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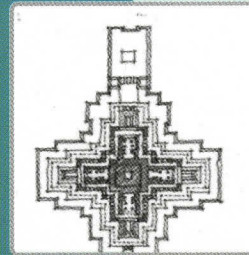
# Protibesh

ENVIRONMENT

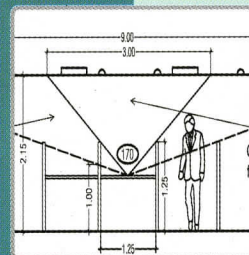
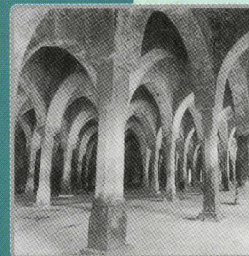
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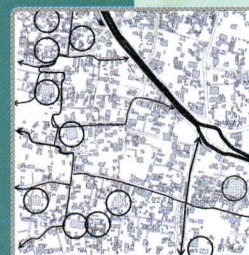
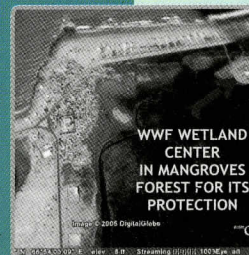
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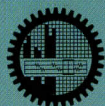
Architectural History



Environment



Urban Design



Bangladesh University of Engineering and Technology, Dhaka

# Protibesh

## ENVIRONMENT

Protibesh is a peer-reviewed research journal published by the Department of Architecture, Bangladesh University of Engineering and Technology, in January and July every year. Protibesh, meaning environment, aims to provide a forum for publication of original research and scholarship, for better understanding of the different aspects of and intervention for environment in urban and rural settlements. Protibesh is committed to act as a catalyst to bridge theory, research and practice in the broad field of architecture in Bangladesh.

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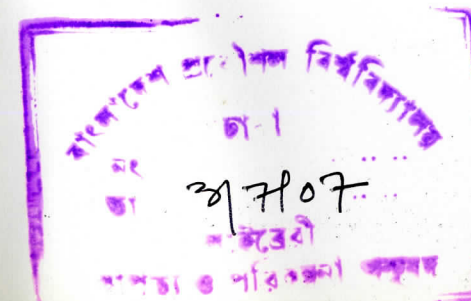
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**Protibesh**, the journal of the Department of Architecture, Bangladesh University of Engineering and Technology, is committed to disseminating research and technical knowledge relevant to the teaching and practice of Architecture. This issue of the journal includes seven research papers on varying topics, which the Editorial Board considers as having the potential to contribute new knowledge to the practice and teaching of Architecture.

The issue contains two papers on architectural history. The first, by M.M Rashid from the NUS, Singapore, discusses the transformation of the Stupa to the Stupa Shrine, relating it to changing Buddhist religious practices. The paper delves into the morphological transformation of the central religious edifice of the Buddhist belief, in terms of form, function and meaning with reference to the changes in religious creeds, practice and symbolism. In its earlier days Buddhism did not require any dedicated structure, as the religion put more emphasis on philosophical aspects of living, than on rituals. The later stupa-shrine, however, has a huge cruciform structure in the centre, that works as focus, surrounded by cells. Given the configuration and size of the cruciform structure, according to the author, it played an important role in the religious practice of the monastery. The paper presents an interesting way to interpret archaeological information architecturally and construct conjectures regarding lifestyles and historical space usage.

The second paper on architectural history by H. Rahaman and K.M. Darain from Khulna, provides a description of buildings in Khalifatabad City, Bagerhat, the ancient capital city of 'Ulugh Khan Jahan', one of the 15th Century saint-generals who ruled over the region. According to the authors, the brick construction, stone plinths and supporting systems adorned with terra-cotta ornaments display a vital interaction of foreign and local building tradition. The paper aims to examine how this indigenous building style responds towards climate and context, and is based on observations on twelve monuments in the area which according to the authors are in a condition well enough to be studied for any architectural research.

There are also three papers on urbanization and human settlements in this issue of Protibesh. The first is on Chittagong, a port city of Bangladesh, situated in a zone where a major earthquake may occur at any time. Its rapid urban growth is causing further deterioration and increasing the vulnerability of human lives, economy and infrastructures. In this paper, Civil Engineers, Ansary and

Alam, discourse on the seismic vulnerability of Chittagong and suggest some non-structural, social mitigation measures to ensure protection of life and property of the inhabitants.

As Chittagong is the most important trade centre for Bangladesh, the loss from a major earthquake is likely to affect the whole nation. To make matters worse, the growth of Chittagong for the last few decades has been haphazard and population density of the city has increased manifold. The paper gives an inventory of buildings in the city, showing that more than two-thirds of the houses are of temporary materials, which make the inhabitants especially vulnerable to earthquake damage. Non-structural mitigation measures suggested to reduce vulnerability involve increasing public education and awareness of the general population, where not only the Government, but also NGOs can play significant roles. The paper is an important one which carries important lessons for Architects as well as non-technical stakeholders.

The next paper concerns the vagaries of rampant unplanned urbanization and related increasing demands for new shelters and infrastructure support. Shrestha, the author expounds on the situation in the Kathmandu Valley in Nepal. The paper attempts an analysis of three different planned residential precincts developed under different techniques on a comparative basis, relating them to the inhabitants' responses. As a basis for the comparison the paper first establishes a theoretical framework of good residential neighbourhoods from published sources. The three case studies are compared with respect to their size, scale and integration with surrounding areas, the street and open space hierarchy within the neighbourhoods, architectural characteristics, opportunities for socialisation, social networks and community institutions and the sense of place and community within the neighbourhoods. The authors conclude with a list of recommendations for enhancing the intrinsic qualities of neighbourhoods in Nepal.

In the following paper, A.K.M.K Islam discusses urban revitalisation through place making, focusing on the case of Khulna, the third largest city of Bangladesh. Considering that the provision of open urban spaces is one of the basic factors for improving the living environment, the paper presents current status of such spaces in Khulna and discusses ways of ridding the city of this

dearth. Based on surveys and observations, the paper lists some of the measures that are imperative for enriching urban life and community participation, both for quality recreation as well as for greater economic growth.

This issue of Protibesh concludes with two papers on environment and design. The first of these presents an observation on daylight inclusion in the lighting of offices in Dhaka. Z.N. Ahmed and M.A.R. Joarder in this paper report the findings of a study of existing office buildings in the City, describing and analysing the luminous environments found within. The paper presents an understanding of the nature of, and influencing factors of, these luminous environments, under the dense conditions found in Dhaka city, through the study of three typical office typologies. The results of lighting measurements in typical spaces in these offices show that despite abundant daylight in Dhaka, it is given little consideration in design of the overall luminous environment. The paper compares the different daylighting strategies available to designers and how they are addressed in the Dhaka situation, finding that most possibilities are neglected. The case is made for supplementary lighting, i.e. using daylight in design and only supplementing deficits by artificial lighting, thus calling for energy efficiency.

The last paper of this issue concerns the consequences of human interventions and over-utilization of natural resources, and takes as a case study the fishing community living along the mangrove forests of Karachi, Pakistan. The authors, Khiani and Dholandas, examine how awareness of the issues that lead to preservation of the mangrove ecosystem can prevent its misuse or commercial exploitation and thereby keep poverty at bay. The paper presents a documentation of the physical realities of the built environment and socio-economic conditions of the community, while advocating for improved accessibility to services and infrastructure. Certain measures taken by the WWFP have been cited with particular emphasis on ways in which the community itself has been made to participate in steps to preserve the mangrove ecosystem.

In order to maintain the standard of Protibesh, the Authors have had to work hard, to finalise the drafts based on the comments and guidance of the Reviewers and the Editorial Board. All concerned, the Authors, the Reviewers and members of the Editorial Board have had to work hard to modify, edit and finalise the papers, and I am indeed grateful for the cooperation that they have all

extended. The contents of the papers and opinions expressed in them, as they are presented here are however the Authors' own, and the success, intellectual and academic value of their papers, likewise, belongs to them alone. We have merely served as instruments in their presentation.

In conclusion, I hope that the objective of Protibesh to contribute new knowledge to the teaching and practice of Architecture will be achieved through this issue.

**Dr. Zebun Nasreen Ahmed**

Professor,  
Department of Architecture, Bangladesh University of Engineering and Technology  
On behalf of the  
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January 2007

## From Stupa to Stupa Shrine: The changing morphology of Buddhist religious edifice per excellence

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### Abstract

The archaeological excavations in the last century have revealed the ruins of a new genre of Buddhist monuments in Bengal and surrounding region that belong to 7<sup>th</sup> –12<sup>th</sup> century AD- the most flourishing period of *Tantric* Buddhism in eastern India. Its architecture seems unprecedented because of the unique cruciform layout, spatial organization and articulation and disposition of different architectural elements. Its strategic positioning within the monastery complex, scale and architectural manifestation indicate that this structure was certainly of significant importance to the contemporaneous Buddhist creed. These later monuments are generally termed as 'Stupa- Shrine'- a hybrid of stupa and shrine because of the solid central core resembling a stupa base and shrine like antechambers at four cardinal directions. However, as architecture whether it really represents a newer type or a simply a variation of stupa archetype is yet to be defined. This paper is an attempt to understand the process through which this new genre of monuments were conceived and materialized. It will delve into the morphological transformation of the central religious edifice of the Buddhist belief, in terms of form, function and meaning with reference to the changes in religious creeds, practice and symbolism.

### Key words

Buddhist Monuments, Stupa, Stupa-Shrine, Bengal.

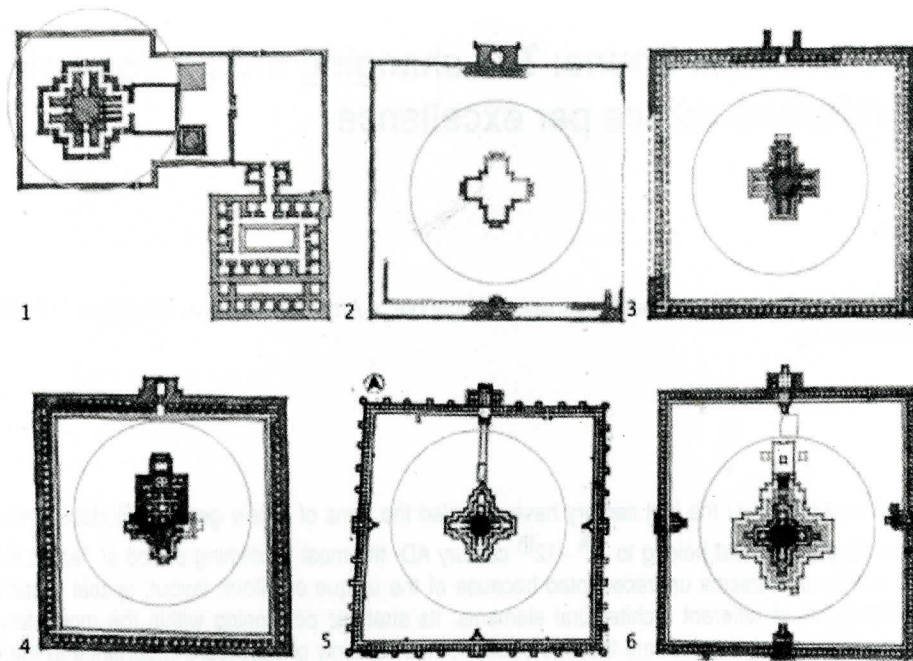
### Introduction:

The early monumental architecture in Bengal mainly belongs to the Buddhist tradition. Despite the scarcity of the complete physical structure, the archaeological surveys in the last century has discovered a group of Buddhist monuments in Bengal and surrounding region that seem unprecedented in terms of lay out, geometry and formal expression. The monuments that are included in this group are Sompur Mahavihara at Paharpur, Salban Vihara, Rupban Mura, Ananda Vihara and Bhoja Vihara at Mainamati and Vikramashila Vihara at Antichak (Figure 1). They were generally square in plan with a central courtyard and accommodating the cells for the monks at the peripheral wings. The most striking feature that distinguishes them from any of the earlier architectural monument of Buddhist tradition is the huge cruciform structure that works as the focus of the composition. From the configuration and the size, it is clear that this cruciform structure played an important role in the religious practice of the monastery. The absence of any precedence of similar

architecture anywhere in the Buddhist world or earlier in Indian subcontinent indicates that this genre of architecture was developed to cater to particular purpose and the existing socio-religious condition was greatly liable for that. Unfortunately, none of them, except Sompur Mahavihara is included in the mainstream discourse on the architectural history of Bengal.

### Stupa or Temple?

The main impediment of studying these monuments is the lack of substantial resources at the disposal of the architectural historian, both physical and literary. Among the five major monuments, only Sompur Mahavihara offers some physical remains of the ruin that is worth to investigate. Hence most of the earlier works on Buddhist architecture of Bengal were centered on this monument. There are two hypotheses that try to define the structure in terms of its function. The first one demonstrate the building as a temple, mainly the *Pancha Ratha* type, that uses Javanese temples like, Candi Loro Jongrang and



1. Rupban Mura, 2. Bhoja Vihara, 3. Ananda Vihara, 4. Salban Vihara, 5. Vikramahsila Vihara, 6. Sompur Mahavihara

Figure 1: 7th-12th Century Buddhist Monasteries in Bengal with cruciform structure.

Candi Sewu as visual parallels. Dikshiti<sup>i</sup> was the first to make such an assumption that was subsequently supported by some other scholars<sup>ii</sup>. Certainly there exists some visual similarity between them with the angular projections, location of antechambers and truncated pyramidal shape. However the manner spaces are organized in a Javanese temple with a central chamber and four surrounding ante chamber and demonstrates a over all scheme of convergence from the outside to the centre, is radically opposite to the scheme that have been adopted in Sompur Mahavihara. An underlying theme of divergence from the centre to the periphery can be discerned once we observed the plan of the cruciform central structure of Sompur Mahavihara carefully. In contrast to the central chamber of the Javanese temple the centre of the composition is occupied here with a solid core with shaft that was inaccessible from any side. Four antechambers were placed in four cardinal direction and multiple terraces were added as the scheme diverges out to the periphery (Figure 2). Hence it is clear that the architecture of Sompur Mahavihara was morphologically different from the architecture of the Javanese temple, although have similar cross-axial organization. The other hypothesis demonstrates this structure as a stupa claimed by schol-

ars like, Myer<sup>iii</sup> and Samuel<sup>iv</sup> who, observed this central core of the structure as the solid core of the stupa and the chambers as further addition to accommodate some ritualistic cults. Although they did not delve deeper into this possibilities but considering the formal expression of other contemporaneous and later stupas and stupa motifs this hypothesis has potentials for further study. Whatever the uses are or the type they belong to, it is sure that these cruciform structures had significant impact on existing Buddhist religious practice and reflective of the symbolism, iconography and cultural practice of that time as well as the aspirations of their patrons. The way they were conceived and constructed, was solely liable to the geo-cultural context of Bengal. As argued by Norberg-Schultz<sup>v</sup>, the way in which the ordering systems are used in a culture's architecture and the broad concept behind the use of various architectural elements in a particular way are closely related to the fundamental paradigms in the culture itself. Hence, in this study we would put more emphasis on the process than the product. We would try to understand how these buildings were conceived and realized under certain condition, which eventually defined these structures in terms of use and their relative role in the contemporaneous religious practice.

