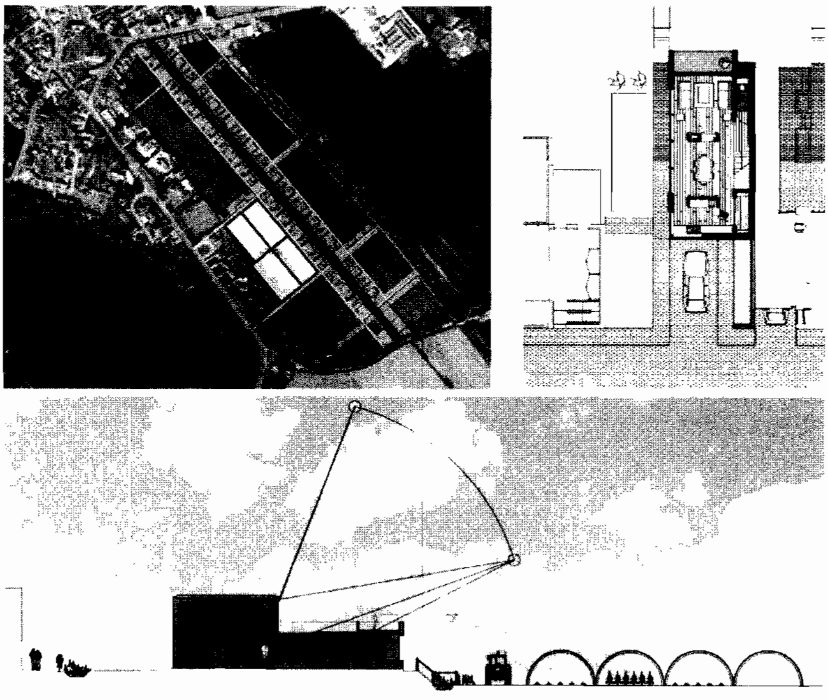

Figure 14. Scenario 3: Street. Site plan, house plan and section.

3.4 Croft

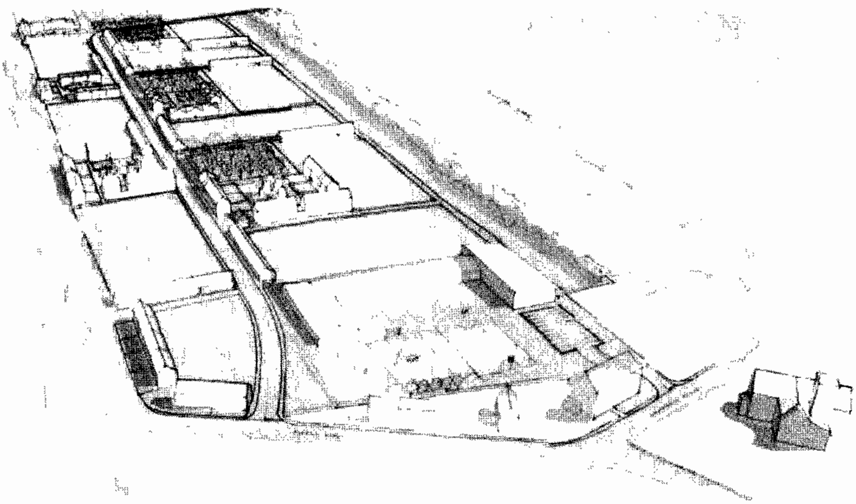

Figure 15. Scenario 4: Croft. Master plan, aerial view.

Croft is a self-sustaining low intensity farming community with mixed land-uses containing small scale subsistence farming plots, densely developed steading-type housing clusters, community green spaces, allotments and orchards (Figure 15). It addresses government agendas for re-establishing crofting: an indigenous system of small-scale subsistence farming, once widespread throughout Scotland but now in decline (Burns, 2007). Crofting has many benefits as it keeps communities alive, enables people to live and work in isolated areas, and helps keep rural schools and other vital public services operating. Crofters traditionally use low intensity management techniques and sustainable farming practices which helps to encourage wildlife and create unique landscapes and habitats. It also sustains a rich cultural heritage reflected in its legacy of language, music, song, dance, poetry, storytelling and literature. In order to survive in the 21st century as a sustainable and productive use of land and as a living culture, crofting needs to be reinvented to encourage young people to take it up as a way of life. The Croft masterplan is based on an irregular grid of one-acre farming plots which could provide a sufficient quantity of food to sustain a family for a year with surplus income capacity to sustain other needs appropriate to more contemporary lifestyles. The plots are woven within a framework of roads, trackways and footpaths. Social and physical networks between crofts, steadings and the existing village create a self-sustaining market for swapping and selling produce. Each croft consists of arable land, storage sheds and a house. Steading clusters of nine dwellings, adjacent to the crofts, provide affordable home ownership. The internal courtyard serving the steading houses contains shared gardens, patios and allotment spaces. The internal layout design of a typical two bedroom steading house groups the vertical circulation and wet services within a core. This arrangement permits free-plan flexibility for the rest of the house to allow the end user to inhabit the space as they wish. The energy strategy for the houses uses simple passive means, thermally active construction systems and high levels of insulation. Space heating, domestic hot water and electricity generation are addressed at district level (Figure 16).

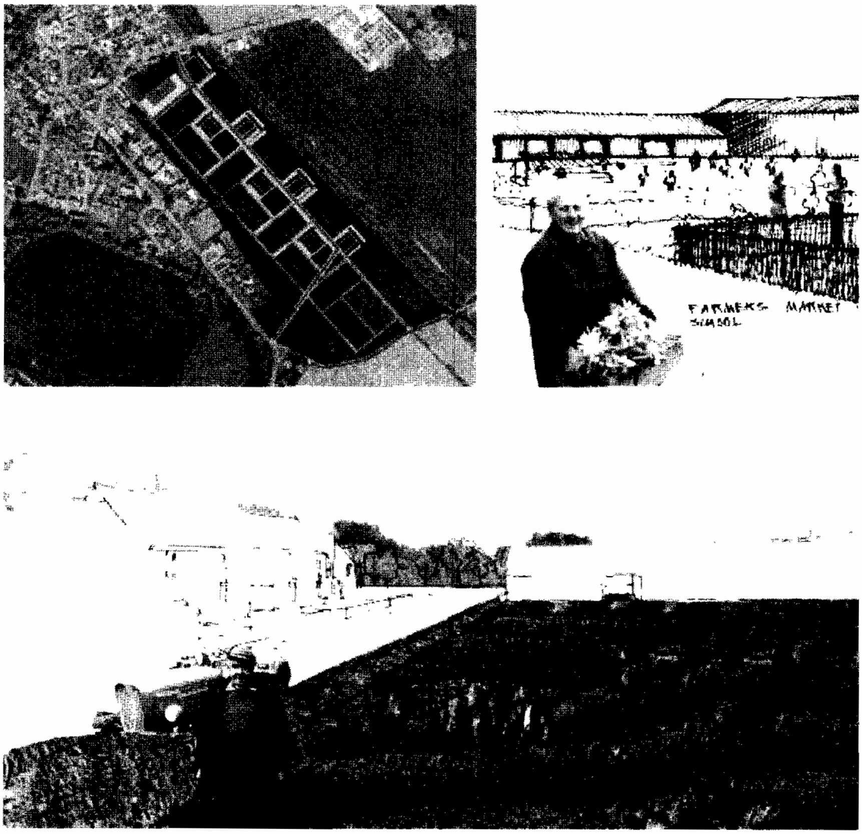

Figure 16. Scenario 4: Croft. Site plan and perspectives.

4 Conclusions

The development of more sustainable, economical and qualitative approaches to rural living will need the formation of more diverse communities. Alternative forms of housing of all tenures with mixed land uses and economies are needed to realise the full potential of a community. A deeper understanding at regional and individual levels of the underlying cultural, environmental and economic requirements of communities may generate more appropriate development frameworks and architectural responses to low-carbon rural living. Anchoring, Court, Street and Croft contain four sustainable strategies for development within a Scottish rural context. Anchoring and Court centralise development adjacent to the village core, extending the village boundary, whilst stitching into the existing fabric. Both proposals leave the remainder of the site for agricultural uses and develop typologies based on more accepted urban frameworks. Street and Croft disperse development across a wider area of the site, developing a typology of land use within a broader framework of sustainable development that has farming as a key generator of form. Whilst the proposals take very different approaches, a number of common architectural issues have emerged from the study. Density and intensive use of land are needed to create clearly defined hierarchies and high quality external spaces. In all schemes, clustering of the built fabric allows very precisely controlled public spaces with clear boundaries and thresholds to be produced whilst achieving higher densities than suburban models. The perception of enclosure (and therefore density) is generated by the boundaries (walls, hedgerows and forest). A more intensive use of land pockets relieves pressure on remaining land which can be released for alternative uses: green-space, wildlife corridors, swales, waterways, farming and allotments. An ordered landscape framework, based not on the primacy of the car, but on alternative land uses can achieve a scale of association with the existing rural landscape with built densities more in-keeping with the existing village. An abstracted order does not replicate the organic formation of the village but seeks rules based on underlying factors more in keeping with contemporary requirements whether these are urban or rural. Identity and character can be achieved by the sensitive manipulation of the built fabric and landscape.

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Low Energy Architecture

Vernacular architecture has lessons for all of us. The seminal book Architecture without Architects by Bernard Rudofsky (1964) describes the place of what he termed non-pedigreed architecture. Perhaps the most durable and versatile examples of this vernacular architecture are the troglodytic towns such as those in Cappadocia in Turkey and Pantalica in Sicily. Other examples are at the oasis of Siwa in Egypt where burial grounds have been converted into living quarters, or those of an underground village near Loyang in Northern China, where every room has a vaulted ceiling carved into the soil.

The strength of vernacular architecture is that it blends buildings into various settings, so that there is a natural harmony between climate, architecture and people. In countries such as Iran, Iraq and Egypt, buildings have evolved which not only demonstrate this harmony and unity between people and their environment but also offer a combination of engineering and architecture with an aesthetic quality.

We learn from the environmental pressures Nature imposes on us. For example in desert regions, mud constructions can maintain fairly steady internal temperatures in spite of very high external air temperatures and solar radiation. Cross-ventilation is important in humid climates, but in the hot, dry regions of the world, shade and protection from solar glare and high temperatures are vital. Measurements have shown how the high thermal capacity of thick adobe walls and mud roofs give pleasant conditions of 24°C to 30°C with midday external air temperatures of 40°C and roof temperatures of 60°C. The beautiful book--Butabu Adobe Architecture by Morris and Blier (2004)--illustrates how earth architecture in the severe Saharan regions offers humane and sustainable solutions.

Ground source cooling is now a much debated topic in many countries and the work of Buhagiar et al in Malta is making a valuable contribution by making measurements to show the most effective arrangements.

Ahsan et al from Bangladesh assess the energy savings offered by simple passive measures such as insulation and hollow block construction. Roofs are ideal solar collectors but can become so hot and uncomfortable for inhabitants. Cheikh from Algeria measured the impact of a rock pool roof and shows a minimum drop of 6 deg C in internal air temperature; with night cooling this can be over 10 C. Heine from the US shows examples of how low carbon housing is being designed.

The world is alight with lowering energy consumption and the consequent carbon reduction but buildings which do not satisfy human needs are not sustainable. Another major consideration is that buildings need to be cared for. A major issue is that most of the variations between energy consumptions of similar buildings in similar locations is occupancy behaviour. Low energy architecture has to consider these matters and their interaction with other aspects such as water, waste and pollution. This session is a starting point.

Derek Clements-Croome
The University of Reading, UK

Ground Cooling and Heating Potential in a Mediterranean Climate: An Evaluation of Temperature Extremes in Malta

Vincent Buhagiar, Cornelia Tabone, Tonio Sant
University of Malta

Abstract

In consideration of the ever-increasing energy demand for cooling in Malta, a typical Mediterranean Island, this paper evaluates the potential for ground cooling as part of a strategic passive design scheme towards low energy architecture. It also extrapolates the potential for heating in winter, given that inverse seasonal temperature differences occur over a six month time lag. The potential lies with the indigenous rock, globigerina limestone, having a high thermal mass and moisture content.

In principle this uses an air-to-air heat exchange process, where two sets of 200mm diameter pipes were laid vertically and horizontally in excavated trenches at 3.0m below ground level. Ambient air was extracted through the pipes into a purposely built test cell. Environmental conditions were monitored throughout. Results indicated favourable ground conditions for cooling, more than for heating, given time lag response of globigerina limestone. The vertical pipe exceeded the horizontal pipe in its performance results can be exploited to reduce indoor spring and summertime temperatures, thus reducing the energy demand for cooling.

Keywords: *energy, ground cooling, earth tubes, natural ventilation, passive cooling, carbon footprint.*

1 Introduction

In today's age of sustainability, architects and engineers strive towards a better overall performance of buildings with a concerted effort to curtail energy demand yet sustain thermal comfort and lifestyle.

In an effort to diminish the energy demand for cooling in warm to hot climates, this study investigates the potential for ground cooling in a Mediterranean Island, such as Malta. Given that winter conditions are considered relatively 'mild', this study extrapolates the potential for heating in winter, given that inverse seasonal temperature differences occur over a long time lag, particularly over spring and autumn (Francis, 1981).

1.1 Background Theory

A building exchanges heat with the environment by conduction, convection, radiation and evaporation or condensation. Although for any isolated building convection, followed by radiation are the more conspicuous modes of heat transfer, however for earth structures with greater ground contact, conduction is perhaps the most significant of these four modes of heat transfer with the underlying terrain. The concept of ground cooling is based on the heat-loss mechanism with the ground, which typically has a temperature lower than ambient conditions.

Various scientific studies have shown that soil temperatures at a depth in excess of circa 3.0 metres are relatively stable, with no diurnal fluctuation and experiencing only a small seasonal or annual variation. This stability is due to the fact that temperate heat waves are dampened as they penetrate through layers of soil.

Sharan (2004) studied deep soil temperatures over a year in Ahmedabad, in western India at an elevation of 53m above MSL. These studies lead to the formation of the following equation:

$$T(t,z) = 27 + 10e^{-\alpha z}\cos\left(\frac{2\pi}{365}(t - 105) - \alpha z\right)$$

Where,

ω	= angular frequency
k	= thermal diffusivity (m^2/day)
t	= day of the year with January 1 as origin
z	= depth from surface (m)
T (THz)	= temperature at depth z, day t (˚C)

This equation demonstrates that diurnal fluctuations in temperature are dampened and diminish within less than a metre depth of soil. However, in consideration that annual waves have a much smaller amplitude of fluctuation, they have the ability of penetrating to greater depths of terrain. The equation also indicates that waves at deeper levels are out of phase, thus resulting in the occurrence of temperature lag (Sharan, et al., (2004).

Lechner (2001) graphically demonstrates the variation of soil temperature with depth and time of year, where it can be clearly seen that the greater the depth, the smaller the variation in soil temperature over time (Figure 1). Therefore, large masses of soil at a stable, quasi-constant temperature render it capable of serving both as a sink and a source of heat.

Despite receiving some attention in the 1970s and 1980s, earth tube systems were not appreciated by a wide audience. This was due to a number of performance issues and limitations, namely associated with their moisture content and costs [i].

1.2 Literature Review

Following an analysis of selected literature on third party case studies, the analysis generally highlighted the advantages of air over water as the principal heat exchange medium (Lechner, 2001). Also, Givoni (1994), in his analysis of earth tube systems, describes the utilization of both air and water as the circulating medium. Opting for air as the more practical testing heat-exchange medium, two systems are presented, namely an open or a closed- loop pipe configuration.

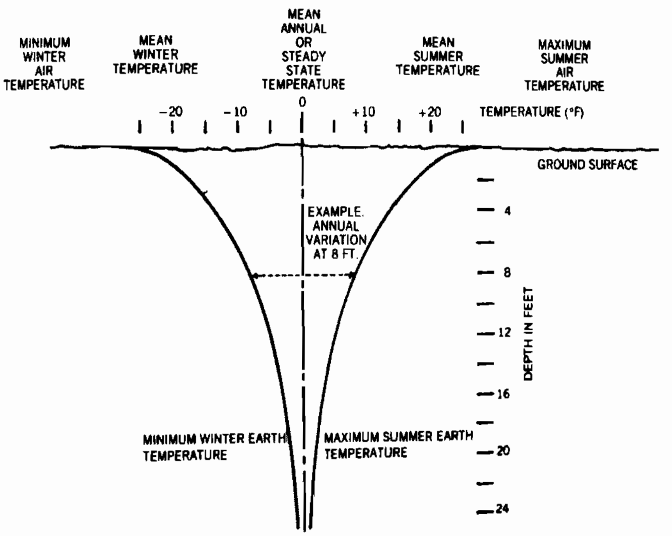

Figure 1: Variation of soil temperature with time of year and depth. (Lechner, 2001).

The open loop configuration entails the drawing of air by a fan into the tubes. This air is delivered directly to the building interior and thus provides both ventilation and cooling of the internal environment. It is this system that has been adopted for this study.

2 Aim of the Study

The principal aim of this study was to monitor two options for ground cooling, namely horizontal and vertical earth-to-air heat exchangers, primarily designed in cooling mode. For this purpose earth pipes were set up in both vertical and horizontal configurations. A comparison and evaluation of their thermal efficiency was the subject of this study.

3 Climate Overview

Typically Mediterranean, the Maltese Islands have a warm to hot summer with a mild to cool winter, without sub-zero temperatures. Summer days are predictably clear with a solar insolation level of $8kW/m^2$ Diurnal variations range from 10-15°C, particularly in summer. The average RH of 76% is understandably high for a predominantly marine environment. It is typically windy all year round with prevailing wind directions being north-west to westerly; only 13% of the year has no measurable air movement (Lechner,2001).

3.1 The Maltese Geology

The principle rock strata of the Maltese islands are composed of *globigeria* limestone, appearing in various types and layers, its density varying with depth. The construction industry in Malta has always been heavily dependent on this local indigenous quarried material. It has its own unique properties perhaps giving it its almost unbeatable popularity among local folk as a standard building material used for over 5,000 years. Its structural integrity, durability, weathering and thermal properties as well as its ease and low cost of quarrying combined with today's technology for cutting, have made it ideal for earlier dwellings to have their own cellar, cool, spacious and robust, hewn out of the limestone (Trump, 2004).

In consideration of the climatic elements as well as the limestone's properties, environmental and physical characteristics point towards exploiting the potential for ground cooling by natural ventilation. This includes air entrainment into underground pipes. Maltese folk have demonstrated their awareness of this in cellars in their early farmhouses.

4 Methodology

4.1 Experimental Setup

Two earth-to-air heat exchangers, a vertical and horizontal twin sets of PVC pipes, both 200mm , 5mm thick and 15m total length. These were installed at a depth of 3.0m below the ground, considered ideal as indicated form previous studies outlined above[1,2,3,4]. The whole experimental set-up was located in a sub-urban, semi-rural area in an open field in Nadur, Gozo, Malta's sister island

The geological strata consisted of a layer of top soil followed by a layer of crushed limestone (a.k.a. *'torba'*), followed by a bedrock of blue clay simulating an indoor space. The set up is illustrated in figure 2

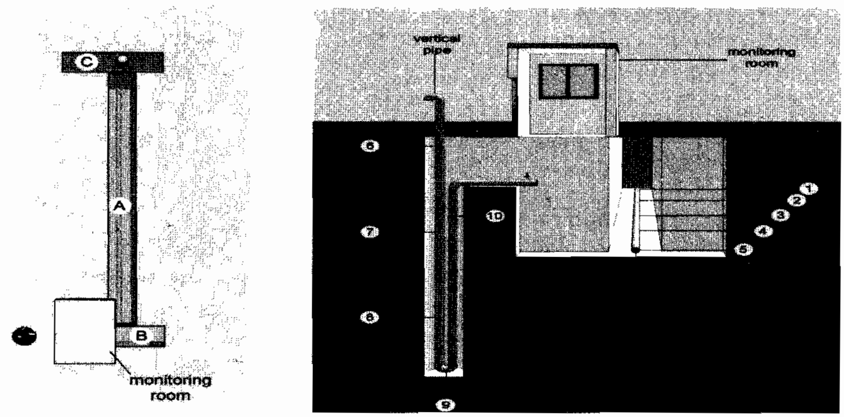

Figure 2: plan & section: horizontal and vertical twin sets of pipes as laid on site at Nadur, Gozo (Malta).

In order to achieve the original aim of the study, the principal parameters monitored included, air temperature, relative humidity and air movement. All pipes and instrumentation were connected to a plenum underground chamber and into a monitoring room above. This simulated an indoor space, having double-glazed aluminium windows and built in HCB (hollow core blockwork) to a height of 3.0m, as typical for Maltese dwellings.

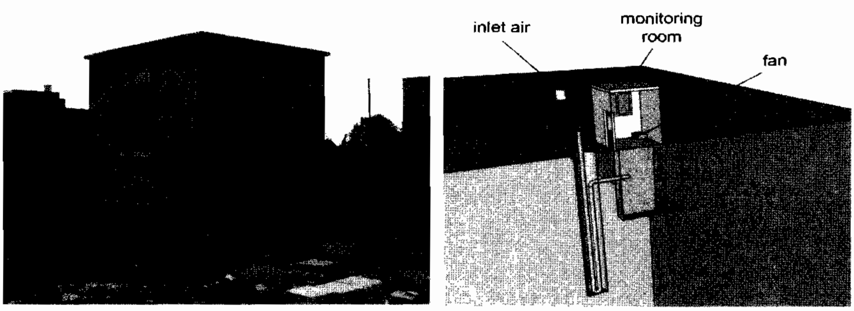

Figure 3:The Monitoring Room set-up

Temperature and RH thermocouples were set up along the pipes at 3.0m intervals. Similar thermistors were used to monitor outdoor ambient conditions as well as soil temperatures outside and away from the pipes. The horizontal pipe was laid to a nominal camber of 2° in order to drain any internal condensation. Air was injected into both systems through a fan at each of the open ends. The velocity of the air circulated through the pipes was monitored through a single air velocity transducer located at one end of each pipe.

5 The Full Study

With lessons learnt from a pilot study, the full study was carried out over periods of between two to four days in April-May 2008, representing spring. Through the vertical pipe ambient air was extracted at a range of velocities between 0.17ms^{-1}, through 0.51 to 0.05ms^{-1}. Separately, the horizontal pipe was subjected to a mean air intake of 0.52ms^{-1}.

5.1 Temperature Response (Vertical Pipe)

Air temperatures dropped steadily through the pipe, as recorded across thermocouples (numbered 6-10 with 6 closest to air ingress and 10 furthest, just under monitoring room). Conversely during the night, temperatures rose steadily as the air approached the monitoring room. Both effects indicate a potential for heat exchange with the ground's thermal inertia and its thermal lag. Fig.4 refers.

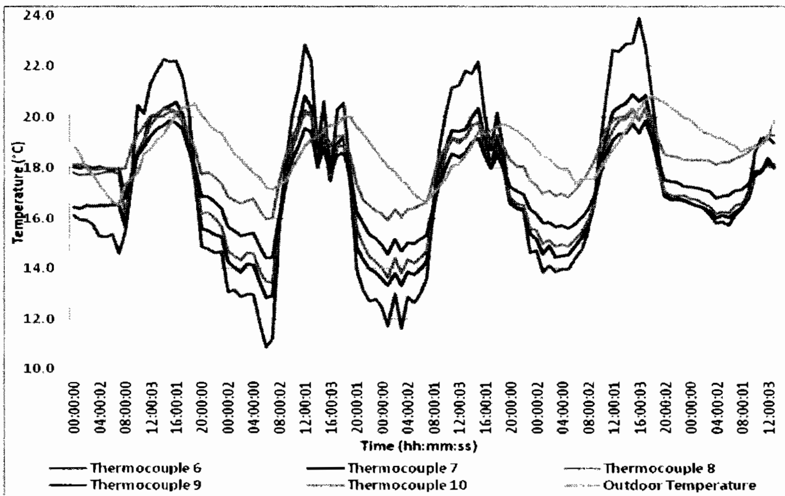

Figure 4: Air temperature profile through the vertical pipe.

The notable difference in temperatures is attributed to the fact that thermocouple 6 was located at the entrance of the pipe circa 1.2m above ground, meaning that inlet air was away from the influence of subterranean conditions.

During the day, as the air is channelled deeper into the pipe, readings from thermocouples 7, 8 and 9 showed a continuous decrease in air temperature, whereas the outlet temperatures recorded by thermocouple 10 increased. A logical explanation for such behaviour of air temperature within the vertical pipe is that as the air travels deeper into the buried pipe, its temperature would decrease. However, given that the outlet of the pipe was at a shallower depth of circa 1.0m soil-embedded, as the air travelled upwards to thermocouple 10, its temperature experienced a slight increase.

An analysis of the same situation but during the night hours displays a reverse effect on air temperature, however with a slight difference: As air travelled deeper in to the pipe, thermocouple readings marked a gradual increase in temperature. However, as the air was channelled upwards towards the outlet, the readings obtained from thermocouple 10 marked a further increase in temperature, despite it being located at a shallower depth of soil. This may be attributed to the effect of solar radiation on shallow depths of soil, circa 1.0m below the surface.

The readings obtained from thermocouples 6, 7, 8, 9 and 10 demonstrate that the channelling of air along the length of the pipe has a damping effect on the air temperature. Figure 4 demonstrates how the outlet temperatures recorded from thermocouple 10 fluctuate much less than the inlet temperatures recorded from thermocouple 6. This can be interpreted as the damping effect that ground conditions have on air passed through it. However it is worth noting that the air flow rate is very critical. This depends on pipe diameter and air velocity.

Simulations with varying air flow were tested retaining the same pipe layout but varying only the fan speed, thus the air intake speed. This results in a different heat exchange rate, given ground conditions remain constant.

Within the same testing period, air velocity was deliberately varied through both pipes in order to assess its effect on temperature. When the velocity was increased to 0.51 ms^{-1} an average increase in temperature of 1.5°C was recorded across all thermocouples.

5.2 Temperature Response (Horizontal Pipe)

When extracting air through the horizontal pipe the maximum and minimum temperatures noted during daytime and night time respectively were across thermocouple 1, the closest to the air intake point. This was as expected, similar to the vertical pipe.

During the day, when outdoor temperatures were as high as 23.0°C, (typical spring-time in Malta), indoor air temperature was reduced by 2.5°C to 21.5°C. However during the night hours, when external temperatures were around 16°C, indoor temperatures were still warmer by 2°C standing constantly stable around 18°C. Figure 5 demonstrates the shallower pitch of the sinusoidal curve between temperature extremes outdoors as reflected indoors. It is also worth noting that when outdoor temperature shot up to 27°C indoor temperatures remained fairly stable, only responding by about 1.8°C. This further highlights the potential of the ground to moderate outdoor conditions, particularly in April-May (during field tests).

Once more a quick simulation of changes in velocity revealed that at higher air velocities, the temperature difference between the inlet and outlet decreases. In this case air speed was increased from 0.17ms-1 to 1.02ms^{-1}. It was also noted that the difference between inlet and outlet air temperatures dropped by 1.2°C from an earlier 2.5°C. Naturally this is attributed o the higher convective losses through the pipe.

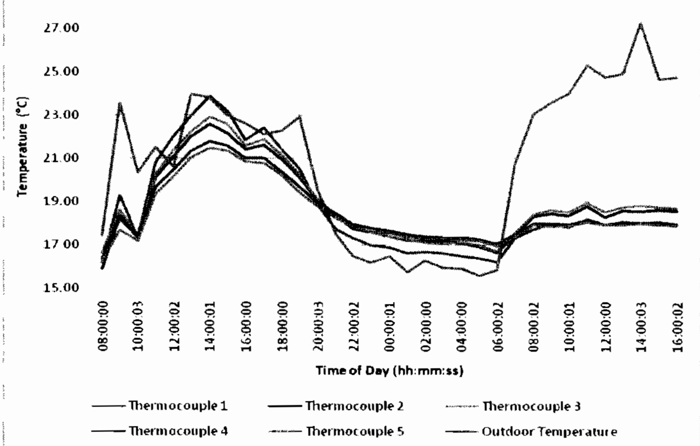

Figure 5: Air temperature profile through the horizontal pipe.

5.3 Relative Humidity Profile (Vertical Pipe)

Figure 6 refers. This demonstrates how the RH profile varies as air is extracted through the vertical pipe at 0.52ms-1, showing a drier air ingress by 6% (99-96%) into the indoor space, although admittedly still high by thermal comfort standards, (Saberi's psychrometric chart).

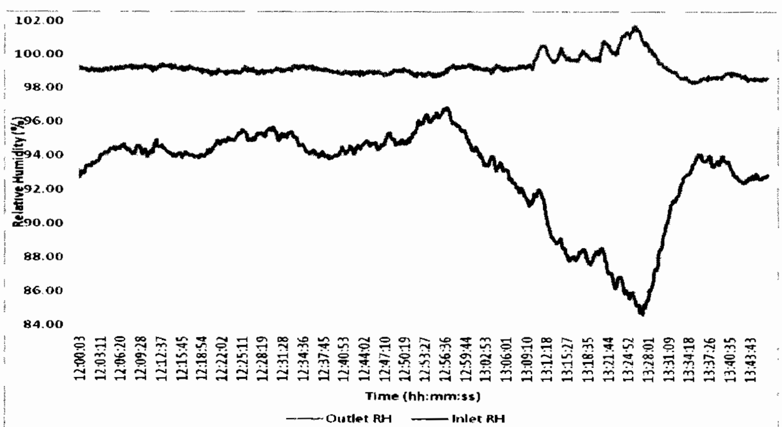

Figure 6: Vertical pipe - RH profile curves

When the air velocity was decreased to 0.05ms^{-1}, it was noticed that the outlet relative humidity increased by 2%. On the other hand, when air velocity was increased to $0.46ms^{-1}$, the outlet saw a 3.3% drop in RH at the pipe outlet, indoors.

5.4 Relative Humidity Profile (Horizontal Pipe)

When the air velocity was increased to 1.02m/s, the relative humidity at the pipe outlet experienced a drop from almost 2% (73.5-71.2%). Once the velocity was reduced to 0.52m/s RH gradually increased to 72.5% . Fig. 7 refers. These results further confirm that with an increase in air flow rate through such a 200mm diameter pipe (both vertical and horizontal), RH is diminished, albeit even if marginally.

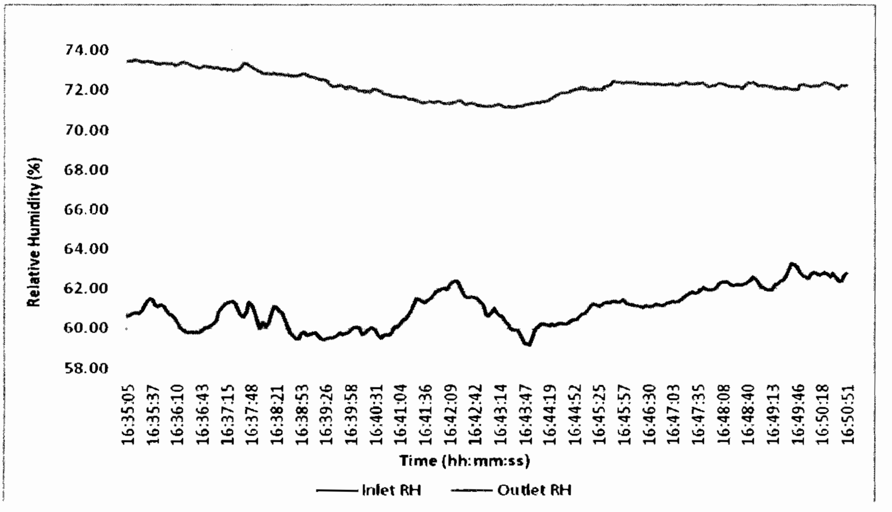

Figure 7: Horizontal pipe - RH profile curves

6 Conclusions

6.1 Temperature Variations with Air Velocity Changes

The above readings were obtained when air velocity through the vertical and horizontal pipes was $0.18ms^{-1}$ and $0.05ms^{-1}$ respectively. Higher air velocities imply higher indoor air temperatures (closer to outdoors). However, in spite of the higher air velocity in the vertical pipe (almost quadrupled), it still managed to reduce the air temperature inside it by double the amount the horizontal pipe did (both had equal lengths of 15m each).

This gives a clear indication of the superiority of the vertical pipe, over the horizontal one (for a given length and diameter), even with higher air velocities. Perhaps a mathematical relationship can be derived with parameters comprising outdoor and indoor temperatures, pipe diameter, air speed and the latent heat of the ground or its diffusivity (quotient of conductivity over the product of specific heat capacity and density) (Santamouris, Asimakopoulos, 2001) However this was considered beyond the scope of this study.

6.2 Relative Humidity Variations with Air Velocity Changes

An assessment of thermal comfort parameters was made with the monitored values of indoor air temperature and RH by inserting these along the comfort envelope on the psychrometric chart, figure 8. This is the result of an overall relationship of all relevant parameters, particularly air temperature, relative humidity and air speed (Lechner, 2001).

When comparing values of indoor temperatures and RH, it was observed that for the vertical pipe, for air velocities which ranged from 0.16 – 0.20 ms^{-1}, the outlet temperature and relative humidity obtained ranged from 20.1 – 20.3°C and 53.2 – 67.8% respectively. On the other hand, for the horizontal pipe, with air velocities between 0.05 – 0.10ms^{-1}, indoor temperatures and RH ranged from 20 – 21.5°C and 47- 73% respectively.

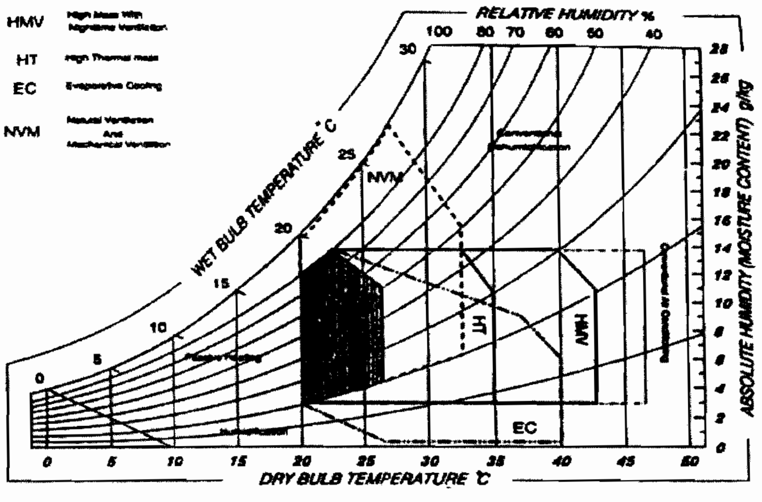

Figure 8: Psychrometric chart (Saberi, O. et al., n.d.)

Therefore, results show that in order to achieve outlet air temperature and relative humidity levels which fall within the comfort zone in the psychrometric chart, air had to be channeled at a velocity which ranged between 0.16 - 0.20 m/s through the vertical pipe and 0.05 – 0.10 m/s through the horizontal pipe.

The results obtained from the on-site tests carried out prove the effectiveness of both horizontal and vertical earth pipes. The stable globigerina limestone conditions resulted in the cooling of entrained warm outdoor daytime air, while during night time, it resulted in the marginal heating of cooler outdoor air. This is particularly significant in spring in a Mediterranean climate such as Malta, where temperatures around 20-27°C, may attract space cooling as early as April-May.

Hence ground cooling does prove to be an effective passive cooling regime, particularly with Malta's staple thermal inertia attributed to be one salient characteristic of its indigenous porous sedimentary rock.

7 Experiment Critique

In an ideal situation, tests on earth-to-air heat exchangers would be carried out in the summer months, when temperatures escalate to relatively high levels. However, due to the fact that such dissertation projects are typically undertaken between Oct-June, such tests had to be carried out between April and May.

One shortcoming was that a plenum chamber had to be excavated under the monitoring room to interconnect all pipework feeding ingress air and for wiring thermistors to the data logger. This may have influenced the indoor temperatures, as it may have had a buffering effect on the simulated indoor space.

The monitoring room was (2.4 x 2.4 x 3.0m high). This was considered fairly small compared to a standard habitable room in a dwelling. Hence internal convective air flow may have influenced indoor air temperatures and RH. However this room had double glazed window and door, constructed of single cavity hollow core concrete blockwork.

Although ideally a proper dwelling should have been tested, this was not possible due to constraints of land availability in an urban area. Hence a purposely built room was constructed, serving to interconnect and house all monitoring equipment.

8 Scope for Further Research

Therefore with hindsight, if the full study had to be repeated the following refinements will be necessary for further and deeper research:

In a more extensive pilot study, different pipe sizes would be tested first (say 100,150, 200, 250, 300mm). However these would need to be tested with different air speeds, as it is a known fact that for a smaller pipe diameter there is a lower convective heat exchange (smaller surface area of pipe contact with terrain), hence this needs to be compensated for with a slower air speed. Conversely for a larger pipe diameter (e.g. 200mm, as for this study) a higher air velocity can be afforded.

In practice, for large-scale experiments, this is particularly relevant for human-scale indoor environments, typically a living room or a whole dwelling. Air change rate is therefore equally important in order to cool a larger indoor space.

Another refinement would be testing out for a longer period, say 8-10 days, also testing for winter conditions, possibly utilising a real habitable space, such as a living room in an inhabited house. In this way a more realistic, live testing would ensue, with the 10-day period spanning a whole working week and two weekends. Such a monitoring exercise could easily be complemented with a questionnaire survey, for subjective assessment of space thermal comfort of occupants.

The tests carried out were on pipes designed as an open loop configuration with air as the circulating medium. These may also be tested on different circulating media, such as liquids/compressed gas, tested on closed loop pipe configurations.

9 Overview

Due to the nature of the typical Maltese plot of land, being narrow and long, and the current scarcity of land available, the implementation of vertical earth-to-air heat exchangers would be an ideal remedy for maintaining comfortable internal environments, particularly throughout the hot summer months. This active means of cooling requires a minimal amount of electrical energy to function and thus can contribute to Malta's current need to reduce consumption of fossil-driven energy. Moreover it effectively reduces a building's carbon footprint.

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Energy Efficient Design Features for Residential Buildings in Tropical Climates: The Context of Dhaka, Bangladesh

Tahmina Ahsan & Orjan Svane
Royal Institute of Technology, Sweden

Abstract

This study aimed at identifying passive design features through literature study that can be incorporated in residential buildings of Dhaka to make them energy efficient. The study also aimed at identifying changes in the design process that can affect energy efficiency in residential buildings. It has analyzed the present electric energy use for cooling and lighting typical residential buildings of upper middle income households in Dhaka through a case study conducted in Dhaka. It has also calculated the possible energy savings by adopting certain energy efficient features in the case study building.

The findings from this study indicate that doubling the thickness of external walls on east and west of the building, use of hollow clay tiles instead of weathering course for roofs and use of appropriate horizontal overhang ratios for all four orientations can reduce the cooling load of the case study building by 64% and thus reduce the total energy use of the building by 26%. Finally, it can be concluded that the process of designing energy efficient residential buildings is not a 'one-man's show'. Architects, developers, interior designers and clients are the other actors who can bring a change in the design practice.

Keywords: *Energy- efficient; passive design features; residential building; tropical climate*

1 Introduction

Bangladesh with an area of 55,598 square miles is a small but one of the most densely populated countries in the world. The population of Bangladesh was estimated at 129,194,224 in July of 2000 (Encyclopaedia of the Nations, 2010).The climate of Dhaka can be categorized as tropical monsoon type with high temperatures, high humidity most of the year, and distinctly marked seasonal variations in precipitation.

The energy infrastructure of Bangladesh is quite small, insufficient and poorly managed (Temple in Mozumder and Marathe, 2007). 82% of the country's electricity is generated from natural gas, 9% from oil, 4% from hydro and 5% from coal (Tuhin, 2008). According to Tuhin (2008), only 42% of the population is served with electricity and per capita electricity use is about 160 kWh. The demand for electricity is growing at a rate of 10% per year (USAID in Mozumder and Marathe, 2007) without any well-designed plan to meet the demand. According to the report of Dhaka Mirror (2009), the country has been experiencing a shortfall of about 1200 MW of electricity against the demand of 4500 MW. Dhaka alone is being provided with 1185 MWs against a demand for about 1800 MWs.

Worldwide, 30% to 40% of all primary energy is used in buildings (UNEP, 2007). Energy efficiency in residential buildings is crucial, especially for a country like Bangladesh where the demand for electricity, as already stated, is growing at a rate of 10% per year. According to BBS (2008), the electricity used by the industrial, residential, commercial and other sectors in the year 2006-2007 was about 21181 GWh. Out of this, 42% was used by the residential sector alone (BBS, 2008). Much of the increased demand for electricity is due to the increased standard of living (People's Report 2004-2005, 2006) among the wealthier income groups. One of the major factors in the increased use of electricity by the higher income group is the use of air conditioning units, which has only recently become quite popular (Hancock, 2006). To make matters worse, a study of the regulations in the national building code of Bangladesh shows that the government of Bangladesh has not adopted building energy codes in any form for building construction. In addition, simple observation of most of the residential buildings in Dhaka shows that developers, architects and interior designers are still not aware of the role they can play in designing energy efficient buildings.

1.1 Aim

The aim of this study is to identify passive energy efficient features for residential buildings in the context of tropical climates such as Dhaka to make a contribution in the field of architecture, by developing and designing energy-efficient residential buildings. Given the specific problems in the preceding section, it can therefore be attributed that there are probably large potentials for improvements in the energy sector and built environment. However, this research focuses on those attributes that can be attained through changes in the practices of architects. This study, based on a case study residential building in Dhaka, is thus expected to answer the following research questions in order to achieve the goals of this study:

1. What is the present electric energy use for cooling and lighting typical residential buildings inhabited by upper middle income households in Dhaka?
2. What are the passive design features that can be incorporated in residential buildings of Dhaka to make them energy-efficient ?
3. What are the possible energy savings in the case study residential building by adopting these energy efficient features?

In terms of the various categories of buildings that are there in Dhaka, this research was delimited to a case study on multi-unit residential buildings and not on a statistical sample. This study confined itself in considering energy use at the operational phase of the building. The study was oriented towards the residential buildings inhabited by upper middle-income groups in Dhaka. This study is delimited to the upper middle-income group, since they use more and more energy as they have increased their standard of living and are becoming increasingly accustomed to the use of air conditioners. The study is restricted to making new residential buildings energy-efficient and does not consider the existing housing stock. Reza (2008) notes that Dhaka city, with an annual growth rate of about 4%, adds half a million people to its population each year. He also states that to accommodate the growing population, the city would need at least 10 million new units/flats by the year 2015 and thus, Dhaka would not be able to cater the energy needs of these new units.

2 Methodology

2.1 Research Methodology

This research is based on a single case study and through literature review to explore the problems specified and seek answers to the research questions. A literature review consisting of books, journal papers, researches and documents defined the theoretical framework for this study by identifying energy efficient design principles that could be used for the context of Dhaka. In addition, it identified the methodology of analysis and issues that were investigated in the case study. The case study is a multi-unit residential building that is representative of inefficient energy buildings in Dhaka city. A fieldwork in Dhaka consisted of visits to the case study building and interviews with the residents. Quantitative and qualitative data were collected from the case study building. The data on energy use of different flats/units in the building were analyzed quantitatively and the design features of the apartment were analyzed both quantitatively and qualitatively. Energy efficient principles that were identified through literature review were summarized and analyzed quantitatively to determine the energy savings of all the features that could be applied in the context of Dhaka. Calculations were then made to see how much energy the flats surveyed in the case study building could save, by adopting the energy efficient design principles.

2.2 Selection of case study

The selection of the case study building was based on the following criteria:

- It is representative of typical multi-unit residential building design in Dhaka
- The architectural drawings of the apartments were available
- It was accessible
- The households were cooperative.

2.3 Issues Investigated

Apart from the design aspects that were identified in the theoretical framework, the following issues in the case study apartment have also been investigated:

- energy use practices of households (appliances used, energy used by those appliances)
- energy use for cooling and lighing in typical multi-unit residential buildings of Dhaka
- general living pattern of the households

2.4 Data gathering strategies

Data gathering strategies were divided into a mixture of qualitative and quantitative approaches. The following different combinations of data gathering strategies were adopted:

- qualitative and quantitative physical survey of the case study building
- qualitative and quantitative semi-structured interviews that have open and closed questions
- quantitative calculation of energy use
- qualitative and quantitative architectural drawings of the case
- archival records of computerized quantitative statistics on the climate of Bangladesh
- quantitative statistics from newspaper clippings.
- photographs (qualitative and quantitative)

3 Theoretical Framework

3.1 Energy efficient residential buildings

Well-designed energy efficient buildings maintain the best environment for human habitation while minimizing the cost of energy. According to the Development and Land Use Policy Manual for Australia (2000), the objective of energy efficient buildings is are to improve the comfort levels of the occupants by reducing energy use for heating, cooling and lighting. United Nations (1991) defines energy efficient buildings to have minimum levels of energy inputs.

3.2 Basic principles in energy efficient building design

It is evident from the above section that energy efficiency in buildings is vital for many reasons. Having justified the needs for energy efficiency it is now important to focus on the basic principles that can bring about energy efficiency in residential buildings of Dhaka. An extensive literature review consisting of different journals, books, researches and related websites was undertaken to establish the basic passive principles for designing energy efficient residential buildings. It must also be stressed that as this study focuses on those passive that quantify the energy savings. Below is the list of aspects for energy efficient residential buildings that show a percentage reduction in energy use and that has been arrived at from the literature review and is based on the context of Dhaka:
Building envelope:

- External wall
- Roof
- Windows
- Shading device

3.3 Building Envelope

3.3.1 External wall

The field measurements and computational energy simulations to examine the effectiveness of passive climate control methods such as facade construction in a typical 14 storey residential building of Singapore by Wong and Li (2007) reveal that the use of thicker construction on east and west external walls can reduce the solar radiation heat gain. It was found that the cooling load can be reduced by 7%-10 % when the thickness of external wall is doubled (229 mm concrete hollow block instead of 114 mm concrete hollow block).

Residential buildings in Dhaka have 125 mm thick external walls made of brick to make most of the floor area and to reduce construction costs. It should be noted that older buildings had thicker walls ranging from 250 mm to 500mm. With the advent of multi-unit residential buildings due to increasing pressure on building land and structural system, these thick walls were replaced with 125 mm walls. The design option put forward by Wong and Li uses concrete for external walls, but concrete is expensive in Dhaka. The local building material for external walls in Dhaka is burnt brick and it is much cheaper when compared to the cost of concrete. According to Gut and Ackerknecht (1993), the transmittance value or U value (measurement of heat transfer through a given building material) of 250 mm hollow concrete block whitewashed externally is 1.7 W/m^2. The U value of a 280 mm brick wall (115 mm brick + 50 mm air gap + 115 mm brick) including an air cavity of 50 mm and whitewashed externally is also 1.7 W/m^2. These U values suggest that energy savings from using brick instead of using concrete should be roughly the same as calculated by Wong and Li. Hence, for Dhaka's context 280 mm brick walls including an air cavity of 50 mm can be used instead of hollow concrete blocks on east and west facades to reduce energy use.

3.3.2 Roof

The roof is an important element of design when it comes to conserving energy because this part of the building receives most of the solar radiation and its shading is not easy. Nahar and Sharma in Tang and Etzion (2004), Vijaykumar et al. (2007) and Alvarado and Martinez (2008) conclude that the heat entering into the building structure through roof is the major cause for discomfort in case of non air-conditioned building or the major load for the air-conditioned building. Vijaykumar and Srinivasan in Vijaykumar et al. (2007) have advised the use of hollow clay tiles (HCT) in place of weathering course for roofs. They have claimed that the use of such a system can save 18% - 30% of energy used in an air conditioned building. Application of hollow clay tiles as suggested by Vijaykumar and Srinivasan is easily feasible in the residential buildings of Dhaka as the cost of hollow clay tiles is not significantly higher compared to the cost of the weathering course for roofs.

3.3.3 Windows

3.3.3.1 Shading device Ossen et al. (2005) carried out a study using computer simulation to explore the effect of six different alternatives on incident solar radiation, transmitted solar heat gain, natural light penetration and energy use. Their main objective was to assess and compare the impact of horizontal shading devices in reducing the unwanted solar heat gain and the amount of natural light penetration into office buildings in Malaysia.. The base-case model developed for the study was a single unit office room with dimensions of 6 metres for length and depth and a height of 2.8 metres. The size of the window was taken to be 4.4 metres in length and 1.82 metres height (from sill to ceiling line). The window area was assumed to be 50% of the net external wall area .The corresponding window to floor area ratio was 22%.The depth of the overhang (external horizontal shading device) was the main variable in this study. A range of overhang depths was investigated to determine the optimum shading for reducing the maximum solar heat gain from form direct solar radiation. Table 1 outlines the various overhang depth studied and the relative overhang ratio (OHR).

Table 1. Description of Tested Cases for Independent Variable

OHR= D/H D= Overhang depth H= Fenestration height	Overhang Depth (Metres)
0.4	0.73
0.6	1.09
0.8	1.46
1	1.82
1.4	2.55
1.6	2.92

Source: Ossen, D.R., Ahmad, M.H. & Madros, N.H. 2005.

Their study reveals that horizontal overhang ratios of 1.3, 1.2, 1 and 1 for east, west, north and south orientations respectively have optimum total energy savings of 14%, 11%, 6% and 8%. Ossen et al. (2005) conclude that in hot and humid climates, external solar shading is the best option to optimize total energy use, considering the trade off between total heat gain and natural light penetration. Even though this study considered orientations and height of opening when determining the depth of the overhang hang, it did not consider horizontal shadow angles, vertical shadow angles and width of openings.

It is therefore reasonable and logical to accept the proposal of Ossen et al. (2005) for the context of Dhaka for three reasons. Firstly, because of the similarities in the two climates, secondly, because of the parameters they have considered in determining the length of shading device and finally because they have also considered the trade off between total heat gain and natural light penetration when calculating total energy savings.

4 Results: Case Study Findings and Data Analysis

4.1 An overview of the case study building

The building is in Lalmatia residential area (Fig. 1), an upper-income neighbourhood, located at the heart of the city. Mohammadpur and Sher-e-Bangla Nagar to the north, Raja Bazar to the east and Dhanmondi and Rayerbazar to the south surround Lalmatia.

Figure. 1. Location of the case study building in Lalmatia, Dhaka Source: Google Map

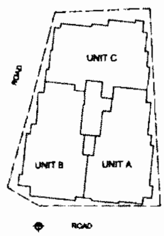

Figure. 2. The Case Study Building

Figure. 3. Location of different units

The case study building (Fig. 2) is a typical six-storied multi-unit residential building with three flats on each floor and fifteen households. The three different flats/units in the building are: Type A, Type B and Type C (Fig. 3). The sizes of flat Type A, B and C are 120, 122 and 120 square metres respectively. Type A is surrounded by a road on the southern side and by a residential building on the eastern side. Two roads, one on the western side and the other on the south, surround Type B. Type C is surrounded by a road on the west side and a residential apartment on the north.

Seven out of fifteen households were surveyed. These households are A2, A3, B2, B4, B5, C1 and C5.The residents of C1 are tenants; all other flats surveyed are owned by the households.

4.2 Design features of the case study building

4.2.1 Building envelope

4.2.1.1 External wall All external walls are of 125 mm solid brick. The owner of flat B4 who was the owner of the land now regrets the limited thickness of external walls. During the interview, she complained that the heat gain on the western side of the building is profuse and unbearable. She claimed that the developers had suggested 125 mm wall thickness to reduce the construction costs of the building. She now feels that the heat gain on the western side would have been less if the external walls were 250 mm. She has admitted that the extra costs of using 250 mm wall thickness and the reduced indoor floor area as a result of the increased external wall would have been worthwhile.

Both external and internal walls have a cement plaster over the brick and white wall finishes. Some exterior walls that face the roadside are clad with light coloured facing bricks.

4.2.1.2 Roof The roof is flat, about 100 mm thick. It is made of reinforced concrete slab with weathering course, a course laid on the top surface of RCC roof slab to protect it against weather elements like rain, heat etc and neat cement finish. The roof has one big room that functions as a community room. The roof is also used by the residents for hanging laundry and as a community space.

4.2.1.3 Windows

Shading devices

Shading devices are needed in Dhaka to ensure protection from the rain and solar heat gain. The depth of the shading device for different orientations of windows in all rooms of the different unit types (A, B and C) was calculated.

The analysis of shading devices for windows (Tables 4- 6) demonstrate that shading devices are either absent or their sizes are much less than the recommended value. This analysis together with simple observation on shading devices represents the general scenario of shading devices in typical residential buildings of Dhaka.

Table 4. Shading device analysis of Flat Type A

Room	Window orientation	Window size (In metres)	Window to wall area ratio (WWR)	Recommended horizontal shading (In metres)	Actual horizontal shading (In metres)
Master bed	East wall	1.5 x 1.4	0.24	1.8	-
Master bed	South wall	1.5 x 2	0.24	2	0.78
Bed 2	South wall	1.3 x 2	0.27	2	0.78
Bed 3	East wall	1.8 x 1.4	0.28	1.8	-
Living	East wall	1.5 x 1.4	0.24	1.8	0.25
Dining	Central void	1.8 x 1.4	0.18		
Kitchen	East wall	1.1 x 1.4	0.18	1.8	-

Table 5. Shading device analysis of Flat Type B

Room	Window orientation	Window size(In metres)	Window to wall area ratio (WWR)	Recommended horizontal shading (In metres)	Actual horizontal shading (In metres)
Master bed	West wall	1.67 x 2	0.38	2.4	-
Master bed	South wall	1.5 x 2	0.25	2	1.16
Bed 2	South wall	1.3 x 2	0.28	2	0.9
Bed 3	West wall	1.5 x 2	0.39	2.4	0.25
Living	West wall	3 x 2	0.70	2.4	-
Dining	Central void	1.8 x 1.4	0.13		
Kitchen	West wall	1.3 x 2	0.26	2.4	0.5

Table 6. Shading device analysis of Flat Type C

Room	Window orientation	Window size (In metres)	Window to wall area ratio(WWR)	Recommended horizontal shading (In metres)	Actual horizontal shading (In metres)
Master bed	West wall	1.8 x 2	0.31	2.4	0.78
Master bed	North wall	1.65x 1.4	0.24	1.4	0.5
Bed 2	West wall	1.7 x 2	0.27	2.4	1.4
Bed 3	East wall	1.09 x 1.4	0.28	1.8	0.9
Living	East wall	1.65 x 1.4	0.24	1.8	0.7
Dining	Indirect windo	1.8 x 1.4	0.18		
Kitchen	North wall	1.3 x 1.4	0.18	1.4	-

4.3 Energy usage of the case study flats

4.3.1 Total energy usage

The energy use of the case study flats depend on the household size, occupancy pattern, appliances used, the power rating of the appliances and the duration for which they are used. The study does not take into account the energy efficiency of the different appliances and energy efficiency related to every day habits that cannot be influenced by design because the study focuses on the energy efficiency aspects that can be addressed through planning and design. The energy use of the households has been calculated for a typical summer month, when the maximum temperature can be as high as 34° C. The monthly total energy use for a typical summer month for all the units studied is given in Table 7. A break up of the energy use pattern (in percentage) of the case study flats for a typical summer month has been outlined in Table 8. Analysis of energy use in Table 8 shows that the energy required for cooling and lighting takes up the largest share of the energy used by a flat. Unit C1 has very low energy use compared to the other units because the household size is small and it does not use excessive fixtures for lighting or air conditioners for cooling. The average cooling and lighting energy used by all the units of the case study in a typical summer month has been calculated as 40% and 39% respectively of the total energy use.

Table 7. Monthly total energy use

	Unit A2 1 A.C	Unit A3 1 A.C	Unit B2 1 A.C	Unit B4 2 A.Cs	Unit B5 2 A.Cs	Unit C1 No AC	Unit C5 2 A.Cs
Monthly total energy use for a typical summer month (kWh)	1762	1401	900	1263	1356	450	1316

Table 8. Break-up of monthly total energy use

Energy used (%)	Unit A2	Unit A3	Unit B2	Unit B4	Unit B5	Unit C1	Unit C5
Cooling (A.C)	25.2 1 A.C	36 1 A.C	16.7 1 A.C	29 2 A.Cs	29.7 2 A.Cs	No AC	37.1 2 A.Cs
Cooling (Fan)	10.89	14.4	18.6	10.7	7.4	19.2	12.8
Lighting	46	30	40	41	42	56	29
Refrigeration	10.05	6.2	19.7	14.1	13.10	19.3	13.5

Other appliances	7.66	13.4	4.8	4.2	7.4	5.10	7.4
Ventilation in toilet & kitchen	0.18	0.22	0.2	0.34	0.05		0.1

4.3.2 Energy usage for cooling

Using the data in Table 9, the average cooling energy as a percentage of the total energy used by all the units of the case study has been calculated as 40 % and the average energy use for air conditioners as a percentage of the total cooling energy alone is 24%. The percentage of total cooling energy for Units A3 and C5 is 50% because they are more dependent on air conditioners as compared to other units in the building; Unit A3 uses 36% of cooling energy for air conditioners and Unit C5 uses 37%. On the other hand, the percentage of total cooling for Unit C1 is extremely low when compared to other units because this household does not have air conditioners.

Table 9. Energy used for cooling

Energy used	Unit A2	Unit A3	Unit B2	Unit B4	Unit B	Unit C1	Unit C5
Cooling (A.C) in kWh	444 1 A.C	499.5 1 A.C	150 1 A.C	366 2 A.Cs	402 2 A.Cs	- No AC	488.25 2 A.Cs
Cooling (A.C) in %	25.2	36	16.7	29	29.7	-	37.1
Cooling (Fan) in kWh	192	202	168	134.4	100.8	86	168
Cooling (Fan) in %	10.89	14.4	18.6	10.7	7.4	19.2	12.8
Total for cooling (kWh)	636	702	318	500	503	86	656
Total in kWh	1762	1401	900	1263	1356	450	1316
Total for cooling in %	36	50	35	40	37	19	50

The energy used by air conditioners depends on their capacity, type, power rating, and usage and setpoint temperatures. Table 10 shows the energy use of air conditioners based on their capacity, type and power rating. According to Tham (1993), a rise of one degree Celsius in setpoint represents a saving of 6% in energy required for cooling.

Table 10. Energy use of air conditioners based on their capacity, type, usage and power rating

Units/ Flats	Air conditioner (A.C)	No.	Rating (W)	Estimated total load for appliance (kW)	Usage per day (h)	Daily energy use during used period (kWh)	Monthly energy usage of A.C (kWh)
A2	Split 1.5 ton	1	1850	1.85	8	14.8	444
A3	Split 1.5 ton	1	1850	1.85	9	16.65	499.5
B2	Split 1 ton	1	1250	1.25	4	5	150
B4	Split 1.5 ton	1	1850	1.85	4	7.4	222
	Split 2 ton	1	2400	2.4	2	4.8	144
B5	Split 1.5 ton	1	1850	1.85	4	7.4	222
	Split 2 ton	1	2400	2.4	2.5	6	180
C1	None						
C5	Split 1 ton	1	1250	1.25	1.5	1.875	56.25
	Split 2 ton	1	2400	2.4	6	14.4	432

Units A2, A3 and B2 have one air conditioner each and that alone is used for 8, 9 and 4 hours a day respectively. Units B4, B5 and C5 have two air conditioners each and both air conditioners in each unit is used for 6, 6.5 and 7.5 hours respectively.

It can be observed that in flats, such as A3, B2 and C5 which are occupied by the households (excluding the housekeeper) throughout the day use air conditioners in the afternoon and at night. This can be interpreted as such that overheated periods that cause discomfort due to solar radiation on the building envelope extend from 10 am in the morning to 8 pm at night. Solar radiation incident on the building envelope raises the temperature of the exterior surface of the envelope, thereby creating a temperature gradient across the thickness of the envelope. As a result, heat is conducted through the inefficiently designed building envelope, causing a rise in the interior surface temperature. Ample ventilation is needed to dissipate this stored heat at night (Gut and Ackerknecht, 1993). As this stored heat cannot be dissipated outside due to inadequate cross-ventilation and placement of openings, it causes the occupants of the flats to swelter in poor ventilation and high temperatures.

Comparison of the energy use for flats with and without air conditioners (Table 7) shows that case study flats without air conditioners use much less energy. This highlights the necessity in paying attention to architectural characteristics and trends that can address the thermal comfort demands of the households without increasing the dependency of air conditioners. Although fans are also used for cooling, the energy used by them is not as significant as the energy use of air conditioners (Table 9).

It must be emphasized that the case study building is representative of upper middle-income households who have a minimum of one air conditioner. The value for the share of energy utilized for cooling by air conditioners would be much more for lower upper and upper upper- income groups who live in four bed-roomed flats and have air conditioners in all their rooms.

4.3.3 Energy usage for lighting

There are substantial variations in energy used for lighting residential buildings. In the United States, lighting uses 12% of the energy used by a residential building (UNEP, 2007) and 9% of energy used in residential buildings of India contributes to lighting (UNEP, 2007). Residential buildings of Taiwan, on the other hand use 40% of the total residential sector electricity use for lighting (Yang and Hwang, 1993). Using the data in Table 9, the average lighting energy used by all the units of the case study has been calculated as 39%.

Table 11. Different types of lights and energy used for lighting

Type of lighting	Unit A2	Unit A3	Unit B2	Unit B4	Unit B5	Unit C1	Unit C5
Incandescent	16	6	6	16	30	8	9
Fluorescent	12	12	11	11	12	10	9
Energy saving	2	16	16	7	3	None	7
Spot	11	5	None	6	4	None	2
Total number of artificial lights	41	39	33	40	49	18	27
Total energy for lighting (kWh)	810.6	422.4	360	518.25	574.35	252	382.8
Energy used for lighting (%)	46	30	40	41	42	56	29

The energy use for lighting in the households is seen to vary with type of lighting, the number of lights, power rating and the usage of lights. Table 11 shows the different types of lights, the total number of lights and the share of energy use for lighting. Analysis of the different types of lights and the energy use of each type of light is illustrates that incandescent lights use more energy than fluorescent lights. The analysis also shows that energy saving lights use less energy. Nagarajan (2006) states that compact fluorescent light (CFL) or energy saving light as it is commonly called is energy efficient and consumes 80% less electricity when compared to incandescent light.

Developers in Bangladesh generally provide a minimum of two average quality wall mountable lighting fixtures, but not the lights. The households studied in this building did not use the lighting fixtures provided by the developers. Instead, they purchased a multitude of lighting fixtures and lights of their own choice or as suggested by the interior designers who were responsible for the interior design of the flats. The number of lights in all flats except unit C1 and C5 are much more than what is needed for strictly practical reasons. Units C1 and C5 are good examples to show that use of excessive lights are not a necessity. It is possible to use fewer lights and have good indoor artificial lighting conditions. The superfluous lights in the remaining households are for aesthetic purposes and to some extent, to signify the status of the households. Gut and Ackerknecht (1993) have advised against the use of unnecessary lighting as it adds up to internal heat gain.

Even though Unit C1 has the least number of lights compared to the other units, energy used for lighting in unit C1 is more than 50% because this household does not use air conditioners and other major energy consuming appliances. Lighting alone contributes to more than 50% of the share of energy used by this household. It is thus seen that percentages are not relevant on their own, but only in relation to a total.

5 Discussion

5.1 Energy efficient design features

The theoretical framework in this study identified energy efficient design features that can meet the purpose of this study and can be applied in the context of Dhaka. The features that have been selected pertain only to the building envelope, reduce heat gain by the buildings, and they mainly reduce the energy use for cooling. It needs to be strictly emphasized that the chosen features reduce only the cooling energy; the features do not influence the energy used for electrical appliances. The research front has been summarized in Table 12 to formulate the energy efficient design features that can be applied in the context of Dhaka.

Table 12. Energy efficient design features

Feature	Application	Reduction/Saving	Reference
External wall	Doubling the thickness of external walls with 280 mm brick walls including an air cavity of 50 mm on east and west facades.	7% - 10%	Modified by the author
Roof	The use of hollow clay	18% - 30%	Vijaykumar and

	tiles (HCT) in place of weathering course for roofs		Srinivasan in Vijaykumar et al. (2007)
Shading device	**Horizontal overhang ratios of 1.3 for east**	**14 %**	**Ossen et al. (2005)**
	Horizontal overhang ratios of 1.2 for west	11 %	Ossen et al. (2005)
	Horizontal overhang ratios of 1 for north	**6 %**	**Ossen et al. (2005)**
	Horizontal overhang ratios of 1.3 for south	8 %	Ossen et al. (2005)

Assuming that the energy savings estimated by the authors above are roughly correct, then addition of the lower range energy saving values of all the features above gives a total energy savings of 64% (7% + 18% + 39%) for cooling. Given the concrete features of the case study building, the energy efficient design features listed above can be recommended for the context of Dhaka and lies within the field of influence of the architect.

5.2 Energy use of the flats in the case study on adoption of the energy efficient features

The energy use of each flat in the case study building has been delineated in section 4.3. Out of all the energy use that the households use, only the cooling energy of each flat has been reduced because the design measures are not connected to energy use for lighting and other appliances. If the building were to adopt the energy efficient features discussed above, then the cooling energy use of the surveyed flats in the case study building would be reduced by 64%. As explained above, the 64% reduction is a summation of the lower range energy saving values of all the energy efficient features.

Table 13. Reduced energy use of the flats

Energy use		Unit A2	Unit A3	Unit B2	Unit B4	Unit B5	Unit C1	Unit C5
Energy use (kWh)	Cooling	636	702	318	500	503	86	656
	Electrical appliances	1126	700	582	753	853	364	660
	Total Energy	1762	1402	900	1253	1356	450	1316
Net energy use after	64 % reduction on	229	253	114	180	181	31	236

adopting design features. (kWh)	cooling energy							
	Electrical appliances	1126	700	582	753	853	364	660
	Total energy	1355	953	696	933	1034	395	896
Percentage reduction in total energy use		23%	32%	23%	26%	24%	12%	32%

Table 13 above illustrates total energy used by the flats before and after adopting the energy efficient features, assuming that the comfort level of the households remaining unchanged. Since the design features reduce the cooling load, 64% was deducted from the cooling energy of each unit or flat. During the calculation of the reduced energy of the flats, the energy used by electrical appliances has been left unchanged as shown by the values in the second row of the table For example, the cooling energy of Unit A2 was 636 kWh before the reduction and it is 229 kWh after a reduction of 64%. The total energy used by Unit A2 was 1762 kWh before the reduction on the cooling energy. After the cooling energy of Unit A2 is reduced to 229 kWh, the consequent reduction in total energy use of Unit A2 is 1355 kWh as compared to the initial value of 1762 kWh. This is a reduction of 23% in the total energy use of Unit A2. The percentage reduction was calculated by subtracting the difference in energy use before and after reduction of 64% and then dividing this value by the total energy use before the reduction.

In a similar way, the percentage reduction on the total energy use of Units A2, A3, B2, B4, B5, C1 and C5 is calculated as 23%, 32%, and 23%, 26%, 24%, 12% and 32% respectively. This is an average reduction of 26% on the total energy use of the building. This average reduction was found by adding the total energy use of all the units before (8439 kWh) and after the reduction of 64% in cooling energy (6262 kWh). The difference of these two values (2177 kWh) is divided by the total energy use before the reduction of 64% (8439 kWh) and then multiplied by 100 to give the average percentage reduction of 26% on the total energy use of the units surveyed.

The percentage reduction in cooling energy is seen to be more in Units A3 and C5 because these units use 50% of the total energy in cooling (shown earlier in Section 5.3.2). Whereas, the percentage reduction in cooling energy of Unit C1 is only 12% as it uses only 19% of the total energy for cooling. It was shown in Section 5.3.2 that units A3 and C5 are more dependent on air conditioners as compared to other units in the building and Unit C1 does not use air conditioners. The unit without air conditioners (Unit C1) is not as benefitted as those that have air conditioners because the reduction in energy use was directed at those who have air conditioners and are very much dependent on them. Nevertheless, households of Unit C1 would have a better indoor climate with lower indoor temperatures and with lower energy use for cooling by fans and lower costs.

It can thus be concluded that a 64% reduction in cooling energy literally implies that more than half of the devices that were used for cooling are no longer used. Households would use the fans for a lesser period of time or to enhance cross ventilation or when there is no air flow. It would also mean that those who are dependent on air conditioners might use it for a lesser period of time or probably do not need air conditioners.

Further reduction in total energy use is possible if the energy required for lighting is reduced by using energy efficient lights. However, discussions on reducing energy use for lighting are outside the scope of this study as mentioned in Section 1.3.2.

6 Conclusion and Recommendation

This study has identified the following energy efficient building features for the context of Dhaka:

- Doubling the thickness of external walls with 280 mm brick walls including an air cavity of 50 mm on east and west.
- The use of hollow clay tiles (HCT) in place of weathering course for roofs.
- Horizontal overhang ratio of 1.3 for east orientations, 1.2 for west orientations, 1 for north orientations and 1 for south orientations respectively.

All the features that were analysed in this study for adoption in the case study building reduce the energy use for cooling. The study shows that it is possible to reduce the cooling load of the flats studied by 60-70% and hence reduce the total energy use of the flats surveyed by 26-30%.

Dhaka City Building Construction Act need to develop building codes to promote and influence energy efficiency in buildings. The focus of the codes should be to incorporate energy efficient design features right from the design stage.

Considering the significant amount of energy used by the residential buildings in general and the prevailing energy crisis in Dhaka, it is important to adopt the reasonably simple energy efficient design features highlighted in this study. These features can reduce the total energy use of the flats in the case study building by a factor of one fourth and also provide increased comfort to the households. Energy efficient design features not only improve the energy efficiency of residential buildings, but can also provide reduced energy costs to users and play a role in improving the overall energy situation of the country

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Experimental Studies of a Passive Cooling Roof in Hot Arid Areas

Hamida Ben Cheikh[1]
[1] *Département d'architecture, Universite' de Laghouat, Laghouat, Algeria*

Abstract

An experimental study of passive cooling roof was carried out for a typical summer day of June for Laghouat in Algeria. The proposed roof design is composed of a metal plate ceiling over which lies a bed of rocks in a water pool. Over this bed is an air gap separated from the external environment by an aluminium plate. The upper surface of this plate is painted with a white titanium-based pigment to increase the radiation reflection process during daytime. Several passive modifications have been introduced to the roof in order to reduce indoor air temperature in hot climates. An experimental investigation, employing passive procedure, has been carried out to study the possibility of reducing air temperature in buildings. The results show that the air temperature can decrease with a range from 6 to 10°K. This decrease can further be lowered by 2 to 3°C if night natural ventilation of buildings is allowed.

Keywords: *Evaporative cooling; Evapo-reflective, Roof; Hot dry climate; Night ventilation.*

1 Introduction

ln regions with arid climates such as Laghouat in southern Algeria, excessive heat is the major problem that causes human thermal discomfort, as concluded Bencheikh & Bouchair (2004). Cooling is then is the basic requirement of building occupants. ln modern buildings, this can be provided by mechanical and electrical instruments. Traditional architecture in hot climate had many passive aspects which contributed to thermal comfort in dwellings, such as, compact urban heavy building structure, white painted external surfaces, blind facades, open courtyards, etc. The presence of trees, vegetation and water around the building in modifying the thermal microclimate was well appreciated. With the advent of energy crisis there has been a renewed interest in those aspects of architecture which contributed to thermal comfort in a building without or with minimum energy consumption, Bouchair (1989, 2003, 2004). Unlike rural areas, where the building is most exposed to external environment via its facades and roof, in urban area the most exposed part of the building to radiation and winds is the roof as shown in Fig. 1 ln many studies such as Runsheng, Etzion, and Erell (2003), Jain (2006) and Amer (2006) show that the heat gain through the roof present 50% of the total heat gain in buildings.

ln recent years, several investigations done by Verma, Bansal, and Garg (1986) were performed and showed that there can be multiple solutions to the excessive heat problem through the roof. The use of low emissivity material in the attic of a building reduced the underside ceiling surface temperature, which lowered the room air temperature, Nahar, Sharma, Purohit (2003). The evaporative cooling approach for passive cooling of buildings in hot arid climates has also become an attractive subject of investigation for many researchers. The relative advantages of evaporative cooling in relation to many other approaches (cavity wall, insulation, whitewash and large exposure orientations, vegetable pergola shading, roof with removable canvas, water film, soil humid grass and roof with white pots as cover) were demonstrated in R. Lambert (1988). The reduction of heat gain through the roofs using evaporative cooling systems was extensively investigated with open roof ponds by Nayak, Srivastava, Singh, Sodha (1982), Sodha, Singh, Tiwari (1980), on water spraying over the roof, moving water layer over the roof, thin water film and roofs with wetted gunny bags Sodha, Srivastava, Kumar, Tiwari (1980) . Chandra and Chandra (1983) have developed a periodic heat transfer model to study the effects of evaporative cooling using water spray and variable ventilation on the temperature control of a non-air-conditioned building.

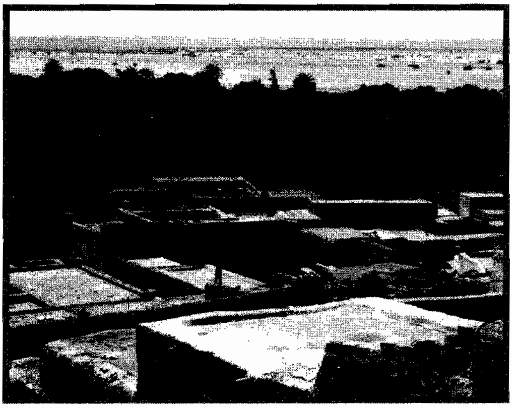

Figure. 1. Roofs exposed to solar radiations

The present study suggests an improved roof design by combining the advantages of the previously described cooling techniques (water ponds, low emissivity surfaces) and inserted rocks of high thermal capacity. The resulting design can be more advantageous and effective than other systems for reducing heat during daytime and storing coolness at night. High thermal capacity materials (rock bed) will delay the entry of daytime heat into the building by such a period that it reaches the interior during the evening, when it is least bothersome and often welcome. The roof is composed of steel plate ceiling and a flat aluminium plate separated by an air space partially filled with high thermal capacity rocks placed in a small quantity of water. The system is properly closed to prevent water vapour escaping outside. A schematic diagram of the model design is shown in Fig. 2.

