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CONTENTS

EDITORS' NOTE

The Journal of Research in Architecture and Planning has treaded into the eleventh year of its publication. Few changes have been introduced in the organization and production of the journal. From 2011, the publication has been made bi-annual with one thematic and the other as a general volume. The present issue is based upon papers belonging to the theme of sustainable built environment.

Sustainability has become one of the most deliberated topics during the contemporary times. From natural resources to ingredients in built environment, several serious explorations have been initiated to find answers to some of the lingering problems. Striking the rational balance between preserving resources and thier gainful exploitation; from modifying existing practices in re-use and re-cycling to the discovery of new methods of harnessing resources and from responding to ever intensifying challenge of evolving consumer life styles to resorting to lobbying and motivation for using less of precious assets, constitute few of the core matters that need universal attention. This issue of the journal is a small effort in that direcion.

Inventory based explorations into a designated built environment generates useful results around a finite scope. The paper by Farhan Fazli delves deep into the historic places in Himalayan region in India to outline the characteristics of houses with traditional construction. Seismic variables, which are perhaps an important ingredient in this challenging milieu, are made the baseline of fact finding. Sound documentation and field research make this paper a significant contribution to knowledge in this area. Another useful article by Amanda Rajapakse from Sri Lanka addresses the Galle Fort site. It focuses on typological perspectives in this outstanding historical setting. Through analysis of findings of original field results, the author questions the status of some of the conservation practices adopted in Galle which is a designated heritage precinct. The case review of Islamabad – the once controversially chosen capital city of Pakistan by Ahmed Zaib - helps reflect on the founding ideas and contemporary reference to the city. The author examines the city across the yardstick of sustainability and generates some very insightful learnings outcomes. A conscious probe into the merits of practical techniques in clientele adjustment by Arif Kamal helps the readers appreciate the old cooling systems incorporated in traditional structures in yester years. In a methodical manner, the author raises an intellectual challenge for the so called modern electro mechanical devices used for the same purpose. And finally, the paper by Nomana Anjum unveils a mini treatise on the experience of instituting environmental design education in a university in Pakistan. The author takes us down the ebbs and flows of this programme with a tinge of introspection and analysis.

The journal contains a pithy review of a monograph on Lahore by William Golver by Sarwat Viqar.

Editorial Board

SUSTAINABLE CONSERVATION OF URBAN TOWN HOUSES IN THE HERITAGE SITE OF GALLE FORT IN SRI LANKA

*Amanda Rajapakse**

ABSTRACT

Sustainable conservation of heritage sites contributes to sustainable built environments in a city. Conservation should maintain the integrity of the physical place with social equity and environmental soundness in order to be a sustainable conservation endeavor. Efforts should go beyond conserving the façade of buildings of heritage value but sustain the embedded social needs of the occupying society.

The study focuses on the heritage site of Galle Fort in Sri Lanka to establish the importance of a sustainable conservation effort that maintains the authentic physical definitions of the place, while accommodating the transforming societal needs within an environmentally sound urban context

Galle Fort was declared a UNESCO world heritage site in 1988 for its unique physical definition and social significance as a living city. It is an outstanding example of an urban ensemble, which illustrates the interaction of European architecture and South Asian traditions from the 16th to the 19th centuries. The "town houses" (attached street fronting houses) within the grid network of streets, form a larger percentage of the built fabric of the Fort and establishes a distinct identity that strengthens the heritage value of Galle Fort.

The heritage value of the town houses goes beyond the surface/ facade of their physical identity. As a living city, the historic layers represent both the physical and social evolution.

The study firstly identifies physical typological characteristics of the town houses that represent authentic spatial definitions. Thereafter, four town houses are presented in detail as cases, to identify the existing spatial definitions to trace the authentic spatial characteristics embedded within and the social context and functional needs of users represented through the evolved physical definitions. Subsequently, the study suggests spatial principles that will sustain the authentic physical definitions while fulfilling the functional needs of the inhabitants within a habitable context (climatically responsive).

The study establishes that sustaining the habitability of the town houses with temporal changes inevitable with changing societal needs is paramount in conserving this living heritage city for posterity, enabling a sustainable built environment that is physically, socially and environmentally appropriate.

1. INTRODUCTION

"Sustainable conservation" of heritage sites should be a prime focus in enabling sustainable built environments in a city. In living[1] heritage sites this becomes a complex task which involves not only retaining the physical character of the historic built fabric, but recognizing the social history of the place and its transformative effect on the physical definition. Recognition of the co-relation between these two forces enables to maintain the authenticity and integrity of places of heritage value.

The term "authenticity" of heritage sites has been defined in many ways to establish the idea as the ability of a property to convey its significance (physical) over time and "integrity" as the ability of a property to sustain its significance over time (Stovel, 2007), which are rather broad and open ended definitions focusing specifically on the physical significance of the place.[2] Although "authenticity" can be used to convey the same meaning, "integrity" becomes more important

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1 *"Living heritage" has been defined in many ways as a socially constructed notion that is represented in both tangible (physical representation in built form) and intangible form (as collection of practices, traditions, expressions, skills, and knowledge that are passed from one generation to the next). What is meant here is a place of heritage value where people reside, representing the evolution of their functional as well as socio-cultural needs in physical built form.*

2 *The World Heritage Operational Guideline tests authenticity based on the parameters of design, materials, workmanship, setting etc. Authenticity is also defined in the NARA document.*

within the context of a living heritage site. In this context, "integrity" could be interpreted as sustaining the key features of the physical identity of the built fabric (which is undergoing a dynamic process of successive transformations) while accommodating the evolving society and their needs that require representation in physical form. The evolved built fabric and the community that occupies them together unfold the story of the place; at the retaining and giving new meaning to the identity of the place.

Conservation of heritage sites should maintain the integrity of the physical place with social equity and environmental soundness in order to be a sustainable conservation endeavor. Many conservation efforts on heritage sites concentrate on maintaining the physical authenticity through "beautification" of buildings (Boussaa, 2010) especially in terms of conserving the "façade" with lesser emphasis on sustaining the social life of the place. This has resulted in ad-hoc development and rundown areas in the internal spatial definitions beyond the façade, especially in residential quarters of heritage sites. While disturbing the authenticity of the place, "conservation of the façade approach" compromises the habitability of spaces at the cost of environmental responses that promote healthy living. This study presents four town houses that characterize this transformation within the residential quarter of the heritage site of Galle Fort in Sri Lanka.

The Fort in the city of Galle is situated along the coastal belt in the southern province of Sri Lanka. It is believed to be the largest surviving fortified Dutch colonial city outside Europe and one of the best examples of a fortified city built by the Europeans in South and South East Asia.[3]

Galle Fort was declared a UNESCO world heritage site in 1988 for its unique physical definition and social significance as a living city. It is an outstanding example of an urban ensemble, which illustrates the interaction of European architecture and South Asian traditions from the 16th to the 19th centuries.[4] *The physical heritage left behind in Galle is primarily the work of the Dutch during approximately 150 years of rule from around 1640 to 1796. The fort is approximately 40 hectares in extent and is divided into sectors based on the standard grid iron pattern of streets established in Dutch colonized cities of Asia (Figure 2).*

The distinct grid of streets defines the structure of Galle

Figure-1: Location map of Galle, Sri Lanka

Fort and apart from the military buildings, contains a built fabric primarily of three categories: residential (town houses), public (hospitals, administrative buildings) and religious (churches) (Paranavitana, 2005, p 72). The "town houses" form a larger percentage of the Forts built fabric and establishes a distinct identity within the street network that strengthens the heritage value of Galle Fort.

Over the past centuries, due to changing ethnicities, lifestyles and needs of inhabitants of the Fort, the spatial definition of town houses both the external facade as well as internal spaces have transformed considerably. The physical additions made by the occupants to the town houses in response to the evolving functional needs have greatly compromised the habitability of the internal spaces at the cost of environmental responses that promote healthy living. The alterations do not follow proper guidelines or building regulations (Manawadu, 2009). Difficulty in obtaining statutory approvals for improvements to old houses compelled the occupants to do illegal constructions that violate basic light and ventilation regulations. This has affected the authentic characteristics of the town houses posing a major challenge in conservation efforts in terms of the limit of intervention needed.

3 *The history of the physical development of Galle commenced when the Portuguese built a small fort in 1589. Considerable physical changes were imposed to Galle after the Dutch took over the coastal areas in 1640 and built massive ramparts and fortifications in early 1660s.*
4 *http://whc.unesco.org/archive/periodicreporting/apa/cycle01/section2/451.pdf (retrieved on 18th August 2011).*

Figure-2: Structure of Galle Fort - grid pattern of streets.
Source-1: Google map (imagery date - 07/18/2009). Source-2: Centre for Heritage and Cultural Studies, University of Moratuwa, Sri Lanka.

1.1 Architecture of the "town house" in Galle Fort

What makes the Galle Fort a distinct monument is not necessarily its 300 year old fortifications, but its urban landscape formed by the grid system of streets and unique street architecture of the town houses (Bandaranayake, 1990).

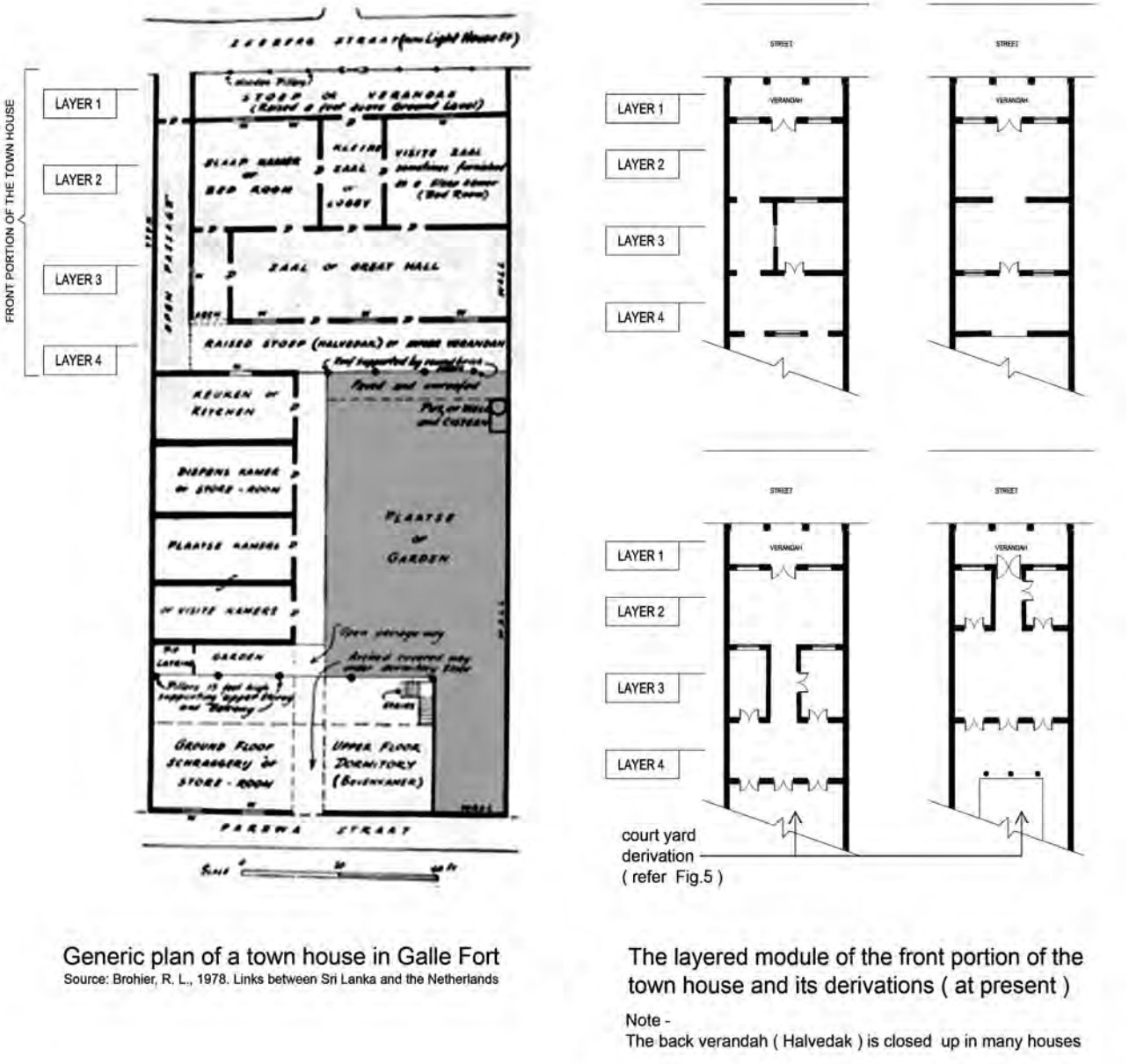
The morphology of Galle Fort signifies a primary response of the buildings to the street. Specifically the town houses have a frontage to the street in order to increase their commercial value. To accommodate more houses along the street, the frontage is narrow while having a deeper plot perpendicular to the street expressing a fairly dense urban character.

What is generally referred to as "Dutch town houses in Galle Fort" have a complex history. These houses have typical characteristics of Sri Lankan vernacular architecture of the maritime region in the 18th and 19th centuries (Bandaranayake, 1990). Culturally, the town houses evolved with the combination of Asian and European concepts, incorporating available technologies to suit the environmental conditions of this tropical country and lifestyle and social conceptions of the occupants. It is not considered authentic Dutch but a hybrid form of domestic architecture, built by local craftsmen based on the knowledge of migrant Dutch, denoting a unique style of architecture of dual parentage. The town houses have a simple functional and structural framework that has the ability to transform and adjust to accommodate sensibilities that respond to evolving humanistic needs and local cultural conditions.

The mainly narrow and deep plots of the town houses have a generic layered module in the spatial and functional organization[5] (Figure 3). The front verandah (Stoep)[6] which forms the first layer and the edge to the street has greatly contributed to the identity of this type of domestic architecture and could be defined as one of the authentic spatial definitions of the town house (Figure 4).

5 *Some distinct elements identified in a typical Dutch Town House abutting a street are;*
Stoep (front verandah), Klein Zaal (lobby) which could consist of one or two rooms on either side, Zaal (Great hall), Zolder (attic - above the Zaal)
Halve dak (back verandah) so called because only half the paved area is covered by roof
Plaatse (Courtyard – paved compound), Slaap Kamer (Bed rooms)
Visite Kamers (Visitors' rooms), Plaatse Kamer (handy room used for different purposes)
Keuken (Kitchen), Dispens Kamers (Store room), Well – usually in the Plaatse
Lavatory. Service oriented spaces like the kitchen and lavatory are zoned towards the rear of the site (Brohier 1978).

6 *Many early paintings on Dutch town houses do not show the colonnaded verandah which suggests that this may have been a later addition after 1750's.*



Generic plan of a town house in Galle Fort
Source: Brohier, R. L., 1978. Links between Sri Lanka and the Netherlands

The layered module of the front portion of the town house and its derivations (at present)

Note -
The back verandah (Halvedak) is closed up in many houses

Figure-3: Layerd module of the front portion of the town house and its derivations that represent the authentic spatial definitions of the town house. Source: Author

There is a definite pattern in the arrangement and relationship between the Stoep (front verandah), Klein Zaal (lobby), the Zaal (great hall) and the Halvedak (back verandah) of the town house, which form the first three to four layers as family living spaces (Figure 3). Lewcock (1998) describes a typical plan of a Dutch house as having central doorway from the verandah which leads to a central square hallway from which open two rooms on either side. The central hallway connects to the main living space which stretches transversely across the plan. As represented in Brohier's (1978) drawing and in many town houses at present, a back verandah faces the great hall which opens to a courtyard. Many Dutch period town houses are a derivation of this layered module with minor changes in the combination of them.

Figure-4: Verandah fronted town houses.
Source: Author

The strength in the spatial definition of the street house is in the linearity along the depth of the plot. This encourages a winged definition in establishing rooms which give a sense of continuity in the spatial experience, compensating for its narrowness. The layered definition encourages this sequenced spatial experience.

Towards the centre of the plot is a courtyard (at times two) which not only provides light and ventilation to the town house but has shaped the other functional spaces around, giving it identity and definition. It represents one of the authentic spatial definitions of the town house. Pulhan (2008) states that the concept of the courtyard has meaning in delighting the senses, providing a different degree of accessibility, giving climatic comfort while having social centrality. As established in many cultural contexts, their significance is varied as practical, functional, spatial, visual, climatic, social and/or cultural. This generic type of planning with courtyards, offers the possibility of very dense urbanization and the maximum use of urban land where it is a responsive typology to low rise high density urban housing (Ozkan, 2006).

In the context of the town house in Galle, the courtyard takes a variety of shapes taking a prominent place in space definition and the possibility of functional zoning. More private spaces (bedrooms) are organized around or along the courtyard. This quiet, interior courtyard is the space around which the domestic life of the family revolved. At present, these courtyards are heavily fragmented and encroached upon.

Based on the courtyard definition, the generic plan of the town house has a typology as follows (Figure 5).[7]

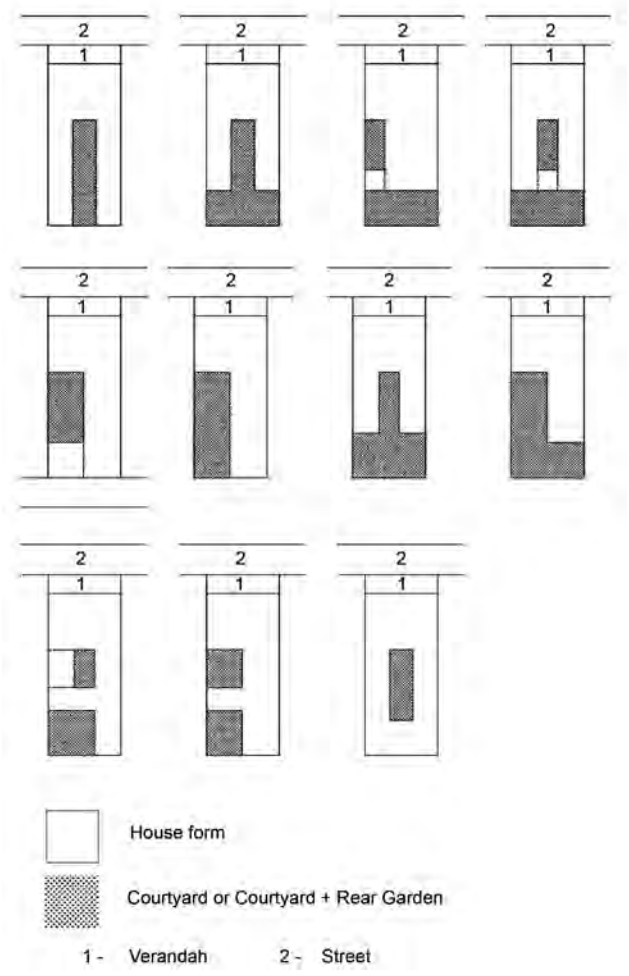


Figure-5: Typology of the generic plan of the town house based on the courtyard definition.
Source: Author

7 *This typology is extracted from the measured drawings done of the 55 houses undertaken for conservation by the CHCS University of Moratuwa.*

The houses appear to be built with the primary intension of function, social accommodation and environmental appropriateness grounded in the local context. The aesthetic intent is an amalgamation of the above factors and assumes a secondary place. It is not pretentious but a natural extension of the functional definition in an environmentally sound context.

Rapoport (1969) states that houses built in this domestic tradition not only fulfilled the functional requirements, but provided protection and comfort from the environmental elements as heat and rain, providing adequate light and ventilation. The built forms had the ability of dealing with climatic problems with the use of minimum resources for maximum comfort.

In the context of the town house, the verandah is primarily a climatic response to rain and solar heat. It protects the inner living areas from the beating rain and solar heat of the tropical wet and humid climate.[8] It also screens off the intermediate space between the public street and more private living rooms.

Several additional features were used to counteract the negative effects of the warm humid climate of Galle, to neutralize the escalation of these affects within a dense and compact built formation.

a) *The layered arrangement along the depth of the plot with verandahs on either side enabled cooler air into the mid spatial layers. The open geometry of the town house plan enabled air flow and cross ventilation (Hyde, 2000).*
b) *The long narrow geometry facing the courtyard encouraged ventilation by inhaling cooler air into the facing rooms.*
c) *The large windows and thick walls insulated the internal spaces.*
d) *The central or side courtyard (at times two courtyards) utilized air movement through convection for comfort and encouraged natural ventilation in a densely built environment.*
e) *High roofs with a roof angle of not less than 30 degrees, with clay tiles as roofing materials left the place cool. The large roofs and deep overhangs extending to verandahs, protected the spaces against both sun and rain, while allowing ventilation during rain.*

1.2 The Evolving Social Context of Galle Fort

The living history of Galle Fort is embedded within the social and physical fabric of the place. The urbanscape represents the underlying social processes within the locality. The evolution and transformation of the physical layers of the town houses best exemplifies this point. Rapoport (1969) states that the house form is not simply the result of physical forces or any single causal factor, but is the consequence of a whole range of socio-cultural factors seen in their broadest terms.

Building a house is accepted as a cultural phenomenon and thus its form and organization is greatly influenced by the cultural milieu to which it belongs.

The evolution and transformation of the town house in Galle has taken place with the chronological occupation of people of varying ethnicities as the Dutch, occupants during British rule and later the Muslim and Sinhalese population (during late British rule). Spaces have been re-adapted and transformed to fulfill many functional and socio-cultural requirements of the ethnicity of the subsequent occupants As is very natural and accepted, the occupants have altered the external and internal spaces of the town houses according to existing opportunities, constrains and social practices.

Considering the definition of the authentic Dutch town house, aspects of Dutch culture could be recognised in the ordering of residential buildings. The Dutch houses depict a living pattern related to the street. The interface of the houses encourage social interaction. As described by Cordiner (1807) the verandah (stoep) facing the street functioned as the main social space. It was not only a space for relaxation during different times of the day, but also the space from where they communicated with adjoining neighbours as well as those across the street. Many descriptions of the social life along the verandahs of the Dutch houses reinforce the fact that they were used for interaction with neighbours and to entertain visitors and friends.[9] Although a hybrid element in terms of architecture, it supported the social life of the Dutch which was later established as a significant

8 *The climate of Galle is generally humid with heavy rainfall, relatively moderate temperatures with little seasonal variation, and strong solar radiation.*
9 *As described by Cordiner (1807; p31) the veranda (stoep) facing the street functioned as the main social space. It was more than a space for relaxation during different times of the day. "The veranda which is separated from the street below by a wooden railing which in addition to its legitimate purpose was often used by the inmates as an arm-rest while indulging in long conversations with the neighbour across the road. And in the evening hours, at which time the streets were daily watered and the air cooled after the burning heat of the day the younger ladies displayed their pretty little fingers in the verandah/ stoep of their parental home".*

component in the identity of Dutch town houses in the colonised towns of Sri Lanka. This contributed to the identity and sense of place in the residential quarters.

According to Al Sayyad (2009) as cited in Kingston (2009), urban adaptations of building types of a mixture of local and foreign cultures (hybrid forms of domestic architecture) are transitional as the cultural experiences within the form. Particularly among colonized cultures like in the case of Galle, where the Dutch occupied town houses were later occupied by the Muslim and Sinhalese population, the patterns of human adjustment are discernible which are represented as hybridized forms or additions.

The social significance of the verandah diminished when the Muslim population took occupation of the town houses. When ownership of land was obtained by the Muslim trading population during the latter part of British rule, drastic spatial changes were made to suit their cultural conceptions. The layered and simple yet aesthetically and environmentally pleasing spatial definition allowed easy adaptation and modification.

The social requirements of the Muslim community express a need for privacy for the women of the house away from the public eye. The verandah which was a significant element in the identity of the town houses was partially enclosed with timber and cement screens for privacy needs of Muslim families. With the passage of time, many verandahs were completely closed up, taking away one of the main authentic spatial definitions of the town house, changing the first layer of space of the town house. This altered the life and character of the streets to a considerable degree.

The authentic spatial definitions of the courtyard have been retained in many town houses; although reduced in size and at times compartmentalized. Adapting to the inner layers of spaces of the Dutch town house may have not been difficult as the courtyards were spatial entities around which communal activities especially conducted by the women were organized. The courtyards along with the internal verandahs of the house may have provided a safe haven away from the public eye to accommodate the needs of the Muslim community (Figure 6).

The changing functional needs of the community at present (need for more bedrooms, attached toilets, pantries) have been accommodated by building in the courtyard and rear garden spaces as the only spaces that could be encroached upon for further expansion.

Figure-6: Verandahs of the town houses enclosed with timber screens. Source: Author

1.3 Deterioration of the Spatial, Functional and Environmental Definition of the Town House

Changing socio cultural needs of the occupants of predominantly Muslim ethnicity and Sinhalese population transformed the spatial, functional and environmental definition of the town house. The two most significant elements of the physical authenticity of the town house that were affected were:

1. The street fronting verandah
2. The internal courtyard/ yards

The unique architecture of the town houses deteriorated further during the latter part of the British and post Independence periods. Post independence landuse policies and usage of facilities within the fort brought with it an irreversible damage to the built fabric of the Fort. The

insurgency in 1971 worsened the situation accelerating the deterioration (Manawadu, 2009). There was an apparent loss of character in the building envelope and in the internal planning of these town houses due to the ad-hoc expansions and changes made to the houses by the occupants. Above the loss of authenticity of the spatial definitions of the town houses, the physical intrusions compromised basic habitability needs, as daylight and ventilation needed for healthy living.

1.4 Conservation Objectives Related to the Town Houses

The acquired status as a World Heritage site in 1988 by UNESCO, encouraged conservation efforts on Galle Fort. Several attempts are made to conserve the historic urban landscape of the Fort since 2007, specifically to restore the town houses. Building regulations of the Urban Development Authority, conservation regulations imposed by the Galle Heritage Foundation and legal jurisdictions of the Antiquities Ordinance are used as tools for the proposals. The Government of Netherlands has been the most outstanding donor in the conservation efforts. The Centre for Heritage and Cultural Studies (CHCS) of University of Moratuwa provided technical assistance as Consultants and the Galle Heritage Foundation (GHF) the implementing authority (Manawadu, 2009).

Fifty five town houses were selected for this programme. Selection was based on the consensus of the occupants on the conservation objectives and proposals.[10] The main objective of conservation was to preserve the outer envelope of the building to sympathize with the surrounding streetscape. This was to be achieved mainly through re-introduction of the front verandah which was one of the most important elements of the town house architecture of the Fort of Galle.[11] Restoration of the roof was also done, where rescue conservation was needed.

The interior spaces of the houses were left to be altered by the occupants to suit their modern day requirements. Above the negative trend of development that was already taking place within the residential quarter of Galle Fort, this decision imposed further negative consequences on the integrity of the place.

1.5 The Study

The study presents four houses conserved by the GHF that exemplify the main generic types most common in the residential quarter of Galle Fort. The study traces;

a) The existing spatial definition of the town houses to comprehend the authentic spatial layers embedded within, that conforms to one of the generic spatial types introduced initially.

b) The existing social context within the town houses and functional needs of the users represented through physical definitions.

c) Through the understanding of the background of the spatial and social layers of the town houses, the study looks at the basic climatic and habitable responses (need of light and ventilation) to suggest alternatives to enable more physically, socially and climatically sustainable dwellings that conform to the authentic definitions of the town house.

2. ANALYSIS OF THE SELECTED HOUSES

2.1 No. 52, Leyn Baan Street:

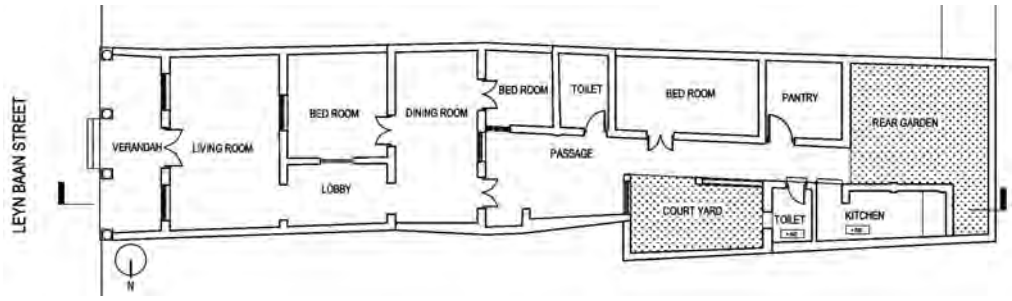
Figure-7: Restored column fronted verandah of No. 52, Leyn Baan Street. Source: Author

10 Prior to the conservation efforts, the occupants of the town houses were educated through various programmes organised by the Galle Heritage Foundation to take their own decision on whether to consent to the conservation method proposed for the respective houses.

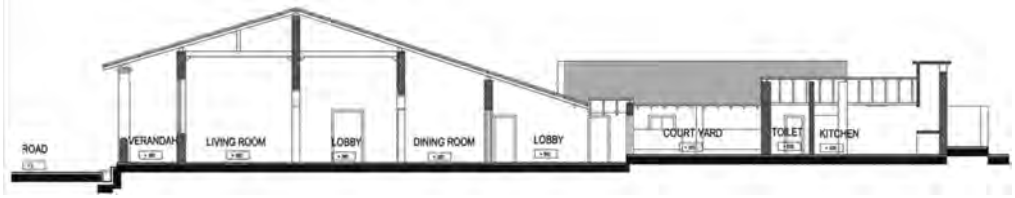
11 During the course of conservation, many masonry columns that were embedded within the enclosed walls of the verandahs of town houses were re-surfaced. These masonry columns may have been constructed during the British periods and embedded under layers of renovations and reconstruction

A Muslim family of five occupies this house and according to the head of the family, they have been occupying the house for generations. The special layout of the house represents their present functional needs.

The plot has a 7m wide street frontage and is 33m deep. The jagged edge in plan form of the plot suggests that it might be a fragmented half of a house which was subdivided along its length. The combined elevation of the town houses



Existing Floor Plan



Cross Section (Existing)

Figure-8& 8a: Existing floor plan and existing section of No. 52, Leyn Baan Street.
Source: Base plan from the CHCS, University of Moratuwa, Sri Lanka.

no 50 and 52 have one continuous roof with the same column spacing and detail. The house No 52 conforms to the generic "L" shaped single storied building with a courtyard along its length which has been modified by building on the courtyard. According to the Report from CHCS , parts of the house appear to be rebuilt or renovated within the last two decades, but no accurate information of the original building is revealed.

The street façade/ verandah has been restored in order to introduce the town house character as part of the conservation efforts of the GHF.

The footprint of the front four layers of space which are Stoep (front verandah), Klein Zaal (lobby), Zaal (Great hall), Halve dak (back verandah now closed up as a dining space

Figure-9: Combined elevation of houses No. 52 (to the left) and 50, Leyn Baan Street.
Source: Author

with an extension of a lobby + passage in front) appear to be unchanged although reorganized.

The front layers are thermally comfortable as opposed to the modified and added spaces in the rear wing. The entire side wing along the courtyard is a recent construction. The rooms along the courtyard have no windows making the rooms dark, hot and also damp during rains.

The courtyard has been built on to add a kitchen and a toilet as additional needs of the household. Physical encroachment on to the courtyard as well as lack of openings in the bedrooms have compromised the level of natural light and ventilation that could be obtained to enable more livable spaces.

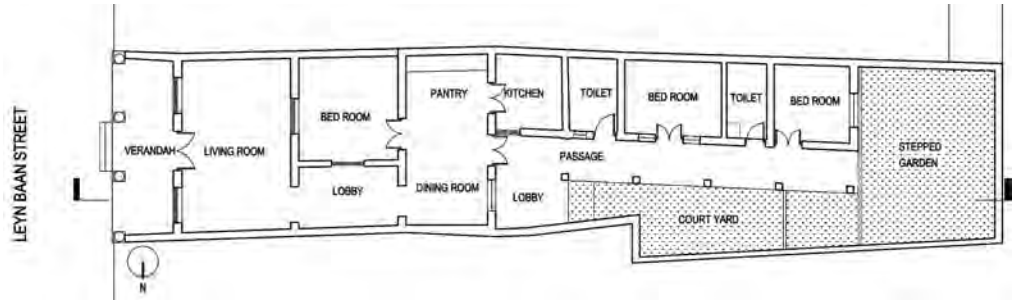
The modified spaces have been built with thinner walls, low roof heights, heat generating material such as asbestos for roofing, cement blocks for walls etc. contributing to a warmer temperature within the building.

The only garden space of this house is at the rear at an elevated height of approximately 0.6m and is used as a storage area for debris etc.

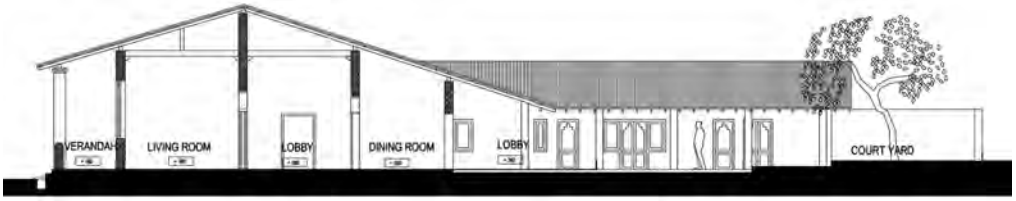
Suggested Physical Alterations

A simple demolition of the kitchen and toilet that is encroaching onto the courtyard enables to restore the authentic spatial definition of the town house while enabling a habitable environment within the house.

The spatial/ functional need is re-organised as shown in figure 10. The kitchen is shifted close to dining area for functional purposes. The side courtyard is extended to the stepped rear garden space. Combining the side courtyard with the rear garden space adds a larger green breathing space to the house that promotes uninterrupted air movement/ ventilation and better light to the spaces. The simple spatial definition along the side wing needs a roof of a comfortable height with an angle of at least 30 degree and a broader overhang that enables a more comfortable walkway/passage that shelters the facing rooms from rain and solar heat. Addition of windows to the rooms in the wing that faces the courtyard enables light into the interior making it more habitable.



Proposed Floor Plan



Cross Section (Proposed)

Figure-10&10a: Proposed plan and proposed section of No. 52, Leyn Baan Street.
Source: Author

2.2 No. 08, Small Cross Street:

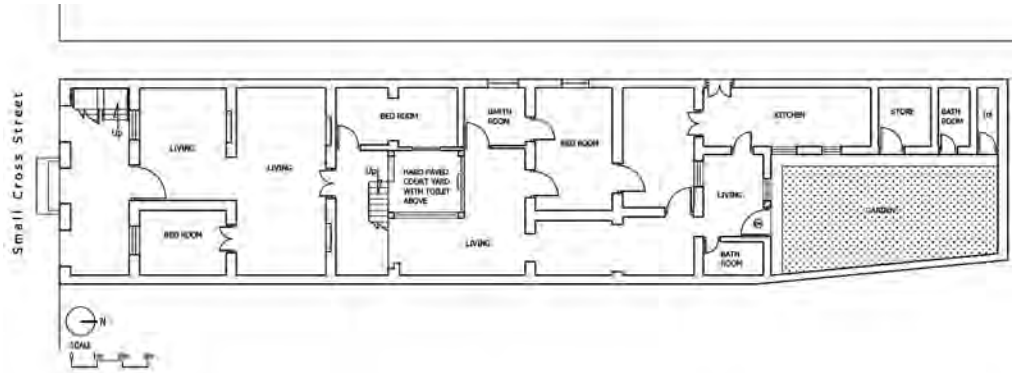
A Muslim family of four, (including 2 children) occupies this house. They run a family business by using the front portion (first 4 layers) of the ground and upper floor of the house as a guest house and café. Zoning the public functions away from the more private living areas was an essential functional need of the occupants

This house is on an 8m x 37m plot. The house has been modified extensively including the roof forms. It is difficult to predict the original generic layout of the house. What remains at present appears as a modified version of a "L" shaped building with a centre courtyard and rear garden that provides light and ventilation to the fronting spaces.