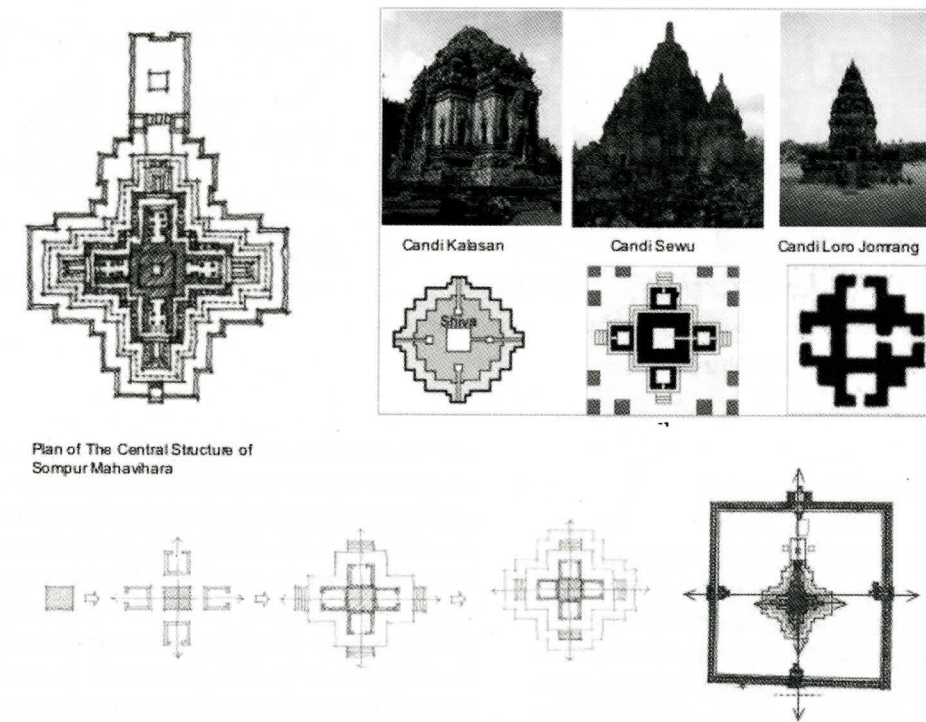


Figure 2: Comparisons of the schemes of space arrangement of Javanese Temple and Sompur Mahavihara

### Buddhist Religious edifice:

Unlike other religion, Buddhism did not require any dedicated structure/ architecture in its early days as the religion put more emphasis on the philosophical aspects of living than rituals. However in the *Vinya Pitaka*<sup>vi</sup> we found mentioning of two types architecture that were somehow related with Buddhas teaching. These are *Vihara* and *Bodhi Ghara*. Actually the *Vihara* or the monastery was the temporary retreat of the monks during the monsoon and the *Bodhi Gharas* were generally tree shrines that were very common in India since the pre Buddhist era. Usually it was a two or three storied structure around a sacred tree. As a sacred entity, Buddha had instructed his disciples to pay due respect to the *Bodhi Ghara*, while they confront any during preaching. Nevertheless neither in his teaching nor in his acts Buddha demonstrated a particular religious structure to be venerated. Buddhism had changed a lot after the death of Buddha and the subsequent centuries. Two architectural types became gradually important in the religious practice. One was the 'Stupa' that initially was erected as commemorative purpose and gradually became the most venerated religious monument as an embodiment of Buddha. The second one was the monastery or the 'Vihara' that was initially

conceived as a more secular form of dwelling for the monks and later became the central institution of the religion to disseminate the teachings of Buddha. With the passage of time these two types went through different changes in terms of architectural form and its associated meaning due to the change of religious canon as well as the prevailing conditions under which certain architecture is conceived and realized, albeit remain distinct and clearly discernible as architectural types. However, in terms of symbolic, ritualistic and metaphoric aspects the stupa became the centre of the religious practice. They were erected through out the Buddhist world for different purposes, sometimes as an individual structure, sometimes as a part of the monastic complex. Usually, in a monastery complex there were numerous stupas of different sizes, constructed for different purposes. However in most of the cases there was a stupa that was considered as the most sacred structure within the territory of the monastery. If we do a simple scrutiny of the lay out and planning of the major religious centre for the Buddhist we could see that among the numerous minor stupas, there was always a large stupa known as Mahastupa that was considered as the focus of all the ritual activities (Figure 3). Considering this there was a very good possibility of the central structure of Sompur Mahavihara to be a manifestation of Stupa.

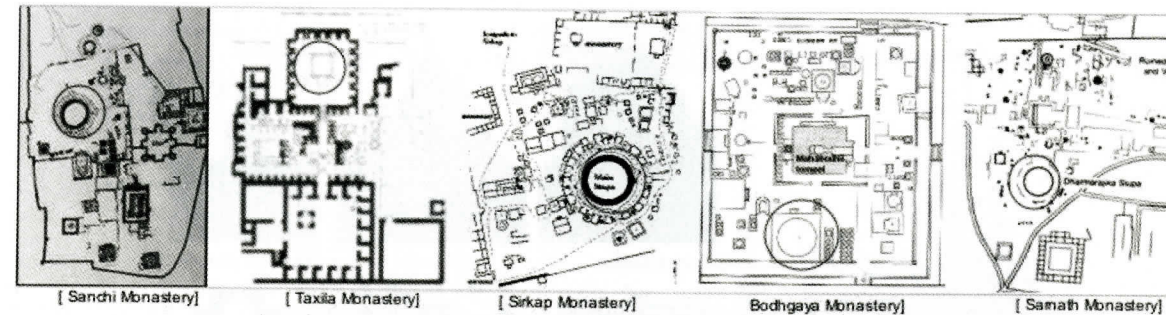


Figure 3: Major monastic complexes with a great Stupa

### Stupa and Its form:

The term 'Stupa' is quite vague in describing a particular form. The amorphous nature of Buddhist philosophy made its architecture most susceptible to the socio-cultural paradigm i.e. the custom of reverence, symbol and rituals of expressing status and customs related to death. Since its early days till date Buddhist religious edifices were transformed not only morphologically but also in their use and meaning. Consequently, stupa took different forms ranging from the simple hemispherical dome to multi-tiered tower while traversing through time and space. Despite all this formal expression there is certain theme that is common and tie them together under the common nomenclature. In general they are treated as single monolithic volume with three distinct parts as an anthropomorphic representation of Buddha. These three major parts are known as *Vedika* or the lower part that includes platform and drum, *Anda* or the hemispherical dome and the *Harmika* or the finials with parasols (Figure 4). Numerous seminal works have been done by different scholars on classifying and describing different forms of stupa from India to East Asia, the reason behind their formal expression and their symbolic and iconological associations. We do not want to go into the details of these studies. Rather we want to summarize the findings of these studies to get a broader picture of how the different stupa forms were manifested in different ways and the reason behind them mainly in South Asia, as this study is focusing on this particular geographic region. This summary is presented in tabular form in Table 01. The table demonstrates that it is not always the religion that dominated or determined the form or morphology of the structure. Rather religion played as one of the factors that may shape a particular architecture. Sometimes, it is the politics, economics, or simple technological reason a particular stupa was manifested with certain formal expression. Another thing is that each of this particular form was cre-

ated to serve particular purpose and they never emerged as replacement or descendant of the earlier type. Rather each of them was individual with their own formal expression and carries different meaning. So it is almost impossible to classify them either chronologically or geographically. The chronological frame that is presented here is more as a guide to indicate when a particular form was flourishing rather than to demonstrate a chronological sequence of development of stupa type from one to the other. That is the reason we frequently observed different types of stupa base in a same archaeological site that were constructed in the same period. Actually each of them was erected to commemorate a particular incident to associate and imply certain meaning to the site. The table also shows that the period when most of the monuments of Bengal (particularly the cases we are dealing with) were constructed was highly influenced with the *Tantric*<sup>vii</sup> philosophy and the principles of *Mandala*<sup>viii</sup> worked as the guiding principle for stupa architecture. Consequently the Stupa base took a cross-axial alignment, with multiple tiers. The drum was elaborated and this cross-axiality was further enhanced by placing four Buddha images in the four cardinal directions. Actually this four Buddhas in the niches were placed to conform with *mandala* of the Five-Buddha scheme (Figure 5), where four *Jinas* or Buddhas dominate the four cardinal directions and the central one, the *Vairocana*<sup>ix</sup> represents the core of the stupa. The *anda* or the dome became slightly squatted and bulbous. The Upper part with *harmika* and *chatrabali* holding the *Yasti* or the vertical axis became important for two reasons. Firstly to attain height and this is a common phenomenon for any religious architecture. And secondly to accentuate the vertical axis of the stupa that eventually connect the human realm of the mundane world to the heavenly realm of the celestial world.<sup>x</sup> Architecturally the cruciform plan or the base, presence of multiple tiers and four niches on four sides has closer affinity with the ruins of the central structure of the Sompur Mahavihara or other similar cases that we are

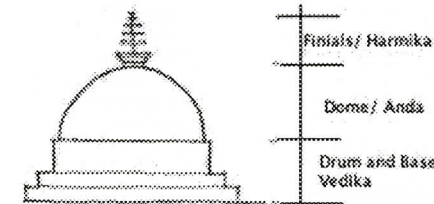


Fig 4: Major Parts of a Stupa

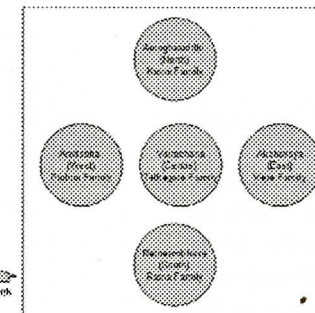


Fig 5: Mandala of the Five-Buddha

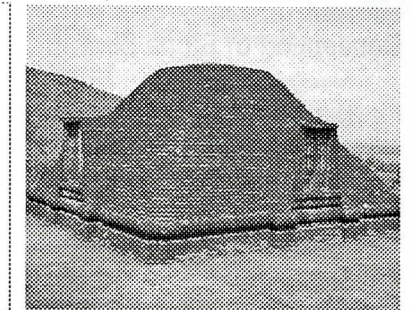


Fig 6: Ruins of Stupa at Udaigiri

discussing in this paper. However, whether this central building was really a manifestation of stupa and if so, then how the designer has come up with such a complicated scheme is something that we need to study deeper. Another question that remains valid is that, whether these central structures were simple manifestation of stupa or there was certain attempt convert a stupa to another building type for certain purpose.

There are certainly some principles that were followed here to organize the plan. From its geometry and consistency of lay out it seems that the whole complex was carefully designed and constructed from the very beginning. The grand stupa found in the Udaigiri (Figure 6) has almost similar formation. It has four elaborated niches that accommodate four *Dhyani* Buddhas<sup>xi</sup> of Five-Buddha scheme and the solid central core symbolically represents the central Buddha *Vairocana*. Udaigiri was one of the famous centres for *Tantric* Buddhism and this stupa is a manifestation of early *Tantrism* in Buddhist practice. However, Buddhist or *Tantrism* became highly ritualistic in the later period and influenced by the local conditions. Therefore, we need to know the preconditions under which these structures were designed and constructed.

### Politics and Religion under the Palas:

Although, *Tantric* Buddhism had penetrated in Bengal in a much earlier period but it was flourished under the ruler ship of the Pala kings in Bengal. The first Pala king Gopala came into power after a great turmoil, popularly known as *Matsanya*<sup>xii</sup>. In such a situation his first task was to establish control over the region and stabilize the country's social and political condition. He started patronizing *Tantric* Buddhism as a tool to establish political hegemony and stabilize the socio-political and economic situations of the empire. The reason was two-fold. Firstly, *Tantric* Buddhism had the capacity to fulfill the religious desire of the common people by making the religion more open and accessible. To popularize the religion and

establish it as a rival of Hinduism, *Tantric* Buddhism has adopted different godheads, tantras, newer rituals and rites to expedite the process of salvation.<sup>xiii</sup>

Secondly it could establish political hegemony over the empire as *Tantric* rituals are closely connected with kingship and power.<sup>xiv</sup> The grand scheme of erecting huge monastery complexes like Sompur Mahavihara throughout the Pala territory was undertaken not only for religious purpose but also as a part of the political pageantry of the Pala kings to demonstrate power, hegemony and authority over the religion.

*Mudra*<sup>xv</sup>, *Mantra*<sup>xvi</sup> and *Mandala* these three things became the key role player of the every aspect of *Tantric* Buddhism. First two are directly connected with worshippers personal state while the *Mandala* represents his connection with surrounding- the ritual space. Nevertheless, the central theme of *Tantric* Buddhism revolves around the concept of *Mandala*<sup>xvii</sup> - a 'psychocosmogram' that connects the microcosm of man to the macrocosm of universe.<sup>xviii</sup> In *Tantric* Buddhism the ritual space i.e. the architecture is considered as a representation of the cosmos and its design and construction are precisely guided by the principle of *Mandala*.

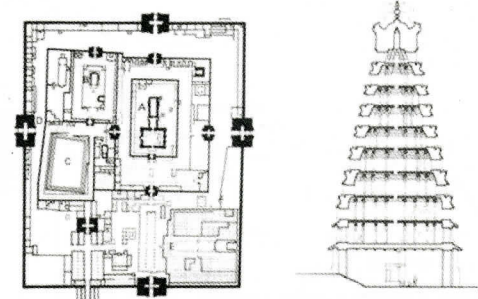
The interrelationship and relative hierarchy between different spaces and architectural element are very important in a Mandalic structure. Hence the central cruciform structure must have certain connection with the principles of *Mandala*. In any Buddhist *Mandala* the centre is considered as the most vital point through which the transcendence from human realm to celestial occurs. Architecturally 'Stupa' is the most sacred and venerated Buddhist edifice. It is a symbolic representation of the mount *Meru*<sup>xix</sup> that connects the two planes- one with human consciousness and another with absolute consciousness. Therefore it is very possible that the central structure of this monastic complex is a manifestation of stupa. How the contemporaneous vernacular designer had come up with such and complicated scheme of architecture with the core concept of stupa is an issue to be

examined.

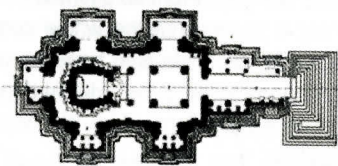
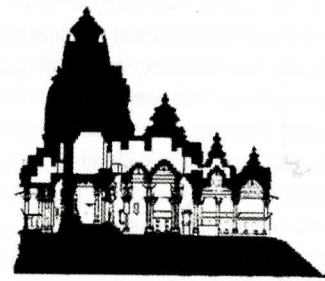
**Conception of Stupa Shrine:**

It is clear now that this 'unique' architectural layout is conceived to cater the religious, social and political aspiration of that time. Yet, in a vernacular nature of building industry where the use of model or variations of models was the main practice for the construction of building, it is difficult to imagine that some artisan(s) had come up with a unique design like the cruciform central structure form solely out of his/ their creativity. Rather it is more rational to think that they have certain model in front of them and they did some additions and alterations of that model to meet the newer demand that created either to substantiate some newer rituals practice or to cater to some political aspiration. However, throughout the process the stupa- the paradigmatic Buddhist religious edifice was kept at the core.