The choice of the roof for our investigation comes from the fact that 50% heat load passes through it. The reduction of heat transmission via the roof was investigated for a typical summer day of June for Laghouat in Algeria (Latitude 33.43°N, Longitude 2.56 E). Theoretical results presented Ben Cheikh H. Bouchair A (2003) shows that the most significant factors affecting the cooling power of the passive cooling roof were the rocks, water volume, aluminium roof thickness and roof air space width. The rocks water volume was 6.5 litres. The weight of the rocks was 65kg. The width of the air gap was variable from 17cm to 27cm.

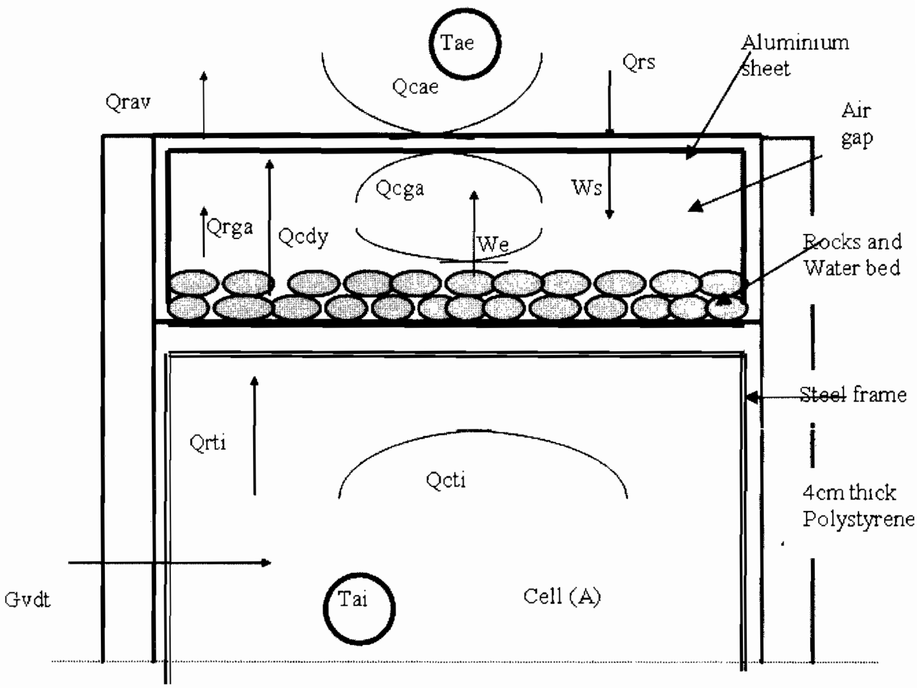

Figure. 2 A schematic diagram of the model design.

Abbreviations

Tae = Outside air temperature (°C), Tai = Inside air temperature (°C)
Qrav = Heat change by radiations between the roof and the sky (w)
Qcae = Heat change by convections between the roof and the outside air temperature Tae (w)
Qrs = Heat gain from solar radiations (w)
Ws = Heat change by condensation (w)
We = Heat change by evaporation(w)
Qrga = Heat change by radiations between the roof and rocks water upper surface (w)
Qcdy = Heat change by conduction between rocks(w)
Qcga = Heat change by convection between the air and rocks water upper surface (w)
Qrti = Heat change by radiations between the inside wall surfaces and the roof inside surface (w)
Qcti = Heat change by convection between the inside air and the roof inside surface (w)
Gvdt = Heat change between Tai and Tae, through exterior walls and by natural ventilation(w)

2 Experimental Measurements

Field measurements were conducted at Laghouat University. The experimental set-up consisted of two identical test cells (A) and (B) fabricated of steel structure, each having dimensions (0.70 X0.7 X 0.90 m). Figure 3 shows the configuration of tested cells. The experimental cell (A), is made of metal frame of (0.70 X0.7 X 0.90 m) interior edge, all sides were strongly insulated by 4 cm thick polystyrene except the roof. The cell was elevated by 50 cm above the ground using four metal supports as shown in Fig. 3. In the North wall a steel door of 30cm x 60 cm dimensions upon which a 4 cm thick extruded polystyrene foam panel was fixed. In the south wall a window of 35 cm x 37 cm dimensions, plastic netting, of fine meshes was fixed on the window exterior face, to limits the transmission of the solar radiation Fig. 3. The door and the window are used two allow night natural ventilation. The experimental cell (B) was the basic reference unit. The roof was constructed of simple aluminium sheet painted white (Fig. 4).

Figure. 3. The experimental cell

Figure. 4. The evapo-refletive roof

3 Temperature Measurements

Air temperatures outside the room were measured using a me theological station installed near the laboratory, far from the test cell by 150m. The temperature at different positions under the roof level has been measured by copper constant thermocouples connected to digital thermometer. Thermocouples fixed under the roof surface the end of the thermocouples were enveloped in thin aluminium paper to reflect the radiation from the surrounding interior surfaces. The readings of all thermocouples have been averaged to give the average temperature.

4 Results and Discussion

Hourly variations of the inside air temperature for typical summer day by using evaporative reflective roof measured and presented in Fig. 5. for different values of air gap width (17,22 and 27 cm). The ambient air temperature is also given in these figures to observe the effective cooling. Roof without any treatment gives the maximum inside air temperature (48°C) when the ambient air temperature was 38.5°C during day hours. However during night hours the inside air temperature fall down to the ambient air temperature. Roof with evaporative reflective roof, when the air gap width fixed at 17cm gives higher inside air temperature (42,5° C) than 22 cm air gap by two degree (40,5° C), 27 cm air gap in the roof gives the same inside air temperature as the 22 cm air gap, that means the optimum air gap is 22 cm. Fig.6. shows a comparison of room air temperatures with cooling roof system and with bare roof without room night natural ventilation. It can be seen from this figure that the evaporative reflective roof can reduce the internal room air temperatures during the day up to 10 °C in comparison to the air temperatures for a bare roof over the room. Fig.7. is the comparison of room air temperatures with cooling roof system and with bare roof when room night natural ventilation is allowed. The ventilation was allowed from 8 pm till 9 am, a period when the outside air temperature is relatively low. This can significantly improve cooling of room air temperatures, as shown in feg 5

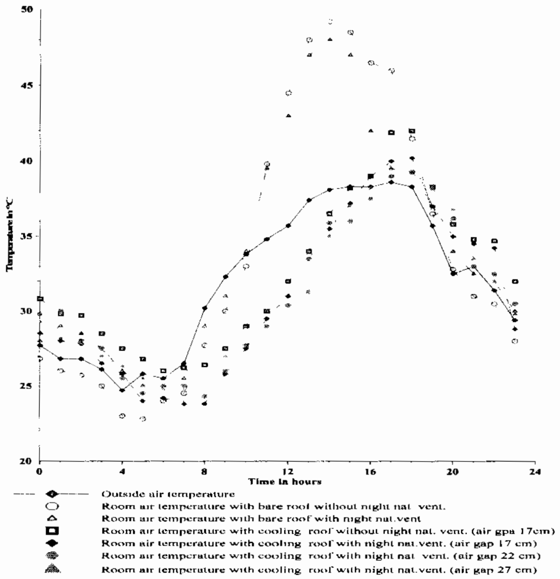

Figure . 5. Comparison of measured room air temperature when roof system is functioning and when the roof is bare (for ventilated and non ventilated cases for variable air gap dimensions

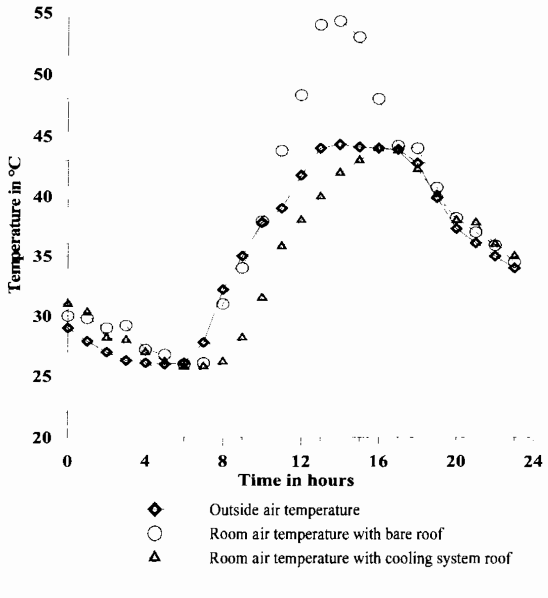

Figure. 6. Comparison of room air temperature when roof system is functioning and with bare roof (without ventilate).

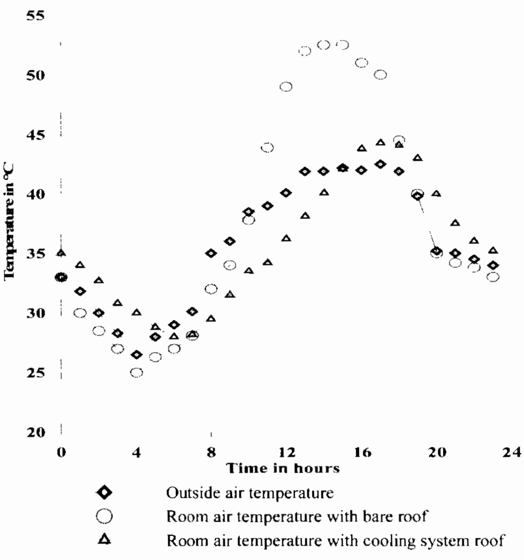

Figure. 7. Comparison of room air temperature when roof system is functioning and with bare roof (with ventilate).

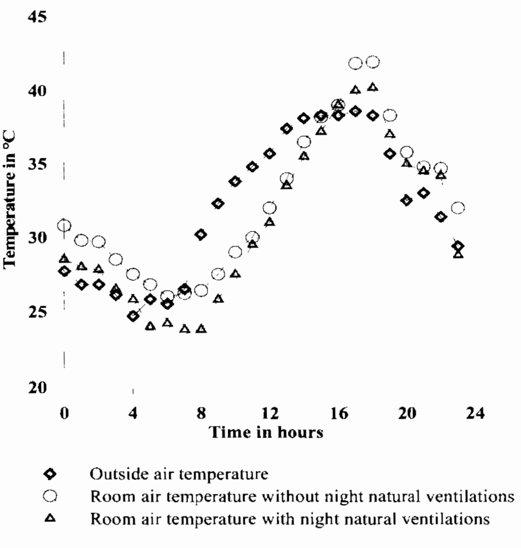

Fig . 8. Comparison of room air temperature when roof system is functioning for ventilated and non ventilated cases.

5 Conclusion

Under hot arid conditions a prototype model for an evaporative reflective roof used to improve space cooling in buildings has been tested. The experimental results examined the effectiveness of such a roof cooling system in comparison to a bare roof. The results showed that cooling inside buildings can be improved by the application of such a cooling design. It was also seen that combining evaporative reflective roof with night ventilation increases such cooling more significantly. From the previous graphs the cooling system had a great effect on the time lag and decrement factor, it increases the time lag so the maximum outside temperature accurse at 15pm, where the inside maximum at 18 30pm at these time the outside temperature was acceptable, which improve the inside comfort in buildings during day times and reduces the cooling load which the energy consumption.

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Design and Validation

Premises and Concept for the Design of an Affordable Low Energy Architecture

Ulrike Heine
Clemson University, Clemson, USA

Abstract

In the upstate of North Carolina, South Carolina and Georgia there is an intriguing climatic condition that results from the region's position between two complementarily opposing climate zones. Specifically, the conditions of these two zones offer the combined challenges of warm, humid, cool and temperate climates, placing conflicting demands on the design of energy-efficient buildings. Warm, humid summers require high volumes of air movement and air exchange to achieve comfortable conditions. However, cool, wet winters require strict ventilation control to prevent heat loss and regulate relative humidity levels. By examining the specific nature of these zones it becomes apparent that some sustainable design strategies are more appropriate than others for use in this region. Effective energy-efficient design begins with an accurate understanding of local climate conditions combined with the knowledge of which design principles, techniques and materials are appropriate for those conditions. The close relationship between comfort, climate and control when using passive design strategies demands a close examination of all three players and how they interact in a given design. This paper examines and evaluates these relationships in the unique Southern U.S. context in order to determine and prove which passive techniques are most appropriate for the successful implementation of sustainable design in the region and how to combine them most efficiently with affordable active strategies. The goal of the current research is to lay academically proven foundations for the later physical realization of the Zero Energy House as a showcase for Clemson University, for the Southern States and for American Architecture.

Keywords: *Passive Design Strategies, Simulations, Sustainability, Thermal Comfort, Zero Energy House*

1 Introduction

In thinking about the current condition of sustainable housing in America, it is important to differentiate between dense, metropolitan America and the more spacious rural America. In contrast to Europe, the United States has an enormous surplus of land, a condition which greatly affects American city and regional planning. This makes possible the American Dream: owning a single-family house on a site that is spatially independent of both its neighbors and urban density. These free-standing houses are typically located far from city centers, realized without considerations of sustainable concepts and, therefore require large amounts of energy – both to construct and operate.

The research currently underway focuses on the design and detailing of an affordable Zero Energy House that implements and demonstrates passive and active sustainable strategies. In addition research is also targeting appropriate specification of materials and methods for the purpose of sustainable optimization and building construction efficiency. Through a process of collaboration the assembled multidisciplinary design + research team examines all design and building models/options to determine and therefore proof the impact on the buildings energy consumption, material performance and cost effectiveness. This cooperative design process allows for informed and intelligent design decisions to be made based on academic research with "real world" applications.

2 Energy Consumption

According to the World Factbook, the US is, with 3,892,000,000,000 kWh, the leading country in energy consumption, followed by China (3,271Mio. kWh) and the European Union (2,926 Mio. kWh) (Central Intelligence Agency, 2009). US energy consumption has been broken down as follows: 29% Transportation (Vehicles which transport people/goods on ground, air or water), 21% Industrial (Facilities and equipment used for producing and processing goods), 11% Residential (Living quarters for private households) and Commercial (Service-providing facilities and equipment [businesses, government and other institutions]) and 41% Electric Power (Energy Information Administration, 2007).

According to the USGBC, in the United States alone, buildings account for: 72% of electricity consumption, 39% of energy use, 38% of all carbon dioxide (CO_2) emissions, 40% of raw materials use, 30% of waste output and 14% of potable water consumption.

Looking at residential construction specifically, energy use can be broken down as follows: 37% for space heating, 15% for water heating, 14% for lighting, 13% for air conditioning, 6% for refrigeration, 6% for electronics and 6% for wet cleaning.

3 Energy Costs

According to the US Government Energy Information Administration, residential energy costs are expected to increase in the next 25 years as follows: fuel oil 72%, petroleum 74.4%, electricity 15% and natural gas 14.4%. (Energy Information Administration, 2009)

In comparison, the BMWi monitored the development of energy prices in Germany throughout the years 1998 and 2007: space and water heating +38%, process heat +56%, lighting 42% and fuels +38%. (BMWi, 2008).

The increasing worldwide demand for fossil fuels without any growth in the supply of these resources has already begun to have serious economic consequences. As resources become scarce, fuel prices will become prohibitively high over the next generation, making our current way of life unaffordable for the average person. In light of these concerns, there is a growing need to improve building efficiency and minimize the energy demand of heating/cooling, lighting and water heating systems.

Investigation into alternative energies is indispensable if we are to reduce our dependency on fossil fuels and avoid an inevitable societal disaster. With oil at $132+ a barrel, tougher building codes and concern about the nation's dependency on foreign oil, there is a renewed interest in energy efficiency that has not been seen in almost a quarter century (William F. Becker Jr., 2008); a movement towards energy-efficient buildings is clearly gaining momentum. History has shown that the more energy costs increase, the more the industry feels the need to develop innovative and alternative concepts and, in turn, the more the consumer is willing to change their personal attitudes. In addition to the need for individuals to change their underlying view of energy as an endless resource, architects should feel a responsibility when designing their buildings to reduce daily energy consumption.

4 Sustainable Development

Due to various political and economic factors, Europe has outpaced the US in the development of sustainable architecture - therefore, it seems prudent to take a closer look at their sustainable concepts. Most of these strategies are community-based solutions focusing on a higher urban or suburban density, in order to lower the development costs and (in the densest case of town houses) even the heat losses, in addition to sharing block heating power plants and solar devices. All of them implement passive building strategies: paying attention to orientation, shading and water collection. Due to the density of these communities, people live mostly independent from their vehicles; there is a special focus on walkways and bike paths.

By simply copying the European concepts, it seems plausible and relatively easy to apply proven principles of sustainability to urban regions. However, most of the US inhabitants do not live in urban density, according to the European standard (City Mayors, 2007). America fills all top 12 leading positions in the land area of the city, but America's densest city is Los Angeles has only 2,750 inhabitants per sqkm (rank 90), followed by San Francisco (rank 104) and New York (rank 114). Due to the abundance of space on the continent, the US follows a totally different spatial concept: in numbers: there are 128,203,000 households in the US, 80,406,000 (62.7%) of them are detached (US Census Bureau, 2008). An average household consists of 2.62 inhabitants with a size of 2,349 sqft and 5.6 rooms per house.

There is a need for sustainable design that serves the average single-family house which fits into the urban, suburban and rural context.

5 Building Costs

With the recent political changes, the topic of sustainability has gained popularity. Homeowners and construction clients are becoming interested in low and zero energy building design. The first low energy houses have been built. However, all of the realized examples seem to be high cost buildings with major technological installations to accommodate the comfort level of the client.

There is an obvious lack of simple and affordable houses that follow the rules of sustainability in the sense of climate sensitive design; a product that is marketable and ready to compete in both function and price with the current level home construction.

6 Project Description

The larger scope of this project is to design, detail, simulate and evaluate a Zero Energy House, which can be adapted to the climatic conditions of Southern American States using passive energy strategies and natural materials. The House will meet the highest standards of contemporary design. The planned building should be a prototype of sustainable architecture - a show-house for students, faculty, researchers and clients - making sustainable, ecological, energy efficient and climate sensitive architecture experiential, touchable and measurable. The goal of the research is to lay the design foundations for the later physical realization of the Zero Energy House as a showcase for the University, for The Southern American Sates and for American Architecture. The outcomes of the research include a novel digital simulation (i.e. movie) demonstrating the process of realizing the House (from factory to building site to use) and a numerical evaluation of this digital simulation for energy consumption, thermal behavior and other performance parameters.

7 Specific Aims

This research involves designing and detailing an affordable low energy house (Zero Energy House) adjusted to the climatic conditions of upstate South

Carolina and implements passive and active sustainable strategies and natural materials, with the ultimate goal of constructing a physical prototype and evaluating it. We are currently conducting a theoretical digression on a meta level to a small, realizable unit, adjusted to the specific situation of South Carolina. We are not only developing the standard design documentation for the project, but generating a novel, digital simulation (i.e. a movie) of the process of its realization, from factory to building site to use by inhabitations. This simulation serves as a model for tracking and evaluating energy consumption and other parameters of the construction and use of the building.

The key requirements of the house are achieving a comfortable indoor climate with a low level of occupant/systems interface (i.e. low energy and low maintenance costs) and the use of natural, regional, recyclable materials. Maxims like compactness, orientation, passive ventilation, passive cooling, passive lighting and passive solar energy gain will be applied in conjunction with more technical innovations such as active storage masses, an autonomous water circulation system, the pre-conditioning of water and solar installations for domestic energy gain. Every installation is supposed to be testable and provable. All other known competitors have not yet worked with an approach of reducing in principle the energy consumption by taking advantage of passive design strategies in combination with low technology energy gain (Robert Gonzalo, Karl Habermann, 2006).

8 Educational Approach

The research is being conducted as a Creative Inquiry course, which will span four semesters. Two graduate students and six undergraduates from the schools of Architecture, Civil Engineering and Materials Science are currently working together to gather key information on sustainable practices, discuss technical considerations and conduct building performance simulations. This collaboration across disciplines not only brings a breadth of knowledge to the discussion at hand but is also an invaluable experience for the students as they prepare for their professional careers.

At the beginning of the project, four teams of two students were each assigned a specific geometric volume (square, rectangle, L-shape, etc.) equal in total square footage and height. Using Design Builder simulation software, the teams began energy use studies on each form, noting the effects of altering building orientation, roof form, window and door openings and shading devices. After identifying the most efficient configuration for each form, this knowledge was then be used as framework for further development of the specific building designs. Every single step of the design, either in floor plan development or façade design was simulated and evaluated and therefore proven due to its impact on the building's performance. In the following steps the simulations will be expanded to compare the performance of different building materials and also to implement various active and passive strategies for controlling indoor comfort. By the end of this two-year investigation, the Zero Energy House project will produce several detailed and realizable strategies for affordable, sustainable residential design.

9 Passive Strategies

At the current stage of the research all low cost passive strategies are in the process of analysis due to their impact on the low energy performance of the Zero Energy House. The strategies described below became part of the design process and were simulated in a second step on one single building form, which was chosen to be the showcase for our specific project.

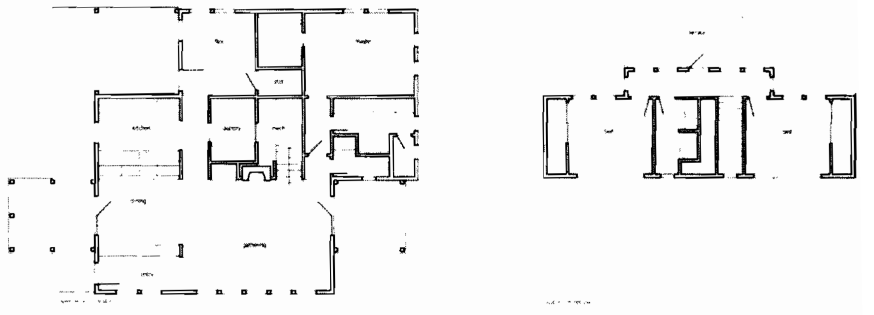

Figure 1: Floor Plans, bottom (left) and top (right) illustrating the functional center core and the clear north/ south orientation and the adjacent porches of the building.

9.1 Compactness (building form and building proportions)

The compactness of a building indicates the surface per volume unit that is related with heat exchange between the building and the ambient environment and therefore according to the thermo – physical characteristics of its materials defines the ability to store and release heat. The ratio of volume and surface is an indication of the rate at which a building heats up during the day and cools down during the night. In any project the urban design is defined by the parameters distance between buildings (density), orientation, access, parking and open spaces, which all have an influence for the later energy use. The building form and its compactness are relevant for the amount of heat transmission losses, which are proportional to the insulating quality and to the heat transmitting surface. The most compact shape for a freestanding house is a cube. Any design of an individual house should be considered with regard on compactness, natural lighting and solar heat gain. The compactness of a building is measured by a ratio of surface area (S) to volume (V) (compactness = S/V)

CZEH [Clemson Zero Energy House]: Following the output of our research of the existing housing market, we decided to design a single-family house with

3 bedrooms and 2.5 bathrooms. Our goals were a square footage of ±2,000 sqft [average household in the US: 2,438 sqft in 2008] and a price no higher than 150,000 USD [average costs: 200,500 USD in the US, 174,000 in the South]. Relating to the program of an average household on the American market today, the house is 25% smaller than and approximately 25 -50,000 USD cheaper than an average household.

Our building was designed around a compact two-story service core including access, all wet spaces (such as kitchen, bath rooms and laundry) and the mechanical space. The adjacent living and bedrooms were situated in the north and to the South, offering optimal solar orientation and also possible expansion.

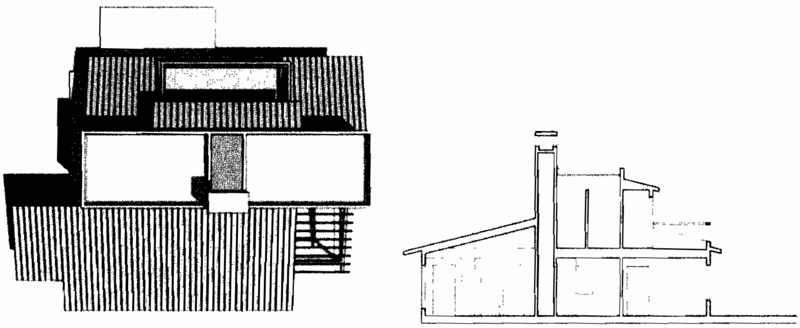

Figure 2: Roof top plan (left) and section (right) showing the two-story service core, acting as a solar chimney and the overhangs in the South.

9.2 Orientation

The orientation of a building must be considered in interaction with the sun and prevailing winds. Unfortunately in most situations they do not coincide and therefore compromises must be made. The solar orientation determines the intensity of solar radiation; therefore the following rules need to be considered: The greatest intensity of solar radiation occurs in horizontal surfaces. The greatest intensity of solar radiation on vertical surfaces is on the eastern (morning) and western (afternoon) façade. The southeastern surface gets less radiation during the hot season (high temperature) and more during cold seasons (low temperatures). The radiation increases in northerly latitudes[9]. While defining an equilibrium between the welcome solar gain in winter and defense against the undesired solar gain in summer, any kind of shading devices, operable and permanently installed need to be implemented into the design process. The wind orientation should be considered for maximizing the natural ventilation. The greatest pressure on the windward side of a building is gained when it is perpendicular to the direction of the wind, but even openings at a 45 degree angle to the prevailing wind direction increases the air velocity and improves the natural ventilation within the building (Holger Koch–Nielsen, 2007). Each building has to be studied holistically, taking into account all aspects of bioclimatic design.

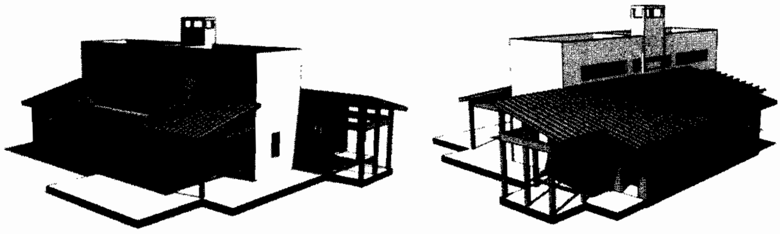

Figure 3: North Facade (left) and South Facade (right) showing the two-story service core and the extensive openings in the South, shaded in summer by the overhangs

CZEH: The orientation of our building follows the idea that the most used spaces during the day (like living, dining and children's bedrooms) take advantage of the southern sun, equipped with a precisely calculated roof overhang to block off the summer sun and provide the desired solar radiation input during the winter. The east and west façade openings are minimized and the north façade provides openings to optimize cross ventilation in all bedrooms.

9.3 Passive Ventilation

Ventilation should provide fresh air from the building's exterior and speed airflow to facilitate for example evaporative cooling of the air, the occupants and the structures. Normally the openings for the air movement correspond very poorly with the ones for natural lighting; therefore they should be treated separately. We differentiate two kinds of natural ventilation

Through wind-generated pressure differences (i.e. different sizes of openings)

Through temperature-generated pressure differences (natural lifting forces)

If the specific climate of the project provides a sufficient difference of temperature between day and night, night cooling should be considered as an efficient way of passive cooling. In this case the building mass should be closed during the day to avoid an overheating of the spaces and be opened during night.

CZEH: Our building is designed to provide cross ventilation in all living and bedroom spaces, the specific climate offers a great opportunity for night cooling during spring and fall. Therefore all windows were modified to two opening elements to provide a safe cooling during the nights.

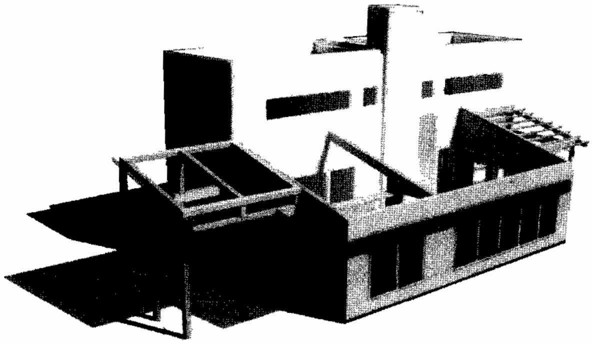

Figure 4: Model showing the divided windows in the south façade for safe night cooling

9.4 Passive Solar Design

The passive solar design refers to the use of the sun's energy for the heating and cooling of inhabited spaces. In this approach, the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun. Passive systems are simple, have few moving parts and require minimal maintenance and require no mechanical systems.

Operable windows, thermal mass and thermal chimneys are common elements found in passive design. Operable windows are simply windows that can be opened. They should be oriented properly and their sizing should be optimized. Thermal mass refers to materials such as masonry and water that can store heat energy for extended time. Thermal mass will prevent rapid temperature fluctuations. Thermal chimneys create or reinforce the effect hot air rising to induce air movement for cooling purposes.

CZEH: The centered mechanical space of our building and its two-story design provides the option of implementing a solar chimney. Simulations for validation are underway.

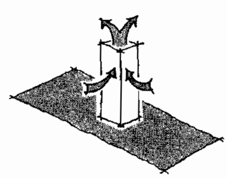

Figure 5: A centred solar chimney can easily be implemented into the design of the service core.

9.5 Passive Cooling

The topic cooling is linked to the concepts of ventilation. If the temperature inside is higher than outside, the heat can be removed by natural or mechanical ventilation. Cross ventilation forced by openings on two sides of the space optimizes natural heat extraction. Convective ventilation, mostly realized in high ceiling situations, takes advantage of the natural lifting forces and replaces the warm rising air with fresh air. The higher the spaces, the higher the air change rate. Heavy, massive elements can provide thermal capacity for the absorption of internal heating loads and the temperature fluctuation in a space. The so-called approach of 'Building Component Activation' takes advantage of this and warms or cools solid building components as walls or ceilings through active (water) or passive (ventilation) measures.

CZEH: The central service core provides the optimal position within the building to be realized in a different building material and also for the activation of the masses. The upcoming semester will focus on the specific materials of the building and their validation.

9.6 Natural Lighting

The concept of planning the lighting is to achieve the maximum daylight autonomy by optimization of the building. The openings need to be designed to provide an optimal amount of light in the house without and also be adjustable (shading devices). Sometimes natural light is impossible or even undesirable, in these cases an adequate source of artificial light needs to be provided, that fits to the usage and uses as little energy as possible. There are numerous computer programs to simulate the light situation in a building. Topics like color distortion, freedom of glare and good contrast should be considered (Hegger, Fuchs, Sark, Zeumer, 2008).

CZEH: All living and bedroom spaces, including all bathrooms and the kitchen are provided with natural light. The design was influenced by the idea, that there should be no need to switch on any light during the day. The mechanical space and the laundry as low occupancy spaces are excluded from this idea.

10 Active Strategies

In addition to the passive strategies, which influence the energy performance through smart design, the actual energy gain needs to be driven by active strategies. We are in the early stages of analysis, evaluating the combination of different strategies and their impact on each other and size them correctly by simulation. Initial costs and the return of investment are a very important parameter in the evaluation process.

10.1 Solar Power and Photovoltaic

Solar Plants use solar collectors to harness solar energy for use in heating water and interior spaces. This system stores the resource in thermal buffers over a long period of time. The installation would need at least 9sqft of a collector area and about 25 gallons of gross storage area.

Photovoltaic systems generate power by converting solar radiation into electricity. Houses can be tied to an existing grid or operated as a stand-alone system. In the first case you would take advantage of the public grid for storage, in the second case you would need a technical unit with a battery.

10.2 Geothermal

The geothermal system takes advantage of the temperature of the earth, which varies from the crust to its core by 2.5-3 degree Celsius for every 30 ft closer to the core. The first 3 ft of earth varies in temperature as the air temperature changes. This first layer also insulates the ground below it and therefore retains a constant temperature below it throughout the year.

Ground heat systems take advantage of this different and constant temperature and passes water or air through a transfer system in contact with the ground. In summer it cools the media, in winter it pre-conditions the media. (The simplest system would be a 30-120 ft ductwork, buried in the ground at a depth of 3-12 ft to precondition air for a building.)

CZEH: So far after the first calculations, the estimated building costs of an 'active ready' low energy house, not including any active strategies, is at 142,500 USD. We are now at a point where the building needs to be situated at a specific site to take the maximum advantage of any active strategies.

11 Conclusion

The awareness of our generation about the mistakes that were made in the past and in the present, especially in terms of our energy consumption, should lead us to a new and different way of design. Good architecture is no longer just spatially beautiful and aesthetic – it is also energy efficient and smart.

Energy is a physical entity and can thus be precisely measured. This means that energy efficient buildings have also become quantifiable, a dreadful notion for many architects. It is not intelligent for architects to go on the defensive when confronted with sustainable building. Instead, they should continue working towards good architecture while including ideas of sustainability in their working methods.

Sustainable building does not have to become a new architectural language as far as style is concerned. It can be applied to any style. It is energy efficient, has intelligent facades, uses materials optimally and has balanced, adequate building services. Constructive elements generate sustainable design processes; new materials generate new aesthetics. The secret to achieving a well-balanced, well-designed and energy-efficient building is hidden in the equilibrium between saving and gaining, always in terms of local conditions.

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Vernacular Architecture and Sustainability

Communities in different parts of the world have developed vernacular architectural and urban solutions to meet their cultural needs. Vernacular solutions are usually the product of historical evolution, with practices modified and transformed to meet changing needs and be better adapted to the geographical characteristics of place. Vernacular solutions have evolved to epitomize the ultimate in the embodiment of sustainability. Building materials are usually locally sourced and used mostly in their natural state. The materials are usually recyclable thereby minimizing footprint in the use of global resources. Vernacular forms have also evolved in ways that utilize passive means to adapt to geographical circumstances; buildings and urban forms adapt to natural topographical forms, while passive systems of heating and cooling ensures that the system of energy use is renewable and sustainable. The rise in the importance of sustainability in public discourse has led to a growing interest in vernacular practices because of their embedded lessons and the potential for exploiting these lessons to sustainably address contemporary development challenges. The papers in this chapter explore the various ways that vernacular practices can inform current development actions to make them more sustainable. The papers explore this in two distinct ways; first through examining cases studies to identify sustainability lessons, and secondly through extracting sustainable principles as guide for contemporary development interventions

The first three papers in the chapter presented case studies. Eliana explores vernacular housing traditions in the Draa valley of Morroco, where locally available earth is used to create sustainable houses. The second and third paper by Rumana explores sustainable practices in Bangladeshi traditional housing practices. The first paper explores the use of passive means of climate control through the use of local materials and cross ventilation, while the second paper examines the use of Bamboo as a sustainable housing material. The remaining three papers focus on extracting principles to guide future interventions. Muhannad et al advocates the use of the courtyard concept as a sustainable strategy for future housing in Palestine in view of its sustainable qualities and advantages. Phuong et al examines the potential for applying environmental characteristics of vernacular architecture to contemporary Vietnamese housing, and presents a set of guidelines and strategies to facilitate this. The paper of Taha and Gamil proposes the decoding of the DNA of places as a means to understanding place identity and sustainable practices, and to facilitate the reproduction of sustainable traditional environments. The papers in the chapter in totality highlight the established fact that vernacular architecture and urban practices embed sustainable lessons that need to be studied and understood so that they can sustainably inform contemporary development actions.

Shaibu B. Garba
Sultan Qaboos University, Sultanate of Oman

Sustainable Vernacular Architecture: The Case of the Drâa Valley Ksur (Morocco)

Eliana Baglioni
Architect, Italy.

Abstract

The Drâa Valley is located in the south east of Morocco, near the Sahara desert and houses one of the greatest earthen architecture heritage in the World, consisting of ksur and kasbah. The built heritage of the Drâa Valley is an excellent example of how the local population and culture have succeed to respond in a sustainable way at the environmental challenge, starting from the environment characteristics and the construction materials availability.

The materials used are available on site and are totally natural, so they are environmentally friendly, renewable, reusable and have very low production and processing costs.

The ksur of the Drâa Valley are just one of countless examples of sustainable architecture in the traditional architectural heritage worldwide, but we have wanted to take as an example to reflect on vernacular architecture, considered in their complexity as a type of settlements, housing and construction techniques.

In the sustainability building and housing response points of view, it seems interesting and necessary to reassess the traditional architectures, improve theme, where necessary, and adapting to the current life and cultural context. The same consideration should be done on earth, too often considered a poor and unworthy material, which instead offers many advantages as a building material. The different soil have a great adaptability for construction use, are easily available and have high thermal and acoustic performance, the earth mixture are easy to prepare, building techniques and the implementation doesn't require specific technologies, so as to enable the self-construction.

Keywords: *traditional building techniques, row earth, sustainability*

1 .Reflections on The Current Situation

The human being, as dominant species of the planet, has over the centuries "forgot" to belong and depend on a complex environmental ecosystems that, in fact, allow him to live, going to affect the natural equilibrium in a always less reversible way.

The last centuries of human history have been characterized by uncontrolled industrial expansion that has defended and developed technologies that require a high energy and water consuming, with an almost total dependence on fossil fuels that continue to be treated as inexhaustible sources knowing that it isn't. Human carelessness and the absence of self-control in the resource management have compromised and transformed the natural ecosystems: issues such as climate change, ozone hole, biodiversity loss, environmental pollution, desertification, deforestation, increasing of natural disasters, genetic alterations, water and air pollution, are some of the direct consequences of our development.

Figure 1: Reinforced concrete building in a Marrakech expansion area, Morocco. (Credit by Baglioni E., 2009)

over 70% of the global energy used, is for the construction trade, including production of materials, transport, construction and operation of buildings. The construction, therefore, creates a big impact on the environment consuming a large amounts of non renewable natural resources, and also produces, either directly or indirectly, a large amount of residues and pollution. Actually, most of the building construction is related to the industrial sector that is strongly integrated in the society, eroding consolidated life styles based on the idea of building the house according to own taste and own traditional languages, and to live in relation with the open space. The reinforced concrete building has gradually established itself as a universal model, even where the climatic and environmental conditions make it totally unsuitable, and it has destroyed the agricultural lifestyle and a mental and psychological balance.

The technology and the development should be flexible means, capable of producing different living conditions, related to certain places and societies, and to the requests of a certain time, but on the contrary, the imposition of universal models and lifestyles has reduced ductility and elasticity of the technological means. Consequently, have spread prejudices related to "rural" and natural materials, which have given rise their use as "poor", convinced by the idea that industrialization represents progress and is recoverable in any part of the World, forgetting the differences of climate, culture and local traditions. Industrial civilization has had a strong influence on the mind attitude, managing to persuade the traditional world of being in need, in the backwardness and in the inferiority (Dalla Casa, 2009).

2 Traditional Techniques And Traditional Construction Types Sustainability

At the points of view of the building sustainability and the housing response, the re-discovery and revaluation of traditional building techniques are interesting and necessary, because these techniques are sustainable by their nature.

The birth of traditional building techniques was mainly caused by climatic and natural factors or else by environmental characteristics and availability of building materials. The construction technique is the means through which a particular culture is able to implement its response to environmental challenge, not by chance wood and earth are the two natural building materials most used in the elementary building process, because the most widespread and available throughout all Earth's surface.

The housing form is rather influenced by human and cultural factors: the social structures, the lifestyle or the relationship between the house and the principal economic activity, may to affect the shape. The traditional houses types, in their complexity, are one of the highest expressions of human know how, because that come from by a slow experimentation process, born spontaneously and perfected, step by step, in the slow course of time with the experience and the observation, going to eliminate or refine each inappropriate or unsatisfactory solution. The traditional houses types are the specific response to the housing demand dependent on the various local factors (Cataldi, 1988, pp. 23-51). Traditionally, the materials used for the construction are those available on site, today called a "zero distance", that comport, therefore, lower transportation, production and processing costs, in most cases it is moreover natural materials, then green, renewable and reusable. In summary, the traditional houses type, is the result of the symbiosis between a determined culture and a specific geographical training area, which generates, however, a number of possible variants; often traditional types are those that best fit into the context landscape.

2.1 2.1 The Drâa Valley ksur (Morocco)

In support of the above, I propose the example of the sustainability of the Drâa Valley ksur, which I had the opportunity to meet directly.

The Drâa Valley is located in south east of Morocco near the Sahara Desert, and host one of the greatest raw earth architectural heritage of the World. The Valley, which is the middle course of the river Drâa, separates the Eastern Anti Atlas by the Western Anti Atlas and consists of a 6 oasis system, characterized by palm forest.

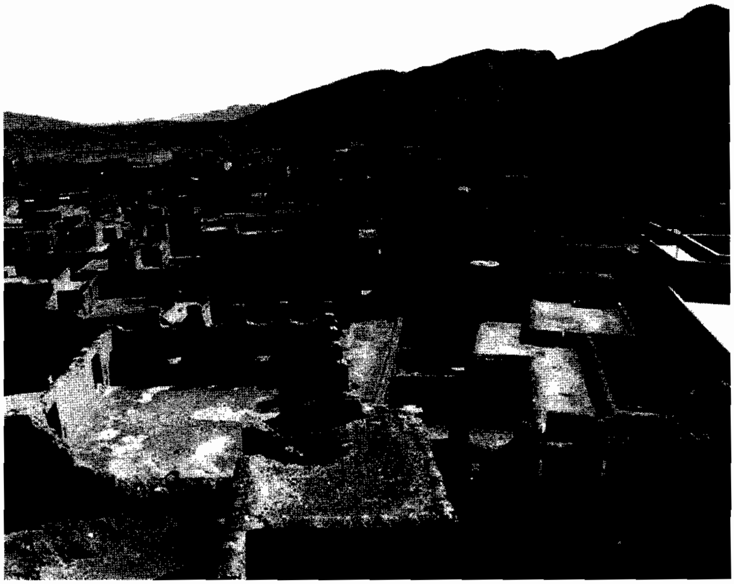

Figure 2: Ait Hammou Ou Said ksar, in the Drâa Valley, Morocco. (Credit by CERKAS, 2005)

The Atlas Mountains divide Morocco not only geographically but also in lifestyles and in architecture occur, along the Drâa Valley, in fact, among the palms, there are over 300 ksur, berber villages constructed entirely with raw earth. These village, rural and fortified, are characteristic of the Drâa and Dades Valleys and date from the fifteenth century, period when the sedentary Berber population was the need to close the villages with high walls and defensive towers, caused by the continuous attacks of the nomadic Berber tribes. The ksur (sing. ksar) have a very dense urban fabric, with houses built each against other in order to defend each other from the warmth, in addition, often the first floor is constructed on bridge on the road, thus creating, below, a fresh and dark tunnels grid, that protect from heat and sand storms (Baglioni, 2009, pp. 22-34). It is interesting to see how this type of aggregation simulate the underground architectures, enjoying the advantage of thermal insulation and, at the same time, solving the big problem of ventilation (Bourgeois, 1988, p. 48).

In addition to ksur, the Valley is spread with kasbah, big fortified houses belonging to berber families who protected the villages and adjacent territories, or, later, belonging to the representatives of Pasha Glaoui, who exercised administrative control until the Morocco independence.

Figure 3: Kasbah Dâr El Hiba into the Tissergat ksar, Drâa Valley, Morocco. (Credit by Baglioni E., 2009)

Both in the kasbah and into the ksur, the housing type used is constant and recognizable, is a patio house. This type, with its specific and different models, has spread not only throughout Morocco, but throughout the Arab World and the Mediterranean. The patio is typical of the Arab-Muslim housing and is identified with the centre and the heart of home and family life; it's a place to live, active, but at the same time intimate and collected. In the Drâa Valley building, the patio isn't just a vertical hole in the building, but it's defined by a perimeter gallery present at all floors, which creates a trading plan between the central vacuum and the private rooms; the patio size and shape are determined partly by local building techniques and climate and partly by the local traditional culture.

The importance of this space in the housing composition is also expressed in the architectural details and decorations, that are very rich compared to other walls where there aren't specific details (Baglioni, 2009, pp. 38-43 & 51-55).

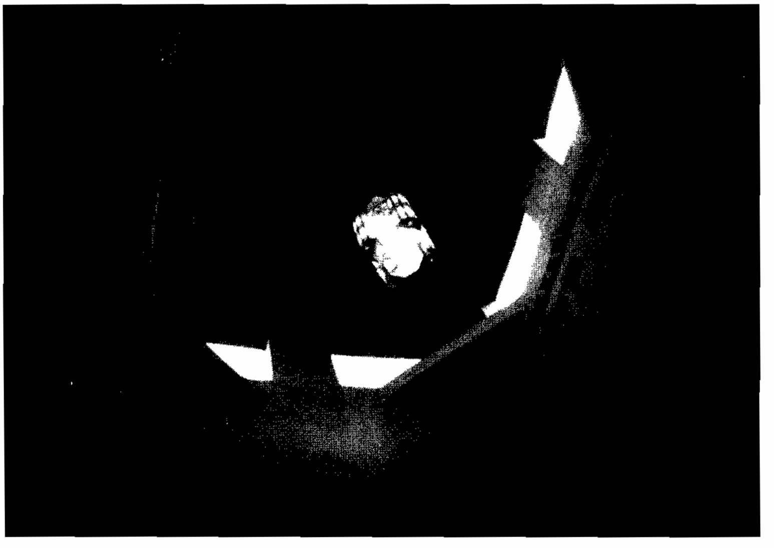

Figure 4: Internal view of a patio in Tissergat ksar. (Credit by Baglioni E., 2006)

The typical plant of the house, called dâr, presents three wall square inscribed one inside the other. The largest is the perimeter of the house, the smallest coincides with the central patio characterized by arches that rest on 2, 3 or 4 pillars on each side. The intermediate square corresponds to the wall separating the rooms from the distribution area around the patio; the scale is in a corner of the room area. The dâr are generally constructed on 3 floors. The ground floor normally hasn't housing function except the central patio which, if covered, is used as a summer living room, being fresh because it isn't invested by direct radiation, and as a warehouse or storage room in the winter. The rest of the rooms housing traditionally stables, agricultural equipment and non-perishable domestic reserves. The first plan, called assfalou, it's more private and reserved for women, shows the kitchen, the bedrooms and the storeroom for the food reserves, this part of the house is forbidden to the strangers of the family. The second floor back to being enjoyed by the guests and has direct access from the stairs, without crossing the assfalou. This plan has a covered part, where there is a living room called mesria, and a big terrace that is used to sleep on summer nights and to perform other household activities. The terrace is always surrounded by high walls, to maintain privacy from neighbors. The house looks modest, but hospitable and adapts to the need of a peasant society, once nomad, subjected to a hostile climate (warm and dry) in which the temperature changes, both diurnal and seasonal, are very marked. For these reasons, the spaces haven't a great specialization, the same room can be used as living room, dining room or bedroom, depending on needs and circumstances; the people practice the daily or seasonal nomadism into the house, which consist to live in different times of the day or of the year in different rooms of the house, to enjoy the best possible comfort conditions (Bounar & Chahid, 2004, pp. 46-47).

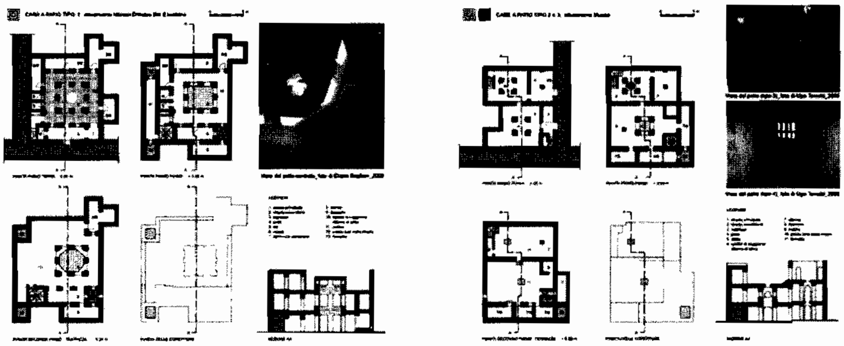

Figure 5: Examples of different dâr plans in Tissergat ksar, Drâa Valley, Morocco. (Credit by Baglioni E., 2009)

We can already see how these houses are sustainable, in the broadest sense, because responding at the housing needs and respecting the local culture closely linked to the nomadic life, link that is reflected necessarily in lifestyle and in the space occupation.

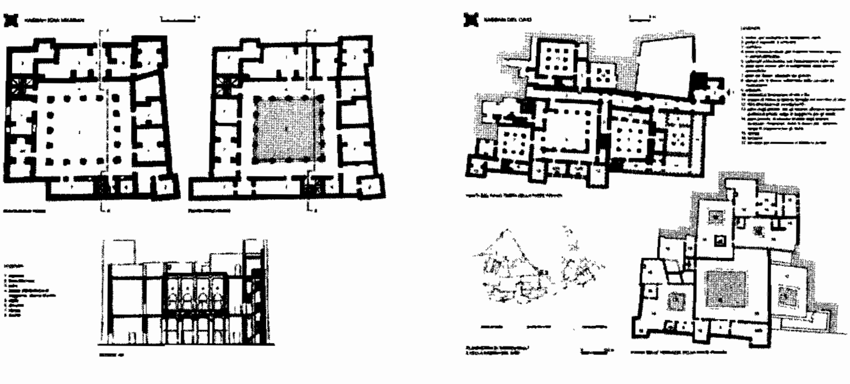

Figure 6: Examples of two different kasbah in Tamnougault ksar, Drâa Valley, Morocco. (Credit by Baglioni E., 2009)

Kasbah, in the simplest case, maintains the quadrangular type plan with central patio, but, unlike the common house (dâr) is larger, both in plan and in high (can reach 6 floors), and presents towers in the corners. Belong to large families, powerful and wealthy, often the kasbah are more articulate and occupy large areas by combining several central patio buildings. The kasbah is thus divided into different areas, private or publicly, available for the various members of the family, servants or guests, and with distinct uses (Anzalone, 2005, pp. 71-83; Biondi, 2005, pp. 157-169; Caltabiano & De Filippi, 2005, pp. 93-106; Lucci & Dania, 2005, pp. 133-144; Marrani, 2005, pp. 107-118; Sánchez, 2005, pp. 119-131).

In the Drâa Valley, characterized by a pre-desertic climate, the use of patio houses and a compact urban aggregation, represents an effective response to weather conditions, creating thus a sustainable urban system. The basic principle of buildings adaptability to the extreme temperatures is that the buildings are such that allow the highest possible ratio between the internal volume and the outer surface, condition that occurs in the ksur of southern Morocco (Abdulac, 1982, p. 2). In the ksar aggregation system, in fact, the outer surface, exposed to the sun, is limited by the adoption of buildings constructed each against other, so to have common perimeter walls on each side, except the entry side at the ground floor. At the same time, the patio is a key element for lighting, ventilation and to maintain comfortable conditions.

The patio functions as a shaft of light, limiting the direct insulation of the ground floor: all rooms of the house facing it and receive indirect light. The house is almost completely closed, only rarely found windows on the free external walls, but never on the ground floor to ensure privacy and confidentiality. The windows are quite small and shielded from wood or metal gratings, called musharabia, that filter the strong outdoor light and limit the interior visibility, however, ensuring the cross-ventilation. The patio also has a ventilation function: like a chimney pulls up the warm air contributing to the rooms cooling and creating a pleasant ventilation.

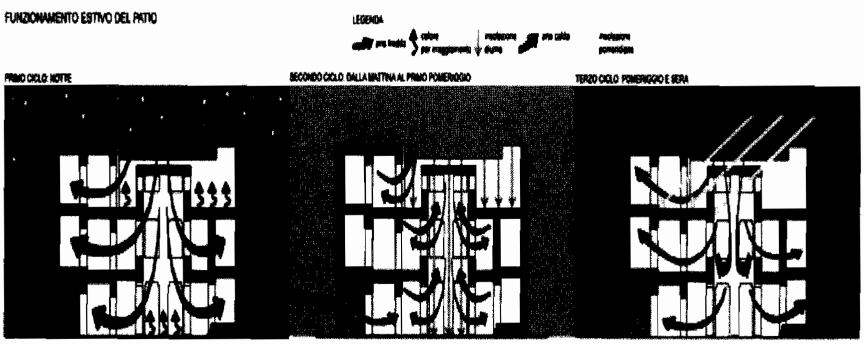

Figure 7: Patio climatic behaviour in the summer. (Credit by Baglioni E., 2009)

During the summer, the patio climatic behaviour can be summarized in 3 regular cycles that exploit the diurnal variations in temperature, higher in the pre-desert dry hot climate. In the first cycle, the cool night air descends on the patio until enter into the around room. All surfaces are cooled and are able to maintain its temperature nearly constant until the late afternoon. The patio and the roof lose, by irradiation, the heat accumulated during the day, and for this is also used for sleeping. During the second cycle, from morning to early afternoon, the patio is invested directly from sunlight, heat and gradually spreading warm air into the rooms, created so a convections motions. The patio begins to work as a chimney, drawing the fresh air replaced by warm, yet create the "breeze". Ventilation can be increased by the presence of some windows on the upper floors or, more often, opening the entrance door to let enter the cool air of the tunnels roads. The outside temperature is very high, but the thick walls (60-80cm) and roofs (40-50cm) made with row earth are excellent thermal insulators and don't allow penetrate the external heat into the house, the displacement between the external and internal wall temperature can reach 12 hours. The houses also being leaning each against other and having common walls on at least 3 sides, would be further isolated from the heat gain during the day. In the third cycle, during the afternoon, hot convection currents increase due to the heat accumulated in the earlier sunny hours, and in the late afternoon, fresh air has been expelled almost completely from the rooms. But outside the sun is weaker, the shadows are longer, temperatures begin to fall and cooler air begins to flow and get into the patio. Begins a new cycle (Al Bena'a, p. 1).

Let's see how, with some typological devices, is possible respond, in an effective and sustainable way, to the comfort living needs, even in hostile climatic conditions, especially without the use of energy expenditure. But an effective building type, if not accompanied by an appropriate choice of construction materials, often alone is not enough.

2.2 The Drâa Valley earth building techniques (Morocco)

In the traditional building technique of the Drâa Valley, the major role is played by the earth material, used in many different situations, which proves to be the most suitable material for an effective response to warm dry climate of the place.

The masonries techniques used are the rammed earth, called alleuh, and the mud brick, called toub, used separately in different parts of the building. Although this techniques are known and spread throughout the World, their implementation demonstrates a local cleverness which allowed at the population to adapt and protect themselves against the toughest aspects of the pre-Saharan climate.

The rammed earth is a technique that consist to compact layers of damp earth in a wooden formwork. This technique allows realize a very tick (40-100 cm) continuous bearing walls. The masonries runs proceeding horizontally until the completion of the entire perimeter, after an appropriate drying time (depending on climate, but not less than one week), necessary to prevent deformation or collapse of the wall, goes to realize the higher level; the building is then lifted for later "layers". This construction system performed by shifting one formwork, block to block, involves the adoption of an almost constant thickness of the wall along the perimeter and, generally, even over the whole height. As for masonry buildings, particular attention should be in the scarf realization to ensure mutual collaboration between the blocks, between walls or between walls and partitions. The formwork may have varying dimensions, in the Drâa Valley has an average size of 200 cm in length, 80 cm in height and a width varying from 60 to 100 cm depending on the height of the building; the height of the plans depends on a finite number of rammed earth blocks. The rammed earth walls behave monolithically, the mass gives stability and strength but low ductility for the response to the earthquake. Thermal inertia is directly proportional to the thickness, these walls are therefore particularly suitable for very hot climates or characterized by extreme temperature changes, as in the pre-desert climate. For the rammed earth, the material preparation and its implementation coincide. The material transformation is totally in the yard and requires technical knowledge that is acquired through experience, since the wall performance will depend entirely on the choice of earth, by mixing and its implementation (Baglioni, 2009, pp. 61-67 & 96-105). The earth required for the rammed earth must be well graded, with gravel, sand, silt and an optimum clay percentage of 20%. The earth is mixed with water in varying percentages, between 4 and 18%, according to the type of earth used, and let repose for at least 2 days before being placed in work. The cohesive effect isn't entrusted only to the clay but also to compaction during implementation. The rammed earth geographical diffusion and the luck along the time are due at least three factors: the ease of finding a suitable soil type, the low amount of water compared to other earth construction techniques or concrete; the reducing use of other natural materials like wood. By contrast this technique requires a large amount of earth and long lead times due to drying.

Figure 8: Rammed earth masonries, Drâa Valley, Morocco. (Credit by Guidoni E., 2007)

The mud bricks are sun-dried blocks of earth, shaped in wooden molds. The block sizes vary widely according to local building traditions, though usually resort to a width equal to half length and height equal to a half width. The earth must be carefully selected, rich in clay (at least 40%) and without gravel. It adds a lot of water until obtain a malleable and plastic dough that is left to rest for at least 2 days. Due to the large amount of clay and water, the mixture is subjected to a strong withdrawal during drying, to limit the effect is generally added straw or other fibers (vegetable or animals). The mud bricks are formed by hand into the molds and allowed to dry in a large sunny area, turning on all sides; once dried can be stored and used later. The drying phase is critical for the mud brick success, it must be smooth and would be better not expose them to direct radiation at least in the early days; the drying times vary according to climate and seasons, from 2-3 days in summer and 10-15 days in winter.

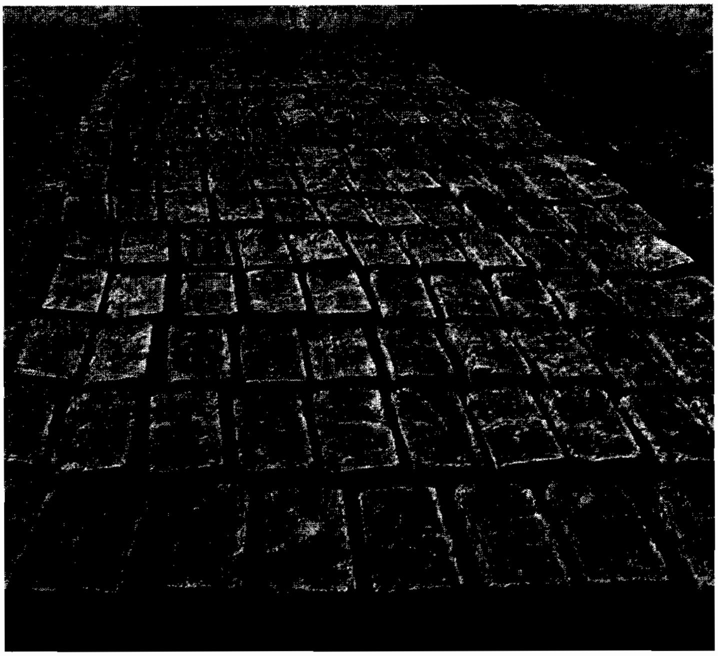

Figure 9: Mud brick sun dried, Dades Valley, Morocco. (Credit by Baglioni E., 2009)

The mud brick wall realization follows the same construction rules of a traditional masonry: the adobes are put in place, at 2-3 or 4 heads, with a earth mortar generally achieved with the same dough; you can build relatively thick walls (min. 30 cm) with a strong inertia, but from a low response to the earthquake, behaving so fragile. The vegetable fiber addition to the mixture improves the material tensile strength, but doesn't make it structurally resistant to this effort. The mud bricks walls are characterized by high thermal inertia due to the high specific gravity and therefore turn out particularly suitable in the areas with high climatic temperature range. In the Drâa Valley the mud bricks are used where the rammed earth masonry is difficult or inappropriate: in the upper floors, where carry the dough is difficult and tiring; as a string course to complete the thickness of the wooden floor; above the doors and windows lintels where press the earth isn't recommended, but is in the pillars and walls of the patio that the mud bricks plays its prince role, pushing up its bearing and decorative capacity (Baglioni, 2009, pp. 68-71 & 106-119).

In the earth masonries, whatever they are, a key role is played by basements, preferably on stone or brick, which have the principal function to limit the capillary rise of moisture from the soil (Baglioni, 2009, pp. 88-95).

In the Drâa Valley, the earth is an essential element of almost every technological solution, plasters and mortars are made with earth, floor and roofs are made of palm wood structure, which is superimposed a reed and various layers of pressed earth. Regarding the floor plan we have two layers of clay earth, both of thickness of about 5 cm, the first is dry and the second is wet. The roof, having to perform the protecting function of the entire building from the weather, differs in quantity and quality of the earth layers and, thus, in the thickness. The package consists of three layers of clay, each of thickness of 5 cm, with different functions and made with different mixtures. The first layer is made with a mixture similar to the rammed earth mixture, so humid, but prepared with a finer earth; the second layer is dry and its function is to absorb water infiltration when the top layer doesn't had a perfect seal. The last layer, in addition to finishing function, must be waterproof, it's therefore done with a moist mixture of earth and lime or earth and straw. Lime is a natural stabilizer which makes the clay waterproof and, once dry, makes the dough more resistant. The roof needs frequent maintenance because it's subject to degradation caused by rain, wind and sandstorms. Maintenance is performed every 4 or 5 years, creating a new layer above the existing finish. (Baglioni, 2009, pp. 141-151).

The date palm is the backbone of the pre-Saharan oases ecosystem and marks the border between the Sahara and the Mediterranean culture. As the only wooden materials usable in construction field, is used to achieve the doors and windows lintels and the horizontal structures of the floors. Its mechanical performance are low, because its trunk consists of bundles of parallel fibers that, subjected to loads, doesn't ensure effective mutual cooperation and suffer intense inflections. The problem is then content and controlled maintaining the lights relatively small, generally 2 to 2.5 m (up to 4 m); dimension that becomes a real module for any building construction (Baglioni, 2009, pp. 84-85).

Let's see how all the materials used are natural, readily available on site and present in large quantities.

The raw earth housing yard are traditional and managed by small artisan "company" consist of a master chief, called maâlem, and a variable number of workers or laborers, but no more than a few units. The working tools are proportional to the type of yard, traditional and craftsmanship (Baglioni, 2009, pp. 73-79).

Sustainability of these techniques is also in the use of local workers and often in the family participation at the construction process.

Unfortunately, in the Valley, we are seeing a gradual abandonment of row earth patio homes in favour of houses increasingly built with concrete blocks, which retain, however, the patio type. The use of cement is spreading because it's considered index of development and progress, although, in this context, is often the bearer of completely inadequate results to the local environmental conditions. The concrete, in fact, unlike the earth, doesn't guarantees the maintenance of a climatic comfort inside the home, creating rooms hot in summer and cold in winter. These data are demonstrated by the fact that the inhabitants of the concrete houses suffering from rheumatism in the winter and move into the earthen houses in summer, because are more fresh.

3 The Benefits and Potentiality of The Earth Construction Material

At the point of views of sustainable building, of energy saving and safeguarding of the planet, the earth, too often underestimated because it's considered a poor material and bound only to the rural environment, presents, on the contrary, many advantages that should help his re-entry among contemporary building materials. Firstly, it's a readily available material on almost all the Planet, as witnessed by its wide use in the vernacular architecture of the most different regions. Although there has been made, in relatively recent times, studies on optimum earth used for construction, the large existing built heritage, often centuries old, shows the great adaptability of earth to be used for constructive purposes. The man, moreover, has always been "engineer" to improve the performance of the available material, making mixtures between different types of earth or additive the mixtures with other "ingredients" mainly from natural sources (straw, vegetables and animal fibers, rice hulls, sawdust, dung, succulent plants extracts, casein, lime, graphite, bitumen, cement, etc.). The earth is an ecological and completely recyclable material, is reusable both in construction that maybe in the agricultural field, in fact, the earthen buildings, if left to themselves, come back to be earth. The earth allows a great variety of different technologies (rammed earth, mud brick, wattle and daub, cob, straw-earth, wood-earth, etc.) all providing low water-consuming for the dough production. The production and installation of earthen techniques, don't require special skills and can therefore be made on site and using local human resources.

This has many advantages: a low product cost and a low energy consumption for its production, a minimum consumption of non-renewable resources, but especially the opportunity to train local workers and so create new skills or new jobs. Another advantage is the possibility to have a economic constructive process and to ensure the maximum respect of the local building techniques, achieving a better integration of new structures in urban and social context, avoiding the imposition of new forms and new systems. The earth also provides very good climatic performance, acting as a natural temperature and humidity regulator. The material inertia makes the heat absorbed from the wall are distributed in the interior within a considerable displacement time: at a constant temperature the effect isn't evident, but in climates with high day-night temperature excursion the heat accumulated during the day is dispersed at night and the morning the wall is cool again, the phenomenon is also reflected in the season. The earth is also a humidity regulator, able to absorb the air humidity and dropping it when the environment becomes drier. These properties mean that the rooms inside earthen walls, are healthy and have comfortable and constant climatic conditions in all seasons. Finally the earth has a good resistance to the fire and can easily be "restore" because it's enough to produce a earth mixtures similar to the originals for compensate any cracks.

Unfortunately, the prejudices on this material are still very rooted because it's considered a vulnerable materials. In fact the only earth vulnerability is water, which can be easily solved with the implementation of appropriate bases and covers, with the use of efficient rainwater removal (guttering and downpipes), and with the possible addition of "stabilizers" materials to improve the performance. A key role, in the protection to the water, is played by the plaster, also made with clay, which must be frequently maintained and renewed.

4 Conclusions: The Actualization Of Traditional Building Techniques

Is undeniable that the traditional homes, alone, they can't cover some new social and housing demands, but the solution isn't necessarily in abandoning or on imposing different lifestyles related to the modernity stereotypes. A clever solution would be respect local diversity, recognized as adequate and sustainable, continuing the "natural" process improvement to adapt to new needs (social, environmental, economic, regulatory, etc.).

As regards new buildings, in this quest for sustainability, during the design and planning phase should be used functional principles and technological building systems that can reduce substantially the energy consumption and the waste generated from the production, construction and life of the building, should also plan the disposal step and the recycling and reuse of materials. It's important that each house is worthy and healthy, that are used healthy materials and not harmful to human health, which takes into account the comfort conditions (lighting, ventilation, humidity, sunshine, clean water, sewer, disposal waste, etc.). and that you respect the cultural, economic and social diversity.

The earth is a material that lends itself well to these demands because respects the environment, is fully recyclable, prevents the relationship with the trade monopoly, allows greater flexibility in the architectural choices, it can maintain and renew the traditions and the expressive languages enough to lend itself to the self-construction. The limit dictated by the long execution times can be killed with the help of semi mechanical processes, such as the use of pneumatic compactors for the rammed earth construction or manual presses for the mud brick production. These methods, decreasing the water amount needed, considerably reducing the natural drying time and make the raw earth a competitive material on the building market. One factor to be reckoned is the economic, because building a house with traditional material costs about half of a cement house and the cost is further cut down if you used the self-construction.

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Sustainable Application of Solar Energy in Bangladesh Traditional Houses

Rumana Rashid
University Technology Malaysia (UTM), Malaysia

Abstract

The concept of design and minimum use of energy in Bangladesh Traditional House is obtaining a comfortable living within comfort zone. The aim is fully achieved as with the use of natural resource and the latest technology. The Bangladesh Traditional House provides an affordable and comfortable indoor microclimate. The thermal performance of the traditional house was done recently in Bangladesh. A set of thermal data logger is used for six months thermal data collection. The selected test house has a built-up area of 37.8sqm including two bed rooms with small living area. Several numbers of case studies was selected from different area of Bangladesh. The design strategy of the house is enhancing with constant uncomfortable hours use of well specified extra efficient technology, to further minimise energy use of the Bangladesh Traditional House (BTH). The amount of energy needed by a house depends on the overall energy requirements and efficiency of the building systems(Alexander,1984). The use of the renewable source of energy from solar radiation is efficient to solve this problem now in Bangladesh. The result of the minimum use of solar energy can make the Bangladesh Traditional House (BTH) more comfortable, economical and sustainable. It reduces poverty by applying the renewable solar energy use

Keywords: *Bangladesh Traditional House (BTH), solar energy, natural resource, comfortable, sustainable*

1 Introduction

The bioclimatic architectural design strategy of the traditional house forms and their inspiration are undeniably important to document. Bangladesh traditional houses represent a unique phenomenon, with devices capable to meet the comfort demand through environmental well-adapted design features. Traditionally housing is designed by the user in his spare, time and based on low investment, local materials, combined with the assistance of relations, friends and neighbours. The green architecture of the future will be shaped by an approach to site and materials typical of the vernacular traditions (Brenda 1991). The practice of drawing on traditional architecture to inform contemporary design has been promoted by many theorists and distinguished architects such as Hasan Fathy (Steele, 1988). Among other advantages they claim, is the benefit to be derived from centuries of experience in adapting form and material selection to achieve comfort in relation to the local climate. Contemporary dwellings which are thermally inefficient and expensive to run, are replacing traditional village housing which is light weight, cool, made of renewable materials and able to be built largely by sweat equity (Kevin Mc Cartery, 2006). The different kinds of houses were developed in different climatic regions of Bangladesh such as mud houses, bamboo houses, stilts houses and timber houses (Rumana, 2007). Minimum use of energy in Bangladesh Traditional House (BTH) is obtaining a comfortable living with an internal temperature of around 24°C-32°C while relative humidity range is 50% - 90% according to Mallik, 1994 comfort range. Thermal performance comparison between BTH and contemporary house result further mention that heavyweight materials in contemporary house such as brick, concrete and tiles have higher thermal capacity with longer thermal-lag compared to light weight materials in BTH. (Rumana, Hamdan, 2010). BTH thermal performance done by Rumana and Hamdan (2008) reported that during daytime indoor temperature is higher than indoor comfort range only for short time 5 to 6 hours, but after sunset it become comfortable very quickly. The goal is fully achieved as by the use of natural solar resource and the latest technology which provides an affordable and comfortable indoor microclimate.

Energy is considered an enabling medium for economic development. Energy helps people in cooking, heating or cooling their homes, pumping water, lighting houses and workplaces, receiving information and getting entertainment. Energy is also closely linked to health care, educational attainment, job creation and climate change. There are many regions in the rural area with a limited accessibility to grid based electricity. Due to economic, geographic and other factors, conventional grid may not be viable for a few decades. Due to economic, geographic and other factors, conventional grid may not be viable for a few decades. Renewable Specially Solar photovoltaic based electricity generation may be a viable technical option for meeting lighting and other low-energy needs of people living in these rural and remote areas. Renewable based electricity would normally provide clean, safe and environmentally friendly electricity. Especially PV can also have many positive impacts in terms of education, community welfare, employment and income generation. Energy conscious BTH is not only reducing the house's loads but also makes economic sense to a house owner. The design strategy of the traditional house is enhancing with constant uncomfortable hours use of well specified extra efficient renewable technology such as solar energy, to further minimise energy use of the Bangladesh Traditional House (BTH). It reduces poverty by applying the renewable solar energy use in Bangladesh.

2 The Climate of Bangladesh

Climate as environmental element is different will generate immeasurable quality (Olgyay, 1973; In Xu, 2004). The climate of Bangladesh, based on the widely used classification by Atkinson (Koenigsberger, 1973), is categorized as warm-humid. Meteorologically the climate of Bangladesh is categorized into four distinct seasons -- winter, pre-monsoon, monsoon and post-monsoon (Hossain & Nooruddin, 1993).The winter months-December to February, are characterized by infrequent rains, cold northerly winds, mean temperature 21°C and maximum below 26°C. In the northern part of the country, the minimum temperature in winter often drops below 10°C. The pre-monsoon period covers the months March, April and May and is characterized by occasional thunderstorms, and a maximum temperature of 34°C. The monsoon is the longest season covering the months June to September, a period with torrential rains 781mm to 1499 mm recorded in Dhaka, with the average relative humidity above 80% and an average temperature of 31 °C. The post-monsoon season ranges between the months October and November. It is also regarded as a transitional period with infrequent rains and temperatures below 30°C.

Table 1: climatic condition in Bangladesh.

Gregorian Calendar Months	Ave. air Temp For 91-06 (K)	Mean RH For 91-06 (%)	Mean Wind Speed & Direction For 91-06 (m/s)
January	18.8	72.4	1.4(NW)
February	21.9	67.0	1.9(N)

March	26.6	63.6	2.4 (SW)
April	28.9	70.9	2.9(SW)
May	29.0	78.4	2.4 (S)
June	29.5	82.3	2.3 (SE)
July	29.1	84.0	2.2(SE)
August	29.2	83.6	2.2(SE)
September	29.0	83.5	2.1(SE)
October	28.0	80.7	2.1(N)
November	24.5	75.7	1.3(NW)
December	20.3	74.4	1.6(NW)

3 Methodology

3.1 Description of the Selected House

The selected test house has a built-up area of 37.8sqm including two bed rooms with small living area.
The selected house is surrounded by similar type of traditional house on the north and south side at respective orientations. The west and east sides (figure 1) are facing 1.5m road.

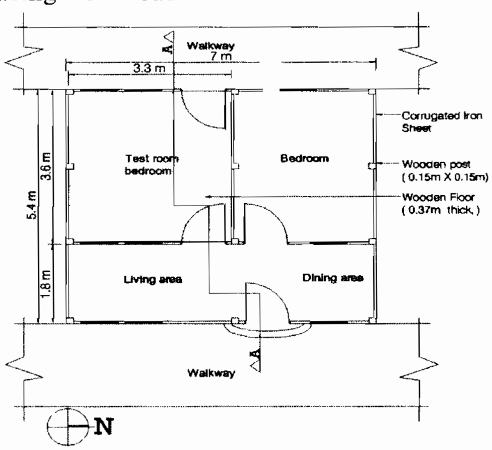

Figure 1: Plan and construction material of the selected house

For recording indoor climatic variables, the bedroom was selected which is occupying the southwest corner of the house. This is the hottest corner of the house according to user experience. The selected room (figure 1) receives solar radiation for a longer period compared to other two rooms and also from a study of Sharma (2002), he found that the relation between hot category rooms and cardinal locations, the west side room took the highest position and southwest room took the second highest position in Bangladesh. This research selects the worst corner of the selected house to justify the thermal performance of the traditional house in Bangladesh.

The room height is 2.8m. The size of the bedroom is 3.3m wide by 3.6m length (figure 3). This room has two windows of 1m wide on west and east side periphery and two doors. This room is connected to living area through a door. Walls are made with 150mm by 150mm wooden post and corrugated sheets. The ceiling is made of 37.5mm thick wooden planks with 125mm by 75mm wooden beams. Furniture of the room consists of a wooden double bed, wooden wardrobe, wooden cabinet and a wooden study table with chair. The floor is raised from the ground and made by wooden planks. There are two 60 watt florescent lights (one is regularly used and the other is occasionally used) and one ceiling fan in the test room. The outer surface of the upper space is made of corrugated iron sheets. It is directly exposed to the sun. The extended roof protects the windows of upper space from sun and rain. The upper space has four windows on west and east wall, which are 1.25m by 1m wide. The window of north and south side of the upper space is closed. The floor of the upper space is of wooden planks. In this area there is an incandescent light, which is used occasionally. Generally upper space is used as a store.