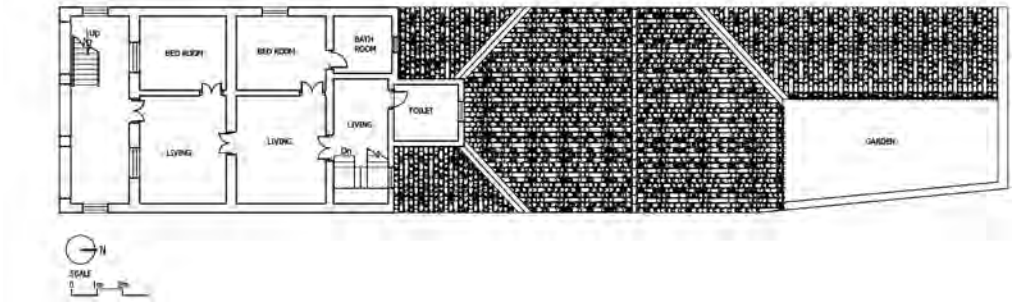
Space definition of the front four layers (verandah, lobby, great hall, back verandah) remain as per the generic/ authentic footprint of the town house. The upper level contains a spatial definition that follows the ground floor with access from both verandahs. The stairway in the front verandah appears to be a later addition to give access to the upper level which functions as a guest house. The spatial encroachment of a toilet built above the central court yard has blocked natural light and ventilation to the surrounding rooms.

The area fronting the rear garden space to the north blocked off with a bathroom and living room prevents a physical connection or cross ventilation through the two open spaces. The potential of using the rear garden space as a positive open area for the house is overlooked and left as a yard for storage (Figure 12). Many spaces are wasted purely for circulation. Demolition of the toilet built above the middle courtyard and enlarging the courtyard (conforming to regulations for daylight) provides better light and ventilation to surrounding spaces and conforms to the modified 'L" typology of the authentic space definition. Demolition of the bathroom/ toilet fronting the rear garden space to the north and opening out the enclosed living room as an open living area encourages better air movement improving the habitability of the house. The re arrangement (zoning) of functions enables more private living areas towards the rear of the site (Figure 13).

Figure-11: Street elevation of No. 08, Small Cross Street.

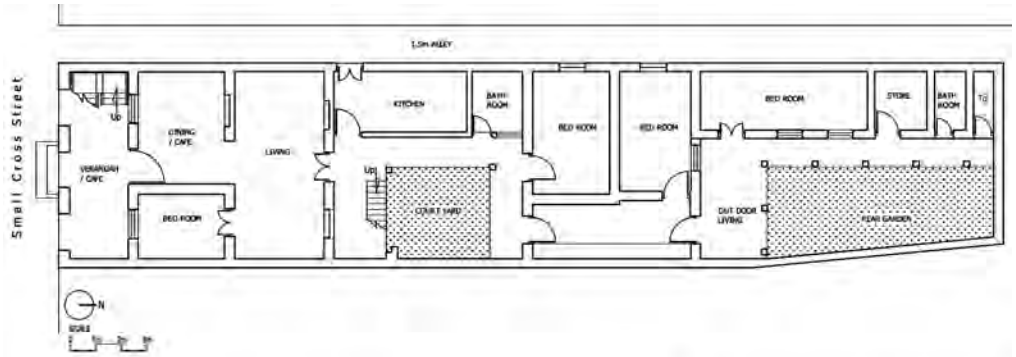


Existing Ground Floor Plan

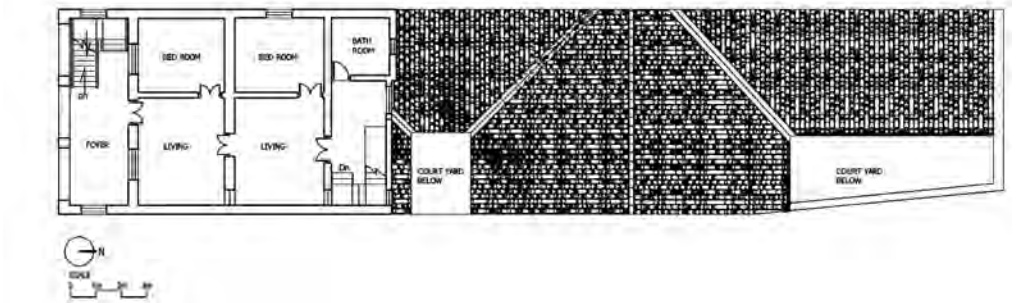


Existing First Floor Plan

Figure-12: Existing floor plans of No. 08, Small Cross Street.
Source: Base plan from the CHCS, University of Moratuwa, Sri Lanka.



Proposed Ground Floor Plan



Proposed First Floor Plan

Figure-13: Proposed plans of No. 08, Small Cross Street.
Source: Author

2.3 No. 43, Church Street:

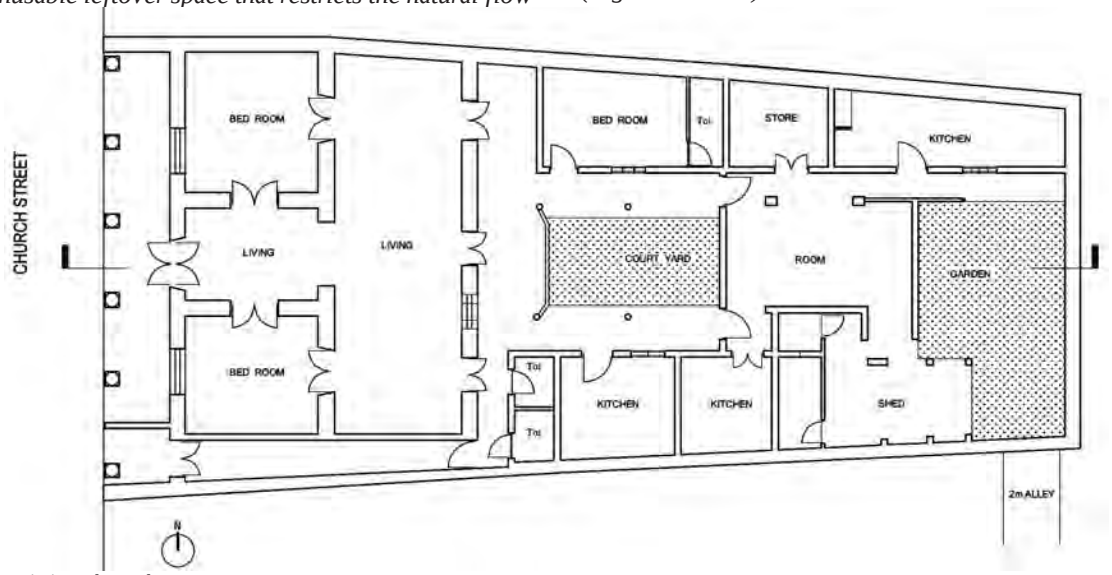
The occupants of the house are an old Muslim lady with a female assistant. The spatial and functional needs of the occupants are minimal.

This is a relatively wide plot of 16.5m X 35m. The house has a courtyard in the middle with two wings on either side. The embedded footprint appears as per a generic "U" shape house. (Existing rooms on either side and middle of the courtyard have been built at a later date).

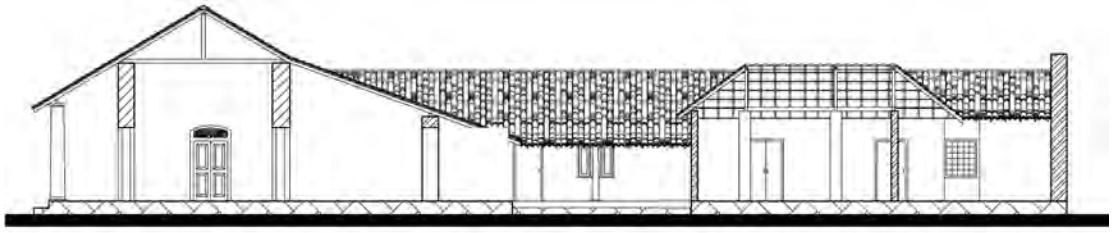
The two side wings are built of thin brick walls, incompatible door and window styles and low roof. As in many other houses, the four layers of spaces towards the front of the house are intact with thick walls resulting in a comfortable temperature.

The room built right in the middle of the courtyard is an empty space devoid of a specific function with blank walls to either side of the courtyard. This space fragments the courtyard and garden and disturbs the authentic spatial form. It is an unusable leftover space that restricts the natural flow of space along the length of the site. There are sheds added to the rear that are temporary in nature used as storage spaces. They are dilapidated structures that take away the possibility of using the original open space to enhance the livability of the place. Many lost and unused spaces (such as unused rooms/ toilets/ sheds) within the house unnecessarily rob the place of its authentic old world charm. No natural light and ventilation to some functional spaces (Figure 15&15a).

Figure-14: Restored Street Elevation of No. 43, Church Street.
Source: Author



Existing Floor Plan

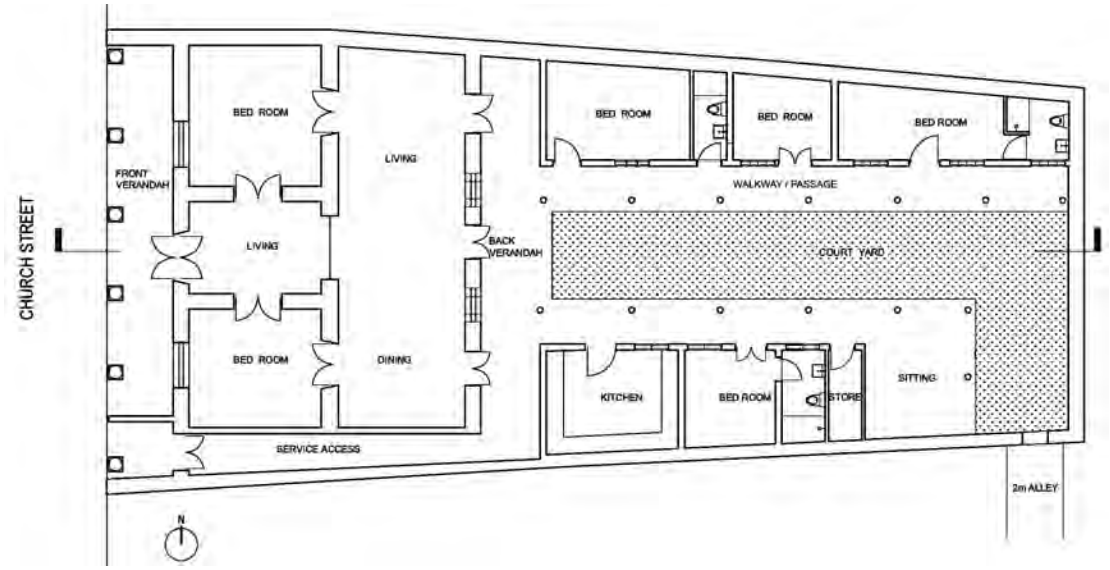


Cross Section (Existing)

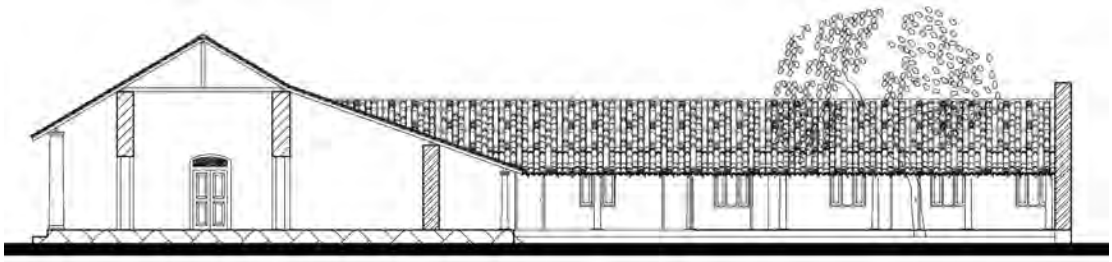
Figure-15&15a: Existing floor plan and existing section of No. 43, Church Street.
Source: Base plan from the CHCS, University of Moratuwa, Sri Lanka.

Suggested Physical Alterations

Re-introduce the generic U formation (embedded in its authentic spatial structure) through removal of excess toilets/ shed/ central room etc that disturbs the spatial flow of the house to encourage day light and natural ventilation. Extending the courtyard to the rear garden apart from reverting to its authentic spatial identity increases the open green area as an aesthetic as well as climatically responsive feature. Extending the partial walkway/ passage that borders the courtyard as a transition space; cuts off solar radiation and rain to the bordering spaces. Zone the functions as per drawing (service areas etc) for efficient usage of spaces (Figure 16&16a).



Proposed Floor Plan



Cross Section (Proposed)

Figure-16& 16a: Existing floor plan and existing section of No. 03, Parawa Street.
Source: Base plan from the CHCS, University of Moratuwa, Sri Lanka.

Figure-16&16a: Proposed Plan and proposed section of No. 43, Church Street.
Source: Author

2.4 No. 03, Parawa Street:

There are four Muslim families (the owner and three other families that amount to six adults and seven children) occupying this house.

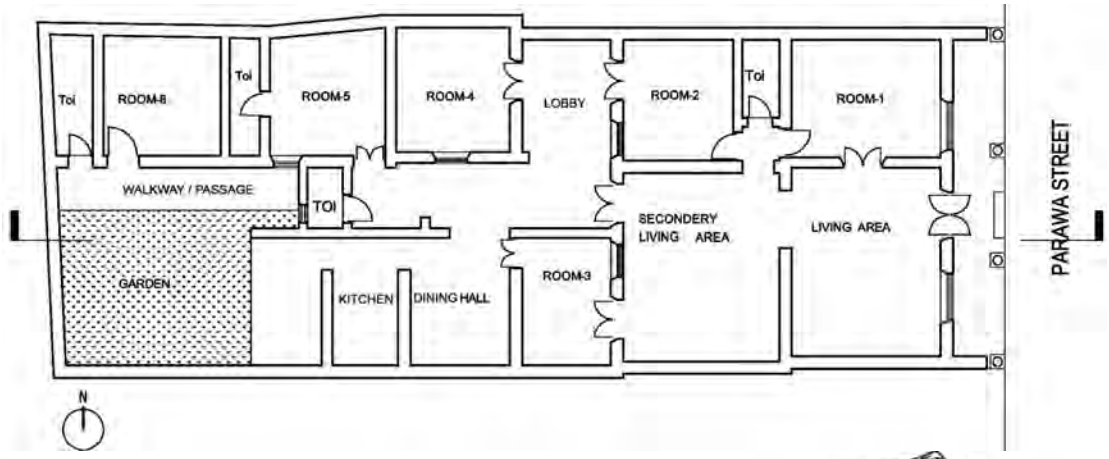
The five bedrooms are shared by the four families with the owner using an extra bedroom and store room.

This house according to the report by the CHCS appears to have been rebuilt or renovated in 1980's, but no accurate information of the original building is available. The plot of land, measures approximately 9.760m. x 27.30m. where most part is built on, except for a small rear garden, part of which too has been covered at a later date. The roof and the hidden spatial definition of the house suggests, the original house may have been an "L" shape.

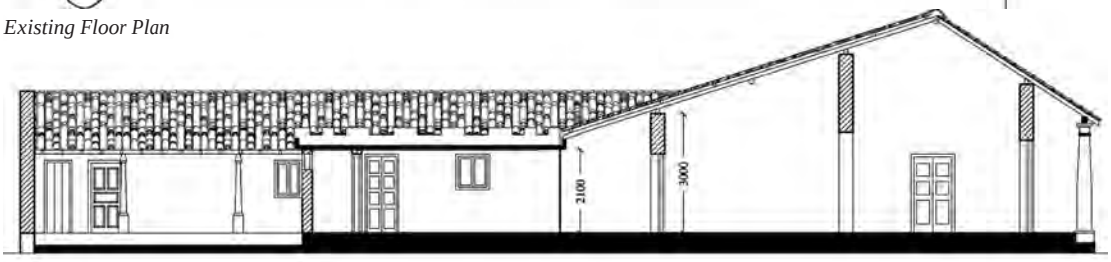
The house though heavily transformed and built upon, possesses common characteristics of the layered town house architecture.[12] *A newly constructed toilet is sandwiched between a bedroom and kitchen blocking what may have been a walkway linking the rooms of the linear wing fronting the courtyard.*

Figure-17: Restored street elevation of No. 03, Parawa Street. Source: Author

Ventilation to the interior spaces is blocked off by the added spaces, and thus is ill lit and ill-ventilated (Figure 18&18a).



Existing Floor Plan



Cross Section (Existing)

12 *The veranda stands as an interface between the private house and the public road. The living room is subdivided to allocate a bedroom. The secondary living space (may have been the main hall /Zaal now subdivided again for a bedroom), connects to what may have been a Halvedak/ back verandah now enclosed and subdivided into a room and lobby space).*

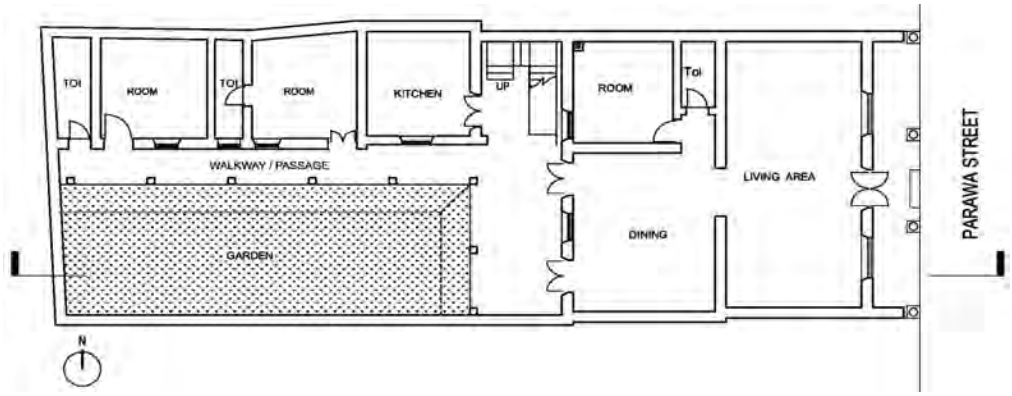
Suggested Physical Alterations

Looking at the embedded spatial organization, re-arrangement of spaces could re-introduce its authentic spatial definition, enabling a more habitable environment. Demolishing the toilet in the centre (along with the wing that contains room 3, dining hall and kitchen) that blocks the existing partial walkway and extending the walkway/ passage and courtyard as per the drawing resolves the light and ventilation issue.

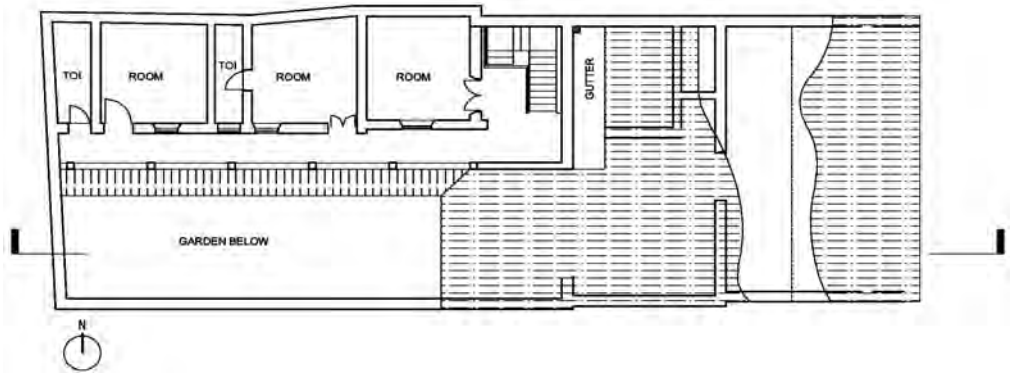
Demolish the room that subdivides the living space to enlarge it to be shared by the four families.

Rearrange/ zone kitchen and dining for spatial and functional efficiency.

Adding an upper floor that aligns with the generic formation of the town house as per drawing enables the owners to live on the ground floor while allowing the other three families to occupy the rooms on the upper floor. This not only provides the functional requirements of the household, but provides a spacious and a climatically comfortable physical definition where all rooms are naturally ventilated and lit (Figure 19&19a).



Proposed Ground Floor Plan



Proposed First Floor Plan

Cross Section (Proposed)

Figure-19&19a: Proposed plan and proposed section of No. 03, Parawa Street.
Source: Author

2.5 General Observations through Analysis of the Case Studies

a) Re-introduction of the verandah by conservation efforts as part of re introducing the authentic physical identity of the town house has given new meaning to the residents in terms of the added heritage and economic value to the property. Despite differences in socio-cultural practices and beliefs, majority of both the Muslim and Sinhalese population see it as a very positive element in the identity of their houses.

b) Most urban houses in Galle Fort have retained the first four layers of space[13] that conserves part of its authentic physical identity. These are the only spaces within the house that are maintained and livable. Entering deep into the house, the spatial and functional layers gradually transform into places of neglect and disrepair.

c) Considering the functional classification, the spaces beyond the four layers have been transformed by division and addition to;

- *a. Add more spaces for larger families – (bedrooms + toilets).*
- *b. Include modern day requirements/ amenities – (internal bathrooms, pantries).*
- *c. Accommodate extended families.*
- *d. Accommodate social habits of occupants in relation to space usage.*

This has disturbed the authentic spatial layering, flow and linear experience.

d) Occupant's understanding of spatial and functional zoning is weak. Thus potential for positive space usage is lost.

e) Idea of space utilization is poor. The town houses generally have large dining rooms and long bedrooms along the length of the bounding courtyard (in relatively larger more comfortable houses). Additions like a pantry bathroom/toilet could have been accommodated within these spaces as opposed to blocking the courtyards to build new ones.

f) Spaces are subdivided arbitrarily and mainly used as storage areas.

g) Courtyards are treated as left over spaces to be built on. They are the most compromised spatial entities in the authentic spatial definition of the town house. The original courtyards evident in all residential buildings have been compromised to gain more private spaces (Mainly bedrooms and bathrooms). In some instances they are completely built on and closed up, leaving small light wells in between. Light, ventilation and proper circulation which are essential for a healthy living environment have been compromised in a majority of houses.

The courtyards that extend to the rear boundary as rear gardens are mostly treated as service yards to store debris, deteriorated materials of the household, garbage etc.[14] The limited rear spaces have the potential of being transformed into positive green garden spaces that control heat and provide shade to the defined functions. The environmental and aesthetic potential of the courtyard and rear garden has been completely overlooked.

h) New renovations have roofs that are low in height with minimum roof angles built out of relatively low cost heat generating materials as asbestos sheets, etc. These materials add to the heat build-up in the interior spaces. Narrow roof overhangs further increase the solar heat gain as opposed to the broad overhangs that originally cut off the sun and rain.

2.6 Spatial Principles for Improving the Sustainability of Town Houses

The front verandah, the layered spaces in the front portion of the house and the generic formation of the courtyards (as illustrated in Fig.4. and Fig.5.) can be characterized as authentic elements in the spatial organization of the town house. A physical intervention needs to trace the spatial definition of the courtyard and retain the courtyard at least at the minimum dimensions required for light and ventilation. (2.3m as the minimum width from one direction in the case of buildings less than two stories in height.[15])

13 *Verandah, living space/lobby, inner living space/great hall, back verandah to courtyard.*
14 *This has been a common practice in Sri Lankan homes where traditionally the back garden was treated as a storage area. Dried firewood, other debris that is not disposed is generally collected in the backyard.*
15 *As stipulated in the building regulations of the Urban Development Authority of Sri Lanka.*

Future expansions should strictly adhere to the courtyard requirement and extend to an upper floor if necessary, conforming to geometric and dimensional characteristics of authentic proportions (and the generic courtyard types in a manner that fulfills climatic requirements etc).

Rooms bordering the courtyard to have a transition space between courtyard and rooms (eg. as a walkway) that allows a generous extension of the roof above. (as a buffer zone that prevents heat transmission from solar radiation and beating rain).

Rear space rule to be strictly conformed to, (in the generic formations that already have them) not only as a climatic/ habitability response, but to add green spaces to the dense urban fabric.

Reconsider zoning options of functions along the courtyard to incorporate modern day functional and spatial requirements.

3. CONCLUSION

The present conservation method adopted in Galle Fort is one that conserves the facade of the town houses. The heritage value of the place goes beyond the surface/ facade of the authentic "physical" identity of the place. It goes deeper as subtle layers that represent not only the physical evolution and transformation but social evolution as well. The spatial definition of the town house has stood the test of time as a simple yet efficient typology capable of accommodating and taking shape with changes over the centuries. It has evolved and transformed to accommodate the socio cultural needs of the community. Conservation should be a holistic effort to protect not only the face of the town house, but the intricate network embedded within the internal layering of the house that represents the life and needs of those living in them.

As universal principles implicit through this study on conservation of houses of heritage value, identification of authentic physical typological characteristics of the houses being conserved is seen as essential. There is a need to re-claim them while allowing for physical representations of the essential functional needs of the occupants. Enabling a habitable, climatically responsive house in this process is seen as vital.

The town houses prior to becoming "heritage" were meaningful places through conscious decisions and unspoken values of people shaped by social processes within a habitable environment. Giving due consideration to the social history and attempt to retain its physical counterparts or physical memory as a way of remembering the social evolution of the place within a habitable context is paramount in sustaining the integrity of the place.

As Loh (2007, pp.10) states, the true spirit of a place is represented not necessarily in the ways a site is conserved and presented, but in the ways it is used and valued by people. How a place is used and animated by its community gives it meaning, just as a place has meaning for its community. Sustainable conservation should therefore draw out the physical uniqueness implicit in the heritage site and integrate it into the social context. This will enable a holistic development of Galle Fort or any living heritage city, to sustain the authenticity and integrity of its built environment for posterity.

REFERENCES

Bandaranayake, S.,(1990). The Galle Fort: A Walled Town of Sri Lanka's Third Urbanisation. Ancient Ceylon. Journal of the Department of Archeology, Sri Lanka, 15, pp 11-13.

Brohier, R. L. and Paulusz, J.H.O.,(1951). Land Maps and Surveys.Vol.2. Colombo: Ceylon Government Press

Brohier, R. L., (1978). Links between Sri Lanka and the Netherlands. Colombo: The Netherlands Alumni Association of Sri Lanka.

Boussaa, D., (2010). Urban Conservation and Sustainability: Cases from Historic Cities in the Gulf and North Africa. Proceedings of the international conference on technology & sustainability in the built environment: King Saud University. Al-Riyadh: KSA.

Cordiner, J., (1807). Description of Ceylon. Aberdeen: Longman, Hurst, Rees and Ovme.

(1988). Illustrations and Views of Ancient Dutch Ceylon 1602-1796. London: Serendib Publications

De Silva, V and Rajapakse, A., (2010) - Spatial Transformation of Dutch period Town Houses in Galle Fort, Conservation South Asia: SANEYOCOP(South Asian Network of Young Conservation Professionals), Newsletter May-Aug 2010, Vol 2/No 2. pp.5-13 ,[online]. Available from: http://www.scribd.com/doc/36462975/CSA-Newsletter-August-2010 [Accessed 05th September 2010]

Hyde, R., (2000). Climate Responsive Design: a Study of buildings in moderate and hot humid climates, London: E & FN Spon

Hyde, R., (2008). Bioclimatic Housing: Innovative designs for warm climates. London: Earthscan

Jokilehto J. (2006), Considerations on authenticity and integrity in world heritage context. City & Time 2 (1): 1. Available at: http://www.ceci-br.org/novo/revista/docs2006/CT-2006-44.pdf. (Accessed 29 July 2011)

Kingston, W.M.H., (2009). Vernacular Architecture and Regional Design: Cultural Process and Environmental Response. Oxford OX2 8DP, UK : Architectural Press.

Kuruppu, I and Wijesuriya, G., (1992). The Conservation of Galle as a living Town: Challenges and Prospects. Ancient Ceylon. Journal of the Department of Archeology, Sri Lanka, 15:pp21-25.

Lewcock, R., Sansoni, B. and Senanayake, L., (1998). The Architecture of an Island- The living legacy of Sri Lanka. Colombo, Sri Lanka: Barefoot (Pvt) Ltd.

Living Heritage South African Heritage Resource Agency http://www.sahra.org.za/LivingHeritage.htm (Accessed 01 August 2011)

Loh, L., (2007). Conveying the Spirit of Place. In: R. A. Engelhard. Asia Conserved: Lessons Learned from the UNESCO Asia-Pacific Heritage Awards for Culture Heritage Conservation (2000-2004). Bangkok . UNESCO. pp 9-12.

Manawadu, S., (2009a). Final Report - Project for Preservation of Private Houses, Fort Galle, Sri Lanka (World Heritage Site). Centre for Heritage and Cultural Studies (CHCS), University of Moratuwa

Manawadu, S., (2009b).Preservation of private houses in historic site of Galle. Tsuji Funo felicitation volume - Kyoto University, Japan.

Manawadu, S., (2010).Competition submission to UNESCO, Bangkok 2009. Unpublished report

Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO) Available at: http://whc.unesco.org/arcive/opguide08-en.pdf (Accessed 03 August 2011)

Ozkan, S., (2006). Foreword - Courtyard: a typology that symbolizes a culture. In: M. Sibley, B. Edward, M. Hakmi, P.Land, eds. 2006. Courtyard Housing: Past, Present and Future. NY,USA:Taylor and Francis

Paranavitana,K.D., (2005). Galle Fort, The Heritage City. Galle. Sri Lanka.The Ruhunu Tourist Bureau.

Pulhan, H., (2008). An Enclosed Court: A Conceptual Analysis of the Traditional Courtyard House In Cyprus. 4th ISVS-International Seminar On Vernacular Settlements. Ahmedabad, India 14-17 February 2008. Available from: http://203.77.194.71:83/isvs-4-1/paper-dump/full-papers/15.pdf (Accessed 10 August, 2011).

Rapoport , A., (1969). House Form and Culture. Englewood Cliffs, NJ 07632 USA: Prentice-Hall, Inc.

Stovel ,H., (2007). Effective use of Authenticity and Integrity as World Heritage qualifying Conditions. [online] City & Time 2 (3): 3. Available at: http://www.ceci-br.org/novo/revista/docss2007/CT-2007-71.pdf. (Accessed 03 August 2011).

Wijesuriya, G., ed., (1995). European Architecture and Town planning (Dutch period) outside Europe. Proceedings of the International seminar held in Colombo, February 24-28, 1995. Ancient Ceylon – Journal of the Department of Archaeology, no.18.

SUSTAINABLE BUILT ENVIRONMENT - EXPLORING EXISTING AND EVOLVING DIRECTIONS FOR HIMALAYAN REGION

*Farhan Fazli**
*Richa Agarwal***

ABSTRACT

The Himalayan region lies in 'Seismic Zones IV & V' in the seismic zoning map of India. This region has very high earthquake susceptibility and is among the major disaster prone areas in the republic. Due to climate change and impacts of related occurrence of natural disasters in this region is increasing day by day. Indigenous knowledge systems of shelter construction that have evolved over centuries have integrated disaster risk reduction features in the choice of materials, designs and construction technologies. These traditional methods of construction are quite sustainable in nature since they incorporate the indigenous knowledge system passed on through ancestors, thereby having a strong social significance. They are very economical since the materials for construction are locally available and are in abundance. They are quite environment friendly since they do not require kilns for burning of bricks and cement plants which emit a lot of smoke polluting the environment. These traditional materials do not require burning of fossil fuel in manufacturing/ production and transportation of construction materials. But in the last few decades, these have been replaced by modern technologies of brick, cement and steel that have invaded the region, without appropriate skills to use them. Due to the absence of trained architects, engineers and masons, local construction workers use the modern materials without technical knowhow – as concepts of reinforcement, curing, structural stability of frame structures and load transfers in such buildings are not properly understood and used. This reduces the pliability of communities against external shocks and stresses, and enhances the impact of future disasters.

The objective of this paper is to analyze the traditional and current construction practices in the earth quake prone Himalayas and to point to possible directions for evolution of appropriate sustainable shelter technologies and processes for the region. It is also an attempt to explore the possibility of alternative materials and technologies such as 'compressed stabilized earth blocks', which are locally available, energy efficient, easy to work and are eco-friendly.

Keywords: Indigenous knowledge, sustainable innovations, energy efficient, traditional construction.

1. INTRODUCTION

The Himalayas extend from west to east for about 2,500 km in a curve, from the Pamir Knot in the northwest to the valley of the Brahamaputra River in the east and with a width of 100 - 400 km. The Himalayas range covers an area of 612,021 sq. km with coordinates 27° 59' 17" N, 86° 55' 31". It passes through Nepal, Indian (5 States: Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim), China (Tibet), Bhutan and Pakistan (www.gogo.com, 2011). This region lies in Seismic Zone IV. It has high earthquake vulnerability and is among the most disaster prone areas in India. Many other natural disasters like cloudbursts, flash floods, avalanches, landslides and forest fires are affecting thousands of lives, houses and infrastructure each year (Bilham 2001). Due to climate change, these natural disasters are increasing day by day. Documents reveal that the return period for a moderate earthquake (6.5+) in Uttarakhand is 8 years, and the longer the time between earthquakes the greater the magnitude.(Kumar, 2011) The last earthquake to affect the region was the Chamoli earthquake in 1999 which caused widespread damage to life and property (IIT,1999).

Seismic zoning map of India shows that the Himalayan region lies in zone IV & zone V. Sustainability of a built environment is an ongoing process. Sustainability is the long-term maintenance for the welfare of human being, which has less impact on environment, economically feasible, and can be socially accepted. It should also have the optimum utilization of locally available material and resources.

The knowledge of traditional construction systems is an integral part of livelihood in the Himalayan region. The local construction systems that have evolved over centuries

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Figure-1: Uttarakhand in the Map of Himalayan Region in India.
Source: www.himalayas. dk/map

Figure-1a: Seismic Zoning Map of India
Source: www.mapsofindia.com

have indigenous knowledge of risk reduction in these areas with choice of locally available materials, traditional design and construction technologies. These traditional methods of construction are more sustainable since they incorporate the indigenous knowledge which passes on through ancestors and has a strong social significance. Such methods are quite economical as well since the materials for construction are locally available and are in abundance. The local people have knowledge of traditional methods of construction imbibed in them from their forefathers. These materials are environment friendly since they do not require kilns for burning of bricks and cement plants which emit smoke polluting the environment. These traditional materials also do not require burning of fossil fuel in manufacturing / production and transportation of construction materials. But with the passage of time the incorporation of modern materials like cement, bricks and steel in construction, is leading to loss of traditional knowledge systems in building construction, adversely affecting in these areas the sustainability of the built environment of this region. The absence of architects and engineers trained in the use of these materials and construction systems is thereby heightened in the Himalayan region.

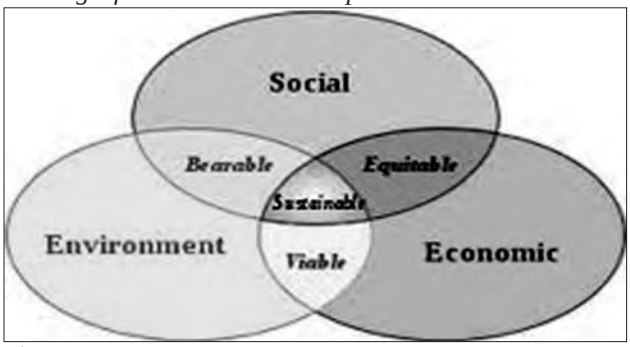

Figure-2:

Figure-3: Typical plan, elevation, view and sketch of a two-unit Koti Banal structure located in Rajgarhi area.
Source: Routela, Timber reinforced Stone Masonry, May 2008.

Structural Element	Seismic Deficiency	Earthquake Resilient Features	Earthquake Damage Patterns
Wall	*Wall thicknesses up to 1.5 ft leading to high dead lodas.*	*1) Flexibility during dynamic shaking since no rigid mortar is used between the stones.* *2) Bearing capacity to high vertical loads.* *3) Preventation of out-of-plane failure through vertical (shear) keys at the outside ranging over several storeys.*	*No damage patterns caused by earthquakes have ever been reported.*
Frame (blockhouse style wooden logs)		*1) Spatial load bearing structure.* *2) Bearing of shear forces through shear pin (tenon) connections between the wooden logs.* *3) Flexibility and weather resistance due to the use of Deydar timber (native cedar).* *4) beams are mostly rectangular in shape with a width/heigh ratio of 2:3 and a cross-section area larger than needed for adequate safety.* *5) Openings are surrounded by wooden elements which are part of the frame.*	
Roof	*1) High dead loads due to heavy roofing material (slate tiles).* *2) Inverted pendulum effect due to concentrated mass at the buildings top (larger dimensions of the upper stories).* *3) Flexible diaphragm effect.*	*Larger dimension of the upper stories thus leading to higher story masses is compensated by the use of less stones and more wooden elements.*	
Floors	*Flexible diaphragm effect.*	*Floor beams that run from the middle of one wall to the opposite wall provide additional stability to the walls.*	

Table-1: Showing traditional methods are more sustainable and earthquake resistant. (Seismic Features)
Source: Routela, Timber Reinforced Stone Masonry, May 2008.