With the available resources in hand we could assume at least two possible schemes of this design cognition. The first one is based on the assumption that this structure is a direct manifestation of stupa. In earlier discussion we have done a scrutiny of the stupa that was flourished under the *Tantric* influence. This particular stupa form was the predecessor for the stupa shrine of the Sompur Mahavihara or in general for all the cruciform central shrine of that period in Bengal.<sup>xx</sup> So we can conclude that this particular stupa form was known to the builders of this mega-structure and thus there is very good possibilities of using it as a basic model to develop the stupa shrine. This basic model is featured with a cruciform base, four niches at four cardinal points with Buddha images, elongated drum, squatted dome and elaborated finials as described in the table. Devotion becomes one of the important parts of the Buddhist religious practice of that period and offering different sacred objects like, flower, incense, and jewelry was an integrated part of expressing devotion.<sup>xxi</sup> The ritual practice became much similar with the Vedic or Hindu religious practice as there existed a clear intention to establish Buddhism as rival of Hinduism. Eventually it led to establish a series of godheads parallel to Hindu beliefs and adopting similar hierarchy in overall religious system.<sup>xxii</sup> That resulted into the need of similar architectural space to house the god as well as to place the offerings from the devotees. Further, similar hierarchy was also established in terms of offering and performing rituals. Generally a Hindu temple has strong hierarchical sequence in its different parts. It represents a journey from light to darkness i.e. from an open and large space to the confined and small space. <sup>xxiii</sup> This small and dark space is basically a metaphor of a cave that houses the god and the temple itself represents the sym-



Temple of Maduari- A typical South Indian Temple



Lakshman Temple of Khajuraho- A typical North Indian Temple

Fig 7 : Hierarchical distribution of spaces in South and north Indian Hindu Temples

bolic mount Meru in which the cave is dug out. In the simplest manner a Hindu temple thus can be divided into two major parts. The first one, where the god is housed is the most sacred and most protected part and known as the 'womb-chamber' *Garbha Griya*. The second part that works, as a transition between the open and the close space, is the place designated to perform ritual by the laities and place offering. It is known as *Mandapa*. In larger temple this part is divided into some other parts depending on the sequences of the 'journey'. There is also a distinction between the spatial layout between the North Indian and South Indian temple type (Figure 7). However, the basic hierarchy that can be observed between these two is same i.e. a space for god and a space for devotees to place offering and perform rituals. Thus, between 7<sup>th</sup>-11<sup>th</sup> century, when the Buddhist rituals became parallel to Hindu rituals and the basic space requirement became same, it definitely demanded a similar pattern of hierarchy between the space for god and the devotees. The niches of the stupa that were already


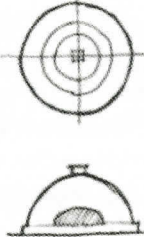
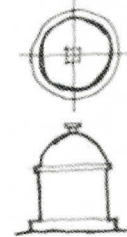
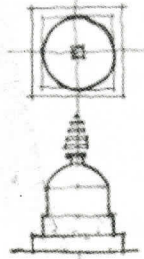
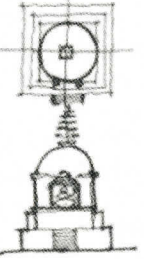
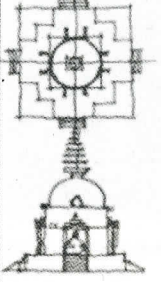
<p>-Early Stupa. -Mortuary relics of Buddha. -Commemorative purpose. -Emperor Asoka used it as political instrument for hegemony and control over India. -Humble in scale. -Brick built hemispherical mound with a circular platform.</p> 	<p>-After Asoka. -Authority goes to local monasteries. -Ambitious attempts enlarge the scale of the stupa to establish as symbol identity. -Financial limitation. -No new stupa was built but older one was magnified by using several encasing. -Encasing of stupa was considered as noble did..</p> 	<p>-Stupa as an embodiment of Buddha. -Three distinct parts. -Worshipping of stupa became the integral part of religious practice. -Attempts to make it higher and dominant. -Elongated drum and base to resolve the problem of occupying much land.</p> 	<p>-Early Mahayana. -Buddha as the Universal King. -Elaborated finials or chatravali. -Anthropomorphic representation of Buddha in smaller scale. [Relief work]. - Emergence of different terrace level, each representing certain phase of Buddha's life.</p> 	<p>-Late Mahayana. -Concept of Multiple Buddhas and Bodhisattvas. -Enshrinement of main Buddha for distinction. -Stupa as a symbolic representation of Buddhist world view.</p> 	<p>-Vajrayana. [ More empirical nature of Buddhism] -Cult of five Buddhas. -Stupa as the centre of the Mandala. -Four Buddhas on four side representing his authority on that direction - Stupa is symbolically connected with world system as centre. [ No more a single entity, but the central part of the world system]</p> 
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Table 01 : Table Showing the Transformation of Stupa

holding the four godheads of *Vajrayana* Buddhism<sup>xxiv</sup> became the chamber for the gods and demanded a similar hierarchical sequence of a Hindu temple. The first attempt could be the addition of the front chamber or hall to house the devotees i.e. a parallel of the *Mandapa* of the Hindu temple. This addition of the *Mandapa* accentuates the cross-axial character of the structure. A clear distinction can be observed between inner and the outer chamber in all four sides. This distinction is done by changing the thickness of the wall, which eventually determined the height of the chamber as well as placing door as a threshold between these two spaces. This is actually common for all the cruciform central structures that have been discovered so far including. In case of Sompur Mahavihara the difference between these two spaces is clearly discernible. Where the outer chamber takes the shape of hypostyle hall or colonnaded chamber, the sanctum remain unadorned and give cave like feeling resembling the character of the character of *Garbha Griya*. Although, whether the presence of four column bases in the outer chamber are actually representative of a hypostyle hall with roof supported by columns or they are actually creating a inner pavilion to accommodate a Buddha statue for circumambulation, remains unresolved, but there is no doubt about the different character as well as purpose of this two spaces. Circumambulation or '*Pradakshina*' is one of the most important parts of the Buddhist religious rituals since its

early days. Any sacred structure, stupa or images must have a *Pradakshina* path around it. With the addition of the *Mandapa* in the front, the original stupa was now transformed into newer entity- the 'stupa-shrine'. This transformation implied a newer meaning to it and the cruciform stupa-shrine now transcended to another level as a sacred entity. The structure itself became an element to be worshipped and eventually needed a circumambulatory path around it for this purpose. The addition of different terrace levels was actually the addition of paths for circumambulation as well as to provide a connection between all the four chambers. As Buddhist considers higher ground as more venerated than the lower one, the whole structure was then elevated to another level with an additional ambulatory path. The first terrace level of the central structure of Sompur Mahavihara that held the stupa or stupa shrine is basically the platform to add veneration to the stupa shrine. That eventually resulted into an 11' wide circumambulatory path with 16 projecting angle as it runs parallel with the second terrace level. Interestingly another level of transcendence took place with this. The whole structure is now became the centre of the Mandala as symbolic representation of mount Meru. It is now connected with the much larger context- the universe, which is resulted into the addition of a grand approach from the north through a huge staircase and a processional path. This theoretical scheme (Figure 8) proposes that the design was actually originated from a



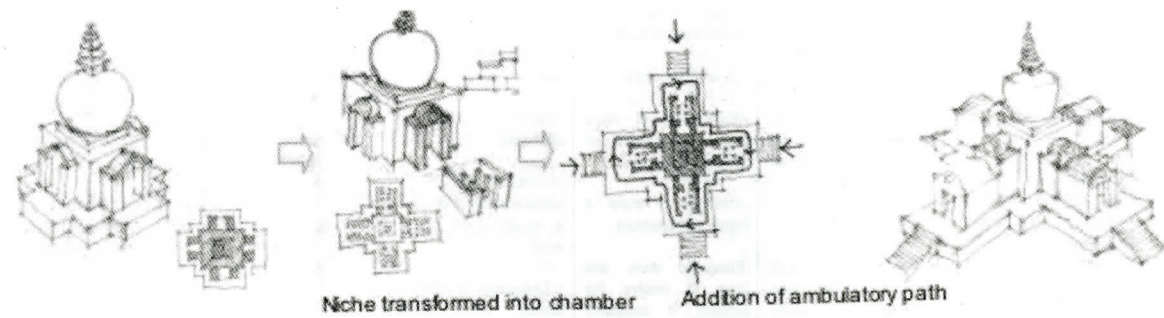
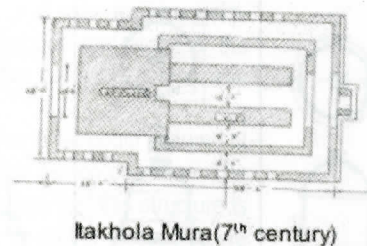


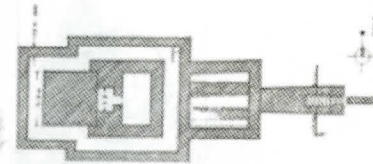
Fig 08 : The First scheme of design cognition of the cruciform structure



Stupa Shrine, Nalanda



Itakhola Mura (7<sup>th</sup> century)



Halud Mhara (7<sup>th</sup> century)

Fig 09 : Some of the earlier 'stupa-shrine' in Bengal and surrounding region

stupa and gradually through the process of addition and transformation that makes the structure to transcend from one level to another, as a response to existing religious need it took the shape of a complicated cruciform structure. The main shortcoming of this assumption is the lack of archaeological evidences. If this is the possible process of the design cognition then it must underwent different trials and errors and their supposed to be some evidences of the buildings or structures of these experiments. Unfortunately archaeological excavations hitherto could not reveal any of the structures that could substantiate this hypothesis.

The second scheme is based more on the archaeological findings. From the records of I-Tsing<sup>xxv</sup> and Xuanzang<sup>xxvi</sup> we knew that temples were also became important architectural types for the Buddhist's in the late Mahayana period (4<sup>th</sup>-7<sup>th</sup> centuries). Although the temples were constructed for different purpose, they were equally important with the stupa in everyday ritual practice.<sup>xxvii</sup> From the archaeological ruins of Nalanda, Bodhgaya and Sarnath we can see that temples and the grand stupas were placed together in the same monastic complex. However, the surviving example of one small stupa with a shrine chamber at Nalanda site III and foundation remains of some similar structure in Bengal actually interest us. In the example of Nalanda site III (Figure 9) a conscious attempt of combining the stupa and a shrine

chamber is easily discernible. The archaeological ruins of some Buddhist temple foundations in Itakhola Mura and Halud Vihara (Figure 9) in Bengal demonstrate a solid square mass was attached in the front of the shrine chamber. The solid mass is identified as stupa base and hence they are similar in terms of morphology with the structure in Nalanda site III. These structures were commonly termed as 'stupa-shrine' by most of the scholars. Why and how these structures were emerged was never answered. However, we could guess that this attachment of stupa and a shrine could be solution of two very practical problems, one functional another architectural. Firstly, as the temple and the stupa both became a part of the ritual practice, the monks had to commute between these two every day, while they came out from their hostel for worship. Secondly, it is an architectural problem to accommodate two structures of almost equal hierarchic importance within the same complex.

The most simple and rational way to resolve these problems is to put them together and treat them as one structure, which eventually gave birth to a newer building type- the 'stupa-shrine'. The plans of the early phases of Itakhola Mura structure demonstrate the attempts of attaching a shrine chamber with the stupa in a quite rudimentary manner. Whereas in the Nalanda example we could see a quite matured architectural piece. However, when the faith was gradually transforming towards Tantric Buddhism the adaptation of the principles of Mandala for

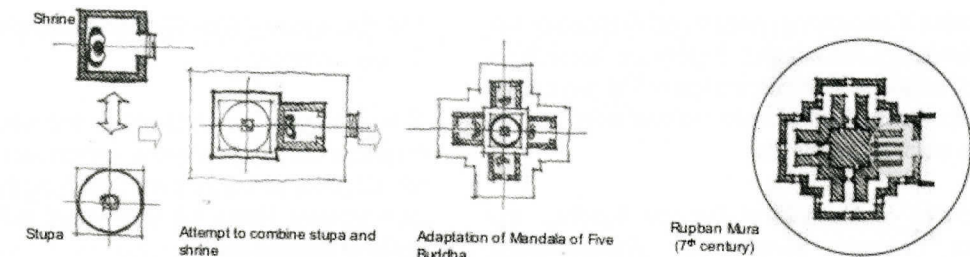


Fig10 : The second scheme of design cognition of the cruciform structure

religious structure became the priority. Converting the single chambered stupa-shrine to four-chambered shrine came as solution. To comply with the five Buddha Mandala of Tantric cult, the four chambers were placed at four cardinal directions to accommodate the four Dhyani Buddhas and the stupa at the centre as a seat for the central Buddha (Figure 10). The plan of the Rupban Mura is the best example of the earlier attempt of incorporating mandala scheme. The morphology of the earlier stupa-shrine with solid stupa and single chamber can easily be discernible by observing treatments of the four radiating chambers. If we observe the other cruciform structures that have been discovered so far chronologically, a gradual progression of refinement and complexity can be observed. The cruciform central structure of Sompur Mahavihara seems as the culmination of the process. We do not propose these two schemes as the definite origination process for cruciform central structure. Here we tried to use the evidences in hand, study the socio-cultural religious tendencies and use architectonic intuition to propose these schemes of design cognition. They are much theoretical and certainly subject to change while further resources would be available.

### Conclusion:

Despite some grey areas in the study that was mainly due to the limitation of resources, we could crystallize some assumption regarding these monuments at the conclusion. The major finding is that the central religious edifices of the Tantric believer was morphologically different from the earlier Buddhist religious monument e.g. Stupa. However, it certainly did neither mark the culmination of stupa cult nor end of veneration of stupa as a sacred monument. From the archaeological remains ( i.e. votive stupas and stupa motifs) of the sites that we have included in these studies, we have observed evidences of several stupas of different shapes sizes. It implies that the stupa cult was still alive during the construction of these monuments and each of the stupa form was individual

with its own associated meaning, as we have argued earlier. This particular genre of monuments was emerged as an addition to fulfill certain requirements, functionally to accommodate the five Buddhas together and provide a space for worship, symbolically to create a Mandala of its own to conform the metaphysical link with the eternity. Nevertheless, through out process of developing this new genre, it kept the stupa, the Buddhist religious edifice par excellence at the core.