3.2 Experimental Procedure

The field measurement aim was to find out the uncomfortable hours in Bangladesh traditional house. To justify the use of The Renewable solar energy during uncomfortable period to enhance the indoor comfort environment. The selected test house has a built-up area of 37.8sqm including two bed rooms with small living area.

Thermal Data loggers were installed in the selected house (figure 2,3) for collection of air temperature and relative humidity data in the three zones, namely upper space, indoor living space and outdoor of the house. The remote data loggers recorded data with the help of external sensors. Data were recorded at interval of every five minutes.

Temperature and humidity data logger and sensor

External sensor of thermal Data

Figure 2: Temperature and humidity data logger position in upper space (left) and placement of external sensor under shade of extended roof of the house (right)

The controlling software assigns range of the logger interval. The loggers are initiated by software Box Car Pro 4.0. The software is required for the downloading of data from the data loggers and in making the graph; and exporting data to excel file. Excel software also used for data analyses.

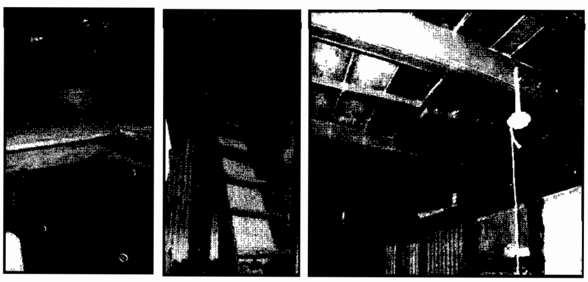

Figure 3: Temperature and humidity data logger position in upper space (right); Entry from indoor space to upper space (left); Wooden ladder for entering to the upper space (middle).

3.3 The instruments are used in the field study were as follows

Temperature and humidity data logger(HOBO H08-007-02)	2 Nos.
External Sensor TM C6-HA	3 Nos.
USB cable	1 No.

3.4 Installation of the Thermal Data Loggers

The thermal data loggers and sensors were installed in the test house in three areas. One data logger (no.1) with two sensors was used for indoor and outdoor data collection. Another data logger (no .2) with one sensor was placed in the upper space for collecting data (figure 4).

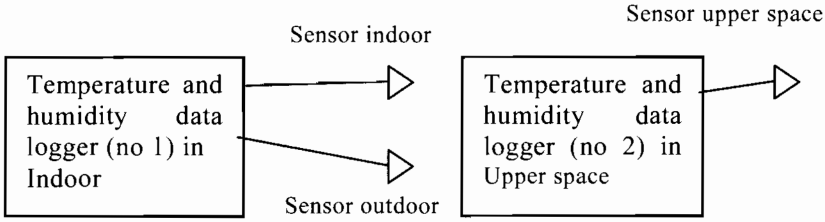

Figure 4: Schematic Installation of Data logger and Sensors

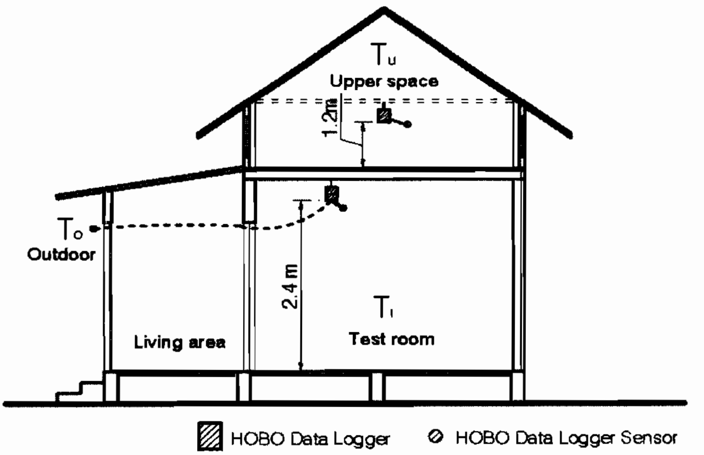

Figure 5: Temperature and humidity data logger position in indoor, outdoor and upper space in section of the selected house

3.5 Data Collection Method

Table 2: Tabular output method of Climatic data collection for the selected traditional house.

Season	Month & Date	Collected Data (Air Temp)			RH	Opening of windows in upper
	In 2007	Indoor	Upper	Outdoor		
Winter	Jan. 10^{th}-31^{st}	Ti	Tu	To	Rhi	0%
	Feb 1^{st}– 28^{th}	Ti	Tu	To	Rhi	0%
Summer	Mar.1^{st} -31^{st}	Ti	Tu	To	Rhi	0%
	Apr. 1^{st} -30^{th}	Ti	Tu	To	Rhi	25%
	May 1^{st} -31^{st}	Ti	Tu	To	Rhi	75%
	June 1^{st} -20^{th}	Ti	Tu	To	Rhi	75%

4 The use of solar energy at Bangladesh traditional house

Energy is considered an enabling medium for economic development. Renewable solar energy is a common practice of decreasing the quantity of energy used. Because of the lack of widespread coverage of centralized energy services and because of the financial and environmental costs of fossil and organic fuel, renewable energy should be considered for traditional housing at rural areas in Bangladesh. At the moment, harnessing solar energy using photovoltaic (PV) solar panels for electricity generation is the most applicable option among other renewable energy technologies for utilization at the individual homestead level.

• Important positive outputs of electricity supply are increased scope for children's evening education and indoor income-generation.

• Current prices of solar energy systems are prohibitive for very poor households, but affordable for slightly better-off households. Organizations should promote and motivate households that can afford it to invest in solar energy systems.

• Organizations such as the Grameen Bank and BRAC are providing solar energy systems as part of micro credit programs. Other organizations should follow this example and build upon existing experience to develop flexible and soft financing schemes. Solar energy systems are advantageous in flood-prone areas because the panels are raised on a pole or on the rooftop and thus avoid damage by floodwater (ADPC, 2005).

5 Government Program of Renewable Energy in Bangladesh

62 KW solar PV is installed by Rural Electrification Board of Bangladesh 10 KW solar photovoltaic systems installed by Local Government and Engineering Department in 30 cyclone shelter.

5.1 Private Sector

5.1.1 Grameen Shakti:

A "not-for-profit" company involved in promotion of renewable energy resources for poverty alleviation Installed 4695 Solar Home Systems up to July 2010. It was initiated in 1996 to 'rescue the rural people from energy poverty which hinders their social and economic development'. Its main objective is 'to produce electricity to fulfil the minimum requirement of electrical power after dusk in the remote rural areas Bangladesh where conventional electricity could not reach in foreseeable future (social goal).'It effectively captures synergy between renewable energy technology and micro-credit in order to give the rural people a chance to improve their quality of life and also take part in income generating activities. Solar Program - for marketing solar home systems through a network of branch offices with a soft loan program.

Figure 6: Bangladesh traditional house and Solar panel over its roof.

5.1.2 PV Program of Grameen Shakti

1. Operating through 23 offices in Rural Areas
2. Encourages the use of these technologies for income generating activities
3. Marketing strategy:
   – Provides soft financing scheme to the customers
   – Helps in using the SHSs for income generating activities for women
   – Ensures proper after sales maintenance

– to make the system more easily accessible by rural households GS sells PV systems on credit.

4. Now the credit system is as follows:
   Customers pay 15% as down payment, and the remaining 85% is paid in monthly instalments within a 3 year period.

5.1.3 Grameen Shakti faced Initial Challenges Like

- Lack of rural network
- No knowledge or awareness among the rural people
- Lack of trained manpower
- High upfront cost of renewable energy technologies
- Lack of funding sources

5.1.4 The cost of production and operating time

Solar PV Module	**Appliances**	**Components Provided by Grameen Shakti**	**Operating Time**	**Package Price in Taka/USD**
30 Wp	Two lamps of 6 watt	One module of 30 watt, One deep discharge battery of 47 Ah, One charge controller (10 A), Two lamps of 6 watt, One structure, Other accessories and installation.	4 hours per day	12,900/ 185 USD
40 Wp	Two lamps of 6 watt & One B/W TV of 14”	One Module of 40 watt, One deep discharge battery of 71 Ah, One charge controller, 2 lamps of 6 watt, One structure, One socket for TV, Other accessories and installation	4 hours per day	16,600 / 238
50 Wp	Three lamps of 6 watt & One B/W TV of 17”	One Module of 50 watt, One deep discharge battery of 100 Ah, One charge controller, 3 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	21,750 /312

50 Wp	Four lamps of 6 watt & One B/W TV of 14”	One Module of 50 watt, One deep discharge battery of 100 Ah, One charge controller, 4 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	22,500 / 322
60 Wp	Five lamps of 6 watt & One B/W TV of 14”	One Module of 65 watt, One deep discharge battery of 100 Ah, One charge controller, 5 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	25,900 / 370
65 Wp	Five lamps of 6 watt & One B/W TV of 17”	One Module of 65 watt, One deep discharge battery of 100 Ah, One charge controller, 5 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	26,900/ 385
75 Wp	Six lamps of 6 watt & One B/W TV of 17”	One Module of 75 watt, One deep discharge battery of 130 Ah, One charge controller, 6 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	33,900 /485
75 Wp	Eight Lamps of 6 watt	One Module of 75 watt, One deep discharge battery of 130 Ah, One charge controller, 8 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	35,400/ 505
80 Wp	Seven lamps of 6 watt & One B/W TV of 17”	One Module of 80 watt, One deep discharge battery of 130 Ah, One charge controller, 7 lamps of 6 watt, One structure, Other	4 hours per days	35,600 / 508

		accessories and installation.		
120 Wp	Ten Lamps of 6 watt & One B/W TV of 17”-20”	One Module of 120 watt, Two deep discharge battery of 100 Ah, One charge controller, 10 lamps of 6 watt, One structure, Other accessories and installation.	4 hours per days	49,900/ 712

6 Result of Research

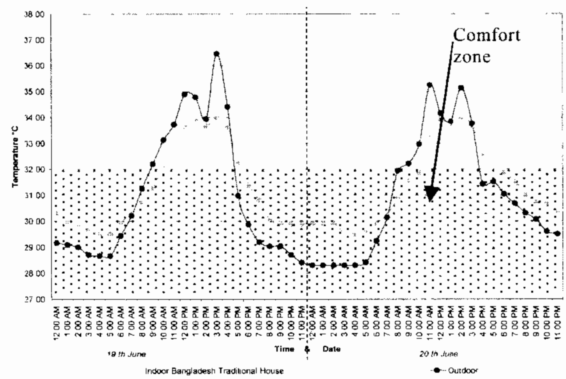

Figure 7: Profile of temperature of outdoor and traditional house indoor.

The research result is analyzed by the combination of the thermal performance of BTH and the use of solar energy. From the result of the field study (figure 7) it can be conclude that the internal environment of BTH is comfortable despite the over crowded condition of the dense outdoor condition of Dhaka city even without any advanced mechanical means like AC or cooler for controlling the indoor temperature. This is because of higher cross ventilation rate in indoor areas, wooden elevated floor, use of all light weight materials with low time lag and well ventilated double layer roof section. (Upper space). Upper space protects the indoor living space from the direct solar radiation. In BTH, it noted that thermally the BTH representing indoor comfort condition at 5pm to 10am is always with in comfort temperature range (24 °C to 32 °C). According to the research conducted by Mallick (1994), air temperature for comfort with no air movement and for people wearing normal summer clothing, engaged in normal household activity indoors are within the range of 24 °C and 32 °C and for relative humidity between 50% and 95%. In still air condition people feel comfortable even in higher humidity, which is expected response in a location where humidity is generally high for most of the years. With the introduction of airflow, relative humidity up to 95% is tolerated.

The time (after 5pm) when maximum people back to home BTH already become comfortable. So the construction elements of BTH can respond with outdoor climate. When the outdoor air temperature is extremely higher then the indoor air temperature of BTH tends to be lower.

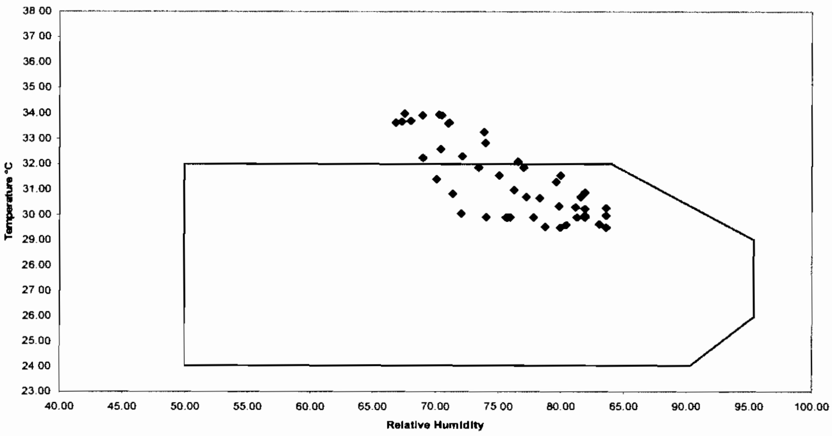

Figure 8: Plotting of the indoor air temperature and the indoor relative Humidity of B.T.H within summer comfort zone. (Source: Authors)

From the comfort zone analysis (figure 8) it can be seen that the relationship between hourly air temperature and relative humidity with superimposing the summer comfort zone (24°C-32°C). Scatter diagram shows 71 % points are inside the comfort zone in the BTH. Therefore indoor condition in the traditional house is more comfortable to live for occupants.

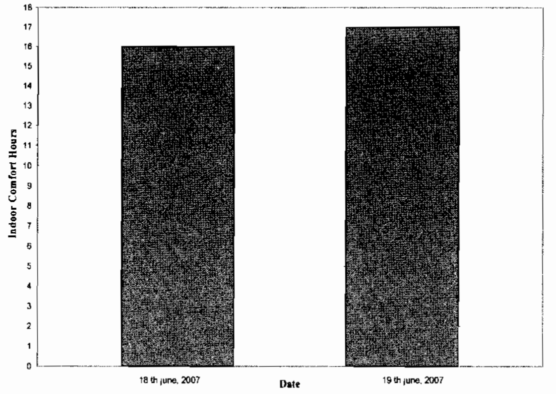

Figure 9: Profile of Indoor comfort hours in both B.T.H within 24 hours. (Source: Authors)

According to figure 9, the thermal performance capability was indicated by longer period of thermal comfort duration in indoor of BTH is justified by considering the thermal comfort hours. In BTH the comfortable hour within 24 hours is 16 to 17 hours. Only for 7 to 8 hours is uncomfortable during day time and this period people do not stay at home. The combination of 10 watt three energy lights and one fan is operating by use of renewable solar energy is enough to solve this problem. Lights are use only during night time, fan is using during uncomfortable period to enhance the comfort environment. The Renewable solar energy is now a very common use in BTH. The solar lanterns emit omni directional light is use for night at least 4 hours on a one hour solar charge within one day. Through this sustainable strategy without any use of electricity in the BTH have an ability to provide sustainable life style in a better natural designed house. Renewable solar energy is efficient to solve energy problem in Bangladesh. The result of the minimum use of solar energy can make the BTH more comfortable and sustainable.

7 Conclusion

BTH has shown a well designed energy saving architecture in the warm humid tropics which can save energy, by obtaining it from sun. The BTH emphasises house orientation, cross ventilation, effective upper space as insulation, adequate number and appropriate size of windows, which can facilitate low energy consumption. By utilizing natural resources that are non-toxic and renewable. With less use of energy it's also reduces the level of $CO2$ and air pollution. The BTH requires less upkeep and provides a healthy and comfortable environment for occupiers. Solar energy strategy tools in BTH provide guidance to young designers. The use of solar energy in traditional house is a powerful hedge against future energy uncertainty in Bangladesh. Local climate responsive traditional house design and the implication of renewable solar energy, makes BTH more energy efficient structure. It is a sustainable environmental and economical policy to reduce poverty of the under development country in world through the use of renewable solar energy in traditional house.

Acknowledgement

In the name of Allah, the most Gracious, the most Merciful, for giving me the determination and will to complete this study. I would like to say thanks to University Technology Malaysia.

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The Sustainable Architectural Principle of Traditional Bamboo Houses in Bangladesh

Md. Sayem khan, Ruman Rashid
University Technology Malaysia (UTM), Malaysia

Abstract

Bamboo is one of the strongest woody plants on planet. Bamboo is usually grown on village homesteads. The use of bamboo in traditional house construction is 100% environment-friendly, can mean a lot of savings in material used and transport. The traditional Bamboo houses are not the product of any theory design, but influence of instinct, intuition, common sense and communal memory. This research takes the steps towards such an understanding by analyzing some field study on several numbers of bamboo houses, as case studies of the significant features of traditional bamboo houses, which make it more durable. Cheap and natural light weight material, aesthetically appealing design, attic space for thermal comfort, proper cross ventilation and renewable construction system of the Bangladesh traditional bamboo house makes it more sustainable in warm humid tropical climate in Bangladesh. The bamboo house form has been defined by climate, site, and purpose, available materials, building technology, historical experience and world view. The best material to build a house wills definitely the local material. By applying the unlimited technology nowadays on the gift of the Allah– Bamboo, this natural bamboo as a raw material have a very high potential to become the best construction material in future for sustainable development in the Bangladesh.

Keywords: *Bangladesh, traditional architecture, design, bamboo house, sustainability*

1 Introduction

Bamboo is one of the strongest woody plants on planet. Its fibres are about 10 times as strong as the wood fibres used today. Bamboo is usually grown on village homesteads. The use of bamboo in traditional house construction is 100% environment-friendly, can mean a lot of savings in material used and transport. The traditional Bamboo houses are not the product of any theory design, but influence of instinct, intuition, common sense and communal memory. Traditional houses are located vastly in rural areas with its natural landscape. The context of Bangladesh traditional bamboo house is a natural projection of the regional imagination. Traditional House local context have its own reality and existence independent of others imagination of traditional village in Bangladesh. Traditional house is designed by the owner and based on low investment, local materials, combined with the assistance of relations, friends and neighbours (Rumana, 2009). It reflects cultural heritage of peoples and also encapsulate traditional forms values and symbolic images of nature. Landscape painters collectively crated the village as a land of dream, a place for passion and sensuality (Bermingham, 1986). Architectural and cultural movement evolved in the late 19TH and early 20TH century such as modernism, rejected traditional forms of art, literature, religious faith, social organization and daily life (Kolokotroni, 1998).This paper presents the structure, construction, design concept, arrangement, important feature and thermal performance of the traditional bamboo house to justify the sustainability. Thermal performance of traditional bamboo house confirms the hypothesis about their environmental sustainability.

2 Climate of Bangladesh

In terms of ecological region or biomes described by UNESCO (United Nations Educational, Scientific and cultural Organisation) (Lean 1990) Bangladesh, lying between 20°34′ N to 26°33′ N and 88° 01′E to 92° 41′E, is in the Indo-Malayan Realm. The climate of Bangladesh based on the widely used classification by Atkinson (Koenigsberger, 1973). Climatic variables are shown in table 1,

Table 1: Classification of the seasons and climatic variable in Bangladesh.

Meteorological Seasons	Gregorian Calendar Months	Ave. air Temp For 91-00 (°C)	Mean RH For 91-00 (%)	Mean Rainfall For 91-00 (mm)	Mean Wind Speed & Direction For 91-00 (m/s)
Pre-monsoon (hot-dry)	March	26.6	63.6	69	2.4 (SW)
Pre-monsoon (hot-dry)	April	28.9	70.9	120	2.9(SW)

Pre-monsoon (hot-dry)	May	29.0	78.4	342	2.4 (S)
Monsoon (hot-wet)	June	29.5	82.3	267	2.3 (SE)
Monsoon (hot-wet)	July	29.1	84.0	371	2.2(SE)
Monsoon (hot-wet)	August	29.2	83.6	335	2.2(SE)
Monsoon (hot-wet)	September	29.0	83.5	293	2.1(SE)
Post monsoon (hot-wet)	October	28.0	80.7	197	2.1(N)
Post monsoon (hot-wet)	November	24.5	75.7	26	1.3(NW)
Winter (cool-dry)	December	20.3	74.4	13	1.6(NW)
Winter (cool-dry)	January	18.8	72.4	11	1.4(NW)
Winter (cool-dry)	February	21.9	67.0	27	1.9(N)

3 Structure of Bamboo House

Bamboo is an easily growing organic material for houses of Bangladesh. So bamboo is a popular material all over the country.

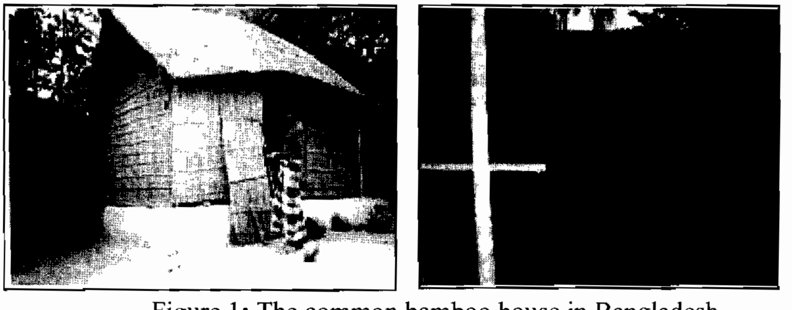

Figure 1: The common bamboo house in Bangladesh.

3.1 Plinth or floor

Cement stabilized earthen plinths are used in bamboo houses. Occasionally, the houses are built with elevated bamboo frameworks and bamboo mats as plinths. In some flood-prone areas, houses have a built-in wooden/ bamboo platform (machan) normally used as storage space, but during flood serves as a raised refuge area. This practice should be encouraged and promoted for wider replication. Stabilization of the typical earthen plinth can be carried out with a mixture of earth and cement. The proportion of cement to be added depends on the nature of the soil, which can easily be tested on site. Capping the plinth with cement-stabilized earth is cheaper, easier to construct and maintain. Complete stabilized earth plinth is more expensive and harder to construct, but the results are more durable.

3.2 Wall

Typically bamboo houses have bamboo mat walls with bamboo or timber posts. Also organic materials like jute sticks, catkin grass are used. Flood with strong currents can destroy wall panels, get washed away and may be partially or complete lost, especially if the connections to posts are weak.

Figure 2: Frame work of the bamboo house and entry way to upper space.

Local treatment of the bamboo mat walls is done by bituminous, oil etc. Simple chemical preservative treatment methods (dip diffusion method, internodal injection method or hot and cold method) for increasing the longevity of organic materials have been developed a long time ago. Cost can increase but can increase longevity by more than three or four times. Untreated, bamboo mat walls do not last more than 4-5 years in outdoor conditions, but after treatment lasts for 15-20 years (ADPC, 2005).

3.2.1 Chemical Treatment of Bamboo Mat Walls

Simple chemical preservative treatment methods for increasing the longevity of organic materials have been developed a long time ago.

Increases cost by 20-25%, but can increase longevity by more than three or four times. If untreated, bamboo mat walls do not last more than 4-5 years in outdoor conditions, but after treatment lasts for 15-20 years. The chemicals are not harmful if proper precautions are maintained. For chemical preservative treatment of bamboo battens and mats, the simplest method is to build a tank made of bricks and concrete, or at cheaper cost, lining an excavation in the ground with polythene sheet, or cutting a cylindrical metal container (e.g.. oil drum) into half and welding them end-to-end.

A typical preservative can be prepared to be mixed in the tank in the following proportions: Copper Sulphate 4%, Sodium Dichromate 4%, Boric Acid 2%, Water 90% = TOTAL 100%. (during chemical treatment safety precaution also taken for the working people). After treatment when the bamboo is dry then it is ready for use. The materials should preferably be freshly harvested, but dry ones can also be treated.

Bamboo battens and mats are to be first soaked in water for at least 24 hours and then dried. They are then to be immersed completely in the chemical preservative solution for 24 hours. After soaking, the materials are to be raised above the tank and supported on bamboo poles or timber battens so that excess chemicals can drip back into the tank and can be re-used. Then they are to be dried in an open shaded space for 1-2 days and then in sunshine for 3-4 days. Gloves or polythene bag covers to be worn to protect hands from chemicals during the treatment process (ADPC, 2005).

3.2.2 Bamboo treatment's cost effectiveness analysis

Cost of untreated bamboo house around 200 square feet = Tk 5,000/ USD 72

Cost of a treated bamboo house of same dimension = Tk 6,250/ USD90

Cost increase due to preservative treatment = Tk 1,250/ USD 18

Cost of treatment increased 25 % of the cost of untreated bamboo house

Service life of conventional untreated bamboo house = 7 years

Minimum expected service life of treated bamboo house = 15 years

That is, 25% increase in cost results in 100% increase in lifespan. (ADPC, 2005)

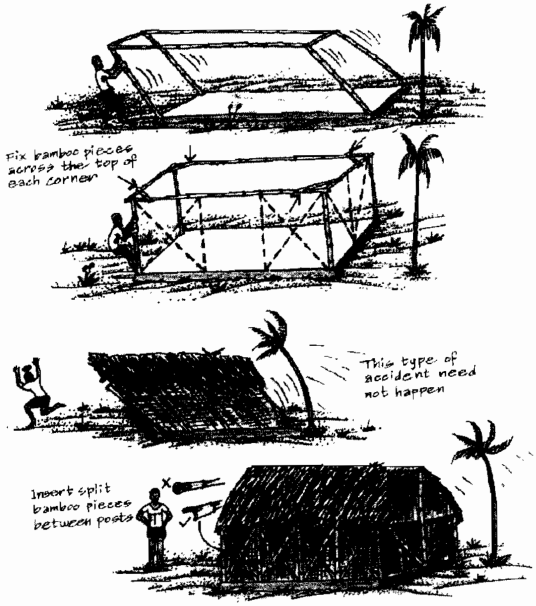

Figure 3: 'Cross bracing' - Structural frame work of the bamboo house.

3.3 Roof

Typically, roofs in bamboo houses are made from catkin grass, rice wheat or maize straws with usually bamboo and sometimes reed stalk framings. Thatching materials can get detached and wash away. Secondary hazards often connected to flood are heavy rainfall, which can cause damage. Strong winds can also blow away thatching materials and damage frames. So in some regions C.I. sheet are also used for roofs.

To increase stability and wind- resistance of the structural frame of bamboo-framed houses, cross bracing with split bamboo sections should be done. If a house becomes weakened at its base due to flood, cross bracing helps to keep the structure stable. Split bamboo sections used for cross bracing should be treated with chemical preservatives so that they do not decay easily and lose their strength. Instead of jute or coir rope, nylon rope or good quality galvanized wire should be used for tying the elements of the structural frame.

3.4 Upper space

Upper space ceiling is used as storage; it should allow ventilation and should be accessible for maintenance. Adequate number and size of perforated bamboo mat walls should be built oriented along the prevailing wind flow direction to allow cross ventilation. Extended roof eaves are to be used to prevent direct wetting of walls during rain.

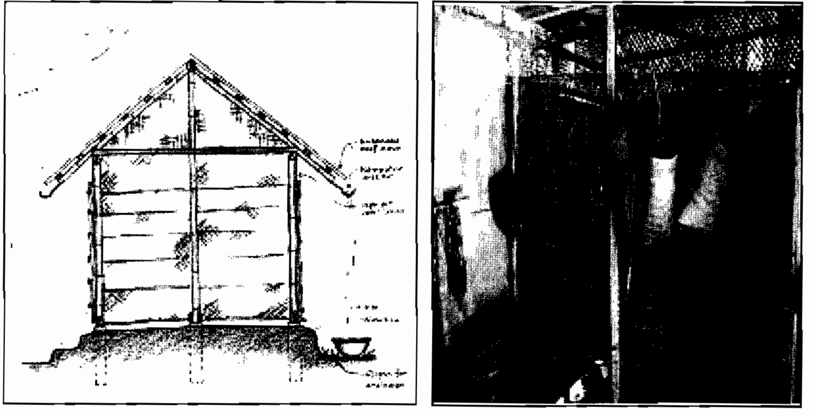

Figure 4: Upper space ventilation of bamboo house and wall gap from floor

Rainwater gutters can be used to discharge water away from the house while collecting arsenic-free rainwater. Houses should be built house on raised homestead with slightly sloping ground for drainage.

4 Bamboo Supply

Although being a vital resource for house construction, bamboo has become scarce in many areas with a resulting increase in price. Inadequate disease prevention and mismanagement of existing resources contribute further to decline in stock. There is thus the need for regeneration of bamboo supply through improved cultivation and management. There are many afforestation and social forestry programs in Bangladesh, but none particularly address bamboo cultivation. There is also potential for introducing hazard-free bamboo treatment as a sustainable process for the utilisation and consumption of the resource within the framework of a wider initiative for its improved and sustainable regeneration, production and management. Various livelihoods are linked to bamboo and an initiative for bamboo regeneration would also regenerate these livelihoods.

5 Bamboo Farming for supplying traditional house material

Bamboo farms should be established to demonstrate the potential of improved sustainable bamboo production and to address the environmental implications of the decline of this local resource. Improved bamboo propagation and cultivation methods have been developed by Bangladesh Forest Research Institute (BFRI) and bamboo farms would allow extend these methods, other than improved bamboo farming, some of the main activities of the farm should be:

-Further research and development of bamboo cultivation and propagation methods.

-Bamboo treatment with adequate safety measures.

-Production and marketing of treated bamboo building products, furniture, household and agricultural implements and handicrafts.

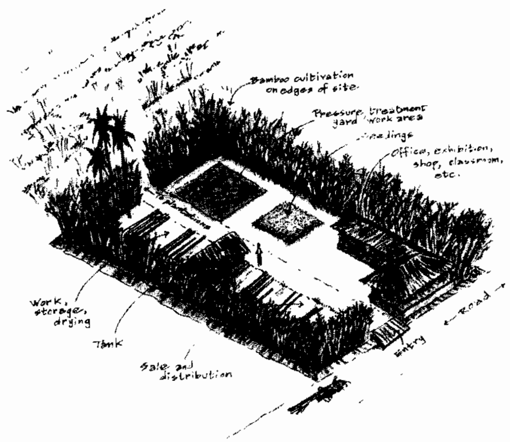

Figure 5: Bamboo Farming

Such farms founded on the principle of sustainable production of bamboo would allow generating sustainable livelihoods for local cultivators, artisans, manufacturers and entrepreneurs.

The farm can work as a model of how bamboo cultivation can be part of the rural environment and serve a variety of domestic and community needs of a village. It can also work as an educational centre for documentation, research, exhibition and dissemination (ADPC, 2005).

6 Methodology

Currently, the field study of Bangladesh traditional bamboo houses are done on several number of bamboo houses at rural and suburban areas in Bangladesh. For environmental study, temperature and humidity data are taken by thermal data logger (HOBO). Set of thermal data logger was installed in one of the selected Bangladesh traditional bamboo house. Thermal Data loggers were installed in the selected house in the three zones, namely upper space, indoor living space and outdoor of the house. The remote data loggers recorded data with the help of external sensors. Data were recorded at every five minutes interval. The controlling software assigns range of the logger interval. The loggers are initiated by software Box Car Pro 4.0. The software is required for the downloading of data from the data loggers and in making the graph; and exporting data to excel file. Excel software also used for data analyses.

7 Thermal performance study

Thermal performance study of bamboo house was done at Dhaka for one month. The initial finding of the research is that the traditional Bangladesh bamboo house is comfortable at night in hot summer season. It is summarized that when upper space window opening's increases than indoor and outdoor temperature difference decreases during summer day time. The maximum indoor temperature is recorded 29.5°C when outdoor and upper space temperature is 29.95°C. Indoor minimum temperature was recorded 26.6°C when the outdoor and upper space was 27.12°C. The indoor temperature is always lower then outdoor and upper space. But the upper space temperature chronologically becomes higher in respect of increasing of upper space window opening. The difference between indoor and outdoor temperature decrease because of heat starts to transmit from hot upper spaces to cool indoor living spaces. According to this phenomenon from the tabulation, it is indicated that it has sufficient difference between indoor and outdoor temperatures during summer nights. So the upper space influences the indoor living space for heat gain and heat loss. During winter season closed window in upper space is desirable for better thermal performance.

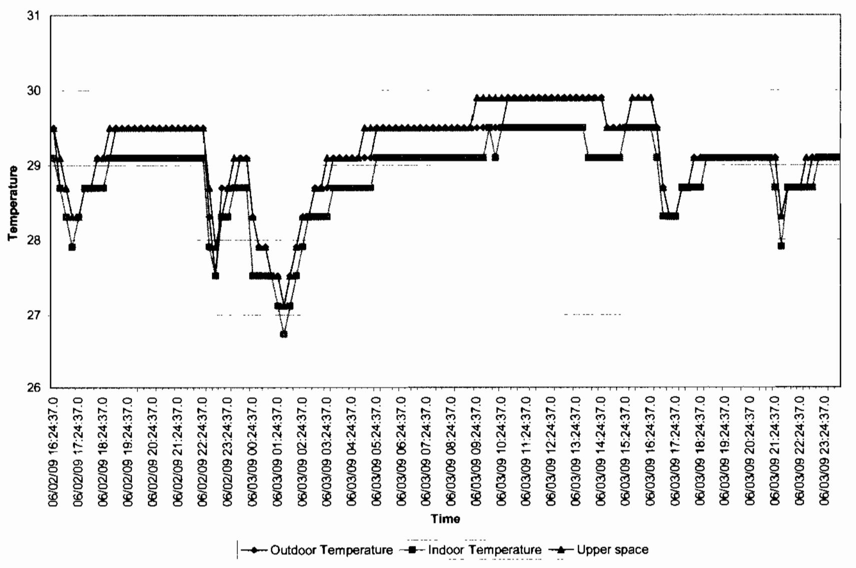

Figure 6: Profile of outdoor and indoor temperature of a bamboo house.

8 Conclusion

This research concludes according to case studies of the significant design features and use of local material in traditional bamboo houses, which make it more durable, available, cheap and natural light weight material, aesthetically appealing design, attic space for thermal comfort, proper cross ventilation and renewable construction system of the Bangladesh traditional bamboo house makes it more sustainable in warm humid tropical climate in Bangladesh. The bamboo house form has been defined by climate, site, and purpose, building technology, historical experience and world view. The best material to build a house wills definitely the local material. By applying the unlimited technology nowadays on the gift of the Allah– Bamboo, this natural bamboo as a raw material have a very high potential to become the best construction material in future for sustainable development in the Bangladesh.

Acknowledgment

In the name of Allah, the most Gracious, the most Merciful, for giving us the determination and will to complete this study. I am also grateful to Universiti Teknologi Malaysia.

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UNESCO (United Nations Educational, Scientific and cultural Organisation)

Courtyard Concept: A Sustainable Strategy for The Future Housing Buildings in Palestine.

Muhannad Haj Hussein, Aline Barlet, Catherine Semidor
GRECAU Laboratory, ENSAP Bordeaux, France.

Abstract

Since the British mandate, particularly after the foundation of the Palestinian National Authority (PNA) in 1994, Palestine has been witnessing enormous political, economical, social and cultural transformation reflected in residences' forms moving from introverted into extroverted schemes. In general, contemporary housing is poorly responsive to local conditions and also failed to meet the dwellers' expectations. Moreover, this modern transformation has caused an obvious divorce between the internal and the external spaces (balconies, verandas and yards). Herein, the vital connection between these spaces has been lost compared to the traditional courtyard houses where they formed an extension of each other. This paper investigates the concept of outdoor spaces in contemporary and traditional housing in terms of sustainability. The socio-cultural, economical, functional and environmental dimensions were examined to find out the feasibility of reviving the courtyard concept in the future designs. Survey results of (300) modern dwellings of different housing typologies (detached/apartment flats) and the analyzed characteristics of traditional architecture, were the base for a comparative study between traditional and contemporary outdoor spaces' features in two different climatic zones Palestinian cities. Results of paper demonstrate that the traditional outdoor spaces are culturally, economically and environmentally responsive designs that could be reintegrated in terms of sustainability in future Palestinian housing. Traditional architecture is still the source of inspiration to every environmentally and culturally responsive housing, and a short path to enhance the inhabitants' quality of life.

***Keywords**: Sustainable design, Courtyard, Modern Outdoor spaces, Housing building, Palestine.*

1 Introduction

Sustainability in buildings means minimizing resources consumption (i.e. water, energy and materials) and increasingly, it also means maximizing the health, safety and quality of life for building occupants (Raman, 2005). Herein, the efficient use of resources is generally an environmental concern and the provision of safe, healthy, productive and usable spaces are social, economical and functional concerns. Therefore, sustainability represents a group of ideas about the balance of economic, social and environmental issues of a lifestyle.

Hence, houses are not only physical space for living, but also a social interactions and rituals place (Ozaki, 2002). Although housing typologies depend on multiple determinants, climate and culture are most crucial (Rapoport, 1969; Olgyay, 1963). In this perspective, outdoor space, which is a buffer zone between inside and outside a building, could provide a safe place for organizing their socio-cultural activities in the favorable climatic conditions.

Traditionally, a central courtyard open to sky, which is locally called *Hosh*, *wast ed-dar* and *sahn ed-dar*, represented the Palestinian private outdoor space (Canaan, 1933), which functions as spatial organizing element due to its location in the heart of a dwelling, and as multi-purpose spaces, including circulation, children's playground, eating, sleeping, relaxing, entertaining, family and women meeting and guest welcoming, in addition to providing shade for the interior spaces, reducing the direct heat from the sun and collecting cool air (Evans, 1980). Simultaneously, it is highly protected from curious pedestrians, preserving high levels of privacy.

However, since the British mandate, Palestinian architecture has transformed gradually from clustered units with central courtyard (introverted scheme), into scattered and detached buildings with small balconies or verandas (extroverted scheme), due to land shortage, and growing demands on dwellings, ignoring issues related to social, cultural and ecological values of the Palestinian society for the sake of cost, rapidity and aesthetic issues (Ghadban, 1998).

Today, the multistory building design (5-6 floors) is adopted as a residential model in Palestine, where balconies, verandas and ground yards represent the dominant forms of the outdoor spaces, the only outlet to nature for closed housing units due to lack of open spaces at the city level. But it, somehow, failed to compete the traditional ones (in terms of cultural, social and environmental aspects), while the vital connection between outdoor and indoor spaces, has been lost in today's housing. Hence, if traditional architecture is analyzed in terms of concepts such as responses to climate and site, spatial distribution of public and private spaces, cultural identity, etc., then lessons could be derived and applied to contemporary designs (Rapoport, 1980).

This paper suggests that a return to traditional architectural strategy of courtyards in modern apartment blocks can improve their sustainability. Moreover, the paper is intended to reveal the distinctive qualities of traditional outdoor spaces in comparison to the modern ones, and explore potentials for addressing them in future housing to promote living quality from socio-environmental perspectives.

2 Methodology and Case Studies

2.1 Three sets of data

The study's methodology consists of three sets of data: sites' climatic characteristics, dwellings' spatial analysis and a questionnaire used to identify features needed for sustainable future housing in Palestine. Climatic characteristics showed how houses responded to site's microclimate. The spatial analysis showed how houses have been designed to meet users' needs.

The questionnaire was built by researchers from the laboratory GRECAU. It aims at evaluating the socio-cultural and environmental characteristics of the contemporary housing, and the role of private outdoor spaces, besides determining the significant characteristics of future housing typologies and outdoor spaces design in terms of sustainability. It contains 56 closed-ended and open-ended questions distributed on three domains:

1- Socio-demographic (age, sex, family members' number, income level, housewife's status , etc) and housing (general housing features, housing facility characteristics, future residents' priorities and needs) characteristics.

2- Outdoor spaces characteristics included typology, area, spatial relationship, social activities, usage periods, residents' satisfaction, individual modifications and future priorities.

3- Interior spaces characteristics included spaces orientation, spatial distribution, spaces area, windows size, natural lighting and ventilation conditions, heating and air conditioning consumption and future residential demands.

The samples of contemporary housing were selected randomly from different neighborhood covering different housing typologies (detached houses, apartment blocks). The fulfilled questionnaires, (240 in Nablus and 60 in Jericho), were collected the next day of distribution, analysis using the frequency distribution method. Only relative questions were investigated in this paper.

The traditional housing characteristics were derived from an analytical study of the cities' historical sites. Plans, elevations and sections of traditional houses were studied and analyzed in terms of conceptual, functional and environmental aspects.

In order to achieve the desired goals, a comparative study between traditional and contemporary outdoor spaces' features, depending on the survey results and the analysed traditional characteristics, was adopted. Herein, for this comparison, which is influenced by Wheeler's directions for urban sustainability, particularly those related to housing sustainable development (e.g. 1- Compact, efficient land use; 2- Efficient resource use, less pollution and waste; 3- Good housing and living environments; 4-Preservation of local culture and wisdom, and 5-Restoration of natural system) (Wheeler, 1998, p. 439), the following comparative characteristics arose:

1. Traditional and contemporary housing configurations and layout.
2. Spatial, visual distribution and relationship.
3. Privacy and communality.
4. Accommodation of residents' activities.
5. Environmental considerations.

The comparison provides an assessing method of such spaces role in enhancing quality of residents' life.

2.2 Climatic characteristics of sites

The targeted cities' selection depended on two conditions: 1- different socio-demographic and topographic characteristics, 2- different climatic characteristics in an attempt to find out their impact on housing buildings' morphology and typology and residents' satisfaction.

Palestine is a Mediterranean country in which the Palestinian territories (6100km2) represent 23.11% of the total area of Palestine. The technical report prepared by Applied Research Institute of Jerusalem (ARIJ, 2003) has defined seven climatic zones in this small area of territories, i.e. five zones are in West Bank (Figure1) and the other two found in Gaza. Moreover, Jericho and Nablus were selected as representative case studies for two climatic zones.

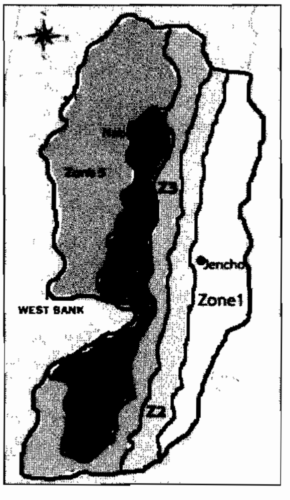

Figure 1: The five climatic zones of West Bank.

Jericho, located in the Jordan Valley, has hot-dry summers and warm winter, while Nablus, located in a mountainous area, has warm sub-humid summers and a cold winter. Table 1 shows the climatic data for each city.

Table 1: Climatic data for the two investigated cities. (Source: Palestinian Central Bureau of Statistics, 2008)

CITY	Monthly Main Temperature		Relative Humidity	Prevailing Winds		Precipitation
	January	August		Speed	Direction	
Zone 1 "Jericho"	8.2°C	38.8°C	54.6%	3.4km/h	E & N	125mm
Zone 4 "Nablus"	5.3°C	30°C	61%	5.5km/h	W & NW	715mm

3 First Comparison Results

3.1 Traditional and contemporary housing configurations and layout

Indigenous used to build their houses in harmony with the environment reflecting family's structure, lifestyle, culture, climate and building stuff.

In Jericho, an oasis settlement, people used to build their mud houses beside water resources, to be used for farming (Nazer, 2006). The simplicity of these houses reflects their primitive lifestyle. The traditional house, which frequently consisted of one storey, usually contained a wide and private outdoor space -*Hosh*- enclosed from all sides with an irregular layout. The living and service spaces have defined the enclosure concept of the house (Figure 2). A covered outdoor space, locally called *Mastabeh,* had been used as a comfortable and shaded outdoor sleeping place (Hanbali et al, 1999) (Figure 2).

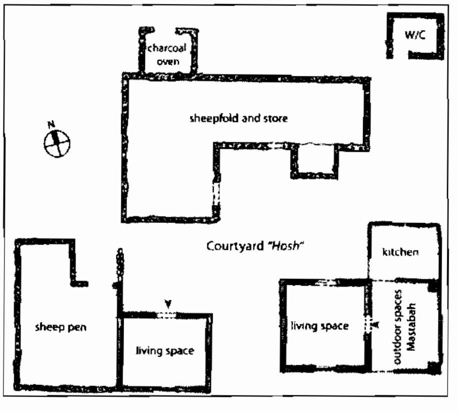

Figure 2: Configurations and layout of traditional houses in Jericho. *(Adjusted by kind permission of Hanbali).*

In other cases, the borders of the living spaces were insufficient for a continuous enclosure around the outdoor space, so additional peripheral walls (Figure 3), which usually could exceed the eye's level, were added to identify the house's domestic territory and to ensure privacy.

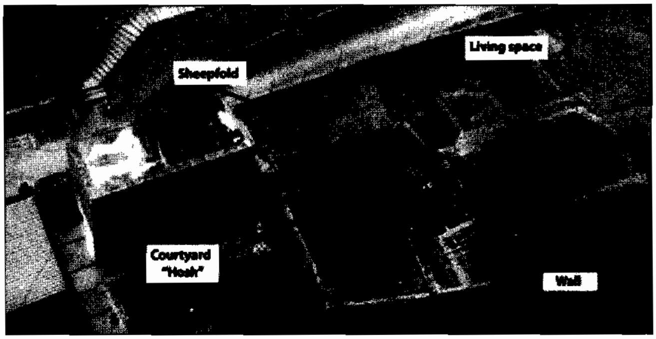

Figure 3: Using the peripheral walls for identifying the enclosure of the courtyard. *(Adjusted by kind permission of Nazer).*

Nablus is considered "Damascus of Palestine" due to the strong economical and social relationships with Damascus of Syria, which played a substantial role in the Nablusis' lifestyle and architecture (Khasawneh, 2001). The old city of Nablus contained compact clustered courtyard houses (Figure 4), with a square or rectangular form surrounded by house's spaces (Awad, 2003) having inward looking into the courtyard, are usually perpendicular to each other despite of any plot geometry.

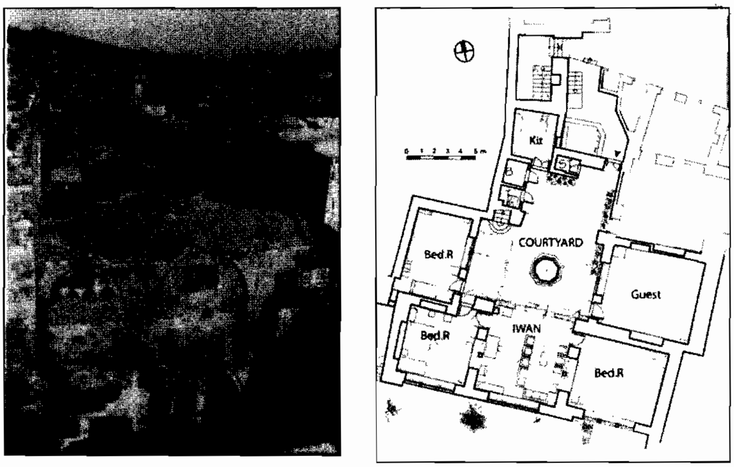

Figure 4: Traditional houses in Nablus.

Such houses consist of one to three stories as maximum, where the ground floor is usually used for commercial and industrial activities (Ahmad, 2008) (figure 5). Adoption of introverted concept for housing design was effective in consuming the entire building plot and minimizing the urban land waste (Amad, 2003).

Figure 5: the commercial activities in the old town of Nablus.

Unlike traditional settlement, contemporary housing areas are scattered and dispersed. The detached houses and apartment blocks (Figure 6) are prominent in both Jericho and Nablus and have lost their local identity.

The findings of the survey reveal that (47%) of Nablus buildings consist of five to seven floors while (70%) of those in Jericho consist of less than three. According to urban planners interviewed, these figures seem to be a real representative sample of urban environment of the case studies.

Modern buildings are constructed in the center of the building plot leaving setbacks -according to new urban regulations- around each block to be used as common outdoor spaces.

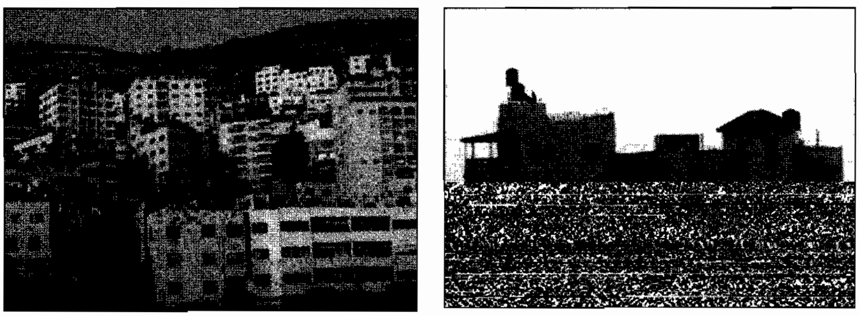

Figure 6: Examples of contemporary apartment blocks in Nablus and detached houses in Jericho.

Regarding private outdoor spaces, verandas and balconies are the most frequent forms in both typologies (Figure 7). Moreover, a private yard or a garden is mostly created on the remaining space of building plot in the case of detached houses.

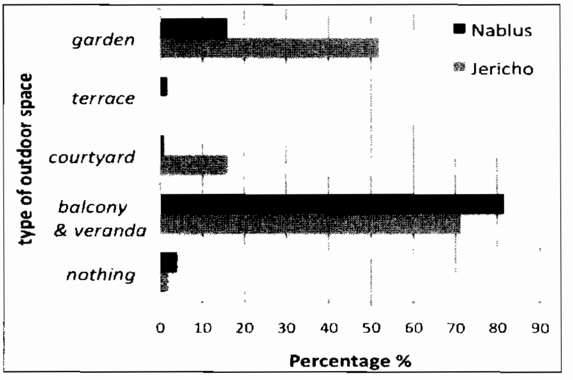

Figure 7: Percentage of current outdoor spaces in each city.

The comparison revealed some financial benefits as though courtyard housing of low-rise and high-density has proved to be efficient in land use. Besides, the sharing walls in these attached and grouped models require less maintenance and construction cost. Nowadays, high-density can be reached by multiplying floors number, and apartments while reducing the built site area for the sake of the new useless setbacks. In this perspective, Martin and March (1972) stated that courtyard model was better than the detached form regarding land use efficiency and economic sustainability: *"The court form is seen to place the same amount of floor space on the same site area with the same condition of building depth and in approximately one-third the height required by the detached form"* (p. 38).

3.2 Spatial and visual relationship

The central location of a courtyard in the traditional housing design enhances its advantage as the core organizing space of the house as most of the spaces have direct access to it, especially the living spaces *"Iwan"* where a fluid relationship between the two spaces was observed, which ensures a functional continuity forming an extension to each other promoting collective use. In addition, a visual relationship was ensured by the inward looking scheme was accentuated between the central courtyard and the different indoor spaces through windows.

Nowadays, the traditional courtyard was replaced by an artificially lighted corridor in the centre of a house, small balconies relegated to the periphery of the housing block and yards created on either the surrounding or the rear of the housing plot. The survey's results reveal that most new outdoor spaces are connected to one indoor space, while connecting two or three indoor spaces to the same outdoor space is rarely observed. The kitchen, or the bedrooms or the guest room are the most indoor spaces directly connected to outdoor spaces. Hence, this transformation from introverted design into extroverted had limited both spatial and visual relationship between indoor and outdoor spaces of the housing units, which reduced the opportunity those modern outdoor spaces be used collectively.

Moreover, the traditional living space *"Iwan"* was replaced by an interior living room away from any connection with the exterior environment, which reduced natural ventilation and lighting inside. Consequently for improving natural lighting and thermal discomfort, 62% of housing units in Jericho and more than 45% in Nablus were designed according to the western open plan concept (Figure8), in which no partitions are used between the living, dining, guest rooms and the kitchen in some cases, though this contradicts the Palestinian family privacy issue where the separation between private and public spaces, i.e. guest room, is indispensable. 64% of respondents reject this trend, whereas for those who accept it; they refuse engaging the guest room in such a design.

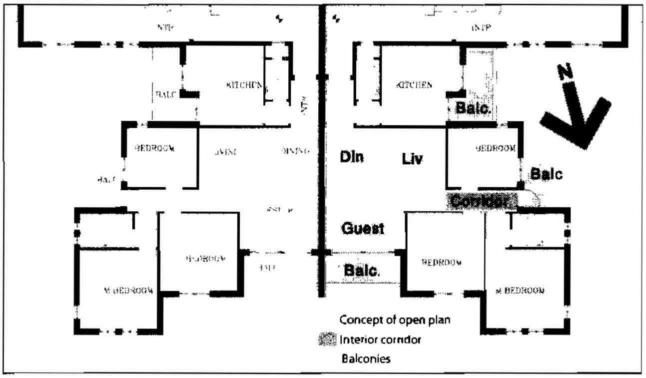

Figure 8: Example of contemporary apartment building.

Moreover, as a way of enhancing the environmental quality inside the living rooms, and getting a spatial extension connecting outdoor spaces to the living room is more preferable in future housing than connecting it to the guest room (over 65% in Jericho and 35% in Nablus).

3.3 Privacy and communality

The Palestinian cities, as well as the Arabian, were established in accordance with the community's values (religious, social and cultural), enhancing social life while respecting the privacy of each member (Bada, 2006). The traditional Palestinian settlements have succeeded to achieve the equilibrium between these two paradoxical principles (privacy and community). The courtyard, which was considered the sacred space for privacy and comfort inside houses, shaped the basic element that organized the whole city, while the shaded streets were the place of social life. In some cases of extended family that lives in the same house, the courtyard itself was used as a common space, while each nuclear family has its own private outdoor space (e.g. small courtyard or Iwan in Nablus, *Mastabeh* in Jericho).

Today, to cope up with lifestyle changes due to new technology and western influence, new concept of detached and free-standing blocks with surrounding unplanted area and shapeless urban spaces have replaced the traditional concept of compact courtyard housing, but failed to promote the social life due to the lack of collective activities (Ghadban, 1998), which, nowadays, have to be designed on the setbacks left around each apartment block, according to the new urban regulations, and the lack of municipal surveillance as though (Touffaha, 2009).

Privacy, which is a socio-cultural criterion, was behind choosing courtyard as a crucial element in Islamic house planning (Azab, 2008). The inward looking concept and the enclosure principle of the traditional courtyard have protected residents from both neighbours and passers-by curiosity. As for the current private outdoor spaces, 52.7 % of dwellers in Nablus and 43.4% in Jericho are disappointed of privacy low levels at their spaces. Women are most affected, 66% showed dissatisfaction. Moreover, privacy affects the period of using those spaces rather than their orientation towards the sun, regardless of the season. Hence, residents have applied individual modifications to their outdoor spaces seeking more privacy, such as window boxes, canopies and enclosed outdoor spaces by aluminium windows (Figure 9), not to mention their environmental benefits too.

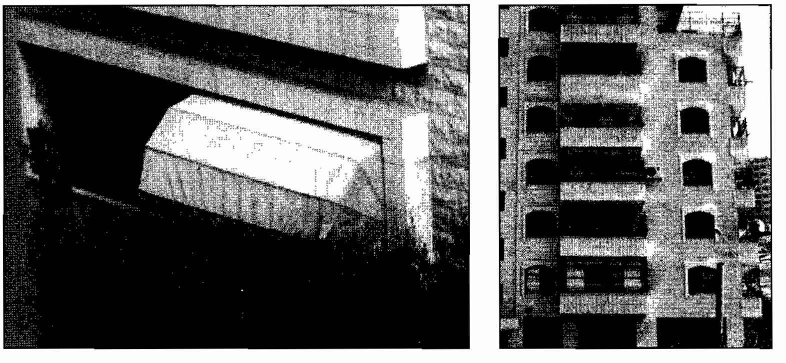

Figure 9: Individual modifications to the modern outdoor spaces.

The comparison showed that privacy and social life, the socio-cultural priorities in the Palestinian community, have enhanced the sustainable social quality in the introverted courtyard concept more than the extroverted contemporary outdoor spaces.

3.4 Accommodation for dwellers' activities

The courtyard, which is the heart and the focal space in the traditional Palestinian houses, derives its importance from its multi-purpose functions. It hosts the various socio-formal celebrations such as weddings and funeral ceremonies side by side, domestic activities such as kid's play, eating, collective cooking, sleeping, entertaining, family and women gatherings, etc. In fact the sufficient area of courtyard, (almost 20% of the total area of the house), has encouraged preserving such activities.

Nowadays, the outdoor spaces have been reduced to approximately 5% of the total area of a unit, which restricted the activities implemented. About 43% of the respondents prefer having a large outdoor space even for the sake of reducing interior, Regardless of its importance.

Outdoor spaces' area has played a role in determining the kind of activities, hosted. In Jericho, the most common outdoor social activities are gardening and guest welcoming. Gardening is still a reflection of agricultural image of this oasis settlement (Nazer, 2006), while in Nablus, family members' gatherings and washings' hanging are the most common. Receiving guests outside was classified as a third activity although the guest room is more connected to the exterior spaces than the living room.

The courtyard can provide a safe place for children to play under the elders' supervision (Reynolds, 2002), whereas in the modern outdoor spaces children play out in the streets, so a kid's playground was a priority for more than 75% of residents in the future housing, as it may enhance social interactions among neighbors and provide security for children (Marcus & Sarkissian, 1986).

3.5 Environmental considerations

The bioclimatic analysis of the two cities demonstrates the necessity for solar gain in winter, and natural summer ventilation in Nablus, while both of a solar protection and preventing the diurnal ventilation in summer are highly demanded in Jericho. Moreover, compact plans with courtyards are recommended as a layout and design concept for buildings (Haj Hussein, 2005).

The courtyard, besides its socio-cultural role, can provide a convenient outdoor microclimate and comfortable interior conditions if design details were taken into account (Givoni, 1998). The spatial analysis of the traditional Palestinian housing, especially in Nablus, revealed that the inward looking of house's spaces and the opened windows into the courtyard have ensured an access to natural sunlight and winds, where the openings onto the exterior were reduced to the minimum.

Figure (10) illustrates the frequent spatial organization of the traditional courtyard house. In addition to the northern openness of living room (*Iwan*) into the courtyard in order to make use of the northwest cool summer winds gathered in the courtyard, it has been oriented towards south for more sunlight in winter. In Jericho, the orientation of the house wasn't precise, where the urban fabric and boundaries have generally influenced it.

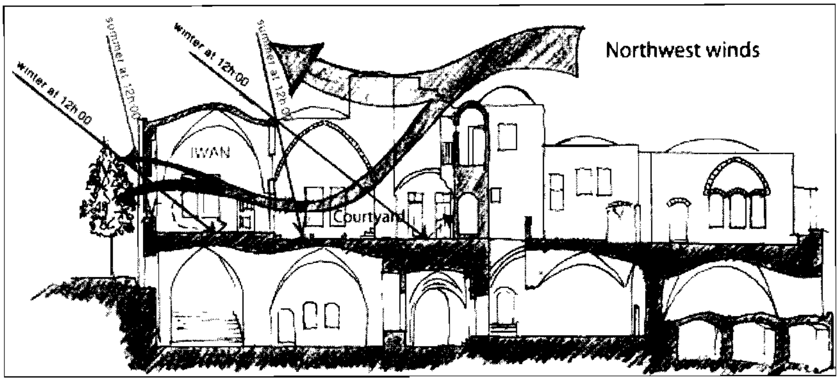

Figure 10: Environmental concept of the courtyard and Iwan, the solar angles were identified by the Solar Tool program.

The inward concept has assessed the indoor spaces with an opportunity of 360° of orientation, regardless of the external surroundings, which helped in controlling and modifying the amount of daylight and clear air penetrating the courtyard and its surrounding spaces as desired (Bagneid, 1988).

Nowadays, outdoor spaces' orientation is determined by the implantation of building on the site and the number of apartment per floor rather than the past climatic factors (sun and winds). However, over (40%) of outdoor spaces have a west orientation that may be useful for tackling the hot summer impacts, especially in Nablus, where the dominant winds come from the northwest, but that's not the case in Jericho where east and north winds are prevailing in summer. Moreover, diurnal ventilation is not recommended due to the high air temperature that could deteriorate the internal thermal comfort of houses (Haj Hussein, 2005).

Furthermore, about (40 %) of current living rooms, especially in Nablus, are isolated in the center of the house. As a result, (96%) of the occupants in Jericho and (57%) in Nablus use artificial air conditioning in summer while (65%) of the respondents in Jericho and (78%) in Nablus need heating devices inside their living units in winter time in a way to enhance both the low lighting level and thermal discomfort, although these devices are high-priced and energy consumer.

Landscape, which improves aesthetics inside traditional courtyard, has created a pleasant outdoor environment. Fountains and trees (e.g. citrus and palm) (Figure 11), were used to ensure a shaded place, humidify and cool air. Hence, the courtyard fulfilled its real function as a living space for family in interaction with nature.

Figure 11: Landscaping inside the traditional courtyard.

Nowadays, landscape is minimized in outdoor spaces, especially in apartment, to small flowerpots, at the time, having a small private garden represent a strong desire for most residents. Furthermore, the unplanted and leftover spaces around the housing blocks and wide streets are considered as a source of heat island problem in the city (Givoni, 1998), while the compact courtyard houses, shaded and narrow streets in the traditional city have reduced the influence of this phenomenon.

The presence of a courtyard has helped to reduce energy consumption where indoor environment was more comfortable than the apartment blocks, where a high-energy consumption has been observed.

4 Conclusion

This paper has studied the role of outdoor spaces in the Palestinian housing design in terms of sustainability through examining the current housing outdoor spaces characteristics, as well as social features based on residents' satisfaction. The survey's results showed that outdoor spaces could play a significant role for promoting future Palestinian housing living quality under certain conditions.

Environment and traditions are pre-requisites for sustainable solutions (Eben Saleh, 2004). Hence, the courtyard is a sustainable strategy where it was able to reconcile the different needs and goals of sustainable qualities (e.g. efficient use of resources, privacy, healthy, safe and usable spaces, etc.). Considering reintegrating this strategy in future Palestinian housing will be highly appreciated.

Privacy, size, usage, spatial organization, orientation and climatic conditions played a significant role in the contemporary outdoor spaces' efficiency as well as in the traditional courtyard. Neglecting such criteria in future designs can lead again to their under-performance today. Moreover, such spaces can improve the dwellings' comfort when used as a passive solar heating or cooling means, according to the climatic zone.

It's worth to mention that only qualitative aspects have been discussed in this paper. Further quantitative studies pertaining outdoor spaces and housing design are necessary to develop new models that may lead to satisfaction regarding inside and outside private spaces quality.

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Applying Environmentally Responsive Characteristics of Vernacular Architecture to Sustainable Housing in Vietnam

Phuong Ly[1], Janis Birkeland[1], Nur Demirbilek[1]
[1]*Queensland University of Technology, Brisbane, Australia*

Abstract

Over many centuries of settlement, Vietnamese inhabitants have developed a vernacular architecture that is well adapted to the region's climatic and topographical conditions. Vernacular Vietnamese housing uses natural systems to create a built environment that integrates well with nature. The vernacular combines site-sensitive, passive solar design, natural materials and appropriate structure to achieve harmony among nature, humans and the built environment. Unfortunately, these unique features have not been applied in contemporary Vietnamese architecture, which displays energy-intensive materials and built forms. This research is analysing how environmentally-responsive elements of vernacular architecture could be applied to modern sustainable housing in Vietnam. Elements of many types of vernacular architecture throughout the country are reviewed as precedents for future building planning and design. The paper also looks at culturally and ecologically appropriate legislative and voluntary options for encouraging more sustainable housing.

Keywords: *vernacular architecture, environmentally responsive design, sustainable housing.*

1 Introduction

Vietnamese originally inhabited the basin of the Hong River Delta – Northern Vietnam, then moved south, taking cultural aspects of their housing construction to the new southern settlements. Archaeological evidence shows that primitive vernacular houses were constructed in the area with climatically appropriate built forms, materials, and spatial functions (Tran, 1999). Unlike the nomads in northern savannahs, the Vietnamese settled down and cultivated the land. Housing typologies evolved in the South to adapt to harsher tropical conditions like typhoons, humidity and flooding through trial and error.

Vietnamese vernacular architecture evinces both socio-cultural and environmentally responsive design. From a cultural perspective, Vietnamese homes are where family members foster spiritual values, teach moral lessons and care for each other. Home owners, usually local peasants, took climatic patterns and regional conditions into account when constructing their buildings. The site planning, house layouts, and external gardens and landscapes work together to create a sense of place and community. Passive solar design significantly reduces indoor air temperature, induces natural ventilation, and protects the house from direct sunshine and rain. Locally available materials create robust structures that can stand up to natural disasters such as windstorms, typhoons and floods.

Applying Vietnamese vernacular housing principles to contemporary design could enable local inhabitants to preserve the regional traditions and socio-cultural values as well as to reduce negative impacts. Vernacular housing does not require resource-intensive methods and technologies in construction, operation, or maintenance. Indeed, the vernacular has, for thousands of years, been shaped by the natural context as well as regional ordinances and cultural norms. Therefore it can provide an effective model system for modern Vietnamese architecture.

2 Climate and Topography

Vietnam is a long S-shaped country stretching from 8°30' to 23°22' North with two primary climatic regions: Northern climatic region and Sorthern climatic region with the border on the latitude of 16 degrees north, which is located on the Hai Van Pass, Thua Thien Hue Province (Vietnam Ministry of Construction, 1985) (Fig.1). The regional temperature varies with the change of latitudes along the stretch of the country. Northern Vietnam has a humid and subtropical climate, while the South enjoys a tropical climate all year round with the two seasons, dry and wet. The whole country is influenced by seasonal monsoons which bring heavy rainfall to all regions. From November to April, the Northern region is affected by north-eastern monsoons which are cold and dry, while from May to October, highly humid monsoons come from south-west direction influence the South of Vietnam.

The temperatures of the country range from 12 to 34 degrees Celsius and the mean temperature is always higher than 21 degrees Celsius. The North has a cold winter where the temperature sometimes drops down to 6 degrees Celsius, while the temperature in the South remains stable between 21 to 34 degrees Celsius. The period of sunshine in the country annually is between 1400 and 2800 hours. Relative humidity is rather high in all regions, and usually over 77 percent. Rainfall is torrential with annual precipitation exceeding 1000 mm almost everywhere. Therefore, regional flora and rainforests are diverse, and have provided many types of timber for building construction. Heavy rainfall usually combines with windstorms, causing floods in many areas of Vietnam.

Mountainous areas occupy three fourth of the country while the remaining are low-lying coastal plains and deltas. Some higher points of the north-west mountainous regions and the central highland have lower temperatures than other parts due to their higher altitude. The slope of the topography gradually decreases from west or north-west to east or south-east. Dwelling areas and vast rice farms are located on the eastern and south-eastern coastal plains and deltas. The Hong River Delta in the North and the Mekong River Delta in the South are the two main 'granaries' supplying rice and agricultural products for domestic and export purposes.

Vietnamese inhabitants constructed adaptable houses that took these climatic and topographic conditions into account. The typical characteristics of Vietnamese housing, especially climatic features, can be identified in terms of site layout, passive design, material and structure.

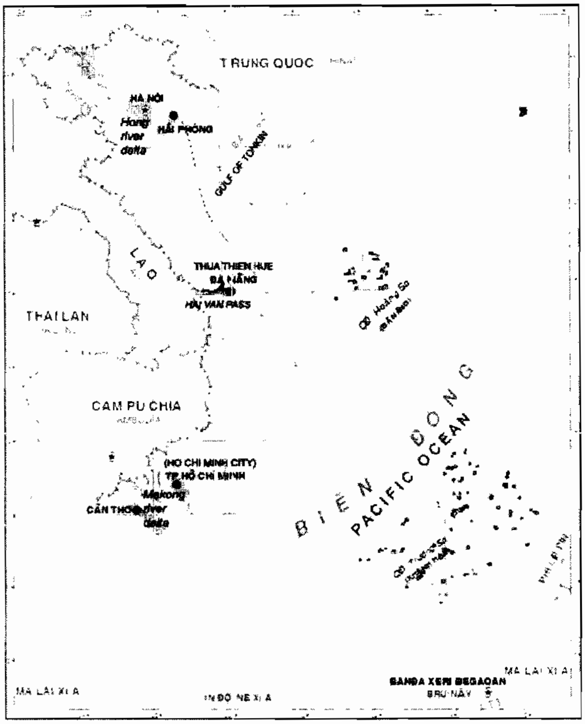


Figure 1. Map of Vietnam. Image edited from Vietnamese Government Website (http://www.chinhphu.vn).

3 Vietnamese Vernacular Housing And Its Typical Characteristics

Vietnamese vernacular architecture has evolved over thousands of years in South-east Asia and has adapted to its regional climate. Images of primitive vernacular houses were reflected on decorative motifs on the tympanums of ancient Dong Son bronze drums (including Ngoc Lu 1 bronze drum) (Fig.2), which are considered the physical evidence of Dong Son Culture, flourishing in the heartland of the Hong River Delta of Northern Vietnam from 2000 to 3000 years ago. The motifs show that the vernacular houses are an on-stilt structure, which has a saddle roof with two deep gables on two opposite elevation sides (Fig.2). This kind of housing is climatically-appropriate because of its heat-resistant tall roof, elevated floor, shaded overhang and lightweight materials for preventing solar access, increasing natural ventilation, and reducing humidity.

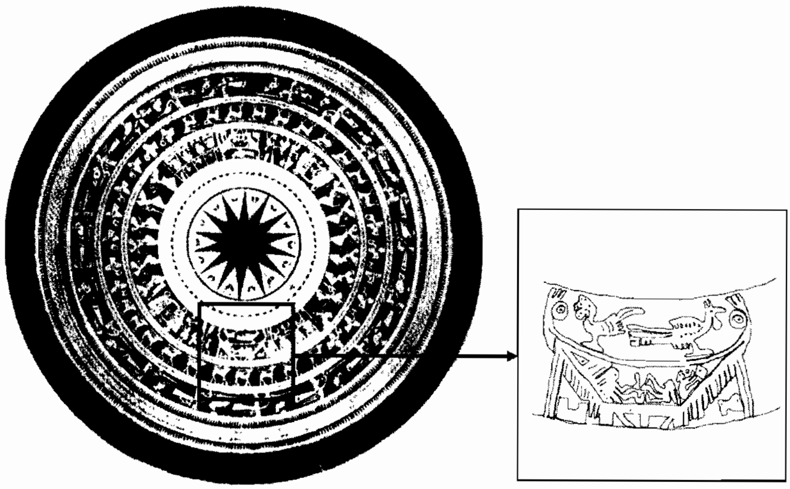


Figure 2. A climatically-appropriate house redrawn from the decorative patterns on the tympanum of Ngoc Lu I, one of the most known Dong Son bronze drums discovered in the Hong River Delta, Northern Vietnam. Photo of the Ngoc Lu I tympanum from Nguyen and Hoang (1975).

Vietnamese vernacular housing has evolved through trial and error to changing conditions of settlement, climate, ecology and culture over time. For example, houses with straight simpler roofs have been preferred over the previous saddle ones to enable quicker construction with limited local materials and skills. Likewise, the on-pile form of houses in the mountains was transformed into ground-lying structures on the plains (Nguyen et al., 2007). As a result, the vernacular was an improved structure to optimise regional climates and to provide comfort for occupants. In Northern Vietnam, the traditional home became a self-contained economic unit within its village that reflects cultural values. In fact, using natural means in construction to provide health and well-being for house owners is the most important function that the Vietnamese vernacular achieved.

Vietnamese traditional housing has adopted principles for designing building in the hot and humid tropics which, according to Lauber et al. (2005), induce maximum natural ventilation and prevent intensive solar heat loads in building living areas. In this paper, typical vernacular houses throughout the country are selected to exemplify their environmentally responsive characteristics. The characteristics are identified in houses located in both rural and urban Vietnamese regions. The houses all use numerous natural means of climatic control. However, common features are the strategies of organising the site, integrating passive solar design, using locally available materials and using appropriate structure.

3.1 Site planning

Depending on available land, rural houses optimize all parts of the site while urban houses, which are usually built on small and constrained plots, integrate with nature through site layout. Vernacular housing in Northern Vietnam is typical of Vietnamese rural houses, which were transferred to other southern areas of the country over the centuries. The rural houses are usually sited on a sufficient large plot that the appropriate orientation - the south in Vietnam - can be selected. Integral exterior design elements such as courtyard, ponds, and vegetation are integrated with the house. In urban houses located on a limited area plot, internal solar courtyards are oriented to induce breezes and to provide natural lighting. Both the rural and urban vernacular designs are adapted to each specific context to facilitate amenity and well-being for occupants.

The rural houses in Northern Vietnam incorporate many common elements such as main housing blocks with auxiliary blocks, sheds for poultry and animals, ponds, a courtyard, an open-air worship place, and vegetation (Fig.3). The compound is well organised so that energy from the sun and wind are optimised to control the house's climate. For instance, the main blocks of housing are usually designed with their long main façade facing south and linked with auxiliary blocks to form a courtyard in the middle. As the heart of the compound, the courtyard induces air flow to living spaces and captures sunlight for drying rice, cereals and clothes. The water ponds are located adjacent to the main blocks to provide cool air for the whole site during hot summers, and treat wastewater with aquatic plants. Fish, poultry, animals and vegetables provide on-site food. Indoor and outdoor places for worshiping the God of land, Buddha, or owner's ancestors reinforce the spiritual values of the occupants.

Water for household use is derived from different sources and treated by traditional methods. Water from ground-wells, rivers or lakes can be stored in containers for depositing and then filtered by tanks that contain layers of charcoal, sand, and grave. Most vernacular Vietnamese houses use rainwater harvesting system to provide water for cooking and drinking. Rainwater is also treated in the same method. After being filtered, water is boiled or baked under sunlight to eliminate bacteria.

In ancient urban areas such as Hoi An - the World Heritage Site in Central Vietnam - most vernaculars have a form of townhouses which have a unique to response to the environment. Located on a small rectangular plot, which is quite narrow on one side and very long on the other, the townhouses serve a dual function of both a shop and a shelter comprised of two or three main timber blocks, single- or two- storey, and solar courtyards between the blocks. Due to facing a street for trading, the selection of the optimal orientation for Hoi An houses is less important, but inside courtyards enable ventilation, lighting and air flows from the interiors to courtyards and vice versa via timber balusters and opening vents. With this type of architectural layout, the urban townhouses are cool and comfortable for residents.