The building configuration provides adequate safety against lateral shear, but there is no apparent safety measure against overturning. These buildings which are up to five storeys tall have survived the overturning effects even of strong earthquakes due to two reasons: (i) good aspect ratio of the buildings, and (ii) the use of lighter timber construction in the upper two storeys. Both mass and stiffness are uniformly distributed in elevation and in plan, thus allowing pure lateral deflection during dynamic shaking while avoiding torsional effects. The primary structural system mainly consists of wooden elements. If designed and used properly, wood assemblies offer a high strength-to-weight ratio compared with other modern work materials. This results in low inertia forces during an earthquake. Sitting of these buildings is another important aspect for their safety against earthquakes. These buildings are generally situated at firm ridge or plane ground having rock outcrop (Routela, 2008).

This paper is an attempt to understand the importance of traditional knowledge system in the development of the built environment by the sustainable use of building materials and construction systems in the earth-quake prone Himalayan region.

2. SUSTAINABLE CONSTRUCTION KNOWLEDGE SYSTEM OF HIMALAYAN REGION

While it is important to consider what shelter would be appropriate to build after a disaster, it is also critical to address how people are constructing new buildings in the area. In the hilly region local labor is using modern materials in their construction without technical knowhow of reinforcement, curing, structural stability of frame structures and load transfers. A strategic approach generated from detailed analysis is needed to identify the strengths and weaknesses of both traditional and contemporary sustainable vernacular technologies and their application in long term development and post-disaster scenarios. In order to make an approach to the development of built environment to be sustainable, the locally available skills, material resources, existing historic trends, and socio-economic factors are to be analyzed. This can help form a framework of safe and sustainable construction practices. Until now there has not been a baseline study into the options for appropriate shelter technology in the region which integrates resource mapping, livelihoods analysis and capacity building programmes.

It is extremely motivating to learn from local people of a particular region about how they built their dwelling without any formal training by using the local natural raw materials and by learning from nature itself, evolving the design through a hit and trial process. Many communities have employed their knowledge to cope with harsh environmental conditions and difficult times. The traditional construction systems of Taq and Dhajji Diwari are sustainable in Himalayan region in the post disaster rebuilding of houses. The local people have enough knowledge to repair their houses after earthquakes with locally available materials like mud stone, bamboo and timber. There are cross bracing and gable bands of timber or bamboo (as available) which binds the structure as a whole and is very helpful in reducing the tension and compression forces of earthquake. The vertical reinforcement and the horizontal earthquake bands at different levels and cross bracing, which are recommended in the "National Programme on Earthquake Engineering Education (NPEEE)" by Indian Institute of Technology, Roorkee, India, in "Guidelines for Earthquake resistant provision at planning stage of building" from August 28 to September 1, after an extensive research on earthquake resistant buildings, were already being practiced in the Himalayan region for a very long time in Taq and Dhajji-Diwari system.

Figure-4: Dhajji-Diwari System: Timber frame with infill walls.

Taq System

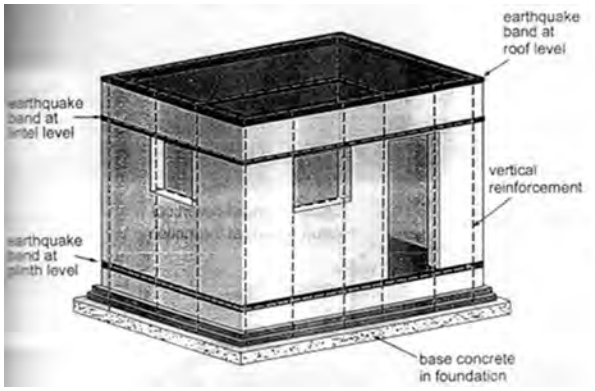

Figure-4a: Vertical Structure of Prone Areas.

Figure-4b: Earthquake bands and reinforcement (Pitched Roof for E.Q).

Source: From NPEEE(National Programme on Earthquake Engineering Education) Manual, Indian Institute of Technology, Roorkee, India, Page No: 23, 12& 3.

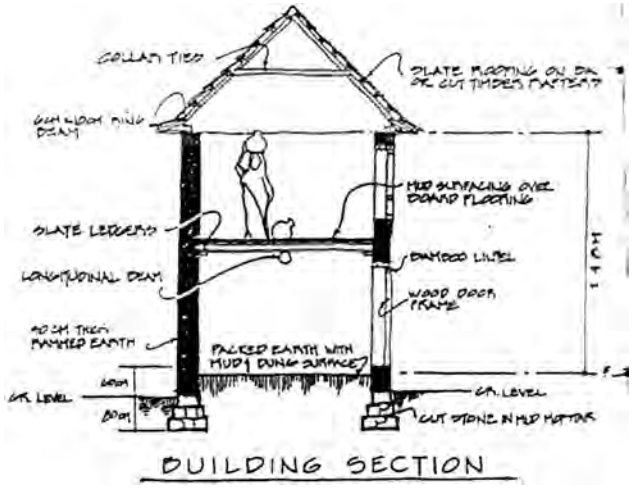

Figure-5: Earthquake resistant building section in Himachal Pradesh.
Source: From NPEEE(National Programme on Earthquake Engineering Education) Manual, Indian Institute of Technology, Roorkee, India, Page No: 23, 12& 3.

Post disaster is defined in the document attached. Though their knowledge about sustainable built environment has often been considered 'inferior', yet they have developed successful lessons and strategies for managing recurring disasters. Various unforeseen events in the past, such as the Indian Tsunami of 2004, have brought into limelight the timeless knowledge embedded within these communities and in their creation of humble origins.

The Kashmir region which is highly prone to earthquakes is known for its traditional earthquake safe construction practices where two types of techniques are prevalent:

- *Taq system: Timber laced system*
- *Dhajji-Diwari system: Timber frame with infill walls*

After the Kashmir earthquake in 2005, existing construction practices were assessed. In cases where traditional knowledge of either Taq or Dhajji-diwari had been applied, the buildings could withstand the earthquake. In contrast, houses using new materials like cement, and R.C.C. without proper professional guidance became highly hazardous (Khan, 2008).

Koti Banal architecture is a hybrid construction style of timber reinforced stone particular to Uttarakhand's Northern district and Southern part of Himachal Pradesh. Many features of these buildings are considered to be the basis of modern earthquake-resistant design. Generally, ornate multistoried houses with abundant use of wooden beams are characteristic of Rajgarhi area in Himalayan region. Locally available materials such as long, thick wooden logs, stones and slates were judiciously used in Koti Banal style. The heights of these structures vary between 7 and 12 m above the base platform. The platform that consists of dry stone provides flexibility during the time of earthquakes (Routela 2008).

The Almora district in Kumaon region of Uttarakhand is dotted with small villages having two-storey residential buildings of modest format. The built environment of this region exhibits many features which speak of adaptation to harsh climatic conditions and seismic vulnerability. The naturally available local materials like wood, stone and mud maintained thermal comfort within the house.

All the above examples demonstrate base how people locally evolved traditional knowledge to cope with the harsh climatic conditions and disaster resistant methods of construction within their own habitat. Thus the success and sustainability of interventions at community level depend on practice availability of local techniques that have been tried and tested, knowledge and indigenous practices that can combine

Figure-6: Map illustrating the respective region in Hiamalayan India where Koti Banal buildings are found.
Source: Routela, Timber Reinforced Stone Masonry, May 2008.

new ideas to generate innovation. We need to understand, acknowledge and respect the indigenous knowledge as a valuable source of information, and as a key contributor to reducing risk and promoting sustainability for our built environment.

3. CONTEMPORARY CONSTRUCTION PRACTICES

The un-engineered concrete is the most readily available material which has superseded the use of almost every traditional material/method in India. The industrialization of cement production in the last 30 years has eroded traditional methods of building, local skills and local markets. The most ubiquitous use of un-engineered concrete buildings in the Himalayan Region in conjunction with rapid urbanization has resulted in significant changes to the risks to and vulnerability of local communities. The life of these structures as recommend by the manufacturers are from 50 to 80 years, whereas the buildings which were constructed using the traditional knowledge system withstand a much longer lifespan with minimum maintenance, and are much environment friendly as compared to these modern materials.

3.1 Thermal advantages of Compressed stabilized earth block (CSEB)

Due to the enormous mass CSEB provides monolithic walls and has excellent thermal performance, reducing heating and cooling costs.

From May 31 to June 3, 2004, the Biology Dept. of , Del Rio, Texas, conducted tests for thermal change on three structures: concrete block, and compressed stabilized earth block. Results indicate the interior temperature of the and CSEB modules were significantly lower than for concrete blocks. With a maximum ambient temperature of 107 °F (42°C), the interior temperatures were:

Conceret Module: 111 °F (44 °C) (four degrees Fahrenheit above ambient).

Adobe Module: 95 °F (35 °C)

CSEB Module: 91 °F (33 °C)

Ecological comparison of building materials				
Product and thickness	No of units (Per m²)	Energy consumption (MJ per m²)	CO2emission (Kg per m²)	Dry compressive crushing strength (Kg/cm²)
CSEB – 24 cm	40	110	16	40 – 60
Wire Cut Bricks – 22 cm	87	539	39	75 - 100
Country Fired bricks– 22 cm	112	1657	126	30 - 50
Concrete blocks – 20 cm	20	235	26	75 - 100

Table-2: Comparative Analysis of Materials (Note: Wire cut bricks are also called as Kiln Fired Bricks).
Source: www.freepatentsonline.com

It is observed that most of the old structures are being put to disuse and are deteriorating fast due to lack of maintenance. It is doubtful whether they'll be able to survive any natural disaster in future. People are also demolishing old structures to reuse the disassembled material for construction of new and modern buildings. Recent trends of shift towards the use of contemporary materials such as brick, cement and steel have resulted in increased levels of risk due to the lack of knowledge among local construction workers on the appropriate use of these alien materials. The new materials bring with them a negative environmental impact due to their high carbon footprint. Higher heating and cooling requirements are a consequence of the thermal conductivity of the materials as well as design changes in elements like thinner walls and larger openings. Interactions with the local people in Ranikhet showed that they could realize the thermal variations between the new and old constructions positively in design (Sharma 2008).

Although the benefits of traditional materials are evident, their usage in the original way is not viable today owing to the depletion of resources, restrictions on felling trees and quarrying stone, and disappearing craftsmanship. Secondly, these require a greater level of periodic maintenance as compared to the R.C.C. constructions. The potential for bamboo construction to play a major part in new buildings, and a cultural renaissance of utilizing local resources, are considerable. The technological barriers behind using this material (bamboo) are being constantly eroded as the state has ploughed a great deal of resources into researching the applications of the material in the context of construction. Aspirations to have a city-like dwelling have resulted in abandonment of the old house eventually leading to their decay and extinction.

The problems which are caused due to the use of the above mentioned modern materials necessitates the exploration of innovative intermediate technologies and low cost alternate materials which have similar attributes having less impact on the environment, economically feasible, and can be socially accepted and have been successfully used in other parts of the country in some form or the other. After a lot of research, various national level organizations such as Central Building Research Institute, Roorkee, Indian Institute of Science (IISc) at Bangalore, and Auroville Earth Institute (AVEI) at Auroville have developed many low cost earth technologies today, like rammed earth technology and earthquake resistant hollow blocks. However considering aspects like available material and local skills, Compressed Stabilized Earth Block (CSEB) seemed to be an appropriate future technology as its production and use presents a sustainable process for any community. Since more than seventy percent of the population in India is still living in villages and are educationally backward, CSEB technology is the easiest to work with for the development of sustainable built environment. However, use of this technology would depend on the infrastructure and skills available in the region (Verma. N, SEEDS).

4. COMPARISON OF CSEB WITH OTHER MATERIALS

Comparisons between traditional and contemporary buildings show that indigenous buildings, which use locally sourced stone, mud and timber as basic building materials were more resistant to earthquake due to their design and flexibility. Besides the cultural suitability of their designs, traditional buildings were also environmentally sustainable due to their low embodied as well as operative energy demands, and higher thermal comfort levels.

4.1 Method of Construction of Compressed Stabilized Earth Block (CSEB)

The input of soil stabilization allows people to build higher with thinner walls, which have much better compressive strength and water resistance capacity. A minimum amount of 5% to 10% cement is added to the soil depending upon the quality of the soil. With cement stabilization, the blocks must be cured for 4 weeks after manufacturing. After this they can dry freely and be used like bricks with a soil cement stabilized mortar. Now CEB are mostly stabilized. Thus today we call them CSEB. A good soil has the following proportions: Gravel 15%+ Sand 50%+ Silt 15%+ Clay 20%. (CSEB code of practice, AVEI, 2010, p. 35) Many stabilizers can be used. Cement and lime are the most common.

Auroville Earth Institute (AVEI) has done extensive research and development on CSEB and various stabilized earth techniques. CSEB can be pressed in many different types, sizes and shapes. Four main types of blocks can be distinguished: Solid, hollow, interlocking and special blocks.

4.2 ADVANTAGES OF CSEB

a. Local Material:
Production is made on site itself. Thus, it saves transportation, fuel, time and money.

b. Appropriate Technology:
Produced locally it easily adapts to the various needs of the people-technical, social, cultural.

Table-3: Comparison of Building Materials at Auroville (Compressed Stabilised Earth Blocks (CSEB) produced on site, July 2011)

		WIRE CUT BRICKS	COUNTRY FIRED BRICKS	CSEB 240	RAMMED EARTH
PRODUCT INFORMATION	Brick size (L.W. H. in cm)	22.0 10.5 7.2	23.0 10.0 7.0	24.0 24.0 9.0	(Wall cast in stiu)
	Volume in brick	1.66 liters	1.61 liters	5.18 liters	(Wall cast in situ)
	Weight per unit	3.12 Kg = 1876 Kg /m^3	2.81 Kg = 1745 Kg /m^3	10.00 Kg = 1929 Kg /m^3	± 2000 Kg / m^3
	Stabilization	Fire	Fire	5% cement	5% cement
	Wastage of raw material	3%	12%	5%	0%
	Units per m^3 (raw material)	601 No.	621 No.	193 No.	No bricks
	Carbon emission (CO_2)*	202.2 Kg / m^3	642.9 Kg / m^3	51.5 Kg / m^3	51.5 Kg / m^3
	Energy consumption*	2.247 MJ / m^2	6.122 MJ / m^2	572 MJ / m^2	572 MJ / m^2
	Dry crushing strength	100 kg / cm^2	35 kg / cm^2	70 kg / cm^2	70 kg / cm^2
	Water absorption	9 to 11%	10 to 14%	9 to 12%	8 to 11%
WALL DETAIL	Wall thickness	22 cm	23 cm	24 cm	24 cm
	Mortar used	1 cement: 4 sand	1 cement: 4 sand	1 cement: 4 soi: 8 sand	No mortar
	Mortar Qty. per m^2 of wall	72.4 liters	73.5 liters	37.1 liters	No mortar
	Units per m^2 of wall	98 (with 1.5 cm mortar)	96 (with 1.5 cm mortar)	40 (with 1cm mortar)	No bricks
	Daily output per team	3.1 m^2 = 300 bricks	4.2 m^2 = 400 bricks	3.5 m^2 = 140 blocks	8 m^2
COST	Unit (brick) on site	8.00	5.25	11.46	No bricks
	Raw material per m^3 **	4,954 per m^3	3,652 per m^3	2,321 per m^3	2,521 per m^3
	Mortar per m^3	2,514 per m^3	2,514 per m^3	1,355 per m^3	No mortar
	Finished wall per m^3	6,474 per m^3	4,673 per m^3	3,588 per m^3	2,798 per m^3
	Finished wall per m^2	1,424 per m^2	1,075 per m^2	861 per m^2	672 per m^2
DATA	Siewed sand	340 per m^3	Mason 450 (day)	Labour male 306 per day	
	Siewed soil	250 per m^3	Helper 306 (day)	Labour female 202 per day	
	Cement (43 grades)	300 per 50 Kg bag			

NOTES

All costs are in Indian Rupees (Rs.) — Auroville, 1st July 2011 - 1US $ = ~ 44 Rs.
* The cost of raw material include the wastage.
All material costs include teh delivery on site.
Block laying team = 1 mason, 1 helper, 1/2 labour male, 1/2 labour female.
The labour cost includes the yearly bonus and the employee providence fund.
Wire cut bricks are also called kiln-fired or chamber bricks.
Country fired bricks are also called village bricks.
The CSEB price is the production cost on site.
Team for producing CSEB = 12 labour male. (Including: siewing, mixing, pressing & stacking)

SUMMARY

ENVIRONMENTAL COST

CSEB and rammed earth are more eco-friendly:

Carbon Emission
- 3.9 times less than wire cut bricks
- 12.5 times less than country fired bricks

Energy Consumption
- 3.9 times less than wire out bricks
- 10.7 times less than country fired bricks

MONETARY COST

A finished m3 of CSEB wall is:
- 23.2% cheaper than country bricks
- 44.6% cheaper than wire cut bricks

A finished m3 rammed earth wall is:
- 22.0% cheaper than CSEB wall
- 40.1% cheaper than country bricks
- 56.8% cheaper than wire cut bricks

STRENGHT

CSEB and rammed earth are:
- 2.0 times the strength of country fired bricks
- 0.7 times the strength of wire cut bricks

Source: www.earth-auroville.com

c. Energy Efficiency and Eco-friendliness:
Production requiring only a little stabilizer (thus little fuel for it) the energy consumption is much less than a fired brick.

d. Local Management of Resources:
If planned in advance, quarries resulting from sourcing soil on site can be converted into rainwater harvesting tanks, wastewater treatment systems, reservoirs, crop cultivation areas, landscaping, etc.

e. Transferable Technology:
This technology requires only semi-skilled labor. One can learn how to produce CSEB in a short time.

f. Job Creation:
This technology allows otherwise unskilled and unemployed people to learn a new skill, obtain a job and increase their social values.

Therefore interventions in the building method must utilize existing traditional wisdom on construction materials or technology, since it has been tested over generations, and is best suited to local environment and culture. Technology should be used in a minimum way, so as to value the traditional system and make them more resilient in the face of new threats like climatic change and global warming. Appropriate processes have to be participatory and based on local culture and skill sets. Awareness generation among the people, sensitization of decision makers, and training of construction workers have to be carried out to achieve an all-round participatory and locally sustainable approach for the development of built environment.

5. CONCLUSIONS

Compressed Stabilized Earth Block (CSEB) has less impact on environment as its production is pollution free. The materials, resources and the labor for production of CSEB being locally available are economically more feasible and are socially more acceptable. Bamboo, timber and mud used for construction of traditional buildings in Himalayan region are locally available raw materials making them economically more feasible. The Taq and Dhajji Diwari structural systems employ local workmanship generating employment opportunities in the region making them socially more acceptable.

To achieve sustainability in the Himalayan region use of CSEB blocks and traditional construction systems can play a significant role due to their unique characteristics. The following initial steps can be taken to provide sustainable built environment to the Himalayan region:

Figure-7: CSEB manual block making machine.
Source: Self documentation, Auroville.

- *Documentation of shelter practices in the various parts of the Himalayan region and other earthquake prone regions in India.*
- *Preparation of a resource data base or harvest map, listing all the resources (materials / techniques / publications), trained craftsmen and skills.*
- *Guidelines/manuals on appropriate shelter technologies and processes are to be prepared.*
- *Construction of prototypes to demonstrate appropriate shelter technologies to the people, non governmental rganizations (NGO's) and government bodies.*

REFERENCES

Bilham, R., Gaur, V. K., and Molnar, P. (2001) Himalayan Seismic Hazard, August 293, 1442-4.

Comparison of Building Materials at Auroville,(2011) Comparative Analysis of Materials [Internet] Available from:<http:// www.earth-auroville.com > [accessed on 17 Dec.; 2011].

Compressed Stabilized Earth Block [Internet] Available from < www. en.wikipedia.org> [accessed on 16 Dec.; 2011].

Compressed Earth Block (September 2009) [Internet] Available from < www. freepatentsonline. com/2962788.html ?query=PN/US2962788+OR+US2962788andstemming=on> [accessed on 22 July; 2011].

Description of Himalayan Range (geographical boundaries)(1996-2000) [Internet] Available from <www.100gogo.com/hima.htm>, [accessed on 16 Dec.; 2011]

Himalayan Region of India. (2006) [Online Image]. Available from:<http://www.himayayas.dkh/map >[accessed on 16 Dec.; 2011]

Khan, A.A., (2008) Earthquake Safe Traditional House Construction Practices in Kashmir, UN/ISDR-19-Bangkok, Indigenous knowledge for Disaster Risk Reduction. Bangkok, July,pp 5-8.

Kumar P, Kumar A, Sinvhal A, (2011) "Assessment of seismic hazard in Uttarakhand Himalaya", Disaster Prevention and Management, Vol. 20 Issue: 5, pp.531 – 542

Map Showing the Seismic zoning in India.(2011) [Online Image]. Available from: <http://www.mapsofindia.com/maps/india/seismiczone.htm> [accessed on 18 Dec.; 2011]

National Programme on Earthquake Engineering Education (NPEEE) Manual, Department of Architecture and Planning, Indian Institute of Technology, Roorkee, Uttaranchal, India, Aug.28- 1 Sep2006

Reconnaissance Report Chamoli Earthquake of 29 March 1999, Joint study by NSET-Nepal and Department of Earthquake Engineering, Indian Institute of Technology, Roorkee, India.

Routela, P., Joshi, J.C., Singh,Y; Lang, D.,(2008) Timber Reinforced Stone Masonry (Koti Banaal Architecture) of Uttarakhand and Himachal Pradesh, N. India, Housing Report- World Housing Encyclopedia by (EERI) & (IAEE), India, May.

Sharma, A., Joshi.M., (2008) Indigenous Knowledge and Modern Science give Environment-friendly Shelter Solution in flood affected Desert Region of India, UN/ISDR-19-Bangkok, Indigenous knowledge for Disaster Risk Reduction. Bangkok, July,pp.9-14.

Shelter Group, (2008) A Design Handbook for Bamboo houses, BIPARD

Thermal Advantages of CSEB, (2011) [Internet] Available from: <http://www.en.wikipedia.org/wiki/compressed_earth_block#Thermal_advantages> [accessed on 17 Dec.; 2011]

TOWARDS SUSTAINABLE BUILT ENVIRONMENT - UNDERSTANDING SUSTAINABILITY PROSPECTS IN A METROPOLITAN FRAMEWORK - THE CASE OF ISLAMABAD

*Ahmed Zaib Khan**

ABSTRACT

The broader intention of this article is to present a methodological framework for working towards sustainable built environments in contexts that are characterized by rapid growth, change and urbanization. The article aims to contribute to this intention by examining the interaction between theory and practice of urbanism through analyzing a specific case - metropolitan plan for Rawalpindi-Islamabad area by the Greek architect / planner C. A. Doxiadis - in the light of the emerging discourse of sustainable urbanism. In analyzing the case of Islamabad, the idea is to see whether the historical development of its plan (1959-63) had any sustainability agenda embedded in its spatial articulation? And whether reinterpreting that agenda, and its original metropolitan framework, can lead to understanding and imagining new prospects that allows working towards a more sustainable built environment? More importantly, the article attempts to examine and reflect upon the capacity and ways in which urban design and planning approaches and strategies deal with the issues of sustainability in the production of the built environment. The article addresses these intentions and aims through three stages of analyses: i] the evolution of the sustainability paradigm and within that the emergence of the nascent discipline of sustainable urbanism; ii] the historical development of the plan of Islamabad and its distinctive aspects in terms of sustainability; and iii] the formulation of a design and policy framework for developing Islamabad-Rawalpindi area towards a more sustainable built environment. Within these analyses, several arguments and findings are linked in developing a case for reimagining urban form as a factor of sustainability that is not only a contemporary concern in the sustainability debate but also embedded in the spatial articulation of the historical plan of Islamabad. For understanding the sustainability prospects through such reimagining, a conclusion is drawn that the making of the plan of Islamabad unfolds a synthesis-based approach to urban design in constituting a metropolitan framework that facilitate a coherent urbanisation process, comprehendible built-form, architectural variety and a symbiotic relationship with the surrounding landscape. Theorising this framework and its key themes that are identified, allows one to comprehend the 'anthropocentric managerialism' based approach towards sustainability, with several elements that imply a precursor to sustainability discourse and a preamble that is being reincarnated as 'landscape' and 'ecological' urbanism. Theorizing such themes alone, however, is necessary but not sufficient condition for unfolding sustainable built environment. In this regard, several shortcomings are identified that contradict the sustainability credentials in the implementation of the plan together with the adoption of an integrated and transdisciplinarity-based approach in formulating design and policy strategies that allow working towards a more sustainable built environment in the Rawalpindi-Islamabad metropolitan area.

1. INTRODUCTION

There is growing awareness of sustainability issues that are manifest themselves on many fronts in society (Knox 2011). Signalled and set in motion through the environmental movement over the last 4 decades, apocalyptic events (ozone holes, chernobyl, melting polar icecaps, climatic instabilities, tsunamis, etc.), alarming pace of urbanisation (70% urban world by 2050), acknowledged by scientific evidence (IPCC, etc.), the issues of sustainability have become the centre stage in global development consciousness. They are discussed and debated across disciplinary fields in academia, practice, politics, civil society, governments i.e. they have become the concern of the world community at large. Within these discussions, consensus has emerged on goals: achieving a global ecological equilibrium as a very question of survival of humanity on this planet [Ingersoll 2006; Farr 2008; UN-Habitat 2009; Lehman 2010]. Means to achieve this goal are however contested and disputed. Clear evidence has emerged also on the fact that built environment)from hamlets to mega-cities and infrastructure, see section-1) contributes

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to most, if not all, of the emissions leading to climate change (Ruano 2000; Farr 2008). There is also a consensus on the need for systemic change in the processes underlying the production of the built environment (Droege 2008). Comprehending such a change is clearly beyond the scope of a single discipline, scale or dimension. This is why there is a lot of theoretical confusion and methodological fragmentation in the design fields dealing with sustainability issues related to the built environment, and the very idea of sustainable architecture and urbanism remain a 'contested' concept (Guy 2001).

This article starts from the premise that built environment and sustainability relationships are complex, multi-dimensional and multi-scalar and that their understanding requires inter and transdisciplinary approaches (Mahsud 2010; 2010a; 2010b; and 2011). From this premise, the intention of this article is to present a methodological framework by examining the interaction between theory and practice of urbanism through analyzing a specific case in the light of the emerging discourse of sustainable urbanism (Farr 2008) as a 'way' of understanding and working towards sustainable built environments (SBE). Such a way is grounded in the broader theoretical discourse about sustainability from an urbanistic perspective (section-1), enriched by historical-empirical findings from a case (the plan of Islamabad, section-2) and operationalized by proposing concrete design and policy strategies (section-3) that facilitate the unfolding of a more SBE in the Rawalpindi-Islamabad metropolitan area. Underlying the analysis in these three sections is also the concern to examine and reflect upon the capacity and ways in which urban design and planning approaches and strategies deal with the issues of sustainability (such as, urban sprawl, economic growth, socio-spatial and environmental cohesion) in the production of the built environment.

Formulating a theoretical and methodological premise for discussing and conceptualising the idea of working towards SBE is the aim of the first section. This aim is pursued by examining the relationship between the evolution of the sustainability paradigm and the role of the built environment, and within that, the question of urban form and the emergence of the nascent discipline of sustainable urbanism. The analyses intend to clarify the connections between sustainability paradigm and the built environment through the lens of urbanism and urban form as a way of conceptual working towards SBE. These analyses are framed by addressing a set of questions: i] What are the internal contradictions and paradoxes within the paradigm of sustainability? What is the position of built environment and the role of urbanism in that paradigm? What are the scientific and theoretical tenets of the discipline of sustainable urbanism? What are its main concepts and prescriptive recipes? What is the value of re-imagining urban form as a framework for working towards SBE? Within these analyses, a series of assertions are made to make the case for reimagining urban form as a factor of sustainability, which implies bringing together the ideas and strategies of sustainable urbanism and models of urban form within a single 'framework' as a way of working towards SBE.

The second section examines the plan of Islamabad (Rawalpindi-Islamabad metropolitan area for 3 million inhabitants) by the Greek architect / planner C. A. Doxiadis as a case in the light of the emerging discourse of sustainable urbanism, and see whether the plan had any sustainability agenda embedded in its spatial articulation? And whether reinterpreting that agenda can lead to understanding and imagining new prospects that allows working towards a more SBE? The focus of analyses is the historical development of the plan (1959-63), and in particular the re-imagining of urban form embedded in its spatial articulation (Mahsud 2008; and 2010), with a view to unfold its distinctive design aspects in terms of sustainability. These analyses provide a historical-empirical base for developing the (above mentioned) framework of working towards SBE, and are guided by addressing a set of questions: What is the significance of Islamabad as a case of reimagining urban form that is still relevant today for the context? How the plan deals with urban 'growth and change'? What is the role of the reflections and reformulations in the making of the plan? How such reformulations lead to significant spatial concepts (and Ekistics theory) that acted as precursor to the sustainability discourse? What is the urbanistic value (idea of urbanity, urban form, new spatial concepts) of the plan in terms of urban design and planning approaches to sustainability?

Reimagining of urban form in the case of Islamabad owes not so much to what it has become today as a metropolis, rather it is embedded in the making of the plan that is analysed here as a case. A case that illustrates an attempt to devise a framework for growth and change that is particularly relevant for the context of explosive urban sprawl that characterise much of the sub-continent even today. Moreover, it is a case that offers a view on new sets of relationships between the old and new parts of the city and between city and the surrounding landscape. It is precisely such a kind of case-based learning through design-based research - deriving lessons from urbanistic experiments of the past that demonstrates the interaction between theory and practice -

that would add an empirical dimension in the efforts for developing the theory and practice of the discipline of sustainable urbanism. Such an argument is substantiated in the last parts (2.2 and 2.3) of the second section by discerning and interpreting the four distinctive aspects of the plan (section 2.2.1 – 2.2.4) as a way of reimaging urban form and as generic design and planning strategies for making a framework that facilitates the unfolding of coherent metropolitan growth over a period spanning as many as four to six generations. Renewed optimism in the possibilities of such a framework resonates in current trends such as 'Landscape Urbanism', 'New Urbanism', and other 'Green' design agendas.

In contrast to the insights and potential contribution of the historical making of the plan and its spatial articulation, its materialisation has developed serious shortcomings from the aspect of sustainability. While taking a stock of these shortcomings in the 'past' and other significant sustainability issues that were not addressed in the historical making of the plan, the third section makes the attempt to formulate a normative synthesis for the 'future'. The intention behind the synthesis is to combine the 'past' shortcomings and (the reinterpreted) distinctive design aspects in the historical making of the plan (second section) with the theoretical assertions (made in the first section) in order to understand and imagine prospects for working towards SBE in an integrated metropolitan framework for Rawalpindi-Islamabad area. These prospects are translated and presented as conclusions in the form of design and policy recommendations for developing an 'Integrated Metropolitan Plan' (IMP) for Islamabad-Rawalpindi Region. They are organized under four flags (3.1-3.4), which represent a thematic reflection on integrated ways of working towards a sustainable metropolis of the future.

2. SUSTAINABILITY PARADIGM, BUILT ENVIRONMENT AND THE QUESTION OF URBAN FORM

The concern of this section is to formulate a premise based on a set of assertions for discussing and conceptualizing the idea of working 'towards sustainable built environment' (SBE). To start with, the first assertion made is that

Sustainability is too broad a concept, and built environment too complex to comprehend within a single conceptual framework.

On one side, the term sustainability or sustainable development implies striking a balance between the environmental, social and economic processes to unfold a kind of "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). On the other side, the term 'built environment' refers to the result of the alteration processes of the natural environment (space) by human activity (from agricultural production to planned organization of space through design, construction, management and different uses), ranging in scale from hearths to cities, which also includes supporting infrastructure, water and energy networks (Mahsud 2011). In this sense, the working 'towards SBE' would, first and foremost, imply focusing on finding and conceptualizing 'ways' whose general target in such alteration processes is enhanced sustainability and resilience of the built environment. Such ways can very well range from innovation in economic activity, social relations, industrial processes, and modes of consumption to land-use and their governance, and whose effects can very well be multi-scalar and multi-dimensional. The question of working towards SBE then is: how to comprehend such ways as to their effects in the built environment allows unfolding SBE? With this the second assertion:

The conceptual challenges of working towards SBE are multi-dimensional and complex.

Since the introduction of the concept in 1987 (WCED 1987), there has been a proliferation of competing notions of what sustainability is to the extent that it has become an empty box, a fragmented concept: sustainability is what you make of it. At best, it is qualified as an integrative framework (UNCSD 2009). With respect to the built environment, different disciplines (planning, design, geography to social sciences) have produced a multitude of competing notions of sustainability in relation to the use, production and consumption of space and resources in the built environment. Some focus on the performance aspect of systems (proliferation of sustainability measurement indexes, eco-labels, etc.), others qualify the ethical dimension as central to the sustainability debate, and yet others look at design, policy, technology and management as the proper arenas for dealing with sustainability in the built environment. Even just listing the multitude of these competing notions is beyond the scope of a single article or even a book. Surrounded and conditioned by much of the confusion and ambiguities created by this multitude, 'sustainable' architecture and urbanism is increasingly being acknowledged as a 'contested concept' (Guy, 2001). Therefore, the intention of this section is not to define what sustainability is, but – third assertion – to clarify the connections between

sustainability paradigm[1] and the built environment through the lens of urbanism and urban form as a way of conceptual working towards SBE.

From a broader paradigmatic perspective, sustainability is seen as emerging out of the previous half century Environment-Development politics as a brokered synthesis by international institutions. Besides its oft-cited definition by the World Commission on Environment and Development of 1987 (see above),[2] several key texts and international conventions are cited in the evolution of the sustainability discourse.[3] A shared understanding of sustainability within this perspective implies economic growth together with the protection of environmental quality and social well being, each reinforcing the other. In essence, sustainability calls for a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own. Hailed as a paradigm shift in geo-political consciousness that promises to reform the western industrial elite from inside out, sustainability has become the "esperanto" of government agencies and religious systems unfolding a "new enlightenment" (Mark 1999, 2003). In this new enlightenment, one discourse is becoming dominant – that is spread through most international media, actors, institutions, conventions, texts, etc. - that communicates the need for an ecological revolution (Ingersoll 2006; Rompaey 2009); a combination of visions and perspectives that point to the need for a change towards a sustainable ecological equilibrium in human activities. This 'new' discourse implies a paradigmatic shift from the 'old' optimistic modernist discourse that is based on the ideas from the 'old' enlightenment, and which states that humans can conquer nature, that history is a straight positive curve, and that technology is our savior when things go bad (Rompaey 2009). However, the transition from one dominant discourse to the next is a gradual evolution and must not be viewed as a black and white opposition, rather a field of tension and ambivalence. Intermediate positions, views and perspectives characterize such a field. For example, on one side there are the sustainability skeptics (Heartfield, 2008), critics (Mark 2003; Pyla 2008), disciplinary orthodox, climate centrists, cultural essentialist, traditionalists (Citta slow, krierstad,..) and so on. On the other side, there are the adherents of hybridism and managerialism that promote transition management, governance, 3P / 3E, and sustainability as an "integrative framework" (Mahsud 2011; UNCSD 2009). It is these views and perspectives between the two discourses that structure, articulate and evolve the sustainability paradigm. Therefore the fourth assertion is:

Sustainability is not a set of static values or dimensions that needs to be satisfied or brought in equilibrium in a 'once and for all way', rather it is a continuing social construction, a dynamic and evolving paradigm that is influenced by a multitude of broader societal forces, views and perspectives.

Within this broader and evolving nature of the sustainability paradigm, however, there is an urgent need for sound theoretical work on linking the critical position of the built environment / urban organization at large with that of the role of related design fields (architecture, urbanism and planning). On one side, unsustainable patterns of urbanisation are identified as the most important challenge for the 21st century demanding change in urban design and planning practices (UN-Habitat 2009). On the other side, the ensuing scientific research on sustainability, however, continues to focus mainly on the issues of global-molecular level (Climate-change, Green-house-gases, etc.) and related techno-scientific fixes, and tends to skip over the durable and deterministic attributes of design related to the built environment (buildings, towns, urban areas, infrastructure, etc.) and their multiscalar effects (Mark 1999; Ruano 2000; Ingersoll 2006; Farr 2008). The alarming pace of global urbanisation (30% in 1950, 50% in 2010 and 70% by 2050) and the consequences of the urban space consumption per capita at the micro-scale on the meso and macro scales (sprawl, emissions, energy and social risks)[4] have fed a consensus (Ingersoll 2006; UN 2010; Pont 2010). The fifth assertion is:

The sustainability question is intimately tied with the urban question.