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- v Christian Norberg-Schultz (1975), *Meaning in Western Architecture*, New York; Praeger.
- vi *Vinya Pitaka* is the first part of the Buddhist religious scriptures 'Tripitaka'. It demonstrates the was the code of ethics to be obeyed by the early sangha, monks and nuns
- vii Tantric Buddhism, was an extension of Mahayana Buddhism consisting of differences in the adoption of additional techniques (upaya, or 'skillful means') rather than in philosophy to expedite the journey towards enlightenment.

viii *Mandala* is an ordering principle mainly based on religious symbolism and associated geometry. According to Buddhist belief it is 'Psychocosmogram' that plays a vital role in connecting human realm material world and the celestial realm spiritual world.

ix According to *Mandala* of the five Buddhas, four Buddhas, namely *Akshobhya*, *Ratnasambhava*, *Amitabha*, and *Amogashiddhi* are placed at four cardinal directions and the centre is occupied by *Vairocana* Buddha

x John Irwin (1980), *The Axial Symbolism of Early Stupa* in *Stupa, Its Religious, Historical and Architectural Significance*, ed. Anna Libera Dallapicola, Wiessbaden; Franz Steiner Verlag

xi The five Buddhas in five different gesture in the five fold scheme of *Tantric* Buddhism are also known as five *Dhyani* Buddhas.

xii Literally the term '*Matsyanya*' means anarchy of the fishes where the big fish eats the smaller one. This is a metaphoric term to be used as the overall lawlessness of state system.

xiii Rama Chatterjee (1985) *Religion in Bengal During Pala and Sena Times*, Kolkata; Punthi -Pustak.

xiv "The concept of power in its political and social application has been intimately connected with *Tantric* theology- so intimately, one might suggest, that one cannot be adequately understand apart from the other"- S.Gupta and R. Gombrich (1986), 'Kings, Power and Goddess', in *South Asia Research* 6(2), Nov. 1986, London; School of Oriental and African Studies, p.125

xv *Mudra* means a particular gesture. This concept of gesture originated from the *yogic* practice where the *yogi* has to seat in a particular gesture to concentrate his mind. In *tantrism* each of the gesture has its symbolic meaning and practiced to serve a particular purpose.

xvi After seating in particular gesture the devotee needs to recite some syllables, which helps him to concentrate more. These syllables are known as *mantra*.

xvii F.W. Bunce (2002), *The Iconography of Architectural Plans: A study of the Influence of Hinduism and Buddhism*, New Delhi; D.K. Print world.

xviii Giuseppe Tucci (1961), *The Theory and Practice of Mandala*, London; Rider

xix A. Snodgrass (1985), *The Symbolism of Stupa*, Ithaca; Cornell University.

xx As all these art works as well as architecture had been created under certain religious environment and it is certain that there should be some underlying theme that ties them together. Hence it is very natural to have a visual similarity between them.

xxi Rama Chatterjee op cit..

xxii Rama Chatterjee op cit..

xxiii George Mitchell (1977), *The Hindu Temple, An introduction to its meaning and form*, New York; Harper & Row. Also see, Stella Kramrisch (1946), *The Hindu Temple*, Calcutta; University of Calcutta.

xxiv Actually, *Vajryana* Buddhism is form of *Tantric* Buddhism, which is based on the five fold scheme Buddha, known as five Jinas. However the central Buddha is considered as a symbolic entity and represented by the central stupa, whereas the other four are placed in there anthropomorphic form in four cardinal direction.

xxv J. Takakusu (1966) (tr), *A Record of The Buddhist Religion in India and Malayan Archipelago*, by I-Tsing, Delhi; Munshiram Manoharlal Publishers ( reprint).

xxvi Samuel Beal (1957-58) (tr), *Si-Yu-Ki; Buddhist Records of the Western World. Chinese Accounts of India by Xuanzang*, Calcutta; Sushil Gupta,

xxvii It can be understood from I-Tsing's description of different Buddhist rituals in Nalanda, mainly from the chapter describing the Ceremony of Chanting, See J. Takakusu, op cit.

## A Description of Buildings in Khalifatabad City, Bagerhat.

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### Abstract

The architectural style introduced by 'Ulugh Khan-e-Jahan' in Jessore and Khulna District shows an uncommon blending of the indigenous techniques with imperial Delhi but is still distinct with its own identity. The features like curved cornice, use of stone as DPC, disposal of rain water, uses of terra-cotta as weather proofing etc. proves that builders were well-known with the geo-climate i.e. the hostile warm-humid conditions of the locality. As a result there developed some finest pieces of architecture with distinct architectural characteristics of contextual sensitivity and better survival quality in Khalifatabad City, Bagerhat. The aim of this paper is to appraise the indigenous excellence of buildings of Khan-e-Jahan style.

### Key words

Khan-e-Jahan style, Khalifatabad, Building components, Indigenous solutions, Context.

### Introduction

During Muslim rule in Bengal (1204-1757 A.D.) a great number of urbanized habitations grew in various regions. The old city of 'Khalifatabad' now known as 'Bagerhat' - south of Khulna is one of those settlements. 'Khalifatabad' was named on one of its ruler 'Ulugh Khan Jahan'. During 15<sup>th</sup> century Khan Jahan was either forced by unknown political circumstances to immigrate, or he was specially commissioned by the court of Delhi to settle a Muslim colony in this distant region (Ahmed. 1984). He ruled over this territory virtually as an independent ruler being very generous to the people.

According to Ahmed (Ahmed. 1984), Khan Jahan adorned his capital city with numerous mosques (traditionally 360 in number), bridges, roads, palaces, mausoleum and other public buildings in an astonishingly short span of time. Large and expansive tanks with regular staircase landings were excavated in various parts of the township to provide salt-free drinking water in this predominantly saline belt. The architectural style, introduced by this saint-general, was limited only to the southern part of Bengal and known as 'Khan-e-Jahan' style (Naqi et al.

2004). The brick construction, stone plinths and supporting systems adorned with terra-cotta ornaments has shown a vital interaction of foreign and local building tradition in an explicit manner. Considering the significant role of the Khalifatabad City in the history of Architecture; it has been included on UNESCO's World Heritage List in 1985.

The aim of this paper is to represent this indigenous building style with reference to their responsive attitude towards climate and context. Collected data from physical survey followed by literature review is the main source of the study. The authors expect the outcome of the study will provide some basis for better understanding of the style and later preservation, restoration or conservation of the buildings of Khan-e-Jahan.

### Natural settings and development of the style

Khan-e-Jahan came to this southern part of Bengal not only as a ruler but also as a 'cultural mediator' the earliest torch bearer of Islam (Ahmed. 1984). In a land of hostility this saint-general came for the salvation of the local peo-

ple and to bring them into the religious orders of Islam through the process of expanding cultivable land by clearing the deep forests of 'Sundarbans'. For his generosity and public works Khan-e-Jahan gained the status of a spiritual leader among his followers, both the Muslims and the Hindus.

The region where he ruled and his style budded was surrounded by deep forests of Sundarbans. The building materials available were bricks and terracotta - bonded by lime or mud mortars; techniques available were the Hindu construction system of corbelled brick and the bamboo 'Chouchala' construction system (Brown, 1942). Stone was rare and the climatic conditions were hostile in nature (average rainfall of Bagerhat recorded from 1902 to 1961 was 163.83cm during monsoon and a 90% of humidity in June-July) (Bari, 1979). From these conditions and constraints of setting the style came up with a solution which produced the remarkable phase of Bengal Architecture.

Utilitarian character was the key concept of the Khan-e-Jahan style. Buildings here were perceived not as art form but as pieces of architecture where forms are generated by contextual needs and organizational simplicity. Architecture here is not seen as a container of decorative art rather a fully independent discipline collecting its resources from art, aesthetics, technique and philosophical ideals (Naqi et al. 2004).

### Methodology

Even, Khan-e-Jahan has some other works at 'Bakerganj' Jessore, but the study is limited to Khalifatabad as these monuments represent the most matured stage of the style. There were numerous numbers of monuments built in the city of Khalifatabad by Khan-e-Jahan. Traditionally the number of monuments is assumed as 360 (Ahmed 1989). The spectacular remains of these are still visible for miles around the ruined city. Most of the sites of the mosques are identified by the location of tanks and ponds. Among them, 12 monuments in Khalifatabad are in a condition well enough to be studied for any architectural research.

Physical survey followed by literature survey was the main basis of the study. A brief literature survey has been conducted on concepts and theories on Khan-e-Jahan style. A physical survey along with photographic documentation of selected buildings with 35mm film accompanied the fieldwork. Then collected factual data and drawings were prepared for final study.

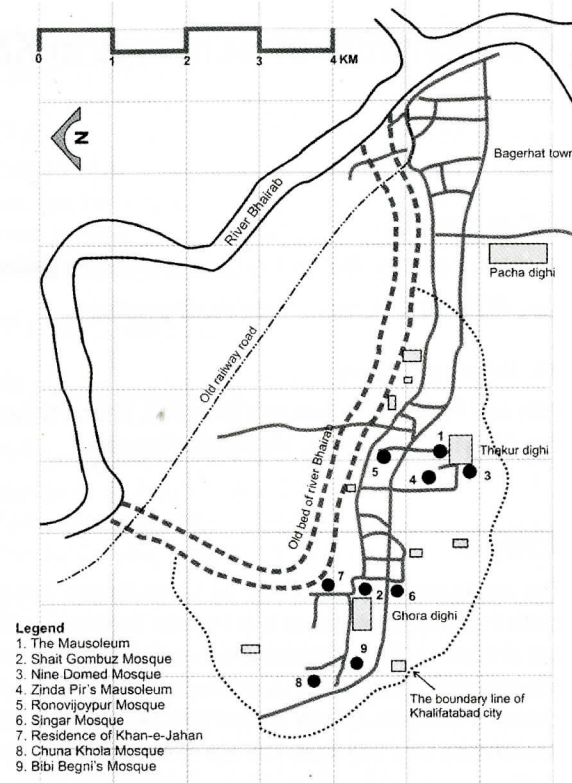


Fig. 01. Location of different monuments in Khalifatabad city. (Source: adopted from Ahmed, 1984)

### Building Components of Khan-e-Jahan style

The architectural style introduced here by Khan-e-Jahan poses an uncommon blending of indigenous techniques with the Tughlaq style of Delhi (Hasan, 1979). The buildings of Khan-e-Jahan is distinct from the rest of the contemporary architecture of the country, but bears affinity to a style of architecture created a century earlier around Delhi by Mohammad Tughlaq, bearing a particular resemblance to the Kalan and Khirki mosque (Fig. 02) (Mowla et al. 1993). Moreover, some other buildings like Mosque of Mollah Simla at Hugli (1377 AD), Eklakhi tomb at Hazrat Pandua (early 15<sup>th</sup> century), Mosque of Binet bibi at Dhaka (1457 AD) have similarities with Khan-e-Jahan style (Michell, 1984).

But, according to Percy Brown (Brown, 1942), the style was mainly conditioned by extreme humidity and the climate of Bengal. The experimental changes in this style, starting from monumental grand pavilion structures to individualistic small one shows the desire of establishing self 'identity' by conceiving the spirit of the context. The individual distinguishing characters of this particular style

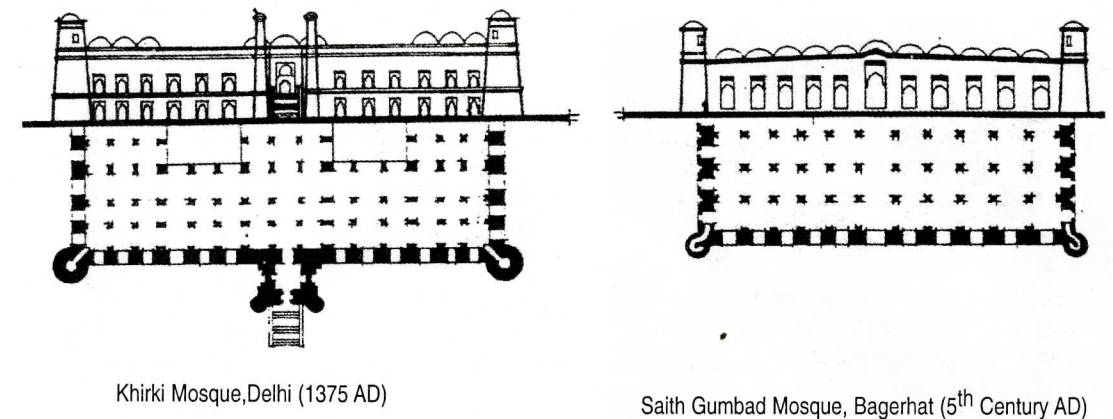


Fig. 02. Resemblance in Plan and Elevation between Khirki mosque and Saith Gumbad Mosque.

is the austere and dwarf looking facade with smaller openings of two centered pointed arch, the circular turrets, the Chouchala roofing system, the perceptual corrections and compact proportions in 'form' generation. In Bangladesh, the style is dubbed as Khan-e-Jahan style (Mowla et al. 1992) and influenced many other buildings (Dani, 1961) outside Khalifatabad region - they are six-domed Masjidkur Mosque at Chandkhali, Masjid Bari Mosque at Patuakhali and one domed Hammad's Moqsue near Kumira.

The style has a very utilitarian character. Due to responsiveness to the local climate the style had to be molded in some aspects. A brief description of some basic building components of the style will clarify the understanding:

#### (a) Foundation

Authorized excavation was not permitted. The upper portion of the foundation, as seen over the ground level gives us an indication about the construction of its foundation. In general cases it has been found that the topmost layer of the foundation is slightly projected outward at the base of the wall. From observation on the structures in dilapidated condition shows that usually foundation-walls contained two layers. The outer, visible part is a layer of regular shaped brick symmetrically arranged; while the inner concealed part consists of a filling of irregular shaped bricks and rubbles. But exception has been found in the mausoleum structure of Khan-e-Jahan. In the mausoleum the base of the walls stands on layers of stone courses with horizontal mouldings. The stone layer provides the upper brick structure with required strength and protection from damp and salinity.

#### (b) Floor

The floors of the monuments are no more in their original state. They have been reconstructed and renovated from

time to time as local peoples are still using the structures as prayer space. Floor level from the ground level also varies in different structure due to alteration of superstructure and protection from submersion. Only the tomb of the Khan-e-Jahan has still retained some of its original hexagonal multicoloured glazed tiles. Small outlets with corbelled tops are found on the floor level for quick drain out of water from inside.

#### (c) Plinth

These monuments have faced different modification and repair works through times. So, it is difficult to draw any comments on the conditions of the plinth level as the floors of the monuments are not in its original state. However in most cases a 6" raised platform placed in each doorway was found to prevent overflow caused by heavy downpour. It is assumed that this low plinth height was determined in accordance with the surrounding low lying area.

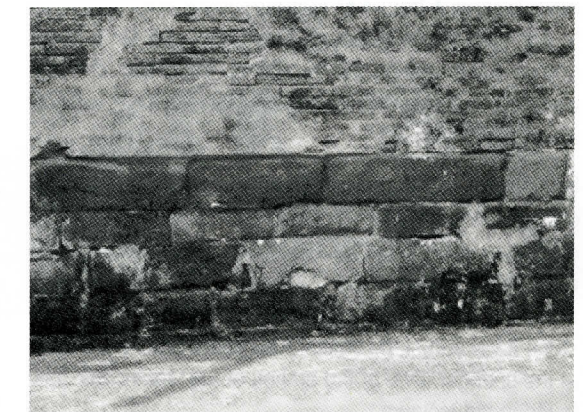


Fig. 03. Brick walls with stone plinth.



Fig. 04. Ruins at Khalifatabad. (photo: Ar. Ali Naqi)

**(d) Walls**

Wall construction of the monuments is quite similar to the construction of the foundations. Usually walls are made of two layers. The outside is furnished with regular sized bricks placed symmetrically one after another and bonded with lime mortar. The inner side that is between of two layers is filled with irregular shaped bricks and rubbles which are bonded by mud masonry. In most cases the inner sides of the finished bricks are rough and irregular.

Walls of these monuments in this region also vary in thickness. It ranges from 4'5" (Zindapir Mausoleum Mosque) to 9'6" (Bibi Begni Mosque). Structures with large single domes have comparatively higher thickness of walls whereas mosques with octagonal turrets have walls of lower thickness.