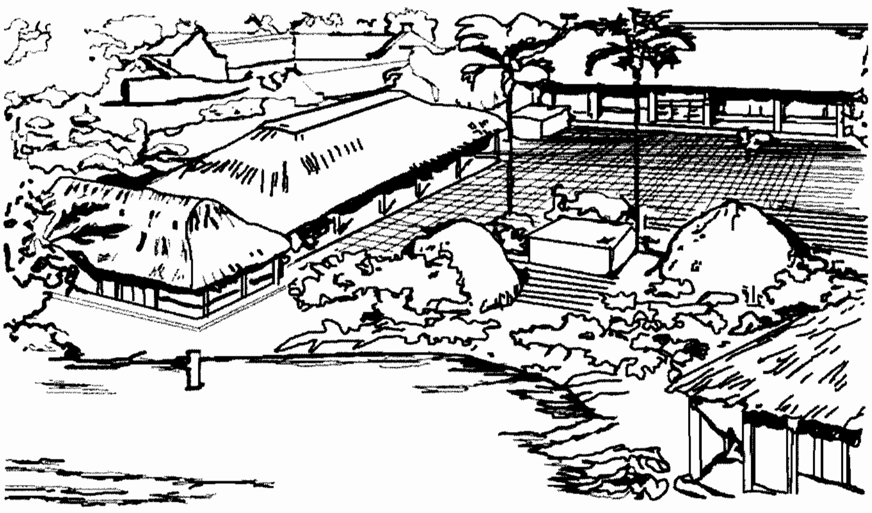


Figure 3. An example of a vernacular compound in Northern Vietnam. Image redrawn from Nguyen and Nguyen (1995).

3.2 Passive design solutions

While appropriate orientation and integrated layout are the two most distinctive organisational features when planning a traditional housing site, passive designs show skill in creating climate responsive housing. The house designs reduce the impacts of solar radiation, wind and rain on their living spaces. Typical solutions in the Vietnamese vernacular include solar courtyard, mediating space, envelope shading device, air vent, and surrounding greenery. Some archetypical passive means can be found in the housing model of Northern Vietnam (Fig.4).

The solar courtyard plays an important role in capturing sufficient natural lighting and cool breezes into rooms. The courtyard is necessary in a rural house. In fact, it is more indispensable in the urban house, which is usually located on a confined plot with surrounded boundary (Fig.5 & 6). As a leeward element, an internal courtyard orients natural air movement into the interiors from all wind directions, and thus cools the house. In rural regions, occupants are able to use the solar access from the courtyard to dry their cultivated rice and cereals. The courtyard provides a place of working and entertaining, and a sense of family identity. It is also a place where ritual activities are conducted.

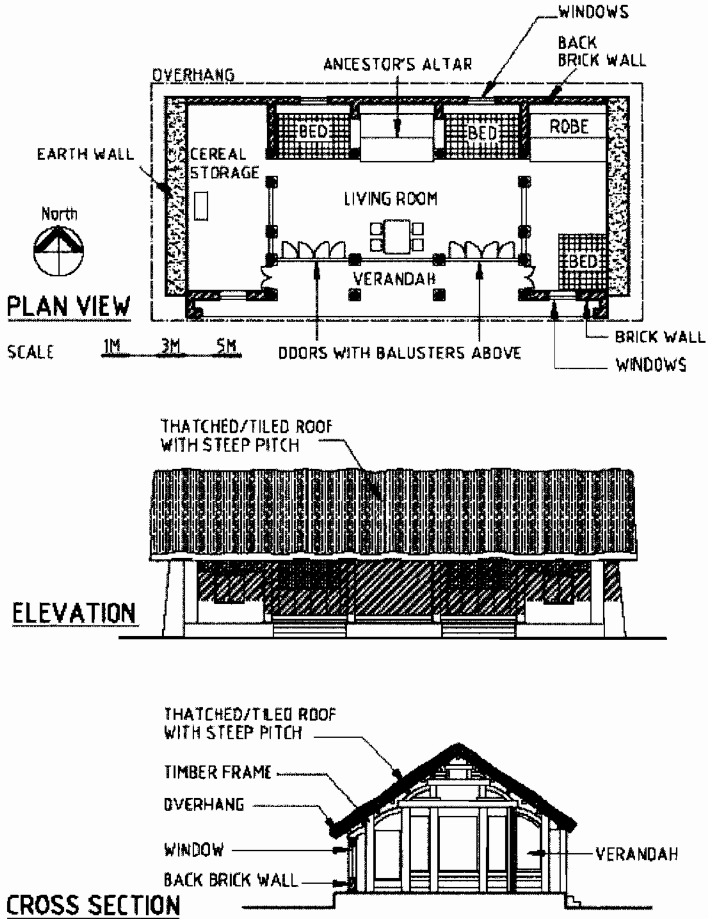


Figure 4. Climate responsive means of a typical vernacular house in Northern Vietnam: verandah, shading overhang, openings and air vents, and appropriate material use of the envelope. Image redrawn from Nguyen and Nguyen (1995).

Most, if not all, Vietnamese traditional houses have mediating spaces such as verandah, porch, balcony, or loggia. These play an important role as a buffer against direct sunshine and rain and connect the house with the surrounding nature. The air under these spaces circulates naturally, providing thermal comfort for occupants. Occupants spend a lot of time in these spaces during the day because they can enjoy cool breezes and daylight, and feel a sense of community. When staying in a verandah or a porch, the view to streetscape is more open than when sitting inside the house. Therefore, the mediating spaces are built with enough space as well as shade for family activities.

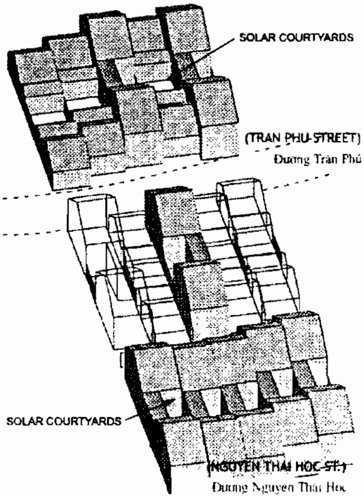


Figure 5. Layout of Hoi An urban townhouses with the use of courtyards to provide a moderate microclimate. Image edited from Institute of International Culture - Showa Women's University (2003, p.40).

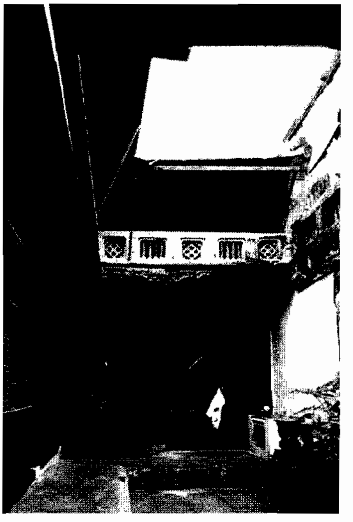


Figure 6. A solar courtyard of a townhouse in Hoi An ancient town, Central Vietnam.

Archetypical shading elements of the Vietnamese house include deep eaves, solar canopies and vertical screens. In the tropical climate, they avoid direct sunlight and rain on walls and external openings of the house. Selecting appropriate shading devices for the house is based on the orientation of housing facades. In Vietnam, the sun is in the south, thus north facades are shady all year round. Therefore, only canopies or verandahs on south elevation are needed to provide shade and air circulation. However, surrounding overhangs are used to protect the house from both sunlight and rain. The south elevation is thus important and become the front of most houses. Thick brick or earth walls with limited openings are used on the eastern and western elevations to avoid heat gain. As a result, even without the assistance of mechanical systems, indoor air temperature is remarkably comfortable.

Openings and air vents are used to make rooms airy. In the climate of Vietnam, the wider the openings are, the more natural ventilation is provided for the house. Natural ventilation replaces polluted and hot indoor air with a fresh and cool breeze. In some areas, ceiling fans in the house are combined with the natural ventilation strategy to provide more comfort. To increase the ventilation effect, openings and air vents are built on the external walls, on internal partitions, and on the front doors of the house with a form of top balusters (Fig.7 & 8).

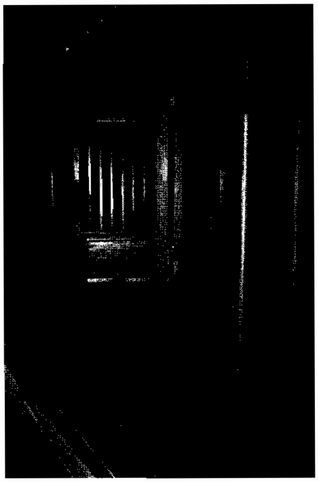


Figure 7. Balusters on doors as air vents for providing ventilation.

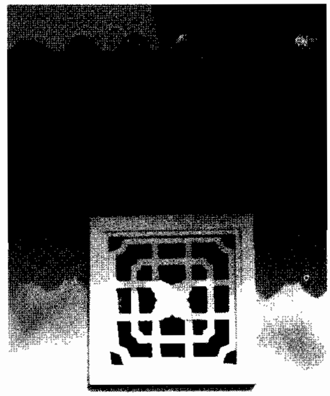


Figure 8. Popular air vents used in vernacular Vietnamese housing.

Last but not least, green spaces are integrated with the Vietnamese house in fruity, herbal, and decorative gardens. They provide landscape, shade, air filtering, food and a reduction of the ambient temperature. On the front of the house, tall slender-trunk palms and herbal shrubs are planted to allow prevailing cool breezes into the house while lush vegetation used at the rear. In Northern Vietnam, rear gardens protect the house against northern cold strong winds in the winter. Gardens also incorporate with solar ponds to regulate the microclimate. Pergolas, trellises, and hanging flower pots contribute to the pleasant living environment.

3.3 Materials

With skills and experiences handed down over many generations, local craftsmen and masons have obtained practical knowledge of material use. They use timber logged from local woods for housing frames. Non-wood plants such as bamboo and rattan are used in construction in various areas as they are cost efficient and locally available. Combined with bamboo frames, rural housing uses inexpensiveness and environmental friendly thatch from rice stems or nipa palms for roofing and walling. Additionally, materials from clay and earth such as fired-clay bricks and tiles are used to build floors, walls, and roofs. Local availability of these materials and simple hand-manufacturing techniques have meant these products have been refined over the centuries.

Timber is popular in most types of Vietnamese vernacular architecture. It is selected for their durability in moist conditions and termite resistance. Timbers from *gỗ mít* (jackfruit-wood), *kiền kiền* (peck-wood), and *gỗ lim* (iron-wood) are chosen in construction according to the value of the house. Timber is used to make trusses, frames, columns, girders, and beams in both rural and urban traditional houses which have a life span of several centuries.

Low-cost vernacular houses use bamboo and rattan for roofing and framing because of their rapid growth and their ready availability (Fig.9). They are treated using traditional means before use to reinforce their resistance to termites and decay. A thatched roof and wall are combined with a bamboo frame to provide a cool interior atmosphere because these materials have a low-heat transmission and high insulation properties. Bamboo fibres can be woven to make walls, shading overhangs, and solar screens of the house.

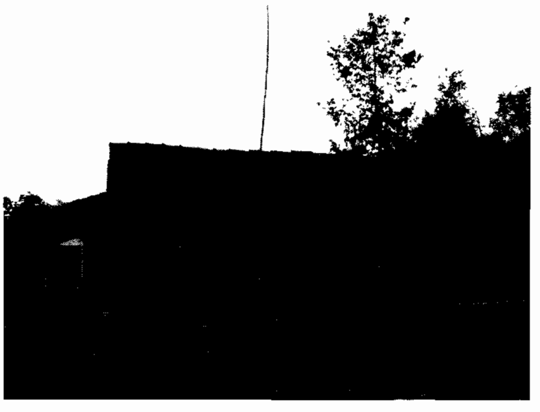


Figure 9. A vernacular house with a thatched roof and wall on a bamboo frame in Tra Vinh Town, Southern Vietnam.

Earth and clay products in forms of compressed earth brick, fired brick, fired tile for roofing and flooring are traditionally used in Vietnam. Earth or brick-work can be walled, based on the orientation of the house to reduce cold wind impacts and provide more privacy. Before the import of cement technology, brick mortar was a mixture of local materials like lime, sand and cane molasses. This traditional mortar has been researched and applied in the conservation and restoration of ancient royal buildings in Hue heritage city, Central Vietnam (Vietnam News Agency on website of the Ministry of Construction, 2009). Roof and floor tiles are commonly selected for housing because of their durability and aesthetic value. Double roof and yin-yang roof of the vernacular are insulated enough to cool the interior without a ceiling system (Fig.10). In fact, most vernacular houses do not have a ceiling because it can prevent air circulation in the roof space. Moreover, the owners can use this space for storing food during floods. Earth and clay products can be mixed with rice husks or straw to make the mixture support more loads.

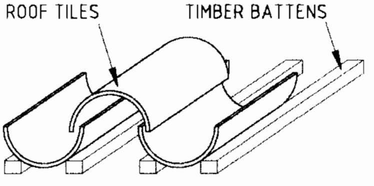


Figure 10. Construction detail of a yin-yang roof. Deep furrows of the roof provide shade and channel rainwater runoff.

The double roof and yin-yang roof are commonly used in Central Vietnam because they can efficiently avoid heat. To provide a cool microclimate, the double roof is comprised of a top thatched roof and a tile layer over a bamboo woven base or timber battens. Air can move into the gap between these layers to ventilate the roof space (Nguyen and Nguyen, 1995). The yin-yang roof is another type of climatic roof, which can shade itself from eastern and western sunshine thanks to its wavy configuration.

3.4 Housing structure

The structure of the vernacular house is made of a timber skeleton and components such as girders and beams, melded together by ties, mortises and joints without modern technical nails and bolts. Traditionally, a main or an auxiliary timber housing block has an odd number of tiered divisions (such as three, five, or seven) with or without two additional wings. Houses with the odd tiered divisions can dedicate the middle compartment to worshiping Buddha and the owners' ancestors. In a cross section, timber trusses, formed by an arrangement of girders and columns, support a pitched tiled or thatched roof. Diverse types of timber trusses have been used in Vietnamese vernacular housing over time according to regional conditions (Fig.11).

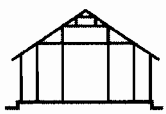
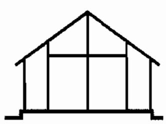
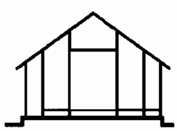
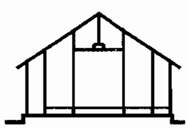
Name of the truss	Diagram	Applied regions
Kèo suốt giá chiêng (Truss with continued multi-layer beams)		Northern Vietnam
Kèo chữ thập (Cross-shaped truss)		Typhoon-prone areas of Central Vietnam due to its wind resistance
Kèo trính (Bridging beam truss)		Flood-prone zones of Central Vietnam due to providing provisional attic for storage
Kèo trính có trụ đội (Bridging beam truss with a prop)		Typhoon and flood prone regions of Central Vietnam

Figure 11. Some examples of timber truss archetypes used in various regions of Vietnam (Thai, 2005).

4 Applying Traditional Characteristics of Vietnamese Vernacular Housing into Contemporary Buildings

Contemporary housing in Vietnam shows environmentally problematic issues which reduce residents' and ecosystems' health and consume more energy and resources. Urban and rural planning regulations have resulted in very dense development patterns to accommodate an increasing population. These regulations do not encourage housing configurations that can take advantage of prevailing winds. Most modern Vietnam housing does not have enough voids for natural air flows, and road direction and vegetation limit the ventilation or shading of buildings.

Vietnamese vernacular architecture is a source of precedents for modern architectural design in terms of its environmental harmony and resource efficiency. Learning from the vernacular does not mean simply copying traditional forms, massing, details or materials. However, by analysing vernacular designs, general lessons or principles can be drawn and applied to future designs (Rapoport, 2006). Legislative and voluntary options can encourage an integration of available resources on site, apply passive design solutions, use local and environmental-friendly materials, and select appropriate structure for the house. Climate responsive strategies applied to contemporary architecture can enhance living conditions and a sense of place and community while protecting ecosystem and the broader life support system.

This research develops guidelines for climatic housing in Vietnam that allows for design creativity and variety. These guidelines consider site analysis and organisation, passive design, material use, and housing structure that can create the sustainable environment for Vietnam.

4.1 Site analysis and organisation

A thorough analysis of the site can better utilise on-site resources and avoid compromising ecosystems and cultural values. Contemporary houses, if having a well-integrated site based on vernacular design, can provide comfort and well-being to occupants with limited energy and resources. The following strategies should be considered:

- **Understand the site contexts and conditions** - including the ecosystems and surrounding habitats, climatic patterns, topography and cultural influences.

- **Protect and improve surrounding natural water systems** which regulate the microclimate and to facilitate rain water runoff.

- **Prioritise south facing buildings** which can capture cool breezes in summer and solar heat in winter (for housing in Northern Vietnam with a cold winter).

- **Select local vegetation** to protect the house from solar access and to channel the air into the building. Shrubs and slender-trunk palms are traditionally planted at the front, and lush and fruit trees are selected at rear for wind control.

- **Integrate the house with courtyard** for air circulation, especially in urban houses which are confined to a closed plot (Fig.12).

- **Combine passive cooling strategies with housing structure and shape** to provide human comfort in Vietnam climate while saving resources.

- **Harvest and purify rainwater** to provide sufficient water for household use; Apply different efficient methods to collect potable water such as solar still and transpiration techniques.

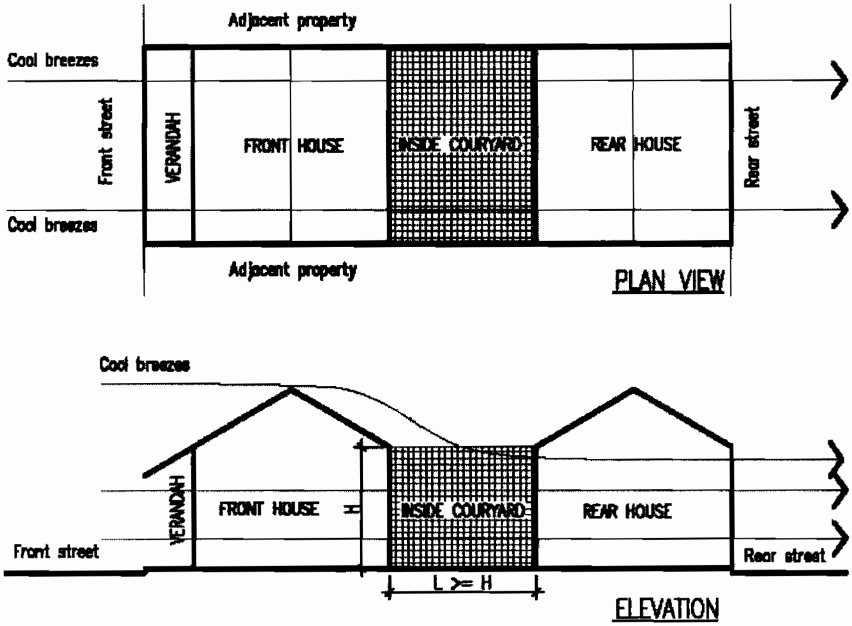


Figure 12. Cool breeze optimisation through internal courtyard and plan layout in an urban ancient house.

4.2 Passive cooling design strategies

Passive cooling strategies can provide natural ventilation and protect the house from heat and rain: the greatest impacts on tropical housing. New technologies for contemporary housing can reduce the impacts of sun and rain but use energy needlessly. Following strategies can be taken into account when designing houses:

- **Construct houses on high ground level or on stilts** for capturing natural breezes for ventilation.

- **Maximise openable windows and air vents** to provide natural air movements through the house. Use top balusters or top hung widows on doors to encourage cool breezes while providing privacy.

- **Use double windows with outside louvers and inside glazing** to provide flexible control in all weather conditions.

- **Ventilate roof spaces naturally** by installing air vents on gables and eave ceilings; Consider double roofs with air space in between for thermo-siphoning.

- **Arrange narrow single rooms** on the layout for natural cross ventilation and heat avoidance. In Northern Vietnam, for example, building with a ratio between its length and depth of 3.7 can maximally reduce sun radiation on all its facades (Fig.13).

- **Guide cool breezes through the building** by using window fins, buffer spaces and courtyards.

- **Use shading devices** such as overhangs and eaves for reducing unwanted heat gain, especially on south facades to shade windows. Moreover, the overhangs also control rain access.

- **Apply thermal insulation to roof**, using natural insulation materials or an air gap.

- **Use lightweight structures** rather than thermal mass construction to avoid heat storage affecting the house.

- **Apply trellises, green walls, and green roofs** to reduce heat gain from the exterior envelope, especially in urban buildings with limited land for gardens.

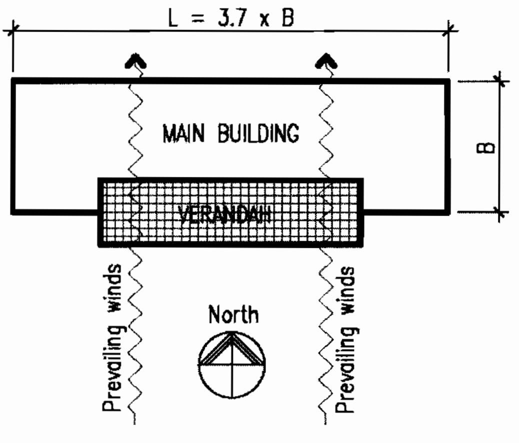


Figure 13. Optimal configuration of a building plan to direct solar radiation in Northern Vietnam.

4.3 Material use

Although hi-tech materials are now imported and used in contemporary Vietnamese housing, local materials are more aesthetically and climatically appropriate. The house will help to create a sense of place if it is built with materials from its own region. Therefore, the use of materials for housing needs to consider the principles below:

- **Use locally appropriate materials** to benefit from cost and energy savings, from the employment of the local labour force, and from the resistance to extreme weather events.

- **Apply rapidly growing renewable materials** such as bamboo, rattan and thatch with a non-polluting treatment process where possible and utilise traditional skills in the use of these materials.

- **Develop technologies for producing durable building materials** from abundant agricultural by-products such as coconut and rice husks (Fig.14).

- **Reuse and recycle materials** where possible to reduce negative impacts on the environment. Timber beams, bricks, doors, windows, steel sheets, cladding panels, etc are reusable elements.

- **Design buildings for disassembly** to facilitate the reconstruction and adaptation process and reuse the materials of building components, including structural skeleton, doors and windows, and roof system.

- **Design buildings for durability and flexibility** to limit the extraction of new construction materials.

Building durability relates to the use of appropriate materials and technologies to avoid condensation and water ingress that can rapidly damage the building.

The flexibility of design aims at providing the capacity for space transformation according to functional changes of the building. This strategy suits the traditional construction of Vietnam as vernacular housing has used assembled timber structure skeletons and a flexible interior space layout.

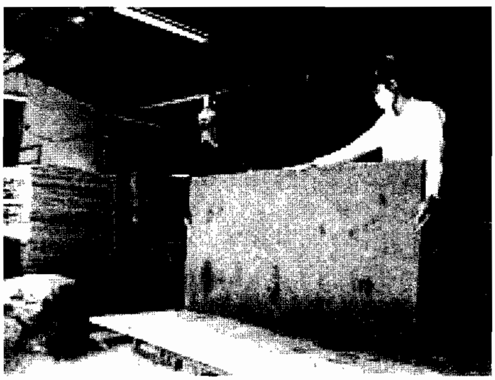


Figure 14. Manufacturing flooring panels from coconut husks in Ben Tre Province, Southern Vietnam. Image from Nguyen (2007).

4.4 Structure

From the lesson of vernacular Vietnamese housing, selecting an appropriate structure for the house is based on specific conditions of the region. The structure should be strong and durable to resist to typhoons and floods which annually affect Vietnam.

- **Reinforce the house in typhoon prone regions**, especially in Central Vietnam, by using storm-resistant types of structure or cable reinforcement.

- **Combine the structure with spatial functions** such as high level storage and shelter to provide optimal adaptability to weather events.

- **Prioritise locally appropriate housing shape, roof pitch, and plan configuration** because they have been evolved over time by trial and error.

5 Conclusion

Contemporary Vietnamese housing should learn from vernacular archetypes to provide greater comfort and reduce negative impacts on the environment. The Vietnamese vernacular housing has become climatically adaptable over time due to the use of on-site integration, passive cooling strategies, natural materials, and appropriate structure. Climate responsive design also creates a sense of identity. Based on the fundamentals from the vernacular houses, guidelines for contemporary housing aim to provide comfort and well-being while lessening burdens of the environment. The guidelines consider sustainable issues, including building orientation, site layout, passive design, suitable material, and appropriate structure in the Vietnam hot humid climate without limiting design creativity. The points in brief are summarised in the following table (Table 1).

Table 1. Climate responsive strategies of the vernacular design applicable to contemporary houses.

Catalogues	**Climate responsive indicators**	**Strategies**
Site organisation	*Orientation*	Priority to north - south orientation to attract prevailing winds and less solar access.
	Integration with nature	Consideration of solar path, wind pattern, vegetation and solar pond in housing design.
	Ventilation optimisation	House on high ground or elevated floor. Use of courtyard and mediating space for air circulation.
	Vegetation	Strategic placement of vegetation on site to channel air movement and provide food and shade.
	Water	Harvesting and purifying of groundwater, surface water, and rainwater. Application of water collection methods of such as solar still or transpiration techniques to provide potable water.

Passive design	*Roof*	Thick roof or double roof to reduce solar heat gain.
	Ceiling	No ceiling for maximum air circulation under the roof space.
	Wall	Use of different exterior types of wall according to the orientation.
	Window and opening	Large windows and openings on south and north for natural ventilation. Openings limited on east and west.
	Door	Full width doors with balusters/hung windows on top for air movement.
	Protection device	Overhangs over windows and wall openings for sun and rain protection, especially on south façade of the house.
Material use	*Local availability*	Use of local timber, thatch, bamboo, and earth products with a consideration of durability and moisture resistance.
	Lightweight	Use of materials with low heat retention and transmission.
Structure	*Type selection*	Use of appropriate structural types based on regional conditions. Priority to local housing shape, roof pitch and plan configuration.
	Functional combination	Structure design integrated with occupant's needs to provide adaptable space to harsher weather events.

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Decoding the DNA of Places towards Exploring a Deeper Layer of Urban Sustainability

Dalia Taha[1], Gasser Gamil[2]
[1]*Department of Architecture, October 6 University, Egypt*
[2]*Department of Architecture, Misr International University (MIU), Egypt*

Abstract

Traditional valuable urban places enhance our understanding, enjoyment of our surroundings, and contribute to our sense of place, sense of identity and general well-being. Therefore, those urban places are not only a concern of urban sustainability, but they can be seen as the essence of sustainability with its inherent characteristics addressing both cultural and ecological contexts.

For the purpose of urban sustainability in such places, there is a need to decode the architecture and urban patterns and characters to reach the DNA of such places in order to explore a deeper layer of its identity and get a set of basic place dimensions that give the character of sustainability. The idea behind decoding the DNA of the built environment could be perceived as exploring meaning and values that constitutes those environments and generate its building codes and vocabularies in order to be able to reproduce these environments again.

Keywords: *urban sustainability, place, DNA of the place.*

1 Introduction: The Era of Urban Sustainability

Sustainable development means simply that in a global context any economic or social development should improve, not harm, the environment. The goal of sustainability, therefore, is mainly to sustain human communities by development that does not destroy the fundamental environmental life supports systems. The field of sustainable development can be conceptually broken into three constituent parts: environmental sustainability, economic sustainability and sociopolitical sustainability, as shown in (see Figure1).

Urban sustainability involves new expanded urban and architectural design processes, which look beyond concerns with the external appearance of development to consider aspects of relationship of buildings and spaces between buildings or between the public and private realms.

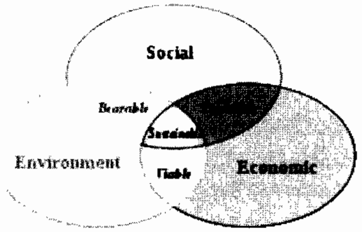


Figure 1: Sustainable development made of three constituent parts

The sustainable design process will benefit from the collective genius of all the individual stakeholders. Thus, for the architect and urban developer, both challenges and opportunities will greatly increase in the design and management of the sustainable city of the future. This includes needs for creativity, safety and security, shelter and a healthy living environment.

In this context, a complete theory and process for generating and operating a sustainable city has emerged, which put five operating principles to the sustainable city by defining sustainability as: a local, informed, participatory, balance-seeking process, operating within an equitable ecological region, exporting no problems beyond its territory or into the future.

The definition starts by identifying the "place", where sustainability could happen;*"Sustainability is a local"*. "Local" is to be read as a *place* (a neighborhood, a city or a region) where sustainability achieved. This *place* defined the largest scale capable of addressing the many urban architectural, social, economic, political and other imbalances, and simultaneously, it is the smallest scale at which such problems can be resolved in an integrated approach. The sustainability of such a place depends on a series of factors which contribute to the quality of life, sense of place and recognition of identity.

2 Place in Sustainability

Place can be seen as the essence of sustainability with its inherent characteristics addressing both cultural and ecological contexts. The use of the Place concept is proposed as a holistic and integrated approach to sustainability projects specifically for developing urban design for sustainability. It is a way of looking at issues from the point of view of human experience, where all design strategies are structured and interrelated for human perception, understanding and action in everyday existence, (Moser, G.& etal, 2003)

In the following sections of this paper, an intensive study of "Place" would be carried out to cover the four basic elements that must exist in order for place to be experienced as meaningful partner in urban sustainability process. These four elements are *man, culture, nature and space*. We strive to understand ourselves and our life by understanding our position within the world, and thc relationship that exists between man and nature. Architecture strives to reflect this relationship and understanding that we have of the world. We build to create a sense of place, and with the help of "place as tool" it may be possible to understand sustainability as an interdisciplinary ficld focused on the interplay between humans and their surroundings.

3 Meaning and Significance of Place

Place, is a rich concept and a very difficult word to define because it relates not only to the physical surroundings but also the mental ones too. (Wilson, 1997), pointed out, "*Place* is a physical geographical entity, a "portion of space in which people dwell together" as well as a "position in a social order".

The concept of place can be understood from two perspectives. In one sense, *place* is the *concrete setting* for human lives. It gathers people in webs of activities and meanings and provides the physical expression of people's cultures in the form of landscapes. It is thus the local settings which is fundamental in the everyday lives of individuals, and at the same time, provides the context for collective acts of the community.

In another sense, place may be thought of as a "continuous process of becoming" (Pred, 1984). This means that place-making is not confined to *here and now,* or in other words, it is not confined to the concrete settings of the present, but rather, it includes places of past experiences (memory), those which be inherent in the imagination, or even those places, which exist in simulations and iconographies (re-presentations). In fact, place is often constituted by a nesting of different, but overlapping, images and interpretations.

Place also has multiplicity of meanings. As (Goss, 1988) suggests: people "'read" and "write" different languages in the built environment". Such multi-coded meanings take shape at both the personalized and collectivized levels. Places can maintain a position of significance for individuals because of preserving personalized memories and they are centers of everyday routines. At the same time, collective emotions, memories, and attitudes too can accord meaning to place. The resultant social places, or "communal sites", as

(Rotenberg, 1993) terms them, are similarly textured by multiple layers of everyday meanings and remains of history. When both personalized and collectivized meanings intersect, place meanings are enhanced.

Exploring meanings of place has produced analysis through multi- disciplinary perspectives. Anthropologists (Richardson, 1982), social psychologists (Altman, 1975), and architects (Rapoport, 1977) have contributed diverse perspectives to the understanding of the importance of place in everyday lives. While varied, they attempt to bring together a range of voices, including geographical, sociological and planning perspectives, and embodying the geographical and sociological imaginations to understand the meanings of place. By exploring the meanings in place along these various axes, it is evident that there is no singular meaning assigned to a place nor a singular way of deriving those meanings.

4 The DNA of Place: Man, Culture, Nature, and Space

DNA is a nucleic acid present in the cells of all living organisms. It is often referred to as the "building blocks of life," since DNA contains the genetic instructions used in the development and functioning of all known living organisms.

The information in DNA is stored as a code made up of **<u>four chemical bases</u>**: adenine (**A**), guanine (**G**), cytosine (**C**), and thymine (**T**). All the biological instructions of a human being can be written with these four letters. The order, or sequence, of these four bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences, (see Figure 2-a).

The DNA segments that carry this genetic information are called genes. A gene is normally a stretch of DNA that holds the information to build and maintain an organism's cells and pass genetic traits to offspring. All organisms have many genes corresponding to many different biological traits, such as eye color or number of limbs.(Wikipedia, 2010)

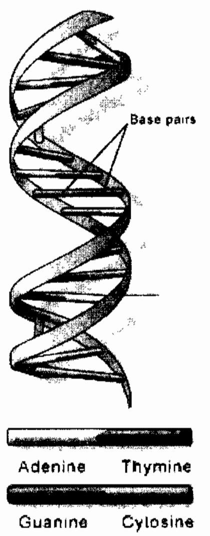


Figure 2-a: The DNA bases

All genetic code is spelled out with just four chemical letters, or bases: adenine (**A**), thymine (**T**), cytosine (**C**) and guanine (**G**). These pair up, (**A**) with (**T**) and (**C**) with (**G**). The human genome has between 2.8 and 3.5 billion base pairs. Decoding the DNA of organisms and discovering the rules that govern its systems enable researchers successfully to enhance the conservation of many animals and plants on the earth using genetic engineering technologies.Building on this success, the paper poses the question: why not in urban sustainability?

Therefore, the paper adopts the hypothesis that conserving the DNA of places will ensure its sustainability.

Place is the philosophical aspect of architectural theory that recognizes the existence of man and the spirit of nature. The ways in which Man builds define an understanding of how his life coexist with Nature. The way in which refelect our Culture and experience our natural surroundings can be defined by the Spacein which we live. The nature of place meanings could be enhanced through a deep understanding of place genetic map.

Like Adenine, Guanine, Cytosine, and Thymine in the biological DNA, the four bases of the DNA of the place; man, culture, nature, and space, (see Figure 2-b). These bases need to coexist in a meaningful way in order for an experience of place to occur. The purpose of this paper in exploring the DNA of place is in an attempt to reveal the characteristics of these four bases and the interaction between them, which must be present in order for a place to be experienced as meaningful. However, "Place" itself, is not a theory, it is the starting point from which all design for built environments should begin, and the start point for urban sustainability to be achieved, (T., Marilyn, 2007)

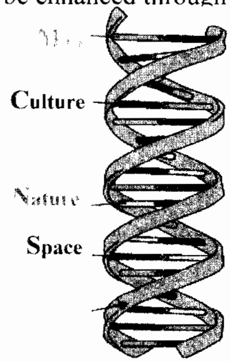


Figure 2-b: The DNA of Place

MAN: Place is deeply rooted in the relationship between man and nature and how we experience this relationship. It is always Man's desire to understand about himself and his existence that gives life meaning[i]. Architectural theory also shares this same interest in developing an understanding to the meaning of our existence and examines how we can use it to create buildings and cities that enhance this aspect of human life.

However, architecture, through its ages, has made many and different attempts to deal with human experience and meaning. In Pre- historic periods, architecture was a relation between Man and Nature. Ancient architecture (Egyptian, Greek, Roman) was schemed by man's relationship with the universe and it paid honor to the gods and the rulers of their time. Architecture of these times illustrates the relation between Man and God. Starting from Renaissance age, architecture is a relation between Man and Science. The 20th century architecture is described as the architecture of Man and Economy. But it wasn't until the early 1960's that human value once again entered architectural theory. Modernism, in its attempt to "repair the fracture between thought and feeling", (Schulz, 2000), failed to relate built-form with the environment and became an architecture of image. The movements that followed; high-tech structuralism that was intended to satisfy thought, postmodernism that was intended to express feeling and deconstructivism that go against all meanings, never managed to complete the necessary components for an architecture of meaning,(see Figure3).

Man's journey to understand the meaning of his existence is elaborated in the philosophy of existentialism that comes to describes man's desire to make rational decisions in the universe and define his own meaning. However, in the shed of this philosophy, place comes to mean *a space with experience added in.* Through interaction with a space, individuals are able to develop a sense of place. "Experiences" means perceiving, doing, thinking, and feeling".

Figure 3: The Relation between Man, Nature, God and Economy

As existential space begins with the environment, so where nature does not satisfy our human existential needs, we modify it to suit - constructing our own physical world that represents our personal existential beliefs, (Schulz, 2000).

Thus, what is important to learn from the study of existentialism is an understanding that the human aspect of architecture must also be considered separate from the objects that make up our environments, so that the human experience of place is not artificially imposed, (see Figure 4).

Figure 4: Modification of environment to suit existential beliefs- building process in a stable Bambara-Mali

Complementary to the study of existentialism (which added the *experience* dimension to spaces), it is important to highlight the human experience that would affect those *spaces* and turn them to *places*. The interpretive study of human experience is embedded in another philosophy called Phenomenology, (Schulz, 2000). Phenomenology deals with the phenomena that make up our physical world. There are tangible phenomena such as rocks, water, trees, sun, moon, stars, animals and houses – and there are intangible phenomena such as our feelings. Everything else; atoms, molecules and data, are abstractions – they are tools that serve other purposes. The concept of place is concerned directly with the content of our existence, rather than the tools. The aim of phenomenology is to examine and clarify human situations, events, meanings, and experiences as they spontaneously occur in the course of daily life.

CULTURE: includes tangible things like tools, clothes, shelter, and intangible things such as beliefs, ideas, behaviors, and practices. Cultural expression in place means the physical representation of a community identity that demands to be passed on to others, (www.humanculture.net).

In exploring the relationship between place and culture, we identify two interconnections: first, that place has its own culture, a character and personality that distinguish it from other places; and second, that people identify with a place, (see Figure5). Feel a sense of belonging and attachment to it. The latter may derive from the former, though it may quite as well exist independently of the other.

Figure 5: Traditional houses in one of Indian settlement

The culture of man- made place is determined by the study of both tangible components: Natural Systems; Land Uses, Patterns, Spatial Organization; Visual Relationships; Topography; Circulation Systems; Water; Features, Natural and Constructed; Structures and Buildings; Spatial Character, Form and Scale; Vocabulary of Site; Furnishings and Objects. These are the tangible forms, features and overall character of the place cultural landscape that expresses its spirit. Alongside these tangible elements, there are other intangible components and values that are nested within place, (www.humanculture.net).

These rooted intangible values are expressed in places that are used for: Festivals, Traditional music, performance; Worship and ritual practices; Traditional practices; Gathering place for native plants; Gathering place for craft materials; Iconic shared community place of memory and present use. Culture establishes an atmosphere, contributing to place form and substance and give it its character. There are three aspects that can be considered as factors that affect the character of places. These aspects being: use, custom and style.

Use of a place affects how it is formed and can determine its character. Use is not only in reference to a particular function that the space is to conform to; it is also related to how we move about in the world and how we experience place – how we use it, (see Figure 6). These other aspects of use pertain to arrival (path/entrance), departure, encounter (experience/atmosphere), meeting (social encounter), clarification (context), retreat and isolation.

Figure 6: Different uses of space in Upper Egypt settlements

Customs: are responses to the traditions that are found within a locality or culture, or by the vernacular of a particular environment. How a building is structured or constructed should be characteristic of the local traditions, materials and customs (see Figure 7).

Figure 7: Customs and traditions of building affect character of place

This is seen more evidently in historical and traditional places and also in some countries such as Rome, Spain, and Italy– where the traditions of building and the use of material have clearly defined the character of the buildings and places of their time, (www.humanculture.net).

Style: also is considered to be a guide to the culture of place, and an aspect that affect its character. Style reflects a language that can be understood from country to country. Because it reflects common meanings or those values found in our universal conscious, (see Figure 8). Style is composed of forms **that are used to create a new totality, as** has been evident in the classic architecture.

Figure 8: Different styles give different languages and meanings of places

Place culture is therefore stemmed from the cultural dialogue between the place users with their surrounding built environment. It comprises all physical and perceptual features of the environment, and it is part of the individual's ongoing processes of emotion and self-regulation that may involve one's sense of self. Meaningful place–making is to develop the sphere where conscious reflection takes place. Such sphere should aim to enhance local memories and experience and makes it explicit and understood by inhabitants as well as other users. A disruption in the continuity of experience will lead to what so called place-less-ness.

NATURE: In the same way that we attempt to define man and culture as bases of the DNA of places, we will also try in this sub- section to gain an understanding of place from natural environment perspective. The natural environment is the physical canvas on which we build, (see Figure 9). Nature exists naturally without the presence of human life.

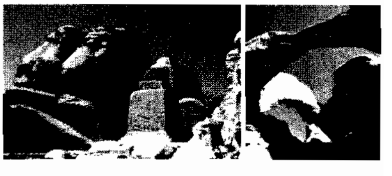


Figure 9: The physical canvas of natural environment

It exists for human life and we must therefore live in harmony with it. We interact with the environment through the creation of built form, or man-made place, so that the place could be described as a concrete term for environment. How man-made place exists in relation to the natural world determines the quality of place and demonstrates a respect between man and nature. We creates our built environments to dwell, between heaven and earth. Therefore man made place must have structure, it must have a sense of enclosure that allows it to relate to its environment. (Schulz, 2000), identifies three ways that man-made places are related to nature.

Through visualization we strive to structure nature more precisely, while we compliment the given landscape by adding what we feel is lacking, and by doing so we symbolize the understanding that we have of nature. Through these three acts we gather what is known from the world, build upon it, and give meaning to our existence. One of the very good early examples of how man built to interpret nature is the early Egyptian pyramids, (see Figure 10). Which were symbolic of primordial mountains reaching to the heavens of the sun god.

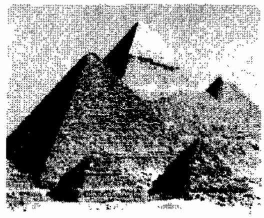


Figure 10: Egyptian pyramids, a coexist in harmony with nature

As nature exists between heaven and earth, man's desire to understand nature is- in its reality- a need to understand the natural things, heavens and the cosmic order, the character of natural places, and finally, the light and time (Schulz, 2000). This understanding is not scientific in nature; but rather its aim is to experiencing meaning.

First is an understanding of things that exist naturally such as trees, rock, water and sky. Schulz claims that a mountain, for example, is a place within a landscape because it gathers known things (rock, trees) and gives meaning to their existence. The second element is the cosmic order, which defined man-made space since Egyptian times and represent different qualities of meaning through different cultures. The third element is character of natural places. The topographic features of the landscape offer suggestions of the character of a place. The last two elements that Schulz identifies are light and time. Light is the most natural phenomena we experience. It reveals texture and color and gives life. Time, with respect to place, relates to our existence, and refers to man's own life and the life of nature.

These elements form the unique spirit of a place. Our architecture and urban development must attempt to find the spirit of place within the environments that we build so that it can be interpreted from the landscape and man-made spaces can compliment what is given and provide spatial experiences that are naturally meaningful.

SPACE: In order to develop an understanding of space as an important biological basis of the DNA of the place, one should start by defining the concept of space itself. However, (Relph, 1976), in his book Place and Placelessness, outlines eight different concepts of space: pragmatic or primitive, perceptual, existential, sacred, geographical, architectural and planning, cognitive, and abstract spaces. The eight identities that he explains illustrate the complexity of the concept of space. Relph described space in his book as "amorphous and intangible". It consists of the sky, the land and the universe. It is vast and requires space defining elements in order for us to organize it within our conscious understanding of space that we have developed, (Relph, 1976).

Relph argued that recognition of space has many dimensions. First, space is recognized through the basic fundamental experience of front and back, in front of and behind of, left and right…Second, there is our personal space, based on our individual experience. As people are faced with public under a variety of circumstances throughout their daily life, the importance and privacy of personal space should have great attention in the design process. Built environments are there for people and they should demonstrate this through attention to user behavior, social interaction and spaces that suit human nature and human scale.

Finally, there is the inner structure of space as it appears in our experiences of the world as members of a cultural group. The spaces of our lived-world are made up of varying types of spatial experiences. Architecture is the creation of space for human life. Architecture and urban design attempt to organize these spaces so that we can understand them in a meaningful way- whether they are understood personally or publicly.

The relation between *space* and *place* illustrated by (Sewall, 1999) as "Place is a space with experience added in". Through interaction with a space, individuals are able to develop a sense of place. In general it seems that space provides the *context* for places.

This interpretation of the space- place relation highlights another important aspect in the understanding of place, which is the space *boundary*. The creation of place occurs when space is defined by way of enclosure. Therefore, it is important to define the qualitative difference between place and boundaries, between building and its surroundings, (see Figure 11).

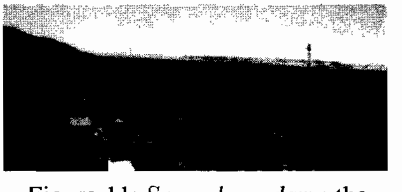


Figure 11: *Space boundary:* the outline of *place* - Elmahamid Settlement, Edfou- Egypt

Enclosure is defined by boundaries, the point at which a building begins its presenting. Interior spaces are defined by floors, walls and ceilings; while exterior spaces are defined similarly by the ground, landscape and the sky. These boundaries define space and provide orientation and an understanding of the contents of place. Boundaries, therefore, define our personal space as well as our communities, towns, districts and the continent. It helps to define the inside from the outside and the horizontal from the vertical. The ways in which these boundaries enclose space define a particular character of the place.

5 Place as tool in Urban Sustainability Projects

In order to achieve urban sustainability, we always in need to create a sense of place. A place that let the individual experience to flourish, while enhance and respect the collective experience too. In this respect, an analysis of the DNA of the place has taken place in order to understand the basic components that create the sense of place and enhance our experiences. This analysis concluded with four elements that must be presented in order for place to exist; Man, Culture, Nature and Space, and they need to have a meaningful presence to create valuable experience of a sense of place.

thus, one could argues that what is experienced in the place is not simply a location but a socio-physical construction that has constituents of physiological comfort and cultural significance, and it means that it is not possible to design meaning into place, because this meaning cannot be pre-determined. That was the formula, and this is why the traditional built environment was more flexible than the contemporary one, and why they enjoyed high spatial flexibility, value, meaning, and creative configuration that responded to changing needs of community and users. The idea behind decoding the DNA of the built environment comes to mean exploring meaning and values that constitutes those environments and generate its building codes in order to be able to reproduce these environments again.

6 Case of Observation in Egyptian Traditional *Places:* Some Reflections on the Dwell Place

Egypt is known for its rich and diverse cultural and traditional heritage and with the architectural expressions that are produced by this diversity. To this day, Egyptian traditional and vernacular architecture is, largely, outside the efforts of development and comprehensive study. Traditional villages and settlements have always been viewed by planners, urban managers and architects as a blob on the Master Plan and simply called the "inner city". In truth, the genome system of those villages and settlements are complex and highly condensed with information and make them cultural resource entities. They interrelationships between the bases of the place DNA, which are Man, Culture, Nature, and Space reflect a wide diversity in their morphological character, being products of different geographical contexts, Specific historic times, characteristics and functions. Every structure and fragment in a traditional village is a true document of cultural and technical knowledge systems, The evidences of their history are preserved as 'layers' of built fabric, making them highly readable entities, (see Figure12).

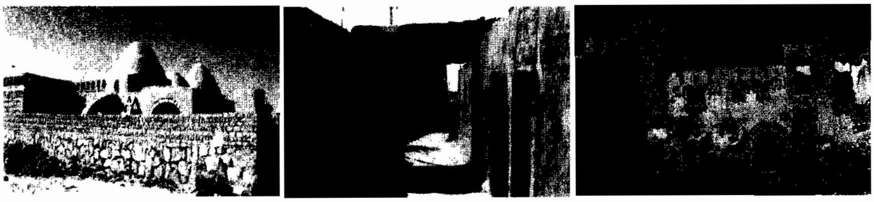


Figure 12: Traditional Villages and settlements in Farafrah Oasis, Egypt

PLACE, in Egyptian culture is firstly affiliated with place of birth "where are you from", and secondly with lineage, "who are you from". So wherever they are, people would refer to their place of birth with mixed feelings of nostalgia identity, solidarity, and collective memory. When Egyptian people talk about the environment, they mostly mean the social environment. Socio-economic impacts of modernity and rapid urbanization have had various effects on different social groups in terms of their place conceptions, and Perceptions of PLACE, creating a culture that is careless by their environment, stressed by economic anxieties, lack of inadequate education; further exacerbated by a harsh and chaotic market economy, alongside a bureaucratic and insensitive planning and governance structure.The current transformations, rapid growth of urban areas require new approaches to urban planning and design in order to achieve sustainability. More inclusion, participation and advocacy in planning; and a comprehensive understanding of place-formation seems promising or needs to be given a chance to achieve sustainability.

In the following sub-sections, the paper will try to have an understanding to the DNA of the dwelling places through the study of the previously determined bases of this DNA, which are Man, Culture, Nature, and Space. The idea behind that lies under the consideration that the architectural thinking requires one to do much more than determine how a building looks. However, one must consider how it works, how it accommodates, how it fits, and what it affects. When speaking about the site of architecture, we do not simply mean the area or location. Rather, a site is the particular circumstance, or situation, within which a building will be located. It involves the non-visual and invisible building codes and vocabularies that would make us able to reproduce these environments again.

6.1 A Closer Look at the Dwelling Place: Connotations of the Word (*Dar*)

The word *Dar* means house. In Upper Egypt cultural context, it does not always refer to the physical structure, but it can also mean wife and family. Sometimes, the word *Dar* when mentioned could be understood as the women's domains within the house (whereas the public spaces are the domain of men).

Houses as the basic shelter dwelling places for the families in traditional places in Upper Egypt are perceived as a further extension of the body images. That is to mean that if male/female domains are not screened off from each other, then people will cover their bodies in certain ways to maintain the barrier (according to their culture and traditions).

6.2 Decoding the DNA of the Dwelling Place: Man, Culture, Nature, and Space Interrelationships

Many activities inside house associated to the woman and the spaces are less formal. In contrast, the men's domains almost always have more formal character. Women's activities are always performed in the house while men's activities are extended to spaces (mosque and Market).

The court (*hosh*) is the most important feature of the traditional houses in Upper Egypt. It exists as one space, or may be divided into two parts (for men and women) that are visually screened off from each other. (see Figure 11) the rooms, kitchen, storage area are connected to women court, while the guest area (*Mandara)*, the reception area is associated to men's court.

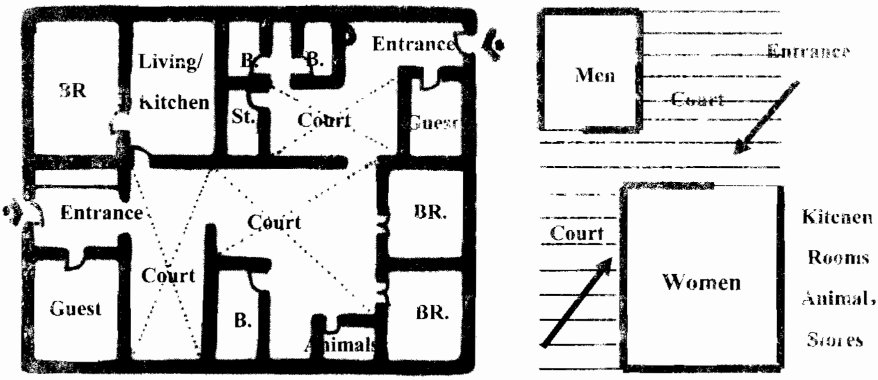


Figure 11: A typical design pattern of traditional housing - Egypt

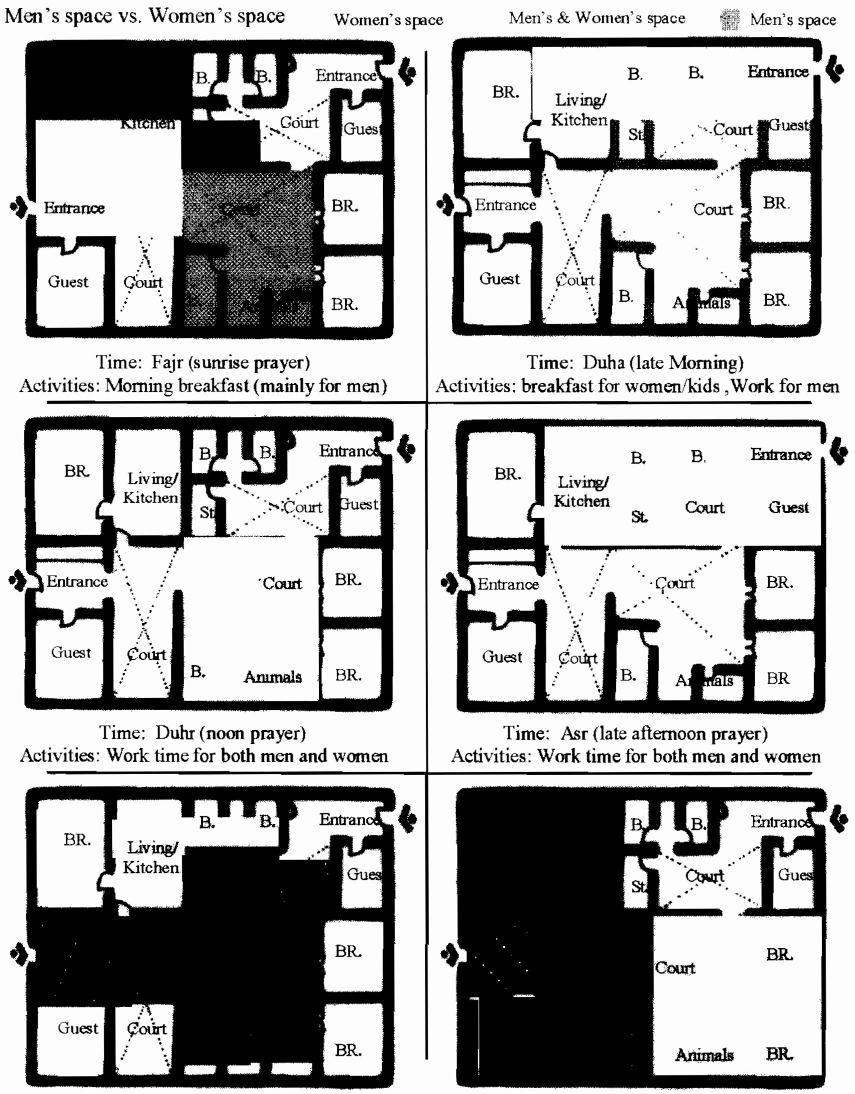
The Guest area (*Mandara)* which is the reception area in the traditional house in Egypt is a space mainly used by men. Even though it exists within the physical context of the house, this reception area almost considered as public space for women. On the other hand, women can use *The Guest area* during the day in some occasions and events when men are away from the house in their extended spaces (mosques or Market).

These patterns give manifestation of how man with his value systems and traditions is interrelated to both culture and space and thus give us some genetic information about the formation of the places in such traditional villages.

The interrelationship between man, culture, nature, and space is demonstrated in those traditional houses in another many aspects. When discussing Nature as a basic element in the DNA of the place, the paper refer to the three elements defined by (Schulz, 2000) to understand nature, and which are the natural things, heavens and the cosmic order, the character of natural places, and finally, the light and time. In those traditional houses, time is very important element of nature that have strong interrelationship with other DNA components (man, culture, and space). However, in those traditional societies the day starts early due to the prayer time and because of the very hot climate most of the year time. Time affects the use of space and affected by cultural aspects that all have effect on the whole sense of place, as follows, (see Table 1).

The men would leave their houses after morning (sunrise prayer). They may return at noon for lunch and leave again. But in most cases, they return back at sunset time (the time of *Maghrib* prayer).The day, activities, and man's and woman's space at the house could be structured according to time (which

Table 1: The day activities for man's and woman's according to prayer times



Time: Fajr (sunrise prayer)
Activities: Morning breakfast (mainly for men)

Time: Duha (late Morning)
Activities: breakfast for women/kids ,Work for men

Time: Duhr (noon prayer)
Activities: Work time for both men and women

Time: Asr (late afternoon prayer)
Activities: Work time for both men and women

Time: Maghrib (sunset prayer)
Activities: Main meal- tea- rest time

Time: Ishaa (Evening prayer)
Activities: Social gathering time, end of activities

defined by prayer times).

7 Conclusion

With this analysis of the bases of DNA of the place (man, culture, nature, and space), one could interpret the lack of sense of place in today architecture and urban places. The new and changing world of science and technology has left us with the inability to distinguish where one place ends and another begins.

Moreover, the experience of places have changed significantly when one consider how we can now visit places across the continent through video or the world-wide-web, gaining knowledge of the place without actually having physically experienced it. Or consider that we can now experience skating on ice within a shopping centre and amusement park in a harsh sunny day in Gulf region with very hot humid climate.

It is however, clear that many of today's man-made environments failed to recognize the importance of their relationship with man, culture, nature and space. They failed to understand the structure of biological system of the place; the DNA of the place, to the extent when it became more beneficial to talk about what place "is not" in order that we better understand the places of today. And because of this lack of understanding, the new settlements and urban places are lacking a clear definition of enclosure and density, streets have lost their traditional use and buildings are viewed independently. There is a loss of identity, a lack of character, and buildings/surroundings are no longer meaningful in their attention to human experience or their existence between earth and sky.

This is why the urban sustainability becomes vital issue in today's architecture and urban design processes. What is needed is an architecture that fully understands its genetic order and its genome system and bases; an architecture that uses these bases as principles for design to give birth to buildings and places with regards to man, culture, nature and space, and recognizing its primary purpose for human experience.

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[i] "Mankind is the only known animal that defines itself through the act of living. In other words, first we exist, and then we spend a lifetime changing our essence. Without life there can be no meaning, the search for meaning is the search for self." Existentialism–A Primer, web-link: www.tameri.com/csw/exist/.html. Christopher Scott Wyatt.

Sustainability in Developing Countries

Developing countries offers some deep challenges to the goals of providing for basic needs and a decent quality of life in an environmentally and socially responsible way. Most research and development interventions focus on understanding and addressing these challenges, often grounding solutions in precedents from the so-called developed world. However, researchers seldom ask what it is that these countries and their traditions can offer to the sustainability discourse. The UNEP/CIB Agenda 21 for Sustainable Construction in Developing Countries (Du Plessis et al, 2002) identified a number of ways in which developing countries can make a contribution to sustainability. The lies in two main areas: the innovative use of materials and technologies that draws on traditional practices, and in the traditional social organization and value systems of third world countries. However, these contributions face stiff opposition from the aspirations of local people for a Western lifestyle and perceptions instilled by colonialism that traditional practices are inferior, if not outright primitive. Allowing the rich heritage of the non-western world to contribute meaningfully to sustainability necessitates therefore that a way be found to re-validate this knowledge and re-invent the practices to make them relevant to the 21ste century.

The papers in this chapter illustrate both these contributions, as well as the challenges of their value and relevance in the changing patterns of human settlement of the Third World. Whether it is re-introducing earth construction in a country with a history of enforced inequality and the resultant deep-seated suspicions (Bosman et al), finding a place for traditional livelihoods and cultural practices in a modernized urban form (Odeyale et al), applying the self-organizing powers that lies in the sensibilities of traditional Islamic legal principles (Barau) and the Indonesian Kampung (Tantarto), the message is the same: a simple return to the past is not possible, what is required is an approach that transcends both the traditional and the modern, taking the best of both to shape a future that is more than the sum of its heritages.

Du Plessis, C. et al. 2002. Agenda 21 for Sustainable Construction in Developing Countries. Pretoria: UNEP, CIB and CSIR. CSIR Report BOU/E0204.

Chrisna du Plessis
Council for Scientific & Industrial Research, South Africa

Changing Attitudes on Sustainable Earth Architecture: A Case Study in the Central Parts of South Africa

Gerhard Bosman, Petria Smit, Das Steyn
University Free State, South Africa

Abstract

South Africa has got a rich tradition of earth architecture influenced by indigenous and European construction methods. The quality of these current earth building techniques are waning, resulting in a general low acceptability for private buildings. The present attitudes in South African communities regarding building materials are equal to comfort and basic services. A burned brick or cement block house are synonymous and sometimes equal to running water, a flushing toilet and electricity. This notion makes an earth constructed traditional house in a rural area, with a pit toilet and a communal water source less desirable.

The measuring of attitudes posed an abstract, subjective and variable concept. A qualitative study with two sets of questionnaires was employed in order to document respondents' attitudes regarding earth construction before and after an intervention in the central parts of South Africa. Workshops and an educational community play were conducted as to determine whether providing information on the positive aspects of earth construction could influence attitudes towards accepting more advanced earth construction technologies.

The research project has been successful in illustrating the appropriateness of earth construction as a sustainable construction method in South Africa. The nature of earth-building is sustainable where local people can be trained and be employed within the construction process and where waste products are minimal. The intervention has been a failure as it did not succeed in changing attitudes dramatically.

Keywords: *sustainable development, earth architecture, training, changing attitudes, methodology*

1 Theoretical Framework

The authors of this paper have been involved in sustainable development and alternative construction technology research and training of architecture, quantity surveying, construction management and urban planning students since 1996. During this period earth architecture was identified as an ideal vehicle for supporting local economic development in a sustainable way.

The use of earth as a building material is well documented in South Africa. Many of the old Cape-Dutch houses, as well as old farmhouses, were built from earth (Greig, 1971; Fransen & Cook, 1965). In many rural areas of South Africa, people are still using earth for building purposes, although this skill is slowly disappearing. In many poor communities in South Africa, e.g. Kuruman in the Northern Cape, small entrepreneurs produce tradition earth blocks, but have upgraded the process by adding cement to adobe (sundried mud) blocks. These groups run small brickyards and make a living from selling the blocks produced. With training, these entrepreneurs could produce blocks of a higher quality which would be more viable.

The research project was aimed at finding ways to change perceptions regarding the acceptability of earth construction in order to make earth construction a part of sustainable alternatives to conventional techniques and to support sustainable local economic development.

The research hypothesis is that proper research aimed at gaining an insight into the present attitudes towards earth construction, together with the dissemination of the necessary knowledge on the modern use of earth construction, may change perceptions and lead to the acceptance of earth construction.

1.1 Methodology

The research project was undertaken in terms of the following structured phases:

The first phase [starting date Sept. 2003] comprised a literature study on three main themes, namely the current perceptions regarding the acceptability of earth construction; measuring the extent to which earth construction is used at present; and ways in which earth construction could help to sustain local economic development.

The second phase [starting date Oct. 2003] comprised the mobilisation and inception phase, during which the project was outlined and developed by the research team. Five target areas were identified:

- Botshabelo and Thaba Nchu near Bloemfontein in the Free State Province
- Tsiame and Magolokeng near Harrismith in the Free State Province
- Taung and Pampierstad in the Northern Cape Province

- Bankhara Budolong near Kuruman in the Northern Cape Province

These areas were chosen on the basis of (a) the presence of earth construction and/or (b) the presence of small brickyards, (c) the willingness of communities or groups to take part in the project, (d) the different earth-building techniques utilised in the respective areas, and (e) being in an arid area looked for earth construction techniques.

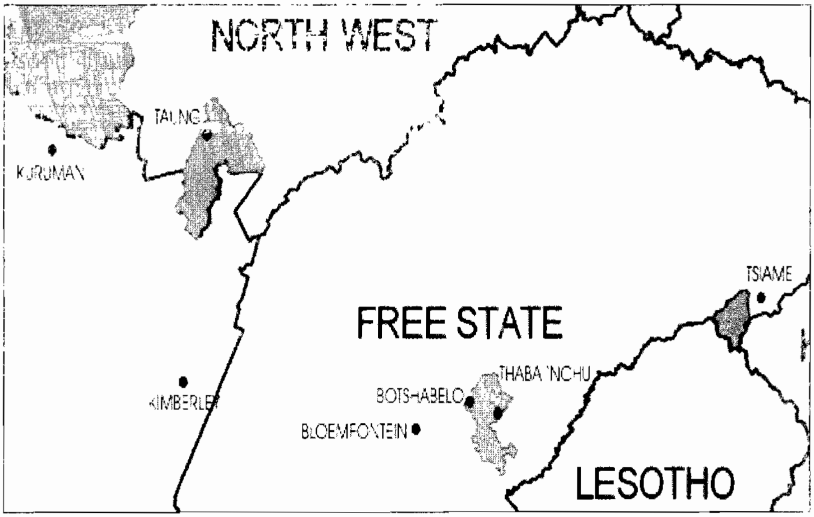


Figure 1: The map shows the areas that were investigated and surveyed.

The third phase [starting date March 2004] involved the planning of the first survey. In each of these areas, the houses were counted and mapped. The sample size for each of the areas was calculated according to Stoker's (1981:13) method:

$\sqrt{(N \div 20)} \times 20$, where N is the stratum size, thus giving the following number of houses for the areas in question:

Botshabelo:	Block K	147 houses
	Block W	56 houses
Thaba Nchu:	Bultfontein Extension 4	220 houses
	informal settlements	107 houses
Harrismith:	Tsiame	72 houses
	Magolokeng	130 houses
Taung:	Pampierstad formal and informal	313 house
	Taung and Manokwane	91 houses
Kuruman:	Bankhara Bodulong formal	231 houses
	Mapoteng	161 houses

As the areas were approximately the same in respect of their characteristics, it was decided that a systematic sample would be used, rather than a stratified random sample, as maps for some of the areas were not available. Areas were randomly selected and then every fourth house was interviewed. Completed questionnaires were periodically collected by the research team, who then proceeded with the verifying process. The questionnaires were codified at the UFS.

The fourth phase [starting date June 2004] involved the collection of data from the different sampling areas in terms of the different households .

Phase five [starting date August 2004] comprised data-analysis and interpretation.

Phase six [starting date February 2006] entailed the completion of a follow-up questionnaire in the study area, involving a smaller sample size, to assess whether attitudes towards the use of earth construction had improved as a result of the interventions (play and workshop).

The seventh phase [starting date September 2006] was the reporting phase, in which all qualitative and quantitative findings were published into a concept report.

The eighth and final phase entailed the dissemination of the findings.

2 Earth as Building Technology

Houben and Guillaud (1994:4) describe earth construction as the use of raw soil in such a way that it is turned into a building element without the use of firing. All earth-building elements are produced by making use of the natural and inherent qualities of the soil. Renewable energy sources like the wind and the sun are used in the production process of these elements.

2.1 The current situation in South Africa

The South African building tradition can be divided into two main streams. The first relates to the use of earth by the indigenous groups of the country. The second tradition is that of the colonial settlers who brought earth-building techniques from other parts of the world.

2.1.1 Indigenous earth-building traditions

There are a great variety of indigenous building traditions, since each of the different groups had their own method. Similar techniques and methods were used by both indigenous people and settlers. The available resources usually played a decisive role in this regard. As people developed a more permanent lifestyle, the walls were built of more solid material, such as sods or stone. Changes in the plan form came about as a result of several factors, including new technologies and materials (use of corrugated iron as a roof material), as well as urbanization.

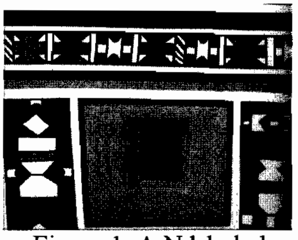
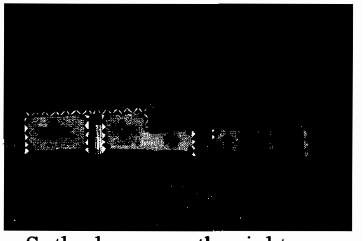



Figure 1: A Ndebele house on the left and a Sotho house on the right

Today, many dwellings built in accordance with these traditional building methods can still be seen in rural areas. The thatched roofs have mainly disappeared, and have been replaced by corrugated iron sheets. The forms have changed; but the building techniques have still remained the same, involving the use of wattle and daub, cob and sun-dried blocks.

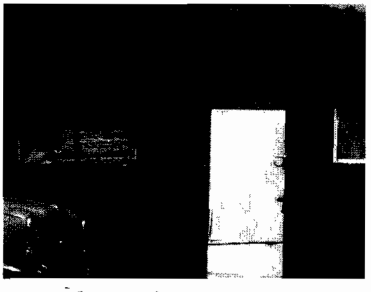
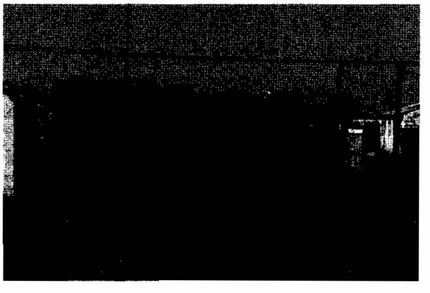



Figure 2: Earth houses in Thaba Nchu with structural problems (left: no lintels & right: no roof overhang)

In urban areas it is a different application where earth construction is seen as a temporary solution. The quality of these buildings is very poor, owing to the disappearance of the original skills, the knowledge involved in the use of the relevant techniques and decoration.

2.1.2 Architecture of the settlers

The Cape Dutch architecture in South Africa displays a wonderful blending of building applications and methods that were known in Europe, with the available materials and skills of a new country (Greig,1971:21). Many earth-building techniques were used in accordance with the available resources. A few examples will be discussed.

2.1.2.1 Wattle and daub

Some of the first houses in the Cape displayed no similarity to the well-known Cape Dutch houses, but were single-storey dwellings, built of wattle and daub according to a rectangular plan. The roofs were thatched (Walton,1952:5).

Examples of this tradition of building with earth are also found all over the country. Elize Labuschagne (1998:26) writes that in the Transvaal, as it was then known, the trekboere (the farmers from the Cape who migrated to the north) built their houses according to different earth-building techniques. Materials included wattle and daub (as used for the houses of the Zulu, Tswana, Venda and also the Sotho) (1898:26). The walls were then plastered with mud, or mud and cow-dung, and whitewashed with lime.

2.1.2.2 Cob

Examples of cob architecture can be found in Tulbach. After the earthquake of 29 September 1969, in which the largest portion of the main street of Tulbach was almost ruined, Dr Gawie Fagan, who conducted the restoration, found that the walls of the houses were made of cob.

Figure 3: Historic houses restored in Church Street, Tulbach

Cob walls were also used in the construction of the early Free State houses (Pretorius 1997:134). When a farm became a more permanent residence, stone and sun-dried blocks were used for construction (Pretorius 1997:134).

2.1.2.3 Sods

The earth sods were cut and left to dry. They were then laid in a shallow trough, with the grass facing the ground. Each layer was placed, using mud as an adhesive; or sometimes the sods were dry-stacked (Labuschagne 1998:27).

South Africa has a rich earth-building tradition, in view of the different techniques, locations and soil types, as well as the country's different cultures. What is possibly even more important is the fact that, in the various earth-building traditions of the people of this country, more similarities than differences can be observed.

2.2 Contemporary sustainable earth buildings in South Africa

During recent years different groups started experimenting with alternative materials and construction methods in South Africa. The word "alternative" is applied to materials and techniques not part of mainstream building practices.

Many of the buildings may not constitute great architecture but they have played a noteworthy role regarding the criteria of sustainability.

2.1.3 The Cape Province

The Alliance Française building in Cape Town designed by ACG Architects and Development Planners, provide the venue for a language school. The process followed promoted the use of compressed earth blocks in a contemporary building. This project provided economic opportunities and skills-training for the surrounding community (SA Digest, 2000:90).

Figure 4: Exterior (a) and interior (b) views of the Alliance Française building in Cape Town

2.1.4 The Free State

The Unit for Earth Construction which is part of the Department of Architecture at the UFS has constructed several experimental buildings since 1995. These include a prototype house, ablution facilities for sports grounds, daycare centers for pre school children, a large multi-purpose hall and a tourist centre. Stabilized adobe and compressed earth blocks were used for these buildings. Training of unskilled small builders and students comprised parts of these projects.

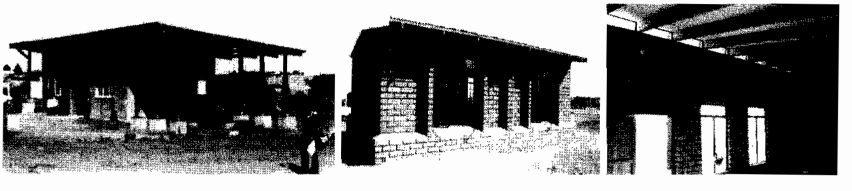


Figure 5: Three projects by the UEC: (a) and (b) day care centers in Bloemfontein and (c) a tourism craft center in Gariep Dam.

2.1.5 The Northern Cape

The South African Council for Scientific and Industrial Research (CSIR) – the main research laboratory in the country – launched a project entitled Thube Makote, with the aim of building a school in each of the nine provinces. One of the requirements was the use of locally-produced materials. In the project entailing the construction of a school in Bankhara Budolong near Kuruman. A group of people from the community received training in the production of compressed earth blocks and the contractor bought the bricks from them.

2.1.6 The Eastern Cape

Another experimental project was conducted in Buffalo City near East London by the Van der Leij Foundation, with the technical support of CRATerre-EAG in France. This housing project was carried out with the approval and co-operation of the municipality.

2.1.7 KwaZulu-Natal

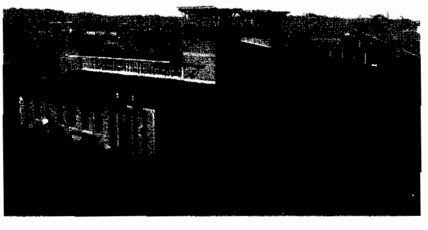
In KwaZulu-Natal, an Australian group, AusAid, worked in the very remote rural areas, using earth as a building material. The work of the Durban-based architect Rodney Harber is a great example of "pushing the boundaries". He uses all kinds of materials in his projects.

2.1.8 Gauteng

In Gauteng, the well-known architect, Peter Rich, designed the offices of Hydraform, a company which produces brick presses. Earth produced by the presses that the company manufacture were used for the construction. This is an example of a corporate building that illustrates the potential of the use of earth in urban areas.

2.1.9 Namibia

The Habitat Research and Development Centre in Katatura by the architect Nina Maritz addressed different issues regarding the different facets of sustainability. The building is the result of a range of materials, techniques and innovative ecosystems. This centre illustrates how the building industry can play a role in the protection of our environment, by encouraging innovative thinking about what we do and how it is done.



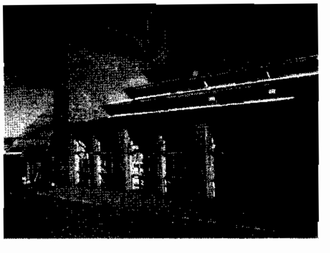


Figure 6: The Habitat Research and Development Center in Katatura, Windhoek.