The correlation between resources (energy, material, etc.) consumption and concentration of urban area (form), and the question of providing water, transport and waste management infrastructure in a sustainable way – the sixth assertion - intimately ties the question of urban sustainability

1 *Paradigm can be understood as a platform of theoretical ideas, a conceptual model, a worldview underlying the theories and methodology of a particular scientific subject, a particular philosophy of life or conception of the world.*
2 *The WCED report is also called as Brundtland report, named after the chair-woman of the commission, Gro Harlem Brundtland.*
3 *They range from Rachel Carson's Silent spring [1962], Barbara Ward's Spaceship Earth and the club of Rome declaration [1972] to Rio conference [1992], UN Framework Convention on Climate Change [1994] and the Kyoto protocol [1997].*
4 *In the European context, the situation is even more alarming: 83% of the European population will be urban by 2050, urban sprawl expands faster than population rise - 8000 km^2 land [size of Luxembourg] became urbanised in just 10 years [1990-2000].*

to that of its form and design. This implies the need for – the seventh assertion - the sustainability question to be asked in terms of urban life, and developing new / more sustainable ways of conceiving the design of the future built environment (Williams 2000; Jenks 2005). This is a concern that has characterised the green and ecological consciousness within the disciplines of architecture and urbanism, which is brought – in a more comprehensive way – together as a foundation for developing the nascent field of sustainable urbanism.

2.1 Sustainable Urbanism: A Discipline in Pre-Paradigmatic State

The ambition of the nascent discipline of sustainable urbanism is to combine environmentalism and urbanism for unfolding SBE (Adriaens 2005; Farr 2008; Lehman 2010). This implies sustainable urban development as a new economic base that will usher an era of green developmentalism. Sustainable urbanism as a discipline is legitimized for meeting the challenges of sprawl, GHG-emissions, transcending functionality, achieving higher spatial quality and creating sense of place and identity (Farr 2008; SUD 2005; Delgado 2005; Naison 2009). Aiming at "a comprehensive reform of the built environment" through a "more human-powered and less resource-intensive life-style" (Farr 2008), sustainable urbanism however relies mostly on traditional patterns, sub-urban and isolated initiatives as examples (TPF 2007). Moreover, it promotes the realisation of green buildings, neighbourhoods, transit-oriented-developments, and communities of different sorts without scaling their effects in relation to urban form (Frey 1999; Jenks 2005; Ingersoll 2006; Robert 2008). Several manifestoes and generic attributes are bestowed upon sustainable urbanism – New / Eco / Green urbanisms, low-rise, high-density, mixed-use, mixed-tenure and energy efficient development etc. – without engaging critics, and advocates of cultural essentialism, traditionalism, hybrid, and evolving sustainability attributes (William 2000; TPF 2007; Heartfield 2008; Edwards 2001; Williamson 2003; Guy 2008). Furthermore, conclusions are drawn, such as, "no viable model for sustainable planning exists in the world" (DCF 2009). This lack of contradiction and the drawing of exaggerated conclusions points to a lack of theoretical maturity of the discipline of sustainable urbanism. It represents a state of pre-paradigmatic confusion, reflected in the ameliorative critique that argues for a multiscalar, inter- and transdciplinarity based approach for its theoretical and epistemological (re)structuration (Mahsud 2010a; and 2010b).

Addressing the lack of theoretical maturity of the sustainable urbanism discipline is a complex endeavour precisely because of the complexities of the scale and variety of urban forms in different contexts, and the intimate interweaving of environmental, social and economic issues (Jenks 2005). On one side, sustainable urbanism continues to mainstream the 'optimal size' bias and an obsessive focus on green buildings and isolated/sub-urban neighbourhoods with little attention to provide a framework grasping their multi-scalar effects. While seeking a scientific and epistemological base in ecological theory, sustainable urbanism remains entangled between the main lines within ecological debate, such as deep ecology, green ecology and social ecology (Ingersoll 2006). On the other side, the research on urban form in relation to sustainability has been marginal – considering urban form as too vague a concept, and thereby, more focus on the building scale – and fragmented between advocates for compact, polycentric and of open / green city models. These models represent a sort of 'one size fits all' solutions, believing their adoption would unfold SBE. Transcending such an approach is necessary for achieving theoretical maturity of the discipline, which means developing new conceptual and methodological frameworks for assessing the performance of urban form and identifying the right scales and strategies for multi-scalar restructuring of urban system (Jenks et al. 2005; Adriaens 2005; Moulaert 2010; Lehman 2010; Mahsud 2010b). This implies bringing together the ideas and strategies of sustainable urbanism and models of urban form within a single framework for mapping their multi-scalar relationships, so that right scales and strategies can be identified for working towards SBE. Neither the global processes nor the building scale alone as a focus, theorising such a framework demands a scale-sensitive focus on reimagining urban form as a factor of sustainability.

2.2 Reimagining Urban Form as a factor of sustainability

Urban form encompasses physical layout, morphology, design, and the three-dimensional character of the urban fabric. It manifests different configurations of urbanistic features (land-use, density, public space, infrastructure) and articulations (grid, linear, radial, hybrid) that are influenced by spatial forces underlying urban growth and development [Mahsud 2010a]. Such a complexity in the notion of urban form is further complicated by the existing urban situation where it is hard to define or even distinguish what is urban i.e. urban / city, its periphery and rural / countryside have merged together in forming an urban field (Ingersoll 2006). New districts no longer lie on the edge of the existing urban complex, but are amalgamated into a much wider and more diffused configuration (Adriaens 2005). Neither comprehendible nor sustainable, the present urban situation has unfolded an upsurge in scientific research on rethinking

the concept of urban form and devising new models for the restructuring of urban systems. Such a research has unfolded along four main lines: Compact city – based on higher densities that emerged from the EU green paper (1990); Green city – advocating the primacy of environment [green and blue networks] in structuring urban form [Ruano 2000; Lehman 2010]; Polycentric city – arguing for the primacy of regional framework and a polycentric structure in organising the urban landscape (Jenks 2005; Knox 2011); and Just and Socially Cohesive city – advocating the primacy of social innovation, environmental justice and politics of urban ecology for restructuring the urban form (Moulaert 2000 & 2010; Fainstein 2010; Heynen 2005). On one side, however, there are increasing disagreements amongst the advocates of different models (Brehney 1993; Frey 1999; Jenks 2005; Droege 2007) and the continued lack of differentiation in the notion of urban form (Mattias 2008). On the other side, a consensus can be discerned in the analytic and conceptual rethinking of urban form along the lines, such as: the relative autonomy of urban form is not an absolute one i.e. urban form should not be understood / conceptualised as a priori form, but as a resulting system capable of organising parts of the urban territory in a dialectical way (Panerai 2004); urban form is not a physical entity alone that is amenable to analysis and intervention but rather a perpetually organising field of forces (economic, social, etc.) in movement, capable of self regulation, innovation and adaptability at different spatial scales (Kwinter 20100.

From the foregoing, it can be deduced that urban form is a dynamic field shaped by spatial forces that are inter-related and interdependent at several scale levels producing multiple relationships and effects (Jenks 2005; Knox 2011). Comprehending the sustainability of such relationships and effects involves re-imagining and evaluating the performance of urban form in terms of sustainability, which requires a multi-scalar approach (Mahsud 2010b). Re-imagining urban form as a factor of sustainability is crucial for: i) efficient provisioning of services, infrastructure and energy, and maintaining a clearer visual and spatial order of the built fabric and open space / agricultural landscape (Ingersoll 2006); ii) for cohesive and integrative distribution of urban fabric within a city or region, which is decisive for the spatial quality that can be achieved (Pont 2010); iii) for unfolding new patterns of space within cities and regions, which could allow preservation of good agricultural land, prevention of urban sprawl, protection of countryside, and facilitate the accessibility and liveability of urban environment (Jenks 2005; Pont 20100; iv) configuration of cities tend to be very long lived, but building may be replaced more frequently, and that form of urban areas and buildings within them don't determine sustainable behaviour, but they might provide the right settings for it (Jenks 2005). It is in this context that the historical development of the plan of Islamabad becomes interesting as a case that represents a different but relevant re-imagining of urban form.

3. THE CASE OF ISLAMABAD

Re-imaging urban form in the case of Islamabad owes, mainly, to dealing with a particular 'context' and illustrating the urbanistic ambition for an 'optimum urban settlement of the future', which are both relevant for drawing lessons for working towards SBE. Explosive growth, urbanization and modernization euphoria of the 1950s-60s that characterized the context within which Islamabad project was conceived has not gone away; most of the sub-continent is still experiencing high rates of growth and urbanization in comparison with European and North American contexts where they have significantly lowered. Doxiadis' ambition to design Islamabad as a 'City of the Future' (COF)[5] has also become more relevant due to the challenges of sustainability that is fuelling a renewed interest and ambition in exploring ideas and alternative futures for urban organization at large. The plan of Islamabad becomes interesting as a peculiar combination of theory and practice, mediation of agendas (political, economic, developmental, see 2.1), preservation and enhancement of the landscape in a context of thriving metropolitan growth frenzy (Mahsud 2008). Moreover, it is also relevant for Doxiadis I claim that the frame for the capital metropolitan area he has created would last for centuries, and the fact that its making is based on an enormous scale of architectural / planning efforts i.e. over 4000 drawings and 8000 pages of text (DA 1960). The contextual conditions, ambitions and agendas led Doxiadis to propose a plan for the specified area (3626 sq. km, see Figure 1) that conceives a modern metropolis of 3 million

5 *Doxiadis formulated COF as a theoretical project with the aid of Ford Foundation (FF) for "cross cultural training in urban planning" by using the opportunity created by the new capital project to demonstrate and develop a methodological framework for the design of an optimum urban settlement of the future. Islamabad offered Doxiadis a favorable juncture of circumstances - assembling an international team of interdisciplinary research experts at FF ìs expense, and pursue the ambition to enlarge the scope of architectural modernism to the international development and postcolonial context characterized by cold war politics and modernization euphoria – to rethink modernism and develop a certain view about the future of urban organization at large. For an overview of the conception of the COF project based on correspondence between Doxiadis and Ford Foundation, see Mahsud 2008, pp. 138-149.*

inhabitants by the year 2000 and is composed of four components: the new capital, a national park, the existing city of Rawalpindi and the surrounding hinterland. In the Master Plan (1165 sq. km, see Figure 2), each component was defined to have a distinct as well as a mutually beneficial role in unfolding the metropolitan focus of a new country

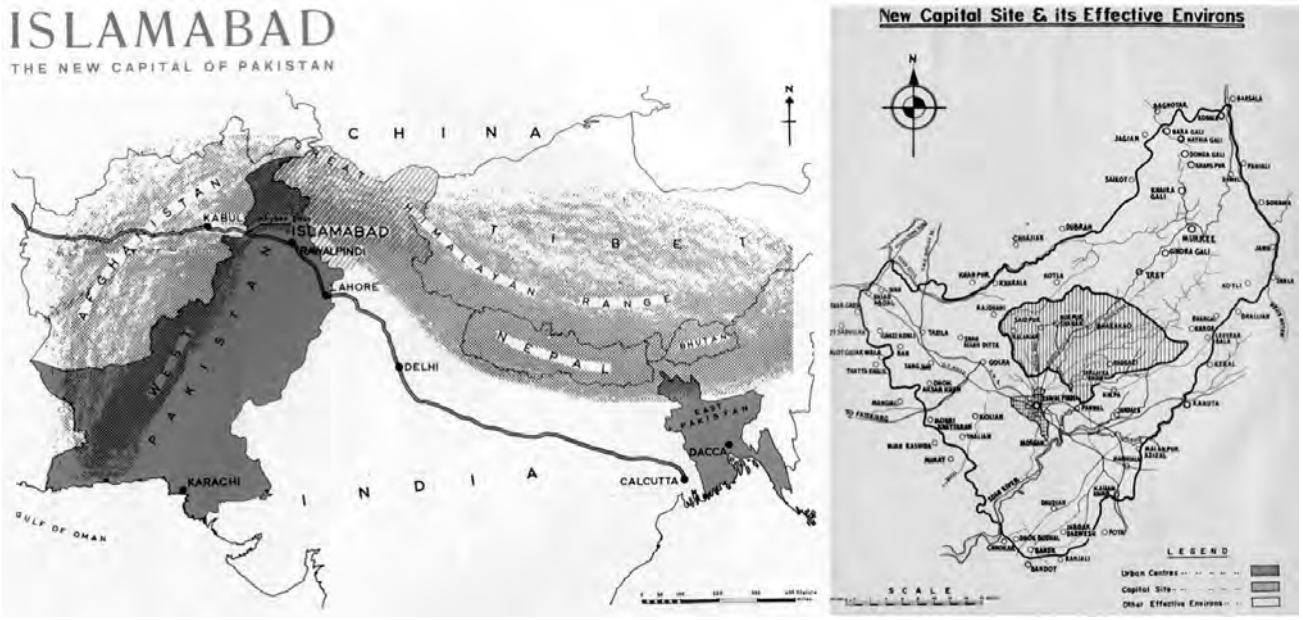

Figure-1: Federal Capital Commission, Location of Islamabad, 1959, Area specified for the creation of the new capital next to Rawalpindi city on the historic grand trunk road. Source: Socio-economic survey, GOP (1960), p. 2; DA (Bulletin 64), p. 1.

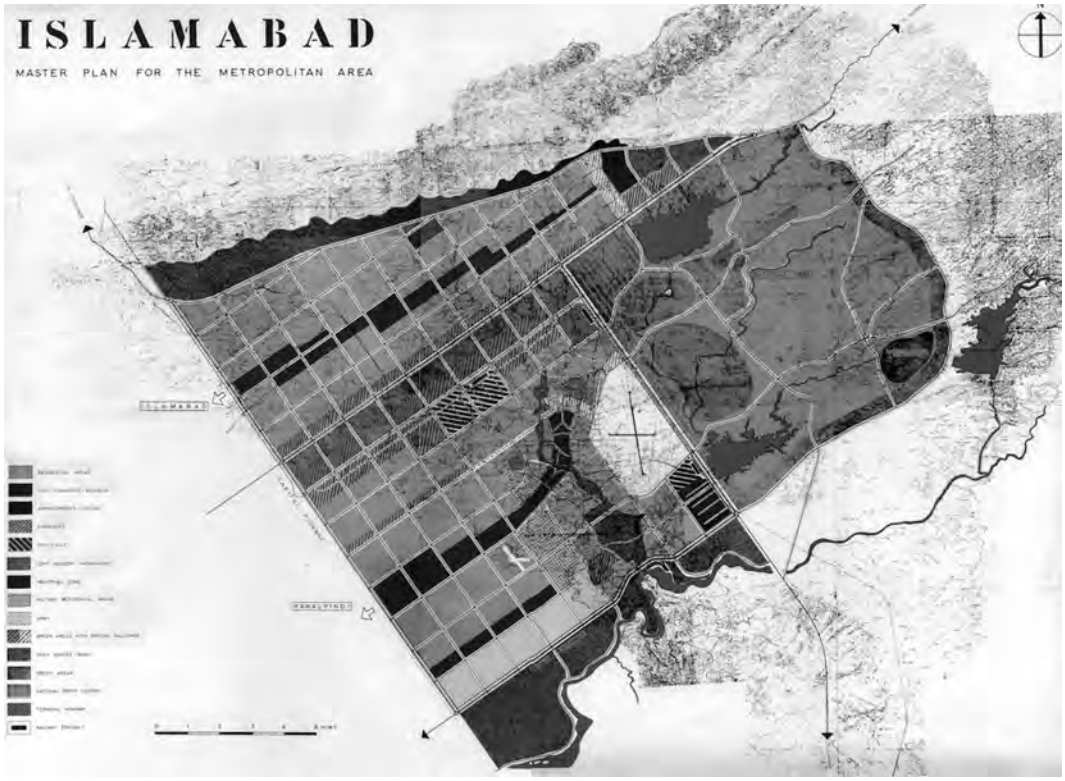

Figure-2: Doxiadis, Final Master Plan for Islamabad, 1960. Source: DA 1960, CDA-A (Capital Development Authority Archives, Iqbal Hall, G-6, Islamabad).

but an old nation (Mahsud 2007).

Fifty years ago the main lines of Doxiadis' Master Plan for Islamabad were being laid out on the landscape that has become today the symbolic focus of the national life. Over the last fifty years, the city has not been static. It has been dynamic; constantly changing, growing and evolving in its architecture, urban spaces, socio-cultural, economic and political life as well as the citizen's discourse about the city (Mahsud 2011a). The extra-ordinary achievement of the plan is that it provided a flexible spatial framework for this gradual evolution towards becoming a metropolis of the future. This framework for growth and change is the illustration of Doxiadis' ideal COF. Embedded in the framework is the idea that size and scale of the city cannot be fixed. Rather it is the trajectory of growth and change and its relation to the surrounding landscape (Margalla hills and national park in the case of Islamabad) that can be designed. Such an understanding of design did not exist at the outset, rather it developed and evolved in the process of the making of the plan that spanned over four years (1959-63). This understanding of design through reflections and reformulations in the making of the plan led Doxiadis to stretch the notions of City and Future beyond their previous limits (Mahsud 2010).

Doxiadis introduced the spatial concepts of Ecumenopolis (see Figure 3) (representing the future city of the inhabited globe) and Ecumenokepos (the natural environment as a global garden). Their harmonious coexistence at various scales is his vision for global urban organization and urbanism (see Figure 4), of which the case of Islamabad is claimed as the best illustration at the metropolitan scale (Doxiadis 1965). Development of such a vision of urbanism illustrates the transformation of the modernist ideas about the city, urbanity and the built environment (Mahsud 2007a). Behind such transformation was the ambition to reform the theory and practice of modern architecture and urbanism that Doxiadis advanced through his self-proclaimed science of human settlements as Ekistics (the science of human settlements): outlining a scientific, interdisciplinary and global urbanism meant to combine development with environmental protection and look at the issues of settlement

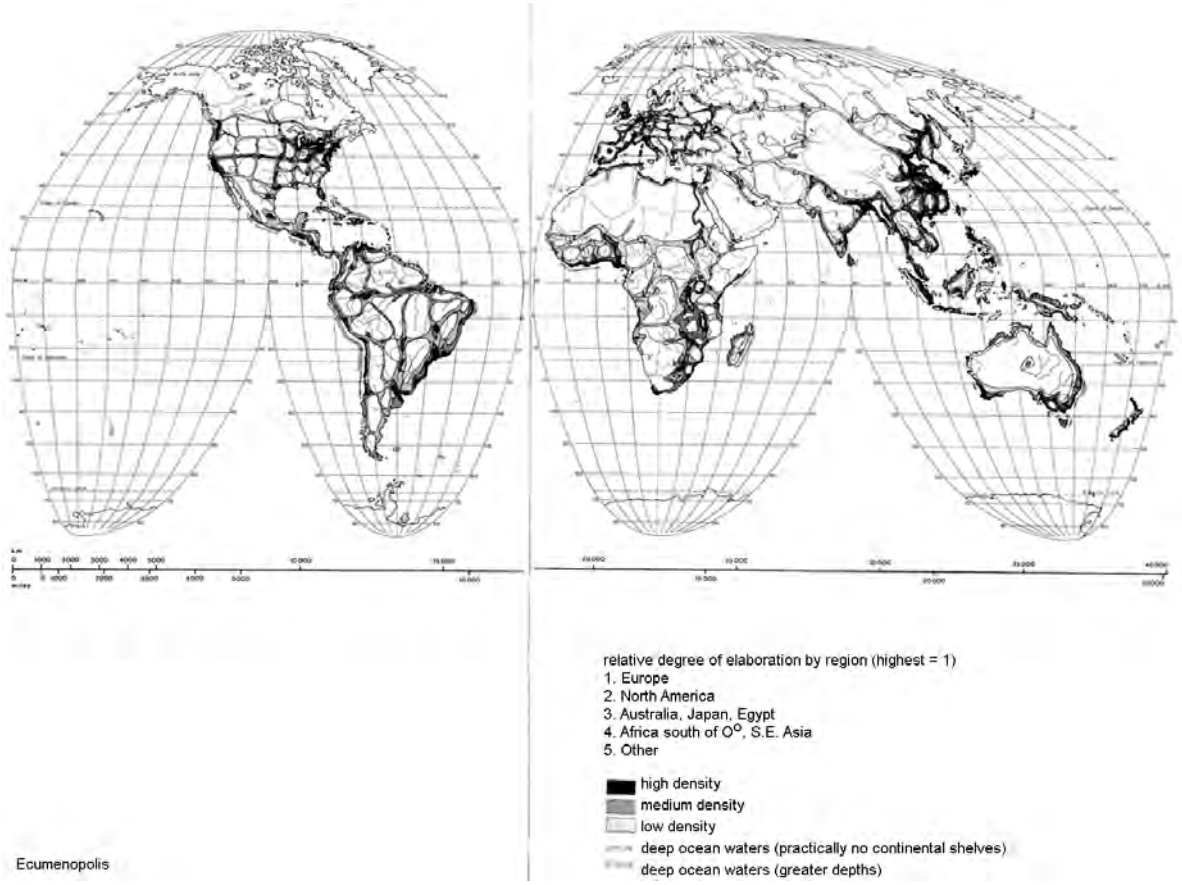

Figure-3: Doxiadis, Spatial vision of 'Ecumenopolis' (the city of the inhabited globe). Source: Doxiadis (1975), p. 234.

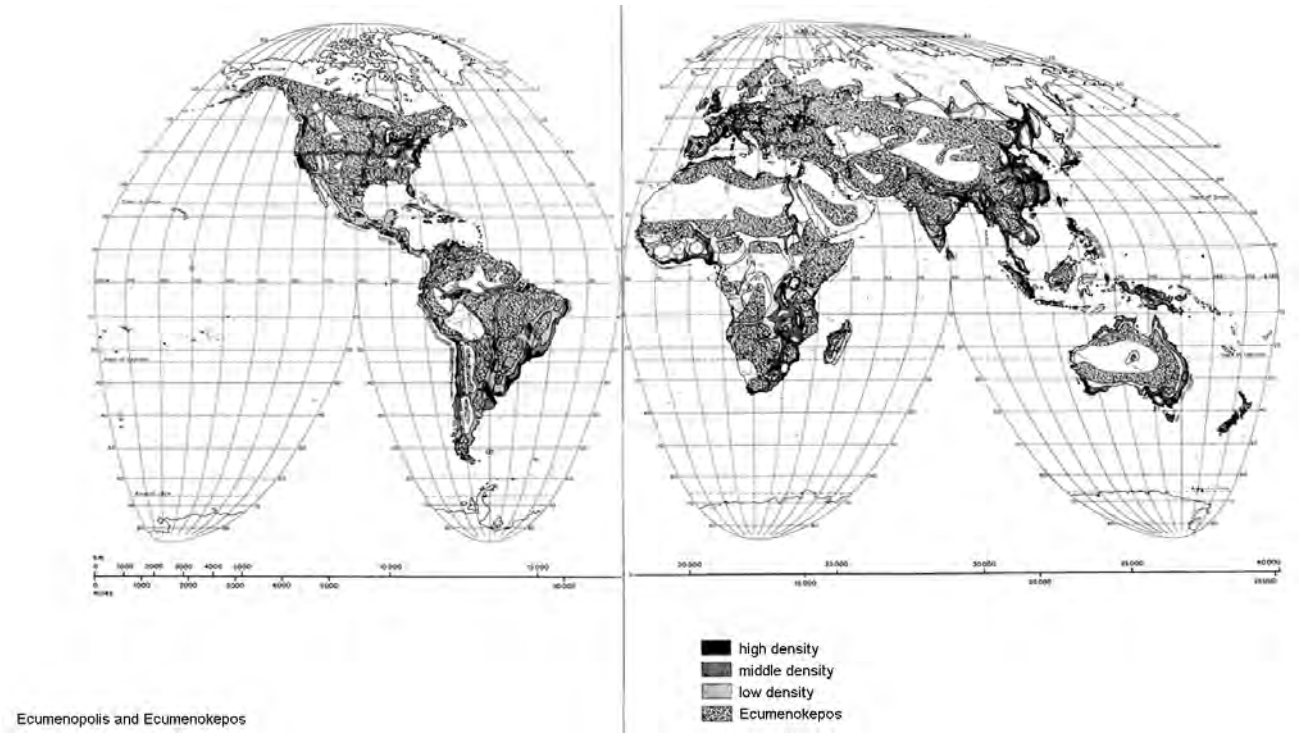

Figure-4: Doxiadis, Spatial vision of 'Ecumenopolis' (global city) in harmony with 'Ecumenkepos' (global garden), 1963-68, scenario for unchecked explosive urbanization leading to awareness and a concern for global environmental protection. Source: Doxiadis (1975), p. 250.

design and planning from a holistic perspective (Doxiadis 1968; Mahsud 2008; and 2010). In such an urbanism, the concepts of 'scale' and 'time' are central for dealing with issues of growth and change. While Ebenezer Howard and Le Corbusier (inventors of the Garden city and the Modernist city ideas, respectively) focused on Tomorrow, Doxiadis focused on the dynamics of growth and change, incorporating them each into the design problems of 'scale' and 'time', which, in turn, led to his concept of Dynapolis (a dynamically growing city). This concept is both descriptive and prescriptive—as are most of his other concepts—showing his peculiar blend of theory and practice. Considering cities growing organisms, Dynapolis qualifies "the optimum speed of growth" of the city and its "relationship to the total space around it" as the central questions for development and design practice i.e. plan-making (Doxiadis 1970; Mahsud 20100. While devising a certain metropolitan framework, the development of the Dynapolis concept in the making of the plan for Islamabad unfolds a synthesis based approach to urbanism (Mahsud 2011a).

3.1 Mediating agendas and development through urbanism: A framework for growth and change

Not so far from what the concept of sustainability as an integrative framework implies – to mediate social, economic and environmental agendas in a way that development remains sustainable – Doxiadis' ambition in the making of Islamabad as a COF was to mediate various agendas through urbanism. Urbanism as a discipline at cross-roads [architecture, landscape architecture, urban planning] that encapsulates both the theory and practice of development was seen by Doxiadis as a synthesis field (Mahsud 2008). While accommodating political, economic, and technological agendas, urbanism was hoped to release the latent socio-cultural potential, a vital element in achieving development. In Doxiadis I believe, the emphasis on economic (production) aspect alone cannot achieve development. Rather, it is the mobilization of development dynamics through urbanism that he advances as 'self-accelerating', which releases expanding internal forces for further development (i.e. sustained development). With such an understanding of the capacity of urbanism, Doxiadis attempts to mediate several agendas in the making of the master plan that characterize the context surrounding the Islamabad project.

The genesis, conception and planning of the Islamabad project happened in a highly technocratic way under the aegis of the then new authoritarian regime of Ayub Khan (ruled. 1958-69). The project was conceived in the absence

of any democratic political representation or public participation. As such, the main stakeholders were the new regime, their appointed FCC (Federal Capital Commission), a host of advisors, the 14 committees represented by various government departments, and the chief consultants (Doxiadis Associates). Behind the conception of the new capital project, there was a peculiar 'development euphoria' of the late 1950s Pakistan as a context that was shaped and characterized by mutually intertwined agendas of several stakeholders and events: the need for a new capital for the state; several attempts to materialize a capital project in and around Karachi that did not realize; political instability in the first decade of post-independence Pakistan; lack of the political legitimacy of the new authoritarian regime of Ayub Khan; the US foreign policy interests amidst cold war; transformation of the planning board (1954) into a planning commission (1959) with the assistance of Harvard advisory group, and their conception of the first five-year development plan in which Doxiadis had been engaged as 'housing and physical planning' consultant since 1954.[6] The regime of the then president Ayub khan can be seen as the principal stakeholder in the Islamabad project, because the project was the outcome of their conscious political decision and part of their ambitious modernization and nation building agenda (Mahsud 2008)[7]. The broader political agenda of the regime was to install stability and order, re-invent and modernize the state, find legitimacy and represent unity of the nation transcending its discontiguous geography (Mahsud 2007). The regime constituted the FCC in February 1959 with Yahya Khan as chairman and several experts as members from various government departments. Doxiadis Associates were appointed first as advisor (February 1959), and later on as chief consultant to the FCC in September 1959 for the preparation of the master plan and programme.

The Federal Capital Commission (FCC) can be seen as the main stakeholder since it was entrusted by the regime with the task of formulating the agenda for the new capital project that ranged from the selection of the site, to studies and surveys of its 14 committees (topography, climate, water, soil, transportation, health, education, administration, energy, housing, town planning, land use, building materials, economy, history, archaeology and architecture), and program and policies for the project. According to the FCC, the material provided to the consultant (Doxiadis Associates) for the making of the master plan had been 'collected through investigations and studies made by almost 100 experts drawn from 46 different specialized agencies of the provincial and the central government'.[8] While studies and planning work was under way, the public announcement was made on 12 June 1959 of the specified area (3626 sq. km; Figure 1) on the Pothwar plateau next to the existing city of Rawalpindi. For the new capital project on this new site, the FCC formulated its agenda in the 'classified' document titled 'Where there is no vision the people perish' (a quote associated with King Solomon], which was based on the preceding six months of studies of the 14 committees, and internal deliberations and consultations with other members of the regime. The document was provided to the consultants [Doxiadis associates) as the client's brief. The agenda in this document can be summarized as 'entangled' that suffers from ambivalence between tradition and modernity, besides carrying certain pragmatism.[9] For a detailed description and analysis of the regime's agenda, see Mahsud 2007 and 2008. The FCC conceives the project as a 'symbol' for nation building with a "regional approach", "climate", "aesthetics" and a skeptical notion of "modernization" as main considerations (FCC 1959).[10] The project was imagined to be a reflection of the nation's larger stance towards urbanism,

6 *Doxiadis was engaged as advisor in February 1959 and subsequently appointed as consultant to the FCC in September 1959. His involvement in the Pakistani scene dates back to 1954; brought in by Harvard Advisory group as a consultant for the housing and physical planning chapter of the first five year plan, and later commissioned several projects ranging from village academies, education, infrastructure, housing and urban development in both east and West Pakistan. For more details, see Alexandros-Andreas Kyrtsis, comp., Constantinos A. Doxiadis. Texts, Design Drawings, Settlements (Athens: Ikaros Publishing, 2006), 373-386; and Mahsud, "Constantinos A.," 22-25 (see n. 2).*

7 *Constituting over 30 commissions (Federal Capital Commission – FCC - as one of them) within first 3 months, and establishing a full fledged planning commission as part of the president's secretariat shows the eagerness to articulate the structure of a modern state. Ayub is modernizing ambitions have been credited by several scholars as "nation's principal architect" by Lawrence Ziring, "From Islamic Republic to Islamic State in Pakistan," Asian Survey 24, no. 9 (Sept. 1984), 935; "the de Gaulle of Asia" by George J. Lerski, "The Pakistan-American Alliance: A Reevaluation of the Past Decade," Asian Survey 8, no. 5 (1968), 412; literally transformed Pakistan from an "ideological" to a "functional" state by Hussain Haqqani, Pakistan: Between Mosque And Military, (Washington D. C.: Carnegie Endowment for International Peace, 2005), 311; and Huntington extols him as "more than any other political leader in a modernizing country after World War II, Ayub came close to filling the role of a Solon or Lycurgus or 'Great Legislator' on the Platonic or Rouseauian model." Samuel P. Huntington, Political Order in Changing Societies (New Haven: Yale University Press, 1968), 251. For a detailed analysis of Ayub is modernization agenda, see Ahmed Zaib K. Mahsud, "Constantinos A. Doxiadis Plan for Islamabad: The Making of a 'City of the Future' 1959-1963" (PhD diss., Katholic University Leuven, Apr. 2008), 95-156.*

8 *FCC, 1960. 'Report on the preliminary master plan & programme of Islamabad', Rawalpindi: President's secretariat, Government of Pakistan.*

9 *For a detailed description and analysis of the regime's agenda, see Mahsud 2007 and 2008.*

10 *Commission on Location of the Federal Capital (hereafter FCC), "Where there is no vision the people perish," (President's secretariat: Government of Pakistan, June 1959) 3, 10-11.*

a catalyst of economic development, and a bridge between the local culture / tradition and the "imagined community" of the modern nation-state.[11] *The FCC prescribes the assimilation of local culture and common faith with a belief that its display would metamorphose the new capital into a "theatre of national culture and ideology" (FCC 1959). Though, ironically, Karachi being a cosmopolitan city already had become 'a theatre for national culture', but going to an interior location isolated from cosmopolitan influence reveals the intentions of seeking 'purity' i.e. the desire to construct a more 'pure' political climate. Besides, the location of the capital on historically important Grand Trunk Road (see Figure 1) is legitimized by continuation of tradition (Nilsson, 19730.*

The FCC clearly spelled out that the capital would be a city of limited size (300,000 inhabitants), surrounded by green belts, orchards and separated from the existing Rawalpindi city (FCC 1959). In terms of the idea of urbanity, the regime sought an efficient, clean, hierarchically organized, climatically healthful, befitting environment for the functioning of the federal government (FCC 1959). The intention of incarnating the command and control center as an isolated ivory tower and an efficient environment with limited population reflects modernistic yearnings (reminding that of Brasilia). However, abandoning the newer colonial outpost (Karachi) and enshrining the political power in renewing the older part of the country unfolds the complexity of the encounter of modernism with a context that has been evolving an architectural and urban culture predating Greek city-states by almost two millennia (Mahsud 2008). Both the regime and FCC aspires the reincarnation of this tradition and calls for the capital to be representative of the new state that was argued, at the same time, an old nation (Mahsud 2008). While unfolding an emblematic analysis of British civil-lines and cantonments, the FCC asks for the design of an environment in which government functionaries "must identify themselves with the people they serve and at the same time, set a pattern of living which people respect" (FCC 1959). However, the means to pursue indigenous inspiration (new capital separated from Rawalpindi) becomes similar to the colonial strategy of locating civil lines and cantonments at a distance from the indigenous towns-cities (Mahsud 2007).

In the regime's agenda, the eagerness to articulate the structure of a modern state prevails, representing a tremendous development potential. It is a context of fluidity; a new state immersed with post-independence crisis, uncertainty, chaos, several dynamics and a confusing situation i.e. it is not a crystallized system, not yet stable. Although, the regime gives an illusion of stability, but it is an opportunity that the engaged consultant (Doxiadis) realizes in developing something new in the sense of urbanism (Mahsud 2008). As the ambitions of the regime became clearer to Doxiadis through working with the FCC, he began to see the project as a perfect opportunity for advancing his agenda of making Islamabad a model for his ideal 'City of the Future' (COF). In this process of working together – the FCC, 14 committees, members, advisors and the consultant, etc. - on the studies and deliberations about the new capital, several agenda's (political, economic, social, spatial, etc.) began to be mediated. This process of mediation led to the conception and design of a metropolitan framework (and not an isolated capital city) for 3 million inhabitants in which the unfolding of a cohesive built environment over 4 to 6 generations became a central question. In this regard, several planning and design strategies were mobilized: capitalizing on the symbolic value of the new project; adjusting the future metropolis to the conditions and potentialities of the local landscape; institutional integration of the different functions for materializing dynamic development; enlarging the scope of the system of orthogonal axes to the metropolitan scale for devising the framework; rationalizing the pattern of movement, time and scale through reconceptualizing 'center-periphery' relations, and so on (Mahsud 2008).