Use of stones in foundation level up to lintel is quite common in most of the mosque of Gour, but only a few structures in Bagerhat have similar stone treatments in walls because of scarcity of stones in this region. One exception is the mausoleum of Khan-e-Jahan which has stone base and stone lintels. Also stone bracket details at the springer level of the arches of the 'squinch' are found in mausoleum.



Fig. 05. Water spout in Khan-e-Jahan mausoleum.

**(e) Bricks**

Bricks made with locally available materials of different shapes have been used for different purposes. Usually walls are built with regular rectangular shaped bricks with a dimension of 2" x 5" x 6". Polygonal turrets have been constructed with polygonal shaped bricks. Wedge shaped bricks have been used for circular turrets. The thickness of these bricks varies from 1.5" to 2.5" and length from 5" to 9.5".

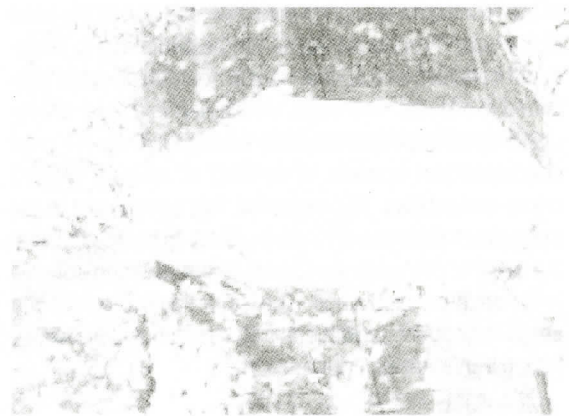


Fig. 06. Polygonal shaped bricks in corner turret (photo: Ar. Ali Naqi).

Name of the Monument	Wall Thickness
The Nine dome Mosque	7'7"
The Mausoleum of Khan-e-Jahan	8'0"
The Mausoleum Mosque of Khan-e-Jahan	7'2"
The Ranvijoypur Mosque	9'3"
The Shait Gombuz Mosque	8'0"
The Singer Mosque	7'0"
The Bibi Begni Mosque	9'6"
The Chunakhola Mosque	7'6"
The Reza Khoda Mosque	5'8"
The Zindapir Mausoleum	5'0"
The Zindapir Mausoleum Mosque	4'3"

Table 01 : Wall thickness of different monuments

**(f) Columns**

The multi-domed mosques are equipped with series of stone columns for supporting the domes. These columns have basically three parts – the base (square in section), the shaft (octagonal in section) and the capital (square in section). Stone was not available in the local region, hence those are assumed to be transported from remote area and for ease of transportation the large stones were cut into pieces. During construction, these pieces of stones were stacked horizontally one upon another and

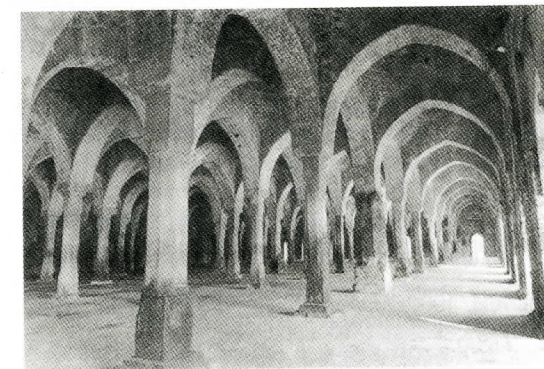


Fig. 07. Columns of The Shait Gombuz Mosque (source: Nazimuddin, 1989).

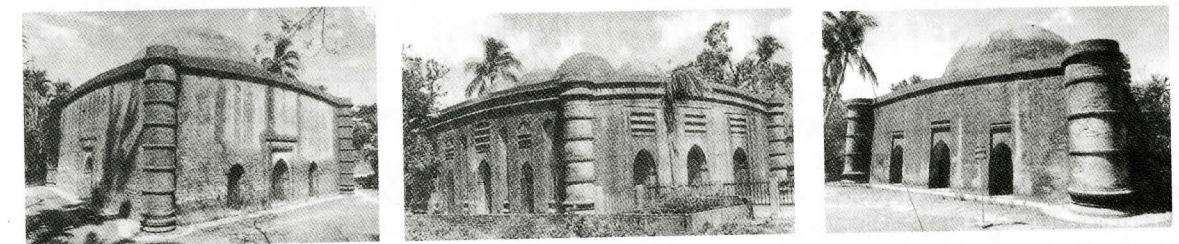
iron dowels were used to fix and keep them in place. The column texture is rough, unfinished and hardly ornamental unlike most of other monuments in Bengal. On the other hand, the single domed mosques are devoid of any supporting column because the domes rest on the thicker side walls.

**(g) Pilasters**

Brick pilasters are generally used in multi-domed mosques. They are projected from the walls and either rectangular shaped or similar shaped like central free standing stone columns.

**(h) Roof Cornice**

Due to heavy rain and to throw off the excess of water during the heavy rainy season, the solution of curve roofing became most convenient. According to Brown (Brown, 1942), this technique of curving was influenced by local roofing system with bent bamboos covered by thatch. Thus a special form of curved roof was devised for the purpose and became in the course of time a fixed convention for almost all buildings of Kahan-e-Jahan style.



Bibi begni's mosque

Nine dome mosque

Ranvijoypur mosque

Fig. 08. Curved roof and cornice in different mosques (source: Nazimuddin, 1989).

Name of the Monument	Shape	Lifted upward at Center point
The Nine dome Mosque	Curved cornice	6.375°
The Mausoleum of Khan-e-Jahan	Curved cornice	10.62°
The Mausoleum Mosque of Khan-e-Jahan	Curved cornice	12.94°
The Ronvijoypur Mosque	Curved cornice	11.69°
The Shait Gombuz Mosque	Sloped towards the sides	2°-6°
The Singer Mosque	Curved cornice	12°
The Bibi Begni Mosque	Curved cornice	2°-6.94°
The Chunakhoia Mosque	Curved cornice	7°
The Reza Khoda Mosque	Roof Destroyed	N/A
The Zindapir Mausoleum	Roof Destroyed	N/A
The Zindapir Mausoleum Mosque	new domed rebuilt with no reference	N/A

Table 03 : Roof Cornice of different monuments

### Conclusion

Khan-e-Jahan was a great builder. Around 360 numbers of monuments were built in Khalifatabad, Bagerhat in his regime. The context where these monuments were built is extremely saline prone low-land with high level of moisture content in the atmosphere. As a result there is always the threat of efflorescence on built structures. But, surprisingly these brick structures have been surviving in this hostile context for more than 450 years.

From the study it has been found that Khalifatabad had experienced the most matured state of construction art of Kahan-e-Jahan. Khan-e-Jahan built his most beautiful monuments with previous experience of Barabazar, Jessore and expressed his significance of architectural response towards climate and nature at Khalifatabad. Building features like D.P.C. of stone as plinth beneath the walls, rainwater disposal through stone spouts from different corners of roof, small outlets in floor level including corbelled tops, curved and sloped cornice, use of terra-cotta etc. proves that the builders were acquainted with the geo-climatic conditions of the context. Certainly this responsive attitude of this style towards climate is the secret of long existence of these monuments.

The style introduced here by Khan-e-Jahan may not be unique and influenced by Imperial Delhi. But there is no doubt that the construction principles of this style were creative, its appearances were ingenious and original and particularly suitable to the climate and purpose for which it was intended.

### Acknowledgement

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## Seismic Vulnerability of Chittagong City and Some Mitigation Measures

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**ABSTRACT:** Recent repeated earthquakes in Chittagong region have generated a potential threat to the people of that locality. Chittagong is situated in a zone where a major earthquake may occur at any time. Its rapid urban growth is causing further deterioration and increasing the vulnerability of human lives, economy and infrastructures. If a large earthquake hit this city, it may cause heavy damage to its infrastructures and consequently the whole country may suffer. Hence, it is essential to develop an effective earthquake risk management plan, which requires long-term plan of action and involves multidisciplinary contribution. This paper tries to give some ideas about the potential threat and impact of hazards due to earthquake and the risks associated with it and thereby reduce the impacts through some relevant mitigation measures. It also focuses on the importance of organizational infrastructure that allows a good working partnership between academics, architectural and engineering practitioners, government regulators, financial institutions and social activists.

**KEYWORDS:** earthquake vulnerability, mitigation measures, risk management, urban growth

### INTRODUCTION

Chittagong is the second largest city of Bangladesh. It is located in the southeastern part of the country and situated on the northern and western bank of the Karnaphuli River. It is also the country's largest port city, which contributes a lot in the economic development of the country. There are a number of divisional head quarters, important trade centers and commercial areas and many industries are located in this city. The country's biggest dam and hydropower plant in Kaptai is located not very far away from the city. But due to its geographical location, Chittagong city is located in a very disaster prone area. People of this area face different kinds of disasters like floods, cyclone and tornadoes at regular intervals. People are used to these kinds of hazards. Earthquake in Chittagong, even in Bangladesh has not yet been recognized as a serious natural disaster. So, people are not at all aware of it and also they are not prepared to face this hazard. Recent repeated earthquakes in greater Chittagong area (Ansary et al., 2001; Ansary and Sadek, 2006; Karim, 2003; Khan, 2003) have generated a potential threat and raised a great concern among the people of the country, especially among those around Chittagong region.

### GEOLOGY OF THE AREA

Tectonically Chittagong occupies a part of western margin of Tripura-Chittagong Folded Belt (Alam et al, 1990). The trend of this folded belt is in the NNW-SSE direction, and folds are frequently dislocated or faulted (Matin et.al, 1983) longitudinally or transversely to the strike. Chittagong city is located in the plunging zone of the Sitakunda asymmetrical anticline (Muminullah, 1978). This anticline is stretched up to the Feni River from the city area. The axis of the fold is to the NNW-SSE direction, parallel to the general trend of regional strike, along the Chittagong-Dhaka Trunk Road. The asymmetrical plunging anticline has steeper western flank and gently dipping eastern flank. The western flank merges abruptly into the alluvium due to a major fault parallel to the axis. The folded sediments are highly twisted and distorted in the plunge area around the city (Muminullah, 1978). There are major faults having evidence of vertical movements, and the minor faults having no evidence of vertical movement, but can be inferred from the lineament and orientation of the valleys. A regional fault in the west runs in the NNW-SSE direction, parallel to the strike fold and the Chittagong-Dhaka Trunk Road. This fault (Sitakunda fault) extends further south and cuts the hills around Marine Academy on the south-

ern bank of Karnaphuli River. Another fault, which runs parallel to Pass Road, is named as Tiger Pass fault. The Mio-Pliocene hills are elevated from the adjacent plains of fluvio-tidal complex due to this faulting. The trend of this fault is in the NW-SE direction and it cuts the regional fault in the west at an angle of 35°. The other major fault named as Karnaphuli fault runs in the NW-SE direction, this fault has elevated the Marine Academy Hills from the adjacent Karnaphuli flood plains. The Karnaphuli River flows through a graben, restricted by the Tiger Pass fault and the Karnaphuli fault. Numerous lineaments and fractures have been developed across or parallel to the bedding plane during the development of the main faults.

The fluviotidal complex of the study area is formed of very recent non-cohesive, homogenous, saturated clayey silt and equi-granular fine sand deposited on Tertiary-Neocene bedrock. The engineering properties of the alluvial sequence indicate that the soil stratum has a very low unconfined compressive strength and moderately high liquid limit, a wide range of plasticity index and the ground water level is near the surface. The seismic properties of the vertical sedimentary sequence in the fluviotidal complex indicate that the soft alluvium may amplify some components of seismic energy (Helly et al., 1979).

**SEISMICITY RECORDS OF CHITTAGONG**

The study area is located in the Tripura-Chittagong Fold Belt (Alam et.al., 1990), where a thick sedimentary sequence deposited through Tertiary to Pleistocene age, which have been folded during the Himalayan orogenic movements (Krishnan, 1982). During this long geological time the area has experienced a varied environment due to the transgression and regression of sea. The area occupies most of the plunge area of Sitakunda Anticline and the plunge area is cut by Sitakunda fault, Tiger Pass fault and Karnaphuli fault. It is also observed that the older sediments are severely jointed and fractured indicating dissipation of accumulated energy. According to the Bangladesh national Building Code (1993), Chittagong City is located in Zone-2 with peak ground acceleration (PGA) value of 0.15g.

Chittagong has a long history of earthquakes. There are hundreds of evidences of earthquakes that jolted Chittagong and its surrounding areas. One of the largest earthquake in history occurred in 1762 at Arakan in the southern part of Chittagong division. Although the magnitude could not be recorded at that time but it caused heavy damages. It also triggered the earliest documented tsunami in the Bay of Bengal. Another big earthquake occurred in 1869 with a surface-wave magnitude of 7.5 at

Cachar, Assam. This was also strongly felt in the whole Chittagong division. The 1912 Mandalay earthquake with a surface-wave magnitude of 7.9 was strongly felt in Chittagong. The 1950 Assam earthquake with a magnitude of 8.6 was also strongly felt in the city and its surrounding areas.

If we look at the recent time we find that since 1996 till date, the Chittagong region, close to Myanmar border, has experienced more than 200 light and moderate earthquakes (Karmakar, 2003). The 1997 Jaintapur earthquake in the border of India and Bangladesh occurred with a magnitude of 5.6. It was felt mainly in Chittagong and also in Rangpur, Sylhet and Meghalya. In 21<sup>st</sup> November 1997, a magnitude 5.7 earthquake which occurred in the border of India and Bangladesh shook Chittagong city. This quake was felt throughout the country. But Chittagong had the most destructive effect. One five storied RCC building collapsed in this incident and 23 people were killed. On 22<sup>nd</sup> July, 1999 another earth-

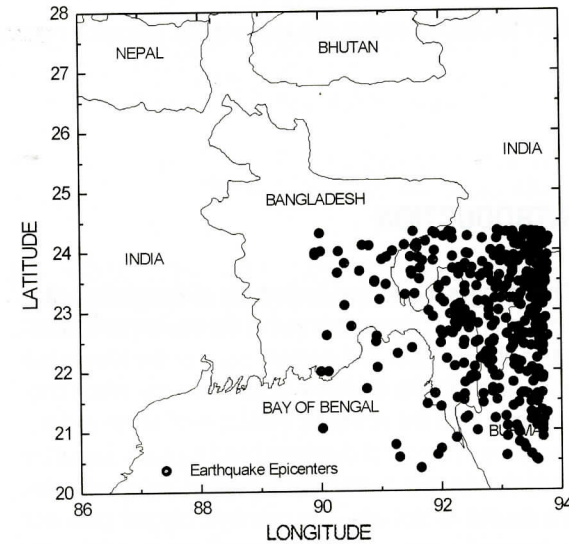


Figure 1: Earthquake epicentres within 200 km from

quake of magnitude 5.2 took place in Moheshkhali Island of Chittagong division. This quake was followed by few aftershocks and caused widespread damage in which at least six people were killed and more than five hundred were injured. Cracks were developed in the concrete structures of cyclone shelters and there was considerable damage of mud houses.