2.2 Informal housing in South Africa

In South Africa every town and city is surrounded by extensive areas of informal and formal housing built by the less fortunate. Vast numbers of poor people live in these townships surrounding towns and cities. The informal houses are made of all sorts of materials that people can obtain at little or no cost. These include plastic, corrugated iron sheets, wood, old bricks and also earth. Many people use the soil from the plot on which they are residing, to make blocks to build a house. This is one of the cheapest ways to construct a house if one has little or no income.

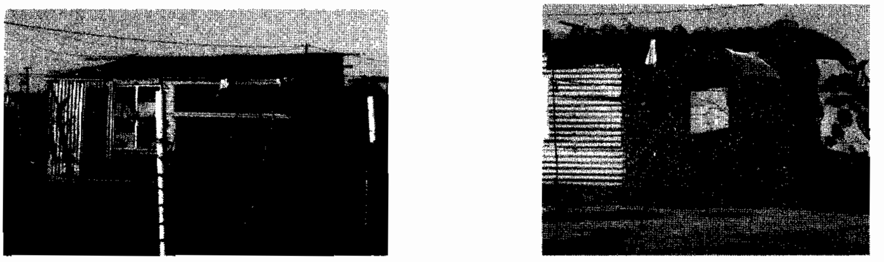


Figure 7: The current situation in respect of housing in the Thaba Nchu

However, these houses all display similar problems, which include one or more of the following:

- A lack of foundations, with the result that houses tend to crack, especially in areas where clay is prominent.
- The floor level on the inside of the house is often much lower than the ground level on the outside with rain water that streams in.
- The bottom plinth of the buildings receives no attention with surface water that erodes the walls.
- Openings do not have proper lintels or at all.
- The absence of window sills and gutters leads to a great deal of water damage under windows.
- The corners are problematic with poor bonding.
- The inadequate roof structures and anchorage leads to extensive water damage and eventually structural problems.
- The use of parapet walls constructed in earth result in water penetration, cracks and loss of structural strength.

Figure 8: Main problems with erosion caused by water penetration

This situation in respect of poverty, informal settlements and the practice of building with whatever materials are available – with little "know-how" or skill has created negative perceptions about earth buildings in general in this country. This is most unfortunate, since if earth buildings are constructed in the correct manner and properly maintained, they can last for hundreds of years. The Cape Dutch houses provide an excellent example in this regard.

2.3 The Government's solution.

In South Africa the government has a policy to provide every citizen with a free house together with a lot of minimum services (Pithouse, 2009). This creates expectations from poor people and away the initiative to do your own thing. Furthermore the government is building all these houses with burned or cement bricks. This is then seen as a better solution.

3 Measuring Attitudes, Sustainability and Local Economic Development

3.1 Measuring attitudes

Throughout the ages, human beings have always been concerned about what other people are thinking and how they are likely to react. The roots of this concern can partly be found in the necessity of self- preservation (and thus, the need to know: "Is the other person a danger to me?"). This eventually developed into a kind of self-interest ("Can the other person help me?"), while later on, an element of curiosity came into play ("How will the other person behave?") Attitudes are complex and variable (Henerson, 1987; Oppenheim, 1992; Leedy & Ormrod 2001). It has long since been established that there is a direct link between a person's attitude and his/her circumstances; and this link needs to be carefully taken into consideration.

3.2 Sustainability

This paper does not aim to provide specific, directly applicable measures for supporting local economic development through sustainable construction. At best, it may provide some guidelines for developing such measures The paper does aim to stress the importance and potential of applying sustainable construction as a means for local economic development.

3.2.1 Sustainable construction

Earth construction was identified as an ideal vehicle for supporting local economic development in a sustainable way. People who are directly or indirectly involved in construction have every reason to be concerned about sustainable development. According to estimations, the construction industry is responsible for approximately 40 per cent of all resource consumption and 40 per cent of all waste production (Du Plessis, 2002: iv).

3.2.1 Sustainable settlements

Truly sustainable construction requires that attention should not only be focused on buildings, but also on infrastructure and services. Furthermore, socio-economic and environmental issues need to be considered; and community involvement is essential. Achieving sustainable settlements is the goal in this regard. In 2001, the CSIR was commissioned by the National Housing Department to carry out a study on the sustainability of human settlements in

South Africa (Du Plessis, 2003: 12-13). One of the chosen points of departure for determining the sustainability of existing human settlements was the quality of life offered to each member of society.

3.2.3 Earth construction as a sustainable alternative
The SANPAD project provided local entrepreneurs with exposure to the production of higher-quality blocks which could prove to be more acceptable to consumers, and which would also be more beneficial from an environmental point of view. Sun-drying, in contrast to baking, does not lead to the emission of harmful substances into the air (air pollution). Raw materials for the creation of earth blocks can be extracted from the production site, preventing the negative impacts on the environment.

3.2.2 Employment
There is no doubt that unemployment is a major problem in South Africa. Existing small businesses that have been running successfully for a period of time should be supported, either financially or through training (Diedericks, 2001: 50).

4 The First Survey

The first survey was conducted from 12 June - 1 July 2004. The survey was conducted with the help of 12 students.

4.1 Results of Survey I

The following results indicate the main issues and problems that can be deduced on the basis of the data collected.

4.2 Categories of three areas

The different locations can be categorised into three (3) main areas:

Area B is comprised of informal urban areas, where settlement took place before any planning had been implemented. Some areas had services and some not at all. Area A comprises formal urban areas, i.e., townships that were planned before settlement took place and, or may not, have all the services, such as water, electricity and/or a sewerage system. Area C consists of rural areas, where the land belongs to the tribe and the local chief is in charge of the distribution thereof. These areas, too, may or may not have all the relevant services.

4.1.2 Acceptability of earth as a building material
The acceptability of earth as a building material was addressed on the basis of several different questions. In response to the question on interviewees' opinions regarding the average quality of walls made from adobe blocks, in terms of a 5-point Likert scale (very good – very poor), the most frequent answer was "poor" (47.3%; n=844), followed by "very poor" (34.3%; n=612). Regarding the

question as to whether they felt that the use of adobe was problematic, 86.6% (n=1546) of interviewees responded in the affirmative. When asked if they considered the use of adobe to be a good idea, 84.6% (n=1377) of interviewees answered in the negative.

Table 1: Three areas surveyed

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	A	1075	60,0	60,0	60,0
	B	329	18,4	18,4	78,4
	C	386	21,6	21,6	100,0
	Total	1790	100,0	100,0	

4.1.3 Reasons for low acceptability levels

The respondents specified the problems which were related to the use of adobe (q22). The responses were divided into the following categories: (a) Collapses; (b) Cracks; (c) Maintenance; (d) Climate/rain; (e) Insects; (f) Not safe/ not strong and (g) Other. More than one of these categories could be selected as arguments for regarding the use of adobe as problematic.

Table 2: Arguments for low acceptability of adobe blocks

Argument	Frequency [-]	Percentage [%]
Collapses	864	55.9
Cracks	337	21.8
Maintenance	224	14.5
Climate/rain	663	40.9
Insects	22	1.4
Not safe/ not strong	189	12.2
Other	187	12.1

4.1.4 Acceptability in relation to specific factors

In the determination of the nonparametric correlation coefficients, a significant correlation was found between the perception relating to adobe, and the fact that a person is (or is not) currently living in an adobe house. This positive weak correlation suggested that respondents who live in an adobe house perceive adobe houses in a more positive light than those who currently do not reside in an adobe house.

5 The Intervention

This phase of the project involved the promotion of earth construction. This was achieved by means of:

the presentation of technical workshops; and

the performances of a community play in Setswana and Sesotho (the local language of these areas).

The aim was to promote earth as a building material with the potential to create better living environments; and to change perceptions regarding earth construction.

5.1 Methodology of the intervention

It was decided that schools in the areas would be used to conduction activities. A classroom, hall or similar venue was utilised for the conduction of the play and workshops.

5.2 The workshops

Five technical workshops (one in each area) were presented. People from different backgrounds attended the workshops. Those who attended included councillors, small builders and chiefs, inter alia. The aim of the workshops was to familiarise people with the contemporary use of earth construction.

5.3 The play

The project team had been looking for a medium through which to tell a story and convey a message that would be of interest to a larger audience. A comedy entitled "Hofeta Makhukhung" – "A Story of Hope". The play, which was presented in the format of a community theatre production, was performed in Sesotho and Setswana. Fourteen performances of this comedy were attended by a total of 5260 adults and school children.

6 The Second Survey

The second survey was done after a one in 50 year flood in the central area of South Africa. Houses built in earth showed problems associated with wet conditions; collapsing foundation walls, plastering that falling off, crack forming in parapet walls etc.

6.1 The methodology

A selection of the questions asked in Survey I were included in the questionnaire, with four new questions added to establish the number of individuals who had attended the workshops and play. Survey I was conducted during the period before the performance of the community play while Survey II (from 3 - 7 March 2006) was conducted thereafter. The areas were homogeneous, as in the case of Survey I (conducted in 2004).

6.2 The results of Survey II

6.2.1 Preferred building material for walls and motivations for preferences. Respondents were asked to indicate which building material they preferred for the construction of walls. Answers to the question relating to the reasons for respondents' preferences in this regard, are grouped into the following categories: (a) Aesthetics; (b) Strong and safe; (c) Fewer problems; (d) Climate; (e) Quick building process; (f) Finances; and (g) Other. Table x indicates the scores in each category, grouped according to interviewees' preferences.

Table 3: Preferences in respect of building material for walls

	Burned bricks N=237		Cement blocks N=363	
	[-]	[%]	[-]	[%]
Aesthetics	84	27.4	25	7.0
Strong & safe	117	48.7	185	49.2
Fewer problems	11	4.8	39	10.9
Climate	8	3.5	31	8.7
Quick building process	1	0.4	2	0.6
Finances	7	3.0	22	6.2
Other	28	12.2	62	17.4

6.2.2 Influence of the play on perceptions regarding the acceptability of adobe blocks

The results of the Mann-Whitney U test reveal that in cases where respondents had attended the play, their perceptions regarding adobe blocks had not been influenced by their attendance; and that no differences were observable between the perceptions of interviewees who had attended the play, and the perceptions of those who had not attended the play, in terms of their opinions regarding the quality of adobe blocks.

6.3 Conclusion of Survey II

On the basis of the results, it must be concluded that no visible effect of the interventions can be observed within the population of interviewees who responded to the questions posed in Questionnaire 2. In order to change people's perceptions regarding adobe blocks, other measures will need to be taken.

7 Lessons from the Research Project

The study has shown that earth construction is being used as a sustainable building method in South Africa. This was achieved by pointing out relevant research and providing adequate examples. On the basis of the results, it can be concluded that no visible effect of the interventions can be observed. In order to change people's perceptions regarding adobe blocks, other measures will need to be taken or the effect of floods before the Survey II influenced people's attitudes towards earth construction.

The search for a sustainable approach to all spheres of development has, in recent times, become an ever more pressing matter. Affordable, effective construction methods that represent sustainable architecture are thus becoming of great importance in achieving this goal. The attempt to change perceptions regarding earth construction was not singularly effective. According to the research results, the respondents ranged from poor to extremely poor. It is thus to be expected that basic services such as running water, electricity and a flushing toilet inside the dwelling could constitute acceptable living standards. The tolerance for earth houses was low, with the most important reasons for dislike of this construction method cited as the fact that these houses collapse, are not strong and stable and cannot withstand climate factors such as rain. In correlation with the hypothesis, this may indicate that the proper skills for building with adobe bricks have fallen by the wayside and that proper training and information about this construction method might help render the negative perception positive.

The perception that earth houses signify poverty, as well as that it can be perceived as old-fashioned, should be taken into consideration. The South African Government has an important role to play in this regard. The diversity and ability of earth construction to adapt to contemporary architecture could be utilized much more effectively in government and semi government initiatives. If the commitment towards sustainable development is to be taken seriously at all, the importance of earth construction must not be overlooked. Building high profile buildings all over the country will be a means to show that the negative attitudes on earth architecture can be changed.

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Sustainable Architecture and Food Production: Impact of Modernity on the Traditional Urban Form

Timothy Odeyale, Behzad Sodagar and Nick Temple
Lincoln School of Architecture, University of Lincoln, United Kingdom

Abstract

Architecture in any period has often been a reflection of the sociological, cultural, economic and technological aspects of its development. Though it has been argued that Africa has no recorded history in the written form, but evidences persist of the rich culture of the different tribes that makes up the constituent of its inhabitants. This paper examines some of these socio-cultural factors that impinge on the historical traditional forms and architectural system in sub-Saharan Africa, by considering the pattern of food production and consumption. It also examines in particular existing relationship between architecture and food consumption that affect the sustainable built form found in southwest Nigeria. The paper is thus an endeavor to discuss the connections, interrelationships and benefits of these concepts in the evolving modern socio-cultural views on Africa. The paper report a recent field survey carried out in the study area, based on quantitative and qualitative methodology. Sizeable numbers of questionnaire are administered to the target population, using stratified random sampling method in order to elicit primary data with 76 percent response rate from the respondent. The survey and interview conducted highlights a number of observations and conclusion of the relationship between food production activities and its role in city development or formation.

Keywords: cultural sensitivity, development, sustainable food-production, social institutions, Nigeria, urbanization

1 Introduction

The key to address the current debate on the sustainable future for the earth especially the urban centres may be found in the activities surrounding the production of food and the built environment. There is a lack of understanding of how food in the historical past has contributed to the formation of the present urban landscape and how it may well shape its future. This lack of understanding is clearly evident in our manner of urban lifestyle and the present unsustainable ways in which food activities were carried out, which has contributed to the deteriorating nature of our towns and cities (Steel, 2008; Alexander, 2009).

Recent researches have shown that there is a lack of information on the growths of cities especially in developing countries, considering aspects of food and agriculture (Steel, 2008; Allen, 1993). The developing countries are especially affected, in their bid to follow global trends has embraced many policies and socio-cultural lifestyles that are unsustainable (Olayiwola, 2000; Olanrewaju, 1996). The developing countries such as Nigeria, accounted for the most number of rapidly urbanized centres in sub Sahara Africa (Mabogunje, 1980; Onibokun, 1985), with its attendant overpopulation, poverty, lack of employment, dependency on fossil based economy and stack abandonment of its agricultural base. Without addressing this problem from the viewpoint of earth scarce resources such as in food production, we may be unable to sustain life in a city. Hence, there is a need for a rethink in order to make adequate provision for the present and future generations. This paper is an attempt to open the discourse on the connection and relationship between sustainable food production and city growth especially in the developing countries.

2 Food and the Concept of Sustainable Development

Sustainable development could be regarded as a process of change in which the exploitation of resources; the direction of investments, the orientation of technological development, and institutional change are in harmony and enhance both current and future potential to meet human needs and aspirations (Egan, 2004; Hewitt and Hagan, 2001). Sustainable development can be viewed as that development that cultivates the environmental and social conditions that will support human well being indefinitely. Discussion on sustainable development received significant exposition through the influential Brundtland report of 1987 (Pearce et al, 1990). Notable organizations such as the International Union for the Conservation of the Nature, World Wildlife Fund and the United Nations Environmental programme, all contributed to the enshrinement of the tenets of sustainable development in the environmental circles. Sustainable development embraces all activities that meet the needs of the present without compromising the ability of the future generations to meet their own needs. Pearce et al, (1990: 10) also defines it as a development strategy that manages all assets, natural resources and human resources, as well as financial and physical assets for increasing long term wealth and well being. According to Repetto, (1986) the doctrine of sustainable development reject all policies and practices that support current living standards by depleting the productive base, including natural resources and leaves future generations with poorer prospects and greater risks than our own. The United Nations conference on Environment and Development (UNCED) held in Rio in1992 and the second Habitat Conference held in Istanbul in 1992 further brought the idea of sustainable development into limelight.

2.1 Sustainability and the sustainable food question

Hence, the tenets of sustainability involve the possible ways of carrying out present activities without endangering the future for generations. For any development to be sustainable, there are elaborate sets of minimum conditions to be present. These minimum conditions are based on "natural capital stock" that should not decrease over time. The natural capital stock consists of all environmental and natural resource assets. Development can be viewed as a desirable change, it consists of list attributes which society seeks to achieve or maximize. Development in this paper, is closely tied to changes in the culture of the people, improvement in the social amenities (involving provision of good infrastructure such as roads, water and energy system to support food production), increase access to basic education and better living condition, the cumulative effect which resulted in a sustainable built environment. This approach places emphasis on sound environmental management for meeting the objectives of sustainable development.

However, the rate at which people are consuming natural resources and polluting the environment (ecological footprint), is rising exponentially. The available resources and capacity of the earth cannot sustain humanity's activities endlessly (Humphrey et al, 2008). Humanity's activities (such as transportation, agriculture, housing, waste and infrastructure) have generated large ecological or carbon footprint, which has increased by around 150% in the last 40 years. If left unchecked will result in a permanent loss of biodiversity, this will affect access to water, food production, health and shelter for hundreds of millions of people around the world (Francis & Gill, 2009).

It is important to point out that there exist strong connections between food production and architecture/ urban planning (Gordon, 1990; Chimbowu and Gumbo, 1993; Greenhow, 1994,). It has been documented that food production and consumption is one of the main contributor to earth's ecological footprint (Sodagar, et al 2008). The three planet model, estimates that an average European consumes three times the amount of food compare to those in the developing countries, . Human population has increased rapidly over the past 50 years and it is estimated to be over 7.5 and 8.3 billon people before 2025; compare to less than 2.5 billion in 1961 and presently 6.5 billion (United Nations Population division, 2009; PAI, 2006). This huge increase in population will require food that must be sourced or produced in a sustainable way. The world can not afford to continue to go about food production and consumption in the usual way.

According to Steel (2008) and Zetter, et al, (2006) food must be sourced locally or produced in the city in order to reduce burden on the rural or hinterland. According to Patrick Geddes the evolution of the city are complex and complicated in nature that encompasses the physical attributes of sustainability; but involves the social, cultural, political, economic and historical issues (Welter, 2002). This must be fully addressed through social justice and encouraging a lifestyle that live within the fair-share of the earth limited resources. Food should not be allowed to become a political weapon in the hand of the rich corporations, nor another means to squander earth resources and increase social inequality among developed and developing countries. It must become a useful tool in building social cohesion and interactions between society's different components leading to a sustainable communities and cities.

Sustainability can also be discussed at different levels these are; the project, building sector, and global levels. The highest level deals with environmental quality such as the global warming, ozone depletion and pollution, which are arguably tied to the issue of food activities. However, there is no single strategy for sustainability. The strategy to be used depends on the objectives and levels of sustainability being envisaged. Hence the paper addresses the necessary socio-cultural issues and principles that can contribute to the creation, maintenance and sustainability of the qualitative urban environment. This in effect is to promote the conservation, rehabilitation and maintenance of the city.

2.2 Social networks and the sustainable question

To attain the noble ideals of sustainability, a holistic view of the existing social context must be taken into consideration. Law (1991: 9-10) argued that 'in practice nothing is purely technical and neither is anything purely social… what appears to be social is partly technical and what is technical is partly social'. Therefore, social issues played significant roles in the development of the society. Need to say that much research attention has been focused on the technical aspects, with little or no concern for the non-technical or social aspect of the built environment (Saunders, 1987). Law & Callon (1992) asserts that these non-technical issues as soft issues are critical to the achievement of a holistic sustainable development.

This paper, however, emphasizes the importance of these socio- issues. In order to capture the essence of the social world, the natural, corporeal, technological and sociological must be understood. However, to entirely describe social changes, a range of issues must be given consideration; economic, political, technological and applied scientific research (Latour, 1987; Law, 1986; 1987; 1991). To achieve the above, Bijker (1997:47) draws up four distinct but related steps of identification, drawing up, delineation and description of "relevant social group"; (a) identifying relevant social groups that played vital roles in shaping societal interactions (b) drawing up of detail description of the identified "relevant social group"; (c) making a clear distinction between various social group, by charting new social boundaries, based on their impact and level of influences and (d) making sense of interrelated and interdependent actors, based on their impact and relevance to the network in this case sustainable food culture in a community.

3 Methodology and Discussion of Findings

The methodology also includes consideration for the historical urban morphology, cultures and the ethnic backgrounds of this community using mixed methods of quantitative and qualitative approaches. A mixed field method (quantitative and qualitative) was employed in the collection, collation and analysis of primary data. The paper discussed a recent field survey carried out in the study area, based on quantitative and qualitative methodology. Sizeable numbers of questionnaire are administered to the target population, using stratified random sampling method in order to elicit primary data; with 76 percent response rate from the respondent. The survey and interview conducted highlights a number of observations and conclusion of the relationship between food production activities and its role in city development or formation. These factors include lack of planning on the part of the government, lack of coordination among the developmental agencies responsible for social amenities, failing infrastructures in the market, poor housing condition especially the low income earner due to large amount spent on food and deprivation of agricultural land. Some of the interview conducted highlights the extra territorial occupancy (due largely to the loss of agricultural land to residential layout), threat to remaining agricultural land through indiscriminate acquisition of land by government and educational institutional in the city.

The initial series of interview are carried out by focusing on key actors involved in food production in the urban context. Bijker (1997:46) suggests following the actors, by the use of the 'snowball' approach, whereby the researcher allows the initial actor contacted to point the way to others actors. The research methods employed include the use of case studies, interviews and questionnaires to elicit primary data and information from key practitioners from the study areas. However, from the exploratory study and initial interviews conducted, it is clear that there is a drive and concern by for the development of a sustainable approach to the food problem in cities and urban centres without harming the earth.

The rapid urbanisation of sub Saharan Africa from a purely rural-agrarian society to a city based urbanised one is an interesting phenomenon to study and it has been of concern to many scholars as documented in several studies (see Hussain and Lunven, 1988; Jamal and Weeks, 1988; 1993; Mabogunje, 1968; Davey, 1996; Ellis and Sumberg, 1998; Drakakis-Smith, 1992; Drakakis-Smith, Bowyer-Bower and Tevera, 1995; Egziabher, 1994). It is also interesting to note that the story of food and food production activities are locked or intertwined in this rapid transformations and urbanization of African society. The transformation of African society is not only physical but encompasses socio-cultural, economic, political and metaphysical in nature. Hence, this study is investigates the roles played by food production activities during the course of these rapid urbanisation or socio-cultural transformation and its impact on the built environment as experienced in the study area under review.

3.1 The Study Area

Nigeria is the most urbanised nation in Africa. It is a country of over 150 million people and it is the most populous black nation in the world. Infact, for every five African, one is a Nigerian. The study area is located in Akure, in southwest Nigeria (see Figure 1). The city is a typical ancient West African city that was predominantly agrarian, but has undergone rapid urbanisation and transformation from a small pre-colonial town to a modern medium sized city through globalization and modernisation. Its history can be traced back to the 11th and 12th centuries and is closely tied to the history of its Yoruba kith and kin. (Osasona, 2002; Eades, 1980).

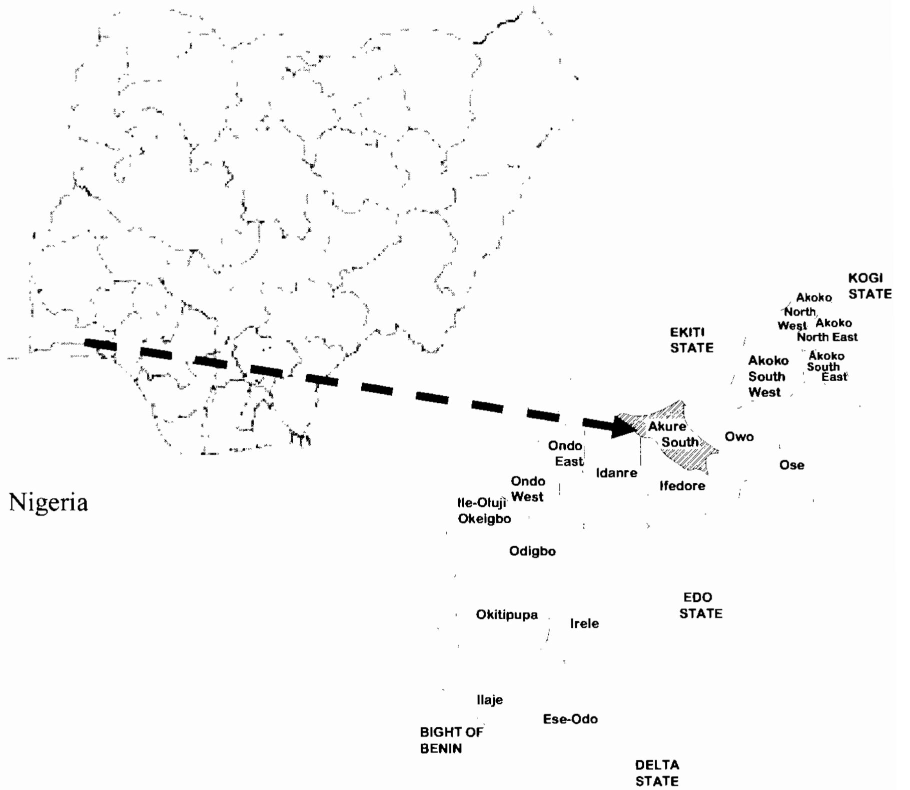

Figure1. Map of the Study Area.

The study is a medium sized city with a population of 408, 984 projected from the 1991 population census at 5% annual growth rate. It is situated 204 kilometers east of Ibadan, 168 kilometers west of Benin City and 311 kilometers North East of Lagos (former federal capital of Nigeria). The city is made of an undulating low land, rich with soil good for farming covering an area of over 16 square kilometers. On the world map, Akure can be found on latitude 7^{0} 15^{1} north of the Equator and longitude 5^{0} 15^{1} East of the Greenwich meridian. It is about 250m above sea level and the land towards Ado-Ekiti is hilly, studded with large granite formation said to be of volcanic origin. The town enjoys good rainfall over 1,500mm yearly with a mean temperature range or between 25°C and 29°C and a prevalent humid tropical condition. The study area offers a picture of a medium sized city that has experienced many layers of urbanization process involving the physical structure, historical, socio-cultural, political, religious and economic development. This can arguably be compared with Patrick Geddes anatomy of a city (Figure 2) based on an analytical triad of geographical (place), historical (work) and metaphysical (folk) aspects (Welter, 2002).

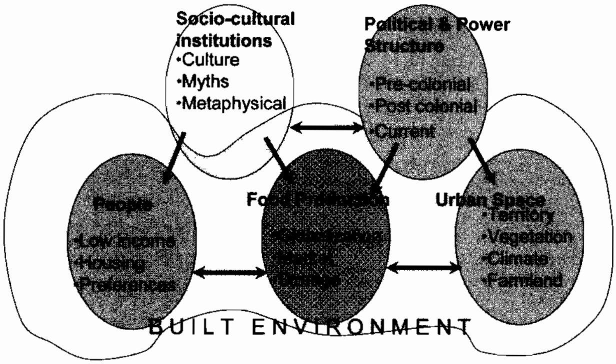

Figure2. Analytical network relationship based on Patrick Geddes city evolution

4 Modernity, Metamorphosis and the Changing Face of Cities

Cities concentrate a lot of people in a small area. It serves as the avenue for commerce and industry. The city attracts a large number of people concentrate because it presents the platform to provide food, education, water and energy in a more efficient way. In the urban centres, a lot more people can be reached by doing less. The people also have more scope, freedom of choice in terms of food in the city. Infrastructure and amenities are available in a more efficient way in the city. It affords the opportunity for socializing; there are cultural and educational reasons to have discussions with your own, your group and mates or peers. Cities are political hotbeds, living in the cities affords the opportunity for taking part in the political process, where political ideas are hatched and cross-fertilized. There is not one model how the city must be designed (Welter, 2002). Economic activities in many cities of the world are of concern because such activities can be liken to one generation creating problem for another to contend with. Sustainable city should be an enjoyable city. It is a city people can move around easily. Improving public transport will help. Sustainability is a question of balance. It is achieving a sense of balance. City sustainability is a holistic concept that is focussed on successful use of available resources and technology to enhance city's liveability. The source of many problems that plagued the city is not just technical related; hence they cannot be solved by technical ways. Many of these problems are socio-political problems such as poverty, food shortage and lack of infrastructures. The food problem is not simply a technical one; hence we need to address them in a socio-political-economic ways.

Figure 3. A market-street scene in southwest Nigeria

4.1 Westernization and acculturation impact on the urban form

The influence of the colonial era led to the beginning of the acculturation process in African cities (Freund, 2007). Gilbert and Gulger (1994) argued that the incursion of the European into the third world has sometimes led to the destruction of the existing local culture. The built environment is an expression of the very basic desire by man to enhance comfort within the area where he lives, works and recreates. Built environments take their shapes from the very functions they are expected to perform and various activities such as shapes its design. Examples are seen in the location of markets for the sale of food in the African urban centre (Figure 3.). The built environment, whether it is a village or town is a product of the skillful organization of space in order to express in the one instance the peoples' social ideals and in another, humanity's notion of reality. The development of the Nigerian built environment can thus be discussed using its traditional architectural pattern as a point of reference because of its cultural influence and practices on the country's landscape. This is epitomized in the people's traditional use of urban space in relation to food production activities usually revealed by three primary - deterministic cultural phenomena. The first is revealed in the built environment as consists of village/town settlements composed of individual house units and family compounds, their structural and conceptual layout across the landscape arrange around a market.

This reflects the ideals of corporate life in the visual pattern of the village, village group or in modern terms, the city or metropolis. The second is that traditional spaces are represented as a system of semiotic units which human settlements are composed as the external symbols. Thirdly, traditional management of urban space refers to given processes of transformations in which cultural components are drawn from the immediate social institutions through skillful manipulation and social interaction.

4.2 Traditional house forms and Socio-cultural Continuity

The layout of the family compounds reflects the social status of family life, the central courtyard makes for intensive social continuity among family members, where food are prepared and consumed. In short, urban spaces are planned to assert group needs as well as foster social cohesion and interaction. Rooms or huts that constitute the basic residential units in any traditional Nigerian compound are often arranged around a central area which may vary in shape, size and characteristics depending on the nature of the elemental units, form of construction adopted, influences of topography, historical influences on the particular culture and individual preferences.

In most traditional compounds such as in chiefly residences, palaces and large extended family units may contain a series of these courtyards linked together by passages. Such compounds are themselves aggregation of multiple residential units catering for different elementary households of an extended family. No matter the form or the nature of this element of Nigerian traditional dwelling, the function tends to be the same, serving group activities of adult and children, visitors and members of the household, male and female.

4.3 Traditional settlement layout and urban morphology

The Nigerian cultural and physical landscape furnishes us with a variety of village and town settlements whose spatial layout and design principles have lessons to teach us on their adaptive potentials for modern sustainable principles. Many of these villages provide the arable farmland for production of food for the country and many parts of West African countries. Factors behind their layout and spatial schemes are as intriguing as their formal attributes which are predicated on cultural factors of habitation not to speak of the environmental issues that influence their planning (Olayiwola, 2000). Such factors include the following: the ideals of society itself, the pressure of population density, social organization, land-use pattern, the nature of available terrains, defense, the need for social and economic associations and religious precepts (see Table 1).

4.4 Transformations of a traditional city core

One important definer of human settlements in many parts of Africa including Nigeria is the notion of the centre. This may be the geometric centre of a group settlement physically or conceptually. In many societies, the center occupies strategic importance in the spatial scheme of settlements. For instance, in the radial-concentric shape of the Yoruba town particularly as a reflection of its social and political organization, the centre is the most strategic for a number of reasons. It is the magnetic centre of the town, which contains the most important unifying symbols, namely: the palace, a playground, and all the important shrines and Oba's market.

These features draw to the centre all the members of the society in connection with rituals and ceremonies associated with it. The same principle applies to other settlement layouts in many parts of Nigeria and sub Sahara Africa. The centre operates as the spatial and structural core of the traditional city's settlement layouts which constitute its most vital point of social interaction. When these corporate symbols are designed in response to the demands of unique local culture, our towns and cities may begin to assume a unique character of their own.

Table 1: Factors influencing urban transformation in Southwest Nigeria

Variables	Frequency	Percentage %
Social Status	55	27.5
Academic background	98	49.0
Cultural beliefs	26	13.0
Others	21	10.5
Total	200	100.0

Source: Author's fieldwork (2009)

5 Conclusion

The understanding of the socio-cultural and related economic activities that underpins the development of the city is paramount in order to plan for the city of the future. To provide a framework that could be used as a model in the developing world, the underlying socio-cultural issues such as food production activities must be taken on board, by the planners and policy makers. Need to emphasis that sustainability and sustainable gains will only be available through a purposeful planning and consideration for social- cultural issues that include the food question. In this regard, city policies, planning and management are expected to be predicated on partnership involving all the relevant actors like the public, private and voluntary bodies at all levels.

This will lead to new approach of different buildings, built environments and agro-urban relationships, thereby serving as the central challenge for food production and enhancement of the built environment. Thus the study of sustainability is mainly to assess the environmental impact of human activities and to search for options, which could have least negative impact on natural environment. The sustainability of the natural environment includes less depletion of natural resources, less pollution and less consumption of energy, which can ultimately yield manifold benefit for mankind in terms of provision for food, clothing and shelter.

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Islamic Instruments for Sustainable Urban Spatial Planning and Management

Aliyu Salisu Barau
Federal College of Education, Nigeria

Abstract

This paper looks at the role of faith-influenced land use planning and management as solution to the seamless urban challenges of this century. In many developing countries master plans fail to guide institutions to engender sustainable urban environment even as environmental changes affect the quality of life. The paper posits that since urban population cannot exist in absence of qualitative natural environmental variables, then it becomes expedient to think of sustainable solutions. Islam as religion and social system regulates space organisation for harmonious coexistence of inhabitants and the natural habitat. This feature characterises many Muslim traditional cities before the 20^{th} century when western planning theories and models become the brain-box of Muslim urban professionals and dream of governments. This paper examines the Islamic instruments of spatial planning and land use management which are enshrined in the concepts of harim, hima and fina. Northern Nigerian city of Kano is used as example for cross-examining these concepts in engendering urban spatial sustainability. The research couples analysis of images, interviews, field assessments and literature review to prop its findings. For many centuries, Kano city grew steadily with passion for the principles of sustainability which are understandable and implementable by grassroots and those in the power towers. At the moment, the three instruments are weak; hence, the city grows in pains of ecological imbalances and couple of land use challenges.

***Keywords**: Harim, Hima, fina, planning, sustainable, land use, Kano city*

1 Introduction

Traditional Islamic urbanism in the contemporary times is confronted by challenges of demographic explosions, globalisation, ecological challenges and the general quest for institutionalising urban sustainability. The pressing urban challenges underscore the decision of the United Nations to tag this century as 'urban century' (UN-Habitat 2008). The Target No.11 of the Millennium Development Goals (MDGs) No.7: environmental sustainability also focuses on challenges of urbanisation such as slums, land tenure, sanitation, poor planning and poverty (Martine 2007). In spite of all efforts, urban land use planning fails to eliminate slums, poverty and chaos in third world cities (Voigt, 2006). Inhabitants of megacities are helplessly exposed to natural hazards and critical, chronic and long term damages to lives, health and other socioeconomic aspects (Hansjurgens, et al 2008).Spatial planning of urban areas remains at the core of policies. The UN-Habitat (2009) suggests use of strategic spatial planning for developing countries for sustainability as alternative to master plans. Therefore, belief systems, culture, norms and values can offer launch pads for strategic planning.

In the Muslim world, one of the major challenges of urban space making has to do with adoption of western urban land use models which prioritise economy in lieu of ecology, morality and equity (Barau 2010). Interestingly, the potentials of Islamic principles of land administration for managing urbanisation is emphasised (UN-Habitat, 2005). One major challenge of urban spatial planning in Muslim countries and other developing countries is the contemporary usage of computer aided urban modelling and simulation processes such as: Alberti and Waddell (2000); Martine (2001); Vanegas; Waddell et al (2008) and many others. No doubt, such models are appropriate for the challenges on the ground. However, the local people and even most of the appointed or elected decision makers for Muslim towns and cities in Muslim republics and kingdoms are not well skilled and informed about such computer driven models and concepts.

Any tool to be used in spatial planning and monitoring should have a clear consideration for the involvement of urban land users and must integrate semblance of the customs and values of the society. By and large, integration of Islamic land use principles into modern urban modelling would in no small measure be of great benefit to professionals, land use administrators and community as a whole.

This paper advocates use of Islamic land use principles for attaining urban spatial sustainability. The objectives of the paper are: to identify the relevance of Islamic instruments urban spatial planning and management namely, hima, harim, and fina; to explore problems and sustainable solutions for challenges of contemporary urbanism in a traditional Muslim city of Kano in northern Nigeria; to examine and assess usage of such models in Kano city in the past; and to examine current implications of misuse of the models in Kano. The paper tries to achieve that through explanations on the background of the concepts of western and Islamic spatial instruments; practical applications for spatial forms and challenges from the case study site. Based on that, an empirical approach follows undertaking the research and its findings, conclusions and implications.

2 Conceptual Framework and Literature Review

Since the beginning of human settlements so many theories and practices define and guide how humans value and make use of space.

2.1 Urban Land Use Planning Theories

Contemporary urban land use studies emerged in the 19th century through David Ricardo's hypothesises that, the most fertile lands around the city attract highest rent (Chisholm, 1970; Ogbazi 2002). It was then followed by the Heinrich von Thünen's 1826 theories of land values and land use structure (Mather 1986). The main variable factor in von Thünen theory is transport cost in relation to production, and distance which in return determines semi- concentric land use patterns for a given city. Other related theories include those of William Alonso's land market model (1964). Walter Christaller (1893–1969) developed the central place theory to explain the location, size, function and economic relations between bigger and smaller urban centres using geometric shapes. August Lösch (1906-1945) modified Christaller's theory by considering effect of physical features on spatial distribution and hierarchy of settlements. Growth pole theory was developed by François Perroux explaining growth of cities through economic and industrial points which attract similar activities (Ogbazi op. cit). The central place theory was also modified by Vance (1970) who fashioned the mercantile model.

Concerning the city structure Burgess in 1925 suggested concentric model with an annular form that has the city's central business district (CBD) at the core. This rather simple and idealised model assumed homogeneity and defined boundaries alluded to various land uses in cities. Hoyt (1939) advanced an alternative model known as sector model. The model has sectors or wedges that radiate outwards from the CBD with lines of communications aiding distinct land uses from different directions. The third popular model was developed by Harris and Ullman (1945) whose multi-nuclei model stipulates that many cities do not grow outward from their CBD. Instead, as they grow they absorb other specialised land uses and consolidate them into separate nuclei that eventually become square, rectangular or irregular in shape (Mather 1986).

The models cited above have provided for zoning ordinances that separate various land uses through Euclidean zoning in 20th century (Burdette 2004). Such divisive land use planning based on non-market controls are designed in theory to minimise incompatibilities, though they promote unnecessary physical and social segregations (Fellmann et al, 2005). Similarly, the theories lack inherent and obvious considerations for ecological dimensions of the urban settlements as habitats.

2.2 Urban Land Use and Sustainable Urbanism

Majority of developing countries have adopted western urban planning concepts. Yet problems of abuse, corruption, squalor and pollution plague their cities (UN Habitat 2008, UN Habitat 2009). In many countries, huge metropolitan growth causes simultaneous displacement, deterioration, and devaluation of the inner core cities (Adhya, Plowright and Stevens 2010). To address these challenges, sustainable city theories emerged in the last 30 years to guide towards sustainable urban design (Lehmann, 2010). Three of the approaches enshrined in sustainable city theory are given by Martine (2001). The first is carrying capacity which entails estimating how much people and activity a given space can support; the second is ecological footprint which measures amount of land needed to sustain a city's population/consumption levels. The third approach is sustainable use of space which obligates: identification of the vulnerable populations with aid of tools like Geographic Information System (GIS); identification of ecosystems at risk and enforcement of their preservation; and search for viable options to expansion. In the same fashion, compactness (density) and biophilia (human access to nature) are prioritised values of sustainable urbanism (Adhya, Plowright and Stevens 2010).

Urban experts now create coupled models based on mathematical and information technology models to help in addressing the pressing urban planning challenges. Examples of such models include (Waddell and Alberti 2000; Martine 2001; McCarteny, Quay, Gries et.al. Vanegas; and Waddell et al 2008). However, Sabri and Yaakup (2008) caution on the high expectations from these models because they do not truly support the users' needs or support only part of plan development process.

2.3 Muslim City: From Rules to Spatial Design and Form

According to some opinions an Islamic city does not exist in a real sense, but some recurring mechanisms generate structure and expressions commonly found in Islamic cities (Abu-Lughod 1978). But this argument is countered by Abdulac (1984) who offers that Muslims designed and developed several garrison towns which include Kufa, Fusta, Basra, Medina, and Jabiya. Al-Hathloul (2005) states that, traditional Muslim city's design is generated based on customs and provisions of jurisprudence on how people use and develop space. Thus, it is not like a modern city whose physical form is predetermined by designer. In general, a Muslim city is characterised by sacred, spatial, ecological and socioeconomic dimensions. Ibn Khaldun (1332-1406) in his Muqaddimah (1978) outlines nine (9) requirements for designing urban land. These are: town walls; strategic location; consideration for prevention of air pollution; consideration for prevention of water pollution and infections; availability of water for the public; pasture ground for domestic animals; lands for urban agriculture; woodlands for energy and construction; accessibility and connectivity for external trade. These requirements are informed by provisions of Sharia on design of human settlement. Prophet Muhammad (S) arriving at Yathrib instantly changed its toponym to Madinah Al-munawwara (Illuminated city) and declares as haram (inviolable) what lies between its two volcanic hills, Gayr to Thawr. Thus, the Prophet forbids removing plants, hunting game and curses introduction of any vicious act there (Albadar, 1429/2008).

Hakim (2007) praises the generative processes associated with most Arab and Islamic cities for being socially inclusive; for their agreed-upon ethical meta-principles; for originating in locality's history and customs; and for their appreciation of individual and collective rights and responsibilities. These principles make settlements look natural and sustainable in contrast to the western city models trademarked by 'master plans' which are static blueprints leading to formation of fabricated structures in cities. Sharia is a sine qua non for place design and making in Islamic countries. For instance, Naniya (2007) and Nast (1996) hint that, the design of the Emir's Palace Kano built in the 15th century reflects on war tactics of the second Islamic Caliph, Umar bn Khattab (634-644); and it is also oriented towards al Qibla - Makkah.

Traditional Muslim built environments characteristically not built by professional architects or planners generate their stable and sustainable form through public responsibility sharing among the people cohabiting the environment (Akbar 1988). In this respect, Hakim and Ahmed (2006) outline some of the rules that operated in the 19th century built environments of the Sokoto Caliphate in West Africa. They listed from Sultan Abdullahi Fodio's book, Diya-al-Hukkam, which explains rules for land uses and fundamental duties and responsibilities for management of water, domestic and industrial waste, common and public properties like access roads and rights of privacy of individual house owners.

2.4 Muslim City: Rules of Spatial Design for Sustainability

From northern Africa, through northern Nigeria, Arabian Gulf to Iran and Pakistan attributes of Islamic urban heritage that promote sustainability include: harim, hima and fina for land use allocation; compactness and privacy of the built environment; natural resources conservation; and city cooling mechanisms (Hakim 2004). The three tools or instruments commonly used in Islamic world for regulating built environments are summarised in terms of their function in table 1 based on Hakim (2004), Hakim and Zubair (2006), Gari (2006), and Barau (2009). Table 1 outlines the applications of the instruments for sustainable design and management of settlements.

Fina' as elaborated by jurists is the part near the house door, and does not extend more than half of the width of the street. In lanes and cul-de-sacs, the fina' covers the whole area abutting the house, and usually extends to include the whole lane's width. The fina', therefore, can be seen as a space belonging to whoever has a door opening onto the street (Al-Hathloul 2005). On the other hand, himā is defined as a reserved pasture, where trees and grazing lands are protected from indiscriminate harvest on a temporary or permanent basis. It existed in the Middle East before Islam; but it was treated as a private reserve for powerful chieftains who were said to have used it as a tool of oppression. With the emergence of Islam, its function changed; it became a property dedicated to the well-being of the whole community around it (Gari 2006). Six types of hima are identified.

1) grazing is prohibited and cutting is permitted during specific periods;
2) Grazing and cutting is allowed only after flowers and fruits are produced. This allows natural seeding of the soil for the next year.
3) Grazing is allowed all year; the number and type of animals are specified with no restriction on grass-cutting.
4) Reserve for bee-keeping. Grazing is allowed only after the flowering season. These reserves are closed for five months (spring months).
5) Reserve for forest trees, e.g. acacias spp., haloxlon persicum. Cutting is only allowed for great emergencies or acute needs.
6) Reserve woodland to check desertification or sand dune encroachment.

Table1: Islamic instruments for spatial planning and monitoring

Models	Applications in Urban Built Up Areas	Potentials for Sustainable Urbanism
Harim	1.Carrying capacity regulation; 2.Pollution control; 3.Protection of local common resources etc	Sustainable use of natural resources and infrastructure at micro and macro ranges within and outside built up areas.
Hima	1.Urban green zone development;2.Biodiversitysinks;3.Wetlands conservation;4.Urban cooling; 5.Air pollution control;6.Recreational resorts; 7.Urban gardening by the poor;8. Land degradation control	Strategic spatial planning of urban spaces in arid and semi arid zones; and maintenance of ecological footprints in cities
Fina	1.Fostering privacy in neighbourhoods; 2.Grassroots sanitation;3 Roads and pathways management 4.Community conflict resolutions	Grassroots participation in space making, management and harmonious coexistence at the neighbourhood levels

The last of the instruments is harim which is defined as buffer zone surrounding a property or a piece of structure which is necessary for its effective function e.g. roads so that people are prevented from harming it. It also signifies space surrounding a well, built environment, forest or a river that protects it from damage, maintain its integrity and prevents it from pollution and destruction (Zahradeen, 1990; Hakim and Zubair 2006).

Therefore, jurisprudential provisions of Islamic legal system (Sharia) and Urf (customs) administered through judges and jurists (Qadis, Muftis) and Muhtasib (community guidance officer) and community members is broad based, and participatory (Hakim 1996; Barau 2009) and that helps immensely in creating order in space use by all and sundry in the society and between it and the ecology.

2.5 Islamic Urbanism and Sustainability in Kano City

Like many Muslim cities, Islam influences the spatial organisation of Kano since 15th century (Nast 1996). Kano became a full pledged walled city since 11th century (Liman and Adamu 2003). The city was compact with gated walls covering 18 miles radius (Olofin and Tanko 2002). The ancient city of Kano was ranked in the 16th century as the third largest city in Africa after North African cities of Cairo and Fez (Dan Asabe 1996).Kano then might look like an eco-city, as only about 1,800 acres out of its 5,400 acres landmass was a built up (Frishman 1977). The existence of numerous ponds, open spaces and scrublands around that period gave Kano attributes of sustainable cities. The said features of sustainability were also consolidated by the 19th century centralised Islamic land policies of the caliphate which include rules of the built environment (Hakim and Zubair 2006). It easy to infer from Hamza (2003), that plantations like those at Dorayi were lands held in trust for society and as such could be regarded as hima lands that lost their original status with passage of time.

The erosion of the relevance of Islamic principles of urban space regulation can be attributed to the centralisation of the land tenure system in Nigeria through the 1979 Land Use Act (LUA) which invalidates all the indigenous land laws of Nigeria (Barau 2009). The LUA is responsible for the current multiple socio-ecological crises over space use in Kano which compounds the city's known features of sustainability. For instance, Maiwada (2000) finds that the open spaces drastically reduced along with their ecological significance. Now in Kano people seek land to build houses from substandard, chaotic and even illegal informal land market (Liman and Adamu 2003). Earlier on Ajayi (1997) observes that spatially Kano grows by 100% per decade. Similarly, Sani (2004) adds that Kano grows aimlessly without master-plan, without focus, or direction and little control spreading over 11 local government areas. But, UN Habitat (2009) criticises master plans and urges for use of strategic plans that tackle the informal urban sector. It is pertinent to add that densification, gentrification and plots fragmentation are common in Kano leading to increased shrinkage of the individual buildings even in the official low density areas (Barau 2008). Similarly, Oumar (2008) finds that over the years the room occupancy rate for Kano has ranged from 1.4 in 1963 to 1.9 in 1980 and 2.67 in 1994. These figures correspond with increasing figures of city from about 100,000 in early 1950s, 1.6 million in 1990s to current 3.0 million. This rapid growth undermines the environmental quality of the city (Barau (2007). Spatially, the city of Kano deepens its growth from within its walled perimeter. Thus, spatial units like wards, zones and other metropolitan sectors continue to emerge from colonial through the post colonial areas (Liman and Adamu op. cit).

3 Data and Methods

In order to investigate the applications of the concepts of harim, hima and fina in the city of Kano in the past periods; and to as well investigate the city's contemporary spatial challenges in the light of absence of their implementation this study is pegged on coupling of field and laboratory methods.

3.1 Study Sites and Sampling

An air-photo mosaic Kenting Africa (1980) and Google Earth (2008) satellite image were used for comparative analysis of the past and present conditions of the city of Kano in respect of environmental variables in the last three decades (1980-2009) as they pertain to the influences of Islamic models of urban form and or spatial organisation and management (fina, harim, hima).

In order to achieve that, equal number of grid lines were drawn on the two images. The grids make stratified sampling the most suitable for consideration of changes that affect open spaces; undeveloped areas; ponds/wetlands; and thoroughfares/cul-de-sacs located within 18 miles radius of the walled ancient city of Kano.

Table 2: Sampling Points and Components

Hima	Harim	Fina	Harim	Harim/ Fina
Undevelo ped area	Wetlands/po nds	Alleyway/ cul-de-sac	City wall encroachm ents	Open spaces
Kabuga Lay- Out (Tal'udu)	Kofar Wambai Ward	Chedi Ward	Dukawuya City gate	Kano Municipal

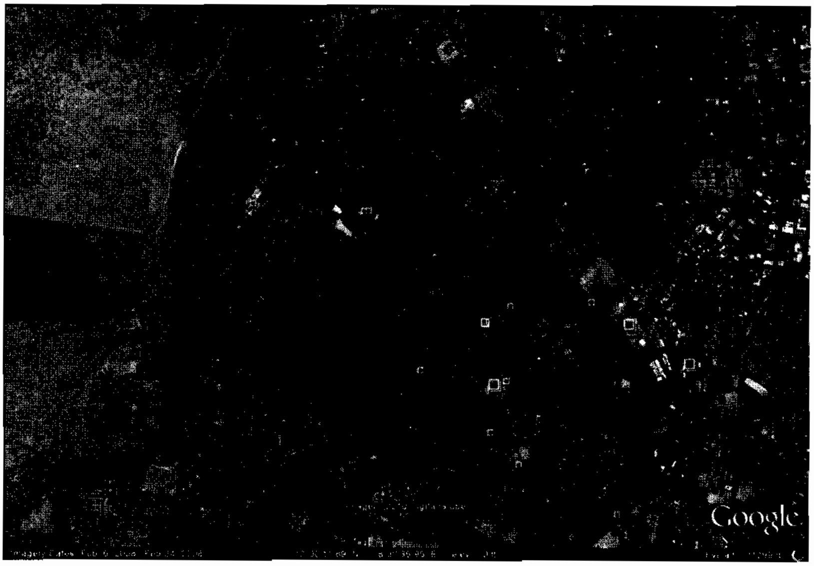

Figure 1: Google image of (heart like shaped) Kano walled city

3.2 Interpretation and Analysis of Images

For analysis and interpretation of the two images used in this research, visual cues such as tone, texture, shapes, and patterns of Kenting Africa (air photo mosaic 1980) and Google Earth (satellite image 2008) were considered.

3.3 Field Investigations and Interviews

Kenting Africa air photo mosaic was used as control and study aid for the field observation of roads sizes; encroachments on open spaces; undeveloped areas, and cultural structures like the city walls. Built-up structural relations surveys between individual and cluster of buildings within sampled points was also imperative in order to fetch idea concerning management of spaces and on the general observation of the Islamic instruments of space use. Participants for the interview were selected randomly from the study sites.

4 Results and Discussions

It is evident from the fieldwork undertaken at Chedi ward and its environs located within the ancient walled city, that the concept of fina is still very much observed and relevant in the spatial organisation of the area. The area has walkable passages that are non-motorable but usable by animals like horses, donkeys and camels. Chedi is among the ancient wards mentioned in Liman and Adamu (2003). Originally the houses there were built of mud, but subsequent reconstructions were done with modern building materials. It is observed that rarely the fina/pathways (with average width of 7 meters) are violated by trespassers. Even within some cul-de-sacs (blind alleys) the situation remains the same. House occupants use the fina space for purposes that benefit the community e.g. installation of electric poles and transformers. The sustenance of this situation is linked to the active role of ward-head (Mai Unguwa in Hausa language) who serves as the local head and exercises the role of muhtasib. Stability experienced in such areas for long period is an element of sustainability that emanates through Islamic rules as noticed by Al-Hathloul (2005); Hakim (1996).

Analysis of the 1980 Kenting air photo shows that areas around Wambai city gate have wetlands and ponds which play crucial role in urban cooling and flood control. The wetlands observed are all missing in the Google Earth 2008. It is obvious that, if the concept of harim is utilised it would have demarcated no-trespassing zones which would have preserved these sites which are now well desiccated. The negative implications of this for Kano city has been noted by Maiwada (2000) and Barau (2007). The erstwhile ponds and wetlands are now replaced by buildings and other commercially related structures.

Kenting air photo mosaic of 1980 shows that about one half of the Kano walled city especially its western axis are lightly developed or undeveloped. The land use is primarily farmed parkland, gardens, scrublands and houses of the poor as well as few educational institutions. The area is part of what Frishman (1977) refers to undeveloped parts of the city and which in the context of this research could be considered as hima. However, during the mid-1980s the area was converted into medium density housing area known as Sabon Titi/Kabuga layout (Tal'udu). The reserve land was issued to the wealthy and influential individuals who relocated to the area from the inner core city and other areas. In this context, hima lands are lost through the process of gentrification which leads to land use and land cover changes. Some sections of these layouts do not have substantive traditional heads like Mai Unguwa who oversees the administration of affairs of the society as Muhtasib and last strata representative of the Emir of Kano. Consequently, unlike in the inner core city potential threats are visible between owners of adjacent houses especially with regard to the types of buildings. For instance, it is observed at Kabuga layout that some duplex houses overlook some of the adjacent bungalows and undeveloped lands (see figure 2 below). This contradicts Islamic traditional city setting which respects privacy of individuals (Al-Hathloul 2005). In general, lack of consideration to Islamic rules on the built environment is caused principally by lack of set of rules to be enforced through an overseer or muhtsib. This opinion is confirmed by some residents interviewed. In this planned layout some house owners extend their walls beyond the fina thereby encroaching on the road and this situation some residents attribute to corruption by some development control officers of the planning authorities and also lack of substantive muhtasib personnel (see figure 3), such situation may also create tension in the community.

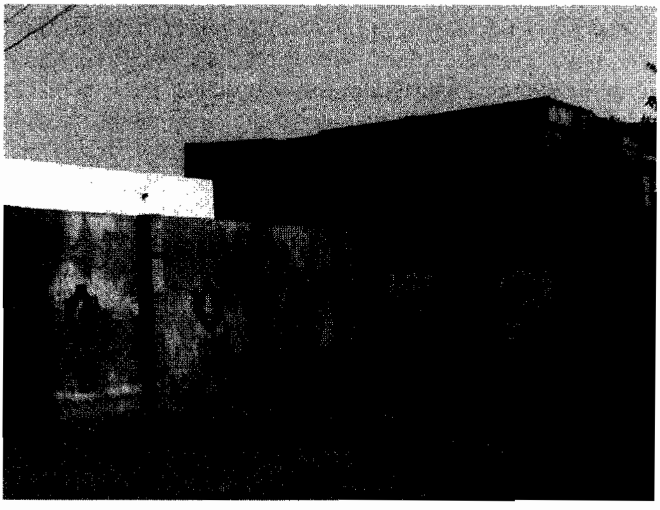

Figure 2: Potential conflict over right of privacy, windows overlook neighbours compounds

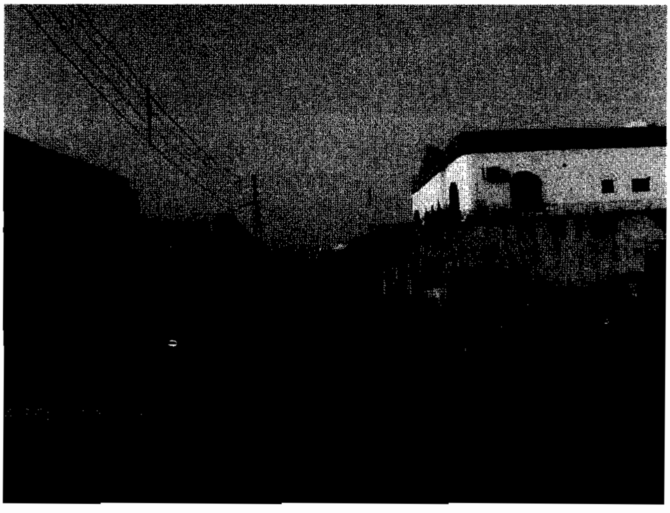

Figure 3: road encroachment by buildings violate fina concept as evident here

Another critical example on erosion of relevance of the concept of harim is manifested on the pervasive direct encroachment of buildings on the Kano walls and gates. The study examines this problem at Dukawuya gate which is one of the youngest gates and walls built in the 17th century. The Kano walls were never demolished or pillaged in the history, they had water filled moats and very wide buffers (harim) that protected them from encroachment. The buffer to prevent harm to all structures as noted by Zubair and Hakim (2006) is now very much disregarded and hence the current negative condition of the walls. The walls also used to have active caretakers (muhtsibs?) until the time the Nigerian federal government took them over as national heritage sites in the late 1960s. However, the secular laws of Nigeria could not secure the walls simply because the laws are not divine. People rarely feel obliged to respect them. Today the walls lack real caretakers and hence the continuous erosion and demolition of the walls (see figure 4 below).

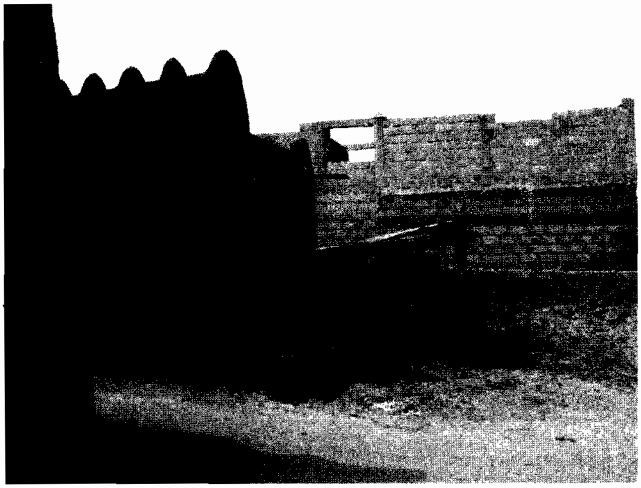

Figure 4: encroachments on the city wall and gate is common in Kano

From the comparative analysis of the two images used for this research, the relevance of the concepts of harim and hima in the management of spatial organisation and in maintaining ecological balance is clearly stated especially as regards open spaces and city ponds of Kano during the last three decades. No less than 70 open spaces and city ponds were counted on the air photo mosaic and this sharply contrasts the 2008 Google Earth image which shows extreme reduction in the number of open spaces and city ponds. Ground truthing conducted helped in identifying the real situation on the ground. Now, most of the city ponds have been desiccated, filled in or replaced by built up structures as the case is with ponds around Kabara, Sharifai, Zango, Yakasai, and Gwale wards are examples. For open spaces many are also lost through massive encroachments by public and private structures. Example of affected open spaces includes those at Kwalli, Gwale, Shahuci, and Yakasai wards. Both open spaces and ponds exercise some ecological tasks like flood control, cooling and waste management (Maiwada 2000). The rapid and continues diminishing of open spaces and ponds leads to massive intensification of the built up areas within the city. From analysis of the Google Earth imagery Kano looks too congested. It is earlier noted that densification is a process needed for urban sustainability (Lehmann 2010), but in the case of Kano urban compactness and densification pose and deepen ecological challenges ranging from microclimate change, pollution and disease prevalence.

5 Conclusions

This paper attempts to identify the role of Islamic instruments of spatial organisation and management of urban spaces. This becomes necessary as the world searches for alternatives and solutions to engender sustainability in the face of widening challenges of seamless urbanisation across the globe. The major conclusions drawn from this study are as follows:

That Sharia and institutions of space control and management play a key role in urban design and forms in Muslim cities and towns. The strength of Sharia institutions for settlement regulation and the models that it promotes such as fina, hima, and harim lies in their sacred essence, simplicity and comprehendible nature. Every member of the Muslim community regardless of sex, level of education and other social variables could participate in their implementation even under minimum guidance.

Adoption of scientific and technical tools of urban spatial planning is becoming a bandwagon affair with so many Muslim countries. Such tools are exclusive enclaves of professionals but vast majority of the population who are the end users or receivers of any policy derived from such instruments are quite disconnected from such mathematical and computer based modelling systems.

Based on study of the situation of Kano city in northern Nigeria, it appears that the city developed its spatial organisation based on the Islamic rules of the built environment that operated in the past. The rules become eroded by the overriding and superior Land Use Act of 1978 and other land and natural resource policies of Nigeria which displace the traditional Islamic rules of the built environment. Now with erosion of Islamic spatial values in the built environment, the city and its population suffer from evident socio-ecological decay. Master plans have failed. Urban renewals are costly and unsustainable.

Open spaces, scrublands and city ponds evolve merely due to Islamic principles. These ecological ingredients are most desirable in dry land urban area like Kano in order to manage growth and development process.

As challenges of urbanisation persist, it is worthwhile for all Muslim professionals, governments and other related and relevant institutions to redirect their ideas, skills, policies and decisions towards Islamic mode of urbanism which underscores responsibilities for space management from individual through community, urban and government levels.

Based on the opportunities embedded in Islamic models of spatial organisation there is need for more advanced studies on how the Islamic instruments could be used as tools of promoting sustainable urbanisation in the developing countries.

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Sustainable Living Community in Urban Kampung . Case Study: Kampung Sekeloa, Kelurahan Lebakgede, Bandung, Indonesia.

Dhini Dewiyanti Tantarto[1]

[1]*Department of Architecture, Indonesian Computer University (UNIKOM), Indonesia*

Abstract

Developing Ssustainable human settlements rests on three pillars: environmental, economic and social. In addition to use environmental resources to develop liveable cities, towns and villages that do not compromise the ability of future generations to meet their own needs, new settlements must also be economically productive and socially inclusive. New developments should have a positive effect on increasing urban employment and reducing poverty. So the majority of households could enjoy some measure of the welfare which accrues from productive employment. Sustainable urban development is also likely to remain an illusion if the urban poor, who are the majority of the urban population in most developing countries, are excluded from decision-making and from being full urban citizens.

Urban poor settlements or Kampungs as spontaneous human settlements should be seen as assets rather than liabilities. The goals of this research are to identify and to map interweaving relationship of place and production system of urban, education and cultural commodities in Kampung Sekeloa, Kelurahan Lebakgede. Also to learn how the community endure and accomodate the development, so sustainable pattern could lead to balancing of economic, social, and ecological factors resulting in a sustainability in a changing environment.

***Keywords**: kampungs, urban educational & cultural commodities, sustainable living*

1 Theoretical Framework

Tjuk Kuswartojo (1998) states that sustainable development as a concept does not seem to cause crucial differences, meaning it is acceptable by all parties. But differences would rise on how to form and create the sustainable development itself. Opinions and ideas on sustainable development as a concept are rooted in three disciplines of science: social, economics and ecology (Ismail Serageldin, 1994). The question is whether the more antropocentric aspect of socioeconomics and the more ecocentric aspect of ecology, could embrace one another. This clarifies that sustainable development emphasizes not only on increasing the human quality but also the environment quality and sustainability of theresources as a *life support system* to improve human welfare as well.

Eventually, social, economic and ecological problem is a changing process which occurs continually in a long term. It shows that sustainable development is a dynamic concept. Poverty plays an important role in this sustainability. Realization of the importance in eliminating poverty to succesful development lead the government to establish programs to eliminate poverty, which in turn will increase awareness of environmental preservation. To balance both economic progress and environmental awareness is a prime challenge to sustainable development.

The economy growth by using natural resources does not improve welfare only it also may reduce environmental quality. But in fact most rich countries are much better in managing good quality environment compared to developing and poor countries., though sometimes even rich countries could not fully solve environmental issues. (J. Kozlowski and G. Hill), However it generally strengthened the opinion that economic approach is best and more realistic to sustainable development.

2 Kampungs in Bandung and Their Creativity

Kampung in Indonesian means village or country. In earlier times, an administrative unit of village was called '*desa*', while *kampung* is a more generally used term in present times. It is one unique feature of Indonesia that urban settlements are also called *kampung*s. It is often said that human settlements in developing regions continue to preserve the characteristics of rural village, and such a concept applies to *kampungs*. Poor physically and economically, but are not necessarily poor socially. It should be emphasized that *kampung* is not a slum. *Kampung* shows a different appearance from the urban settlements in western cities. Destruction of social structure and crimes are rarely seen in the *kampung*. It is also not a discriminated settlement but a community that has its own social system and values. *Kampung* as an urban settlement has its special characteristics as an autonomous community model. Funo (1987, 2002) discusses the characteristics of kampungs and points out what we can learn from *kampung* communities.

Bandung is far from ideal cities that creative-base industries could grow well. Landry in Franke 2005 mention that being creative as individual or organisation is relatively easy, yet to be creative as a city is a different proposition given the amalgam of cultures and interests involved. The characteristics tend to include: taking measured risks, widespread leadership, a sense of going somewhere, being determined but not deterministic, having the strength to go beyond the political cycle , and – crucially – being strategically principled and tactically flexible. The problem is how we can create a good environment in Bandung. Creative milieu is a place that contains the necessary requirements in terms of hard and soft infrastructure to generate a flow of ideas and inventions. A milieu can be a building, a street or an area. Florida (2003) states that there are several things that creative people actually value in locations, for example; *lifestyle*, a place gives a distinctive lifestyle. *Social interactions*, places give the user an opportunity to interact with others. *Diversity*, it means 'excitement' and 'energy'. Creative minded people enjoy a mix of influences. *Authenticity* it comes from several aspects of community- historical building, established neighbourhood, a unique music scene or specific cultural attributes.

An authentic place also offers unique and original experiences. *Identity*, place provides an increasingly important dimension of our identity. Many creative class people also express a desire to be involve in their communities. T*he quality of place*, related to local homes industries. Firman (1997) stated the criteria of local economy as : the usage of local resources, moved by local citizens, the usage of human resources that are dominated by locals, small service scale, the presence of economic activity's organization/group that organizes and transform local potential, they have multiplier effect for other activities and the emergences of new enterprises/entrepreneurs. Definition of local economic development stated by Blake (1989) as a process by which local government and /or community-based groups manage their existing resources and enter into partnership arrangements with the private sector to create new jobs and stimulate economic activity in a well-defined area. Florida, in Franke, 2005 stated the creative age is not going to solve our problems. It's not going to make our segregation. In fact, it may indeed compound may of those problems. But in the other side product designed or produced by creative society is valued much more increasingly for the creative portion of value added than for the physical or the material. Creativity is the motor force of our economic growth.

3 Development of Kelurahan Lebakgede, Kampung Sekeloa

3.1 Kelurahan Lebakgede as The Pocket Area of Jalan Dipati Ukur

Recents years, Dipati Ukur Street is developed as an Education Area, although there is not a formal classification as such. Several Universities stand in this area. State University: Padjajaran University and Private Universities such as Indonesian Computer University (UNIKOM) and Institute Technology of Harapan Bangsa(ITHB) grew very rapidly. In the past years, Dipati Ukur Street was a housing area, which northen area was dominated by low income housing, and southern area by a high class society. Sekeloa area was occupied by low income dwellers. Before, majority of the community worked as temporary laborer, unskilled laborer or textile laborer and some of them were even jobless.

Since The Faculty of Dentistry of Padjajaran University was built here, many of them changed their professions. They worked at home to do business such as computer rental, canteen or boarding house (boarding room). Around year 2000 when the goverment policy drew up a policy to the regulate education autonomy, some of educational institution accepted many students in order to raise fund. Many faculties were opened, and some were over populated. Thus, Dipati Ukur became a booming area as a student district. Many of newly rich households came from this area. Although they live in inner urban area in a small unit houses, but they own many units of houses in this kampung. They became a different community. From working outside the area , they now are able to generate income within the Kampung. While the government wants to resettle them somewhere else in order to develop the area (since the area was rent from the government), many dwellers hold out in this area. They believe that their fortune is in this area, so they do not want to move out.

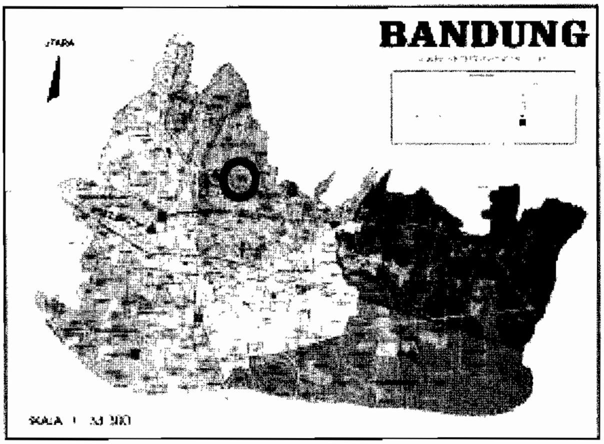


Figure 1: Observed Kampung Location in Bandung City

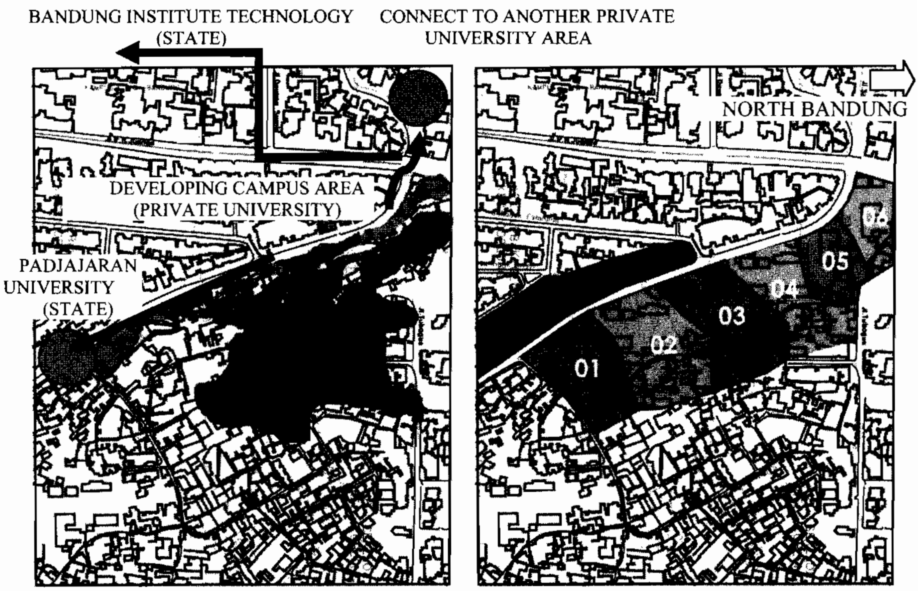


Figure 2: Neighborhood administrative unit of Kelurahan Lebakgede

Kampung Sekeloa, Kelurahan Lebakgede, which borders with Dipati Ukur street, situated in Coblong District. Kelurahan consists of a few RW's (RT: Rukun Tetangga is a neighborhood administrative unit. A group of RTs makes up one RW: Rukun Warga).The observed kampung is located in RW 0 (consists of 7 RT's), RT 03 and Rt 04 are the ones which are connected and have more acces to campus area, as shown in Fig.2. The composition of local population in these two RT's are shown in following table 1:

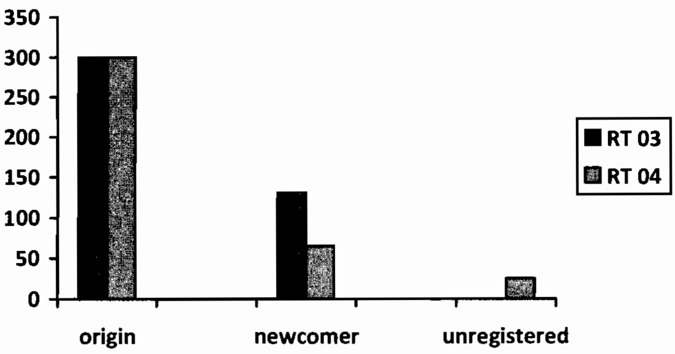


Table 1: Population in RT 03 dan RT 04

Table 2: Mata Pencaharian Penduduk

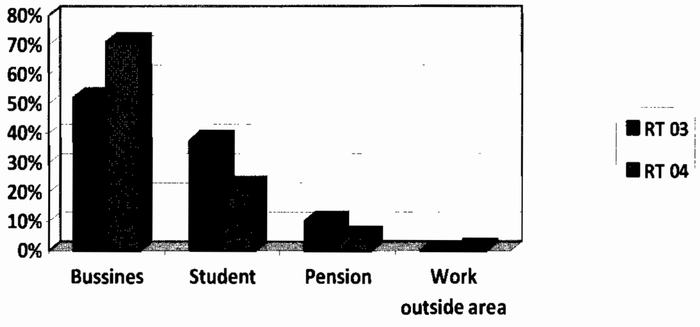


Table 2 shows the population in Sekeloa area, dominated by business owners, those who used to be workers.

3.2 Development of Kampung Sekeloa

Since Bandung is known as a fashion city and Sekeloa area is dominated by young occupants, thus many fashion shops are built here. Young people manage to run bussinesses such as T shirt or moslem wear and becames the founder of distro (distribution store) which is now famous in Bandung. Many dwellers become parking landlords, laundry bussinesmen, a stationary and copy center bussiness owners and thesis production service owners. The others sell a variation of food: an everyday homemade cooking, a western or eastern food and coffee shop. There are stalls or vendors providing light meals to heavy meals, that opened in various hours. From formal restaurant to non permanen food stalls which opened only at night when the stores are closed. No wonder if this area is running for 24 hours. Some of households changed parts of their living areas to into boarding rooms, monthly renting housing or such.

The living spaces are developed into a mix of production, commercial and living spaces. They reconstruct their living space for economic purposes. Every household in this area made some effort to change their home.The successfull one even have more than one unit of businesses.