First and foremost, the capital project for Doxiadis was a "political decision" that represents the greatest symbol of a nation state. Symbolic value of the new capital for him was its capacity to develop at best, a "new culture", and at least, provide a beginning towards a new era for modernization, and surprisingly give paramount importance to the naming of the new capital. In this regard, the FCC organized a public survey of a few thousand people (limited mainly to government employees, prominent members of the civil society – businessmen, intellectuals, media persons, etc.) who were given a choice to select one out of four names: 'Islamabad', 'Ayubabad', 'Muslimabad', and 'Jinnahpur' (DA 1959). The public announcement based on the results of the survey was made in favor of 'Islamabad' by the cabinet on 24th February 1960. While the naming was underway, the plan making began with identifying the potentiality of the local landscape by documenting and analyzing the morphological elements of the physical environment of the area (existing city of Rawalpindi,

11 *Mahsud, 2007, p. 62; for the concept of 'imagined community" see Benedict Anderson, Imagined Communities: Reflections on the Origin and Spread of Nationalism (London: Verso, 1991).*

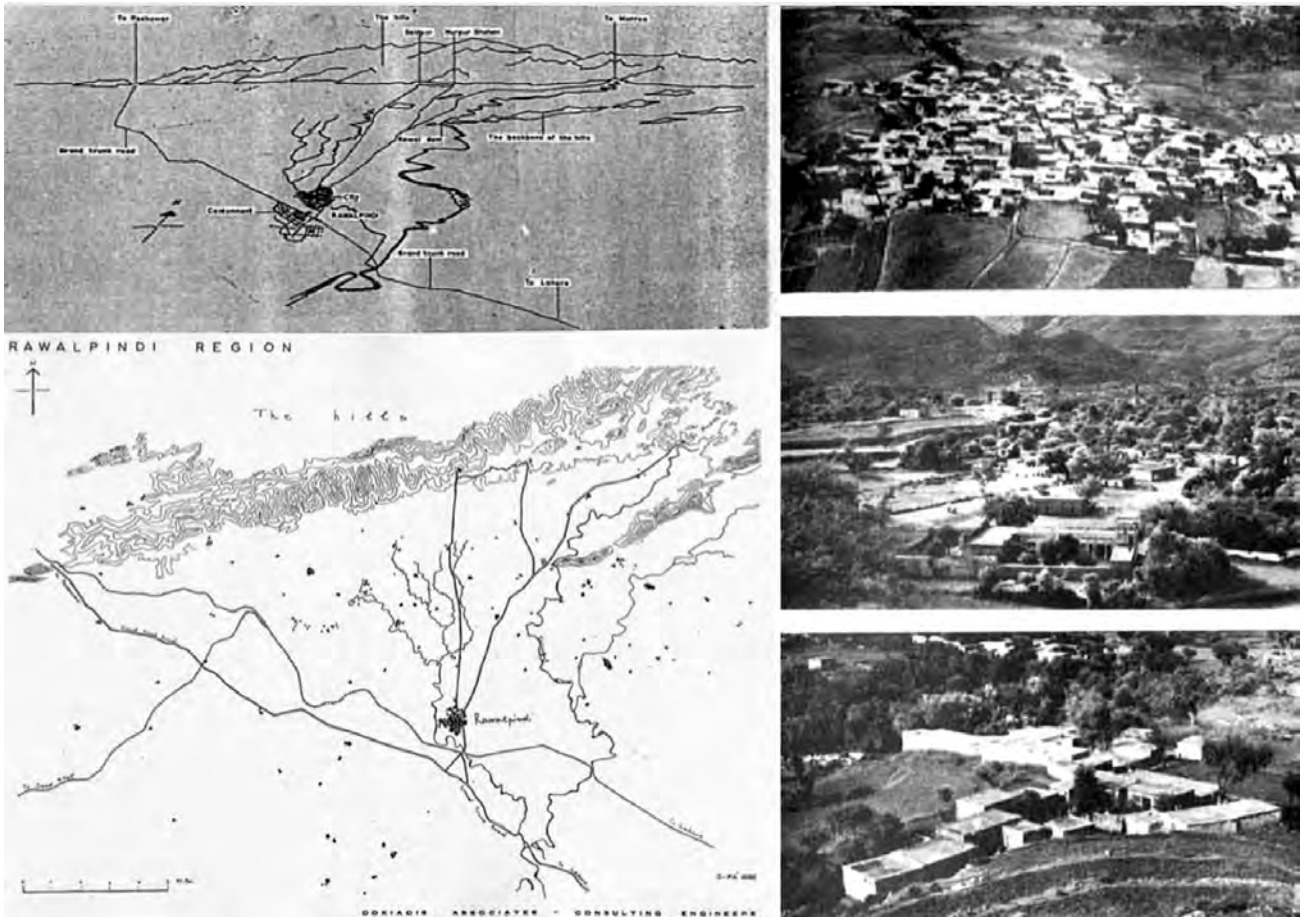

Figure-5: Doxiadis, Physical landscape of the capital area, 1959-60, Morphology of the Physical Landscape (upper left) and villages (bottom left) scattered over the area of the new federal capital (right). Source: DOX-PA 33, p. 25. DOX-PA 77, p. 229; DOX-PA 33, p. 7.

infrastructure, Margalla hills and the several villages, see Figure 5). Several points of contention emerged between the FCC and Doxiadis in the plan making process. For example, Doxiadis showed empathy for the cultural landscape of existing village settlements and their architectural character, which the FCC considered of no value (Mahsud 2007). The local vernacular gave "unity" and "character" to the landscape that Doxiadis interpreted as 'purity' and 'incorruptibility'. Whereas the contemporary architecture-culture of Rawalpindi city for him was "disorganized and chaotic", showing a peculiar anti-city agenda.

Analysis of the local landscape was pivotal in the formulation of the two central axis and the external boundaries of the plan. Doxiadis derived the first central axis (SE-NW, 14 miles long and 400 yards wide) "Islamabad highway" from the historic G. T. Road, and crowned its tip with the grand mosque (see Figure 6). The second central axis (SW-NE) followed the deepest lines of the physical landscape (river

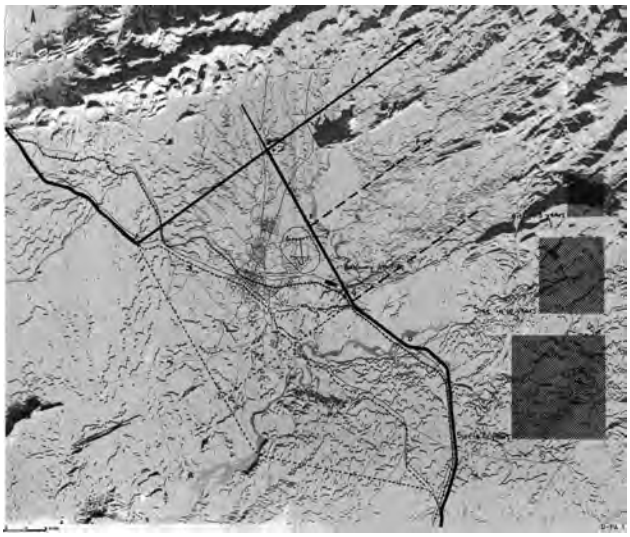

Figure-6: Doxiadis, main axes articulation, 1960. The two main axes: SE-NW crowned with Faisal mosque; and SW-NE for capitol complex location. Source: DOX-PA 77, p. 259.

valleys and parallel to the formation of hills), and at its end Doxiadis placed the capitol complex. Believing that a more enduring solution can be evolved if the boundaries are adjusted to the natural landscape features of the area, he chose the foot of Margalla hills in the north, the "Murree" hills in the northeast, "Ling" and "Soan" rivers in the south-east as external boundaries. Whereas, the south-western boundary was a choice that suited his ambition; it is in the direction of the open plain with capacity to accommodate future expansion of his conceived dynamic growth. The two central axis – one derived from historical reference and the other mimicking the physical structure of the landscape – forms the skeletal frame that Doxiadis called the "urban nucleus" (Figure 7) of the federal area and clearly stated his ambition (COF) that "we are sowing seeds of a metropolis of the future" and that this frame would last for centuries (Mahsud 2007). For materializing dynamic development within the frame, Doxiadis proposed a three-fold institutional role for the new metropolis: the "regional", "administrative", and "cultural". Besides these foundational functions, he argued that "subsidiary functions" (housing, trade, industry, education, etc.) enable the former to operate smoothly and rationally, although they are not subsidiary in themselves since they are the ones that bring a settlement into existence and secure its maintenance. Unlike the modernist model of Brasilia or even the regime's insistence for an isolated capital, Doxiadis believed that combination of all four elements is equally important in a great capital and which completes it in its function as the country's highest symbol.

The two central axes (SE-NW and SW-NE) and the external boundaries constitute a system of orthogonal axes that contained Rawalpindi, the new capital area located in the north, and the large national park in the north-northeast section (DA 1960a; 1960b). For cohesion in the early stages of development, both the new (capital complex) and the old (Rawalpindi) became the starting points for the expandable linear cores of Doxiadis' twin-foci Dynapolis. Over the skeletal frame and the cores, a grid of 2,100 by 2,100 yards was laid out as the "modulus" and "building block" of the metropolis (see Figure 7, DA 1960c). This oversized grid—marking Doxiadis' sector for 30,000 to 60,000 inhabitants is derived from an analysis of the average size of historic cities—is intended to provide historic continuity in the modern metropolis (Mahsud 2008). The distinctive design feature of this sector is the spatial variety achieved through integration and overlapping of the civic amenities and housing with the natural ravine (naalas) system (see Figure 8). All the citywide functions—commercial, residential, industrial, administrative, and even recreational—are grouped together at various scales in multiple linear spines capable

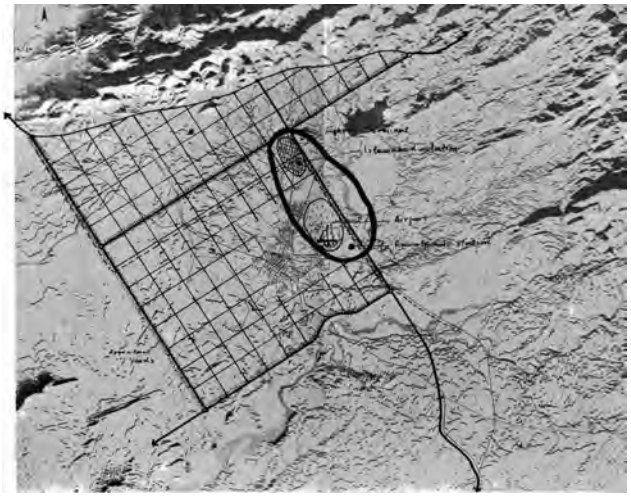

Figure-7: Main axes and other boundaries forming the skeleton, and the grid of 2100x2100 yards forming the sectors of the metropolitan area. Source: DOX-PA 77, p. 329.

of gradual extension, with their programmatic complexity regulated by the fixed size of the sector. The size and scale of the sector was meant to rationalize the movement of both pedestrian (within) and vehicular (outside) traffic in terms of time, generating a different conception of "centre" and "periphery"; both the sector (polis) and the city (metropolis) are traversable from their respective centre and periphery in the same amount of time (ten to twelve minutes) on foot and by car respectively. This owes to the size of the sector

Figure-8: Doxiadis, Model of central part of Islamabad, 1961, Blue area (CBD) flanked by two residential sectors (F-6 above, G- 6 below), & the public buildings area facing the administrative complex. Source: DA-A (Doxiadis Archives, Benaki Museum, Athens).

and the design of highways without traffic lights or level crossings, enabling automobiles to travel at a speed of 100 miles per hour (DA 1960a).

Re-conceptualization the relationship of center to periphery in the organization of urban areas is at the heart of urban form discourse aimed at developing a framework for urbanization. In both Howard's garden city and Le Corbusier's modernist city, center and periphery are organized in the classical sense.[12] *In Doxiadis' plan, the center and periphery are meant to grow interdependently in a linear and specific direction. That is the premise of his Dynapolis model, which advances an urbanism and urban form that neither adheres exclusively to the logic of the conservative garden city and neighborhood-unit paradigms, nor to the radical kind of CIAM / modernist urbanism with its strict separation of functions and zoning based on isolated towers in the parks. It also rejects the notion of a linear city. Designed as a framework, the urban form in Islamabad's plan illustrates the active unfolding of a city's development. It promotes an urbanism that is low-rise, high-density, and mixed-use in a thick mesh continually extended into, but in a dynamic relationship with, the surrounding landscape.*

Analogously, the urban form in Islamabad's plan can be seen as a synthesis for developing a framework that is based on typological enlargement of the idea of a house (solid) and a garden (void) (see Fig. 2): it is the combination of two opposites—a city and national park of almost equal size, one solid and the other void—in which a dynamic relationship is promoted through a dual strategy of juxtaposition and layering. Iteration of such a relationship in a context of global urbanisation and urban sprawl led to the conception of global spatial concepts of Ecumenopolis and Ecumenokepos (see Fig. 3 & 4), their theoretical elaboration through Ekistics (1968), and a distinctive form of urbanism that Doxiadis succinctly presented as his ideal in the illustration of Entopia (Doxiadis 1974, see Figure 9). Entopia (see also section 2.3) represents a future metropolitan Athens, a vast agglomeration structured by the penetration of nature into a variety of sectors. The old parts of the city are preserved, the new parts are kept in scale with the old, industry is located under a large park, and transportation is routed into conduits below greenways. Entopia has transcended capitalism's cathedrals of commerce (sky-scrapers) and has become a thick mesh with only community centers, in the midst of the sector, soaring above everything

Figure-9: Doxiadis' illustration [1974] of Entopia showing Greater Metropolitan Athens by the year 2121 A.D. Source: Doxiadis (1975), p. 254.

12 *One represents the horizontal spread-out centre city surrounded by six garden cities [see Howard 1898; 1965]. The other proposed the "vertical garden city" [see Hilberseimer 1960]. However, both visions remain classical in their conception of centre surrounded by periphery [see Holston 1989; and Dunnett 2000].*

else. Obedient to Aristotelian tenets, the city is humane, comprehensible, and in harmony with nature, a place where difference is celebrated and a variety of social and religious groups can coexist. According to Doxiadis (1968, p. 317), "In this city we can hope that man, relieved of all (the) stresses that arise from his conflict with the machine, will allow his body to dance, his senses to express themselves through the arts, his mind to dedicate itself to philosophy or mathematics, and his soul to love and to dream."

3.2 Distinctive design aspects of the synthesis in the framework

The distinctive design aspects of Doxiadis' plan are embedded in his synthesis for developing a framework aimed at guiding coherent metropolitan growth over a period spanning as many as four to six generations. According to my interpretation through research by design and detailed analysis (Mahsud 2007; 2008; and 2010) at several levels, this framework is informed by a four-fold synthesis of: 1) the historic and the modern city, generating the notion of the "historic city as a body of design knowledge"; 2) various scales of human association and the interaction between the grid and the built-form, producing the notion of "multiple scalarity"; 3) nature and the city, rural-urban continuum and their interdependence as a frame that breaks apart classical notions of urbanity; and 4) process design and open space system.

3.2.1 Historic city as a body of design knowledge

By eliminating isolated high-rise structures and allowing the coexistence of old (Rawalpindi) and new (Islamabad) parts of the city, Doxiadis' urbanism brings the historic city (see Figure 10) to the fore as the context for modern urbanism. Attempts to preserve human scale and recover the intimacy

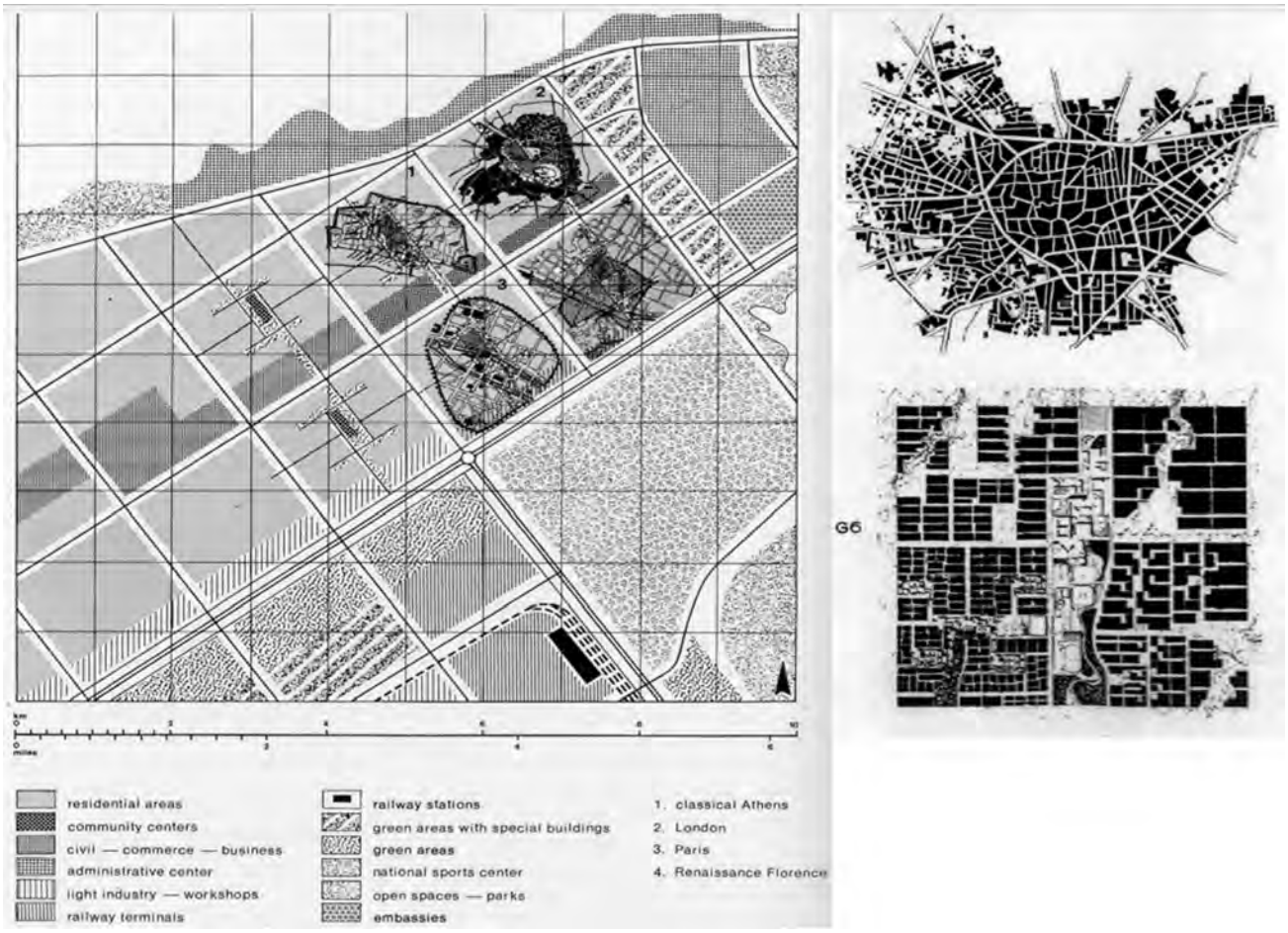

Figure-10: Islamabad's sectors as the city of the past [left image, see the first 4 sectors inserted with plans of classical Athens, London, Paris and renaissance Florence]. Unfolding the metropolitan area through the multiplication and repetition of historic 'polis' in terms of size and scale, and the figure ground (right image) of historic Rawalpindi and the first residential sector of Islamabad (G-6) at same scale. Source: Doxiadis (1975), p. 292 ; DOX-PA 81, p. 29.

of life in the sprawling metropolis are reflected in his design of new sectors that mimic the historic city in scale. The attributes of the historic city contribute to the design of public space and the relationship of solids to voids in the sector. Public space is conceptualized and designed as a system, composed of interconnected paths, streets, courts, squares, plazas, esplanades, and other open spaces, all separated from vehicular traffic and charged with a range of housing types. Variety in the closely-knit public spaces and their scale correspond to that of the building volumes, and their coordinated interaction gives a fuller, more-satisfying articulation to the architectural space of the city. Unlike the modernist city, where void prevails, Doxiadis articulates a balance between solids and voids, favoring a low-rise city—but not a low-density city. This notion of urban design is derived from an analysis of the historic city, which mainstream modernism considered irrelevant and anti-model. It obviously retains its relevance, exhibiting concerns that Doxiadis shared with some of his contemporaries (such as Sert, Bacon, and Kahn) and anticipating the return of "history" as championed by Aldo Rossi and Colin Rowe (Mahsud 20100 .

3.2.2 Multiple Scalarity

Conceptualizing a system based on interaction between the grid and the built-form by which to vary scales in urban settlement design is another hallmark of Doxiadis' urbanism. In the case of Islamabad, this is discernable through the integration of three infrastructures as spatial design grids or networks (see Figure 11): Eco or the green and blue (the preserved natural ravines forming the diagonal open space

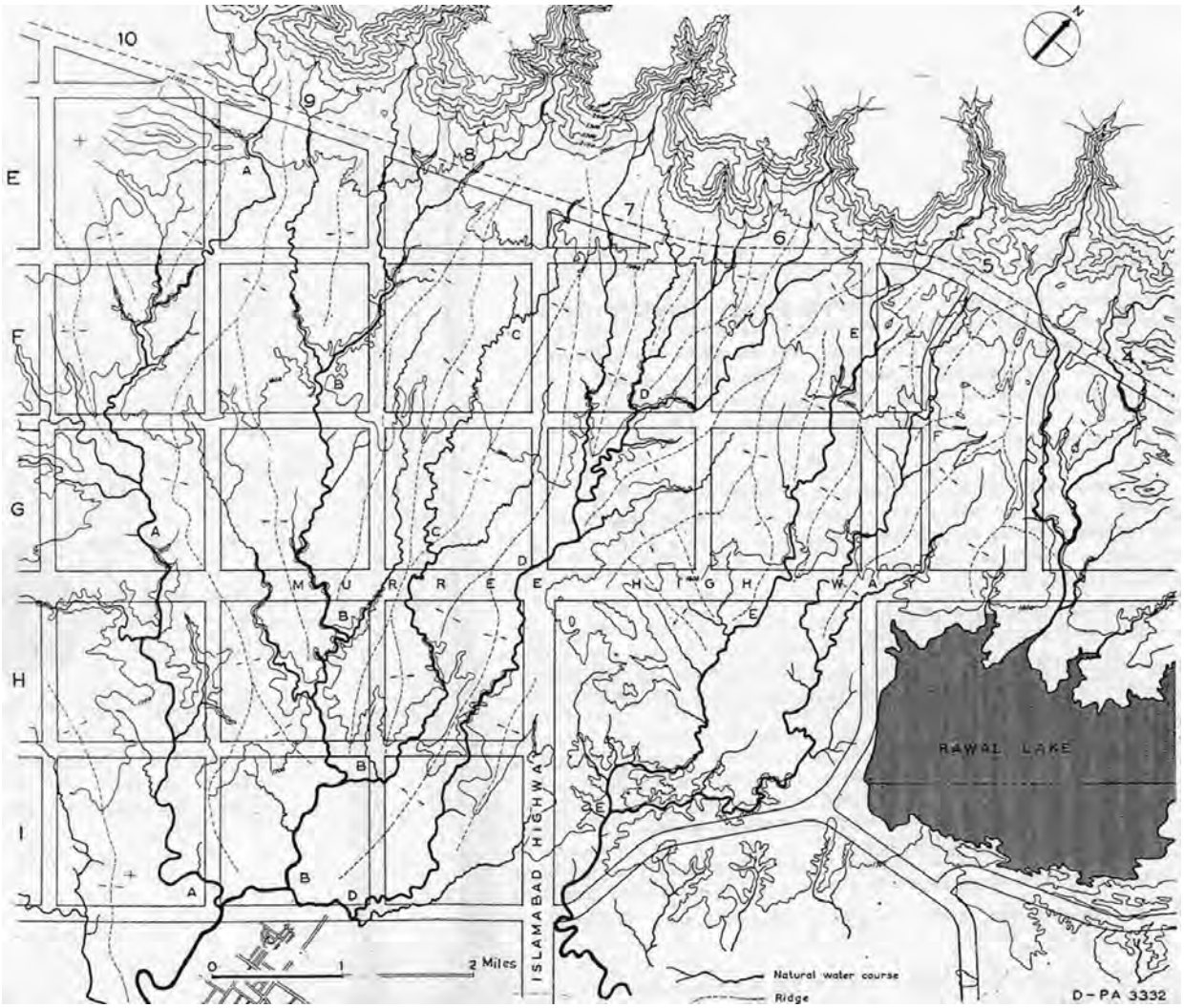

Figure-11: Doxiadis, Natural landscape and the city interlocked through Juxtaposition of the formal grid [2100x2100] over the eco-grid [natural ravines / naalas], 1961-63. The mapping of natural watercourses, ridges, and their classification. Source: DOX-PA 217, p. 13.

system), Social or the public space (the pedestrian network across the city), and Formal or the mobility (the 2,100-yards grid as mobility, utility, and green corridors). This three-way interaction and integration (see Figure 12) allows the overlapping of multiple scales (differing in function and size) of the metropolis, correlating the ordinary (housing) and extraordinary (civic, monumental) elements of the city, resulting in a kind of urban system that displays considerable coherence. Unlike the modernist city, in which zoning dominates, Doxiadis' urbanism correlates different housing types through variation of size and texture of the building fabric. For example, the central core in Islamabad becomes more finely grained as it penetrates the residential sector. Moreover, each building type is correlated with the others through the provision of common features such as courts, patios, and semi-covered areas, and their volumes correspond to the incremental increase in scale from the residential to the civic and monumental parts of the city (see Figure 13). A precise system of sizes and dimensions, determined through the use of a modulus, regulates the production of scale in both built-up and open spaces. Their coordination through the synthesis of levels of scale results in an enlarged design vocabulary, which is needed to ensure coherence at the metropolitan scale (Mahsud 2008) and in its regional setting.

3.2.3 Nature and the city: Rural-urban continuum and their interdependence

Owing to his belief that the "integration of nature and city enhances the citizen's sense of well-being," Doxiadis' urbanism promotes their systematic integration. In the case of Islamabad, the use of an eco-grid as part of the public open-space system adds certain positive attributes: it brings nature into close proximity to the residential areas; produces ventilation corridors; adds variety to the architectural treatment of the metropolitan area; makes nature omnipresent and accessible within the city; and establishes a system of urbanization in which nature and infrastructure are interlocked in a framework that avoids garden suburbs and satellite towns. Combining the natural landscape's topographical and ecological elements in a way that complements the system of open public spaces harmonizes landscape and townscape and yields the amelioration of local climatic conditions (Mahsud 2008). Such integration helps to secure the city's economic future in an ecological way. Adhering neither to the earlier notion of green belts nor to the idea of skyscrapers situated in unarticulated open green spaces, this way of conceiving the city within the framework of nature and, more specifically, bringing nature inside the city, also breaks away from classical notions of urbanity.

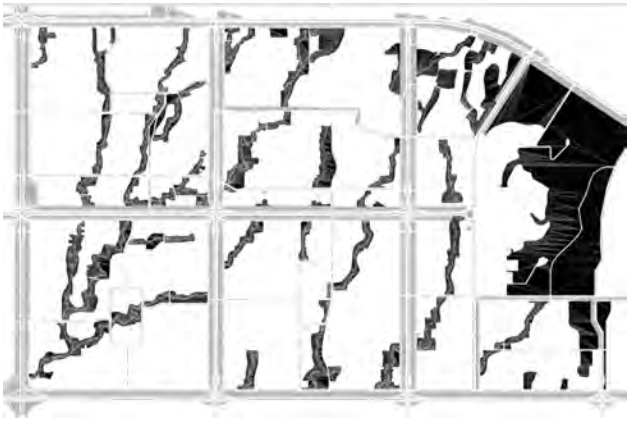

Figure-12: Interlocking of Formal, Eco, and Social grids in the first four sectors of Islamabad [F-6, F-7, G-6 & G-7]. Island spaces created are juxtaposed by building volumes with a range of housing types in the first four sectors of Islamabad. Source: Author.

Figure-13: Figure-ground relationship in the first four sectors of Islamabad [F-6, F-7, G-6 & G-7]. Interlocking of Formal, Eco, and Social grids unfolds the focus on the design of open space structure that shapes and regulates the built form. Source: Author.

3.2.4 Process design and open space system

the "plan as a process" and the "open space system as the focus of design" is discernable in the making of the plan (Mahsud 2008). These are necessary to achieve spatial coherence in the projected development of the metropolis, so that the aesthetic balance achieved in the early stages is not destroyed when additions are made. Doxiadis provided for the internal expansion of each element of the city (and for the addition of new elements) along separate axes (see Figure 14). The central axes, sector grids, and linear spines for specific housing types are the constant elements, while the content of the grid, degree of overlapping, and interpenetration of housing types are continuously subjected to feedback from the development of the previous sectors (DA 1960c; Botka 1995). This feedback process is

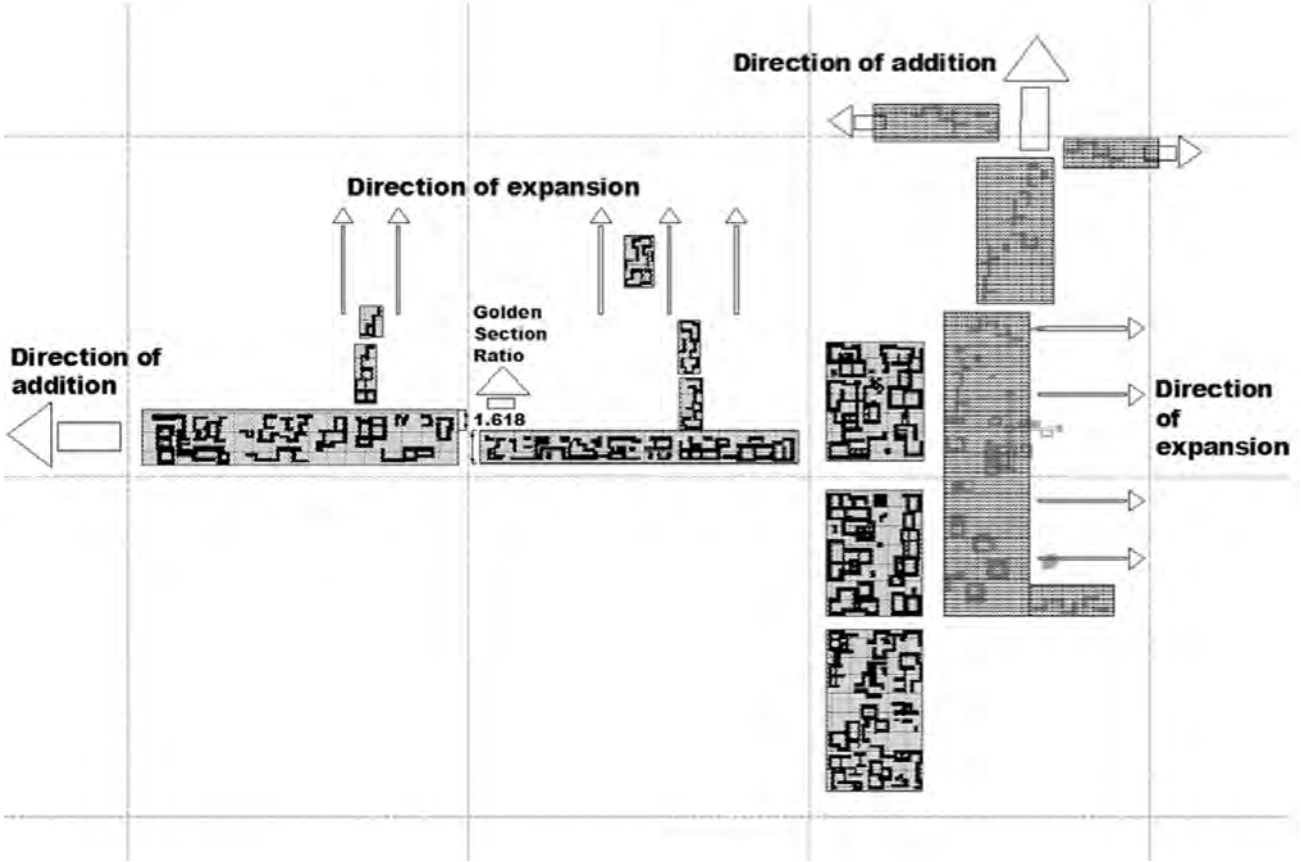

Figure-14: Urban Design synthesis based framework for CBD and capitol complex. Application of the principle of vertical axes; Direction of addition and expansion separated along vertical axes. Source: Author.

complemented by the focus of design on the open-space system embedded in the interlocking of formal, ecological and social grids. Their interlocking creates island-like spaces that are the site of building volumes, and are the locale of a range of programs and housing types, which creates a flexible framework for the coherent development of the metropolis. Such a framework based on process design and the precise articulation of the pattern of movement throughout the city-of people, machines, power, water, and other networks-within and in between buildings, and at various scales, allows absorbing change and transformations in a coherent way (see Figure 15). That is to say, the framework takes into account socio-spatial dynamics together with environmental concerns as integral parts of the process of urban development.

3.3 Rethinking the case for sustainable urbanism: Spatialising the dialectics of globalization and sustainability

Seen from a contemporary perspective, the reimagining of urban form in the case of Islamabad - and its subsequent iteration into global spatial concepts and development of Ekistics - illustrate the attempts to spatialize the dialectics of globalization and sustainability as a framework for design (Mahsud 2010). Rethinking the case of Islamabad through such a framework offers insights for the theoretical development of the discipline of sustainable urbanism. Such insights can be discussed in three ways: the four distinctive aspects as planning and design strategies up to the metropolitan scale; the harmonious co-existence of Ecumenopolis and Ecumenkepos as a framework for global spatial strategies; and interdisciplinarity and the proliferating urbanisms. The four distinctive aspects of the plan (section 2.2.1 – 2.2.4) can be seen as generic design and planning strategies for making a framework that facilitates the unfolding of coherent metropolitan growth over a period spanning as many as four to six generations. Seeing them together as synthesis making design strategies transcend the 'one size fit all' (compact or polycentric urban form) thinking that represents a major flaw in the theoretical structuration of the discipline of sustainable urbanism.

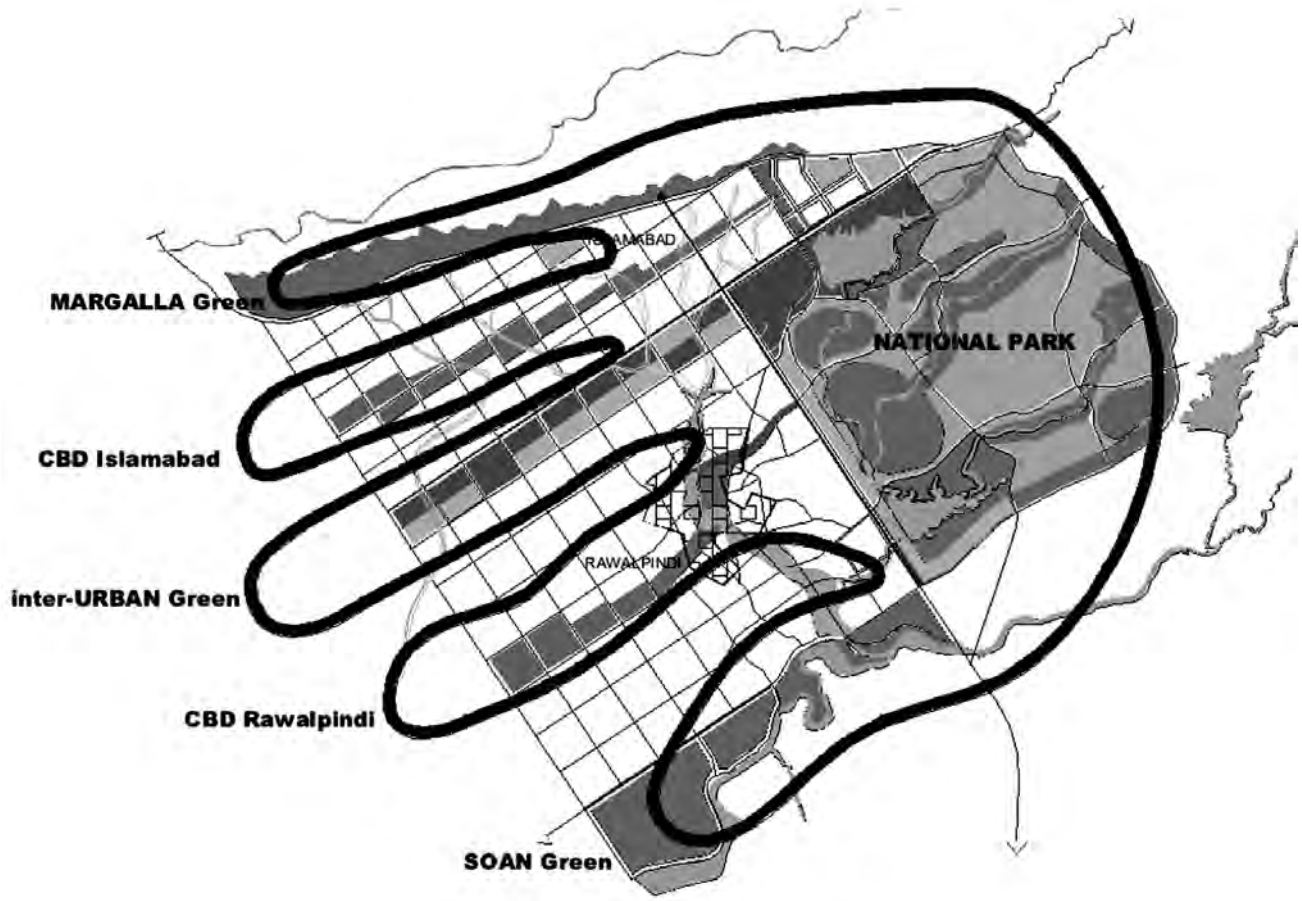

Figure-15: Author / Doxiadis, structural interpretation of the metropolitan framework for urban design, 1960. The hand form with national park as the palm, the three green zones and two CBDs as fingers. Source: Author

The global spatial concepts of Ecumenopolis (see Fig. 3 and 4) and Ecumenokepos, and their harmonious coexistence at various scales, as a framework allows to work towards generating design strategies and visions for sustainable urbanism. The strength and clarity of such a framework illustrates well the main issue of sustainability – the global ecological balance. However, one needs to be critical of the discourse such a framework generates. Behind this framework is an unusual combination of theory and practice named Ekistics, which aims at addressing issues of sustainability in a way that does not negate development (Mahsud 2008; Pyla 2002). Such an aim is fuelled by the ideological underpinnings of Doxiadis' vision; he assumed, without specifying just how it would happen, that stimulating growth-based development through urbanism would diminish the gaps between developing and developed countries, and that their economic integration would transform the differences between East and West, capitalism and communism into some form of a global federalism (Bromley 2003). The urbanism that he promoted is a curious mix of pragmatism and idealism, a vision of what he called an anthropocentric Entopia (see Fig. 9). Neither successful practice, nor utopia, nor dystopia, Entopia (in place) was the benign face of his urbanism. Entopia is thus a middle ground promoting what Doxiadis believed was feasible: a universal democratic society consisting of communities that are not aggregations of structures and infrastructures but rather organic human settlements capable of growth and change (Winnick 1989). Such a society ought to have freedom of choice. This implies replacing the production of definitive plans for cities all at once by flexible and adaptable frameworks whose designs are informed by a more-complex understanding of the interrelationships of the elements, forces and processes involved in urban development (Mahsud 2011b).