The recent earthquake that jolted Chittagong city and the adjoining hill districts occurred on 27<sup>th</sup> July, 2003. The magnitude of this earthquake was 5.6 (surface-wave magnitude). It's epicenter was at Kalabunia village of Barkal upazila of Rangamati district (Ansary and Sadek,

2006; Karim, 2003; Khan, 2003). Two people died and around three hundred people were injured. About 150 buildings including a school were damaged throughout the region, among them the Union Parishad building and the roof of a health complex collapsed. Five acres of land near Kalabunia village reportedly caved in. The shock was also strongly felt in the port city. During the quake power supply of some parts went out as a transformer exploded a sub-station at Madhunaghat, Chittagong. Cracks developed in several buildings, including Public

which is more susceptible to natural hazard. Large-scale catastrophes from urban disasters have been graphically and tragically demonstrated in the recent years. In 1995 an earthquake in Kobe, Japan caused more than 6000 fatalities and over \$US120 billion in economic losses. In 1999 an earthquake in Izmit, Turkey caused 20,000 fatalities and an estimated \$20billion in economic loss. In 2001 an earthquake in Bhuj, India caused more than 16,000 casualties and in 2005, the Kashmir earthquake caused more than 80,000 casualties. Since cities are the

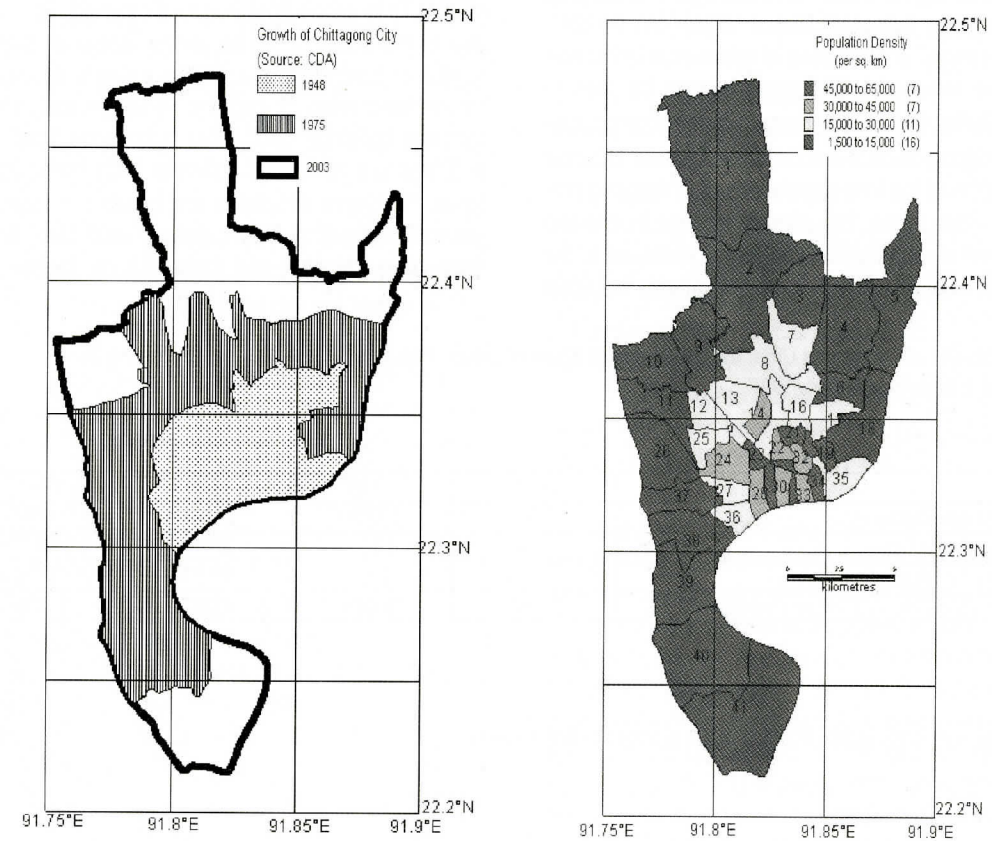


Figure 2: Growth of Chittagong city for the last few decades and population density

Library, Chittagong Jail and Polytechnic Institute Building at Chittagong. Cracks also developed in buildings of Cox's Bazar, Moheshkhali, Kutubdia and Sonadia. Many mild aftershocks of different magnitude were felt in Barkal and Rangamati. Figure 1 show around 403 earthquakes which occurred within 200 km from Chittagong city for the last few hundred years.

**DEVELOPMENT TREND OF THE CITY**

The risk associated with natural disasters is steadily increasing all over the world. But it is the urban center,

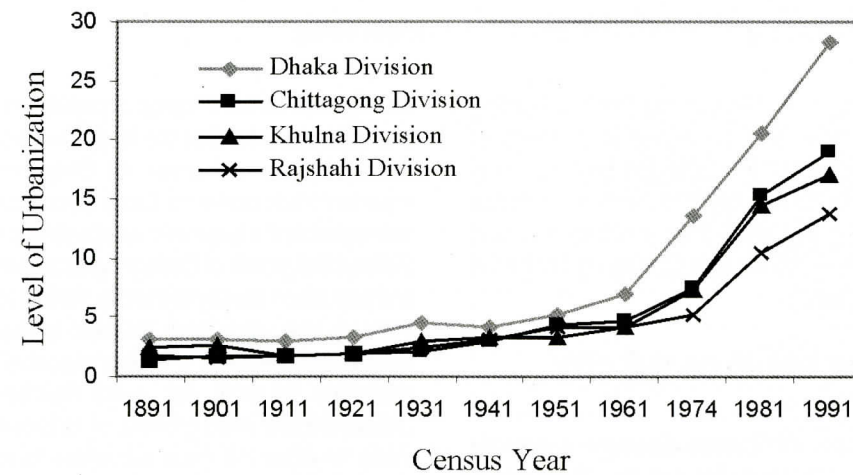
main growth center in terms of population and economy, it is quite apparent that the losses will also be higher in cities than the rural areas. As Chittagong is the most important trade center for Bangladesh, the loss would be unimaginable if a large earthquake strikes this city. Figure 2 shows the growth of Chittagong for the last few decades and population density of the city. Failure to plan development in the poor and disaster prone country like Bangladesh will result in greater exposure to natural and manmade hazards for large number of people. Unplanned and rapid growths of its urban centers have made its cities the most vulnerable to potential earthquakes.

According to a census (BBS, 1991), 22% of the country's population is urban. The urban population has grown at a rate 4.67% per annum during 1981-91 (see Table 1). Although current trends indicate that urbanization is inevitable and unavoidable in the most developing countries, the rate of growth of the urban populations is too fast and exceeds the capacity of the infrastructure to absorb and support it. Chittagong is the second largest of our four metropolitan cities with a projected population of 2.4 million in the year 2011. Dhaka region emerged as the highest urbanized region since 1911 census. Chittagong region has been following Dhaka region since 1941. Significant upward growth trend of urban population was found in the regions of Chittagong as can be seen in Figure 3. Earlier less than 2 percent of the total population of Chittagong division lived in urban centers. But now more than 20% of the total populations of Chittagong division live in urban areas. The primary reasons for this fast growing trend of urbanization are largely attributed to the presence of seaport, divisional headquarters, industrial

Table 1. Variations in the Level of Urbanization & National Share of Urban Population (1961-1991) of Chittagong Div  
Source: BBS, Urban Area Report, 1997

Year	1961	1974	1981	1991
Total Population	10140	13876	16940	21865
Urban Population	569	1273	2994	4757
Level of Urbanization	5.61	9.17	17.67	21.76
National Share of Urban Population %	21.54	20.29	22.12	21.36

Figure 3: Trend of Urbanization in some major divisions of Bangladesh



frames are called flat plates. Flat plates are becoming popular day by day among the architects of Bangladesh, but this type of slab construction is not suitable for severe earthquake prone zone like Chittagong. There are also steel structure buildings, although little in number; they are mainly used for factory buildings. Wooden and bam-

deposit, which is very much susceptible to liquefaction. Besides this, some groups of people are involved in cutting of hills and construction of illegal houses. If there is a moderate tremor, it may cause massive landslides and those structures resting at the foothills will become simply death traps for the dwellers. But what Chittagong city

Table 2. Number of houses with different roofing systems in Chittagong City  
Source: BBS, Community Series (Chittagong), 1992

No. of Houses with Straw/Bamboo roofs	No. of Houses with Tiles/CI Sheet roofs	Total no. of Temporary houses	No. of Houses with Reinforced concrete roofs	Total no. of Houses
75117	72445	147562	67357	214919
34.95	33.71	68.66	31.34	100%

boo made buildings are also there and these are safe against earthquakes. The numbers of houses using different kinds of roofs in Chittagong city are shown in Table 2.

The Chittagong city is in greater need for efficient and effective development planning and land use management as most of the city areas are unsuitable for development works. The best suitable zones around Station Road, Reazuddin Bazaar, Jubilee Road, Diwan Bazaar and Dampara areas are already occupied by unplanned dense settlements. Even before the last two decades people had the choice to stay around these places but presently the city is developing so fast that people have to move and live in the hazardous areas like Pachlals, Chandgaon, Agrabad, Nasirabad, Pahartali and Halishahar. Hilly areas are associated with landslide or mass movement and slope instability. Flat areas are hazardous because of low bearing capacity of soft soil

makes most vulnerable against earthquake is the biggest unplanned development, haphazardly distributed throughout the whole city. Different land use categories are shown in Table 3. It is obvious that large unplanned residential areas, commercial and industrial areas and especially hilly areas are most vulnerable areas to earthquake. Architects, engineers and urban planners need to be cautious during finalizing a project location.

In Chittagong there are about 68.66% temporary houses (BBS, 1992). Most of these are safe against earthquake except those having roofs made of tiles. But the temporary houses are vulnerable against secondary hazard due to earthquake i.e. fire. Among the permanent houses masonry buildings more than two storied have greater possibilities to be damaged during an earthquake. The buildings without a continuous lintel are also vulnerable to earthquakes. Structural and architectural design of buildings requires special attention to be earthquake resistant.

Table 3. Different land use categories in Chittagong city  
Source: Land Use Survey, 1995

Category of land use	Land used (Acres)	Percentage
Planned residential areas	1961.45	4.97
Unplanned residential areas	10378.62	26.29
Commercial areas	988.4	2.5
Industrial areas	3243.3	8.21
Cultivable land areas	10996.4	17.86
Hilly areas	5930.64	15.02
Tidal areas	2594.6	6.57
Unclassified areas	1899.7	4.81
Mixed areas	556	1.41
Other areas	926.65	2.35
Total	39475.75	100

A study on seismic vulnerability of buildings of five major cities of Bangladesh was recently conducted by the Department of Civil Engineering, BUET sponsored by CARE Bangladesh (Ansary and Choudhury, 2002). In this study the seismic damage prediction was made according to macro-seismic intensity scale. This assessment gives an idea of how many buildings are susceptible to earthquake hazard, the grade of damage they are to suffer and the number of possible injuries among the occupants of those buildings. Table 4 shows the seismic damage pre-

diction of Chittagong city under earthquakes of different intensities. Figure 4 and 5 show distribution of buildings based on average of floor area and year of construction.

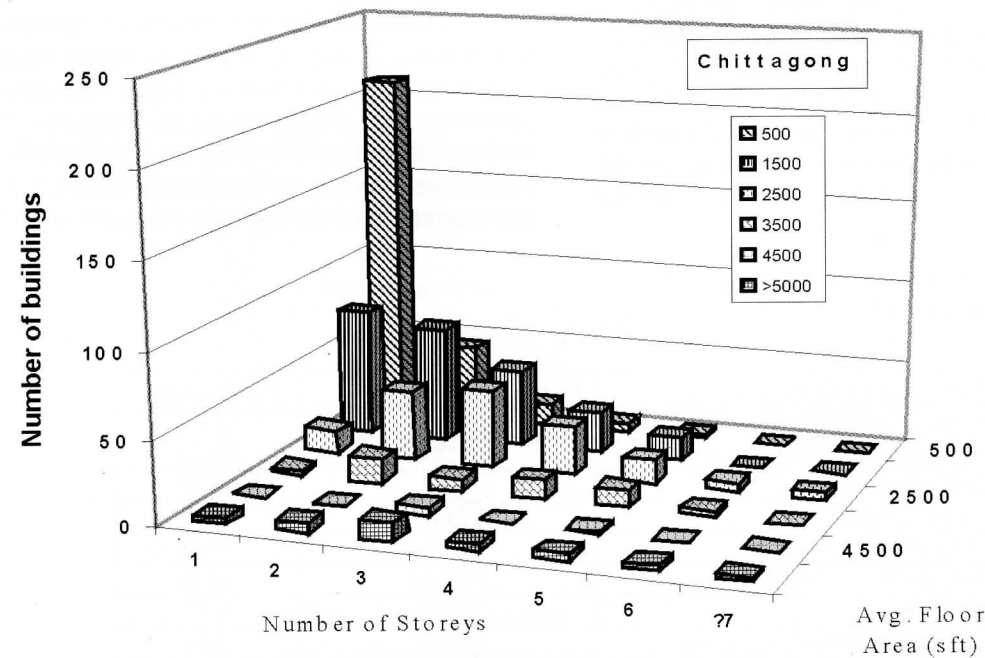
**MITIGATION MEASURES TO REDUCE VULNERABILITY**

The most cost effective actions to reduce the impact of earthquakes are those that reduce the vulnerabilities of cities. The solutions are mainly of two types: structural

**Table 4.** Vulnerability Assessment of Buildings of Chittagong of Bangladesh due to earthquakes of EMS intensities VI to X (after Ansary and Choudhury, 2002)

City	Number of Buildings Surveyed	People living in those Buildings	Intensity	Intact	Slight Damage	Moderate Damage	Serious Damage	Partial Collapse	Collapse	% Affected Population
Chittagong	756	27709	VI	300	380	76	0	0	0	61
			VII			79	1	0	0	62
			VIII			374	79	1	0	100
			IX				374	79	1	100
			X					374	79	100

**Figure 4:** Distribution of buildings based on average floor area and number of storeys



**Public Education and Awareness**

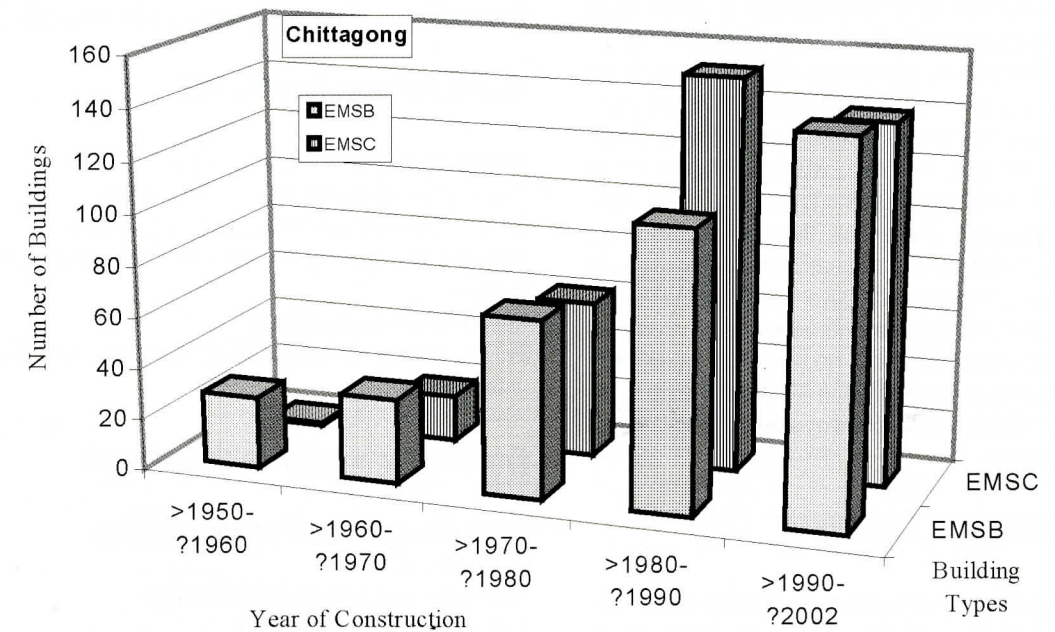
People can be educated about various hazards, its effects and mitigation measures through seminars, symposiums, and dramas. Some articles can be incorporated in primary level books to educate the children about earthquake and other hazards. Awareness to potential hazard and what to do if an adverse event occurs can help tremendously in responding to that event. Awareness program may be conducted in all the disaster prone areas through training to local people, women's group, sports club, elderly citizens, organizing interaction among the literate persons and supplying earthquake and fire safety tips and manual kits. School children program like debate, oratory, art and essay competition on the disaster-oriented themes may be organized to use children as the family motivators.