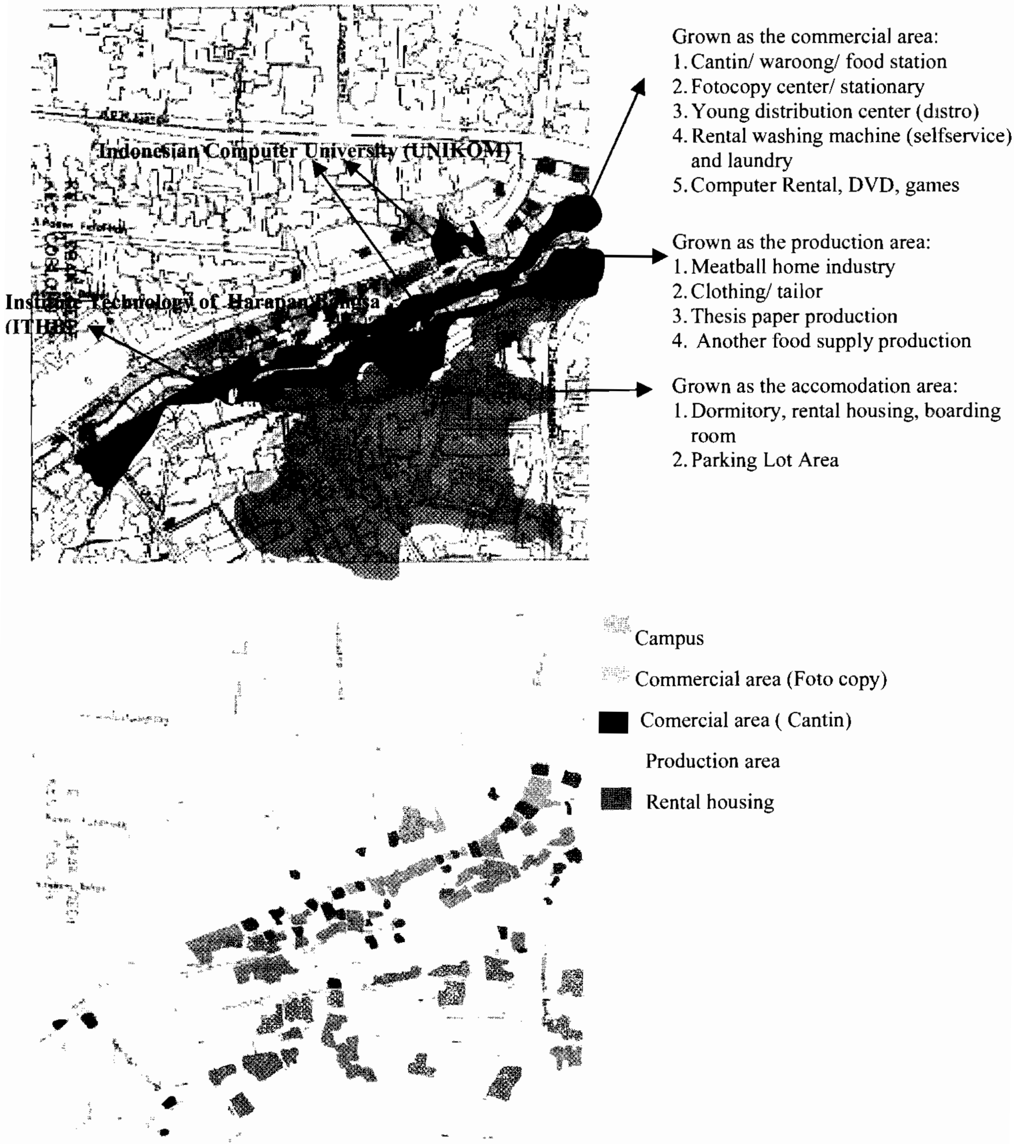


Figure 3: The Development of Sekeloa Area

Commercial area
Grown as the production area
Grown as the accomodation area

Figure 4: Bird's eye view of Sekeloa Area

3.2.1 Zoning Area based on Activities

Kampung Sekeloa, Kelurahan Lebakgede is the spontaneous settlement area as shown in Figure 3 and 4. The majority of the buildings here are built by the residents themselves without proffesional held. So the density is unbelievable high. Correspondingly, the production space here is pretty complicated, with the following characteristics:

Firstly, the production, commercial and dwelling spaces are highly mixed spontaneously in the urban space. The mixed up is social and physical. Generally speaking, the commercial and the production spaces are almost located along the main lanes, because those parts are more open and convenient to people. On the contrary, the dwelling areas are more private, they often occupy the quieter places inside the lanes.

Secondly, different workshops are relatively spread in different areas. Figure 2 shows that the production areas take different spaces based on product characteristic. But, still the production houses are not far from the main street. As a matter of fact, workshops which need smaller spaces are mostly located upstairs or in the basement (since the area were in the high levelling contour). The first floors are usually used to display items and function as an entrance of the shops. At night, these spaces also used as sleeping areas for the workers and families.

Thirdly, living and business areas are vertically segmented in accordance with different functions in Kampung Area.

Together, the distribution of the production space in the city is a comprehensive subject for us to study. It shows close relationships with traffic, housing, and so on. In other word, it is influenced by the society directly or indirectly, resulting in the physical nature of the Sekeloa spaces.

3.2.2 The Interior Space of Different Activities

Figures 5 to No.13 show illustrations and photos of different mixed use spacea (actually there are more model variations). It is obvious that the quality of the spaces are quite low, the living spaces are generally small, basically without good ventilation and lighting. Most of them are alterations or additions to the houses made by residents here. The shape and the size of the houses are varied, without a unified direction.

Furthermore, the use of indoor spaces differ from one another other based on different procedures or functions. At the same time, the function is highly mixed and the space is compressed. For example, though a house might seem like a single working room without a kitchen or a bedroom, but all the needs of everyday life could be self-solved well by cooking beside the front door and sleeping on the mezzanine floor. It is incredible and rather efficient. Sometimes the plan is very small so they build vertically because they cannot expand horizontally. The number of people living in the house sometimes is very high, since they still have good family kinship. They invite their relatives from village or countryside to help their businesses.

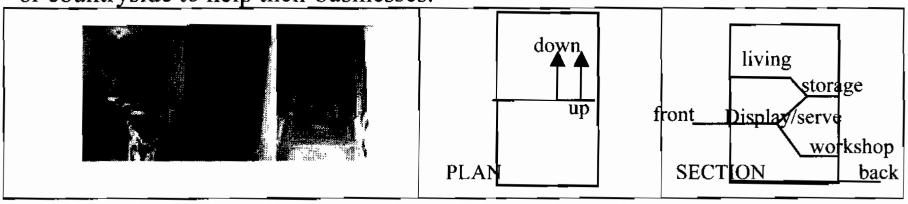


Figure 5: Mix-use living area and computer rental-maintenance

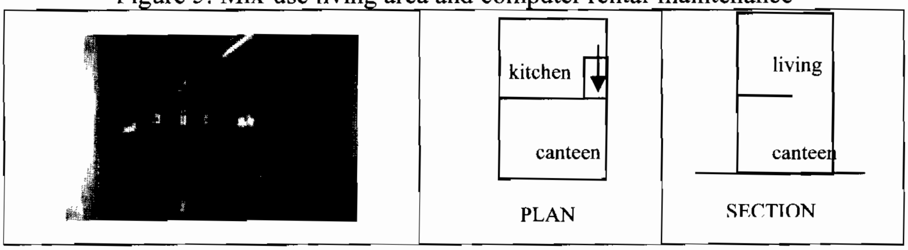


Figure 6: Mix-use living area and canteen.

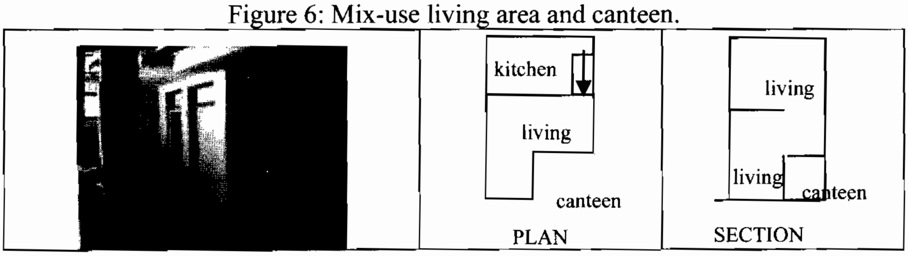


Figure 7: Another Model of Mix-use living area and canteen.

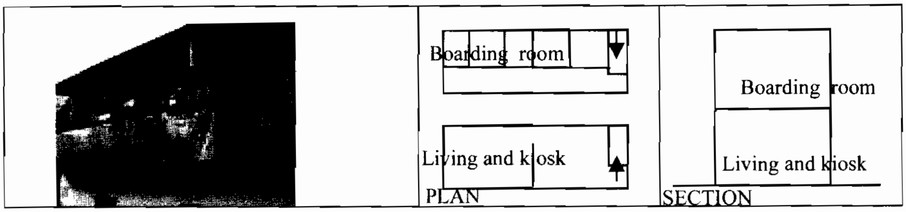


Figure 8: Mix-use of living and boarding room

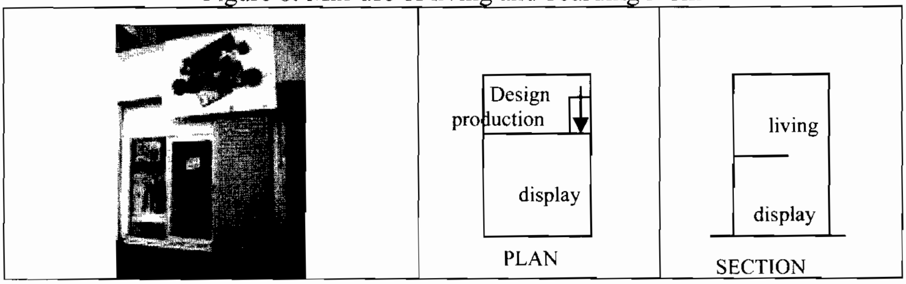


Figure 9: Mix-use of living and production house

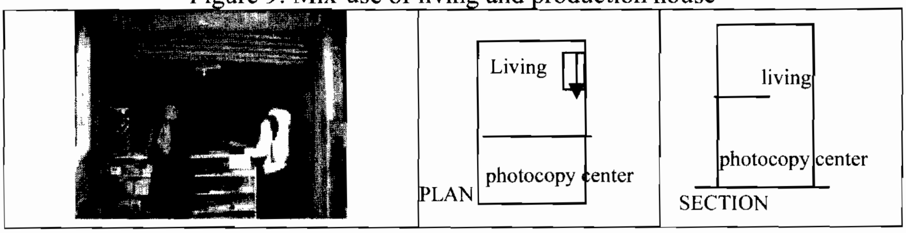


Figure 10: Mix-use of living and photocopy center.

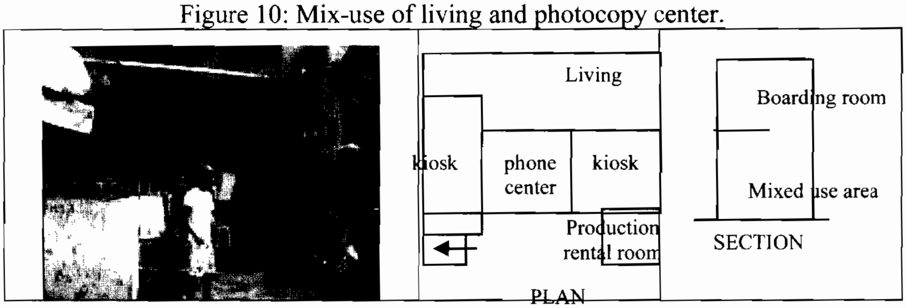


Figure 11: Mix-use of many activity

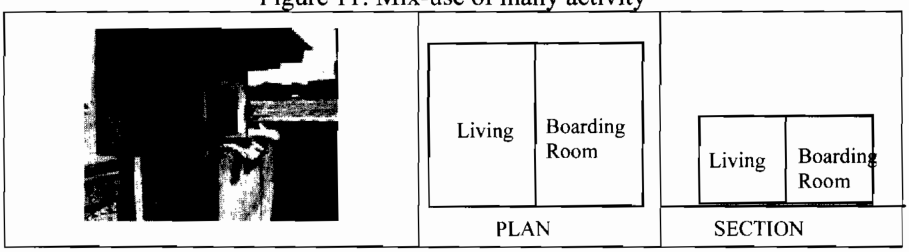
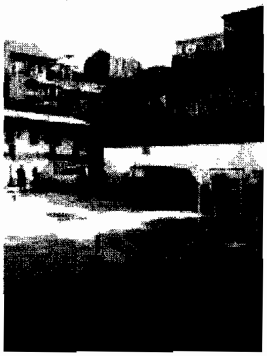


Figure 12: Another model of Mix-use of living and boarding room.



Morning:
1. Sport (older community)
2. Breakfast food selling

Noon:
1. Private car repair workshop
2. Wood-made workshop

Afternoon:
1. Children Playground
2. Woman area for hang-out

Night:
1. Badminton/ volley
2. Midnight food selling
3. Parking area

Figure 13: Mix-use of community open area.

3.3 Sustainable Living Characteristics in Kampung Sekeloa

Obsevations on physical changes in the buidings caused by economic growth as results from creativity in economic activities, supported by possible social condition shown by Table 3. Not all changes bring good quality in improvement.

Table 3: Relation between Economic changes, Environment and Social to Sustainable Living Concepts.

ECONOMIC				
SYSTEM	BEFORE	AFTER	quality	
			+	-
ECONOMIC DEPENDENCY	Laborer	Business owner	√	
URBAN TRANSPORTATION LOAD	Need transportation to work outside area	No need to go out from the area, lesser urban transportation load	√	
DEFINITE JOB	Occasionally labor	Having a definite job for sustain in living	√	
CREATIVITY IN BUSINESS	Worker	Creativity in bussiness varies	√	
ESTABLISHED IN ECONOMIC	Having no established.	Improved environment economy and relatives in country areas.	√	
LEVEL OF WELFARE	Do not own vehicle	Own Vehicle, need parking lot area		√

ENVIRONMENT				
1. ARCHITECTURE				
a.SITE			quality	
SYSTEM	**BEFORE**	**AFTER**	+	-
SIDEWALK CONCEPT	Disorder because of having no rules of building entrances	Have an order, flowing pedestrians, and clear.	√	
	Only use by pedestrian	Also used by motorcycles		√
AIRWAY	Having no cross ventilation, dark room	Become healthy home with better air circulation and sunshine	√	
OPEN PUBLIC SPACES	Only 1% of the area	Become 5% of the area. Some of the habitant gave away their land to build public open space	√	
	Used for social activities	Not only for social but also commercial		√
b.BUILDING				
EXPRESSION	Disorder	Form follow function	√	
ORIENTATION	Disorder	The circulation become clear, building facade is according to the pedestrian lane.	√	
FORM AND CONFIGURATION	Disorder	Have an order, double loaded circulation across the pedestrian lanes. Ideal standard of dimension is applied based on human activity	√	
		Those who only think of profit, not considering optimum space for occupants		√
FACADE	Disorder	Have an order, 1 floor building become 2 floor.	√	
CONSTRUCTION AND MATERIAL	Not permanent	Using better material, permanent, local material: brick, bataco	√	
TROPICAL CLIMATE CONSIDERATION	Not considered	Condering tropical climate in building, which needs oblique forms of roof and minimum 1 m wide canopy with 1:3 height	√	
SYSTEM	**BEFORE**	**AFTER**	+	-

BUILDING UTILITY SYSTEMS	No system	Start to consider the system of electricity , plumbing and septic tank. But not in grey water.	√	
DRAINAGE AND SANITATION	1 RT hanya only have 2 public toilets: ladies and gents	RT 04 every households has toilets. RT 03 only 80% has.	√	
	Central area septic tank	Not resolved yet.		√
TRASH	No solution	Not resolved yet (trash disposal still a big problem in most cities in Indonesia).		√
CLEAN WATER	Well	PDAM (State Waterworks)	√	
c.LANDSCAPE				
VEGETATION	No awareness	Space esthetics taking into considered by planting trees	√	
OPEN SPACES	No awareness	Used according to needs: social and bussiness activities	√	
RIVER MANAGEMENT	No awareness	Beginning to care the system by the clean management	√	
2. PROVISIONING STRATEGY				
SELF HELP	They are already have	Still have these atmosfer, so that makes the habitants stand alone	√	
SELF BUILD	Self help community	Still have these atmosfer, so that makes feel at home for all habitants. Since they come from countryside, so they still have these feeling.	√	
SELF SUFFICIENT	No awareness	Still no awareness, because of no understanding so they need guidance from proffesionals.		√
SOCIAL				
EDUCATIONAL BACKGROUND	Low level or having no educational background	In educational environment (campus area), having some knowledge	√	
SYSTEM	**BEFORE**	**AFTER**	**+**	**-**

COMMUNITY SELFHELP	Community selfhelp to build their house or doing activities	Still have these atmosfer, so that makes feel at home for all habitants.	√	
RESPECT ELDERS	Respect the elders.	Still have these atmosfere, so these feeling make kampung secure	√	
TOLERANCE	High tolerance in differences: religion, race, ethnic	Still have, and make kampung stay in peace	√	
SECURITY	Origin habitant know one another well	Not registered new comer make crime-infested in kampung		√


Figure 14: Before: non permanent building


Figure 15: Become permanent and have 2 stories

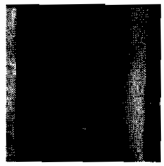


Figure 16: Before: no cross ventilation, dark room


Figure 17: healthy building with air circulation and shiny


Figure 18: Before: Public Toilet


Figure 19: now almost every households have toilets


Figure 20: Before: poor river management


Figure 21: Now awaring to river management by cleaning and planting


Figure 22: Space esthetics taking into considered by planting trees


Figure 23: Before: have flat roof

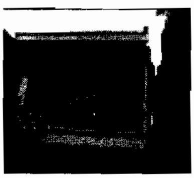


Figure 24: Condering tropical climate in building, which needs oblique roof

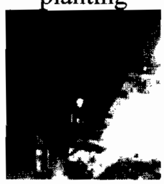


Figure 25: minimum 1 m wide canopy with 1:3 height

Figure 26: Before: Trash is put everywhere

Figure 27: although not resolved yet they begin to collect the trash and put into District Collection

Figure 28: Still throw away the grey water to river

Figure 29: Not registered new comer make crime-infested in kampung, so they start to build a fence

4 Conclusion Remarks

Description of Urban Kampung Illustration showed conclude that:

As the main lane grows, urban kampung which is located close to it could also grow accordingly, and thus, does not fall into poverty.

Sustainable development is still an illusion in developing countries. It cannot be reached without a good economic growth. As an example, kampung Sekeloa, Kelurahan Lebakgede showed that even without proffesional intervention as it grows, the awareness of preserving environment emerges when they reach better economic level or welfare.

A good economic level could be achieved through a creative way of thinking in the midst of the surrounding growth. Creativity would occur if it is supported by these social factors: feel of togertherness, share another's trials and tribulations, high tolerance in differences, cooperation, kinship values and secured feeling.

Sustainable development could only be achieved by the understanding of residents and neighborhood awareness of all paries. Strategies such as *self help, self build* dan *self sufficient* that happens spontaneously in a small economic community has been proven to have bigger potential leading to sustainable development.

Eventhough the awareness to preserve environment emerges when a certain economic level is reached. Still, the improving kampung such as kampung Sekeloa, Kelurahan Lebakgede needs proffesional guidance and cooperation between decision makers and implementations officers to reach a more organized planning and development.

Acknowledgements

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Reflections on Sustainability

Read as a whole, the papers within this chapter are at once thought-provoking, and often provocative, as they hit at the very heart of Sustainability as a Humanist endeavor. Through various vantage points, each portends that sustainability must become evolutionary, needing to evolve beyond science and policy and into something of a social ethos before it can become truly effective. The case studies and scientific research sited are well-founded and presented, but each plays as background to the optimistic yet challenging call for a new Ethos.

Several papers reflect on the need to sort out weather the key to our cities and built environments, both existing and newly planned, lie within an older, pre-Industrial paradigm, or a new paradigm altogether. Delightfully, they progress to suggest both, that new readings of old models overlaid with new and innovative ideas may provide new and creative possibilities. It is this optimistic idea of harnessing our intellectual knowledge base that is so fascinating, and in so doing, providing an applicable method for the evolution of our current ethos of consumerism and consumption.

Another underlying theme within this chapter is the poignant realization that with new technologies come new responsibilities. While we have enjoyed the fruits of the Industrial and Informational Ages, we have yet to embarrass them fully and responsibly, and are yet to define our current Age. As with Darwinian theories of Evolution, the newly evolved must at times endure the weeding-out process of the unfit hybrids. Rather than over a millennia, we find the evolutions at hand taking their course seemingly overnight, making it incumbent as a global society to become global citizens, sharing a global ethos to handle the changes with intelligence and application. Technology will not save us, but enlightenment and intellectual pursuit just might.

This chapter suggests that perhaps it is no longer the Information Age, but rather, an Age more akin to Reason and Enlightenment necessitated by the hard lessons in disciplined self-reflection. After several eras of unabridged consumption as a way of life, we are slowly coming to the realization that a different lifestyle is not to be feared, and that a sustainable way of life is reasonable, convenient, and, shockingly, profitable. Several papers document the path blazed by select multi-national corporations that in embracing sustainable practices as an ethos, have found new profit bases as well as the most coveted of all commercial assets, self-generating intellectual properties and their ability to commercially proliferate. Matched to this rising economic ethos is it's mirror within the collective design communities, that sustainability is no longer an inarguable necessity, but rather intellectual Ethos of Reason.

Mark Harris, AIA
Mark Harris ARCHITECTS, INC., USA

Revisiting London's First Garden Cities: Failed Utopian Vision or a Sustainable 21st Century Model?

Jeff Risom[1], Maria Sisternas[2]
[1] *Project Manager at Gehl Architects, Copenhagen*
[2] *Urban Development Project Manager at MedCities, Barcelona*

Abstract

In the UK, the 'compact city' model for urban development has heavily influenced Urban Renaissance planning policy of the last ten years. This complex and contested ideal has been greatly simplified and selectively implemented throughout London. This paper examines the guiding framework for this form of 'compact city' policy. Some Urban Renaissance policies are reminiscent of the Garden City model put forth 100 years earlier. Yet this paper intends to investigate these "sustainable" policies as they manifest themselves specifically through a proposal for a tall building in the Garden City suburb of Ealing. Our analysis leads us to criticize regional policy used to designate the scope and scale of development at the local level as it fails to identify key socio-economic and spatial characteristics that contribute to the phenomenology of each specific location. This failure stems from an ideology that is largely rooted in convenient but overly simplified notions of what constitutes 'urban' and 'suburban' areas. We conclude with two bundles of policy and urban design interventions that address the flawed relationship between the regional and the local, identifying new evaluation criteria, while maintaining the strengths of current policy's main goals and aspirations.

Keywords: *sustainable suburbs, compact city, polycentricity, density, intensification, Garden Cities, regional planning policy, local governance*

1 Ten Years of the Urban Renaissance

1.1 The London Plan and the Compact City: a sustainable 21st century model?

The first London Plan, released in 2004 after four years of preparation, is a regional planning document that sets out then Mayor Ken Livingstone's vision for London, as an "exemplary, sustainable world city" (GLA, 2004). The 'compact city' model for urban development was integral in achieving this vision and was envisioned as the most sustainable paradigm: environmentally, in terms of conserving energy and land; socially, by promoting the already vibrant and diverse quality of life found in the City; and economically, enhancing London's growth through economies of scale implemented through strategic partnerships. .The plan designates *areas for growth*, in both inner and outer London, but fifteen of the twenty-five identified *areas for intensification* are widely considered suburban, including the Garden City of Ealing, and are located in Outer London.

Over a century ago, Howard's plan for the *Garden Cities of tomorrow* laid out many of the 21^{st} century sustainability principles: Howard envisioned a framework of several 'compact' communities each highly accessible by foot (bicycle) and public transport and each offering employment diversity and residential amenity. These new urban areas were to be linked by an "intermunicipal railway". While this ideal drove Scandinavian post-war planning particularly in Stockholm and Copenhagen, in practice Howard's vision has only been partially realized in numerous English (Letchworth, Welwyn, Milton Keynes, Ealing, etc) and American cities (Radburn, Chatham Village, Baldwin Hills).

Howard's Garden City vision of 'Town-Country' that "would gain the opportunities of the town and those of the country" (Hall & Ward, 1998) perhaps still remains the English ideal, over 100 years after it was first formulated. Yet, the 21st century lifestyle is a carbon and energy-intensive one, which contradicts the perceived benefits of 'local proximity' and dense urban living promoted in the 'compact city' policy. It is argued in this paper that London's 'compact city' model risks imposing inferior 'apartment' housing types onto localities that lack sufficient provision of services, thus merging the worst of town and country. The next paragraphs critically examine the main tools for achieving a more compact and thus more sustainable city according to the London Plan: brownfield redevelopment, and regionally determined density targets.

1.2 The redevelopment of Brownfield sites

Brownfiled policy can increase land values, thus pricing certain income classes out of the city and disconnecting established social networks. Basic principles of urban economics state that restricting the supply of land increases land values (O'Sullivan, 2007; Chesire & Sheppard, 2005). This is further exacerbated in suburban areas. Other studies refer to econometric evidence showing "that urban dwellers value local open space and underdeveloped land considerably more than they do greenfield land outside the city" (Whitehead, 2008, p.8). Therefore, urban policies aiming at developing brownfield sites come at not only financial costs but also detract from the social sustainability of the local community as such sites could otherwise provide local amenities.

At a broader scale, current focus on brownfield development in London restricts house building in places where employment is growing because they often do not coincide with the zones that have most brownfield land. (SOLUTIONS, 2009). Thus, current policy is advocating the construction of thousands of new homes, far away from existing and new employment centres resulting in increased demand for car use and longer commuting times.

Finally, The London Plan assumes that brownfield sites are centrally located and " ideally suited to this form of intense and integrated development" (GLA, 2008, p. 64 section 3.6). While this may be the case in certain contexts, Research shows that local policy often fails to address the relative accessibility of brownfield sites (SOLUTIONS, 2009). This critique is not to say that brownfield policy is entirely misguided, but must be adjusted to specific sites and context as in the absence of robust local policy that responds to specific contextual issue, the rigidity of the less contextual policy of the London Plan can be misinterpreted at the local scale.

1.3 Density targets – regional focus versus local context

Planning and built densities have been rising rapidly across England and especially in London over the past 25 years in response both to government policy and market pressures (Whitehead, 2008; SOLUTIONS, 2009). Yet one can question whether the dramatic increase in densities of residential development is marketable in the long-term. When considering the built density alone (the regulated supply of housing), suggested densities found in current London policy advocating for at least 60 dwellings per hectare are "far higher than anything observed in new building [in the UK] for many decades" (Whitehead, 2008, p.4), and substantially higher than the density of 25-30 dwelligns/ha. of the first Garden Cities. With higher densities on a constrained land supply, the result is that new units are smaller than existing units. This seems to imply that housing stock being produced will not be desirable in the long-term as this contradicts the prevailing trend in high income groups to demand not only high quality homes but also more space.

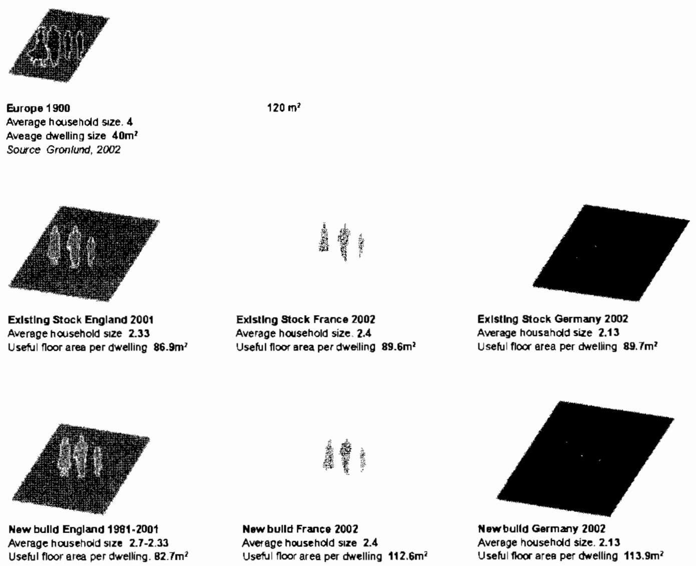

Figure 1: Useful floor area per dwelling over time. In the UK, new homes on average are nearly $5m^2$ smaller than the existing building stock, while new homes in France and Germany are nearly $25m^2$ larger than existing dwellings.

Proponents of higher density argue that more compact urban forms built at higher densities reduce carbon emissions, often referring to the causal relationship between density and personal energy, powerfully illustrated by Kenworthy and Newman in 1989. Yet conclusive proof of this causal relationship is contested. The study is criticized for neglecting the 'real' (income and fuel prices) and 'opportunity' costs of transport (time and access) (Rudlin and Falk, 2001; SOULTIONS, 2009). Specific research in the suburban context implies there is little or no correlation between density and private car use (Echenique, 2005). Thus higher densities can lead to traffic congestion rather than decreased automobile dependency and negatively impact environmental sustainability. These negative effects can be measured in terms of increase in fuel consumption and subsequent emissions and pollution caused by "queing and stop/start traffic flow" (Echenique, 2005, p. 126).

Furthermore, The London Plan sets a generic target to "maximise the potential of sites… compatible with local context, the design principles in Policy 4B.1 and with public transport capacity" (GLA, 2008a, policy 3A.3). With no maximum density set in regional policy, the question of appropriate density is left to local authorities. Yet these local decision makers are caught in a difficult situation between local demand for housing and regional policy. These competing claims are still very much contested.

1.4 Critical evaluation of the "Compact City" policy

While limiting sprawl and encouraging more efficient land-use, current 'compact city' policies that may appear sustainable, often result in negative externalities as well. . Economically and socially, it could be argued brownfield targets restrict land supply, driving up land prices and the cost of living, which in turn threatens to disconnect established social networks. By not explicitly tying land re-use to building re-use, brownfield policy has a potentially net negative effect environmentally as well.

The tendencies of market and policy forces have contributed to reduced new dwelling sizes, contradictory to demand in the UK for more dwelling space. Intensification policy tends to neglect context and services, focussing predominately on access to public transport as justification for building at higher densities. Narrowly defined categories used to regulate levels of intensification fail to address the complex and diverse nature of London's outer boroughs.

This narrow approach leads to social conflicts and economic distortions in the Outer boroughs of London, where one-time envisaged Garden Cities like Ealing are located, but are today widely categorized as suburban. Ultimately, restructuring spatial relationships and policy guidelines might result in better mechanisms for evaluating how density should be allocated, determining the 'optimum' potential of a site in a suburban context, and rationally designating development on either green- or brown-field sites..

2 A Polycentric London?

2.1 Measuring polycentricity

The Garden City model was proposed as a series of walkable mixed-use communities that would create a series of self-sufficient employment and residential centres to be linked by a quick public transport network. Today many argue that London's urban form today is indeed polycentric and therefore conforms to both Howard's vision and the 21st century sustainable model. It can be argued that London's polycentrism, however, is not due to Howard or anyone else's 'planned' vision, but is more a market response to a congested Central London, and the subsequent interventions of the public sector constantly seeking to optimise the physical expansion of the city.

Despite being unable to attract the type and quantity of light industrial employment, Howard envisioned, by the end of the 19th century, the popularity of predominately residential towns of Letchworth, Hampstead and Ealing, (each designed by Unwin and Parker following his Garden City ideal), created a large demand for single family houses with gardens. Yet the 'golden age' of suburbs has recently degenerated into a 'pseudosuburbia' (Hall, 2006): the market has found mechanisms to dilute the Social Cities as originally envisaged by Howard. This way, the growth of suburbs "was partly made possible by the construction of estates, groups of houses built as a single scheme by speculative builders" and "was undertaken systematically, with row housing of a defined and codified typology, which facilitated the urbanization of large areas" (Panerai, et al. 2007). This raises questions of not only how truly polycentric London is today, but also how suburban are London's suburbs.

Measuring polycentricy is relative; what might be polycentric at one scale, can be perceived as monocentric at another scale (Hall and Pain, 2006). Cartographies of everyday lives of Londoners reveal different degrees of polycentricity according to each of the variables. Outer boroughs now only host a third of the jobs they used to offer. Consequently, local authorities have reconverted former industrial sites into back offices, superstores, shopping centres or multiplex cinemas (Buck, et al., 2002). Thus, the proliferation of tall office buildings in the City and Canary Wharf is the physical expression of how monocentrically London operates for working people.

Central London employs 1.3 million, with over 50% of those employed with Level 4/5 qualifications, while smaller centres have only "around 30 per cent of employees in Metropolitan Town Centres have a first degree or higher" (GLA Economics, 2009, p. 8). It has been showed that "employees with higher qualification levels are likely to travel further to work than those with low qualifications" and since "Central London is shown to be the major source of employment for the highly qualified workforce in the region" the geography of London for the highly skilled is decidedly more polycentric than for the low-skilled (GLA Economics, 2009, p. 4). Polycentricism is connected to notions of social justice because as soon as a centre is defined, it means for another area to become peripheral; it implies a hierarchy of spaces. Only the wealthier can afford to pay for the surplus any central position has to offer.

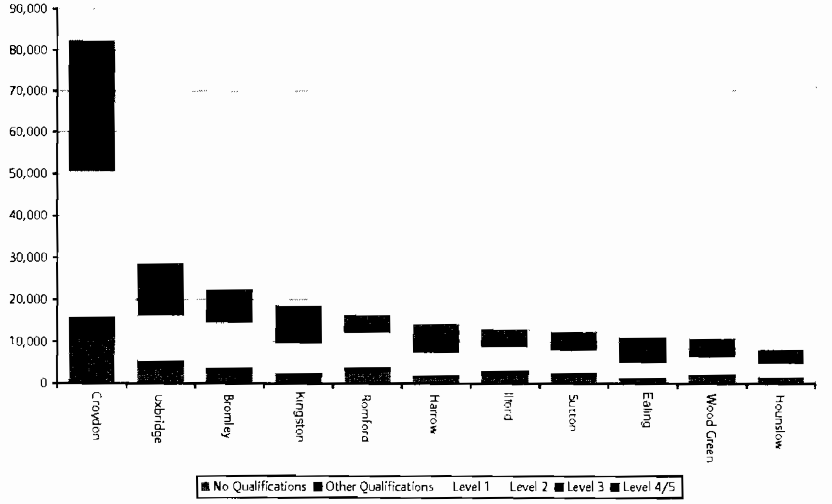

Figure 2: Employees by qualification in Metropolitan Town Centres (GLA Economics, 2009)

This leads us to propose that a more polycentric city –as Howard suggested - can be a more socially just one: the setting of a network of small economically viable centres can potentially allow more people to benefit from the diversity and opportunity for innovation inherent an urban economy. For the suburbs to overcome a long process of decay, they need to become central again. Centrality, in the context of suburbs, should relate to their transport accessibility, but also to the role of their open spaces, weekend activities and, more importantly, to their capacity to generate employment. Because suburbs need to develop their own identity as centres, inevitably, the kind of jobs located in the suburbs cannot be the same as those that compete to be located in Central London. This notion of complementary, rather than competing job creation again coincides with Howard's original vision.

2.2 Metropolitan Centres

The expansion of London's poltical and physical boundaries resulted in areas such as Ealing, once conceived as Garden Cities far removed from the centre of London's dirt and crime, being engulfed by the city and re-categorized as Metropolitan Centres. In July, 2009 Mayor Johnson re-emphasized the public sectors commitment to invest in such Centres, as a way to "beat the recession" by "target[ing] resources at town centres across London, helping them to thrive and attract new business" (GLA, Mayor of London, 2009). A consistent physical definition of Town Centre is elusive, in urban economic terms, a centre may be defined by the quantum of employment or area of retail space. In this paper we are focusing on Metropolitan Centre, which has no universal definition but in the London plan is defined as: *"mainly in the suburbs, serve wide catchment areas covering several boroughs and offer a high level and range of comparison shopping. They also have significant employment, service and leisure functions"* (GLA, 2008, p. 413).

2.3 Town Centre Analysis

The geography of the city and the perception of centres of economic, retail, and leisure activity vary depending on factors such as level of qualification ethnic background and also urban morphology, socio-economic composition and transport habits. Additionally, differences in terms of history, political affiliation, and proximity to other centres further differentiate Town Centres and strengthen claims for a more place based approach. Indeed, Mayor Johnson has recognized deficiencies in the current treatment of Town Centres by calling for a more differentiated approach that is not a 'one size fits all' but rather builds on existing characteristics. (Greater London Authority, 2009 p. 36).

These proposed changes in policy, however, will only achieve so much unless real differences and similarities between places in general and Town Centres in particular are analyzed and used to inform regional and local policy. The comparative matrix to the bottom suggests typical perceptions of 'inner' London as better suited to pedestrians might no longer hold true, as Croydon residents commute to work by foot in similar high numbers to people living in Inner London Camden. Thus a similar pedestrian strategy for Croydon and Ealing (where far fewer people commute by foot) would be unambitious for Croydon but misguided in Ealing.

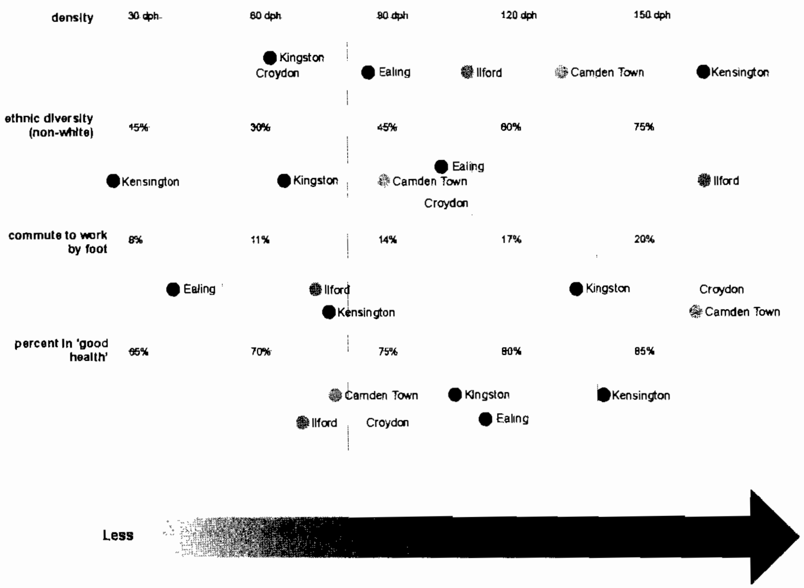

Figure 3: Comparative analysis of town centres and boroughs according to density, ethnic diversity, lack of housing affordability, commute to work by foot, percent in "Good Health"

Conversely, identifying centres that share similar socio-demographic characteristics regardless of their proximity to Central London, can be implemented to achieve a more contextual approach. For example a shared regional policy for density of development might be more appropriate for Ilford and Camden Town, that are already more dense but not for Croydon and Kingston. Moreover, identifying similarities between centres that are not located in the same sub-regions might lead to additional knowledge sharing and exchange of information between centres not competing for the same local patrons. A centre like Ilford for example with a low amount of pedestrian activity, might benefit from learning about the factors in Kingston that contribute to a much higher percentage of people commuting to work by foot.

An analysis based on statistics and mapping is not comprehensive, nor can meaningful regional strategies for centres be produced from extrapolating the similarities and differences illustrated here alone. What the matrix above does illustrate, however, is that real categorizations such as Metropolitan Town Centre or Inner London do not adequately capture meaningful and important differences vital to the successful implementation of both regional and local policy. The differences here suggest that regional policy that tends to prescribe similar guidelines for centres based on by proximity to central London and quantum of retail space, are misguided if considered in isolation. This analysis demonstrates the need for an additional layer of regional strategies that can inform local strategies. Establishing constituency maps on behalf of unique localities would enable these places to establish productive relationships with central or other peripheral locations. Eventually, these strategic synergies, rooted in the local, could inform regional efforts and policy.

3 Assessing the 'Leaf' proposal for the Arcadia site in Ealing

Howard's ideal was never achieved because it was financially unviable, and politically impossible. Yet the social and environmental aspects of the vision, if achieved today, would be widely considered an innovative and robust model for sustainable 21st century urbanism. In that way, the vision of Howard remains worthy of aspiration today, but equally elusive due to similar economic and political contingencies. In order to understand the effects of compact city policy in a suburban area of London, and evaluate broader sustainability criteria replicable throughout Outer London we examined the Call-in site of Arcadia in which the Leaf project, containing 567 residential units housed in a 26-storey tower together , a project signed by Foster and Partners. Although the final decision of the Secretary of State to was to reject the proposal in December 2009, it is our contention that the policies for compaction as contained in the London Plan actually set out the conditions for high-rise building that the Irish Developer Glenkerrin were proposing. The development was rejected due to "the harmful effect on the character and appearance of the conservation areas, which are the central features of Ealing Town Centre, overweight the benefits of the scheme" (Report to the Secretary of State for Communities and Local Government, 2009). However, it is our contention that the proposal perfectly responded to 'compact city' regional planning laws, as it was: to be built on derelict brownfield land, and to be located near an underground station. These regional policies fail to recognize that at 350 dw/ha the planned density of the project far exceeded the surrounding Garden City planned context of 25-30 dw/ha and would overburden existing services.

The project perfectly illustrates that it is not by concentrating all physical growth in empty sites that cities will be able to make their suburbs more sustainable. Rather, policy makers will have to come up with more place specific solutions in order to meet the Sustainable Garden Cities ideal. In the following paragraphs we propose two boundles of policy that may contribute to the creation of more sustainable suburbs.

3.1 Achieving compactness (physically / economically)

The year 2007 marked the first time more people on earth are living in urban than rural areas. Coincident to this shift to the urban, changes in lifestyle, (especially mobility) and a knowledge based economy have dramatically altered the definition of a region, a city, an area, and a 'community'. The expansion of the urban space regularly used by urban residents is reducing the importance of proximity in everyday life, blurring the limits and the physical and social differences between town and country (Ascher, 2003). In London, our analysis illustrates that typical planning designations of 'urban' and 'suburban', 'inner' and 'outer' appear less and less useful. Yet, despite amendments and modifications, the basic structure of land use planning in Britain has remained fundamentally unchanged in terms of both its central aims and mechanisms since 1947 (Chesire, 2005; Hall, 2006); the role of the planning system in the UK political system and the lack of meaningful interface between social, economic, and cultural disciplines remains the same.

The Urban Renaissance may have signalled a paradigm shift and a romantic reference to 'traditional' city reminiscent of the Garden City model put forth 100 years earlier and largely influenced by Continental urban influences in general and Barcelona in particular. But in the words of François Ascher "it is highly improbable, in a society which has such efficient means for transport and communication, that people will restrict themselves to those urban forms that were once the only ways of construction a city, creating proximity and providing choice" (2003).

Following are recommendations for achieving the goals of the 'compact city' and Urban Renaissance policy in the 21st century context that are all potentially applicable to a wide range of urban and suburban conditions. These address the generic structural relationships between regional/city and local objectives. The second and third sets identify spatial policy recommendations based on the Ealing case but again applicable in several urban and suburban areas .

1. **Regional relations** – Realign power relations and planning responsibilities to allow for more meaningful local influence on local policy. Consider multiple definitions of 'local' to guide the development of such strategies:

(a) Define regeneration objectives locally, (b) Consider alternative definitions of local, (c) Develop area specific strategies at "people" scale.

2. **Reduce the footprint -** Reduce energy consumption and promote less carbon intensive transport by improving conditions for pedestrians and cyclists. Promote price mechanisms to address externalities not captured today in the price of peripheral land.

(a) Create a 'finer grain' street form, (b) Introduce new pedestrian routes, (c) Local suburban Policy:

(c.i.) Re-use / retrofit existing buildings, (c.ii) Introduce pricing to capture the cost of fringe infrastructure, (c.iii.) Include price signals to address externalities

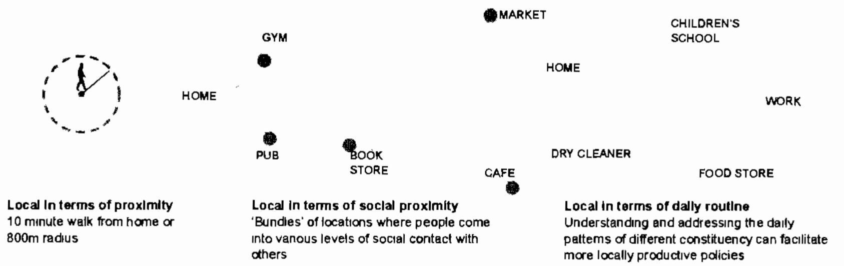

Figure 4 With changing lifestyles come new definitions of 'local'

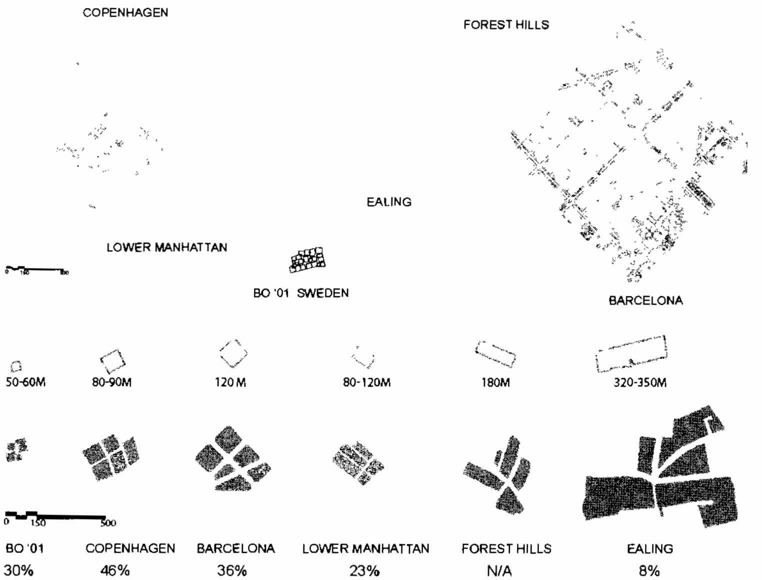

Figure 5: Block size and commuting patterns: without suggesting a causal relation, it is interesting to analyse average block size together with the non-motorized (walking and cycling) modal share of cities. Sources: Urban Age, www.idescat.cat, ONS neighbourhood statistics, www.kk.dk

3. Grow from within - Limit Urban sprawl and promote more efficient land-use through alternative notions of density beyond concentrations of tall buildings. Ensure intensification of services and amenities accompany a denser built environment.

(a) Re-imagine density: (a.i) Intensify horizontally as well as vertically, (a.ii) Expand definitions of target density, (a.iii) Intensify beyond the existing high street

(b) Promote 'smaller' development: (b.i) Restrict new development plot size, (b.ii) Develop modern co-operative land assembly legislation

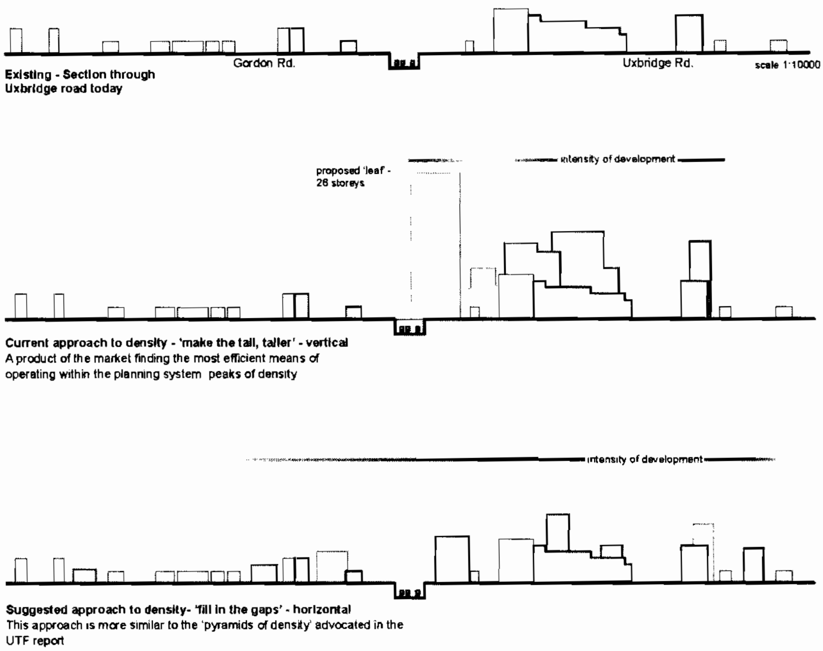

Figure 6: Comparing physical solutions: Existing Section / Current approach to density –'make the tall, taller – vertical / Suggested approach to density – 'fill in the gaps' - horizontal

3.2 Facing a different social spectrum (socially)

Despite nostalgic claims of a better past, the population spectrum in Ealing is very different from what it was back in 1900. Since 2001, the number of migrants has increased by 50%. If 'urbanity' was to be measured by the diversity of its population, Ealing would be one of the most urban sites in the UK. Additionally, the borough is increasingly polarised. While average income in Ealing Broadway is £40,000 per annum, the Southall Green and Southall Broadway wards have an average income lower than £27,500 per annum. In fact, they are the 6th and 7th poorest of the 633 wards in London when considering household sizes.

One of the biggest problems in Ealing is the affordability of its housing stock. There is a large demand for social housing, exacerbated by high land values, site availability and a too slow rhythm of construction. Due to 'Right-to-Buy' programmes, the Council looses around 50 properties per year, out of a stock of 13 400 tenanted units. Some claim increases in density lead to a congested urban environment that undermines the quality of life of residents. Interestingly, however, in Ealing, an already low median density of 55 residents/Ha gives place to a congested urban atmosphere. Population surveys undertaken by the Council conclude that traffic congestion is the major concern amongst Ealing residents (State of Ealing, 2009).

That Glenkerrin was willing to pay for the expensive operation of bridging the railway tracks, probably indicates that land values were high. This suggests that, so far, the implementation of the London Plan in Ealing has been successful in terms of stimulating the market but the market alone fails to deal with the social and economic problems of the bourough. The following list enumerates the barriers to development and physical interventions that could respond to such constraints:

- **barriers to housing:** it is a priority to build social housing units or to reintroduce into the market vacant properties to match an increasing demand and deal with overcrowding. More importantly, new units must be built at the appropriate typologies.

- **aesthetic prejudices:** it would be more respectful with the character of the area to build with a complete different language rather than trying to imitate what was built at another time, with another technology. It is crucial to have a strong sense of the local history to appropriately shape the masses and volumes of new buildings, but covering a massive 12-storey residential building with local bricks and copper won't make it less harmful for the context.

- **overcoming the obsession with density:** local oppositions to density are an understandable reaction to the takeover of an ideal by the market. However, there is scope for densifying: with an ageing population, largest under-occupied properties could be horizontally divided by means of specific legal settings.

- **infill strategy:** instead of concentrating residential growth in large sites, urban strategies should seek to replace the most downgraded or incomplete fragments of sites with intermediate housing units, and when possible, using ground floors to locate retail or local shopping facilities. A functional regrouping of houses in packages that contain a balance of mixed uses would easily make the area more comfortable to local residents. As a lesson to be learnt from Hampstead, plots placed at the corner of two streets could be occupied by pubs or cafés.

- **a more durable built environment:** larger plots at Uxbridge Road could be used for bigger interventions. Working on the section of the artery, opening its ground floors to commercial activities and promoting exemplary demolitions of buildings that cannot be reused due to state of disrepair

- **boundaries of open spaces:** The perimeters of the parks should be equipped with small activities that promote the flow of people from the road system into the network of open spaces. Privileging the circular connections between wards instead of the radial dependencies on the centre would reduce the isolation of pockets of deprivation.

- **lack of services and amenities:** Local residents are more likely to accept developments if they are invited to actively participate in the design and use of new amenities. It would be highly unrealistic to try to compete with the shopping centres of Brent Cross or White City. Instead, the setting of a special area for a food market at a former industrial building or warehouse, with possibilities to expand through informal outdoor stalls, would strengthen the local economic activity .

Local authorities shouldn't rely on the construction of a landmark to regenerate suburbs. Rather, they should seek to empower those who are deprived from public life participation through the analysis of a broader informational basis that reflect increasingly polarised social realities.

Figure 7: Major Open Areas and Green Corridors / Residential areas, Town Centres and Employment Locations / Plan of proposed strategy: span the strict boundaries of the Town Centre and consider the main arteries of residential areas

4 Conclusion

This paper has analysed London's spatial strategy to accommodate growth. The strategy based on the 'compact city' policy, seeks to create planning certainty through the designation of Metropolitan Centres and Town Centres to attract private investment. This regional policy aspires to create a more polycentric London, but is often outmoded and incapable of adapting to specific locations. The London Plan, based on the 'notion of strategic partnerships' is intended to inform but not replace local policy, acting as mediator between the market and local authorities to balance the need for area specific investment with the demands of local residents. In the absence of sufficient local policy in the suburban context, however, the balance tips toward the demands of private investment, resulting in to economic distortions, social conflicts, and environmental 'green wash'.

While the Urban Renaissance has strengthened the appeal of vibrant urban areas, the prospect of a spacious home and fresh air continue to attract people to London's less densely populated areas. The geography of the city and the perception of centres of economic, retail, and leisure activity vary depending on factors such as level of qualification and ethnic background, which in turn seem to affect other indicators such as income and indices of deprivation. Mayor Johnson has recognized such deficiencies in the current treatment of Town Centres by calling for a more differentiated approach that is not a 'one size fits all'. Using the case study of the Arcadia site in the suburban outer borough of Ealing, it has been asserted that in the absence of a local planning framework at 'people' scale, the London Plan alone fails to provide sufficient guidance to respond to the unique needs of existing local residents thus neglecting rootedness and failing to promote site specificity in design. The relationship between policy and the market established in the London Plan succeeds in terms of enforcing the greenbelt policy and maximising land use to promote densities that can support public transport. These strengths are most apparent in dense urban settings with more homogenous urban morphology, but become controversial in suburban locations where notions of heritage and sense of place are more varied and contested. It has also been shown that if the maximization of the potential of one specific site is replaced by a retrofitting strategy, there is scope in the suburbs to densify.

While several policy changes are needed to ensure the social, economic and environmental vitality of all of London - some of which may be included in these pages - it will be difficult to move beyond the tendency for planning policy to be disconnected from economic, social and cultural realities. Revising policy and retrofitting our physical surroundings will result in only so much change. Not until the talents of architects and planners together with sociologists and urban economists become fully focused on these realities, rather than falling prey to utopian aspirations, can we begin to holistically create urban and suburban environments for the 21st century.

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Sustainability Is Not About More Iconic Architecture

Faida Noori Salim
University of Baghdad, Iraq

Abstract

Most modern iconic architecture breaks the existing urban codes and regulations. They tend to operate outside the existing rules of the urban fabric. The Architects and the clients of such projects start with these intentions in mind. Hence, such architecture can only argue against the present status quo. On the other hand, it is only through the present and collective memory that one can argue for the sustainability of culture. As such, all iconic architecture that ignores the present cultural context, in the name of difference and iconicity, will inevitably participate in the process of a change to an alternative.

In the current circumstances, all such changes are lead by celebrity architects, who are effectively participating in the creation of a new global culture supported by some complex theoretical arguments that can only sincerely serve one cultural outlook or, in case of deconstruction against European cultures, and for that same matter, all old existing cultures. This leading role of theory in architecture has resulted in a state of hyper theory, which can only lead to greater fragmentation of existing cultures.

No culture can sustain a continuous course of celebrating the rich, the expensive, and the excessive. It was not a coincidence that modern architecture developed itself through the architecture of the house and the neighborhood. Most existing cultures are formed around a stable and basic social institution, the family. Whereas, today, global culture is being formed around celebrity figures, of which celebrity architects are examples.

The paper argues through interpretation that sustainability of cultures through architecture is not and cannot be about celebrity architects or iconic architecture. However, change is inevitable, and the new can be thought of through the natural sustainability and cultural sustainability of values and institutions, and iconicity should be understood as coming from the community and from the identity

formation processes of individuals in the process of meeting their own essential needs for cultural sustainability and social stability.

Keywords: *Iconic Architecture, Celebrity architects, Sustainability, Culture, Violence, Present, Image.*

1 Introduction

Architectural practice and teaching today has mostly evolved in the last forty years around celebrity architects and post modern iconic architecture. So, we read for Venturi: "let us now abandon our hopeless search for new form and define the artful dimension of architecture as iconographic." (Venturi, 1996) However, that does not mean that past periods did not enjoy such a trend. Naturally and throughout its history, architecture has aligned itself with power. But given the egalitarian paradigm, that advocated universal equality for all people, power was declared as disembodied. Yet, celebrity architects, today, form centres of power and attraction and their work receives instant recognition, some architects have sought or found themselves in such a place and worked to maintain it by continuous invention of the 'new'. Such a state of architecture is not necessarily a sign of better life, and as Brecht says through Galileo's character in his play 'life of Galileo': "unhappy the land that is in need of heroes." (Brecht, 1937-1939, p.95)

In an interview with Gehry, he said that democracy is noisy. This means difference and individuality creates noise and pollution of images, not to mention the impact of advertisement. This has gone so far that a well known critic like Charles Jencks will search for an explanation from Frank Gehry for what Charles Jencks perceived as repetition of architecture while recalling the similarity between Disney Hall and the Guggenheim Museum in Bilbao, and probably some other projects. (Jencks, 2005)

In contrast, the Modern Movement in architecture was more attentive to the ordinary and the public. The house and the neighbourhood became their focus in what emerged later as urban design. Rather than complexity and contradiction, simplicity, efficiency and healthy environment for the ordinary was their focus. Their work was meant for a disciplined society. Today's developed cities exhibit architecture that is competing for attention and is more for a surveillance society. Postmodern designs of circulation in buildings are not studied according to the rationale of the disciplined person, but rather take on a life of their own, and depend on surveillance cameras for security.

When Venturi called on architecture to pursue such aesthetics he did not ignore the importance of harmony. In fact his invitation and enthusiasm for images that are part of the physical environment and different from that produced by Modern Movement is an invitation to live in harmony with what existed and to abandon the bulldozer strategy. It is an invitation to work with an eye on the context and a mind that creates through an urban design focus.

More recently some architects seeking more technological images are promoting digital architecture. Though the images are aesthetically attractive (at least on paper) society, however, cannot sustain such competition, contradiction and pollution of images, on a city-wide scale. Again, to quote Brecht, "there are times when you have to choose between being a human and having good taste." (Quotations page , 2010) Thus architecture today is faced with the dilemma of having to choose between some utopian thinking of which architectural form becomes its vehicle that can only promises future, and the present where all our social, political, cultural, and climatic problems appears.

2 Image Impact and Reality

Neil Leach has submitted his understanding of how to advance the new but to still incorporate the present in what he calls 'Camouflage theory'. He explains that:

Camouflage, then, is understood here as a mechanism for inscribing an individual within a given cultural setting. This need not be a literal state of visual equivalence with that setting – mimicry - such that the definition of the self is lost against the background of the other or a building is masked against its surroundings. The role of camouflage is not to disguise, but to offer a medium through which to relate to the other. Camouflage constitutes a mode of symbolization. It operates as a form of connectivity. (Leach, 2006, p. 240)

Leach offered such a theory after a lengthy investigation into the various aspects of human psychology and analysis that relate people to their surrounding environment. The theory as defined stands against violent actions towards the order of the present without denying the right of the new to appear different from its background, certainly such thinking is important to an image–driven culture. (Leach, 2006, p. 241) Leach adds that, "in this respect the concept of camouflage is aligned closely with psychoanalytic perspectives that recognize the important role of representation in the constitution of identity." (Leach, 2006, p. 242)

Leach argues that his theory of camouflage stands against the ontological argument of culture. However, his reference to its importance to the constitution of identity reveals the opposite. He explains that commodities and the use of the impact of images do not conceal identity (as Guy Debord has argued, because things are reproduced through images that promote even the person as a commodity, (Debord, 1975)), but that identities are forged. (Leach, 2006, p. 242)

Leach also does not agree with Baudrillard that the real has been, or will be, murdered, because for him reality is imaginary. So, the theory of camouflage celebrates this linkage which philosophically has been argued since Plato's theory of forms. However, this time, the unreal is produced by technology, not by nature. The difference is that nature can adjust itself to different circumstances and technology cannot. Hence, the cycle of adjustments will not be in accordance with some reality but rather it will be in accordance with the development of the unreal itself that is controlled by individuals who are adjusting to new circumstances.

Newness in architecture promotes image consumption that has built a tradition in architecture through which the building will not have a worth in its architecture if it does not present new mostly formal spatial language. Whereas historically, architecture developed through adopting human needs as they evolved in the progress of culture and the way in which people lived and conducted their activities and rituals. However, Leach did not forget to mention that visual imagery that is affecting our cultural elements including architecture is indeed a reductive approach. He says that the "totalizing treatment of visual imagery within much of postmodern discourse is itself a reductive one." (Leach, 2006, p. 242)

The more subtle psychology of familiarity and belonging that Leach is trying to explain can be seen in traditional neighbourhoods where people relate to all elements that form the street, public space, and the dwelling units. Even the little cracks and writings on walls convey meanings to the memory of the children playing in the semiprivate cul-de-sac, whereas in an image-based culture, the new is mediated globally through that which is used to serve a global culture and promotes global powers.

In such a promotion no accommodation is made for what is different. Such an accommodation would establish an increased connectivity among people's activities and their built environment, which will allow an easier assimilation of the new by the users. Correctly, Leach mentions the need "to counter the horror vacuia of a depersonalized, atomized self in a society of increasing alienation." (Leach, 2006, pp. 244-245) He presents camouflage theory as providing a "sense of belonging in a society where the hegemony of traditional structures belonging has begun to break down." (Leach, 2006, p. 245)

However, camouflage still works through image production; whereas in the traditional structures architecture is involved in what is more than mimetic relation. Traditional neighbourhoods give information that can be structured as a worldview through which individuals can differentiate their identities, without which the person can easily slip into alienation. No three dimensional images within any camouflage perspective can provide such a worldview and, hence, a feeling of security.

For architecture to be successful, it does not need to sacrifice its cultural context and alienate its inhabitants. The impact of images, whether they are two or three dimensional, cannot in general go beyond the impact of the dwelling and its refreshing and secure appeal.

In addition, the emphasis on the process of activation of the place is important. For without giving the individual a chance to feel the possibly positive outcome of the link with the space, s/he will not proceed in occupying it in such a way that will turn it into a secure personal horizon. As such, repetition of some details of the older environment becomes important to make possible such link and initial feelings of security.

All architecture can be viewed as processes in the making, which starts with a brief and will continue as long as the building exists. So, architecture is in a sense an invitation for people to interact with their environment and to enhance their identification and becoming processes. This is why cultural context is important to architecture and is what renders dangerous to the stability of the society the thinking through media-commerce promoted iconic architecture without allowing the community to mark such iconicity on its own terms and required time.

3 The Importance of the Present

Architecture should defend its context instead of challenging it. However, if challenge is an imperative in the project it will not necessarily mean taking an offensive strategy against existing cultural horizon. Architecture cannot be only about what is next, but also should be about what exists. If the new project seeks newness despite the context, it will mean that it has already assumed the death of the present. While a more balanced response would be to let the present live whilst at the same time giving a chance for an alternative that can be the 'other' within the existing cultural language.

We grow in social life and cannot help but be social creatures. We grow with others to be a piece in others. So, when architecture affirms the importance of the present urban fabric it will harmonize it, but when it seeks difference it will contradict it, as in famous iconic architecture, which tends to undermine relations with the present in the name of invention and a better future outlook. Such a type seeks to start new conditions, and to avoid the present dilemmas of architecture by promoting new aesthetics; as if all the dilemmas have emerged from architecture's aesthetics.

The architecture of images avoids the real and the present by pointing to the future. But how can a future be without its present? The only way is to import different present conditions, which at this time cannot be other than global generic assumed conditions, to frame the context of the project and based on the assumption that current celebrity architects are promoting.

Importing present conditions from elsewhere can mean two things: either ignoring or dismantling the current urban context despite its current identity, or aiming at constructing a new identity where the current one does not measure up to the aspiration of its people. However, no new identity can be constructed without any link to the present identity formation process, and when an identity is constructed, it should not be easy for others to dismantle it nor will it be easy for its people to search for alternatives without falling under the threat of alienation.

One may also argue that the present is always in flux as in the state of becoming, which is true to a certain extent. But, there is no becoming without being, and for all practical purposes, the present is continuous, as all buildings continue to exist for some time. On the other hand, only natural and manmade disasters can change habits, beliefs and social systems, and iconic architecture is not an outcome of such drastic changes. It is an outcome of peace and luxury, and its message of change is not affordable any more, as the recent financial crisis, and the logic of sustainability that is against luxury and overconsumption, tell us.

We are at war with time over the avoidance of further environmental disasters. Architecture cannot go on in search only for the sustainability that is environmental and ignore the by-products that can affect the sustainability of resources and of existing cultures. It cannot afford a role in destabilizing the existing social fabric by encouraging the fragmentation of the urban fabric. To this effect, architecture and urban design should consider themselves in a state of crisis, and at war with the perception that the architectural aesthetic is their contribution to culture and social collective identity; at war with the perception that architecture is about ideas; at war with the immersion of architecture into theory to the extent that teachers of architecture will let an artistic sketch pass as an architectural project because of its possible outcome in accordance with their own personal imagination and not necessarily with that of the student.

So, the perfect murder, which for Baudrillard is the murder of the real by the new technology, is a kind of unwanted utopia that cannot and should not be allowed to happen. Architecture in particular cannot be other than real if we relax the grip of its postmodern theory. So it is in the interests of the profession that the present as real be the focus of our attention. All regulations, codes, and laws assume a stable present. Without such a responsible present (state of being), no court of justice can function. So there is no point in exaggerating the impact of the promised change to a global culture aside from what the national and/or collective identity can absorb, because such exaggeration will destabilize the existing social and political system.

Correction of urban form in the name of inventiveness and the shedding of a new light on the present context is desirable but not to the extent of promoting complexity and contradiction without harmony. People need to fathom the built environment. They need to live in harmony as much as they need change, and that can only happen in time and with familiarity. It is difficult to see how individuals can feel secure when the image presented in their urban built form says something else. Why is it necessary to impose the concept of singularity on architecture? The articulate individual of the democratic society cannot live as a case of singularity. S/he can be singular only within a society, of which he/she is a part. Thus singularity should be about the particular. Being different in democratic society is not about fragmentation.

4 Iconic Architecture and Sacrifice

Some iconic architecture defies the need for limits, and specifically the need for limiting change. All stable communities impose such limits for obvious reasons, why then doesn't architecture impose limits on its attempt to change and bring in the new. The new postmodern architecture that Philip Johnson started with his AT&T building in New York (Jencks, 2005) has brought with it a greater contribution to energy consumption: "In New York, almost 80 percent of CO2 emissions come from heating, cooling and providing electricity to buildings." (Reportingtheworldover, 2010)

If we can explain such energy consumption as the price that should be paid for creating a great city like New York, then we should be prepared to sacrifice more when other cities will like to compete with such global visual and cultural impact. But should we allow the sacrifice of nature for such man made creation? Sacrifice is part of the rituals that most cultures practice when starting the constructing of a new building. For Henri Hubert and Marcel Mauss, the building sacrifice aims to evoke some form of guardian spirit. (Hubert & Mauss, 1964, p. 65) Today this guardian spirit is born into the building through admiration and through the amount of belonging that it attracts, and the same can be said about cities.

Claude Levi-Strauss views "sacrifice as a mechanism of identification," (Leach, 2006, p. 194) because in the rituals of some cultures sacrifice aims at establishing a relation with God to protect the place to which the sacrifice is made. However, considering the rationale of sustainability, in the current competition between cities to gain the global status or to promote attractiveness to tourists, nature and resources are becoming the sacrifice, thus entailing the destruction of nature.

For Bataille, "sacrifice restores to the sacred world that which servile use has degraded, rendered profane. Servile use has made a thing (an object) of that which, in a deep sense, is of the same nature as the subject, is in a relation of intimate participation with the subject." (Bataille, 1988, p.55) According to this understanding then, our sacrifice of nature is a matter of sacrificing our human nature for the benefit of the profane object. As Leach puts it, "the purpose of sacrifice is not necessarily to kill but, rather, to surrender and give up." (Leach, 2006, p. 198) However, one hopes that such sacrifice will not confuse the present collective identities and results in the destabilization of the present.

Moreover, sacrifice for those who believe in God is a constant reminder of the limited time and power of all creations and that it is only the absolute spirit that continues to live. As Bataille notes, "it is always the purpose of sacrifice to give destruction its due, to save the rest from a mortal danger of contagion." (Bataille, 1988, p. 59) Girard says, "Christ dies not as a sacrifice, but in order that there be no more sacrifices."(Girard, 2008) According to his Mimetic Theory, all religions aim at ridding communities from such violence, through the mechanism of sacrifice.

All previous styles of architecture grew through their social and cultural context in a long process of differentiation, but not without sacrifice. However, most iconic architecture has consumed more resources than expected, whether in the starting budget or later operation cost. The regulating principle for architects and clients should be that surrendering to others is, also, living through others, without setting aside the differentiated self. (Girard, 2008)

5 Iconic Architecture and Violence

Most contemporary iconic architecture stands as an edifice of violence. When a new architecture is initiated by a building that means either there was no order previously or that the existing order needed to be sacrificed to channel these violent feelings towards the present urban form. It is difficult to deny the importance of iconicity in architecture, but such iconicity, as dictated by the architect and the client, cannot, and should not, be received passively. Iconic architecture has to be received as an important addition that can be a source of aspiration to individuals involved. At the same time its iconicity should not defy its natural and built environment.

Rene Girrard's Mimetic theory warns against the nature of acquisition that breeds envy, because acquisition, on one hand, develops homogeneity and cements society through market oriented nature, but on the other hand, it fuels the violent nature of society, because it breeds greediness and unnecessary competition. "The only way this violence can be checked is by the imposition of a form of order which — in being imposed — itself subscribes to the same logic of violence. Inevitably the moment comes when violence can only be countered by more violence." (Girard, 2008)

Hence, the cycle of the current violence will continue and will be nurtured by any encouragement of acquisition. Architecture by its nature clearly shows such human nature. The competition to build higher and higher skyscrapers, or a better house or villa reveals the power of such desire. The same is true for cities wanting to acquire more attractive buildings. What is dangerous about such envy is that it consumes resources for no particular rationale of sustainable culture or suitable environment but is only understandable for sustaining or constructing an identity. However, sustaining an identity should not follow the same measures that are being advocated by global culture that requires global homogeneity due to its very nature. Yet, in such competition the difference will be reduced to form and size.

All such relations are evolving through desires that grow under the impact of the mediation of others. Mimetic theory explains the impact of fashion which, through the iconicity of architecture is falling under its mechanisms and impact. We know that Frank Lloyd Wright is one of the great modern architects, but how many of us have had the direct experience of living in his architecture or meeting him or experiencing his studios and teaching? The answer is a very small number of architects. The same is true of all celebrity architects and iconic buildings. So we judge not on a direct experience but through the information to which we are introduced, and through the impact of media. This is true in case of the clients who wish to own an iconic piece of architecture, or an architecture designed by celebrity architect.

The danger about some iconic architecture is that it acts as a sovereign who ignores the existing rules of the built environment to establish a new order for a part or the whole of a city. The scapegoat here is the existing codes and regulations, which can include limitations on scale, materials, density, movement, and so on. Competition tends to extend these limits.

In addition, due to the impact of consumerism and fashion, architects have started to compete for individual authenticity and singularity, not for the authenticity of the urban and natural context. They have used the media and the network of information in order to open up the market for their products through the theorizing of architecture to convince the public of the inadequacy of their traditional or present urban built form. As such, almost all the younger generation of architects have been taught that violation of the urban fabric and personal authenticity is the right understanding of how innovative architecture is created.

Such a tendency, as Girard explains, will eventually lead to extremes: each of the competing parties will start borrowing from the other, and will eventually show rivalry. This will lead to vengeance and that will stir up violence either by direct confrontation or through a substitute that will be the scapegoat who is weak enough not to have the ability to retaliate.

Rene Girard established the category of Mimetic Desire (MD) …. The analysis of the interactions of characters in selected 19th century novels shows that people imitate each other's desire and that objects are desirable not through need, scarcity, or intrinsic desirability but because someone else desires them. The other's desire makes them desirable because the desiring self imitates the desire of that other. (Hamerton-Kelly, 2009a, pp. 4-5)

In case of architecture's progress into postmodernity the scapegoat has been the international style, in the name of defending local aesthetics and cultural identity, the impact of regionalism, the requirements of local climate and the anthropological importance of settlements. While the scapegoat for the Modern Movement was the older styles. So the moment when a group have agreed to one scapegoat, is the moment when a new thinking in architecture emerges. (Hamerton-Kelly, 2009a, p. 13) The good things about the Modern movement and the International Style were forgotten, because the scapegoat should be presented as dangerous.

The war of "all against all" becomes the war of "all against one" and the "all" united by violence against the "one" is the first stable human community. Thus a small act of deflected violence stops an escalation to disaster of reciprocal violence and forms a community of killers (Hamerton-Kelly, 2009b)

Currently all previous arguments against international style have been concluded to favour more areas of difference, fragmentation, abstract aesthetics, technology, and multiculturalism, where everything points towards a global form of culture. At the same time, global culture encourages imitation rather than differences as did the international style. The creation of celebrity figures, including celebrity architects and iconic architecture, is an act of encouraging imitation through the marketing force of the media and the network of information. As an excuse for differentiating the current imitation from the previous one which was used as a scapegoat, the idea of good mimesis has been introduced as Hamerton-Kelly explains:

There have been recent discussions in Girardian circles about the possibility of "good mimesis" and the focus of discussion has at times wavered from imitation as violence to imitation as compassion. On this definition mimesis is necessarily violent, and benign mimesis is the result of meliorative factors in culture, but the first of even these meliorative factors remains violence, the good violence that controls the bad via the ritual of religion.