On the one hand, Doxiadis' urbanism attempts to link process

design (feedback and local knowledge) and infrastructure (economic, social, and formal) (see 2.2.4) as local socio-spatial and environmental concerns—sustainability avant la lettre. On the other hand, his urbanism is a vehicle for structuring urbanization and fostering urban development in the interest of stimulating global socio-economic growth and development. Doxiadis' urbanism, then, resolves the often mutually incompatible impulses of sustainability and globalization into a dialectical framework that informs his design practice (Mahsud 2010). Such a framework, even if it takes the form of a "master" plan, produces a provisional synthesis of nature and infrastructure within which the building volumes and open spaces develop in a way that attempts to ensure the dynamic coexistence of nature, culture, and ecology. This is a synthesis in which open space and the built environment, the local and the global, the historic and the modern, the process and the end state are all continuously interacting. In short, such a synthesis deals simultaneously and coherently with the speed of and the ease of development.

Rethinking Doxiadis' urbanism through the dialectical framework of globalization and sustainability potentially offers insights into how to deal with "spontaneous" urbanization and urban sprawl, and in how to build a greater awareness of environmental and development concerns. The interdisciplinarity—combining architecture, landscape, ecology, land use, geography, urban and regional planning—and spatial logic based precisely articulated framework for urban design synthesis is a response to facilitate a coherent urbanization process. In its attempts to reconcile global development and local cultures, Doxiadis' urbanism unfolds an awareness of sustainability as a major factor, not just an after-thought. Such awareness is different from mainstream modernism and the contemporary "bio-centric polemics" and from "corporate brand" notions of sustainability governed by economic criteria (Pyla 2002). Rather, Doxiadis' urbanism analyses of the spatial dimension of development and environmental protection in a way leads to the vision of a parallel coexistence of Ecumenopolis and Ecumenokepos and their coordinated action. This pairing, besides stimulating significant ideas such as global ecological balance and the carrying capacity of systems, brought the global ecological balance and the carrying capacity of systems, brouht the global ecosystem to the forefront as teh ultimate framework for urbanism.[13] Renewed optimism in the possibilities of such a framework resonates in current trends such as 'Landscape Urbanism', 'New Urbanism', and other 'Green' design agendas. Simultaneously ameliorative, reconciliatory, and regenerative, Doxiadis' complex and dynamic framework offers many more urban and environmental design strategies to generate alternative yet broadly relevent forms of development.

4. THE NEXT FIFTY YEARS?[14]

Towards a sustainable metropolis of the future: Urban Design and Policy Recommendations

In contrast to the insights and potential contribution of the historical making of the plan and its spatial articulation, its materialization through implementation over the last five decades has unfolded serious shortcomings from the sustainability perspective. These shortcomings can be grouped into six broad areas of concern. Some of them are well known facts, others based on empirical evidence, analyses presented in the previous sections and research by design. They are also supported by observations through my participation in the several master plan and urban design review processes and practice in the context of Islamabad spanning over the last decade and a half. First and foremost is the fact that Islamabad is the only city in Pakistan that does not have an elected representative municipality. It is still governed in the same technocratic, bureaucratic and authoritarian way by the CDA (Capital Development Authority) that was constituted in 1960 as a successor of the FCC (Federal Capital Commission). Despite some attempts through civil society activism and media campaigns, there is in-sufficient realization that the bureaucratic mandate of the 'authority' (CDA) for development is over and that the city needs to be entrusted to its citizens and civilian representatives for governance. This is a big hurdle in the way towards 'democratic governance', 'public participation' and 'social inclusion' that are the main policy imperatives and a must for the unfolding of a sustainable metropolis of the future (see 4.2 below). Second, and most importantly, is the abandoning of the metropolitan framework of the original plan i.e. separation of Rawalpindi and isolating Islamabad from its regional dimension and related developments in the hinterland. Third is the complete disregard in the design of the sector that was based on

13 *For global ecological balance and carrying capacity of systems, see Roderick [2001] and Wackernagel [1996].*

14 *These design and policy recommendations were first presented at the occasion of the 50th anniversary of Islamabad – an event organized by IAP Rawalpindi Islamabad chapter in 2011. They represent a thematic way of working towards sustainable built environments. Their thematic development owes to the Author's work in collaboration with Social polis [FP-7] team under the guidance of prof. Frank Moulaert in the research project of 'prospective urbaine' / exploring urban futures in European cities [see Mahsud 2011c].*

historic city as a body of design knowledge - strict separation of pedestrian and vehicular circulation, mixed use and housing types for a wide variety of income groups, higher densities and a variety of public spaces - and the feed-back process as advocated in the original master plan. Fourth is the departure from the dynapolis based concept of staggering alignment of the CBD with connection to the sectors on both sides. Fifth is the ignoring of strategies related to integrating nature and the city and all the related projects of landscape enhancement and amelioration of local climatic conditions, and so on. Sixth is a host of shortcomings of the original master plan itself; they are the challenges from the aspects of social exclusion, cultural diversity, participation and democratic governance that were not really addressed in the historical making of the master plan. Also the declaration of the then existing villages in the national park area as 'protected areas' has proved to be not sufficient; in the absence of detailed strategies for integrating them as part of the metropolitan area has resulted in fragmentation and pervasive sprawl in the ecologically sensitive park area.

Taking into account the variety of these challenges - together with the theoretical and empirical analyses, arguments, and sustainability prospects of the plan identified as the distinctive design aspects in the preceding two sections - the main aim of the design and policy recommendations is to provide a framework for developing an 'Integrated Metropolitan Plan' [IMP] for Islamabad-Rawalpindi Region. With somewhat pragmatic leaning. they are organized under four flags (3.1-3.4), which represent a thematic reflection on integrated ways (Mahsud 2011c) of working towards a sustainable metropolis of the future. Their transversal dimensions include the following:

- *Policy imperatives: Based on an extensive survey of sustainability literature, 'Social Cohesion', 'Environmental Sustainability' and 'Democratic Governance' come to the fore as complementary policy imperatives. Their complementarity is needed to ensure the provision of social services for all, including livability, efficiency in transportation networks, reducing environmental problems, minimizing resource use and waste generation, assuring water and energy services for all, and active citizenship and participation in urban management.*

- *Dynamic density: Development of an urban design based dynamic density model for the Rawalpindi-Islamabad metropolitan area should be seen as a way of absorbing future population growth, and securing the socio-economic base of the metropolis. The model implies that all sectors [present and those that are part of the original master plan] should be allowed to have a range of 60,000 to 100,000 inhabitants (200 – 335 persons / hectare). The densities in Rawalpindi Central and Blue areas should obviously be 2 to 3 times that range. With such levels of density allowance, 8 – 10 million inhabitants can be accommodated within the original master plan urban area, which implies the unfolding of tremendous socio-economic opportunities in the metropolis. Achieving this gross density of 200 p / ha is essential for a minimum sufficient tax-base to finance and maintain an efficient modern multi-modal metropolitan public transport system – an absolute must for a sustainable metropolis. Allowing the increased densities within urban area, generating more facilitated and affordable urban housing space for new comers, is also the only way to relieve the national park and other surrounding areas from the alarming pressures of urban sprawl. An integrated participative approach to the preservation and protection of ecological resource (Margalla hills, national park, naalas inside the urban area, Soan river park, etc.) is also an absolute must for unfolding the sustainable metropolis of the future.*

4.1 Re-orienting architecture, urban design and planning toward sustainable development

An integrated approach towards a sustainable metropolis of the future requires reorientation of the current modes (both academic / curricula and practice) of architecture, urban design and planning towards 'socio-spatial cohesion' and 'environmental sustainability' at multiple scale levels. The recommendations include the encouragement, promotion and integration of the following in the educational curricula and professional practice:

- *Eco and energy efficient, mixed- use/ tenures/house-types, compact, human-scaled, low-rise and high-density architecture, urban design and development.*
- *Creating, connecting and preserving public space [from street, neighborhood to regional scales], so that it becomes a main vector in the articulation of social life.*
- *Sustainable mobility through walk-able neighborhoods and multi-modal mobility networks (that allow integration of public transport, walking, cycling and reduction of car use).*
- *Sustainable land-use and settlement patterns through better coordination between transport, land use, open space planning with environmental controls, high standards of management and preservation of green and blue networks.*
- *Promoting participatory design and planning methods as well as capacity building methods to involve a diversity of actors.*
- *Progressive shift towards a more human-powered and*

less resource-intensive buildings and site design as the core of all architecture and urban design curricula.

4.2 Working towards democratic, efficient and multi-level Metropolitan Governance

An integrated approach towards sustainable metropolis requires citizenship-building, collective responsibility and reinventing access to social services through social innovation. They are transversal for working towards a metropolitan governance system that guarantees a sustainable future. In this regard, the main recommendation is the dismantling of CDA in favor of a democratically elected multi-level metropolitan governance system. Following are the core dimensions for shaping the process of working towards such a system:

- *Governance and new forms of institutions: Multi-level governance should in particular aim at enhancing the capacity of the local bodies (neighborhood, city level administrations, union councils, etc.), developing new forms of institutional settings (for coordination of actors and interests) and public-private partnerships in tackling metropolitan challenges in ways that accommodate more inclusive forms of socio-economic development. The new forms of civic and social mobilization and local social capital formation should be seen as strategies for coping with the negative consequences of urban restructuring and changes in roles, positions, and scales of urban 'governance'.*

- *Active citizenship and the right to the city: Advancing towards a scale-sensitive and inhabitant-centered conception of citizenship that requires active participation for guaranteed rights. This implies linking participation with concrete improvements in living conditions, and harnessing the potential of the often-neglected 'voluntary', 'private' and 'informal' sectors for common deliberation, mutual learning processes that leads to a broader vision of urban development and the creation of a sense of solidarity.*

4.3 Working towards an Ecological Metropolis

This implies the transformation of the social-natural-technological assemblages of urban life in ways that help build socio-environmental justice whilst reducing the risks of biodiversity collapse, neo- liberal globalization and climate change. The recommendations include the following:

- *Joint public-private investments in the "greening" of public infrastructure, building stock and production processes, renewable energy, ensuring urban biodiversity and food security, exploiting new 'green' technologies and building new industrial sectors. They should be seen as a huge domain for urban innovations and employment generation.*

- *Linking the processes of social exclusion with issues of ecological justice and increased awareness of socio-ecological issues through social participation at the local level (e.g. schools, media, NGOs, firms, city-wide events, etc.) to initiate a bottom linked transition management towards ecological resilience of processes underpinning city life in ways that reduce carbon footprints.*

4.4 Working towards an Educational and Participatory Metropolis

Free and fair accessibility to quality education, socio-ethnic sensitivity in the location of schools and modes of education that promote life long learning for all are critical factors in working towards the educational metropolis. The recommendations include the following:

- *Appropriate mechanism should be established for the promotion of an "open-up" educational model based on a pedagogical system that places the emphasis on learning rather than on teaching and also reinforces values such as: autonomy, responsibility and cooperation. This involves several interrelated shifts towards focus on work – learning, policy-learning, learning in and from the city, development of mutual and multi-generational learning places, and increased public-private partnerships and investment in civic centers and libraries projects.*

- *Building pro-cosmopolitan politics of identity in the metropolis through ensuring the accessibility to the social services (education, health, training, jobs, etc.) for all ethnicities, social and income groups and particularly the involvement of the local voluntary and community sector in the process.*

Promoting the creative use of digital infrastructure for enhancing community life and active citizenship including: accessibility to social resources and welfare; improve social interaction across social classes and age groups; re-connect places and to reinforce the sense of community; and to revitalize both the street and the sector levels in unfolding the larger cohesive metropolitan environment.

REFERENCES

Adriaens, Femke, et al. (2005): Sustainable Urban Design; Amsterdam: Beursloge Projecten Foundation.

Botka, D. (1995): "Islamabad after 33 years," EKISTICS 373-375 [July–Dec.].

Bromley, R. (2003): "Towards Global Human Settlements: Constantinos Doxiadis as Entrepreneur, Coalition-Builder and Visionary," in Urbanism: Imported or Exported, ed. Joseph Nasr et al., New York: John Wiley and Sons, 316-340.

Castells, M. (1979): The Urban Question: A Marxist Approach, Cambride: MIT Press.

Doxiadis Associates (1960): Principles for a City of the Future, DOX-PA 72 [Feb.].

Doxiadis Associates (1959): A Commission - A Name - A plan of Action, DOX-PA 22 [Jul.].

Doxiadis Associates (1960a): Preliminary program and plan, DOX-PA 77 [May].

Doxiadis Associates (1960b): The grand trunk road, DOX-PA 50 [Jan.].

Doxiadis Associates (1960c): Islamabad: programme and plan, DOX-PA 88 [Sept.].

Delgado, T. (2005): Is a Sustainable Urbanism Possible in XXI Century America? Yale: Center of Urban Ecology.

Doxiadis, C. A. (1965): "Islamabad, The Creation of a New Capital," Town Planning Review 36, no. 1 (Apr. 1965).

Doxiadis, C. A. (1966): Between Dystopia and Utopia; London: Faber and Faber.

Doxiadis, C. A. (1968): Ekistics: An introduction to the Science of Human Settlements, London: Hutchinson.

Doxiadis, C. A. (1970): "Ekistics, the Science of Human Settlements," Science 170, no. 3956 (Oct. 1970).

Doxiadis, C. A. (1975): Building Entopia, Athens: Athens Center for Ekistics.

Droege, P. (2007): The Renewable City. Wiley & sons.

Dunnett, James. (2000): "Le Corbusier and the city without streets," in The Modern City Revisited, Thomas Deckker, ed., London: Taylor & Francis.

Dynamic City Foundation (DCF). (2009): A Case Study of Evolutionary Green Planning, Shenzhen: World Expo.

Howard, E. and Osborn, F.J. (eds) (1965) Garden Cities of Tomorrow; Cambridge, Mass.: MIT Press (originally published in 1898 and 1902)

Edwards, B. et al. (2001): Rough Guide to sustainability; London: RIBA Publications.

Farr, D. (2008): Sustainable Urbanism: Urban Design with Nature; New Jersey: John Wiley & Sons.

FCC. (1959): "Where there is no vision the people perish," Commission on the location of the new capital, Rawalpindi, President's secretariat: Government of Pakistan.

FCC. (1960): 'Report on the preliminary master plan & programme of Islamabad', Rawalpindi: President's secretariat, Government of Pakistan.

Fookes, T. (2008): A Generic Policy Framework for Urban Sustainability. Shaping the Sustainable Millennium, C. A., 1-22.

Frey, H. (1999): Designing the City: Towards a more Sustainable Urban Form; London: Spon press.

Guy, S. (2010): Searching for Sustainability. Architectural Theory. Crysler G. et al. (eds.), London: Sage.

Heartfield, J. (2008): Green Capitalism: Manufacturing Scarcity in an Age of Abundance; London: Mute.

Heynen, et al. eds. (2005): Nature of Cities: Urban Political Ecology & Politics of Urban Metabolism. London: Routledge.

Hilberseimer, L. (1960): "City Architecture: The trend toward Openness" (1960), in Modernism and the Posthumanist subject Michael Hays, ed., Cambridge, Mass.:ÊMIT Press, [1992].

Holston, J. (1989): The Modernist City: An Anthropological Critique of Brasilia. Chicago: University of Chicago Press.

Ingersoll, R. (2006): Sprawltown: Looking for the city on its edges. New York: Princeton Architectural Press.

Jenks, M. et al. (2005): Future Forms and Design for Sustainable Cities. Oxford: Architectural Press.

Knox, P. L. (2011): Cities and Design. London: Routledge.

Kwinter, S. (2010): Requiem: For the City at the end of the Millennium. New York: Actar.

Larkham, P. J. et al. (1991): A Glossary of Urban Form. Birmingham: Urban morphology research group.

Lehmann, S. (2010): The principles of Green urbanism: Transforming the city for sustainability. London: Earthscan.

Madanipour, A. (2005): Public spaces of European cities. Nordisk Arkitekturforskning. 1, 7-16.

Mahsud, A. Z. K. (2007): "Representing the state: Symbolism and Ideology in Doxiadis' plan for Islamabad," in The Politics of Making: Theory, practice, product, ed. Mark Swenarton et al., London and New York: Routledge, pp. 61-75.

Mahsud, A. Z. K. (2007a): 'Doxiadis' Legacy of urban design: Adjusting and amending the Modern,' in: Ekistics: the problems and Science of HUMAN SETTLEMENTS, Vol. 73, No. 436-441, Athens: ACE / ATO, pp. 241-263.

Mahsud, A. Z. K. (2008): Constantinos A. Doxiadis´ Plan for Islamabad: The Making of a 'City of the Future' 1959-1963. [PhD dissertation, KULeuven].

Mahsud, A. Z. K. (2010): Rethinking Doxiadis´ Ekistical Urbanism: Sustainability and Globalization as a dialectical framework for Design. Positions: On Modern Architecture and Urbanism, vol. 1, pp. 6-39.

Mahsud, A. Z. K. (2010a): Scaling sustainable urbanism: Re-imagining Urban Form as a factor of Sustainability, FWO [Flemish Scientific Research] ranked postdoc project proposal, Research groups OSA and P&D, KULeuven.

Mahsud, A. Z. K. (2010b): Urban Form and Sustainability: Scaling Urban Metabolism - The Case of Brussels, project proposal, Future Research – Brussel Hoofdstedelijk Gweest / Brussels Capital Region.

Mahsud, A. Z. K. (2011): Transition management in the built environment [TMinBE], IOF [Industrial Onderzoek Fonds] Project Proposal, P&D Research group, KULeuven.

Mahsud, A. Z. K. (2011a): Urban Design of Islamabad: Historiographical legacy of the framework for a sustainable metropolis of the future, in: Pervaiz Vandal et al. [eds.], Historiography of Art & Architecture in South Asia, Lahore: THAAP [in press].

Mahsud, A. Z. K. (2011b): 'Achieving a dynamic urban form: A multi-scalar synthesis of landscape and urbanism in Doxiadis' plan for Islamabad,': Ekistics, vol. 74, no. 442-447 [in press].

Mahsud, A. Z. K. Moulaert, F. and Novy, A. et al. (2011c): Exploring Urban Futures in European Cities: A Social Cohesion-Based Approach, Final report for EU Framework program Social Polis [FP-7] and research commissioned by MEEDTL/PUCA [Paris] on behalf of URBAN- NET [FP-6], 90 p.

Mark, J. (2003): Sustainability, Architecture, and "Nature": Between Fuzzy Systems and Wicked Problems. Thresholds 26.

Mark, J. (1999): Molecules, Money, and Design: Sustainability's role in Architectural Academe. Thresholds 26, 32-38.

Mattias, K. (2008): Setting the Scale of Sustainable Urban Form. Conference Architectural Inquiries, Göteborg, 1-10.

Moulaert, F. et al. (2000 and 2002): Globalization and Integrated Area development in European Cities. Oxford: Oxford

University Press.

Moulaert, F. (2009): Social innovation and Territorial development. Surrey: Ashgate.

Moulaert, F., Martinelli, F., Swyngedouw, E. et al. [Eds.]. (2010): Can Neighborhoods Save the City? Community Development and Social Innovation, New York: Routledge.

Mostafavi, M. et al. (2010): Ecological Urbanism. Baden: Lars Müller Publishers.

Nilsson, S. (1973): The New Capitals of India, Pakistan and Bangladesh. Scandinavian Institute of Asian Studies, Lund: Curzon Press.

Panerai, P. Castex, J. et al. (2004): Urban Forms: The death and life of the urban block. Oxford: Architectural press.

Pont, Meta Berghauser, et al. (2010): Spacematrix: Space, Density and Urban Form. Rotterdam: NAi Publishers.

Pyla, P. (2008): Counter-Histories of Sustainability. Volume 18, 14-18.

Robert, C. (2008): Public Transport and Sustainable Urbanism: Global Lessons. Science Council of Japan, 1-10.

Roderick, L. (2001): "Human ecology," in Our Fragile World: Challenges and Opportunities for Sustainable Development, M. K. Tolba, ed., Oxford: Eolss Publishers.

Rompaey, A. Van, et al. (2009): Landscape capacity and social attitudes towards wind energy projects in Belgium. Final Report. Brussels : Belgian Science Policy 2009 – 84 p. (Research Programme Science for a Sustainable Development).

Ruano, M. (2000): Ecourbanism: Sustainable human settlements. Barcelona: Gustavo Gili.

Shannon, K. & Smets, M. (2010): The Landscape of Contemporary Infrastructure, Rotterdam: NAi Publishers.

Swyngedouw, E., Moulaert, F. et al. (2002): Neo-liberal urbanization in Europe. Antipode 34.3, 542–77.

The Prince's Foundation (TPF). (2007): Valuing Sustainable Urbanism. London: TPF for the Built Environment.

UN-CSD (Commission for Sustainable Development). (2009): Sustainable Development, 2nd Communication of the GA, 2 Nov.

UN-Habitat, (2010): State of the World's Cities 2010/2011 - Cities for All: Bridging the Urban Divide.

UN-Habitat, Naison D. M. (2009): Scaling new heights: New ideas in urban planning. UN-Habitat: Urban World, 1(4), 16-24.

Wackernagel, M. et al., eds. (1996): Our Ecological Footprint: Reducing Human Impact on Earth. Gabriola Island, Canada: New Society Publishers.

Waldheim, C. (2006): The Landscape Urbanism Reader. Princeton Architectural Press.

William et al. eds. (2000): Achieving Sustainable Urban Form, London & New York: Spon Press.

Williamson, T. et al. (2003): Understanding Sustainable Architecture, London: Spon Press.

Winnick, Louis. (1989): "The Athens center of Ekistics: The Urban world according to Doxiadis," Ford Foundation Urban History [unpublished manuscript, New York: Ford Foundation Archives].

REINVENTING TRADITIONAL SYSTEM FOR SUSTAINABLE BUILT ENVIRONMENT: AN OVERVIEW OF PASSIVE DOWNDRAUGHT EVAPORTAIVE COOLING (PDEC) TECHNIQUE FOR ENERGY CONSERVATION

*Mohammad Arif Kamal**

ABSTRACT

There has been a drastic increase in the use of air conditioning system for cooling the buildings all around the world. Interest in reducing emission of greenhouse gases, caused by fossil fuels to power the cooling requirements of the buildings has stimulated the enthusiasm towards adoption of passive cooling techniques for buildings. Passive systems use non-mechanical methods to maintain a comfortable indoor temperature and are a key factor in mitigating the negative impact of buildings on the environment. Of the different methods to reduce the cooling load, passive cooling of houses and buildings is the most suitable and sustainable method. Passive downdraught evaporative cooling (PDEC) is a passive cooling technique which involves spraying of controlled volumes of microscopic water droplets into hot, dry ambient air, thereby causing it to cool and descend into a required capture zone within a building. This paper is a review paper in which a study of Passive Downdraught Evaporative Cooling (PDEC) as a passive cooling technique for providing thermal comfort and its significance in energy conservation in buildings has been done. The interrelationship between sustainability and cooling needs of buildings has also been discussed. Further two applications of PDEC in contemporary architecture (Torrent Research Centre, Ahmedabad, India and New office building at Catania, Italy) have also been analyzed. Finally a critical analysis of using PDEC system in the buildings has also been done.

Key Words: Passive, downdraught, evaporative, cooling, energy conservation.

1. INTRODUCTION

The last two decade have witnessed a grave energy crisis in developing countries especially during summer season, primarily due to cooling load requirements of building. There has been a lot of reliance on energy-consuming technology in cooling and ventilation system to achieve thermal comfort in buildings. The mechanical means of providing thermal comfort are not only unsuitable because of their initial and recurring costs but also because of non-availability of artificial sources of energy on a regular basis. Increasing consumption of energy has led to environmental pollution resulting in global warming and ozone layer depletion. Hence, the need to reduce the emission of greenhouse gases caused by fossil fuels used to power the cooling requirement of the buildings, has stimulated the interest towards adoption of passive cooling techniques for buildings.

In vernacular architecture, there are examples of passive cooling systems, particularly those using evaporative cooling particularly in countries around the Persian Gulf. However in modern times due to the availability of electrical power to run active cooling systems, focus on use of these techniques had been forgotten. Passive Downdraught Evaporative Cooling (PDEC) techniques offer significant potential for reducing the energy demands for cooling of non-domestic buildings in hot dry climatic regions. Passive downdraught evaporative cooling (PDEC) is a passive cooling technique which involves spraying of controlled volumes of microscopic water droplets into hot, dry ambient air, thereby causing it to cool and descend into a required capture zone within a building. From here the cool air enters the adjacent occupied spaces through carefully sized and controlled openings. With PDEC cooling process, the air temperature may be reduced by 70-80% of the wet-bulb temperature depression, providing the potential for very significant cooling in hot dry climatic regions.

2. COOLING NEEDS OF BUILDINGS AND SUSTAINABILITY IN ARCHITECTURE

Enhanced living standards in the developed world using climatically non-responsive architectural standards have made air conditioning quite popular. This has increased energy consumption in the building sector. There are more than 240 million air conditioning units installed worldwide

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according to the International Institute of Refrigeration (IIR). IIR's study shows that the refrigeration and air conditioning sectors consume about 15% of all electricity consumed worldwide (IIR, 2002). In Europe it is estimated that air conditioning increases the total energy consumption of commercial buildings on average to about 40 kWh/m^2/year (Burton, 2001).

It is evident that the total energy consumption of buildings for cooling purposes varies as a function of the quality of design and climatic conditions. In hot climates, commercial buildings with appropriate heat and solar protection and careful management of internal loads may reduce their cooling load down to 5 kWh/m^2/year, while buildings of low quality environmental design may present loads up to 450 kWh/m^2/year (Santamouris and Daskalaki, 1998). Hence, the quality of built environment has a large impact on environmental sustainability.

Architectural sustainability is linked to the Brundtland definition, through an emphasis on limits to the carrying capacity of the planet and it point to the UK's Building Services Research and Information Association (BSRIA) definition of sustainable construction as 'the creation and management of healthy buildings based upon resource efficient and ecological principle' (Edwards and Hyett, 2001). In principle, sustainable buildings relate to the notion of climate-responsive design, which places emphasis upon natural energy sources with the aim of achieving building comfort through an interaction with the dynamic conditions of the building environment (Hyde, 2000). Sustainable architecture is an approach to design where building technology is integrated with the concept design and has the potential to reduce the need for high-tech systems and reduce the energy consumption of buildings. There are many different methods to reduce the cooling load, but Passive downdraught evaporative cooling (PDEC) adapted in buildings is one of the most sustainable methods. Since air conditioning is recognized as a significant factor in global warming and climate change, passives downdraught evaporative cooling proves to be both technically and economically viable alternative, especially in hot-dry or composite climate and where the cooling requirement is around 6-7 months in a year.

3. TRADITIONAL COOLING SYSTEM WITHOUT AIR CONDITIONING

Passive Downdraft Evaporative Cooling is an old technique was applied in Islamic architecture. Evaporative cooling was extensively used in the vernacular architecture in Pakistan, Iran, Turkey and Egypt (see Figure 1). The tradition of 'cooling without air conditioning', has its origins in ancient Egypt; it subsequently spread eastwards through the Middle East and Iran to north India with the Mughal empire, and westwards across North Africa to southern Spain. In the Middle East there is an established tradition of using various techniques to encourage evaporative cooling both within and between buildings. Wind catchers called 'malqafs' captured wind and directed it over porous water pots, causing evaporation and bringing a drop in temperature as a result of latent heat of vaporization (Ford, 2001). This system maintained a balance between two important parameters of passive cooling – thermal performance and ventilation effectiveness. In this tradition, wind-catchers guide the outside air over water-filled porous pots. This induces evaporation and brings about a significant drop in temperature before the air enters the interior of the building.

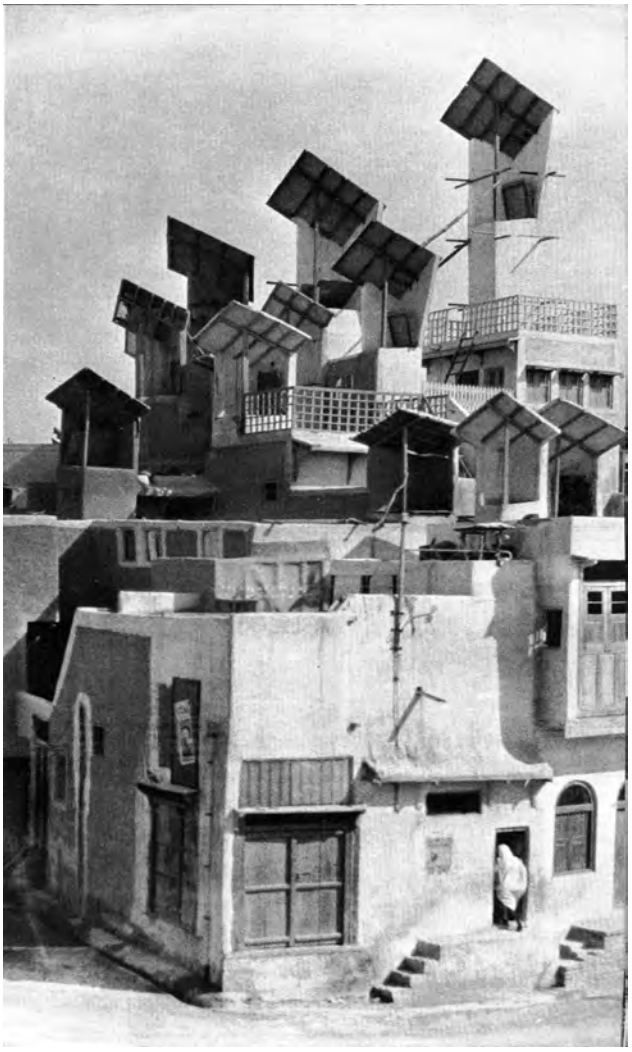

Figure-1: Wind catchers in traditional architecture of Sindh, Pakistan.

More recently, this tradition has been taken up by Hasan Fathy and others, and developed for cooling schools and other buildings. Often, the air flow rate is enhanced by catching and redirecting the prevailing wind. Fathy comments on design strategies to exploit these effects not only within buildings but in external spaces as well (Fathy, 1984). In north India, the Mughal palaces and gardens exploited evaporative cooling to delight the eye and other senses as well as providing thermal relief. Thin water chutes (salsabil) and other evaporative cooling techniques were features of Mughal architecture from the thirteenth to the seventeenth centuries. The intense dry heat and dust of the summer in north India calls for the creation of an internal refuge or haven from the extremes of the external world. The diurnal swing in temperature is dampened by the mass of stone and earth, and the air is further cooled by the evaporation of water in the ventilation air flow path. This is exemplified perfectly in the beautifully atmospheric Rai Pravina Mahal in Orcha ((Ford and Hewitt, 1996).

4. PASSIVE DOWNDRAUGHT EVAPORATIVE COOLING (PDEC)

Maintaining a comfortable environment within a building in a hot climate relies on reducing the rate of heat gains into the building and encouraging the removal of excess heat from the building. Passive-cooling techniques concentrate mainly on reducing unwanted heat gains into the building. In the twentieth century, evaporative cooling was applied in buildings throughout the world in conjunction with a mechanically driven air supply (known widely as desert coolers). Recently, attention has returned to the potential of exploiting the benefits of direct evaporative cooling while avoiding mechanical assistance by using buoyancy or wind forces to drive the air flow. In the late 1980s, a number of successful experiments were undertaken which tested the evaporation of water within a downdraught tower, hence the term Passive Downdraught Evaporative Cooling (Ford, 2001).

The device consists of single or multiple towers equipped with a water vapour supply placed on the top. This innovation consists of replacing the wetted pads with rows of atomisers (nozzles, which produce an artificial fog by injecting water at high-pressure trough minute orifices). During the constant injection of water, droplets descend through the tower and conditions close to saturation are produced along its length. Cool air descends the tower and exits at its base where it is delivered to the adjacent spaces (see Figure 2). The concept is based on the relatively large amount of energy required to convert water from its liquid to gaseous form within a local thermal imbalance with subsequence differences in air density. This leads to the movement of air from a zone of high pressure, where air is hot and less dense (top of the tower) to a zone of lower pressure, where air is colder and denser (bottom of the tower). The situation of the micronisers in a tower gives rise to a natural downdraught effect.

5. CONTEMPORARY APPLICATION OF PDEC

Contemporary passive downdraft evaporative cooling systems consist of a downdraft tower with wet cellulose pads at the top of the tower. Water is distributed on the top of the pads, collected at the bottom into a sump and recirculated by a pump. Certain designs exclude the re-circulation pump and use the pressure in the supply water line to periodically surge water over the pads, eliminating the requirement for any electrical energy input. In some designs, water is sprayed using micronisers or nozzles in place of pads, in others, water is made to drip. Thus, the towers are equipped with evaporative cooling devices at the top to provide cool air

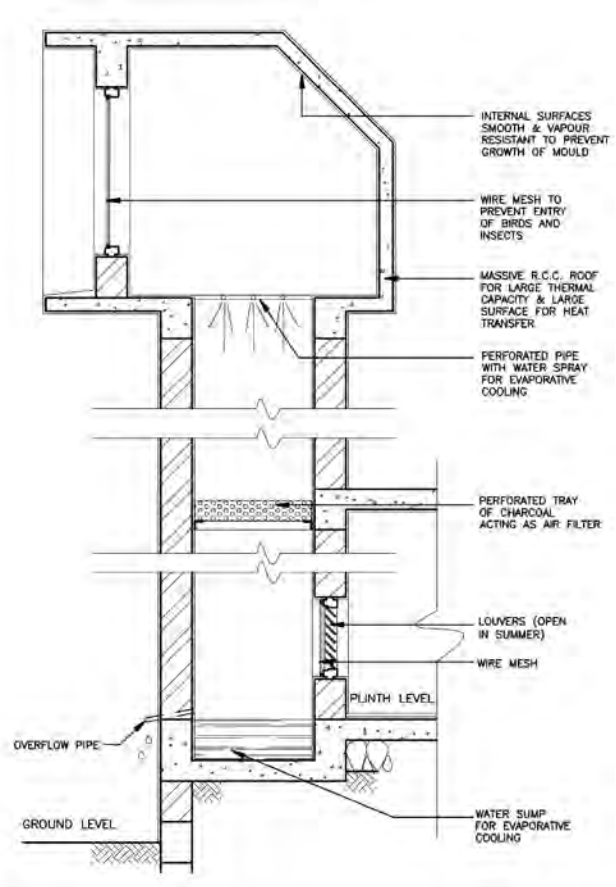

Figure-2: Cross Sectional details of Passive Downdraught Evaporative Cooling.

by gravity flow. These towers are often described as reverse chimneys. While the column of warm air rises in a chimney, in this case the column of cool air falls. The air flow rate depends on the efficiency of the evaporative cooling device, tower height and cross section, as well as the resistance to air flow in the cooling device, tower and structure (if any) into which it discharges (Thompson, Chalfoun and Yoklic, 1994).