For the awareness program production of educational materials must be in local language, Bangla for the awareness program. Materials may be in the form of posters, leaflets, pamphlets, and booklets especially for the different target groups. The flow of updated information has to be maintained through the available local

and nonstructural. The structural solutions include earthquake resistant design of new buildings, retrofitting existing vulnerable structures etc. The nonstructural solutions include incorporating risk considerations into urban planning processes, insurance coverage of existing structures, educating community etc. The structural solutions are elaborately discussed in a recently published earthquake resistant design manual (Ansary and Noor, 2006). This paper explains more elaborately on the different existing nonstructural solutions.

Despite making the cities prepare to respond to the emergency, the total impact of earthquakes is greatly dependent on the social, cultural and economic conditions of a community. It is not only a technical issue to be addressed by seismologists, architects and engineers; there are other aspects, which cannot be practically ignored. We need to focus on promoting preparedness and the inclusion of risk management in urban planning, raising public awareness of the existing risk and of affordable measures to reduce it, and incorporating the entire community in long-term risk management initiatives.

**Figure 5:** Distribution of buildings based on year of construction





mass media like radio, television, newspapers and other publications. To encourage people to think, speak, write and work on disaster for the attitudinal change in society and institution building, incentives may be offered to the people of different level and organizations in the form of prizes, awards and seed money.

Building national capability in reducing risks it requires a clear plan for raising awareness and bottom-up approach to developing disaster management plans for all major urban centers of Bangladesh. Bangladesh Disaster Management Bureau, under the ministry of Relief and Disaster Management has gained sufficient knowledge and experience in flood, cyclone, tornado and draught. Now it has began its program to include earthquake in its program of disaster management. Bangladesh University of Engineering and Technology, Dhaka University, Bangladesh Earthquake Society and some international organization and NGOs are also working to increase awareness and promote earthquake disaster mitigation activities.

### NGOs in Risk Management

Local non-governmental organizations (NGO) may play an important role in the reduction of earthquake risk in urban areas by complementing the work done by the local authorities. Since the long-term solutions of community problems should come from the government in the form of funding, regulations, and application of those regulations, it is indispensable to involve the government in risk management initiatives from the beginning to inform them about the problem and get their interest. But there are several shortcomings associated with working with the government. These problems include contradictory political and economic interests, conflicting priorities, and periodic changes. It is, therefore, vital to incorporate local non-governmental organizations to keep the focus, interest and motivation, and ensure that the process is not interrupted by the political and administrative changes. In most of the communities, the government has the means, authority and the organizational structure to implement risk management activities. However, the motivation, impartiality and continuity that an NGO could bring to the process should definitely speed up the work and increase its effectiveness.

### RESPONSE AND RECOVERY

Government organizations have the primary roles in taking the responsibility of disaster and risk management. They have to make progress in improving their disaster response capabilities by institutionalize the application of

disaster management in day-to-day operations of urban planning, construction monitoring and disaster preparedness. Pro-active actions of preparedness and mitigation are the only ways to reduce future losses. Moreover, discipline in the private and public institutions involved in risk management will reduce the volatility of losses, decrease the costs of operations and increase the efficiency and credibility of the organizations. It is important to share the experiences of mitigation, response and recovery processes that are followed in other earthquake affected countries such as Iran, Japan, Turkey and USA where they have well defined action plans against disasters. Sharing their strategies and risk management and considering the socio-economic condition of Bangladesh, the functions and responsibilities of respective governmental organizations and departments of Bangladesh (MoFDM, 2006) may be summarized as follows.

### Disaster Management Bureau and Armed Forces Division

Prepare ward maps of all the localities of Chittagong Division for proper planning and regulations  
Develop contingency plans  
Prepare computer based geo-hazard maps  
Set up emergency communications and early warning system  
Operate 24 hours control room for emergency system  
Develop Timely Warning Information System (TWIS)  
Operate Disaster Service Management System (DSMS)

### Health Services and BDRCS

Emergency response during earthquake  
Prepare trained rescue squad for emergency  
Control epidemiological outburst during disaster  
Provide medical facility to emergency camps and relief shelters  
Keep medical supplies ready  
Provide training on First Aid Treatment to the local volunteer groups

### Fire Service and Police Department

Prepare trained staffs for disaster emergency  
Build rescue team  
Train volunteers through Mock Exercise  
Regulate hazardous materials  
Manage required equipment and materials for emergency  
Establish and protect temporary field hospitals

Provide security to the disaster affected areas  
Take preventive measures against fire  
Carry injured people for recovery treatment  
Remove debris  
Help distributing emergency supplies  
Manage emergency service e.g. fire-brigade and ambulance

### The City Corporation and Chittagong Development Authority

Enforce law and regulation for the implementation of earthquake safety measures in design and construction works  
Adopt and enforce building codes for building design and construction  
Use seismic information to prepare land use planning maps  
Develop seismic zoning maps based on site amplification, liquefaction and landslides  
Prepare inspection team for the construction works  
Plan transportation and road networks for performing rescue operations speedily

### Public Works Department

Retrofit the existing structures vulnerable to earthquake  
Rehabilitate and reconstruct the damaged structures after disaster  
Renovate public utility services like electricity, water supply, sewerage, telephone etc.  
Demolish the hazardous structures

Besides these, it is also important to create a *Family Earthquake Plan* for home preparedness against earthquakes. This may include the followings.  
Learn how to shut off gas, water, and electricity in case the lines are damaged  
Check roofs, wall foundations for stability  
Keep breakable and heavy objects on lower shelves  
Put latches on cabinet doors to keep them closed during shaking  
Know the safe spot in each room, (under sturdy tables, desks, or against inside walls)  
Know the danger spots, (windows, mirrors, hanging objects, fireplaces and tall furniture)  
Conduct practice drills e.g. physically placing children and themselves in safe place  
Decide where the family members will reunite  
Keep a list of emergency phone numbers  
Develop a portable/auto survival kit

### Safety Demand, Disaster Assistance, Insurance and Reinsurance

We have to change the culture of risk acceptance. It is very important to make the consumers aware of the earthquake threats so that they demand for safer housing. Economic consequences of any catastrophic event to the population depend on how the disaster assistance programs are formulated. Spread of risk through insurance and reinsurance can provide a community considerable relief in mitigating the economic disruption caused by the event. At the same time insurance company will compel the builders to build a safer house instead.

### CONCLUSIONS

Recent repeated earthquakes have indicated that Chittagong and its surrounding hill districts are located at a moderately seismic zone. An earthquake of a larger magnitude ( $M > 6.0$ ) may attack this zone at any time. And if it does, it will pose greater threat to the urban centers of Chittagong. Especially the unplanned and hilly areas of the city will be affected heavily. Necessary steps should be immediately taken to face the seismic hazard in the area, especially at the port center. Seismic risks should be assessed correctly and subsequently mitigated to the extent feasible. Innovative and domestic disaster mitigation procedures should be adopted. Emphasis should be given for strengthening the most critical structures and lifeline facilities. A comprehensive disaster mitigation plan has to be developed and implemented as soon as possible. Political and institutional capacity needs to improve more than just the technical aspect. The effort will have to be multidisciplinary.

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## Planned Residential Neighbourhood Development in Kathmandu Valley: Community Building OR Provision of Physical Infrastructure?

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### Abstract

Though public sector initiated residential neighbourhood through site and services scheme and land pooling technique differs from the private sector implemented housing project in the Kathmandu Valley, nonetheless, both of them have common denominator – more successful in provision of physical infrastructure with little consideration of community building. Poor neighbourhood environment in such planned areas is due to the combination of absence of urban design approach in master plan and building construction as well as reflection of ineffective existing development control and poor capability of the concerned agencies. To reverse this trend, linking community to the built environment through mixed land use, provision of social and emergency amenities and formulation of planning standards and urban design guidelines for master layout plan and individual building construction and their strict implementation is essential.

### Key words

Residential neighbourhood, Community, Infrastructure, Design guidelines, etc.

### Background and Overview

The rapid pace of urbanization of the Kathmandu Valley is greatly increasing the demand for new shelters, infrastructure provisions, employment opportunities and social and emergency services. Though the government has acted lately through the implementation of different land development techniques (site and services, guided land development and land pooling), formation of Kathmandu Valley Town Development Committee and Ministry of Housing and Physical Planning (in 1988 and now converted into Ministry of Physical Planning and Construction), formulation of National Building Code and Joint Apartment Act including participation of private sector in housing development, housing loan, and so on, its efforts have proved to be inadequate and ineffective. As a result, the rate of haphazard urban growth has increased many folds than that of the planned developments, implemented by both government and private sectors. Nonetheless, these limited efforts of land development and planned residential areas through different techniques, initiated from the mid seventies under the Town Planning Implementation Act 1973 are yet to be reviewed not only to identify the shortcomings in their planning process but also to propose policy and guidelines for new neighbourhood design. Against this background, this paper aims to

analyse the three different planned residential precincts developed under different techniques on a comparative basis with threefold objectives. First, it studies numerous literatures on theories of residential neighbourhood to develop a theoretical framework for a good residential neighbourhood. Second, it compares and contrasts the three case studies of residential neighbourhoods within the established theoretical framework and relates them to the inhabitants' responses. Finally, it draws a conclusion and proposes some key recommendations for future residential development.

### Theoretical Framework of a Good Residential Neighbourhood

After the emergence of urban design profession in the 1960's, not only have the spirit, values and virtues of residential neighbourhood been rediscovered but also incorporation of resident's participation and introduction of advocacy planning has been advanced leading to the formation of 'New Urbanism,' which advocates a balanced mix of human activities (dwelling, shopping, working, schooling, worshipping, recreating, etc.) within a walking distance (five minutes walk or radius of a quarter of mile) in neighbourhood planning with formation of pub-

lic spaces and fine network of interconnecting streets (Duany and Zyberk, 1994). Others have sought for achievement of diverse, lively, safer and convenient public realm through mixed land use, high density and compact urban fabric including provisions of local employment and public transport system to gain local identity, community value and sense of place (Lennard and Lennard, 1995; Roseland, 1998). An effective neighbourhood comprising a clear, complete, and consistent political and administrative entity, therefore, should provide basic necessities of life and society – a small grocery shop, a local park and playground, a meeting place either in the elementary school or in a recreation centre that also houses community activities, a fire station and a post office including the police precinct. The socio-cultural perspective of theory of neighbourhood focuses on community building. As neighbourhood provides a place for inhabitants to raise children, to satisfy the socialising needs of people and to develop intimate friendships, it fosters community and civic pride (Von, 1978), enhances the 'sense of security and belonging' and finally connects the individual to the society through its support and facilities (Bartuska, 1994). Geographical proximity (locality), social completeness or cohesion (social criterion) (Davis, 1949) including sharing of the basic condition of a common life (community sentiment) are essential to form a community (MacIver and Page, 1955), which is influenced by size, density and heterogeneity (Wirth, 1964). Therefore, a community requires (a) a set of households, relatively concentrated in a delimit

tionships between human experience and behaviour and built form (Proshansky, 1970) and shapes the residential life. The notion of 'culture' as – a system of shared meanings (Greetz, 1973; Hall, 1966) and public standardised values of a community (Douglas, 1966) – creates values and norms embedded into people behaviour, which shape the spaces and use them in everyday life (Coolen and Ozaki, 2004). After reviewing numerous literatures on different aspects of residential neighbourhood, a theoretical framework for a good residential neighbourhood is developed with three interrelated components of (a) Residential neighbourhood as *Place*: Size and shape of the neighbourhood, Street network and open space hierarchy, Architectural meaning, (b) Residential neighbourhood as *People*: Opportunity for socialisation and Social network and institution, and (c) Residential neighbourhood as *Meaning* (linking people to place): Sense of place (and community) and Daily activities and cultural functions.

**Comparative Study of the Planned Residential Developments**

Three planned residential developments namely Kuleswore Housing Project (KHP), Gongabu Land-pooling Project (GLP) and Sunrise Home (SRH), differ in physical layout and site context, population density, land use and neighbourhood community are selected for the comparative study (Table 1).

Table 1. Comparison of contextual parameters of the selected residential neighbourhoods

Particular	KHP	GLP	SRH
Location	Kuleswore - KMC, Ward No. 14 (Urban area)	Gongabu -KMC, Ward No. 29 (Peripheral area)	Baikumari - LSMC, Ward No. 9 (Peripheral area)
Project type	Site and services	Land pooling	Private housing
Planning area	522 Ropani (26.5 ha.)	280 Ropani (14.2 ha)	45 Ropani (2.3 ha)
Development period	1977 - 1987	1988 -1996	2002 - now
Development agency	Government	Government	Private Sector

Source: Department of Housing & Urban Development, no date; Department of Urban Development & Building Construction, 2003; Kathmandu Metropolitan City, 2001; Oriental Construction & Development Co. Pvt. Ltd, no date

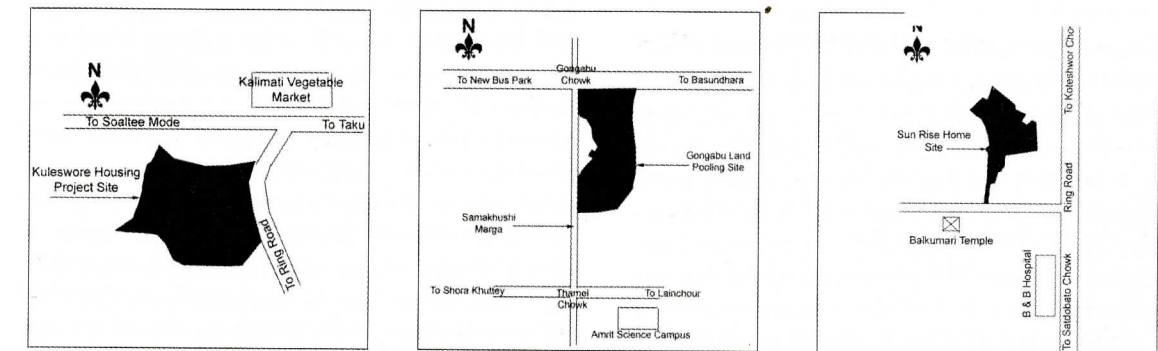
ited geographical area; (b) a substantial degree of integrated social interaction by the residents; and (iii) a sense of common membership, of belonging together. Finally, neighbourhood community can be perceived by characteristics and views of the inhabitants (micro-level approach) and formal organisation and institution that looks the community within a greater context (macro-level approach) (Downs, 1981). Individual experience, cultural background, social setting together with the physical condition determines the rela-

Located on the urban area of Kathmandu Metropolitan RCity's (KMC) ward no. 14, Kuleswore Housing Project was the government's first 'Site and Services Project' to house the civil servants. Gongabu Land-pooling Project situated on the northern peripheral area of KMC's ward no. 29 was also planned by the government through 'Land Pooling' technique with objectives to control haphazard urban growth and to ensure basic services and social amenities in the developed area (Figure 1). Initiated by the private sector after the enactment of the

'Joint Apartment Ownership Act -2054 BS' Sunrise Home is an ongoing housing project (targeted for upper middle and high economic status group) located on the peripheral area of Lalitpur Sub-metropolitan City's (LSMC) ward no. 9.

developed land, Compared to SRH, KHP and GLP have respectively eleven and half times and more than six times larger lands. However, SRH is two and half times denser than that of KHP and GLP.