To be sure, neutral imitation is the starting point of the definition, as RG [Rene Girard] says when he calls it "Mimetic or Imitative Theory," but in the context of the theory imitation is never neutral, but rather necessarily competitive and inevitably violent. There is no "good imitation" or "good mimesis" within the purview of the theory. (Hamerton-Kelly, 2009a, p. 2)

The establishment of a new order within postmodernity has meant a series of changes in the context that cannot be justifiable in the required rationality of sustainable thinking. The only justification is the creativity of the architect and the brief of the client. As such, this approach has to die first so that a new order can emerge. At this point since all are arguing for sustainability, then our scapegoat will be all architecture that has ignored the importance of natural adaptation to climate (and has resorted to technology to insure controlled climatic conditions of the inside) empowered by the impact of its aesthetical appeal. At this time, this kind of architecture has been lead by an iconic form of architecture and celebrity architect.

The scapegoats that I am suggesting -iconic architecture and celebrity architects- is a rational sacrifice to stabilize our practice in architecture and urban design and to stabilize the present cultural identity, and all should be in favour of the sustainability that is becoming general enough to accept individual innovation. To this effect, the global culture is flexible and can accept change. Such was the stand of Philip Johnson. He joined and applauded the new order. He understood that a new stage had to be set for the new era. As such, he cleansed himself of all accusation laid on the victim: modern architecture and the international style. Thus, he is not anymore to blame for what went wrong there.

6 Conclusion

Currently the younger generation is happily celebrating the virtual world. So, architecture should act as a field of assemblage that can bring the difficult aspects of reality to a peaceful resolution to maintain stable horizons, and if networks are adequate enough for information, science and people, why cannot they be good enough for architecture. Architecture should act within the complex network of information, communities, politics and economy as a network of places linked to the outlook of society but, even so, architecture can be different within a network of urban fabric.

The iconicity of the building should evolve through the social system and its culture. It should emerge from spiritual and natural needs rather than from aesthetical objective and its sensational impact that will assert only consumption, which is an important element of the current global culture. If we remember one important ethical principle of almost all religions in addition to the outcome of the French Revolution and that is, equality, we should not let the gaze of the poor on such luxurious buildings reflect a different reality. Urban design practice should also be regulated to emerge through sustainability and to the effect of harmonizing the existing urban images.

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The Cartographer's Dilemma

Paul Guzzardo[1], Lorens Holm[2]
[1]*Independent media activist, St. Louis, USA & Buenos Aires, Argentina*
[2]*Director, Geddes Institute for Urban Research, University of Dundee*

Abstract

The city is quickening. We hover between built space and media places. Place making that takes no heed of the knowledge environment is no longer sustainable. In the era of pervasive computing we need better maps to manage the built environment. The Cartographer's Dilemma proposes a new place making action plan for a withering public sphere. We need to develop new epistemic assemblages - street probes - for navigating a landscape of space and information. The city as site and form of knowledge begins with Patrick Geddes, the evolutionist/planner who celebrated the Greek *polis*, who was a pivotal link in an intellectual lineage that extends from Darwin to contemporary media theorists. With projects like the Outlook Tower and the Cities Exhibition, Geddes left behind a tool kit on synthesis, gear to map sites and record knowledge, and assemble places where mapping persists. He saw the city as an evolving search engine, a tableau you drifted through, synthesizing as you move. For Geddes, you became a citizen when you glimpse the future and humanize it. Mindful of Geddes - and wedged between a data space and a hard place - this paper will explore how place makers can begin to rethink the neighbourhood enclave and reprogram them as precincts for knowledge creation and creative action. This paper uses Geddes' work on the city to rethink the implications of the digital environment for the space we call Civic. It recalls projects in the UK context, that address this space as an archive of knowledge and identity. The Cartographers Dilemma is relevant for the re-cabled megalopolis that will need strategies for capitalising on this status. It will argue for a new definition of the sustainable city, by projecting the urban planning theories of Patrick Geddes onto the evolving 21st century media environment.

Keywords: *digital media, urbanism, civics, map, game, Patrick Geddes, sustainable community.*

1. Shrink Wrap City: small medium and large

Paul Guzzardo
If you listen closely you can hear a sucking sound. I'll start this with a call for an epistemological beachhead and rant against the shrink-wrapped city.

Lorens Holm
Let's grab something from our Abstract and dub it a map.

> The city is quickening. We hover between built spaces and media places. Placemaking is no longer sustainable because it takes no heed of the knowledge environment. In the era of pervasive computing we need better maps to manage the built environment. The Cartographer's Dilemma proposes a new spatial practice, a muscular cartographic practice for a withered public sphere. We need to develop new epistemic assemblages - street probes - for navigating a landscape of space and information. The city as site and form of knowledge begins with Patrick Geddes, the evolutionist/planner who celebrated the Greek *polis*, who was a pivotal link in an intellectual lineage that extends from Darwin to contemporary media theorists. With projects like the Outlook Tower and the Cities Exhibition, Geddes left behind a tool kit on synthesis, gear to map sites and record knowledge, and assemble places where mapping persists. He saw the city as an evolving search engine, a tableau you drifted through, synthesizing as you move. For Geddes, you became a citizen when you could glimpse the future and humanize it. Mindful of Geddes - and wedged between a data space and a hard place - this conversation will explore how place makers can begin to rethink the neighbourhood enclave and reprogram them as precincts for knowledge creation and creative action.

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I want the spotlight off of Larry Page and Sergey Brin _ those Google titans _ and flash it on Geddes and the City. So here's a Geddes quote.

> *The general principle is the synoptic one, of seeking as far as may be to recognise and utilise all points of view and so to be preparing for the Encyclopaedia Civica of the future.*[1]

LH
And another.

> *Town plans are thus no mere diagrams, they are a system of hieroglyphics in which man has written the history of civilisation, and the more tangled their apparent confusion, the more we may be rewarded in deciphering it.*[2]

PG
The dilemma in the tera--perabyte world is getting deciphering gear on the street. Without that *techne* the city is less and less a stage for knowledge creation and synthesis. We need new place making action plans. We need new interfaces on the ground linking the city space and data-landscapes. Place making that takes no heed of the evolving knowledge environment is no longer sustainable. If the end game is a sustainable city, the city has to be a knowledge generator. And without a street/data/scape interface - new crossover nodes - it's neither. Time is short. This brief should have been started twenty years ago. That's when the info-age began slamming us. But it never got written. Now the digital buckshot is coming at hyper-speed. And we've got a gaping hole in the city. We're wedged between a data space and a hard place, and left with a shrink-wrapped something or other.

LH
The city already functions as an archive and learning environment. If this were not the case, it would not be possible to follow a guidebook. We see it in street names and in blue plaques on buildings; in the way that bus shelters mark the city as a flow of people, or manhole covers mark the city as a flow of sewage (think of the great Victorian sewage works, those monuments to hygiene and civic pride). For Geddes the evolutionist (student of Huxley), the city was an artifact in the continual evolution of intellect. For this reason he was conservative in his approach to the renovation of the city. He advocated 'surgical' interventions to destroy as little fabric as possible. *Tabula rasa* planning was intellectual suicide, tantamount to the loss to civilisation of the library of Alexandria. We need to invent the spatial notation to mark the city as a flow of data and discourse.

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[1] Patrick Geddes, *Cities in Evolution: An Introduction To The Town Planning Movement And To The Study Of Civics* (London: William & Norgate, 1915) p320

[2] Patrick Geddes, *Cities in Evolution* (London: William & Norgate, 1949) new and revised edition, p170. This quote is not in earlier editions.

PG
But a new tool set, a new systems approach is essential, or as Geddes would say "the *principle is the synoptic one*".

2. Geddes Game Board no.1

LH
We need to develop a spatial system of form-types and grammar, and a strategy for location. In another register, it is not miles away from the question of the coherence of the city addressed by Aldo Rossi in his theory of types, or of Palladio in his pages of villa plan forms. What are the abstract principles, and what elements repeat endlessly in different circumstances. What are fixed and what contingent?[3] How do we represent the city to ourselves as a flow of ideas, knowledge, love, money, political affiliations. We are looking for nothing less than a new vision of coherence and cohesion on a par with Nolli's vision of Rome. Nolli showed us that the city was an infrastructure of surfaces, continuous, plastic, inside-outside. The cartography that allows us to map the knowledge of the city back onto the city will not be a new map that replaces Nolli's (what Venturi sought to do), but a process, a recursive mapping process: continuous and without end – a Recursive Urbanism. Imagine an urbanism where a continually updating cartography replaces the static map. It is a

[3] We have this formula – fixed and contingent - from my colleague Graeme Hutton. It was the framework for the Urban Design Studio, Dundee School of Architecture.

technical process, what Mumford called *technics* (he posed man's *technic* outside against his Freudian inside).[4]

PG

The question is: where are we going to get the crew to move towards this coherent vision? To get that *Nolli update*, place-makers have to rethink cultural precincts and creative practices. The remix digerati have to be on the street. We don't want a generation of creatives secreted in clandestine places, shackled to screens and virtual sites. Or shunted to mutating gaming consoles, where buttons and a directional joystick rein the drift. They have to be on the ground navigating through the digital fog. That's the place to double, layer and go off in several directions. But they need gear to cut a path in the data maelstrom. They need way stations; places to map, to plot a course, and platforms from which to peer into the city. But they don't have it. As technologies quicken and the public realm shrivels it is time to act. Place making and makers have yet to respond to the sucking sound.

LH

This is not a question of re-equipping the digerati or new cultural precincts, but of imagining new forms of public space, and new notations for marking it. We are losing the space of public discourse that was represented, if not wholly instantiated, by Aristotle's *polis*. The role of space as the platform for the collective expression of public opinion is slipping away. Civil disobedience is scarcely conceivable today. Most public space is now simply amusement space. And that doesn't leave much room for the city as a repository of knowledge. We need mapping stations for collating the knowledges and identities embedded in AND OUT OF the city, for writing new narratives and counter narratives; we need "doctors' surgeries" for surgery upon the city.[5] It poses problems for strategies of location. Geddes proposed the Cities Exhibition as the place to collate local knowledge and put it into circulation. Each city was to have an Exhibition as a permanent civic institution along with the courthouse, museum, etc. He argued that it was a necessary condition for participatory democracy, because you could not make informed decisions if you did not know about the place you lived, and its relation to the city, the region, the country, the world....

PG

... and *its relation to* the virtual place, the blended space. The surgical insertion is the way to go. Slide the scope in. Its how I positioned my digital street praxis. Think of them as mapping nodes that slip into what's already there. When it works you end up with ocular devices that peer through the digital fog, and that's

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[4] Lewis Mumford, *Art and Technics* (London: Oxford University Press, 1952). This gem of a book.

[5] The idea of the doctor's surgery or 'Environmental Health Clinic', where residents of a place could go to consult about the repair of their place, is floated in Benjamin H. Bratton & Natalie Jeremijenko, *Suspicious Images, Latent Interfaces* (The Architectural League of New York, 2008), pp. 22ff. Situated Technologies Pamphlets 3.

not far from Geddes. Geddes's place making emerges out of the liminal world of Greek philosophers who played with comings and goings, ins and outs from caves. Geddes understood the city as a blended site. He was more than a student of Darwin/Huxley. He was an apprentice of those classical Greeks. The Geddesian playbook opens on the Greek *polis*. The *polis* is where the first citizens - creatives - drifted and mixed things up. Good things happened there, like knowledge and synthesis. It was a platform for problem solving. It was a change agent. Today, our media environments have taken us _ and our blended selves _ back to these liminal places. We still mix and drift, but we don't do much on the street. It's in a soft space, the virtual realm, where we tell our stories and learn. But if we could get back on the street, maybe some good things would happen in this here and now.

LH

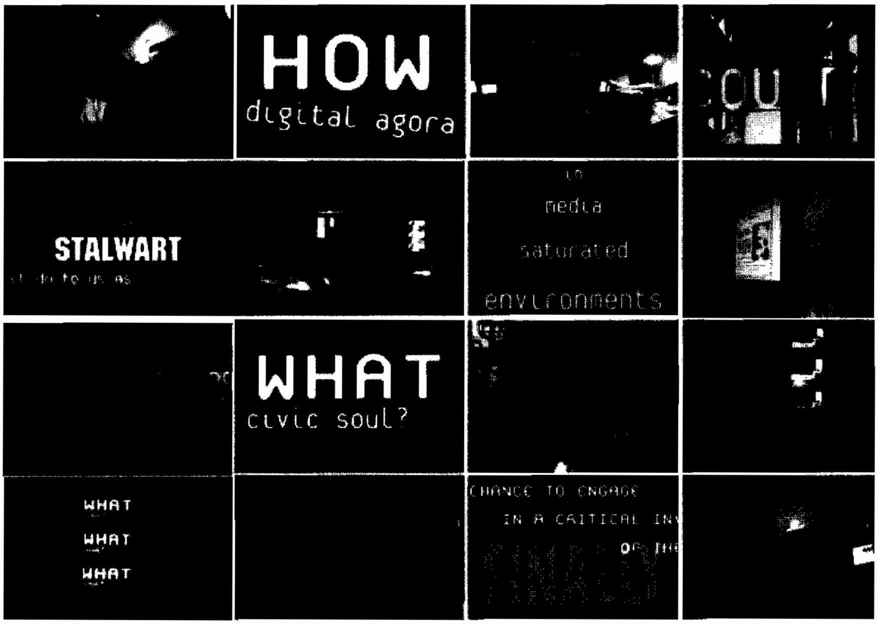
I'm all for delaminating people from their bedrooms and getting them back on the street, but this is not about creatives, because to segregate a special form of cartography for a special form of people is just another version of the cultural Acropolis and what we are looking for is a cultural infrastructure for scoping the city. I call it *infrastructure* because – unlike Geddes Cities Exhibition - we need a cultural institution as ubiquitous and dispersed as phone booths, post boxes, public toilets, manholes, which creates a network of stations for reflecting upon the city and mapping that new knowledge back onto the city. If we take Geddes seriously, the knowledge is already there, and it is about creating the moments for accessing it, reflecting upon it, and transmitting it to others. Instead of the media environment shadowing the city like an Other scene that mimics it in complexity draws off its energy, its civics, its intellectual life, can we not engage it to create a hybrid.[6] Imagine local gallery + *QuestionTime* + webscape *congestion* (thanks Koolhaas) with link to local authority website (except that it might replace the local authority at least at the community level). It will be a hybrid media platform and public space showcase.[7]

PG

[6] For Freud, the Other scene was the dream, that landscape of unconscious desire, that was marked by an other spatial and temporal logic than the logic of the city. If we succeed in drawing the media environment into dialogue with the built environment, it will doubtless not domesticate its Otherness.

[7] There is also interesting work on the city and media environments coming out of interaction design. See for instance: SJ O'Neill 'The Interactive Spectacle and the Digital Situationist', in *Exploration of Space, Technology and Spatiality: Interdisciplinary Perspectives*, ed. by P Turner, S Turner, E Davenport (Hershey, PA: Information Science Reference, 2008) And: SJ O'Neill 'Presence, Place and the Virtual Spectacle', in *Psychnology Journal* special edition on *Space, Place and Technology: Human presence in mediated experiences*, ed. by L Gamberini, G Riva, A Spagnolli, Vol 3(2) (2005), p149 & 161, http://www.psychnology.org/pnj3(2)_space_place_and_technology.htm

I played in that soft space, first in Cabool, my media nightclub,[8] and then in the MediaARTS lab. The lab was blended place, a straddled one. It was on the street, a sort of polis update: *Release 99....* The lab wrapped a windowed corner in downtown St. Louis. Artists used digital collage, remix to create new urban narratives, to map and re-mythologize the streetscape. Their work, the evening's digital amalgam/remix was projected on screens and monitor walls facing the street. Subject matter included meditations on film/digital editing; art/science practice; the effect of information technology on social practice; 9/11; the millennium, comic books; and Orwellian media culture. It ran off and on for a couple years. It was street theatre, a tool to advance synthesis and awareness, with the hope that it might lead to collective action. When I was hanging out on that Midwestern street corner you were doing things here. Then we collaborated on *laser\net* in Dundee.



3. St. Louis MediaARTS LAB: Polis Game Board no.2

LH

MediaArt St. Louis and *laser\net* join a good trajectory of projects, which create opportunities for Geddesian reflection upon the city. They are part-projects. None are complete yet, perhaps they will always only ever be gestures to the

[8] For Club Cabool (1992), see *Interior Design* (December 1997), *DisenoInterior* (1998), and *Lofts: vivir, trabajar, comprar* (Barcelona: Koneman, 2001)

future, achieving their aims by falling short of them.[9] Fergus Purdie's *Curating the City* (2009) maps the intellectual history of Perth onto Perth. It began with a Geddesian survey of the learned societies, clubs, and guilds embedded in Perth's history. It issued in an exhibition of maps and screen prints which located them in the city fabric and history of Perth. It was not exactly an urban design project, but the prolegomena to one.[10] For *Glasgow: City of Dreams* (1996), Will Alsop's strategic proposal for Glasgow, Alsop divided the river Clyde into an enfilade of 12 navigable 'rooms' running through Glasgow, a division which recognized their different characters, and asked different practices to develop ways of drawing out their history and character. For our room, we proposed a mechanism that allowed pedestrians to access an archive of digitised images of Glasgow's Clydeside shipbuilding history and project them across a monumental visual space straddling the Clyde.[11] We are still planning the *Re:mix the city* project, a network of media stations for Dundee. There is a pedigree of such projects that includes Cedric Price's *Potteries Thinkbelt*, his hybrid open university-cum-transport system that traversed the Midlands 19th C pottery belt.

PG

laser\net was an experiment in mediating spaces and communities with media platforms. *laser\net* was a gallery installation in which a central screen had projected upon it the spaces that it divided. The crowds could communicate across it and could trigger images and sound files that occluded it, from position points in the space. Perhaps the best bit was the blog.[12] But an online off-street installation can only do so much. The blogosphere starts to feel a little shrunk. Not always the best arena for the mapping tools that *expose the archetypal drama of life*. The phase is Mumford's, his sum-up of Geddes.[13]

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[9] 'Part-project' is borrowed without permission from Lacan's 'part-object'. The part-object functions by always being less than what it promises to be, like the bits of the body that we eroticise.

[10] Vulcan Works (5 Melville Street, Perth) is a live project in response to *Curating the City*, an exemplar of direct action in the real world, based on the relation between artist + city. VW demonstrates the Geddesian principal of conservative surgery and resulting regeneration. It is an outlook tower. For more on Fergus Purdie Architects see http://www.fwp-architect.com/

[11] Published in *The MAC Journal* 1996. This project was done by Noble Associates Architects, London, with Lorens Holm as project architect.

[12] ***laser\net*** (2006) was a collaboration between Guzzardo, Holm, John Bell, and Adam Covell, funded by the AHRC. It was installed in Centrespace in the University of Dundee's Visual Research Centre. Cf. Guzzardo and Holm, 'Is there a digital future landscape terrain' in Michael Spens, ed, *Landscape Architecture: Site-Non-Site*, special issue of *AD: Architectural Design*, 77:2 (2007). Cf. also (http://www.dundee.ac.uk/pressreleases/prfeb06/laser.html) and (http://www.dundee.ac.uk/geddesinstitute/lasernet.htm).

[13] Lewis Munford, "The Geddesain Gambit," in *Lewis Mumford and Patrick Geddes: The Correspondence*, ed. Frank G Novak (London: Routledge, 1995) p360

LH

The stage has to be the street. We have to reclaim it as an agent against the programmed amnesia inherent in most city planning, which turns the city into a spectacle for tourism, for business, for raising tax revenues, above all for amusement and investment. Its hyper-real flythrough tropes turn the city into a display whose effect, intentional or otherwise, is to sedate us; to turn us away from the difficult issues confronting us, issues about our relation to our environment, built and natural, which, if we could reflect upon them, we would have a hope of solving. Need some new spaces to confront bad times.

there is a **Digital Future Landscape Terrain**...
Future Landscape Terrain: fingerly, numeric, parcelled.
Digital Landscape Terrain: imagined imminent immensity.
Digital Future Terrain: a narrative *scaped* by the land.
Digital Future Landscape : a tussocked surface, rough going.

4. *laser\net*: Cahokia Indian mound on the outside, digital platform on the inside

PG

It's time for new projects-praxis. How do we build an ur-map? How do we build a wiki on the street?[14] Its not going to happen without a radical rethink of place making, creative practices and media re: sources. I know that system thinking and Walter Benjamin are rarely coupled but this is going to take a tiger's leap off street and then back. And there is something happening 'off street' that draws me. It has money and smarts. It is computer gaming. And yes most computer games fall in that vast hyped hyper-bounce *blastscape*. This is a niche. It is called Serious Games and has a Geddesian hum to it. Here's the canned definition:

> *The ecology of computer games with a purpose beyond play...* games that have *the potential of immersing the individual into an environment that is engaging, challenging and fun, and most importantly, educational*[15]

[14] wikipedia, an 'Encyclopaedia Civica of the future', went on line in 2001, eighty six years after the publication of *Cities in Evolution*. A wiki is a software that allows multiple users (players) to introduce content to a collaborative or community website. It involves the visitor in an ongoing process of creation and collaboration that constantly changes the Web site landscape. The most well known use is the online encyclopedia, *wikipedia*, from which this note was paraphrased. Cf. http://en.wikipedia.org/wiki/Wiki

[15] Serious Games website at http://www.seriousgames.org/about2.html

Serious gaming emerges out of "deep game engine" architecture. Players move "in and out" of a trajectory, a sequence of domains. Serious game theorists examine game design in terms of the potential for rich learning and literacy. The sage behind the field is James Paul Gee.[16] When I read Gee it seems as if Geddes's *œuvre*, devised for the city as a creative cauldron of progress and humanization, has been hijacked to a gaming space. *Polis*-sequel has drifted to soft *semiotic domains*, a term within game engine architecture. The platform has switched, from city to game. The new *lingua franca* of serious gaming - issues of domain and social practice, effective participation, domains for multi-literacy, experiencing the world in new ways - all share a jolting similarity to the Geddesian playbook. And like the one on the ground, it involves trajectories through a sequence of tableaus, places for lingering meditation, for thinking *flaneurs*. Intended or not, these game theorists have appropriated Geddes' read of the city as the platform for shared understanding and knowledge.

LH

Traffic is a serious game. We play it all the time. We glimpse game-space in the traffic congestion of our cities. Not because it is accessible to all, but because it is interactive for all players; more so in Europe than in the US (where drivers slumber in their lanes). It has a grammar, a precise domain, rules. It continually evolves in response to the city, and the city continually evolves in response to it. Lets celebrate the much maligned traffic engineer for his Geddesian drift of the city.

PG

The game is about drift. So is the city. But the team is now playing in a virtual realm, and there is no indication that it is coming off that field. And that's a problem. It involves more than discourse. It's also about money. The sustainable city and the serious game are both in search of new system platforms, platforms that are more than spectacle delivery shunts, new maps for a recursive urbanism. The barrier that separates city and game praxis needs to blend. We need collaborations, a profound rethinking of civics, planning, and creative practices.[17]

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[16] James Paul Gee, *What Video Games Have To Teach Us – About Learning And Literacy* (New York: Palgrave McMillan, 2003)

[17] "Games for Change" is a serious game not for profit. Here's the mission. 'Games for Change seeks to harness the extraordinary power of video games to address the most pressing issues of our day, including poverty, human rights, global conflict and climate change. We are a voice for the transformative power of games, bringing together organizations and individuals from the nonprofit sector, government, journalism, academia, industry and the arts, to grow the sector and provide a platform for the exchange of ideas and resources. Through this work, Games for Change promotes new kinds of games that engage contemporary social issues in meaningful ways to foster a more just, equitable and tolerant society.' Visit (http://www.gamesforchange.org/ourwork)

LH

Geddes understood the itch to game. The agonistic frontline for this biologist was the street. It was the font for creative struggle, wakefulness and synthesis. Here are a couple lines.

....competition is the essential factor of the progress of life. For, if competition be, as we are told, the life of trade, competition must also be the trade of life. What could the simple naturalists, like Darwin and his followers, do but believe this and thence project it upon Nature and upon human life with a new authority![18]

PG

Seems apt that 'the Dundee street' where Geddes spent twenty years teaching is home to Realtime Worlds, the company that brought us *Grand Theft Auto* and now *All Points Bulletin*. Street maps and street fights, mixed and remixed by Scotland's digerati. Here is a cut and paste from their website:

> *All Points Bulletin is a massively multiplayer online free-form combat and driving-based game, designed by the creator of the original GTA franchise. Developed by Real Time Worlds Ltd, APB brings players into a living, breathing city where cash is king and territory equals respect...*[19]

According to Dave Jones, *APB* is a server-based *real time* interactive city environment, that is modified by user CONTENT. You enter the game through a street space.[20]

LH

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[18] Geddes, *Cities in Evolution* (1915) p77

[19] *Grand Theft Auto* is a video game series created by David Jones, founder and creative director of Realtime Worlds. The Grand Theft Auto franchise has had a significant impact on the medium of the videogame. It is now one of the most recognized video game brands on the market. *APB* (*All Points Bulletin*) is an upcoming massively multiplayer online video game based in urban sprawls and featuring two sides, Enforcement and the Criminals. Players may join either side, and form sub-groups in these. The quote was accessed on 13 01 2010 from the *APB* website at http://www.apbgame.com/. For images of *APB*,... there are twelve screen shots of *APB* at http://www.apb.com/screenshots/. Our strip of 3 favorites (accessed on 13 12 2010) are numbers 12, 10, and 6. They imagine locations in the city of San Paro (http://www.apb.com/features/).

[20] Dave Jones introduced his upcoming MMO *All Points Bulletin* at Develop 2009 where he was a keynote speaker. According to Jones, one of the key features distinguishing *APB* from its competitors is that it runs on a server and therefore allows the street to exist in real time. Visit Youtube for his presentation (accessed 13 12 2010):
Part 1: http://www.youtube.com/watch?v=l8wxgfeFl0w
Part 2: http://www.youtube.com/watch?v=uqPow9J8D8M

Lets speculate: it is only a matter of time before someone in the gaming industry develops gameware that would allow you to navigate a model of a real city. You could then join a community of players organized by the on-line game infrastructure - *and* by the city. This presents the possibility of a community – not yet realized - for whom the idea of location raises interesting questions: location would become on-line and place-based at the same time. A splitting of location. It would begin the process of recognizing a form of media and built environment hybrid. The planning department at UCL already has a model of London.[21] Make it interactive, make it the environment for a *GTA* or an *APB* type game. You would be able to meet your mates downtown, shoot up your own high street and then drive to your friend's and shoot up hers. The challenge for planners will be to take this interaction off the virtual stage and transfer it to the built environment. And to make the city plan respond to it. But it is ironic that the most advanced examples of deep gaming always go toward spectacle. These street spaces are hyper real and drained of content at the same time. Of course, the driver for the gaming industry is no different than the driver for development of the city: it is the market. Although both the city and the game model social relations, they are first and foremost investment opportunities. And the image of the city that they both produce is – literally and metaphorically – plunder.

PG

Market or not, the media environment is too big to look the other way. Better than Brahms or the big box. The question is how can we grab the gaming phenomena and use it to transform civics? How do we graft it onto the street? The contest is inevitable. Spectacle may win.

LH

We need to call time. Our editors want to know what all this has to do with urbanism and sustainability.

PG

Traffic cops and game designers aren't the first to be gripped by drifting and splitting, layering, and flowing in several places simultaneously. Our modernist fathers – Giedion, Léger, Sert – imagined it.

> *Modern materials and new techniques are at hand, light metal structures.... panels of different textures, colors and sizes; light elements like ceilings which can be suspended from big trusses involving practically unlimited spans...Mobile elements, changing positions and casting different shadows when acted upon by wind or machinery, can be the source of new architectural effects. During night*

[21] Professor Mike Batty at the Centre for Advanced Spatial Analysis, University College London, presented clips of it at *Managing metropolitan regions: Geddes and the Digital Age* (2007) a conference hosted by the Geddes Institute for Urban Research at the University of Dundee.

> *hours, color and forms can be projected on vast surfaces.... Man-made landscapes would be correlated with nature's landscapes and all elements combined in terms of the new and vast façade, sometimes extending for many miles, which has been revealed to us by the air view. This could be contemplated not only during a rapid flight but also from a helicopter stopping in mid-air.*[22]

LH

Their radiant city never happened. They didn't have the technology to inject, penetrate and overlay knowledge. Nor was it to hand when *the situationist city* succeeded *the radiant one*. Now we have the chance to structure change. We can start "that irrigation of territories", and this time, zone in on knowledge. Build a network of storefront mapping stations where we can read the ecology we're plumbed into. For Koolhaas, the city is a flow of space, money, psyche, and information.

> *'If there is to be a "new urbanism" it will not be based on the twin fantasies of order and omnipotence; it will be the staging of uncertainty; it will no longer be concerned with the arrangement of more or less permanent objects but with the irrigation of territories with potential; it will no longer aim for stable configurations but for the creation of enabling fields that accommodate processes that refuse to be crystallized into definitive form; it will no longer be about meticulous definition, the imposition of limits, but about expanding notions, denying boundaries, not about separating and identifying entities, but about discovering unnameable hybrids; it will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions – the reinvention of psychological space. Since the urban is now pervasive, urbanism will never again be about the new, only about the "more" and the "modified." It will not be about the civilized, but about underdevelopment.'*[23]

PG

Geddes' greatest contribution was to realise that how we understand the world will change over time; and that the street is a tool to crank out maps to refresh that understanding. In this time of rapid change, this is the BRIEF – the BRIEF for the design of a sustainable city.

LH

[22] Siegfried Giedion, Fernand Léger, and José Luis Sert, "Nine Points on Monumentality" (1943), reprinted in Paul Bentel and Lynn Hopffgarten, eds., *Harvard Architectural Review IV: Monumentality and the City* (Cambridge, MA: MIT Press, 1984)

[23] Rem Koolhaas, "What Ever Happened to Urbanism?" (1994), in *S,M,L,XL,OMA* (with Bruce Mau) (Monicelli Press, New York, 1995) pp. 959/971.

Geddes' contribution was to imagine the city as an expanding archive of knowledge. Our knowledge is inscribed on the surface of the earth. To know yourself and to understand your relation to the world, you have to be able to reflect upon this surface, and find the technology to instrumentalise it, visualize it, manipulate it, and put it into circulation. To imagine this possibility, we draw on the experiments of gaming, serious or otherwise. The problem of sustainability is thus a problem of creating spatial and digital places for collective reflection and thought about ourselves and our world. Without these forums, there is no possibility for sensible decisions about the environment. This was Guattari's point in *The Three Ecologies* (an essential read), where he argued that the ecologies of the physical, social, and psychical worlds are interrelated; and that the problem of ecological sustainability is not a lack of knowledge or technology but a problem of homeostasis. We will never achieve a homeostatic relation with the physical world - built or unbuilt - until we are in homeostatic relations with Others and with ourselves. We will not be able to make sensible ecological decisions until we put our social and psychical houses in order. Controversies asides, Rachael Carson published *Silent Spring* in 1962; and Greenpeace was founded in 1971. We have been living with climate change under one name or another for two generations, yet we pretend we have just discovered it. The UK Research Councils are now talking about Connected Communities, and their supporting technologies, a belated recognition that if we are not able to build mechanisms that bring us together to make sensible decisions, all the zero carbon technology in the world will not help us.[24]

If there is to be a new urbanism, it will have to be a sustainable one. Giedion and Koolhaas are both problematic references: although they imagine the city as an armature for continual change, integrated consciousness, community, and new creative possibilities; if there is to be a new urbanism, it will not be based on monuments or the fantasy of laissez-faire urbanism. The point I want to leave with: a sustainable urbanism is a matter of creating forums where people can make sane decisions about the city they live in. These forums will be spatial and digital because these are the primary media of community and communication. These forums have to be in the city, fully engaged with it, because the city is our primary repository of knowledge about ourselves, our society, our material world.

PG

We need platforms on the street to plumb the complexity/dynamic of Guattari's 3 E's, to allow an ongoing 3 E's assessment, that relationship between humans and their environment. That is what Geddes attempted with his surgical interventions, his outlook tower, his cities exhibitions – what is now being done off street with John Paul Gee and serious gaming. We simply want to bring it back to street; we have to find room out there on the street to build.

[24] Felix Guattari, *The Three Ecologies* (London: Athlone Press, 2000). Transl. by Ian Pindar and Paul Sutton from the original French, *Trois Ecologies*, 1989.

LG
Patrick Geddes was a message Huxley and Darwin sent to the future. He died in 1932; the same year Aldous Huxley published *Brave New World* - another dispatch. Geddes left us a tool chest packed with maps. They're maps to build platforms that glimpse, peer ahead, assess what is coming, and maybe humanize this new place.

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Beyond Colours: Sustainability Pentagon as a Proposed Integrative Framework for Sustainable Development Implementation

Jerry Kolo, Ph.D.
American University of Sharjah, Sharjah, United Arab Emirates

Abstract

Sustainable development (SD) now features prominently in policy and scholarly discussions about growth and development at all levels of society. A heated and unsettling aspect of these discussions remains how communities, with their vast differences, can achieve the intent and ideals of SD. Of the various extant agendas and initiatives for SD implementation, one premier and fascinating initiative is what is loosely called 'green development.' In virtually all professions, there are 'green development' initiatives, defined anyhow. This paper contends that these initiatives are necessary but insufficient to achieve SD goals, especially in the developing world where the cost of green development is prohibitive. From a policy analysis stance, the paper argues that SD implementation cannot be couched in 'jargons' that may make for political grandstanding and public relations but not for SD implementation. Beyond colours, therefore, SD implementation frameworks are needed that target the root causes of unsustainable policies, attitudes and practices in different communities. In the context of policy modelling, the paper proposes a sustainability pentagon, which consists of five 'E-principles', as a promising integrative framework for SD implementation, from policy making to policy implementation (vision to action). The five Es include the classical three Es delineated by the Brundtland Commission, viz, Environment, Economy and Equity. The two additional Es of the pentagon are Enlightenment and Engagement. The paper concludes by rationalizing that, beyond colour-coding, SD implementation will be effective only if community citizens are fully enlightened about SD policies, options, initiatives, costs and benefits, and if they are engaged in the processes of formulating and implementing SD initiatives. Citizen knowledge and citizen participation must be integral components of any SD policy that aims to be effective. On these two accounts, most global and local SD initiatives are found wanting, and the way forward must shift the paradigmatic framework for SD implementation. Sustainability pentagon is an example of a promising pragmatic and culturally relevant framework.

Keywords *Sustainability principles, green development, enlightenment, engagement*

1 Introduction

Rarely are there discussions of development policy, research and projects anywhere in the world today without overt, passionate or veiled reference to the spirit and intent of sustainability. Yet, the attainment of SD goals around the world raise more questions than answers, especially in parts of Africa and Asia, where the results are disturbingly dismal. The contention in this paper is that rigidly top-down and elite-controlled frameworks for formulating and implementing SD policy initiatives are indeed part of the causes of poor SD achievements in most parts of the world. Yet, while development policy and planning scholars continue to identify gaps in SD implementation practices through purely empirical studies, rarely are 'courageous' steps taken to engage in theoretical policy modelling, where these scholars, like their counterparts in physical science and engineering, prescribe, through what this paper calls empirically-based policy cerebration, SD implementation frameworks that, if diligently tested in the context of political reality, could close some of the loopholes in the SD decision-making, planning and implementation processes. The exercise in this paper is an example of such theoretical modelling, albeit informed by empirical observations and professional experience by the author.

Since the release of the Brundtland report, the groundbreaking report, Our Common Future, published in 1987 by the World Commission on Environment and Development (WCED), the concept and lexicon of SD were introduced into all realms of development discourse and practice. Since then, "sustainable development has rapidly acquired such global salience that it is now a strategic concept at virtually every level of international and national government where public policy is discussed" (Bressers and Rosenbaum, 2003:5). From international reports, such as the latest UN-Habitat (2009) report, themed 'Planning Sustainable Cities,' to grassroots programs such as those operated by Kishkinda Trust in the remote village of Anegundi in India (Conway, 2010), SD features prominently in discussions and programs aimed at making the world more liveable for current and future generations.

In spite of the global embrace of SD as a desirable cornerstone of growth and development, Bressers and Rosenbaum (ibid) noted, quite appropriately, that "what sustainable development implies about the appropriate means to this end or about what is to be specifically achieved, is a matter of continuing debate." It is in the context of this debate, viewed in this paper as desirable and healthy, that the paper posits that extant SD implementation initiatives are necessary but grossly ineffective for pursuing and achieving SD ideals and goals, especially in the developing world where the challenges of daily sustenance make the cost of most current SD initiatives prohibitive. The paper examines current "green development" initiatives as an example of such cost-prohibitive SD implementation endeavours, and contends that, complementary to such initiatives must be implementation frameworks that target the root causes of unsustainable policies, attitudes and practices in different communities worldwide. The paper proposes a sustainability pentagon, which consists of five 'E-principles', as a promising integrative framework for SD implementation, from policy making to policy implementation (vision to action). The five Es include the classical three Es delineated by the Brundtland Commission, viz, Environment, Economy and Equity. These are illustrated in Figure 1. The two additional Es of the pentagon are Enlightenment and Engagement, as illustrated in Figure 2. The paper rationalizes that SD implementation will be effective only if community citizens are fully enlightened and aware about SD policies, options, initiatives, costs and benefits, and if they are meaningfully engaged in the processes of formulating and implementing SD initiatives. Citizen awareness and citizen participation must be integral components of any SD policy that aims to be effective. As Henrique Cardoso (2002:6) clearly stated, SD must occur in the context of "progressive governance which emphasizes democratic processes and the participation of the population in decision-making processes." Implicit in this view are the twin principles of engaged and informed citizens, as prescribed in this paper.

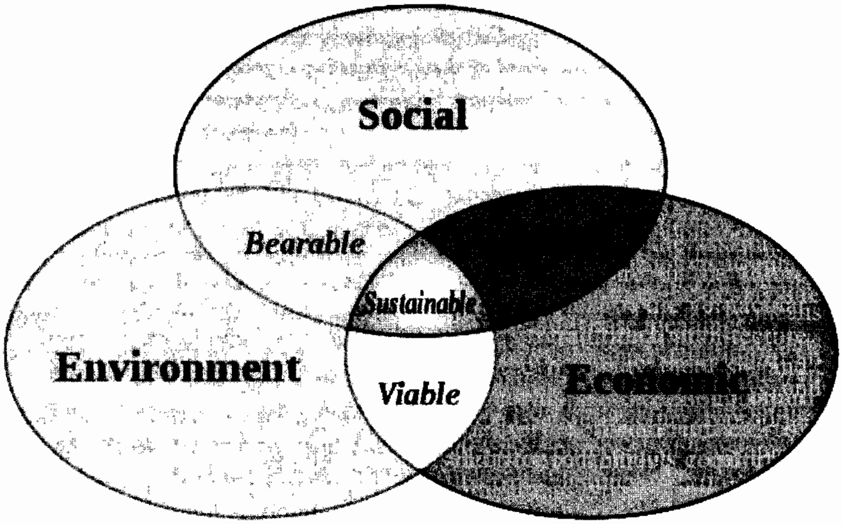
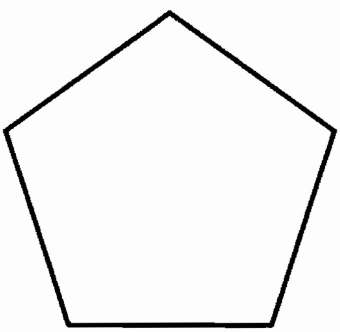


Figure 1: Sustainability Triple Bottom-Line

(Source: http://en.wikipedia.org/wiki/Sustainable_development)



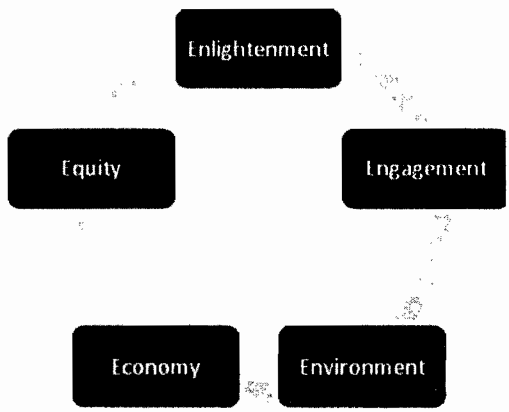


Figure 2: Sustainability pentagon as an integrative framework for SD planning and implementation (Any side can represent any principle, but the key issue is the integrative relationship among the principles)

2 SD Implementation: A Brief Overview of Initiatives an A Critique of the Colour-Coded Approach

Efforts and initiatives to implement SD ideals and goals are ongoing in all spheres and at all levels of governance worldwide. Implementation efforts are accompanied, complemented and enhanced by research and scholarship efforts to understand and articulate SD as a concept and framework for development policy and implementation. At the level of governance, for example, there have been international and local policies and programs aimed at achieving SD goals. Some of the commonest examples are the United Nations (UN) Agenda 21 that resulted from United Nations Conference on Environment and Development (UNCED) held in Rio de Janerio, Brazil in June of 1992; and, the UN Millennium Development Goals (MDGs), which the world leaders adopted, and want achieved by year 2015, in a Declaration at the UN Millennium Summit in 2000. Examples of other global and local SD initiatives are the 1990 Kyoto Protocol, made under the United Nations Framework Convention on Climate Change (UNFCCC) urging nations to reduce their collective emissions of greenhouse gases; the green development movement, which was popularized by the Rocky Mountain Institute's 1998 book titled 'Green Development;' and, the eco-municipality program, initiated by Swedish oncologist Karl-Henrik Robert, founder of The Natural Step (TNS) (James & Lahti, 2004).

At the community level all over the world, the community being the 'theatre' of policy and program implementation, while SD policy and decision making remains the domain of policy makers, implementation is being led by professions involved in the built environment, arguably because of the immediate and visible impacts of built structures on the environment. Architects, for example, are at the forefront of designing buildings that meet pre-set sustainability requirements, while engineers are involved in designing structures and inventing technologies that meet and promote the ideals of SD. Also, the thrust of organizations and programs at the forefront of SD implementation around the world is the built environment. Popular examples of such organizations and programs are Leadership in Energy and Environmental Design (LEED), developed by the US Green Building Council (USGBC) and officially launched in 1998; the UK Building Research Establishment (BRE) Environmental Assessment Method (BREEAM), created in 1990 and used across the European Union; Hong Kong Building Environmental Assessment Method (HKBEAM), which has been in use primarily in Hong Kong, China and East Asia in general, since 1996; the Pearls system, was developed by the Abu Dhabi Urban Planning Council in 2009 for use in assessing new projects in the United Arab Emirates; the Green Star, which is the environmental design system most widely used by projects in Australia and South Africa since 2008; and France's High Quality Environmental standard or Haute Qualité Environnementale (HQE). All these initiatives represent what this paper dubs the colour-coding of SD implementation, which is a lopsided approach to SD implementation at the expense of a more integrative framework for all the pertinent principles of SD.

The color-coded approach to SD implementation is exemplified by no other initiative than the popular "green development" movement that now grips the world. The concept and practice of green development form a broad canopy for a myriad of ideas and initiatives that are currently being implemented in communities worldwide. Virtually every human activity today is prefixed with the term 'green' in an attempt to prod and encourage people to ensure that their activities do not harm the environment. There is a growing body of literature that is trying to bring some clarity and focus to the broad subject of green development and its allied concepts, such as green building and green infrastructure. Randolph (2004:134) observed that "green building" and "green development" are additional examples of emerging trends toward more sustainable design and development. Expatiating on green development, he noted "the concept aims to integrate two, often conflicting values – ecology and real estate," adding that "green development emphasizes four process elements: whole system thinking, front-loaded design, end-use/least-cost considerations, and teamwork including community involvement" (ibid:135). He further stated that:

Green development includes … building designs and practice but extends them beyond the housing market to include commercial developments, beyond the site to include the community and cultural context, and beyond the building design and construction to include real estate financing and marketing (ibid:134).

Randolph (2004:134) described green buildings as "more efficient, environmentally friendly, and healthier residential designs and construction." He noted that:

"Green building" promotes new building designs that do the following:

Provide greater energy efficiency and reduce pollution

Provide healthier indoor air

Reduce water usage

Preserve natural resources through effective material usage

Improve durability and reduce maintenance.

Compared to green buildings, Randolph (2004:95) submitted that "green infrastructure planning is still a new concept" and green infrastructure plans are called "greenprints."

Green infrastructure (GI) is defined as an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. The network consists of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks, and other conservation lands; and working farms, ranches, and forests (idid:98).

Green development, like all other SD initiatives, regardless of profession, sphere of activity or nomenclature, is about using society's natural resources prudently to meet the needs of current generations while saving enough resources for future generations to meet their needs, as espoused in the definition of SD postulated by the Brundtland Commission (WCED 1987:8). At the crux of all SD initiatives, new and not so new, seems to be attempts to minimize or eliminate, where possible, any negative impacts of human activities on society's natural resource or capital base. What this paper surmises is that green development and most other current SD initiatives worldwide tend to be concentrated primarily on the 'Environment' and, to some extent, the 'Economy' principles of Brundtland Commission's triple bottom line illustrated in Figure 1.

This paper finds SD initiatives wanting on the 'Equity' principle due to problems, such as the Not-in-my-backyard (NIMBY) syndrome in mostly affluent communities, spatial and racial segregation in cities, and classism and socio-economic stratification especially in the developing world. The paper also contends that, in spite of significant strides and accomplishments worldwide on the 'Environment' and 'Economy' principles, there is yet a long way to go in achieving the desired integrative intent, spirit and results of SD, especially in the developing world where several intertwined obstacles continue to undermine SD implementation. Specific examples of such obstacles are the marginalization and outright ostracism of grassroots citizens from SD decision processes and the local, national and, by extension, international levels; lack of culturally contextual institutional frameworks for SD implementation; inadequate or lack of government capacity to undertake feasible SD policy, planning and implementation; and, sheer ignorance of ordinary citizens about government's SD agenda, owing primarily to government's failure or ineptitude in communicating such agenda effectively. While some may argue that SD funding is a more important obstacle than those listed here, the view in this paper is that it is these obstacles that account, to a large extent, for the mismanagement of the limited funds allocated or available for SD implementation from local, national, international and philanthropic sources.

3 Potentials of Sustainability Pentagon as a SD Implementation Framework

Based on the aforementioned examples of SD implementation obstacles and the overall ineffectiveness of SD programs, especially in the developing world, this paper contends that SD implementation and achievements will be greatly enhanced if policies and programs are designed or formulated on the sustainability pentagon framework prescribed and illustrated in Figure 2. The intent and purpose of the pentagon are to integrate, balance and harmonize the principles of SD into policies, programs and projects designed to make communities livable and sustainable. The rationale for both the Enlightenment and Engagement principles are discussed in greater detail elsewhere by this author (Kolo, 2009). Suffice it to say that, SD implementation must go beyond the classical 3-E principles in Figure 1 to include the additional principles prescribed in the sustainability pentagon in Figure 2. Table 1 is a summary of some of the fundamental potentials, hence advantages, of the additional principles. These advantages are assured to add great value to SD implementation at the local level, especially in local communities across the developing world

Table 1: Value-added Advantages of the Enlightenment and Engagement Principles

Enlightenment/Awareness	Engagement/Participation
1. Knowledge or awareness about the environment, its uniqueness and relationship to life and human activities	1. Citizen buy-in into the SD policy, planning and implementation processes
2. Sense of responsibility toward the environment	2. Partnership and coalition building in the SD network
3. Accountability for one's actions to self and to society	3. Sharing and learning about best practices in SD implementation
4. Conviction and excitement about choices	4. Collective sense of responsibility
5. Sense of empowerment (the truism that knowledge or information is power)	5. Confidence in, and respect for, SD processes, institutions and policy makers
6. Knowledge or awareness of options, choices and implications of one's choices/actions (creating a win-win situation for humans and the environment)	6. Infusion of experiential (culturally contextual) knowledge into SD processes
7. Interest in, and awareness of, sustainability issues and practices elsewhere	7. Incremental and pragmatic implementation of SD initiatives (healthy balance or mixture of indigenous and foreign SD practices)
8. Awareness of participation channels on SD initiatives	8. Designation of roles and responsibilities based on competency, capacity and interests
9. Keen sense and motivation to participate in SD initiatives locally and beyond	9. Collaborative approach to sharing SD benefits and absorbing liabilities (we are in this together)

Besides the advantages of the sustainability pentagon enumerated in Table 1, the pentagon will also address, from a pragmatic standpoint, what this paper considers to be some major weaknesses of extant SD initiatives, especially at the international and national levels. One example of such weaknesses is the very elitist, one-way and to-down approach to SD policy making and programming. Generally, policy agreements are reached at the international and national levels with little or no input or participation by the masses that would be affected by those policies. The Engagement principle of the sustainability pentagon is intended to address this weakness. A second weakness, which both the Engagement and Enlightenment principles aim to address, is the sheer ignorance or unawareness of grassroots citizens in some parts of the world about SD policies and programs, which are targeted at them. In most parts of the developing world, there are inadequate media to reach the masses. Yet, where media exist, bureaucratic ineptitude, political corruption and infrastructure deficiencies make genuine information dissemination impossible. A third example is illiteracy, which militates against full comprehension of global concepts, such as sustainability, by rural masses. In an Internet survey conducted in preparing this paper, it was discovered that many ethnic groups in Africa lack precise diction that is the equivalency of sustainability, or of its allied concepts, such as Millennium Development Goals, global warming, etcetera. In the survey, while respondents of the Arabic, Persian, Bulgarian and Spanish ethnicities stated categorically that they have specific words for the SD terms listed in the survey, it was interesting to note that many other ethnicities, including French and German are quite 'sensitive' to the context in which most terms are used, while most African languages simply had to use stories, similes and allegories to convey the meanings of the terms listed in the survey. For example, the colour green in the Yoruba and Nupe languages of Nigeria is compared to a 'leaf', while the word development is understood through the concept of 'moving', 'advancing', or 'progressing' forward. Sustainability implies longevity of life, while there is simply no word for millennium, as is also the case in the Sotho language of South Africa. Thus, combining 'green' or 'sustainable' and 'development' would require stories or even allegories in order to grasp the meaning of sustainable development or other allied concepts. A fourth example is the lack of procedural or institutional frameworks for citizens to learn about, and participate in, sustainability issues and causes. A fifth, albeit not final, example is the de facto superciliousness of foreign, mainly Western, sustainability initiatives, compared to indigenous initiatives.

The weaknesses exemplified above are just a few of several, which make SD implementation very problematic and ineffective in many parts of the developing world. Among the practical values of the sustainability pentagon proposed in this paper is that it forces SD policy makers and technocrats to ponder and ask some poignant questions about the feasibility of each SD policy formulated, and each program and project undertaken. Besides policy making, the questions would help with 'realistic' SD planning, implementation and funding. Examples of such questions are as follows, based on the 5-E sustainability principles of the sustainability pentagon. All the questions are relevant and applicable to all SD policies, programs and projects in communities worldwide.

Environment – What are the real and potential impacts of a policy or activity on society's natural resources or capital and by what factors can these impacts be disaggregated?

Economy – How does a policy or activity address society's need for economic growth that respects the environment yet creates a healthy employment and revenue base for the society at large?

Equity – Does a policy or activity make or contain realistic provisions or conditions to provide citizens with equal and just opportunities to participate in policy or program implementation, and to access or enjoy the benefits accruing from their participation?

Enlightenment – Are there mechanisms in place to inform and educate all interested stakeholders about all aspects of a policy or activity in a timely manner?

Engagement - Does a policy or activity make practical room or arrangement for all the community stakeholders, who choose to participate in the opportunities provided by the policy or activity?

4 Conclusion

There is no dearth of academic and professional evaluation studies of SD programs and initiatives anywhere in the world. As noted in this paper, however, little seems to be occurring in the area of formulating procedural models that could help implement SD programs more cost-effectively, irrespective of differences in political and cultural contexts and realities. One of the positions in this paper is that frameworks for SD policy making, planning and implementation need to be broad and integrative, striking a consistent balance among the sustainability principles discussed in the paper. The paper also contended that current SD initiatives are skewed toward the environment and the economy, almost to the detriment of the other principles. In spite of the environmental and economic benefits of prevailing initiatives, such as green development, the 'tilt' of initiatives toward the built environment has serious negative implications for SD implementation, especially in the rural communities of the developing world, where illiteracy and political disenfranchisement give citizens no stake whatsoever in the processes of SD policy making, planning and implementation. In these communities as well, the SD initiatives currently practiced to achieve the environment and economy principles and goals of SD are mostly culturally irrelevant, cost-prohibitive, or little understood or known about. It is in the attempt to address these problems that this paper proposes the sustainability pentagon as a SD planning and implementation framework, with special emphasis on the enlightenment and engagement principles.

This paper submits that there are ardent advocates for the enlightenment and engagement principles featured in the sustainability pentagon, as critical factors required for SD implementation in communities where poverty, degradation of natural capital and population pressure are among the forces undermining people's ability to live to live decent, fulfilling and quality lives. Speaking on the need for enlightenment or education, for example, the Independent Commission on Population and Quality of Life (1996:170, 171) noted that:

Education is one of the keys to social development, and to virtually every aspect of the quality of life. Education is about developing intellectual curiosity and enquiry. Education improves the quality of life and empowers people to solve all kinds of social and environmental problems... . Education also equips people to participate effectively in democracy and to assert their political and legal rights. In a world confronted by many complex challenges and conflicts, education becomes more and more critical in the development of skills and attitudes in order to analyze problems and find solutions.

Equally forceful on the need for engagement or participation, particularly in reference to green development, are Roseland (2005) and Randolph (2004). The latter stated that:

The process for developing an open space/greenway plan should be highly participatory. By engaging public stakeholders in plan development, the plan can reflect community needs and desires and stands a greater chance of acceptance. The participation process can also serve to inform the public of the benefits of open space and environmental protection and its connection to other community goals (ibid:96, 97).

It is important to state that, the desirability and advantages of enlightenment and engagement do not make them any easier to implement or achieve in the 'real' world. As Porter (2000:2) noted quite tersely, "translating the lofty ideals of sustainability into the rough-and-tumble world of everyday development can be a daunting task." A foremost implication of this task is for all societal stakeholders to work collaboratively in all aspects and facets of SD planning and implementation. The top-down, elitist approach alluded to in this paper has not been ineffective in securing the buy-in and shared responsibility required of all community stakeholders. The types of collaborative approaches required to implement SD initiatives cost-effectively already exist in most communities and, as Sachs (2008) suggested at the global level, all the world needs is to "rejuvenate, modernize, and extend" global cooperation to address SD challenges. The enlightenment and engagement principles of the sustainability pentagon have the potentials to keep all stakeholders informed, involved and accountable. These initiatives are not color-coded, but they complement and enhance color-coded SD initiatives, making SD implementation the integrative process it must be to be effective.

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Sustainable Cities Possible or Impossible: A Critical Review

Hisham Moustafa, Husam AlWaer, Tamer Gado
University of Dundee, Dundee, Scotland

Abstract

Half of the earth population is living in dense urban areas, today, while only a third of the population lived in cities in the 1950's. This phenomenon clearly states that there is an increase in the demand for city lifestyle, leading to the emergence of the sustainable city concept. The literature revealed a variety of definitions and descriptions for sustainability and sustainable cities in their complex shapes and sizes with a wide range of strategies, frameworks, phrases, concepts, indexes and indicators. This controversy created a huge diversity of opinion and confusion to the literal performance of the term "Sustainability" and "sustainability indicators" and to accentuate the vagueness of indicators two principles - acclaimed as the most successful philosophies - for how a sustainable city should perform are compared. They are: 1) The commission of Architecture and the Built Environment (CABE) for sustainable cities and 2) The ten principles of Melbourne.

The Ultimate aim of this paper is to identify the key limitations of existing principles and discuss the philosophy of control that sustainability imposed on cities and how it should be relinquished to the citizens. It presents a critical review of different related concepts including sustainable, eco, liveable and intelligent cities. The results indicate that the concept of sustainability is not an erroneous idea but stakeholders need to evolve the concept in itself. The Sustainability concept is vulnerable and due to its vagueness it lead to the emergence of the Integral City which gave a more refined definition for the city future.

***Keywords**: Sustainable cities, socio-ecological city, Vagueness of sustainability, Melbourne Principles, CABE, Eco-City, Intelligent City, Integral City, City Participation, Control.*

1 Introduction

Over the last 100 years that cities have become an attraction for the world's population. There are as many people living in the countryside as there is in the city and that is an unusual event to occur, according to history (Egger, 2006). Cities occupy only 2% of the Earth's surface and yet at the beginning of this century it contains almost 50% of the world's population (Burdett and Sudjic, 2007).

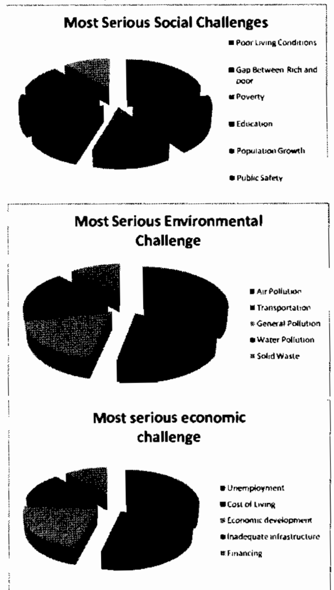

Figure 1: The most significant problems in each aspect of sustainability in cities(Scan and Hazel 2007)

Cities will reach a certain level when a huge percentage of the world's population will live in cities and the minority will live in the countryside. This phenomenon was achieved in 2007 and it is still expected to rise dramatically in the next 30 years (Pietro et al., 2005). The world's population is expected to rise to 2 billion persons by 2030 while the rural population will rise and then decline to a staggering 20 million (Pietro et al., 2005). This growth will be mainly concentrated in developing countries with 94% of the increase found there (Pietro et al., 2005). By 2020 of these 2 billion persons, 75% will be living in urban areas (Pile and Brook, 1999).

The emergence of the mega-city was predicted in 1900 were there were only 3 cities with a population more than 3million (London, Paris and New York). The amount in 2000 there were 19 cities with a population exceeding 10 million and it is expected to rise, in 2015 to 23. These 23 cities will house 30% of the world's population (Wenzel et al., 2005).

Rapid Urbanism is attributed to this rise in population. This concept led to the immigration of many people from rural villages to urban and newly growth areas and making them new urban dwellers. Urbanisation is a perceived notion that brings changes in social and cultural settings of the population. This change could lead to a change in attitude, worldview, and way of life of urban folks as well as socio-cultural changes among urban communities (Ahmad et al., 2009). This concept leads to the emergence of the concept of the city with in a city, or better known as "Suburbia".

Suburbia has many names and one of them is "City on the Highway". These cities were designed to fix the problems existing in the city. It was designed to have all the services within walking distance and they emerged because of the automobile existence. Its solution is to have people leave the city and commute from the main city to these extensions (Suburbia). This lead to the increased importance of the Automobile, people could travel longer distances (I.E. the decentralisation of cities) (Hall, 2002) or urban Sprawl.

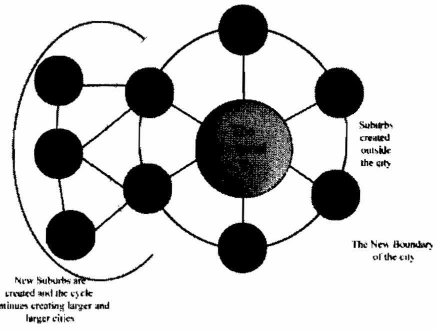

Figure 2: How Suburbia originated and how the cycle will keep on going

Transportation is a huge problem that is plaguing cities. Today, cities are designed with the car in mind; however this type of design creates a lot of environmental based problems (ITS, 2009). Despite many efforts of controlling traffic within cities there is still the exasperating problem of car growth, the political strength of the car lobby and a public wanting of car usage (Richards, 2001). Mass production and mass consumption have worked together to reduce the cost of car ownership, making a preferred means of transport (Pile and Brook, 1999). The city after the invention of the car has become a broad network of dispersed, low-rise residential neighbourhoods mixed with open land reserves - and, in contrast, bold on the skyline, a number of dense, intensive districts replete with culture; street life; diversified commerce, business, and residential opportunities; and a multitude of services and entertainment (Safdie and Kohn, 1997).

It is still important to understand if the city evolvement is actually possible? And if they evolve from what have they evolved from? And are they still evolving? Evolution is an influential factor that affects humans' physical, mental and psychological features and thereby the are evolutionary explanations around the ergonomic and social explanations for the human built environment of rooms, buildings, streets and cities. Cities evolved from earlier kinds of settlements, going back to the simplest imaginable settlement, for example a ring of huts or tents around a single fire. This philosophy suggests that the first settlement (or city) came after the creation of the first building. However, some state that settlements are not derivative of buildings, but both modern cities and buildings would be a descended from an earlier proto arrangement. This means that the creation of settlement is not an accidental by product that happens to be placed in proximity (Marshall, 2009).

The first signs of planning in cities emerged in the Pharonic era, followed by the Babylonians leading to the Greek, Roman, Early Christian, Byzantine, English, Islamic Cities, industrial cities, etc... (Fletcher, 1905) . All these city designs later on evolved to the modern city. This concept evolved in the late 19th century, it was driven by horror at the Immorality of slums that emerged in the industrial cities and by the perception of the start of the new age (the machine age) in which societies would harvest benefits of accompanying technological development and industrial production. This philosophy had its problems and it evolved to post modern design. This movement emerged in the 1960's and it focused more on living in suburbs which was aforementioned in this section (Carmona et al, 2003). The philosophy of cities later on evolved in to the concept sustainability, societies needed to rethink how they lived, worked, played and shopped. The path to reach growth is built on the principles of smart growth, new urbanism and green buildings (Farr, 2008). However, this section focuses greatly on control.

2 Sustainable Cities

How to shape cities fundamentals and urban design has only recently started to incorporate the greenhouse debate. Formerly, much of the concern circled around the active façade technology for eco-buildings and solely technological determined solutions. The cities concept was missing in this debate (Lehmann, 2009).

The city is a Circular Metabolism which was presented by Herbert Girardet in his book "*Creating Sustainable Cities*". His diagram shows that each city has inputs and outputs and how their needs to be a circular and regenerative system within a city (Girardet, 2009). However, the city is not as simple as a one way metabolism; they are ecosystems were everything is inter-dependent on each other. It is a place where people live, play, work and interact with each other and nonliving elements (Newman and Jennings, 2008). This proves that the city cannot be simplified to just inputs and outputs. The figure introduced three new factors; (a) Concerns/challenges, which were earlier mentioned in this section, (b) Impacts (I.E. Factors that contribute to the growth of the city) (c) Responses How the governments or city will respond, for example, increasing the demand for energy if required or raising taxes on fuel to try to reduce its consumption.

To better understand this concept the paper compares seven cities with different standards of living. They are; (a) New York City, (b) Shanghai, (c) London, (d) Mexico City, (e) Johannesburg, (f) Berlin and (g) Kuwait. It looks at their Population, energy and water cost, the number of cars, Gross Domestic Product (GDP), Average density and housing rents. All these factors affect the metabolism.

Table 1 shows the above hypothesis at work; the metabolism of the city is not as simple as the input entering or exiting it as Girardet stated in his book.

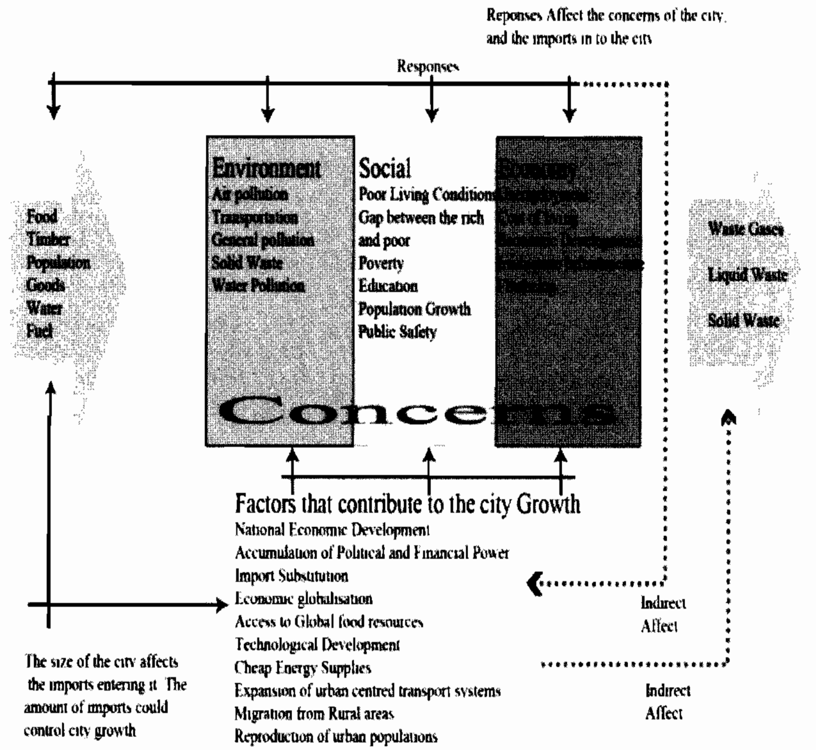

Figure 3: modified model for the city Metabolism, Based on (Girardet, 2009)

Table 1 shows the above hypothesis at work; the metabolism of the city is not as simple as the input entering or exiting it as Girardet stated in his book. There are many factors that affect the amount of input and output in the city, such as population, lifestyles etc… Looking at the figures in table 1 Berlin has the lowest population of the three and has high consumption rate while a city like Mexico City with the highest population has a lower consumption rate. This means that one of the biggest factors that affect the city's metabolism is the ecological footprint.

The Ecological footprint of the city is premeditated by its resource consumption and its affect on the city and its surroundings. It represents land area necessary to sustain current levels of resource consumption and waste discharged by that population (Newman and Jennings, 2008). So it is important to understand what causes the increase in outputs and inputs of the city to reduce its ecological footprint.

Table 1 Comparison of seven different cities (Burdett and Sudjic, 2007)

	New York City	Shanghai	London	Mexico City	Johannesburg	Berlin	Kuwait
Population 1950	5,000,000	3,500,000	7,500,000	4,000,000	2,000,000	4,000,000	152,000 (Kjeilen, 2009)
Current Population	7,960,000	16,610,000	7,540,000	18,900,000	3,230,000	3,400,000	2,690,000 (Kjeilen, 2009)
Average Density (People/km sq)	9,610	2,590	4,800	3,700	1,960	3,810	103 (Consulting, 1998)
Housing (Average Rent $)	2,500	360	2,390	810	640	750	N/A
[illegible]	[illegible]	6,300	38,400	16,400	5,100	[illegible]	[illegible]
Travel (Cost of Public transport $)	2.0	0.5	2.7	0.2	1.2	2.5	N/A
Crime (Murder rate 100000 inhabitants)	6.7	1.5	2.1	17.6	18.9	1.4	N/A
Energy (KWh per capita per annum)	63,000	5,600	20,500	1,800	5,600	21,600	12,681(UN, 2010)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Car Ownership per 1000 persons	210	38	341	383	183	361	1300 (Al-Qattan, 2010)

Table 1: some of the Definitions of Sustainable cities

Definition Author	Definition States	Target and focus	Problems
Herbert Girardet	A Sustainable city is a city that is just, aesthetically beautiful, Creative, Ecological, have easy contact and mobility, is compact and polycentric and finally diverse (Girardet, 2009, p. 72)	Idealism within a city	Too idealistic
Steven Moore	That the sustainable city is a city that "negotiate[es] a balance between the competing social interests that alternately promote economic development, environmental protection, and social Equity (Boltz, 2008, p. 13)	Social, Environmental and economic	Concepts Cannot be Balanced in cities as each city has its own agendas
Richard Register	A sustainable city, or eco-city is a city designed with consideration of environmental impact, inhabited by people dedicated to minimisation of required inputs of energy, water and food, and waste output of heat, air pollution - CO_2, methane, and water pollution.(Register, 2006, p. 215)	Environment and pollution	Not complete as it neglects the economic and social aspects

The connection between sustainability and the city is unclear. This is a surprising concept as cities consume almost half of the energy produced (Lehmann, 2009). Sustainable city is a complex phenomenon, and as Graham Vickers stated "*Cities are all the same, cities are all different*" (Marshall, 2009), meaning that maybe all cities will have the same goals but all have different approaches to achieve that goal. Thereby, the concept of sustainable city is the common goal and the ways that each city attempts to reach it is different due to different priorities or concerns and that is evident in table 3.

To Change cities into "Sustainable Cities", they should value systems and underlying processes of urban governance and planning need to be rehabilitated as well as the change of urban form, transportation systems and water, waste and energy technologies. High energy and material consumption and waste production could be attributed to the highly auto-dependant, resource consuming cities. This concept leads to the attribution of the compact city (Kenworthy, 2006).

The compact City concept encompasses the belief that urban revitalisation and the future of the city is only achievable through the re-compactness of cities and the use of clearly devised, more compact sustainable urban design principles (Lehmann, 2009). The complexity in this sense is that cities have different sizes, location, resources and capacity and this is one of the complexities of obtaining sustainability and that was evident in table 1.

The vagueness in definition led to the development of many new concepts that focus on certain aspects of sustainability. This was because of the unattainable philosophy of sustainable cities. Concepts like the intelligent Cities, which aimed for citizens to *live, work and play*. It concentrates on the social and economic aspect and neglects to the ecological aspect. The second is the Ecological city, all the concentration is given to the ecological aspect. Thirdly, the liveable city, it focuses on the environmental and social aspects.

2.1 Vagueness of the term "Sustainability" and "Sustainability City *Indicators*" (SCI)

There are many definitions given to the term sustainability or sustainable cities. This creates confusion between people and hence the concept could be applied incorrectly.

The concept of sustainability, on the national and international scale, has become an important concept especially during the discussion following the Burtland report and the 1992 Rio summit. The concept of sustainability is a desirable and could be attained on a global perspective (theoretically) unfortunately, smaller scales have difficulty applying the concept (Doughtry and Hammond, 2004).

Sustainability cannot have one singular definition, as various different concepts have articulated a wide diversity of possible definitions and meaning. The definitions of sustainability are many, some complement the concept while others are contradictory (Lehamnn, 2009). Sustainability, on the conceptual level, connects to maintenance or the enhancement of the natural systems. The focus of this concept is the sustainability of the human population as it tries to control people and their actions that impact the global environment (Egger, 2006).

Sustainability is a goal for international and national policy makers; however, there is no measuring element at to assess the policy practically. The measuring and the process of defining sustainability is very difficult due to its vague and complex concept (Phillis and Andriantiatsaholiniaina, 2001). The concept in itself is an admirable goal for carefully designed purposes; however, it could be an invisible trap for those well-intentioned un-suspectors. As a goal it has an honourable perspective in the environmental movement which has been successful in the fight to create a *THEORETICAL* and *STANDARDISED* acceptance on the global scale (Marcuse, 1998). The concept is legible from a theoretical perspective, however, no country has been able to implement it and this could be due to political, economic, social aspects, etc… The problem, with standardisation is that each country is different and each has its own agenda, to standardise a concept on an international scale identity will be lost.

Brink in 1991 stated that to create a definition for sustainability, it should follow a set of rules ; (a) Define clear objectives; (b) concern the system as a whole; (c) Quantitative Character should be established; (d) easily understandable by all; (e) include parameters that could be used for periods of one or more decades (Marcuse, 1998)..

If however, sustainability was used as a constraint rather than a goal, then it could be considered a criterion in the evaluation measures in the achievement of otherwise define desired goals. This evolves on the Brundtland commission's definition.

Measuring the level of sustainability in cities is not an easy process. It is difficult to determine the most effective quantitative and qualitative indicators. However, the indicators are essential in measuring the progress of cities in all the aspects of sustainability on all the different spatial scales. Sustainability Indicators (SIs) have become a tool that is used extensively to measure the performance of systems and policies projects (AlWaer, 2008).

The selection and the use of SIs is not an exact philosophy as there are many contributing factors to it such as; pressures, agendas and biases. Governments usually render themselves in the best possible way and it is easy to believe that reference conditions may be set with a political agenda in mind. The concept of SIs is to try to break down a complex system into its components and study how they work in isolation and then together. This system is known as the reductionist approach. Unfortunately, this concept is greatly criticised due to the fact the concept of sustainability is too complex with millions of variables and it is impossible to look at every single one. One of the biggest problems regarding SIs is the encapsulation of these complex and diverse processes in a relatively few simple measures (Bell and Morse, 2008).

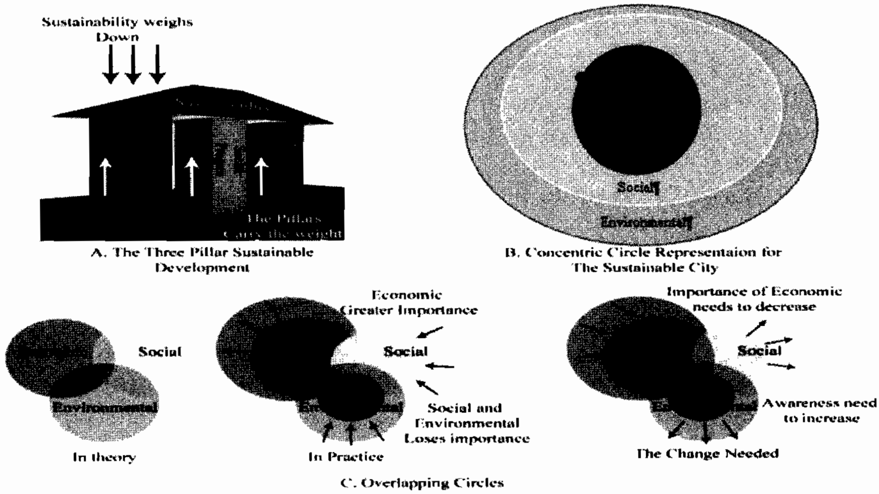

Figure 4: The representation of sustainability (Adams 2006), p2)

Sustainability indicators generally fall under three major categories and they are the three pillars that carry sustainability; (a) Economic, (b) Social and (c) Environmental. In theory, all three aspects are equal, unfortunately in the practicality of the concept more accentuation is given to the economic aspect. Hence the other two aspects need to fluctuate to the return the balance of sustainability (Adams, 2006). This representation could be shown in three different modes. They are; (a) The Pillar Model, (b) The concentric model and (c) the overlapping circles. This is evident in Figure 4. The look and shape of this figure is dependent on how the city approaches to solve concept of sustainability from their perspective.