Two examples are presented below from India and Italy:

5.1 Torrent research centre, Ahmedabad

The first large-scale application of PDEC was in the Torrent Research Centre, a pharmaceutical research laboratory in Ahmedabad (see Figure 3). Designed by Abhikram Architects and completed in 1998, this project demonstrated that this approach to cooling could be applied to a large, complex laboratory building ((Ford, et al. 1998). The total built up area of the complex is approximately 20,000 Sq. Mts. 72% of the central building has achieved human comfort conditions using Passive Downdraft Evaporative Cooling (PDEC). It has been able to establish extremely low levels of energy consumption, as well as considerably decreased carbon dioxide emissions per square meter of area. Around 200 metric tons of air-conditioning load is saved. The performance has been consistent over the past eleven years of its use. It has realized healthy financial returns on the investment in the way of building costs. The entire cost of the building will be recovered from the electrical savings alone, in 13 years of operation (Abhikram 2009).

Measurements of air temperature and relative humidity in different parts of the building in April 1998, revealed that very significant cooling and high air change rates were achieved. Peak temperatures of 27°C in the ground floor laboratory and 29°C at first floor, were achieved when the external maximum reached 38°C. Over the same period, air change rates of 9 per hour on the ground floor and 6 per hour at first floor were recorded. The staff reported that, during the summer (February-June) the laboratories are comfortable without fans and are not stuffy or smelly, as most chemistry labs are, even when air conditioned. During the monsoon (July-September), the evaporative cooling system is not operated, of course, so ceiling fans are used to enhance comfort for these two to three months. In the first year since its occupation, the Torrent Research Centre was reported to have used approximately 64% less electrical energy than the equivalent conventionally air-conditioned building (Ford, 2001).

5.2 Office Building in Catania, Italy

A high performance example of PDEC is the design proposed by Mario Cucinella Architects for the new office in Catania, Italy (see Figure 4). The design consists of a 27m wide by 70m long, 4 storey office building punctured by nine 3m diameter glazed cylindrical PDEC towers. These towers protrude above the roof of the building by about 6m. The microniser spray and baffles to avoid wind effects were located in this tower head region. Air entered each of the 3 floors and the ground floor through high level openings in each PDEC tower leaving the building via the highly glazed double-skin facade. The main idea was to create a number of PDEC towers that passed through the building vertically. Each tower cooled the air in the adjacent area when needed (see Figure 5). The towers were also used for night ventilation and to bring daylight into a deep plan space (Elizabeth and Ford, 1999).

Figure-3: Passive Downdraught Evaporative Cooling in Torrent Research Centre, Ahmedabad.

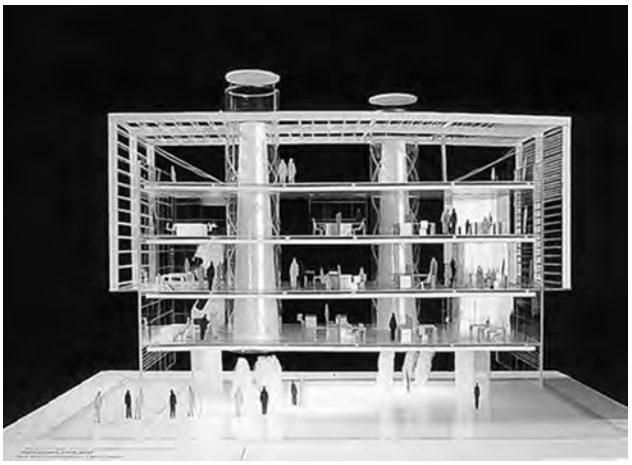

Figure-4: The new office Building in Catania, Italy by Mario Cucinella Architects.

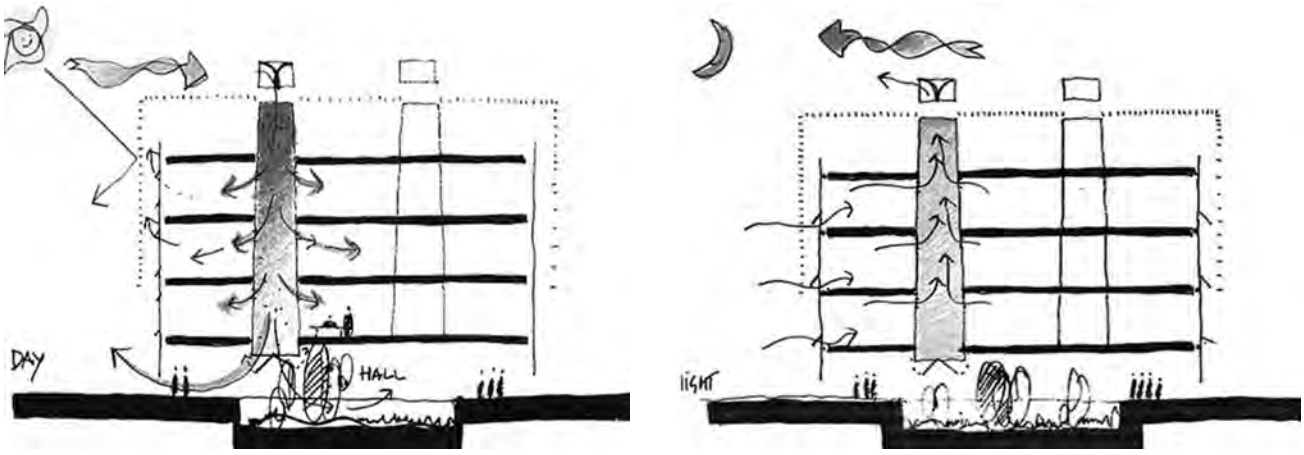

Figure-5: Day and night functioning of PDEC in office building in Catania.

Architect Mario Cucinella, a partner in a multidisciplinary research group funded by European Commission's Joule program, explored how to apply this passive cooling technique to commercial buildings in southern Europe's hot and dry regions (Cucinella et al, 1998). Thermal analysis of the Catania office building was undertaken by ESII using PASSPORT-Plus in which a PDEC tower model had been incorporated and the CFD program FLUENT. The thermal simulation analyses indicated that:

- *The tower height should be 6m above the building roof;*
- *Under this system, peak cooling loads could be reduced by a third, from 82 W/square meter to 58 W/square meter, compared with the original single atrium design.*
- *With an external air temperature of 29°C and an internal heat load of 30.7 W/m2 thermally acceptable conditions could be obtained on the office floors using PDEC;*
- *PDEC alone could not maintain comfort throughout the year and so had to be supported by a mechanical cooling system;*
- *For a building which is wholly air-conditioned the annual cooling energy demand would be 28.5 kWh/m2 of floor area. Using PDEC supported by mechanical cooling, the predicted cooling energy demand was 20.9 kWh/m^2, an energy saving of 27%. The water demand for PDEC cooling was equivalent to 10 litres per person per day.*

6. PERFORMANCE ANALYSIS OF PDEC SYSTEM

The PDEC system depends on two basic factors that determine its effectiveness: (1) amount of cooling of the ambient air achieved, and (2) the rate at which this conditioned ambient air replaces the stale air within the building. The former can be easily achieved by increased air-water contact zone. This factor usually dictates the height of the tower and in turn, influences the massing of the building design. The second factor, however, requires a complex interplay of different variables to achieve an effective performance. These variables dictate the configuration of the tower termination, the positioning of multiple towers within the building, circulation pattern within the building, and even the configuration of openings between adjacent spaces served by these towers. The temperature of the incoming ambient air drops while crossing the pads. Therefore, the height of the tower and the area of the wetted pads are not expected to have any appreciable effect on the temperature of the air in the tower in a given combination of ambient dry and wet bulb temperatures. However, these two system design factors affect the airflow rate, and hence the total cooling effect generated by the system (Givoni, 1994).

Through evaporative cooling, the ambient air can potentially be cooled down to the dew point temperature simply by saturating it with moisture. This type of cooling is thus particularly efficient in relatively dry climates. But in humid climates it is also possible to generate cooled air flow through evaporative cooling (Yajima and Givoni, 1997). PDEC systems have been used with various types of cooling devices such as spray assemblies (pressure and ultrasonic nozzles), aspen fibre pads and corrugated cellulose pads. The

performance analysis would thus vary depending on the evaporating cooling facilities provided in the tower. Aspen pads cause a high pressure drop relative to sprays and corrugated media, but they are low in cost. Spray devices may require efficient mist eliminators for removing fine droplets from the air because mist impedes air flow ((Thompson, Chalfoun and Yoklic, 1994). PDEC can avoid the need for ductwork, fans and suspended ceilings, thereby reducing the overall height of buildings. In less severe climates, or in less demanding buildings, PDEC might avoid the need for air-conditioning entirely. PDEC provides 100% fresh, cool air with no re-circulation – as is often the case in air-conditioned buildings. PDEC ought, therefore, to provide an environment with high air quality.

In a research project funded by the European Commission, Mario Cucinella Architects and partners, an assessment of the potential application ofÊPassive Downdraught Evaporative Cooling in Southern Europe was done. The table 1 below summarises the stock areas and potential energy savings of four European countries and shows that energy savings could be around 1.5% to 2.5% of the national annual electricity consumption.

6.1 Limitations of PDEC

The hardness of the water is a significant factor, therefore water quality has to be good otherwise nozzles will block. High pressures (>40 Bar) are required to minimize water droplet size and maximize evaporation, which implies more expensive pumps and plumbing. The risk of microbiological contamination of the water supply to the misting nozzles must also be minimized. This can be addressed by a combination of design measures (including the use of UV filters in the supply line to the micronizers), regular maintenance, and testing, but it would clearly be better if this was not an issue. In many parts of the world the potential disadvantages of using micronizers (risks of microbiological contamination, blockage of micronizers, high-pressure stainless-steel plumbing fittings are a powerful disincentive. 'Low-Tech' solutions may be more appropriate in locations where water quality is poor, or where high-pressure plumbing is unfamiliar. The practical integration of such systems within the building envelope is fundamental to the feasibility of this approach. If simpler techniques currently under investigation do prove technically and financially viable, the market potential could be significant.

7. CONCLUSION

The use of air conditioning has increasingly penetrated the market during the last few years and greatly contributes in the rise in absolute energy consumption due to improving standards of life and increasing world population. Since air conditioning is recognized as a significant factor in global warming and climate change, passives downdraught evaporative cooling proves to be both technically and economically viable and is competitive with respect to conventional air-conditioning. Countries such as India can benefit more where most of the population resides in hot and dry or composite climate and where the cooling requirement is around seven months in a year. The technique of passive downdraught evaporative cooling has only recently been applied to buildings, but has enormous potential to displace the need for conventional air conditioning.

Table-1: Potential energy savings through PDEC (ALTENER, 2012).

Country	Commercial buildings area millions m2	National electricity consumption millions KWh	PDEC potential energy savings millions KWh	Energy saving as % of national electricity consumption	Reduction in CO2 emissions tonnes pa	Potential value of energy saving pa euro million
Greece	39	46,099	1,124	2.44%	766,596	85.4
Spain	116	201,159	3,341	1.66%	1,472,654	257.9
Italy	161	283,737	4,637	1.63%	2,809,643	490.4
Portugal	25	41,146	720	1.75%	391,414	59.0

With the ever growing global concern for the use of energy and resources, architects have a greater responsibility to design buildings that are environmentally sustainable. Therefore, in present day architecture, it is now essential for architects and building engineers to incorporate PDEC as a passive cooling technique in buildings as an inherent part of design and architectural expression and that they are included conceptually from the outset. Incorporation of PDEC would certainly reduce our dependency on artificial means for thermal comfort and minimize the environmental problems in buildings caused due to excessive consumption of energy and other natural resources and will evolve a built form, which will be more climate responsive, more sustainable and more environmental friendly.

REFERENCES

Abhikram Q. & A. (2009), Green by design, Home Review, Marvel Infomedia Pvt. Ltd., Mumbai.

ALTENER-Solar Passive heating and Cooling: Market Assessment of the Potential Application ofÊPassive Downdraught Evaporative Cooling in Southern Europe, (2012, January 14). Available http:// www.phdc.eu/index.php?id=10.

Burton, S. (2001) Energy Efficient Office Refurbishment. London, James and James Science Publishers.

Cucinella, M., Elizabeth, F., Ford, B. et al, (1998), The Application of Passive Downdraught Evaporative Cooling (PDEC) to Non-domestic Buildings, Final Publishable Report, De Montfort University, UK.

Edwards, B. and Hyett, P. (2001) Rough Guide to sustainability. London, RIBA Publications.

Elizabeth, F. and Ford B., (1999) Recent Developments in Passive Downdraught Cooling - An Architectural Perspective. London, James and James Science Publishers.

Fathy, H. (1986) Natural Energy and Vernacular Architecture. University of Chicago Press.

Ford, B. (2001) Passive downdraught evaporative cooling: principles and practice. Architecture Quarterly, Vol. 5, No. 3.

Ford, B. and Hewitt, M. (1996) Cooling without Air Conditioning - Lessons from India. Architecture Quarterly, Vol. 1, No. 4, pp. 60 - 69.

Ford, B., Patel, N., Zaveri, P. and Hewitt, M., (1998) Cooling without Air Conditioning: The Torrent Research Centre. Proceedings of World Renewable Energy Congress V, Florence, Pergamon.

Givoni, B. (1994) Passive and low energy cooling of buildings, New York, Van Nostrand Reinhold.

Hyde, R. (2000) Climate Responsive Design: A Study of Buildings in Moderate and Hot Humid Climates. London, E. & F. N. Spon.

International Institute of Refrigeration - IIR. (2002) Report on Industry as a partner for sustainable development – refrigeration. Paris, France.

Santamouris, M. and Daskalaki, E. (1998) Case Studies - In Natural Ventilation. London, James and James Science Publishers.

Thompson, T.L., Chalfoun N.V. and Yoklic M.R., (1994) Estimating the performance of natural draft evaporative coolers. Energy Conversion and Management.

Yajima, S. and Givoni, B., (1997). Experimental performance of the shower cooling tower in Japan, Renewable Energy, Volume 10, issue 2/3, pp. 179-183.

EDUCATION FOR SUSTAINABLE BUILT ENVIRONMENT: AN APPRAISAL OF ENVIRONMENTAL DESIGN PROGRAMME AT ALLAMA IQBAL OPEN UNIVERSITY IN ISLAMABAD

*Nomana Anjum**

ABSTRACT

The emergence of environmental movement has brought forward the interconnection between ecological conditions and built environment. As part of wide-spread movement for the sustainable development and realization for the significant impact of building design and construction on the overall environment Allama Iqbal Open University (AIOU) initiated the continuing education programme for the built environment professionals. This paper has examined the relationship between the global environmental issues and built environment quality. The level of commitment of built environment professionals is examined alongside the need for environmental design education in Pakistan. The experience in developing and launching a postgraduate level environmental design programme for architects, civil engineers and town planners through a "blended learning" system is also reviewed. The learning outcomes have been evaluated considering the professional diversity, geographical as well as age distribution. Literature review, evaluation of programme literature and interface with staff and beneficiaries of the programme constitute the research methodology.

Key Words: Environmental design education in Pakistan, sustainable built environment, green architecture

1. INTERCONNECTION BETWEEN ECOLOGICAL CONDITIONS AND BUILT ENVIRONMENT

The emergence of environmental movement has brought forward the interconnection between ecological conditions and built environment. The architecture and design practices are being currently reviewed in regard to climate change, energy crisis, depletion of ozone layer, need for water conservation, and use of renewable natural materials, so on and so forth (Han, et al 2010) (Lo, S. M. et al, 2006) (Vezzoli, C., 2003) . Apart from global environmental issues, the sustainability concerns are also imporant in the local and regional context (Huisingh 2006, Ghazinoory and Huisingh 2006). A building design and construction plan in Asia must relate to cultural, economic, political and social needs of this region (Hussain 2010, Qureshi 2010, Shakur 2010). Similarly, a housing scheme or a single house unit covering all sustainability aspects, ideally planned and executed in suburbs of Bangkok city may not be a right option to be replicated in suburbs of Islamabad. This realization is quite recent, and a lot has been mismanaged in architectural practice for the last three to four decades. The disintegrated and fragmented architecture is to be re-integrated to suit the local climatic conditions, and to accommodate prevailing cultural values and needs. Day (2004) refers to architecture and environmental design in this context as "Healing Art" and urges the professionals, educationists and researchers to join hands to heal the environment that has been so brutally attacked throughout the course of twentieth Century. Papanek (1995) reviews the design process inclusive of architecture and explains six potential stages where wrong decisions may lead to ecological harm. From the built environment point of view, it includes, exhaustion of scarce/finite resources; manufacturing of building materials causing green house gases and production of chlorofluorocarbons leading to ozone depletion; unwise land use decisions resulting habitat destruction and species extinction; ill planned in construction activities that contribute to air and noise pollution; and eventually, at the end of building life cycle generate waste that becomes an environmental burden that is to be dumped in the land fills. The built environment that is in harmony with nature is denoted with the term eco-friendly design. The ability of architectural design and building stock to sustain in current economic, social and geopolitical pressures has raised many questions that are being researched under the domain of 'sustainable design'. One current example is energy crisis and its impact on buildings that were designed without much sensitivity to energy consumption for heating and cooling the buildings. In short, sustainable development requires deep understanding of many complex and often subtle interrelationships. The interconnection between ecological conditions and built

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environment may include environmental and ecosystem management strategies, land use and reform policies, social or political mechanisms, building design and climatic situations, ecology of building materials, new buildings and urban form, habitats and landscape conservation measures so on and so forth. These interconnections are now being researched extensively to re-engineer the entire building design and construction process (Hall, 2005, Helms et al. 2009). Work in this direction is being done in both developed and developing countries.

2. PARADIGM SHIFT: HUMAN CENTERED AND ENVIRONMENT-FRIENDLY DESIGN TRAINING AND EVALUATION

All buildings are designed to fulfill user needs or to carryout some kind of special activity. Apparently, quite simple notion but most buildings, designed world over in the second half of the twentieth century, are criticized for being neither user-friendly nor environment-friendly. The failure of many buildings on account of performance, functionality and environmental quality (for example poor thermal comfort, heavy reliance on artificial lighting, inadequate noise control and deficient indoor air quality causing redness in eyes, headache and sore throat) has now motivated an increasing number of designers, developers and building users to pursue more environmentally sustainable design and construction strategies (Qureshi, 2008, Scheuer 2003, Shah and Anjum et al 2009). In Christopher's (2003, p.33) words, "Every building situation is unique. The building relationship to its surrounding is unique; its users, even if we don't personally know them are individuals. If designers live up to their responsibilities they must listen to each individual environment, each particular set of user…The better buildings are matched to people and place, the better they will be cared for, and the more tolerant the occupants would be of any shortcomings".

The environmental designers have strongly argued that human-centered buildings contribute in health giving process. Health care design professionals have even claimed through their extensive research that properly designed recovery rooms add to the healing process and may reduce the recovery time. Human centered and User-friendly design is the focus of Environmental Design Programme under discussion (reflected in the main themes and list of courses presented in Sections 5 and 6). Examples of similar nature Environmental Design Programmes have emerged mainly in the developed world with the exception of a few in the developing world; Environmental Design Programme at McGill University, Calgary University, Canada; University of Canbera, Griffith University, University of Melbuorne, University of Western Australia and University of Tasmania, Australia; Cardiff University, Cambridge University, University of Salford, Dundee University, UK; Illinois University, Taxas Tech University, University of Hawaii, Carnegie Melon University, North Carolina University (More than 31 Universities offer Environmental Design Programmes in USA); College of Environmental Design, King Fahad University. Environmental Design has a dual mandate to offer both professional practice competencies at the first professional degree level in Architecture and to offer advanced interdisciplinary design and research collaboration opportunities in the Master of Environmental Design and PhD degree programs.

3. CONSENSUS ON NEED FOR "GREEN ARCHITECTURE"

Last few decades have seen a huge increase in ecological awareness in most developed and technologically advanced countries. The concept is also now well understood among professionals in the developing world. The concept is interpreted with at least one dozen varied terms. To name a few, these include Green Architecture, Sustainable Architecture, Climate Responsive Architecture, Ecological Design, Sustainable Design, Environmental Design, User-friendly Design, Human-centered Design, Eco-design, Participatory Design, Zero-energy design, Low Carbon dioxide emission Design. Whatever is the domain of interest or design activity there is "consensus" among professionals to confine the design activity in harmony with nature. This harmony is required not just at the time of development but as a continued process "For something to be sustainable it must continue and, as nearly every stable ecosystem in today's world is held in balance by a partnership of humanity and nature, this continuously depends on people" (Day 2003, p. 30). To attain sustainability in built environment the users and investors of building should be in partnership with architects and builders. A building designed on sustainability principles may not achieve anticipated energy and water conservation objectives if not used with energy – conscious life-style. "It's easy to dismiss the attitude of users as outside the sustainable design sphere. Their attitude, however, is crucial to its success" (Day, 2003, p.31).

Another obstacle to attain the sustainable architecture is finding the solution to the identified problems. Very little research has been undertaken to resolve multifold environmental concerns. In times of energy crisis do we need passive cooling and heating strategies or should we focus on alternative energy solutions or perhaps we need to

explore both. Then the question arises what should be the right combination for various types of buildings (schools, hospitals, housing etc.). Professionals also feel the need for extensive research to enlist the environmental performance of various building materials locally produced. Similarly, world is exploring the use of various waste materials to manufacture building materials. This strategy has a dual benefit; low cost building material is produced with added advantage of proper waste management. This also needs attention in the context of Pakistan. To address these issues two courses are added to the list of Environmental Design Programme entitled "Energy and Environment in Architecture" and "Sustainable Design Practices and Ecological Building Materials" (refer to Section 6).

The good environmental design application has one more perspective. It is aimed to satisfy the soul which is implied as humane design. The architecture is just not lived in physically but experienced through senses. Hence, the environmental and ecological elements are multi dimensional. "We recognize sunlight as not just for thermal energy but also to warm the soul. Like wise material is not just something to recycle but is anchoring and rooting; water not just to conserve and clean but also to enliven us through its fluid mobility and rhythmical motion; and air not just an issue of pollution, but particularly through sound and scent an agent of emotional connection between, for instance, indoors and outdoors" (Day, 2003, p.34). "Environmental Aesthetics" is one of the core courses raising awareness on harmony between nature and built environment (refer to Section 6).

4. NEED FOR ENVIRONMENTAL DESIGN EDUCATION IN PAKISTAN

The history of Environmental Design education in Pakistan is rather short and adoption of sustainability agenda is slow in the architectural practice (Ahmed, 2010). Environmental design has often been confused with , also known as green design, but the two are not the same. Ecodesign is one aspect of environmental design, and addresses sustainability concerns, but environmental design is a much broader discipline that also involves taking the surrounding environment into account when planning a design (wise Greek, 2012). Successful environmental design is a synergy between a building, landscape, or even a product and its surroundings, to the benefit of both. The concept was valued and recognized in the limited circles of professionals in the 1990's.[1] However, no formal training or educational programme was offered before 2003. In 2000 a formal feasibility was conducted by writing to all the engineering universities to invite expression of interest to collaborate with AIOU for developing an environmental design programme at postgraduate level. The response was overwhelming and all universities through their architecture departments replied with a positive note and identified a senior faculty member to deliberate on the concept. The response was carried forward by visiting the concerned departments. Initial discussions and explorations at Pakistan Engineering Council (PEC) and Pakistan Council for Architects and Planners (PCATP) lead to three main decisions:

a. *The programme should preferably be for the built environment professionals (architects, civil engineers, town planners and interior designers).*
b. *The programme must be with holistic approach to cover all aspects of design and construction.*
c. *The programme should be designed for practicing architects, engineers and designers to raise awareness on environmental issues to foster environment-friendly building design in the local context.*

A proposal was prepared for collaboration among AIOU, National College of Arts, Lahore and University of Dundee, UK and submitted to Department for International Development (DFID) of the British Government through British Council to initiate the development of Environmental Design Programme. The proposal, after a competitive process, secured funding for three years that allowed exchange of visits of experts between UK and Pakistan to conceptualize the course contents and decide upon modalities of course offering.

5. CONCEPTUALIZING THE COURSE CONTENTS

Initially, the graduate programmes in all the four disciplines (architecture, civil engineering, town planning and interior design) were reviewed to establish the commonalities and to identify various strands that required re-thinking on environmentally conscious building design. This effort was also part of wide-spread movement to attain the sustainable development (Anjum and Iqbal 2009, Bergea, 2006, Eagen and Streakewald, 1991, Papnek, 1995). Environmentally conscious building design manifests itself as interdisciplinary. It requires expertise from two distinctive domains (engineering and sciences). Both broad fields have their own sphere of activity and processes and their own technical

1 *The emergence of field of environmental design is published earlier by the author (Anjum and Paul, 2004).*

language, therefore, pose a great challenge for professionals to understand each other. Moreover, applied, social and behavioural sciences are also interlinked. There was a dearth of literature that was based on scientific knowledge to facilitate the engineers and designers for making right decisions at various stages of design and execution. The few books written in this context were mainly addressing the environmental problems prevailing in the cold climates, western cultures and energy intensive countries. As stated earlier (refer to Section 1) the building design must relate to cultural, economic, political and social needs of the region, and so all efforts were made to design course contents in the local context. Extensive discussions, exploratory visits, exchange of ideas revealed seven main themes to develop the course contents. These were

a. *Understanding ecosystem in relation to built environment.*

b. *Conservation of resources (energy supply, building materials).*

c. *Promoting harmony between building design and user needs in all types of buildings.*

d. *Environmental up gradation in poor settlements.*

e. *Evaluation of Built Environment for Physical Sustainability.*

f. *Reviewing indigenous materials and construction techniques.*

g. *Re-thinking design to inculcate environmental aesthetics.*

In addition to these broad themes it was agreed that "Sustainability" will be central theme of the taught courses and research projects. This approach is in line with other sustainability initiatives reported earlier to attain 'Sustainable Development" objectives globally (Karal, 2006) (Wells et al, 2009).

6. THE PEDAGOGICAL OPTIONS - A REVIEW

Various combinations of teaching methodologies were explored for effective teaching and learning process. Development of Environmental Design programme coincides with emergence of innovative educational technologies and teaching concepts [Fleming and Easton 2010, Lo et al 2006, McCormick et al. 2005). A new term "blended learning" was introduced in US in 2000 (Bliuc, et. al 2007) This form of educational experience has varied meanings and applications. However, the main purpose is mixing technology enhanced learning experiences, with other more traditional learning experiences. AIOU has been offering its degree programmes with combination of various modes for in-service practicing professionals for last 30 years or so. This includes television, radio, non-broadcast audio and video programmes, print media, lecture sessions, field visits, and lab based practical. More recently, web-based on-line components are also included (see Figure 1a,b,c.).

Figure-1a,b,c: Tutor training by Tamer Gado for architects and engineers on 'Sustainable Building Design' and application of 'Ecotect' software.

The decisions regarding the methodological options were facilitated by author's 25 years of experience in designing course material at graduate and postgraduate level with mixed mode strategy. During the process the visits were also arranged at the Ecological Design Training centers, UK Open University and Sri Lanka Open University to have broader perspective on pedagogical options (see Figure 2a,b,c). Eventually, print media was carefully combined with electronic media and further supported with face to face teaching in the form of lecture sessions, field visits, course workshops and survey research. More recently, environmental design and environmental science laboratories were also established at the main campus of AIOU to strengthen the research-based learning. In 2009 the programme was converted into credit hour system on the directives of Higher Education Commission in Pakistan. Thus it is easier for the students now to transfer their credits to other universities abroad. Semester wise presentation of programme is depicted in Figure 3. This move has increased the number of face to face contact hours (The initial 26 hourse/ course/ week has now increased to 48 hours/ course/ week).

Sr.	Course Title	Credit Hours
Semester I Core Courses (15 credit hours)		
1.	Introduction to Environmental Design	4(3+1)
2.	Environmental Planning & Practice	4(3+1)
3.	Environmental Psychology	3(3+0)
4.	Research Methods	4(3+1)
Semester II Core Courses (15 credit hours)		
1.	Evaluation of Built Environment for Physical Sustainability	3(3+0)
1.	Environmental Aesthetics	3(3+0)
2.	Women and Environment	3(3+0)
3.	Appropriate Technologies	3(3+0)
4.	Environmental Impact Assessment	3(3+0)

Semester III Elective Courses (18 credit hours)

Sr.	Course Title	Credit Hours	Sr.	Course Title	Credit Hours
1	Ecological Design: Cities, Transport and Landscape	4(3+1)	7.	Sustaining Culture and Design	2(1+1)
2	Sustainable Design Practices and Ecological Building Materials	4(3+1)	8.	Environmental Construction Management	3(3+0)
3	Building Evaluation Techniques	4(3+1)	9.	Environmental Considerations in House and Housing Design	4(3+1)
4	Environmental Issues in Workplace Design	4(3+1)	10.	Environmental Law	2(1+1)
5	Health Care Design	3(2+1)	11.	Environmental Ethics	3(3+0)
6	Design for Children	2(1+1)	12.	Energy and Environment in Architecture	4(3+1)

Semester IV		
1.	Statistical Methods in Environmental Health	4(3+1)
2.	Research Thesis	12
	Total	64 Credit hours

Figure-3: M.Sc. Environmental Design (Scheme of Studies).

Figure-2a,b,c: Curriculum designing meetings in UK institutions UK Open University, Pishwanton Ecological Design Training Centre, Glasgow and Findhorn Eco-Village, North of Scotland.

7. IMPLEMENTATION STRATEGIES

AIOU with its 36 regional campuses and coordinating offices has the potential to offer the nation-wide educational programmes. However, owing to the faculty constraints the programme was initially piloted in the two cities of Lahore and Karachi in 2003. The programme Coordinators were drawn from the NCA, Lahore and NED University, Karachi. AIOU regional campuses in Lahore and Karachi facilitated the appointment of part-time faculty members, delivery of course material in coordination with full-time faculty members at main campus in Islamabad (Brief summary of time line to develop the programme is depicted in Figure 4).

DURATION	ACTIVITY	OUTCOME
August 1999	Feasibility Study i) In house conceptual discussions to address environmental issues emerging in the building design and construction.	Conceptual Approval
Nov. 1999	ii) Visit of two experts from UK University to AIOU Inland visits to architecture/ engineering universities	Collaboration of NCA, AIOU and University of Dundee.
Dec.-April 2000	Development of Proposal i) AIOU, NCA and Dundee University jointly developed the proposal	Proposal approved and funding secured from British Council under DFID Higher Education Link for three years.
June /July 2001	Development of Scheme of Studies i) Curriculum designing meetings ii) Coordination and Collaboration with relevant academic departments iii) Visit to UK for curriculum review	Scheme of Studies Approved from all the statutory bodies
August 2001 to March 2002	Development of Course Material i) Writing of course material ii) Preparation of CDs/Study guides Visit from UK	Developed course outlines for the semester I and II Semester I Courses ready
June 2002	Identification of Resource Persons	
April-Sept. 2002	Setting up of Study Centers	
Jan –March 2003	Announcement /Finalization of Admissions	Total 130 applications received and 65 admissions finalized
June/ Nov. 2003	Holding of Lecture Sessions and Workshops in Lahore and Karachi Holding of Final Examination	Workshops held in Karachi and Lahore
Dec. 2003	End of semester Evaluation	Evaluation report compiled
June 2003 January 2004	Preparation of Course Material for the Subsequent Semesters	Course books and allied Material prepared
January 2004	Launch of subsequent semesters Final Evaluation	
August 2004	Submission of Proposal for HEC-BC Funding	Second Proposal secured Funding through HEC-BC Link
March/ June 2006	Production of videos	Recorded videos disseminated
March/ April 2006	Visit From UK Tutor Training Workshop at National Level on Sustainable Architecture	Director, Sustainable Built Environment, University of Dundee delivered workshop and introduced the ECOTECT Software.
March/August 2006	National and International Linkages Env. Design Lab. established for Research	Linkages established with universities and institutions
Jan 2009-Jan 2012	Publication of Research	12 papers published in International Journals and Conference Proceedings.
February 2012	Future Plans	PhD at Planning Stage

Figure-4: Time line for development and implementation the Environmental Design Programme.

The lecture sessions were designed to be held in the evenings over the weekends. An evaluation on course contents and mode of learning was carried out at the end of first semester. On the basis of evaluation some minor revisions were made in the curriculum and implementation strategies. In the following year the programme was extended to Rawalpindi and Islamabad. This allowed wider geographical coverage of the programme and close monitoring at the main campus. Now the professionals from towns like Khoshab, Jehlum, Abbotabad, Peshawar, Mirpur and Muzzafarabad also got the opportunity to enroll in the programme and attend classes in Rawalpindi. The main campus also provides hostel facility for students to stay over.

At the end of third launching in Rawalpindi, another evaluation was carried out which by and large confirmed the acceptability and popularity of the programme (Shah et al (2008), Shah and Anjum, 2009). However, some shortcomings were also identified to be overcome to enhance the quality of programme;

a. *faculty training was arranged for part-time tutors in Karachi, Lahore and Islamabad on "Sustainable Building Design" by inviting an expert Ar. Tamer Gado from University of Dundee;*

b. *Video documentation was made of 20 building design projects on the theme of "Sustainable Architecture" to expose engineers to sustainable design professionals in the local context; (Fig.5 & 6).*

c. *Setting up of Environmental Design Laboratory was initiated to incorporate practical learning activities with the help of acquired instruments (such as environmental meters, sound and luminous meters, data loggers etc.) and computer software (such as Ecotect) (see to Figure 5).*

8. THE LEARNING OUTCOMES - AN EVALUATION

The learning outcomes are evaluated on three categories,

a. *Professional diversity*

b. *Geographical distribution and*

c. *Age distribution.*

8.1 Professional diversity:

As stated earlier the students enrolled in this programme are from all disciplines and include civil engineers, architects, town planners and interior designers. About 850 students are enrolled in that last eight years and programme has attracted professionals from varied educational background related to built environment. The major proportion of students (75%) is from the civil engineering background as is the case in the overall national profile of registered engineers; however, recently architects' number is increasing in the programme with the rising awareness of sustainable building design. The diversity in the educational and professional background with a common interest in sustainable design enriches the learning experience and extends the debate on all aspects of building design and construction. The enrollment is now open to electrical and mechanical engineers who are engaged in building construction. Recently, B (Tech) honours in Civil and Architecture graduates are also made eligible to enroll for postgraduate diploma in Environmental Design. The diversity in educational background is also complemented with varied job commitments that include public sector departments, private organizations and engineering practices and educational institutions (see Figure 7).