The numbers of sustainability indicators are increasing at a daily basis. However, this explosion supports two particular interesting features. Firstly, there is an emphasis on a sub-national level, and secondly there are many situations were indicators are being used (Rydin et al., 2003). There is a growing concern for the use of sustainability indicators on city level. By measuring certain phenomena's such as waste recycling rates, water quality or vehicle miles travelled, current information could be provided to measure the current trends and conditions to track the city goals progress. Indicators are also valuable due to their driving influence for city to show what is essential and helps in the engagement of citizens to achieve a certain goal, mentioned in section 2.2 (Gahn et al., 2003).

Indicators are an important occurrence as it shows how adjacent or distant the city is to the targets of sustainability and how cities could improve them (Pinfield, 1996). Indicator development is not purely technical or scientific process; rather, it should be an open communication and policy process (Valentin and Spangenberg, 2000).

There are many sustainable city indicators around the world. This paper concentrates on two main concepts. These concepts were chosen as they claim to be the most successful in the world. They are; (a) the 10 principles of Melbourne, (b) the CABE (Commission of Architecture and the Built Environment Principles) principles.

The paper looked at several different SCIs around the world and out of the SCI set, the two selected were the most ideal for this research. The choice was based to show how the different indicators attempt to reach the same goal but through different priorities.

The 10 Principles of Melbourne are a set of aspirations developed at an international charette in 2002. These rules were later on endorsed by the Johannesburg summit in later that same year. These principles are the keys to achieving the concept of designing the city as a sustainable ecosystem. They are flexible to be applied in their own unique way. The path to sustainability is global goal which relies on informed citizens and an effective city government, joined together in a global compact to ensure that urban humanity and all planetary life can coexist and thrive (Newman and Jennings, 2008).

The CABE Principles focus on the concept of making cities more low carbon. It focuses on planning, designing and managing a sustainable place. It cuts through the intricacy with simple and clear conducts. Following its set of principles certify a more resilient economy, healthier residents, a more beautiful place and a better quality of life for everyone (Practitioners, 2007).

Using different solutions to tackle the same problem doesn't necessarily mean that the outcome is similar and this was evident in table 3. This means that the philosophy behind sustainability, or sustainable indicators, is not an exact science and there are many fluctuations that occur between each given scenario.

Eventhough they have differences there are still some similarities. There are similarities that are directly linked in both set of principles and there are others are others that are indirectly linked. For example, Leadership in CABE and Governance and hope are identical in the concept but the names differ. Governance and hope indirectly affects energy, waste management and water management.

Table 2: criticises the difference between two SCIs

Melbourne / CABE							Partnerships	Empowerment	Sense of place	
		●					○	○		
	○	○	●	●	●	●				
		○		●	●					
		○		●						
				●						
Public Space									●	
									●	
		●								

Key: Combines the Three factors of sustainability ▒ Environmental ▒
Economy ■ Social □ Direct Link ● Indirect link ○

Many authors believe it is difficult to measure the sustainability and yet still trying to find a direct and more precise definition for environmental indicator. The indicators supplied by the scientific community commonly have a low degree of collectiveness and an excessive amount of information and vice versa (Gagliardi et al., 2005).

However, SCIs grading cannot be generalised as what is important for one city could be could be of less importance in another city. This means for example a huge issue for a city like Kuwait is access to water, this issue could be less important in a city like London and vice versa on other issues. This is also evident in table 5, there are 2 different SCIs and both from different countries, one is from Melbourne and the other is CABE from the United Kingdom (UK). It is obvious that Melbourne tried to incorporate all the aspects of sustainability, while CABE focused a great deal on the environmental issues with minor concentration on the remaining two factors, meaning that it is impossible to have a standardised process of measuring sustainability

Between regions and countries, there are many Cultural and social variations and sustainability measurement may vary from one region to the next, even if the same criteria are applied. A flexible assessment system is therefore required to take spatial boundaries into consideration whilst still retaining the understanding of the occurring changes and their reasons. As a consequence, to have a holistic view of sustainable development, assessment methods have emerged over the previous year's incorporating a broad range of criteria. The selection is based upon a series of bias, genders and agendas and they are presented in quantitative and qualitative formats which depend on what aspect of the performance is being assessed and at what spatial scale (Alwaer et al., 2008) .

From Table 3 it is clear that the most well rounded of the two SCIs are the principles set by Melbourne. They cover a wider range of issues and are more flexible. This is the reason for its selection in table 4 to be compared against the city concepts mentioned in section 2.

Table 3: Compares the Intelligent and Ecological city Concept with the 10 Principles

	Vision	Economy & Security	Biodiversity	Ecological Footprint	Cities as Ecosystems	Empowerment	Partnerships	Sustainable Production & Consumption	Governance & Hope
Economy									
Accessibility									
Property									
Environment									
Degraded Land									
Fit The Bioregion									
Balance develop.									
Urban Sprawl									
Energy Perf.									
The Economy									
Health and Security									
Community									
Equity									
History									
Cultural Landscape									
The biosphere									

2.2 Sustainability and Control

The concept of sustainability, as was mentioned in section 2.1, is control. Sustainability attempts to control. Many researchers have recognized that complex problems often are not solved by pure logic or science, monitoring or engineering, as these approaches focus mainly on efficiency and how to make "what is" more efficient. They cannot easily shift to creating solutions that are not just efficiency gains (Newman and Jennings, 2007, p. 157). Sustainability focuses more on mastery, control and efficiency and this tends to generate cities that are fragmented without soul or character (Ellin, 2006). It is a philosophy that is based truly and utterly on control. It attempted to control people's movement and community growth (Farr, 2008; Clark, 2010), uses, nature, water usage , etc... Control has also been attempted through guildelines, policies, measurments and legistalations.

Decision and Policy makers need to understand that perfectionism should not be the main goal, and that it may not bring happiness or improve the city. The pursuit of perfectionism is not linked to happiness, but it only could be considered successful if it meets the user's needs. Otherwise it is considered a neutral affect or sometimes even worse. So instead of the egotistical concepts between cities of creating the best, it is more important for cities to understand how the use of their spaces, on a daily basis, can be made more harmonious and more satisfying, by this concept indirectly reach their symbolic goal of creating plans that do not harm the environment (or sustainable) (Ellin, 2006).

To create successful cities, planners need to relinquish some of their control and give it to the public. There needs to be a collaborative network between the users, the government and the planners. The public concerns, needs and values need to be incorporated into governmental and corporate decision making. They should be able to see their decisions in the design process and be able to see how they influenced this design. It should communicate their interest and facilitate the people who are directly affected (Creighton, 2005).

The influence of power in the design process is primarily exerted by people who have an influence within the project team or have a controlling power over a project such as head and senior directors, expert designers, commissioning clients, regulators, investors, etc.... Figure 4 attempts to show the relationship between the level of citizen involvement and empowerment. The less information given to the participant the weaker the empowerment, this means that the empowerment level is directly related to the amount of information given. However, relinquishing all the control and handing it to the public is a high risk process, as the amount of information given is very complex and the risk could lead to negative impacts on the social and environmental issues. This is why the paper suggested that some of the *control* needs to be relinquished and citizen *involvement* should be considered. This gives citizens the necessary empowerment that they crave and yet the risk that is involved with partnering the citizens could be avoided.

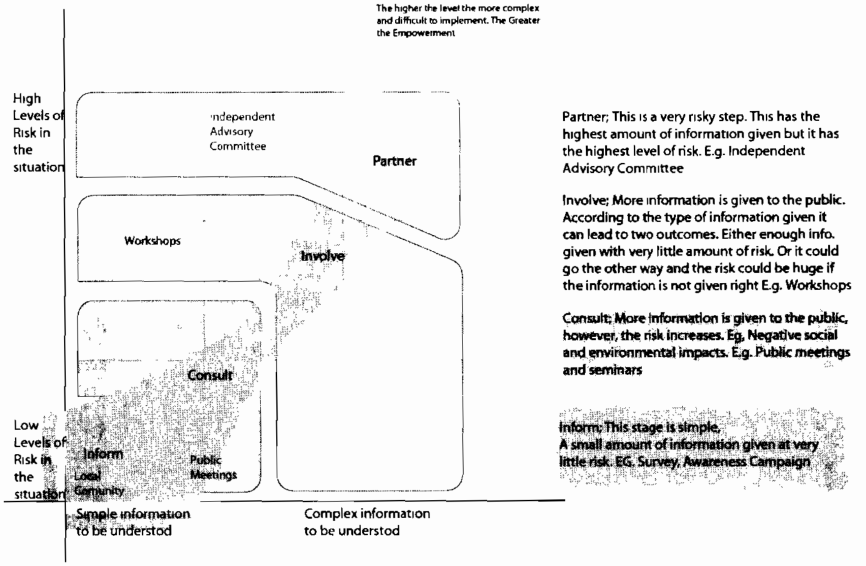

Figure 5: Citizen Empowerment Modified from (Newman and Jennings, 2007, p. 162)

Participation in decision making helps people to appreciate the complexities of issues and feel a sense of ownership toward the outcome. It encourages people to take responsibility and care for their human community. Empowerment is about making people to make more control of their day to day lives and have the ability to make decisions about their surroundings. This issue is important because it is a human right, but also because the sustainability issue is far too difficult and complex and to resolve it needs many different views as possible in a creative strategic conversation (Newman and Jennings, 2007, p. 157).

3 Sustainable, Intelligent, Liveable or Ecological Why Bother?

The vagueness and the misinterpretation of Sustainable city definition created many versions and many other concepts to benefit the city itself. What is evident from table 2 is that the most idealistic is Herbert Girardet's definition of the sustainable city which combines all the aspects needed in a city. This means it covers economic, social and environmental aspects of the city, however, as it is an idealistic approach, many cities started to incorporate sub categories to the sustainable city concept. The ones mentioned in this paper are; (a) Intelligent, (b) Liveable and (c) Ecological Cities.

Table 5 shows a comparison between all four concepts mentioned before. It shows what each concepts main purpose of existence. It proves that each philosophy has its own priorities and goals and as do all cities. It shows that each concept concentrates mainly on one aspect with minor neglect to the remainder. For example, the intelligent city focuses greatly on economy and social aspects and neglects the environmental aspect, while the ecological city focuses greatly on the environmental aspect and gives minor importance to the social and economic aspect. Finally the Liveable city, focuses on the people, how they live their lives and their connection to the environment and gives no consideration to the economic aspects.

Intelligent cities or Intel-Cities focus on serving the human society. Cities are collective tools whose features emerge rather than carefully planned. Intelligent cities is a new concept an emergent of the 21st century instead of the construction of that act as an intermediary between mankind's physical conditions and nature, it attempts to make spaces and collective tools that increase mankind's intellectual capacity and improve city usage between its citizens, in order to learn, innovate and reach new limits (Komninos, 2008), thereby its neglect to the environment.

"Cities are more than just wires and cables, smart offices, trendy bars and luxury hotels, and the vast number of people who live in cities deserve more than just these things. Because the smart city label can work to ideologically mask the nature of some of the underlying changes in cities, it may be a partial impediment toward progressive urban change." Robert G. Hollands (Hollands, 2008, p. 316).

Ecological Cities or Eco-Cities aims to create cities that are coherent with nature. It needs people to think of a city as a living system, this means it needs to be built on a basically three dimensional, integral, complex models, not flat, random, and in large areas uniform and simple. It aims the city to be compact and should be designed for a population of living things rather than the automobile (Register, 2006). This proves that cities main concern is the environmental aspect with very little or no recognition to the remaining.

Liveable Cities is a city that contributes to physical, social and mental well being and personal development of all its inhabitants. It concentrates on the quality of urban spaces that offer and reflect cultural and hallowed enrichment (Timmer and Seymoar, 2005). However, the liveable city isn't a sustainable city as it only concentrates on the wellbeing of its residents, it doesn't care about the city surroundings and the amount of waste it produces.

Table 4: The Comparison of the four city concepts

	Sustainable City (Girardet, 2009)	Intelligent City (Jenks and Dempsey, 2005)	Ecological City (Register, 2006)	Liveable City (Allison et al., 2005)
Economic	[illegible]	[illegible]	[illegible]	
Social	Just and Equity, Quality education Vibrant Culture Employment, Meeting people with Special requirements needs Empowerment Diversity, Creativity and Heritage Governance	Accessibility Environment; concerned with safety and security, ambience and conviviality, and local partnership and commitment assessed in terms of availability (the number of hours the environment is active), sense of place, cleanliness, amenities and key attractions	Encourage Community Promote Social Equity Respect History Enrich the Cultural	Designing on a human Scale Diversity Mixed used development Preservation Vibrant Public Spaces Identity Design Matters
Environmental	Clean air and water Energy and renewable energy Recycling Respect Nature Land use development Restoration of degraded land Pollution and transportation Provide health and Security		Restore degraded Land Fit the Bioregion Balance development Halt Urban Sprawl Optimise energy performance Provide health and security Landscape Heal the Biosphere	Vary transportation Options Protect Env. Resources Conserve Landscapes

Table 5: Comparing the Intelligent and Ecological City Concept with the city Challenges provided in Figure 1

	Pollution	Trans	Waste	Living Cond.	Equity	Poverty	Edu	Pop Growth	Public Safety	Unemplo -yment	Living Cost	Econ Develop	Infra	Finance
Economy														
Accessibility														
Property														
Environment														
Human intelligence														
Restore Degraded Land														
Fit the bioregion														
Balance Development														
Halt Urban sprawl														
Optimise Energy Performance														
Contribute to the Economy														
Health and security														
Encourage Community														
Promote Social Equity														
Respect History														
Cultural Landscape														
Heal the Biosphere														
Human Scale														
Diversity														
Mixed Use														
Vibrant Public Space														
Identity														
Design Matters														
Vary transportation Options														
Env. Resources														
Conserve Landscapes														

Table 6 attempted to show how the challenges of the city, mentioned in section 1, and how each philosophy attempts to answer the problems of the city.

Table 5 and 6 both look at the concept of the city future. Each philosophy discussed in both tables on a certain aspect of city design. This is due to the idealism that sustainability set for its cities. Each city concept never really tackled the complete set of concerns for the city set in this paper. However, a combination of all three could tackle all the major concerns of the city.

4 The Integral City

The conclusion that originated from table 6 lead the author to introduce the concept of the integral City, as was mentioned in section 1, the city evolved from prehistoric times till what is seen today. This philosophy originated to eliminate the philosophy of total control that sustainability imposed. It attempted to create cities were people had an influential impact on the city and its use (Ellin, 2006).

The philosophy of integralism in cities focuses greatly on the philosophy that cities are habitats created by and for people. It is important to explore it within of whole and living systems. It concentrates and gives and understanding of the intelligence of the human society. It follows the philosophy that the human condition is a never ending quest involving continuous adaptation and change. The city focuses on 12 different forms of intelligence; (1) Ecosphere Intelligence; focuses on the location of places for the human city, (2) Emerging intelligence; sees the city a whole system rather than individualised ones, (3) Integral Intelligence; Evaluates the exiting and evolving patterns of the Human city, (4) Living Intelligence; understands that the city is an organism that lives and dies, (5) Inner Intelligence; concentrates on the conscious capacity of the Human city, (6) Outer Intelligence; the embodiment of the right action in the human city, (7) Building Intelligence; the creation of structures that flex and flow in the city, (8) Story intelligence; understanding the historical progression of cities, spiritually and physically, (9) Inquiry intelligence; it focuses on releasing the potential of the human hive, (10) Meshing Intelligence; The enabling of order and creativity in the human hive, (11) Navigating intelligence; the easy movement within the city, and (12) Evolving Intelligence; imagining how the

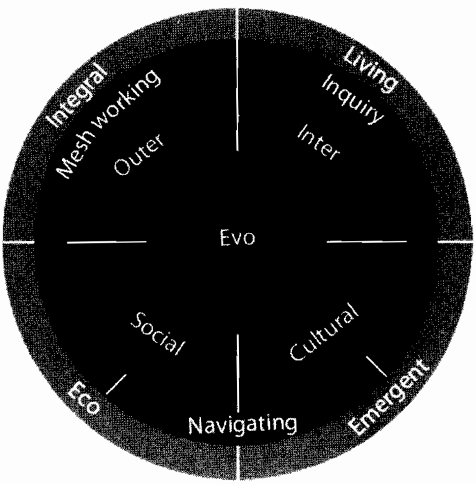

Figure 6: the integral city main principles

city will evolve (Hamilton, 2008). This is evident in figure 6.

The centre of the circle is the evolutionary intelligence, which is the core of the movement, the further along you go in the circle, the weaker the principles to the integral city philosophy it would be.

5 Discussions and Conclusion

The paper attempted to investigate three major points. They are (a) understanding the complexity of the city metabolism, (b) Understanding how the vagueness and idealism of sustainability and sustainable city definitions lead to the emergence of many other concepts and whether these concepts attempt to improve the challenges of the city, and (c) Understanding how different Sustainable city indicators, who have the same final goal, reach their goals through different means.

The concept of sustainability is a relative concept and not an absolute science. The vagueness of the term sustainability and their counterparts sustainability indicators have been an ongoing struggle for several years and were discussed in a variety of papers. The problems that affected the term sustainability were conveyed on the definition of sustainable cities and similarly to the sustainable city indicators. The concept of combining sustainability and the city are relatively recent as Steffen Lehman stated in his papers and hence it is still an evolving concept.

The idealistic concept of sustainable cities has been an evolving argument for the past several years. Many people still believe that the concept of sustainable cities still exists and in the Ettore Maria Mozzola's paper states sustainable cities are possible with the current town planning transform. There are also people who argue that the use of sustainability indicators is un-accurate and un-just due to government manipulation and their huge complexity.

The reason this study was conducted was to understand that the definition for a sustainable city is very complex and this created many misinterpretations and concept. Each concept on its own has its own downfalls and the combination of all concepts together in the socio-ecological city will give a better and more direct understanding of the sustainable city. Another point that gives importance to the study is to understand that each country needs to have its own measuring tool to achieve its sustainable cities.

The study had many limitations as the concepts that originated from the vagueness of the term sustainable cities were construed to three concepts and these concepts evolved in too many newer concepts. For example, the intelligent city evolved in to smart cities, digital cities, E-Cities, etc... and the sustainability indicators chosen were only two and there are more indicators available.

One subject that still remains to be explored is how the Integral city contributes to the enhancement of the city concerns. There also needs to be a more detailed mentioning of the remaining concepts for city futures. The increase of the number of SCIs will give a more accurate assessment of whether or not there are differences between the indicators produced in different cities.

The findings of the paper show that; (a) The city is complex network of concerns, impacts, outputs and responses. It aimed to show that the city is not just a simple concept of just inputs and out puts, instead these complex systems needed to involved in this metabolism concept. (b) The paper also investigated the vagueness of the term sustainable city, which lead to evolvement of many concepts under its name. They are (a) Liveable, (b) Intelligent and (c) Ecological. These concepts on their own failed to measure up to deal with all the challenges of the cities mentioned in this paper. Finally, (c) the paper also examined how different indicators, from different countries attempted to reach the same goal through different means and that was evident between the comparison that occurred between Melbourne and CABE.

The city is a complex system and each city has its own goals and priorities, it cannot be just simplified into a set of rules and guidelines. The problem with the concept of the sustainable city is its wide generalization and idealism. Unfortunately sustainability is not an exact science and the attempt to simplify it or generalize it is impossible. Problems arose from the evolvement of the concepts, they lacked many aspects of the city challenges and on their own they were inadequate. This lead to the concept of the socio-ecological city as it is the combination of all three concepts provided in this paper.

Sustainable City indicators do not give a clear or adequate explanation to the sustainable development of the city. There are a number of conclusions that emerged from the past literature review on SCIs. They are;

- Not two indicators achieve the same goal in the same way.
- Each city has its own priorities when designing its own indicators.
- They are government influenced.
- Governments portray themselves in the best possible picture.

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A Corporate Agenda to Catch-Up with Sustainability

Mustapha Madi
Dar Al Handasah, Beirut

Abstract

The issue of sustainability promulgated post the Bruntland report of 1987. The Middle East & North Africa and Gulf regions caught-up with the term in the mid 90s with the outburst of master planned developments; however, it was not before the beginning of the new millennium that sustainability became the new buzz word of the 'development industry'. After the 2008 global financial crisis, there was enough attention given to the essence of sustainability, but only to become a catalyst in a medium of stagnation and anticipation.

This paper will examine a unique approach to sustainability from the consultancy firm angle. Today's challenging economic climate fosters the right environment for more sustainable outlook for organizations in order to ensure current and future success. Globally present consultancy firms have not only the ability, but also the responsibility to influence their employees, clients, partners and suppliers, whilst ensuring to benefit the environment and their communities. These firms, like all types of businesses, are driven by commercial incentives and the pre-requisite of being a 'leader' in their domain. For such firms, the role of a corporate agenda is to enlist all possible resources to clarify and achieve the commercial drivers and incorporate it into the core business.

Three global consultancy firms have successfully indulged into a non-traditional strategy to incorporate sustainability, which strives to set practices that help restoring environmental quality and build social equity, while increasing long-term profitability. This paper will argue that their success is internally/commercially driven to maintain a market niche as 'leaders'. It is the adoption and commitment to a sustainable approach that will imprint onto the staff, the clients... and feed into the cultural and social responsibility.
Keywords: sustainability, development, consultancy firms, corporate responsibility.

1 Background

As early as the 1960s, environmental awareness embraced the political and social scenery of urbanism while its discourse escalated to a global scale. Reference to figure 1, there are six major milestones related to global awareness to sustainability. In 1987, the Bruntland Report was circulated in the UN and became the first global 'official declaration' of concern in regards to the environment and the future of population on this planet under an agenda of sustainable development. The report defines sustainability as meeting "the needs of the present without compromising the ability of future generations to meet their own needs"(WCED, 1987). Martin Pawley in his lecture at Audacity Conference in 2008 referenced Peter Smith definition of sustainability as "leaving the planet to the next generation in no worse state than that in which the present generation found it" (Pawley , 2000). However, if one would dig deeper into the meaning of the term, it would appear that it has been there, not necessary under the same name but within the same principles, for much longer period.

1972
Stockholm Declaration

1987
Our Common Future

1992
Rio Earth Summit

1997
Kyoto Climate
Change Protocol

2002
Johannesburg
World Summit on
Sustainable Development

2009
Copenhagen
Climate Change
Conference

Figure 1: Important Milestones

More recently, Talal K. Shair, Chairman of Dar Al Handasah Consultants (Shair & Partners), claims that environmental awareness, in its broadest terms, and sustainability, as the keystone of 'social health', has been evolving for the last 5,000 years ever since the ancient middle-eastern civilizations. He also argues, based on the late 14th Century theoretician Ibn Khaldoun that "cities cyclically regenerate to maintain a certain level of 'social health' The balance point is achieved through synergies of the city dwellers with their cities, context and available resources. On similar lines, the Chicago School, some 600 years later, describes the evolution of cities to that of a living organism" (Shair, 2009). The multi-facet aspect of sustainability, sustainable development, its role in urbanism and the city evolution, kept the discourse busy with almost every large scale development at a global scale.

Such concerns have reemerged in the Middle East and North Africa (MENA) and Gulf regions and started to catch-up with the term in the mid 90s with the outburst of master planned developments. Real estate and marketing campaigns focused on master planned community and self-sufficient scenarios in developing large real estate projects, down towns, new cities etc. it was not before the beginning of the new millennium that sustainability became the new buzz word of the 'development industry'. The backbone of the real estate ventures, especially in the Gulf region, was composed of sustainability, environmentally friendly and self-sufficient products. In the last 10 years, the United Arab Emirates in specific, started to follow LEED, BREAM and other similar 'green credit' rating systems. In the last three years, Abu Dhabi Emirate formulated its own ESTIDAMA rating system (Estidama is the Arabic for Sustainability). More importantly, Abu Dhabi Emirate is turning the system into applicable and operational vision through incubating the MASDAR initiative (a zero-carbon emission research city) and other projects. The condition set by the authorities dictated that all projects in the Emirate should be screened by the Estidama system.

Under such 'constraints', what are the responses of the different businesses to sustainable development? More specifically, what is the new path followed by consultancy firms in that regards. The following will focus on the corporate responsibility within such firms, particularly three international consultancy firms: Dar Al Handasah, Perkins and Will and ARUP that operate on regional and international scenes.

2 A Business Window onto Sustainability

Sustainability is the single biggest business opportunity of the 21st century, and will be the next source of competitive advantage.(H. Lee Scott, President and CEO of Wal-Mart)

Today's challenging economic climate fosters an atmosphere for a sustainable outlook for organizations in order to ensure current and future success. Consultancy firms that operate in the global economy have not only the ability, but also the responsibility, to influence their employees, clients, partners and suppliers, while also ensuring to benefit the environment and communities. Often this is what is referred to as the 3Ps: People, Profit and Planet.

Some claim that "interpreting and applying the concept of sustainable development is increasingly viewed as being the way to promulgate just and practicable economic, environmental and social policy" (Lumley & Armstrong, 2009). More than a decade ago, others formulated the triple bottom line (TBL) reporting framework to introduce ecological, social and financial performance indicators in traditional reporting (Elkington, 1998). Some prominent businessmen adopted and expanded on formulas related to businesses' impact on environment and their sustainable approaches to conducting business. Roy Anderson, CEO of Interface, is an American businessman who used an evolutionary perspective on environmental problems, a formula prepared by Paul and Anne Erhlich: I= PxAxT (P: population; I: environmental impact; T: technology; A: affluence) first published in 1991, to explain his vision. He 'upgraded' and transformed that formula into: I= PxA/T and added H (happiness with less _ to satisfy needs) to the formula to become: I= PxA/TxH to formulate his company's business model for mission zero in horizon 2020. Such examples are significant and illustrate the level of commitment and how far a company, and it sustainability champion, could, and is willing to, go not only to change its corporate mission but to actually 'practice what it preaches'.

Eventually "the agenda of sustainability and corporate responsibility is not only central to business strategy but will increasingly become a critical driver of business growth…" as Patrick Cescu, CEO of Unilever claims (The Sustainability Agenda_ PWC, 2008). The remaining component is to establish a corporate will to undertake and sustain such responsibility. To read further into this issue, this paper picked on three consultancy firms with different approach in incorporating sustainability in their "business as usual". The paper considers each of the firms approach to sustainability a unique one due to the firm's history, its evolvement, clients, and fields of expertise and why and how they are tackling the integration of sustainability into their business. There are two firms that belong to the same holding company DAR GROUP; these are Dar Al Handasah and Perkins + Will. Dar Al Handasah, engineering and design practice, with heavy business concentration in the MENA region. Perkins + Will, architecture and planning design practice, with business concentration in North America and Eurasia. The third consultancy firm is a UK based firm with European, North America and Middle East presence, ARUP. In a nutshell, the three are global players with a 'genuine' interest to market themselves as 'sustainable' consultancy firms.

2.1 Dar Al Handasah: www.dargroup.com

Since 2008, Dar Al Handasah has been heavily involved to incorporate sustainability into its well greased internal operations. For a consultancy firm that was established in 1956 and based in four design offices (Cairo, Beirut, Pune and London) the kick-off was not easy. It goes without saying that the consumer, the client in this case, backlash embellished the wake-up call. Dar has identified a changing mood in the market place, competitors and clients' appetite to developments and it was evident that sustainability was in the driver's seat; it was sufficient to prompt a major rethink in the industry from the firm's point of view.

An evolving business mindset was required to respond to such condition. The first order of business was to identify key indicators to this claimed change; the following was highlighted:

- Referencing sustainability on reviews of design criteria, standards and norms.
- The widespread use summary of benchmarking to sustainable precedents.
- There is an evidence of updated reviews of project objectives and ambitions to meet with sustainable inspirations.
- A shift in client ambitions and expectations towards more sustainable products.
- Espousal of practitioners' policies and commitments to sustainable developments.

This was followed by a response strategy. The fact that Dar recognized the need to respond, then responded by preparing an internal overhaul, in root and branch, through developing its capabilities is an indication of understanding sustainability concepts and opportunities. It was evident that this is a far reaching change, challenge and it requires a shift in the overall philosophy of design and project development processes, the bread-and-butter of the firm's expertise. The aim is to lead clients, develop business and the biggest challenge is to internally adopt a sustainable business approach as part of its corporate responsibility.

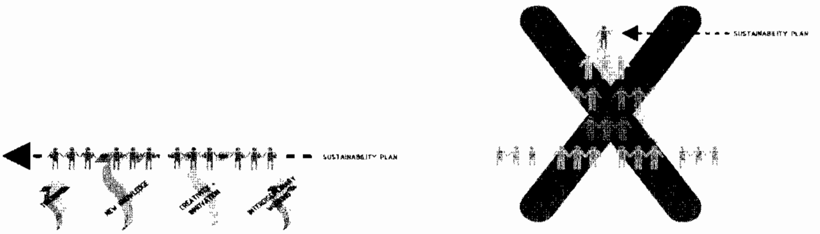

Figure 2: Dar's Approach to implement the Sustainability Plan (Courtesy of Dar Al Handasah)

Currently a tentative approval has been granted by Dar's board of directors to formulate a Sustainability Plan. It will branch out from the different technical department as action plans and each department will elect a champion to ensure that the department will attain an acceptable level of commitment to such endeavour. Eventually, a 'sustainability matrix' will be used to screen all types of projects prepared by the firm. Two major challenges have been identified so far: upper management concession and extracting enthusiasm from employees. To overcome this resistance, a dual process is taking place; both management and employees are being bombarded with sustainable examples with cost/benefit assessment and small doses of personal as well as corporate responsibility are injected. It is implementing in both not only the need but the benefit of becoming a fully sustainable business. This approach is based on the principle that such contribution must be developed from within, and disseminated throughout 'bottom up'; while individual motivation is the principal generator of creativity (Figure 2). Dar is incubating corporate citizenship and a sustainable business in the making.

2.2 Perkins + Will: www.perkinswill.com

Although Dar Al Handasah and Perkins + Will are part of Dar Group, they are at two different plateaus when it comes to sustainability. For years, Perkins + Will has successfully maintained its founding principles of sustainability, integrity, and design excellence. The brochures at Perkins + Will highlight that it takes both vision and experience to build an environmentally sustainable future. The firm has been an advocate of sustainable design since its founding in 1935; they have a long list of award-winning sustainable buildings to prove it.

On their website, the firm clearly states the obvious: "While other firms are still in a learning curve, we are perfecting our sustainable design skills at a time when clients are increasingly becoming aware of the financial, social and environmental benefits of sustainable buildings". Even though it is a marketing tool the company has a distinct and focused mission to pursuit new solutions, share the knowledge, and produce ideas and buildings that "honor the broader goals of society". For the firm, sustainable design is more than a process of reducing environmental impact. It is a holistic approach that incorporates environmental concerns into the design process from inception.

The firm has focused input on the design procedures to integrate sustainable approach threw out the design process. They have devised an integrated design process that graphs the processes to a better sustainable approach (Figure 3). These are simplified below:

- Performance and conservation that promotes energy and efficiency.
- Strategic building orientation and site design to reduce the negative impact of a building on its ecosystem.
- Sustainability-harvested material from renewable resources.
- Society and sustainability of the human resources where employees are the most important asset to any organization.
- Site analysis and solar orientation that will offer and maximize the opportunity to utilize environmental factors.
- Community and eco-system enhancement that has a cost-effective outcome

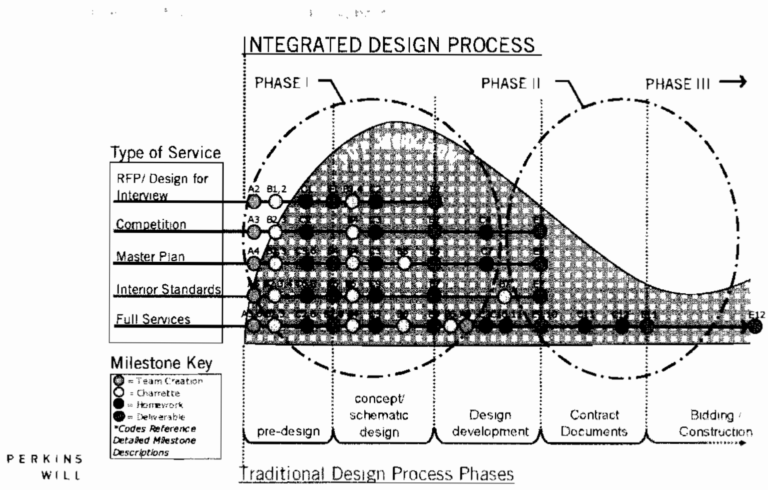

Figure 3: P+W Integrated Design Process (Courtesy of Perkins + Will)

In addition, Perkins + Will is making sure that all its facilities are environmentally sensitive. They adopted a "Green Operations Plan" to establish guidelines for the day-to-day operations. In 2007, they pushed the boundaries and broadened their approach to make a positive impact on the environment. Currently the firm has more than 750 LEED accredited professionals and a dedicated budget per annum for sustainability and environmental research. The broader goal entails industry leadership, integrated design services, knowledge leadership and operational excellence. The firm even adopted the 2030 challenge for all its new projects which laid the roadmap to meet their sustainability commitments. Using the words of Peter Busby, an executive director at Perkins + Will: “Successful sustainable design strategies are not finite but a process of experimentation, testing, learning and revisiting. Synergies create new opportunities and better solutions. Learning sustainable design is an organic process, as it should be”. Evidently Perkins + Will is taking sustainable approach to design, and by de facto sustainable development, through its services to clients, to the next level. Both ends of the design development spectrum in the firm (from group leader to the junior designer) are in sync with the sustainability plan and because of their commitment their clients, and by transition their projects, are designed as sustainable developments.

2.3 ARUP: www.arup.com

The last and third consultancy firm is ARUP. It is the firms work and products that is believed to leave a significant legacy to subsequent generations. This power, to design and influence the built environment, carries with it a responsibility. By placing sustainability at the middle of its work allows Arup to positively influence on the built environment. Investing in research and development is another way that the firm replenishes innovative approaches to sustainable design.

As part of Arup corporate responsibility, which is a policy, is shaping a sustainable future particularly through the urban environment. The firm considers it one of the greatest challenges in the 21st century. To rise to the challenge, Arup has been investing in research, innovating and creating better sustainable solutions for its clients to create enhanced sustainable developments. This is being done through promoting Arup's vision and more importantly how it is translated and transferred to its clients and their projects.

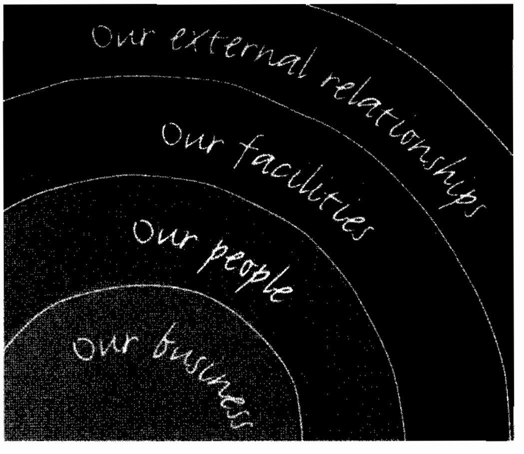

Figure 4: Arup's Sustainability Report (Corporate Report, 2008)

At Arup's web site the firm claims commitment to sustainability which in return informs the firm's approach to design a project. The firm is acutely aware of the responsibility "to do the best possible work for current and future generations". Similar to P+W, Arup's issued its Sustainability Policy in 2007 approved by its board and born out of staff engagement. Obviously for such policy to work requires the involvement of all types or professionals at all levels within the firm. It also requires a systematic approach to attain sustainability. Figure 3 above summarize the major keystones within Arup (Corporate Report_ Arup, 2008):

- Provide value to clients by building upon its reputation for integrated design and a holistic approach to projects
- Employ and retain staff who have a high degree of awareness and expertise in sustainability for all disciplines and provide continual education and training for all staff to support innovative approaches to implementation of sustainability strategies

- Maintain management systems to assist with implementation of sustainability objectives and develop a strategy for the firm to move towards sustainable uses in its operations

What is intriguing in Arup's corporate report is the fact that it is made of both the sustainability report and the financial statements. Even if not clearly stated, the fact that the firm packaged their annual report by joining sustainability to financial is an indicator of their firm belief that adopting sustainability had a financial ramification on the firm's financial statement. On their web site, the firm claims that in 2008, the date they launched the regional sustainability strategy, it witnessed an annual revenue growth of 27% and profit increase from 8.5% to 11.2%...

3 The Lesson

Having described the three firms in some details above it seems important to shed some light on their background and internal issues that shaped their current situation, as well as those that led to the incorporation of sustainability into their daily businesses. To start with Arup, it should be noted that this is a publicly traded and owned multi-disciplinary entity with stocks listed in the market; hence, a corporate social responsibility is part of its by-laws decision processes. Arup is also a market-leader and probably the first to incorporate any decisions in the firm overall approach to doing business even whilst auditing its own projects. When sustainability took on the stage, the firm took onboard commercial risks and restructured how business is conducted and restructured their internal organization to meet the requirements. But as a truly global firm, it had to be a trend-setter as well, so an extreme make-over was designed to keep the firm in front of others. It is evident that the Arup has a strong internal driver that kicks in to preserve its alpha-leadership as part of its business development protocols.

Perkins and Will are predominantly an international architecture practice looking and relentless working towards establishing a well-rounded design practice. The firm has part of its business core the green plan and LEED, to the extent that 90% of their staff is LEED certified as GAs or PAs. Currently, the firm is a leader and reference on LEED issues while other firms are tuning their business models to follow that of P+W. To escape potential business stagnation the firm is expanding and diversifying their core business to leap from architecture into diversified design approaches with a common theme of sustainability attached to it. The firm is truly global in its presence, but more prominent as a reference on sustainable architecture (LEED, green plan etc.). The commercial driver to expand beyond their current status requires expansion in their business development targets.

The third firm, Dar Al Handasah, is a strong regional player with international presence. It is a multi-disciplinary and privately owned consultancy firm that is following the sustainability trend. Dar's core business and main involvement is in mega-projects with public or government profiles; add to that historically and culturally conservative context, the market place for the firm is a slow pace prone-to-change. The regional market is slowly evolving and identifying sustainability as a cornerstone for development and recognition, accordingly Dar is recognizing an opportunity to maintain its regional leadership by adopting sustainability into its business. The commercial market driver has trickled a change in the firm's multi-disciplinary practices to reaffirms its regional role as a follower of international trends.

4 The Challenge

In comparison, the three consultancy firms are well known and established businesses that have been servicing clients for more than fifty years. Lately, they are all involved in producing sustainable developments for their clients, but more importantly it is evident that they had to adopt sustainability as one of their core business services and goals. They have also enhanced their corporate responsibility to formulate missions that starts within the organization and cast its impact on the firm's products. Perkins + Will seems to be the most involved and most dedicated based on their claim that their founding codes evolve around the same principle of sustainability and environmental awareness. Arup, on the other hand, appears to have paved the way to a proper passage into fully integrating a sustainable business into its daily operation and in 2008 they started see the benefit of their preparatory work in the form of regional sustainability strategies. Finally, Dar Al Handasah seems to be a late joiner but with the tools to do so in short time. The latter's processes are intriguing because they reveal some of the issues that need to be surpassed to claim commitment to sustainability in a consultancy firm.

A simplified version of the above would declare that initiatives and performances are different from strategizing and practicing… the continuous challenge is to communicate that operating sustainably is an imperative for all types of businesses and specifically those into consultancies that shape our cities and living environments. Moreover, there is a growing awareness, shared by the consultancy firms, at different levels, that the requirement of trade-off between sustainability and profitability is outdated mode of business approach. One might claim that there is a new formulation of a business mindset that looks into operating in a sustainable environment from mitigation and leveraging of opportunities perspectives. The consultancy firms, in specific, have adopted, as per the examples above, a special approach to doing business by injecting sustainability in their approach to problem solving. All three firms and many more have incorporated sustainable approach in their day-to-day business, regardless of internal and external resistance to change. They are slowly but effectively transforming their sustainable –free 'business as usual' approach to a sustainable-integrated 'business as usual'. They are doing so on three fronts simultaneously: selling it to their clients, injecting it in their design approach and most importantly educating their human resources by creating challenging environment and a personal stake in it.

There is loud call for a non-traditional strategy that set practices to help restoring environmental quality and build social equity, while increasing long-term profitability. From the quick overview of the three consultancy firms, it is apparent that such goals can only be achieved from the inside-out. The road-map starts with a full corporate adoption of a sustainable approach to design, then to imprint such culture onto their clients by setting an internal guidance to monitor the design product and finally to allow for a synthesis procedures to ensure the design product outcome. The establishment of sustainable corporate agenda seems to be adopted with the examples listed herein. Such agendas enlist different resources, set the mood of the overall business approach and pave the way to shifts in core business to respond to commercial drivers.

For firms in general, if there are lessons to be deducted it boils down to the following:

- Sustainability is the new buzz word, and will stay for near future;
- Commercial driver(s) tags sustainability at all times;
- Adopting sustainability is related to the belief in its essence and benefits;
- Incorporating sustainability can only occur from within the firm as a first step; and
- Sustainability over-spills to the greater benefit (social responsibility).

Acknowledgements

A special appreciation is due to Dar Al Handasah (Shair & Partners) for supporting this endeavor by exposing the firm to the world of 'corporate responsibility and awareness' and relentlessly pushing the firm into sustainability. I would also like to thank Mr. Peter Busby (P+W) and Mr. Peter Speight (Dar Al Handasah) for their input and insightful presentations on sustainability.

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The International Prize for Sustainable Architecture: Achievements and Potentials

Luca Rossato, Marcello Balzani, Cristina Vanucci
University of Ferrara, Italy

Abstract

The International Prize for Sustainable Architecture, now in its seventh edition, arose from the important manifestation of the tenth anniversary of the Ferrara School of Architecture foundation, held in 2003.

Conceived and promoted by the School itself and Fassa Bortolo company, its spirit and goal are to contribute to the research of a system of development in the building sector that is more sustainable than our current model, which has lead to a state of deterioration and pollution, bringing us to the verge of a global crisis of the Earth's entire ecological system. Receiving every edition more of one hundred submitted projects, the Prize during the past years has become one of the most important European events for sustainable architecture.

The Award is a testament to the outstanding growth of the sustainable approach toward architecture in Europe. It contributed to the implementation of an ecological conscience through the prizes awarded to young professionals that nowadays are part of the European sustainability movement.

During the past years, the Award has become internationally renowned even within the academic realm. The submitted entries reflected an ongoing change inside architecture pedagogy. Whereas in the past, sustainability played only a secondary role and was not taken on by the faculties' best design chairs, nowadays it must be part of the young professionals' knowledge and skills.

Keywords: *sustainable architecture awards, bio-architecture, sustainable construction awareness.*

1 The Beginning of the International Prize

In 2003, during the important international manifestation of the tenth anniversary of the foundation of the Ferrara Faculty of Architecture, the School itself and Fassa Bortolo company (Fassa S.p.A., registered holder of the trademark "Fassa Bortolo") joined their forces to create an award in order to re-examine the relationship between the process of construction and the environment.

In that period, the school, involved since the foundation in a sustainable approach towards architecture, wanted to provide incentives for architecture capable of satisfying the needs of our generations without limiting those of the future by the indiscriminate consumption of resources and the production of pollution.

The Award was created from an understanding of the importance of sharing with a large public the results of research in the field of civil construction, recognizing the fundamental role in architecture of environmental protection, education and social promotion. Of course while maintaining the responsibility of representing the concrete expression of cultural development and of the society's collective interests.

Thus the prize aims at spreading the concept of a new architecture that is perfectly adjusted to the environment and conceived for the necessities of mankind. Since the first awarding in 2004 it's been stated that each individual candidate or group can take part to the competition with only one project, which must has been realized and implemented within the past five years.

It was further decided that lecturers or professors teaching in the competition year at the Ferrara Faculty of Architecture may not take part in the competition.

In that first competition the Ferrara Faculty of Architecture and Fassa Bortolo realized how tough it could be to implement an international award based on issues shared only by a few people. At the time sustainable architecture in Italy was a concept addressed only by elite architects).

In that year the Prize collected only 13 projects, the majority of which came from Italy. Only a few entrants were from central Europe. The first winner was the Austrian Georg W. Reinberg, a great supporter of sustainable architecture in his country.

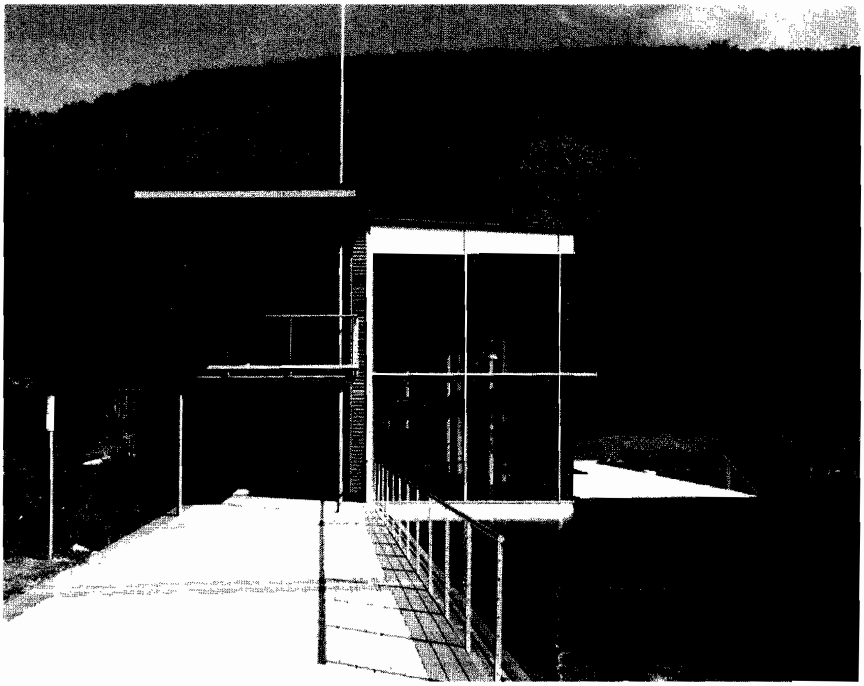

Figure 1: Office and studio of the "biotop" Company in Weidling, by architect Georg W. Reinberg, Prize winner in 2004.

2 The Early Stage

In 2005 and 2006 the Award had slow growth, reaching the number of 20 entries in 2005 and 27 in 2006. The participating projects were mostly from Italy. In Europe the competition was almost unknown but the overall quality continued to be very high as demonstrated by the Jury reports.

In 2005 Ernesto Mistretta's "Countryside house" (Located in Trapani, Italy) won for its transformability, an important characteristic of an unpretentious country house. The big sliding walls and the external mobile roofing offered a great variety of possible configurations.

An introverted house, closed in itself, that suddenly opens in total harmony with the landscape.

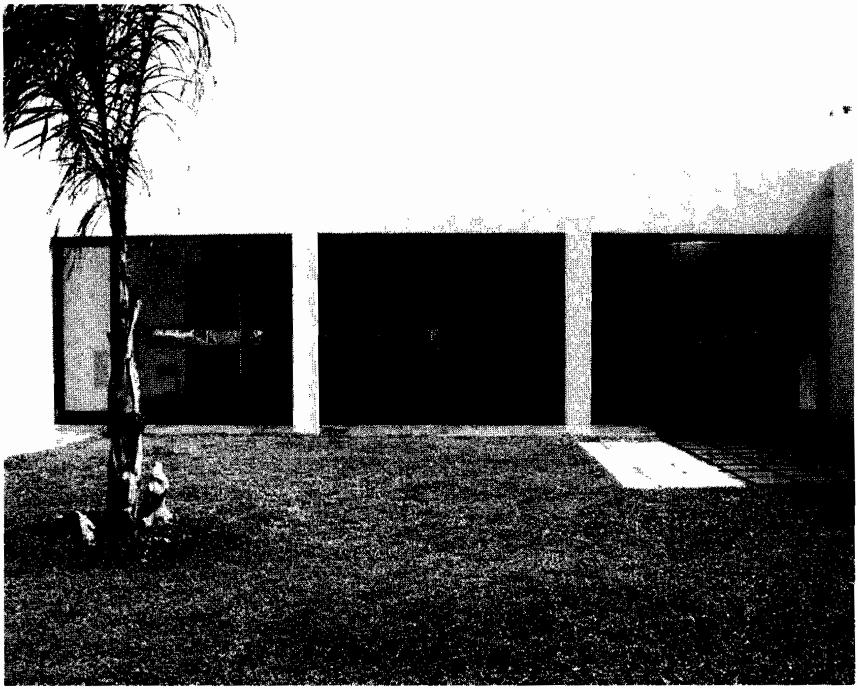

Figure 2: Country house in Trapani (Italy) by architect Ernesto Mistretta, 2005 winner of the Prize.

The 2006 competition was characterized by a first prize and two special mentions of high quality. Furthermore three projects were commended during the Jury evaluation.

The first prize went to the "Wine Facility Collemassari", a project by Edoardo Millesi, Archos Engineering consulting.

The building, a clear and representative volume inserted in the rhythmic mesh of the vineyards, developed the topic proposed by the competition notice. It proposes the modification of the landscape considering economic drives and architectural contemporary language.

The technological mix of both natural and artificial materials seemed well balanced to the Jury.

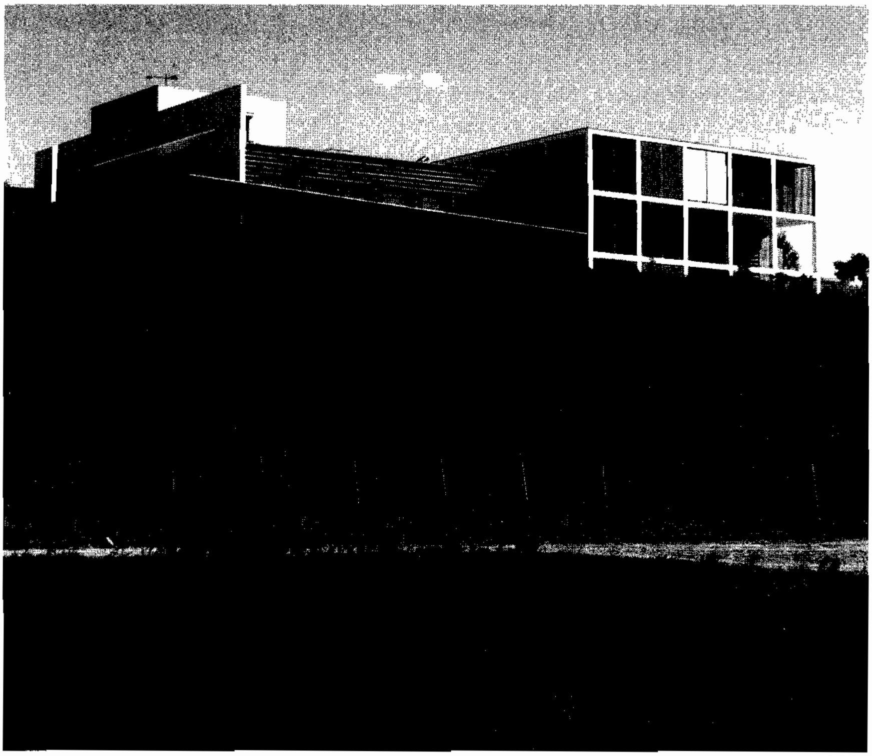

Figure 3: Wine facility "Collemassari" in Grosseto (Italy) by architect Edoardo Millesi, 2006 winner.

3 The Introduction of the "Degree Theses" Category

In 2007, after an in-depth analysis and an internal debate, the Award was opened to academia; the award has a "Degree Thesis" category. Students in various architecture schools involved in sustainable architecture topics can apply to this category.

In his category of the award, the applications for the Prize could be submitted by individuals or groups that have presented the degree thesis in the last 2 years before the competition at a Department of Architecture or Engineering, as well as in equivalent educational. They must have obtained a mark superior to 100/110 or equivalent.

The introduction of this category injected new lifeblood in the Prize. The links between the academia world and the professionals generated a quick profusion of knowledge in sustainable architecture issues, and it has created new momentum for the next cycles of the Award.

The 2007 Jury unanimously awarded First Prize the "restoration of a farmhouse and a new multi-purpose hall" project (located in Altedo di Malalbergo, Bologna, Italy) by Diverserighestudio.
The rigour of the project solved important compositional and climatic topics with an extreme consistency. It paid particular attention to the issues concerning sustainability, environmental respect and ecological requirements, thus it perfectly met the topics indicated by the competition notice.
Among the degree theses entries, the Jury selected a first prize and two special mentions highlighting works' great architectural quality.

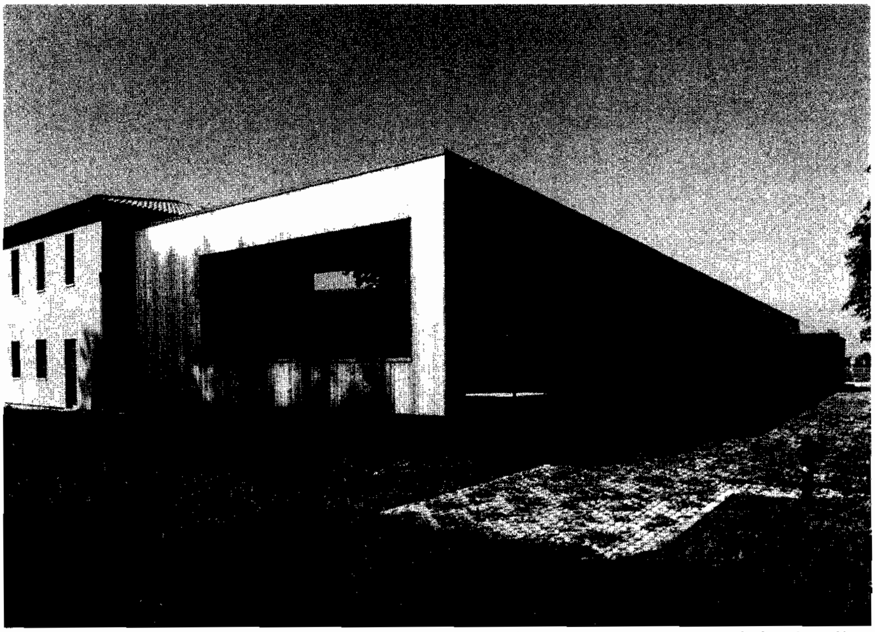

Figure 4: Corte Campedelli restoration in Altedo (Italy) by Diverserighe Studio Architects, 2007 winner.

4 Signs of Change

The 2008 Prize attracted entrants from 11 countries. This confirmed the wide international reputation and growing interest for these kind of awards. Entries included an increasingly diverse range of architectural projects: from new buildings to renovations, from private to public construction, from leisure to industrial sites.

Meanwhile, all around the world, bio-climatic issues were being discussed and, slowly, Italy started to develop an awareness about the great power of attraction of this branch of architecture.

For the first time in the Prize's history, 5 winning projects and 5 special mentions were selected due to the high standard of the works presented and to the fact that all the projects represented excellent solutions able to synthesize the complexity and diversity that characterizes the sustainability issue.

For this reason, the Jury deemed it appropriate to award the prize to several works which, as a whole, emphasize the diversity of the project themes and singularly, represent, in each case, the most suitable solution, showing how each project requires a customized approach.

This is also expressed in the Jury report through the Chairman, the internationally famous architect Prof. Thomas Herzog "All projects have, among their characteristics, pioneering aspects".

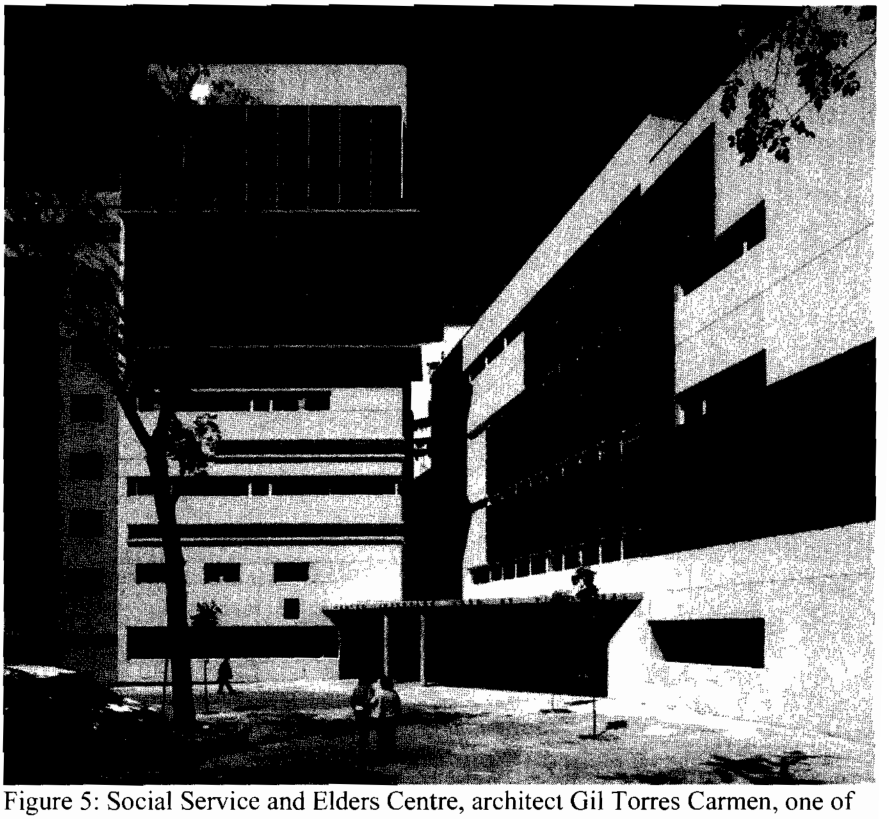

Figure 5: Social Service and Elders Centre, architect Gil Torres Carmen, one of the five winning projects selected by the 2008 Jury.

5 An Internationally Renowned Award

In 2009, under the guidance of Prof. Thomas Herzog, Jury Chairman for the second year, the Prize reached great popularity, being one of the most important competition for sustainable architecture in Europe.

Even the Jury had an international look, due to the presence of famous professionals such as Sir Micheal Hopkins (from UK) and Françoise Hélène Jourda (from France) currently, among the most important "green architects" of the world.

Figure 6: From right to left, Prof. Thomas Herzog, Sir Michael Hopkins, Prof. Françoise Hélène Jourda, Arch. Nicola Marzot and Arch. Gianluca Minguzzi: the Jury of the 2009 Award.

In this sixth competition, after many sessions the Jury unanimously chose 6 projects out of 61 coming from 19 countries worldwide to put on the candidate list for the prize or the honorable mentions.

All of them had a high architectural level and contributed to the scope of the International Prize for Sustainable Architecture in very different ways.

So the Jury decided to award these projects, and also to select another 13 completed projects (included in the final shortlist) worthy of mention for particular interesting aspects.

For the degree thesis division it was decided to award special mention to 4 degree thesis works.

All of the projects which have been awarded a mention have developed certain significant aspects in relation to their different functional typology that as a whole make an interesting contribution to the subject of sustainability. The winner of this important edition was the Simone Solinas and Gabriel Verd project "26 social housing dwellings in Umbrete" (Seville, Spain). The Spanish residential complex represents a significant response to that challenge.

The excellent result of the design process undertaken by the architects has found just the right compromise between the countless overall aspects that influence the realization of building work. Issues connected with the setting (climatic, town-planning, cultural), technological problems, energy assessments and economic balance were harmonized.

6 Shigeru Ban Project

During the built up phase of the first years the contributions understandably came mainly from Central Europe. This fact has changed considerably: in 2010 there was material from all over the world, varying in characteristic, size and use.

Part of the reason could be the high level jury of internationally renowned architects. It guaranties a changing individual understanding of architecture every year. They take into consideration different regional and cultural views which show important development and qualities.

Compared to the previous years, in 2010 there was an enormous difference in the student contributions. An ongoing change in the universities can be clearly felt. Whereas in the past, sustainability and the use of environmental energies played only a secondary role, and was not taken on by the faculties' best design chairs, this year for the first time we had a remarkable range of complex, high level contributions.

The winner of this edition was a Kyeong Sik Yoon-Shigeru Ban project for a new golf club-house in Seoul, South Korea. The project makes a valid contribution to the development of new uses for wood in construction. The building system provides an integrated solution to the many different functional requisites, while at the same time meeting static, architectural and technical systems criteria.

The wooden structure supports the building envelope, providing good natural and artificial lighting of the interior and creating channels for natural air movement. The essential, elegant structure illuminates and colours the inside of the building, defining the atmosphere of the spaces and the architectural identity.

Figure 7: Haesley Nine Bridges Club House by Kyeong Sik Yoon + Shigeru Ban 2010 prize winner.

7 Contemporary Sustainability Concepts

7.1 Traditional materials and new technologies

The clubhouse awarded in 2010 designed by Shigeru Ban and Kyeong Sik Yoon could be an example of how we can improve the way of using traditional materials in new, more efficient ways. The building, located near Seoul, is composed of three buildings. One of these, the regular members' clubhouse, has a wooden hexagon grid shell on the roof. This ecological and natural ventilated concept of hexagon pattern occurred from Korean traditional summertime pillow (called "the bamboo wife").

This wooden structure is fire-resistant and the roof and columns are exposed in the interior spaces. Using the most advanced computers and cutting machines technology the designers were able to find the most efficient structural form and minimized the assembling process and quantity of timber.

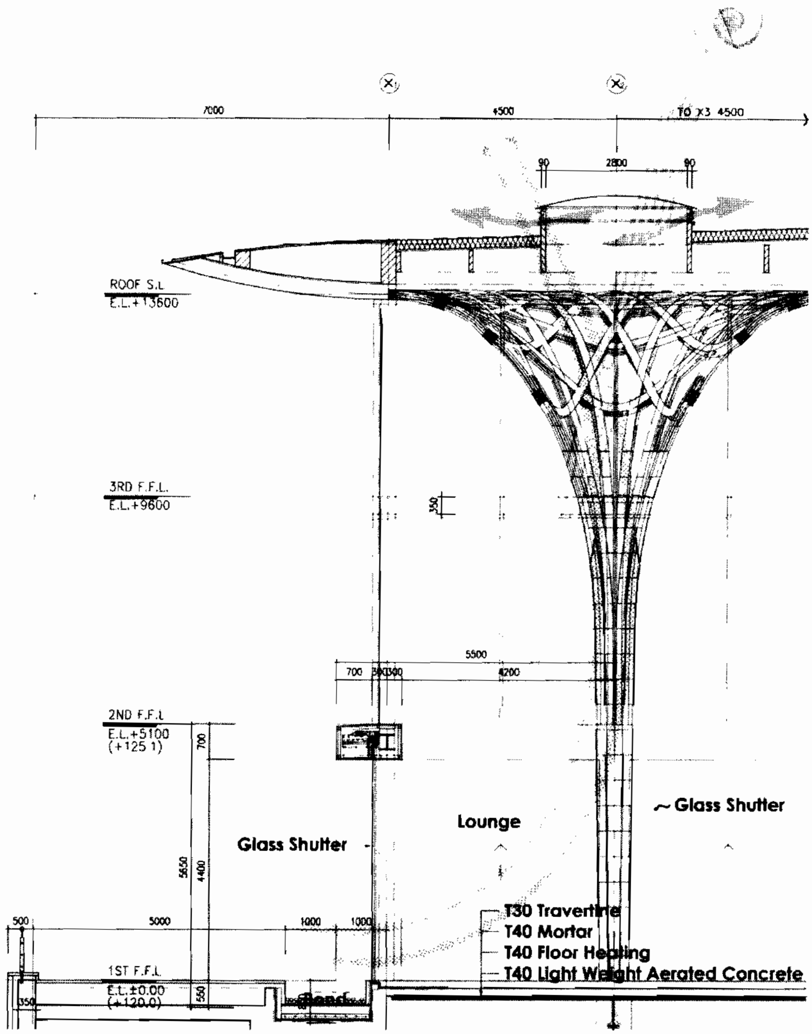

Figure 8: Haesley Nine Bridges Club-House by Kyeong Sik Yoon + Shigeru Ban natural lighting and ventilation, a remarkable example of traditional materials and new technologies

Although the design was developed through innovative research, it's based on practical principles. these result from careful analysis of the points of reference to the local building tradition. Beyond of its uniqueness, the project therefore reflects some aspects of local traditional architecture.

This development of a new timber structural system will encourage architects, engineers and clients to utilize traditional materials such as wood in future sustainable buildings.

7.2 Social housing projects

The need to construct efficient and architecturally high quality buildings under stringent economic working conditions is a major challenge for the building sector today.

For example, in the above mentioned Solinas-Verd 2009 awarded project, the dwelling units inside the developed area are delineated according to a very simple, clear and functional plan. This simplicity is accompanied by a division of the space that generates a measured sequence of solid and void, which defines the interaction between the internal and external dwelling space in a functional way. It does this both in terms of use and in a bioclimatic sense, resulting in a high complexity of relationships.

In Umbrete, the perimeter of the area is occupied by the system of buildings in such a way that it forms a city block with compact frontages. This gives a feeling of unity, of interaction with the urban fabric and harmonious coexistence in terms of scale and proportion with the surrounding examples of conventional domestic architecture.

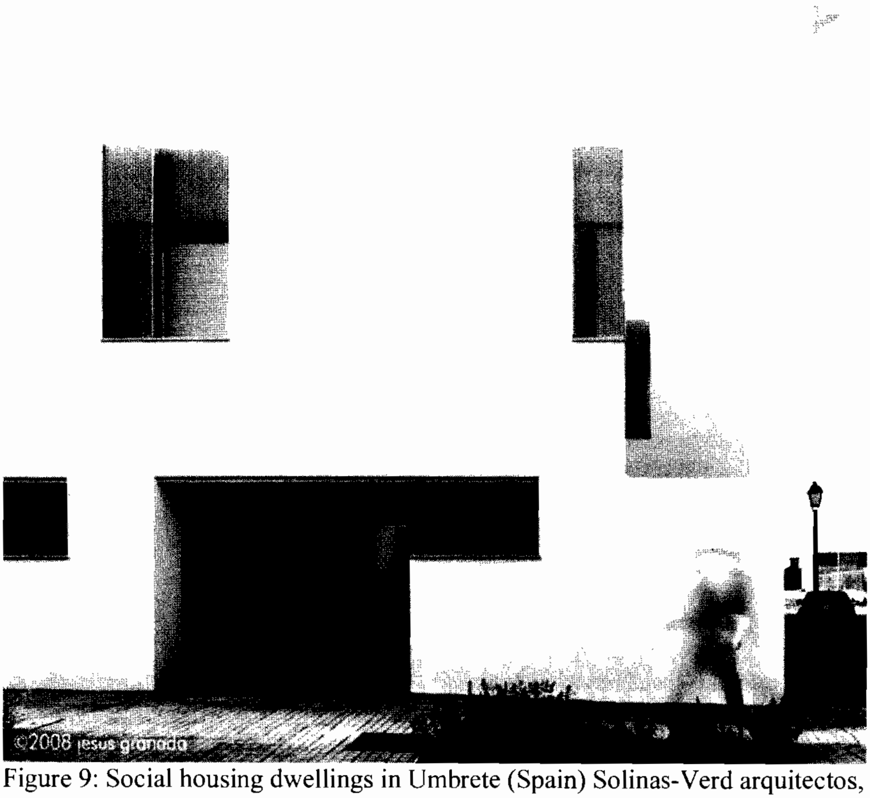

Figure 9: Social housing dwellings in Umbrete (Spain) Solinas-Verd arquitectos, winner of the 2009 competition.

The arrangement of the rooms thus creates an architecturally interesting spatial organization, which is also ideal for generating efficient natural cross ventilation and adequate shading of the openings in the summer. The latter is achieved through precise control of the seasonal variation in the angle of incidence of solar radiation at this latitude, thereby avoiding the risk of overheating.

The preference for extreme constructional simplicity and the use of materials well known to local workmen also meant that a quality constructional level has been reached which is very affordable.

7.3 Affordable projects

Another big issue is making the housing projects for the neediest classes of our society working. This problem has always been difficult to resolve, especially in the poorest regions of our planet. The social housing project in Iquique (Chile) by ELEMENTAL, awarded with a special mention in 2009 edition of the Prize, is one possible specific approach for tackling this emergency.

The principle that has been adopted is one of using the limited available budget to build the minimum living spaces for each household, fitting them out with the structures and services that only a specialized firm can do. This basic work has been conceived as a minimum structure featuring alternating solid and void functional spaces. They are designed to provide a support for subsequent extension, although within a well-defined layout which ensure controlled expansion of development.

Therefore the construction layout approach manages to offer the actual owners the best conditions for extending the dwelling units. This can be done in the times and ways according to each one's needs with low-cost self-help housing systems and in all safety.

The project fulfils the idea of social housing that can appreciably increase its value over the years with minimum investment. The architecture is not used as a formal justification, but as a tool and a useful resource to help overcome poverty and extreme social inequality. It does so without forgoing a recognizable, elegant, modernist heritage enriched by the spontaneous process of progressive saturation of the voids.

The work therefore emphasizes the ethical importance of the architecture in a period when the image often prevails over the substance, and the social function, of the architect's professional services.

Figure 10: affordable housing in Iquique, Chile, by Elemental, an example of a house expanded by local resident.

7.4 The importance of the local context

But even projects bearing an humble background, such as the project for a new school in Africa, perfectly represent a suitable direction in order to have sustainable buildings. For example the work of Kerè-Architecture, an high-school building in Dano, Burkina Faso, answers the need to enlarge an existing school complex in a small African town. The design philosophy guides the construction process towards a building that truly belongs to the place.

This is achieved through the use of materials that are available on the spot, plus operating strategies that are calibrated according to an analysis of the local microclimate. It is a basic design, providing a comprehensive answer to a need for functional spaces in conditions of poverty, and with few means available. Such aspects are also clearly explained and documented in the presentation of the work.

The roofing framework is made with modular lattice elements consisting of iron bars welded on the spot and assembled in situ. Inside, a convex ceiling with white paint distributes the light into the classrooms. Meanwhile crosswise slits communicate with the outside to provide efficient natural ventilation of the rooms helped by shuttered openings arranged along the walls.

Throughout the entire construction process, local workmen were trained to use new techniques. This ensured that they learned building methods seen as precious knowledge to be used for the future construction of other buildings for the local community. These techniques will be handed down to future generations.

Figure 11&12: self construction, a school in Dano, Burkina Faso, by Keré Architecture. Special mention project in 2009 competition

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Participants

Scientific Committee Co-Chairs

Steffen Lehmann, University of Newcastle, Australia
Husam Al Waer, The University of Dundee, UK
Jamal Al-Qawasmi, CSAAR, Jordan

International Scientific Committee

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Fodil Fadli, University of Liverpool, UK
Francisco Serdoura, FAUTL, Portugal

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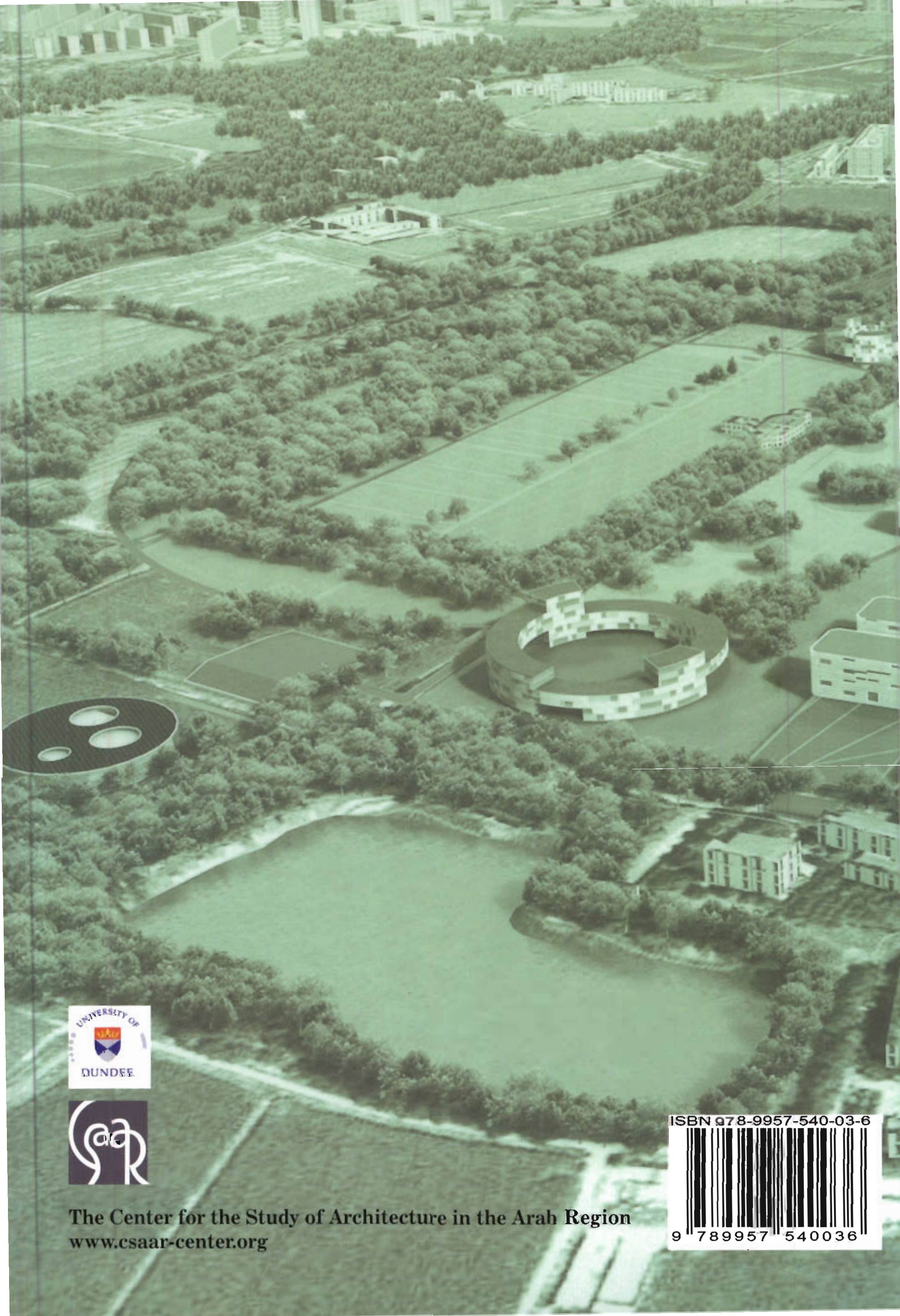

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