Figure-5: Examples of sustainable design projects documented in video form by Institute of Educational Technology at AIOU. Photographs of video coverage of projects by Ar. Dr. Shakeel Qureshi, Ar. Naeem Pasha and Sohail A Abbasi, Ar, Ayesha Noorani)

Architect / Engineer	*Building Project*	*Salient Sustainability / User friendly Features*
Architects Naeem Pasha & Sohail Abbasi	*Church in Islamabad*	*Passive cooling and heating measures through shades and verandas.* *Use of ecological building materials (use of brick for interior and exterior finish).* *Optimum use of day lighting.*
	WAPDA Training Center Islamabad	*Use of brick as low maintenance ecological material* *Passive cooling measures and extensive use of natural plantation for shading.* *Natural lighting in most offices and hostels.* *User-friendly approach in selection of materials*
Architect Shama Usman	*Residential Project Islamabad*	*Natural vegetation and passive cooling measures* *House designed for an elderly lady with user-friendly features.*
Architect Hammad Hassan	*Residential Projects Islamabad*	*Energy efficient approach* *House designed for a couple for specialized professional needs.* *Energy efficient features incorporated.* *Natural vegetation and water element for maximum cooling during summer.*
Archtect Prof. Sajida Vandal	*Girls Hostel at Kinnard College Lahore*	*Special architectural elements to attain privacy in interior spaces.* *Use of low maintenance ecological materials.*
Architect Dr. Shakeel Qureshi	*Residential Project Lahore*	*Innovative approach for passive cooling in a split level house.* *Roof gardening and water fall for optimum cooling.*
Architect Ayesha Noorani	*Residential Project 1 Lahore*	*Use of lime instead of cement on walls and ceilings.*
	Residential Project 2 Lahore	*Innovative cooling techniques through architectural features.*
Architect Prof. Fauzia Qureshi	*Women's Resource Center Lahore*	*Use of low cost high finish materials* *Central courtyard design for thermal comfort.* *Space maximization through split level construction.* *User –friendly spaces throughout the center.*
Architect Sajjad Kauser	*Shopping Centre in Lahore*	*Renovation Project of an old market place through low cost indigenous materials.*
	Residential Project Lahore	*Extensive use of verandas and shades.* *Minimum use of mechanical devices for heating and cooling.*
Architects Arshad and Shahid Abdulla (Video recording by (Architect Aqeel Bilgrami)	*Nusserwanji block at Indus Valley School of Architecture*	*Reconstruction of a building from old building blocks at a new location.* *Re-use of old doors and windows.*

Figure-6: Projects recorded in the form of videos to portray sustainability and user-friendly features.

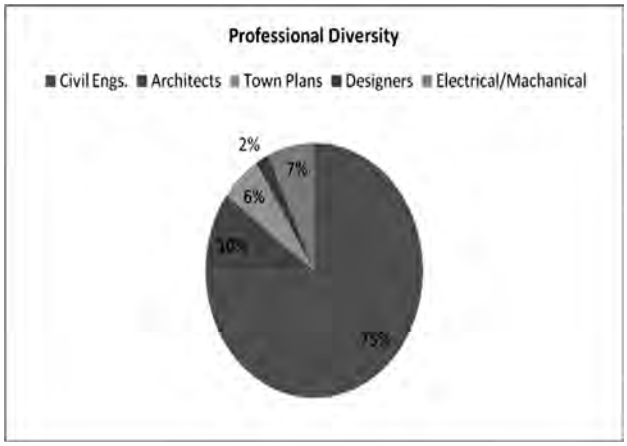


Figure-7: Diversity of student enrollment enrolled from varied educational background. (Source: Adapted from HEC-BC Link Project Report)

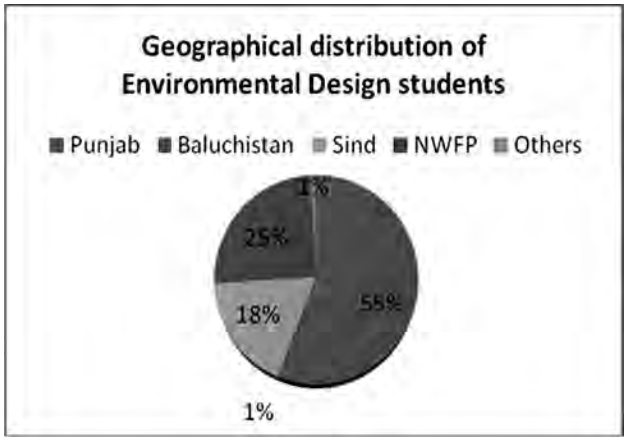


Figure-8: Student representation from various provinces. (Source: Adapted from HEC-BC Link Project Report)

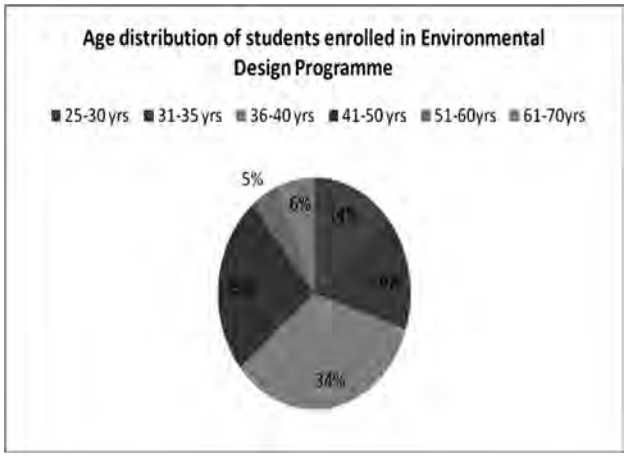


Figure-9: Range of age groups enrolled in the programme. (Source: Adapted from HEC-BC Link Project Report)

8.2 Geographical distribution:

Students are enrolled nation wide belonging to all provinces; mega cities, small cities and towns. This distribution and representation shows the wide-spread impact of student's research in their own localities addressing the environmental problems and issues at all levels (see Figure 8). Since study centers were only established in Lahore, Karachi and Islamabad, not many students from Baluchistan (only 1%) managed to travel from Quetta and other areas of Baluchistan to attend the lecture sessions and workshops arranged in Karachi. However, recently the university has set up video conference facility in many regions and there is now likelihood of attracting students from far off locations to enroll in this programme.

8.3 Age distribution:

Students who have shown interest in this programme range from 26 to 65 years of age. The data indicates that half of them fall into the age group 31 to 40 years and about three fourth are in the age groups of 31 to 50 years. This broad distribution of age has allowed the instill of sustainable/ environmental design concepts among all age groups in building industry (see Figure 9).

9. SYNTHESIZING THE IMPACT AT INSTITUTIONAL AND POLICY LEVEL

During the process of developing and launching the Environmental Design programme and now after running it for last seven years, many hidden problems and issues that were not perceived earlier are now brought into discussion. There is no single answer to how designers and engineers should respond to growing environmental issues. Many architectural decisions are inter-linked with political, social and economic scenarios in the country. Although, Pakistan responded well to international treaties and agreements related to environmental sustainability, most key positions, for long, in the environment ministry and its interlinked departments were held by the non-technical personnel and no significant effort was made to promote the environmentally conscious practices in the community. The initial launching of this programme in 2003 attracted many professionals in the government and non-government organizations, who were dealing with global and local environmental agendas, to enroll in this programme. Wells (2009) showed similar concerns with inadequate collaboration between regional sustainability initiatives and higher education establishments, and its negative impact in pursuing the development goals. Martinez et al. (2006) have established that universities can play a vital role in integration of local

and scientific knowledge for sustainable development and can extend their role from professional training to improving the living standards for the larger community to improve the quality of life, especially for the poor.

The programme with its holistic approach appraised on need for sustainable design practices and introduced strategies and techniques to take up the building assessment research (such as Environmental Auditing; Building Evaluation Techniques; and Strategic Environmental Impact Assessment). Further, inclusion of Environmental Psychology and Environmental Aesthetics Courses portrayed the interrelationship among people, buildings and natural landscape. Psychological theories pertaining to environment-behaviour relationship are applied to change the prevailing mind setting towards conservation and preservation. Environmentally destructive behaviour is assessed in these courses and directed towards environmentally responsible behaviour. The concept, theories, methods and practices of environmental aesthetics and environmental psychology are derived from art history, architecture, literature, philosophy, psychology, environmental studies, landscape design, law and urban planning. These courses encourage students to take up research to set pointers on local problems and direct them to identify local solutions. The core courses offered in the first two semesters bring many professionals from varied background to one platform. The range of electives offered in the third semester provides opportunity to take up specialized courses to pursue research in these areas.

The diversity in professional background is also reflected in the choice of research projects. In 2005 when the country was hit by the most devastating earthquake of its time, students opted to take up research in seismic design and disaster management strategies. More recently, when the country is facing the worst energy crises, students are pursuing research in alternative energy sources and environmental auditing of public buildings for energy conservation, and is also designing for the passive heating and cooling strategies. Other important areas where students have continued interest are; waste management strategies, exploring re-use and re-cycling options for household and industrial waste, evaluation of buildings (schools, hospitals, offices) for optimum performance and maximum user satisfaction; evaluation and conservation of traditional architecture and evaluation and up-gradation of poor settlements. Issues of air and noise pollution alongside transport management, preservation of natural landscape and concern for wildlife are considered with town planning issues. Water conservation and water purification have also been major research considerations (see Figure 10).

RESEARCH TOPICS	
1	*Study of Appropriate Building Construction Techniques and Materials in Northern Pakistan.*
3	*Exploring the opportunities of use of renewable energy for Academic Block of AIOU.*
5	*A study of bioclimatic building design in Lahore.*
7	*Environmental Health and Safety Protection Evaluation in Steel Rolling Mills in Islamabad.*
9	*Social Assessment of K220 KV Grid Station and Transmission Line Project at Lahore.*
11	*Evaluating the Building and Environment of Poly-technique College, Mansehra.*
13	*An Assessment of Effects of Building Materials on Environment of Seismically designed Building (GGHS Abbottabad No. 2).*
15	*An Environmental Impact Assessment of DHQ (District Headquarter Hospital) Gujranwala to Assess User Needs (Patients and Staff).*
17	*Assessment A study of Social Noise Pollution in a congested area of Rawalpindi.*
19	*Assessment of Environmental Awareness in a Government Department associated with Design and Construction.*

RESEARCH TOPICS	
2	*A. Study to Design an Echo Resort in the vicinity of Islamabad*
4	*Environmental Audit of High Court Rawalpindi.*
6	*Green Roof – Feasibility for Environmental Design.*
8	*To Study the Possibilities of waste Water Management through Recycling and Reuse.*
10	*Environmental Assessment of School Building in Peshawar.*
12	*Environmental Up- gradation of Urban Slum Ensuring Sustainability*
14	*A Study to Develop Guidelines for the Construction Waste Management in Housing Sector of Pakistan*
16	*A Study to Develop Guidelines for the Construction Waste Management in Housing Sector of Pakistan*
18	*EIA of Waste Management "Reduce, Reuse, Recycle" at Musa Khail*
20	*A Framework Based on Ecosystem Services Valuation for the Provision of Good Ecological Status of Lake View Point-Islamabad.*

Figure-10: Examples of research topics (2010).

From institutional perspective the programme was developed with innovative approach into most challenging and much needed field of knowledge. The two formal evaluations carried out in 2005 and 2009 and current enrollment trends indicate the programme to be successful in achieving the targets. Programme is reviewed after every two years so as to revise course contents or to add more courses as per the demand. The number of elective courses has grown to eleven now (Fig. 2). The academic board (2010) has recently approved a restructuring of the programme to the MS level (equivalent to MPhil) that would allow extensive research. Such blending of theory and research has also proven effective in the sustainable development programmes in most universities world-wide (Hansen 2006).

Many students are currently holding the key positions in government departments such as development authorities (CDA, KDA, LDA, FDA etc.), ministries of environment and planning, National Highway Authority, Environmental Protection Agencies, Academia etc. (see Figure 11).Their exposure to this programme is (directly or indirectly) paving the way forward for sustainable design policies and implementation strategies (see Figure 12). Similarly, the experts and resource persons are also drawn from key environmental institutions (both government and non-government) to develop the network and opening a dialogue for much needed change in policies and practices. Development authorities have gone through major revisions in building rules and regulations since this programme is developed and launched.[2]

10. SUSTAINABLE DESIGN PRACTICES: FUTURE GUIDELINES

It is now established that "sustainability" is not a myth but a real world challenge to be accepted and practiced with full professional commitment. Sustainability, though, in building design context is fluid in nature it primarily applies to all design and execution stages. Author's perception about "Sustainability" is, above everything, "vision for future". Any action taken or decision made now is to be visualized for its consequences in years to come. Lack of this is the main reason for this vital phenomenon being neglected or over-looked. Most professionals lack training in this context. This is like seeing beyond horizon. The educational programmes require the "Environmental Sensitivity Training" through course contents and teaching methodologies. It is much like architecture and design training that requires visualizing the two dimensional drawing into three dimensional forms in real setting. The sustainability approach is now challenging the design professionals to visualize the implications of their design activity on the whole planet. They now feel responsible to minimize the environmental degradation and reverse the consumerism exploited through design activities in 1970s and 1980s. The excessive focus on consumerism and over use of resources is still continued in the developed world and has now penetrated in the developing world as well.

Sustainable design is concurrently considered to be cost effective, affordable for most, close to nature, long lasting and possibly re-usable and recyclable. The persuasive power of design to create "new" can be effectively used to find sustainable solutions (Scheuer et al 2003, Kamp, L. 2006). Scientific knowledge derived from various life sciences need to be fused with engineering and design processes to acquire healthy living environments for now and future. Professionals and scientists from various fields of knowledge need to come closer for imaginative and enlightened planning; exploring simplistic designs requiring indigenous materials and low energy maintenance strategies. Design professionals must engage themselves in research to evolve theory and practice for unveiling the complexity of "Sustainability".

Many current practices in Pakistan and other neighbouring countries in Asia when compared with more advanced consumer societies are more promising on sustainability criteria. These are to be valued and reviewed with more respect and dignity attributed to these activities. Re-use and recycling of materials is normal practice in our part of the world. This can be done in more systematic way with wider acceptability and increased popularity. The Asian countries sharing similar interests can setup formal organizations and associations to promote such concepts and to learn from varied and rich cultural experiences. Asian cultures have not gone that far to completely loose on sustainable practices. We must review our current practices and all development plans from now onwards must be taken forward after evaluation for "Sustainability".

2 *For example, CDA has introduced the concept of rain water harvesting for bigger residential units in Islamabad, optimum land use, control over visual pollution and proper waste disposal are few more measures towards sustainable built environment.*

Names & Educational Background of Students	Position / Designation and Department / Institution	Degree / Diploma Acquired
Major Naseem Afzal Baz Civil Engineer	Director Environment National Highway Authority, Islamabad	PGD
Muhammad Ijaz Town Planner	Deputy Director, Planning Wing TMA, Rawalpindi	PGD
Col. Murtaza Ali Shah Civil Engineer	Executive Director Resource Development Foundation, Rawalpindi	MSc
Zafar Iqbal Zafar Town Planner	Deputy Director, Planning Wing CDA, Islamabad	MSc
Samra Mohsin Khan Architect	Associate Professor Architecture Deptt, COMSATS, Islamabad	MSc
Imran Shami Civil Engineer	Senior Manager Implementation Plan International, Islamabad	MSc
Muhammad Nasim ul Haque	Housing & Works, Karachi	MSc
Muhammad Habib ul Haque Civil Engineer	Deputy Director, WASA Fasilabad	MSc
Col. Syed Nadeem Mehboob (TI)	Director Works, Arm Forces, Lahore	MSc
Muhammad Ali Tirmazi Archietct, Assistant Professor	Architecture Department NCA, Lahore	PGD
Yasira Naseem Pasha Architect	Department of Architecture and Planning Dawood College of Engineering and Tech., Karachi	MSc
Nazar Abbas Kazmi Architect	Director, Nazar Associates Multan	MSc
Col. Furrokh Haye Civil Engineer	Director Works Arm Forces, Islamabad	MSc
Inayat Ali Ch. Civil Engineer	Deputy Director Environment Protection Agency, Multan	MSc
Saima Manzar Civil Engineer	Lecturer Env. Design AIOU, Islamabad	MSc
Muhammad Akram Nizamani Civil Engineer	Senior Engineer Multi National Company, Mangla	MSc
Col. Hassan Salim Haqani Civil Engineer	Managing Director National Construction, Islamabad	PGD
Muhammad Qasim Town Planner	Deputy Director, Planning CDA, Islamabad	MSc
Muhammad Sohail Civil Enginner	Project Director Works, PM Barani University, Rawalpindi	MSc
Muhammad Tariq Civil Engineer	Deputy Manager(Environment) National Transmission & Despatch Company, Lahore	MSc

Figure-11: Students' profile depicting widespread impact at policy level.

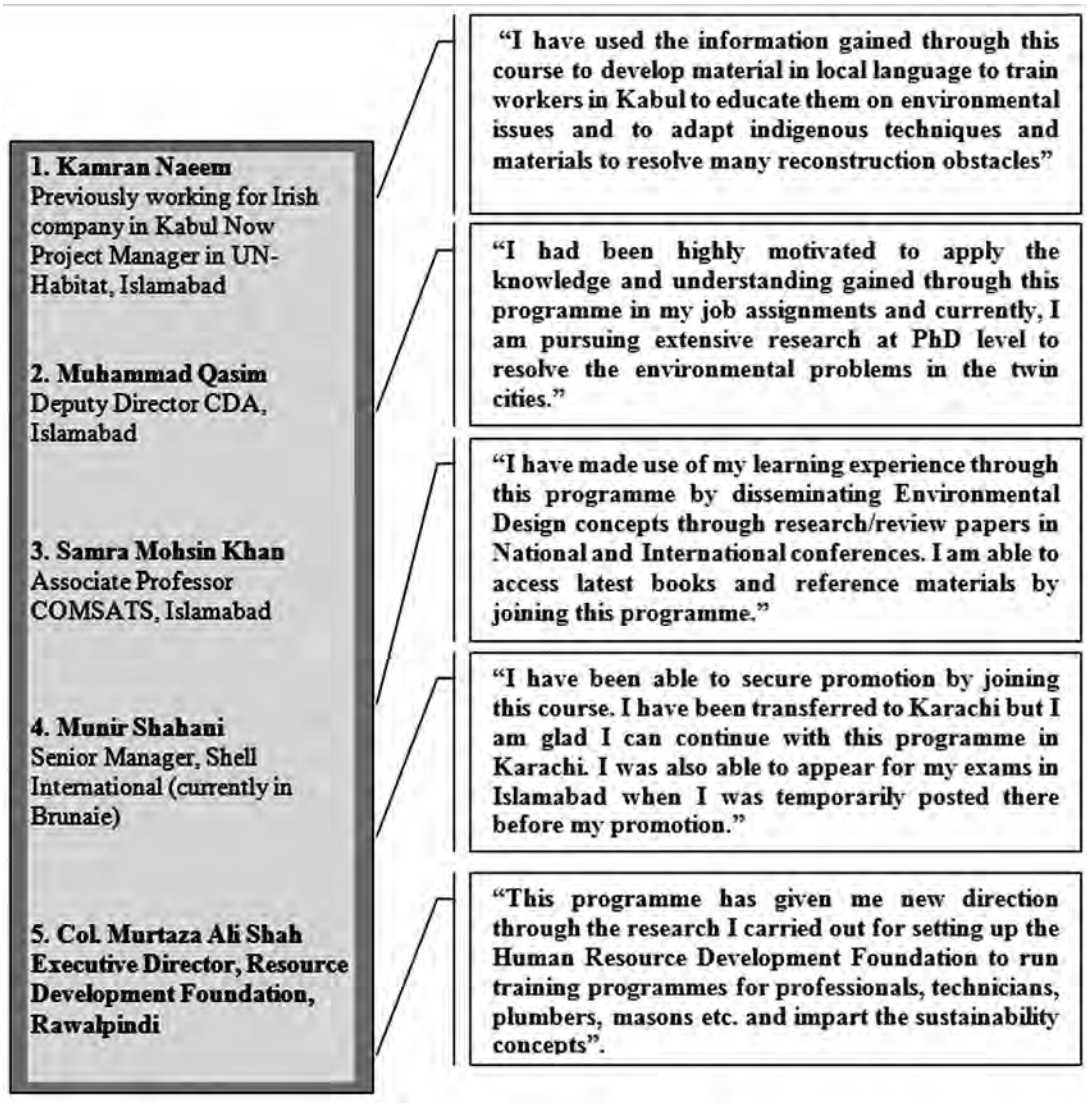


Figure-12: Students' perspective regarding usefulness of programme.

11. CONCLUSION

The relationship between environmental conditions and building design/ construction practices is well established globally. More recently, architectural practice is being reviewed in Pakistan to question the various aspects of sustainability. Discussion forums have now established that there is a dire need to focus research on environmental and user friendly design in the local context. It is agreed that architectural training programs need to strengthen the sustainable building design concepts. The built environment professionals with varied educational background require a collective effort to attain harmony among buildings, environment and users/occupants. More interdisciplinary training programs should be initiated nation-wide for broader and extensive research to address localized environmental problems in regard to building design and construction.

REFERENCES

Ahmed, T. (2010), "Sustainable Building Design: Need for re-educating the Architectural Professional in Pakistan", 3rd International Conference on Sustainable Design in South Asia: Past, Present and the Future", "SBD 10", 9-10 January 2010.

Anjum, N and Paul, J. (2004), "Environmental Design-An emerging field of study for professionals in the Building Industry", Science Technology and Development-A quarterly Journal, 23-1, 43-48

Anjum, N., Iqbal S. (2009) "An Environmental Assessment of Public School Buildings in Capital City of Pakistan" Proceedings of the Commemorative International Conference on Sustainable Development to save the Earth held from 7th-9th April in Bangkok, Thailand.

Bergea, O. et al (2006), "Education for Sustainability as a transformative learning process: a pedagogical experiment in Eco Design doctoral Education", Journal of Cleaner Production, 14-1431-1442.

Bliuc, A., Good Year, P., Ellis, R.A., (2007) "Research Focus and Methodological choices in studies into students' experiences of blended learning in higher education", Internet and Higher Education 10 231-244.

Day, C. (2003), "Consensus Design: socially inclusive process", Architectural Press, Elsevier.

Day, C. (2004), "Places of the Soul: Architecture and Environmental Design as a Healing Art, second editon", Architectural Press, Elsevier.

Eagan, P. D., Streckewald, K. E. (1997), "Striving to improve business success through increased environmental awareness and design for the environment education.", J. Cleaner Prod. 5-3, 219-223.

Fleming, M. L., Easton J. (2010) "Building environmental educators' evaluation capacity through distance education", Evaluation and Programme Planning, 33, 172-177.

Ghazinoory, S. and Huisingh, D. (2006), "National program for cleaner production (CP) in Iran: a framework and draft", J. Cleaner Prod. 14, 194-200.

Hall, K., (2005), "Green Building Bible", Green Building Press.

Han. H.J., et al (2010), (New developments in illumination, heating and cooling technologies for energy-efficient buildings", Energy 35,2647-2653.

Hansen, J. A. (2006), "Agents of change: Universities as development hubs" J. cleaner Production, 14, 820-829.

Helms, M., Vattam, S., Goel, A., (2009) "Biologically inspired design; process and products" Design Studies, 30-5 606-622.

Huisingh, D. (2006), "Sustainability in Higher Education: What is happening? J. Cleaner Prod. 14, 757-760.

Hussain, M. (2010), "Rediscovering the Sustainable Features of Vernacular Architecture", 3rd International Conference on Sustainable Design in South Asia: Past, Present and the Future "SBD 10", 9-10 January 2010.

Hutanuwatr, P., and Manivannan, R. (2005) "The Asian Future: Dialogues for Change-Vol. 1", Zed Books Ltd. UK.

Kamp, L. (2006), "Engineering Education in Sustainable Development at Delft University of Technology", Journal of Cleaner Production, 14, 928-931.

Karol, E. (2006), "Using Campus Concerns about Sustainability as an educational opportunity: a case study in architectural design, J, of Cleaner Production, 14, 780-786.

Lo, S. M. et al, (2006), "Perceptions of building professionals on sustainable development: A comparative study between Hong Kong and Shenyang", Energy and Buildings 38- 1327-1334.

Lozano, R. (2010), Diffusion of Sustainable development in Universities' curricula: an empirical example from Cardiff University, Journal of Cleaner Production, 18, 637 – 644.

Macris, A. M., Georgakellos, D.A. (2006), "A new teaching tool in education for sustainable development: ontology-based knowledge networks for environmental training", Journal of cleaner production,14-855-867.

Martinez R. L M (2006), "Incorporating principles of Sustainable Development in Research and education in Western Mexico" J. of Cleaner Production, 14, P1003-1009.

Maze, R and Redstrom, J. (2008), "Swith! Energy Ecologies in Everyday Life" I J Design, Vol. 2-3.

McCormick, K., Muhlhauser, E. et al (2005) "Education for Sustainable Development and the Young Masters Programme", Journal of Cleaner Production, 13, 1107-1112.

Papanek, V. (1995), "The Green Imperative: Ecology and Ethics in Design and Architecture", Thames and Hudson.

Qureshi, F. (2010), "Historical/Traditional context to sustainable design and construction", 3rd International Conference on Sustainable Design in South Asia: Past, Present and the Future "SBD 10", 9-10 January 2010.

Qureshi, S. (2008), "Sustainable Building Design: a seminar report", Liverpool, UK, July 28th-29th 2008, Built Environment Review, 6 – 3, 56-60.

Scheuer, C et al, (2003), "Life cycle energy and environmental performance of a new university building: modeling challenges and design implications", Energy and Buildings, 35, 1049-1064.

Smith, P.F., (2005), "Architecture in a Climate of Change: a guide to sustainable design", Architectural Press, Elsevier.

Shakur, T. (2010), Roles, Performance and the limitations of the Built Environment Professionals towards Sustainable Building Design in South Asia", 3rd International Conference on Sustainable Design in South Asia: Past, Present aand the Future "SBD 10", 9-10 January 2010.

Shah. A Haq E, Anjum, N. (2008) "Role of Open and Distance Learning in the Capacity building of Engineers." Published in the Proceedings of First International Conference on Construction in Developing Countries NED university of Engineering and Technology held on 4th-5th August 2008 at Karachi, Pakistan.

Shah, A .Anjum. N, Ahsan, H. (2009) "Green Building Design-A New Paradigm" paper delivered in International Conference on Science, Technology and Innovation for Sustainable Well-being (STISWB), 23-24 July 2009, Mahasarakhan University, Thailand.

Vezzoli, C., (2003), "A generation of designers: perspectives for education and training in the field of sustainable design. Experiences and projects at the Politecnico di Milano University, Journal of Cleaner Production, 11, 1-9.

Wells, P. et al. (2009), "The role of academia in regional sustainability initiatives: Wales", Journal of Cleaner Production, 17, 1116-1122.

MAKING LAHORE MODERN: CONSTRUCTING AND IMAGINING A COLONIAL CITY

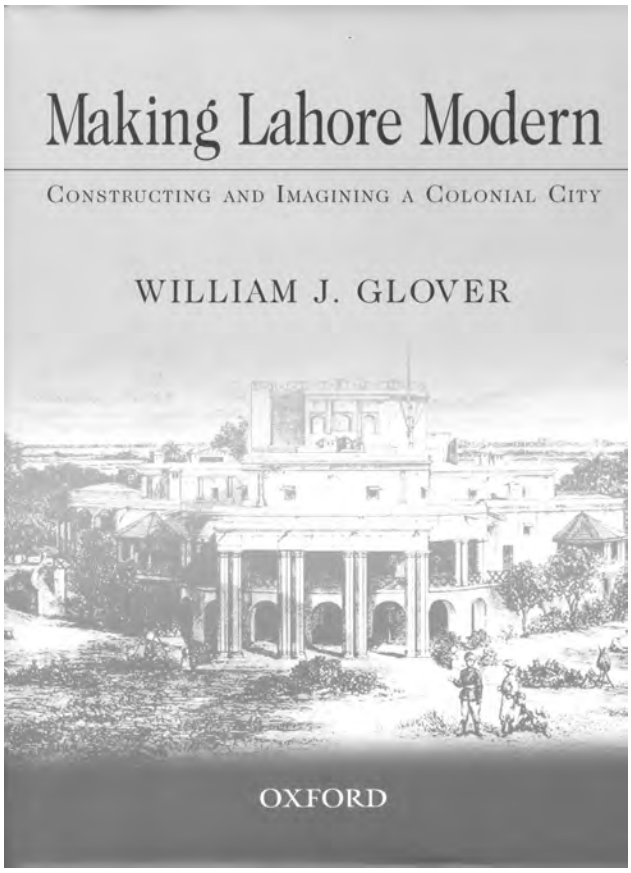
by
William J. Glover

Reviewed by Sarwat Viqar

In Making Lahore Modern, William Glover, while elucidating the forms of British colonial planning, draws attention to the ways in which this new discourse of architectural design and planning was constitutive of both urban form and urban subjectivity in Lahore. At the heart of British conceptions of urban planning was a preoccupation with what Glover terms the "object lesson." Rooted in the utilitarian ethic of emerging European thought, the British colonial spatial imagination was preoccupied with and informed by "the systematic observation and analysis of material phenomena on the ground in an effort to render them useful to a discourse on the proper distribution of objects in space" (29).

The first chapter lays out the pre-colonial spatial configuration of Lahore in which we learn the important role that this configuration, composed of the old urban footprint, monuments, both ruined and intact, and old re-used buildings, played in the reinvention of Lahore as a colonial city. Glover outlines the older planning order of the city in which "ethnically diverse practices of place-making" (9) were constitutive of Lahore's urban identity. His account of Lahore's past also points to a dynamic process of urban development that had been underway long before colonial intervention, and features of which persisted well into and beyond the colonial period.

In the second chapter, Glover concludes that the colonial spatial imagination was able to exert itself most successfully in the suburban rather than inner urban areas of Lahore. This conclusion speaks to his earlier focus on the pre-colonial spatial order of Lahore, which he suggests, proved, to a certain extent, "inscrutable" for colonial planners. Thus interventions in the inner city were made in more of a piecemeal fashion and this is where the idea of the 'object lesson' became useful. While at the same time, much more intrusive and larger scaled interventions were taking place in the countryside. Indian villages became a major object of improvement in terms of new planning principles and sanitation regimes. Here, the over-riding concern was to create an "exemplary milieu" as a way to achieve social reform.



The major part of Glover's work concerns the making of colonial Lahore as a collaborative enterprise between colonial and local elites. The collaborative ethos was rooted in creating a certain kind of legitimacy for colonial rule, a rule of benevolence. Colonial historiographers working on other colonial contexts, notably Gwendolyn Wright have pointed to similar efforts at architectural collaboration in the colonies that created new architectural settings and idioms.[1] An interesting aspect of this collaboration that Glover covers

* *See Wright, Gwendolyn. 1987. "Tradition in the Service of Modernity: Architecture and Urbanism in French Colonial Policy 1900-1930." The Journal of Modern History 59:2. pp. 291-316*

is architectural pedagogy. By examining the early architectural curriculums as well as the settings in which they were taught, he brings to the fore the historical particularities of the circumstances that created what were later adopted as the norms of architectural instruction and practice.

Based on early accounts of Lahore's building traditions which included colonial debates on what kind of changes could be effected in the built environment, as well as early building plans and permits and anecdotal evidence, Glover lays out the traditional patterns of use and appearance of the residential buildings of the old city and how they appeared to British observers. In the colonial mind, a comparison was inevitable – for example Compton observes that "Indian houses had no furniture" and "the size and quality of houses bore little burden in terms of annotating the status of households" (129). These observations offer interesting insights into the way expectations of what the appropriate built environment should be, were later incorporated into the design and use of buildings. Glover takes up the example of the Model Colony, relying on a catalogue published in 1937 and entitled Joshi's Modern Designs, to expose the way new residential layouts, linked to new patterns of living, were introduced and became constitutive of modern subjectivity. He posits that the planners of these new developments "had no hesitation in adapting for the purpose Howard's garden city, a scheme whose intellectual roots may have been foreign but whose principles and assumptions had been made familiar over time in a multitude of colonial projects" (157). However, he makes it a point to emphasize that these Model Towns followed their own development in terms of patterns of social use and the developing needs and aspirations of the residents who "took as much of the garden-city model as they wanted or needed, holding on to those elements of family and social life they wanted to preserve intact" (129).

It was not just Indians who were adopting and adapting to new ways of living, but the British as well. Seldom have colonial accounts been examined to understand the ways that colonial rulers were subject to local influences. In that, Glover's account of the British Bungalow and its expression of "anxieties at home" is a welcome addition to emerging scholarship on the way metropolitan subjectivities were constituted through the colonial experience.[2] Glover also shows how the evolution of Bungalow design expressed the tension between the colonial desire to maintain separation and segregation from the natives and the dependence on native domestic labour to maintain the household. This tension expressed itself in the "anxieties and ambivalences" of lived colonial experience which consisted of at the same time colonial guilt over having usurped native space and the longing to "be at home" in this home away from home. Glover draws extensively on the writings of Rudyard Kipling, an understandable choice when considering that the domestic realm often featured significantly in his work.

In the final chapter Glover explores urban writing on Lahore, emphasizing how narratives on the city were meant to convey certain didactic messages. Thus, for the British "Punjab's cities were increasingly seen as effective sites for the presentation of didactic messages, since abstract propositions about progress and cultural superiority could be revealed through monuments in tangible, material form" (187). There were older Indian traditions of history writing, though, which also informed emerging narratives on the city. For example, Chisti's encyclopedia on the city of Lahore, written in a "literary Persianate Urdu" relied for sources on authoritative accounts handed down through the generations which also consisted of legends and hearsay. Second-hand information was accepted as credible in the Indo-Islamic historiographic tradition, but not, however, by British reviewers who considered this method as unscientific and unreliable. Glover's point is that, even though the colonial spatial imagination worked to effect changes in the material and conceptual realms of the urban, it could never be sure that such changes had been effected in the way they had been envisaged. Other conceptual and material realms found their way into the fashioning of the urban and in doing so destabilized the notion that "materialist reform entailed principles – and produced effects – that were universal in nature" (199). This is one of the most interesting insights to emerge from his work which has significant implications for the way liberal frameworks are seen to be universally applicable. Ultimately Glover's work speaks to the "diverse expressions of modernity that emerged" from the colonial experience in which the local did not remain separate and external but was constitutive of the modern experience.

Glover's work does a great job of particularizing and denaturing the planning practices of colonial governance and is an important contribution to emerging scholarship on

2 *See Chattopadhyay, Swati. 2006. Representing Calcutta: Modernity, Nationalism and the Colonial Uncanny. Routledge. Chattopdhyay looks closely at the demands of trade and property transactions in colonial Calcutta and concludes that when Europeans started living and working in the colonial city they started adopting patterns of space-use, multi-functionality between residential and commercial, for example, that went against strict notions of segregated spaces defined by their functions.*

South Asian planning governmentalities. There are echoes of Mitchell's work on colonial Egypt which also engaged with the question of the universalization of the particularities of colonial governance.[3] However, where Mitchell engages quite thoroughly with the political context of colonial rule in Egypt, an examination of this context in colonial India seems a bit thin in Glover's work. Perhaps it would have been useful to see how social upheavals like collective demand-making, the independence movement, rising nationalism also worked with the specific local planning practices to constitute urban subjectivity in Lahore.

3 *See Mitchell, Timothy. 1998. Colonizing Egypt. NY: Cambridge University Press. and Mitchell, Timothy. 2002. Rule of Experts: Egypt, Techno-politics, Modernity. Berkeley: University of California Press.*

INVITATION FOR CONTRIBUTIONS - 2012

Journal of Research in Architecture and Planning is an initiative taken by the Department of Architecture and Planning, NED University of Engineering and Technology, to provide a medium for communicating the research and the critique in the broader domain of architecture and planning in Pakistan and beyond. From 2012, the Journal of Research in Architecture & Planning is going to be a biannual publication; one of these will cover general topics related to architecture and planning, while the other shall focus on a specific theme.

For our forthcoming issues of the Journal, the editorial board invites contributions from researchers, scholars, architects and planners. The papers can be based on ongoing researches or analytical and hypothetical concepts related to relevant fields. Interested authors should download and read the Instructions to Authors Manual (www.neduet.edu.pk/arch-journal/index.htm) for all details of requirements, procedures, paper mechanics, referencing style and the technical review process for submitted papers.

Format of Contribution

- The length of the article should not exceed 5000 words.
- Text should be typed and printed on A-4 sized sheets. It should be in the format of Microsoft Word document. The paper can either be sent on a floppy disk or CD or it can be e-mailed to the address given below.
- Photographs should be original and preferably black and white. Do not embed graphics, tables, figures or photographs in the text but supply them in seperate file along with captions. Scanned images will only be accepted in *jpg* or *tiff* formats with 300 resolution.
- Google maps should also be kept black & white along with its legends to use in different tones of black and gray.
- Drawings and maps should also be on A-4 format. If drawings are on AutoCAD they can be sent on a floppy disk or CD or e-mailed to the address given below.
- Refer to Website: www.neduet.edu.pk/NED-JRAP for referencing details.

E-mail: jrap@neduet.edu.pk

Forthcoming issues:

2012 First Issue

Deadline:

February 1	Abstract
March 1	Full Paper
April 1	Final Paper (After Review)

2012 Second Issue

Deadline:

August 1	Abstract
September 1	Full Paper
November 1	Final Paper (After Review)

Contributions for our 'Book Review' section are welcome in the form of a brief summary and a sample of the publication related to the field of architecture, planning and development.

Editorial Board