Fig. 1. Location plans of the case study residential neighborhoods



**Residential Neighbourhood as Place Size, scale and integration with the surrounding areas**

If a population range of 500 to 10,000 inhabitants or minimum of 150 dwelling units (considered enough to sustain local retail outlets and an elementary school) is the base for an effective neighbourhood (Gans, 1962), then SRH comprising 164 units with total population<sup>1</sup> of 820 can be considered as the smallest neighbourhood while KHP and GLP are respectively five times and two and half times larger residential areas (Table 2). Similarly, in terms of

Small urban blocks (no longer than 90-135M) increase physical and visual permeability (Bentley et. al., 1985), provide more street frontages and junctions, allow development of diverse land use and building types. Average urban blocks of KHP are five times bigger than that of SRH and are arbitrary oriented in all directions. Both GLP and SRH have slim and elongated urban blocks but with opposite orientation (Table 2). Though clear boundaries in residential neighbourhood are necessary to establish and sustain identity whereas integration in terms of street layout, urban blocks, population density and land use with

Table 2. Comparative study of physical aspect of the case study neighbourhoods

Particular	KHP	GLP	SRH
Urban fabrics			
Total developed area	522 Rop. (26.5 ha) (11.5 X SRH)	280 Rop. (14.2 ha) (6.2 X SRH)	45 Rop. (2.3 ha) (1X SRH)
Total no. of urban blocks	21 <sup>1</sup>	26	9
Average urban block size	24.85 Rop. (5 X SRH)	10.77 Rop. (2.1 X SRH)	5 Rop. (1X SRH)
Total no. of plots	842 (5.13 X SRH)	406 (2.5 X SRH)	164 units (1X SRH)
Average plot nos. per urban block	40	16	18
Population density (person per hac.)	159 ppha (1.1 X GLP)	143 ppha (1 X GLP)	356 ppha (2.5 X GLP)
Urban block orientation	Arbitrary (all direction)	East-West (mainly)	North-South (mainly)

the surrounding existing areas results in smooth transportation, orientation and views, the three planned neighbourhoods do not have clear identifiable centres and edges and their geometrical shaped urban block, plot size and street layout do not match with the surrounding haphazardly (and spontaneously) growth residential and commercial areas.

The large neighbourhood size of KHP compared to GLP and SRH is further supported by the residents' views,<sup>3</sup> as majority of the respondents (62%) think their neighbourhood is of big size, while similar percentage of inhabitants of GLP and SRH feel that their neighbourhoods are of appropriate size and scale. Surprisingly, none of the residents living at KHP and GLP and only insignificant percentage of inhabitants of SRH are in the opinion that their neighbourhoods are of small size. However, majority of the inhabitants feel urban blocks at KHP and GLP are of normal size while they are small at SRH.

**Street and open space hierarchy**

Having symbolic, ceremonial and political roles, streets and open spaces are not only physical spaces for movements of people and goods but they are also venues for multiple activities – socialisation and participation, exchange of services, enjoying, watching and so on (Jacobs, 1993; Gehl, 1987). They can be evaluated on the basis of physical parameter, micro-climate criteria, amenities and activities associated with them (Heng and Chan, 2000).

As the street layout and open space allocation at KHP and GLP are guided by the pre-determined plot sizes with little consideration of surrounding built form, they have not only created variety of urban blocks with invisible and confusing alternative routes to travel from one point to another but also formed unscientific street junctions' design, difficult to turn emergency vehicles. Absence of 'sense of enclosure' (due to variations in setback, height and architectural character of the buildings of the both sides of the same streets), lack of identifiable activity nodes or any prominent structure at the street junctions combined with absence of sidewalks and other basic amenities such as dustbin, benches, plantation, street lamps and so on have converted these streets into 'pedestrian unfriendly' places. Walking in the neighbourhood is monotonous, boring and confusing and danger at night particularly for women. Compared to the 20-25% of the recommended circulation area for housing projects (Caminos and Goethert, 1978), areas allocated for the streets (14.3 -17.5%) in these cases are inadequate (Table 3).

In the case of SRH – six cul-de-sacs linking to the main street which connects the whole neighbourhood to the outer public road - are neat and clean, in good condition with street width to building height ratio within the desirable limit (H/W = 1:2). As the outsiders are restricted through a gate keeper in the main gate, such streets are generally monotonous without human activities.

Particular	KHP	GLP	SRH
Open space hierarchy and street patterns			
Open space area allocation (%)	4.4	5.2	4
Area occupied by street (%)	14.3	17.5	15.0
Street width (M)	2-3-4-5-7.5	4-6-8	5
No. of street junctions	40	51	7
Street width to building height ratio (approx.)	1: 1.3	1: 1.7	1: 2

Source: Modified from – Department of Housing & Urban Development, no date; Department of Urban Development & Building Construction, 2003; Kathmandu Metropolitan City, 2001; Oriental Construction & Development Co. Pvt. Ltd., no date

**Architectural meaning**

Architecture is not limited to layout of interior spaces of buildings but it has also public face and community dimension. Layout of building on the plot and its architectural characters defines the housing density, helps the formation of public space and expresses the socio-economic status of the inhabitants. However, these attributes have got little attention in preparing master plans. First, the layout of building on the plot with setback from all the sides – pavilion type – at KHP and GLP has resulted in lower density with formation of fragmented open spaces between the two buildings, which is hardly useful other than for lighting and ventilating building units, whereas the layout of building in row on the plot with street in front and a minimum setback on the back – row housing type – at SRH has allowed moderate level of density (Table 4). Second, variation in design of the transition spaces between the street and the individual private houses has created a chaotic landscape at KHP and GLP. Third, newly constructed buildings with different architectural design and detailing, material and technology used are difficult to relate with the existing surrounding houses. Interesting design of individual unit with uniform building set back at SRH has failed to produce legible residential landscape due to repetition of the standard unit in a row on both sides of the streets without any reference point. Dwelling units of SRH, mostly of two to three storey high though oriented to North South axis, are climatically ineffective as almost all the rooms have one side window only with many spaces (dining hall, family lounge or staircase hall) without direct light and ventilation.

While asking for overall performance of buildings in the neighbourhood, majority of the respondents of KHP (71.4%) and SRH (64.3%) think that the buildings in their neighbourhoods are good, whereas eighty percent of the respondents of GLP guess that they have just 'average' (neither good nor bad) buildings in their community. None

Planning and design of open spaces in these three case study neighbourhoods are not satisfactory due to numerous reasons. First, the amount of open spaces allocated (between 4-5%) is far less to fulfil the various needs of different age groups - passive quiet area for adult, safe and private area for women, recreation and playing field for youngster and children (Table 3). Second, the shape and location of these spaces are inappropriate and inconvenient. In fact, spaces of irregular shape and size left over after plotting of the serviced lands and street layout at the best location, are kept as open space. The open spaces of KHP (a triangular plot roughly at the middle and tiny rectangular plots on the peripheral areas) and GLP (five different small rectangular plots below the hi-tension electric line) are of little use not only because of their fragmented nature but also due to vehicular streets encircling them. Similarly, the isolated corner plot below the hi-tension electric line, surrounded by parking lots developed as a Children Park at SRH can never be a meaningful place.

Though fair condition of street with vehicular access to each house, low vehicular traffic and hence low air and noise pollutions have made the streets 'convenient' for majority of residents of KHP (62%) and SRH (100%), significant number of people of GLP (32%) find the streets of their neighbourhoods 'inconvenient' due to conflict of vehicular and pedestrian traffics, bad condition of street and practice of disposing households and construction wastes on the streets. Regarding urban open spaces, majority of the community in all the cases are aware of the usefulness of them in their daily lives. However, significant number of residents of KHP (62%) and GLP (50%) realise that the existing open spaces in their residential areas are insufficient and non-functional due to poor location, irregular size and shape and absence of basic amenities (Figure 2). Even in the case of SRH, forty three percent of the respondents are not satisfied with the allocated amount of open space.

Fig. 2. Comparative study of residents' responses (in percentage) on the use of street network and open space

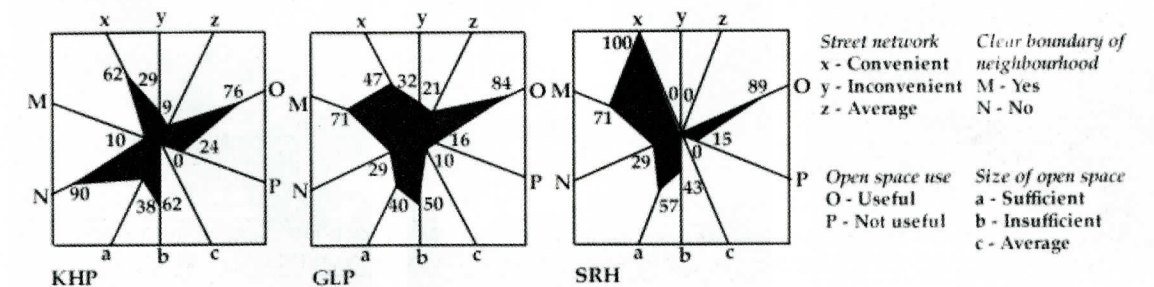
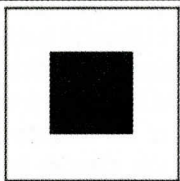
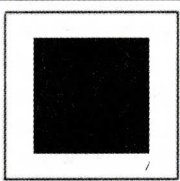
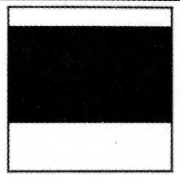


Table 4. Comparative study of characteristics of housing

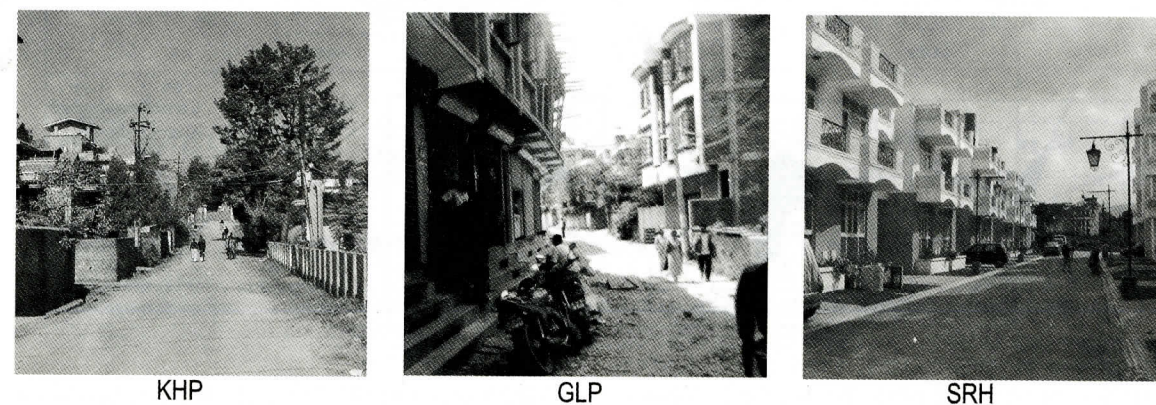
Particular	KHP	GLP	SRH
Building and site relationship	 KHP (Pavilion type)	 GLP (Pavilion type)	 SRH (Row housing type)
Building layout on plot	Pavilion type	Pavilion type	Row housing type
Orientation	Arbitrary (in all directions)	Arbitrary but mostly on East - West axis	Mostly on North-South axis
Building type	Detached/individual bungalow type	Detached/individual bungalow type	Mostly attached in row
Building storey	3-4 storey	3-4 storey	2-3 storey
Light & ventilation	Mainly four sides but two for fronting street	Mainly four sides but two for fronting street	Only two sides

of the inhabitants in these three cases has the idea of existence of bad buildings in the neighbourhoods.

**Residential Neighbourhood for People**

While thinking residential neighbourhood for 'people' the key issue is the neighbouring – developing close friendships, borrowing the odd item or the casual contact in the street. It means feeling of home, security and social support and has considerable significance in resident's everyday lives. Though people socialise both in and outside the neighbourhood, nonetheless, local ties among the neighbours for elderly people and those outside the labour force in particular and for contemporary city dwellers in general is essential, as most people live in narrow 'gemeinschaft' world of neighbourhood and kin (Pahl, 1991). Thus opportunity for interaction among the residents, social networking and community institution are essential to strengthen local ties and feeling of belonging and ownership.

Photo 1. Comparison of streetscape for socialisation in the case study neighbourhoods



**Opportunity for socialisation**

Basically three types of activities – community facility and social amenity (schools, health centre, recreation centre, community building and so on), streets and open spaces and temple complex and cultural function – facilitate socialisation among different age groups. However, minimum opportunity exists for interaction in these case study neighbourhoods. The reasons are numerous. First, except for the allocation of few percentage of land for open spaces, no provisions of community facility and social amenities have been provided at KHP and GLP, allowing them to run in residential buildings on ad-hoc basis in the subsequent years. Second, absence of well defined semi-public (and semi-private) spaces in the transition from public street to private building, together with failure of individual building in producing meaningful spaces between the houses and streetfront (due to arbitrary orientation of house, high boundary wall on the property line and variation in building setback) at KHP and GLP has greatly reduced the scopes of interaction, indi-

vidual relaxation, social mixing and assistance among the neighbours. The situation is not different at SRH, where individual units are directly linked from the street without any semi-private spaces and facilities around which neighbouring relationships might develop. Third, the existing street layout and open space design offers little opportunity to attract residents and to engage them for multiple activities. Located away from daily pedestrian movement network, poor physical and visual permeability combined with absence of basic amenities such as benches, street lamp, plantation and vegetation all have discouraged people of using these spaces (Photo 1).

More than half of the inhabitants of KHP (57.1%) do not find any suitable place (or facility) for building friendship with other members of the community, whereas the remaining respondents meet their fellow neighbours either at community buildings (community based organisations or ward office) or on the street and open spaces. Nearly one third of the interviewees of GLP visit the community facility (swimming pool) whereas another one third interact their neighbours on the streets and open spaces; the remaining one third visit nowhere to socialise (Figure 3). It is only the case of SRH, where more than half of the respondents visit the shopping complex and interact with their neighbours. However, in all the cases, the frequency of interaction is of casual type on monthly (or weekly) basis. Finally, all the neighbourhoods lack comfortable children play area, as mentioned by majority of the interviewees in each case.

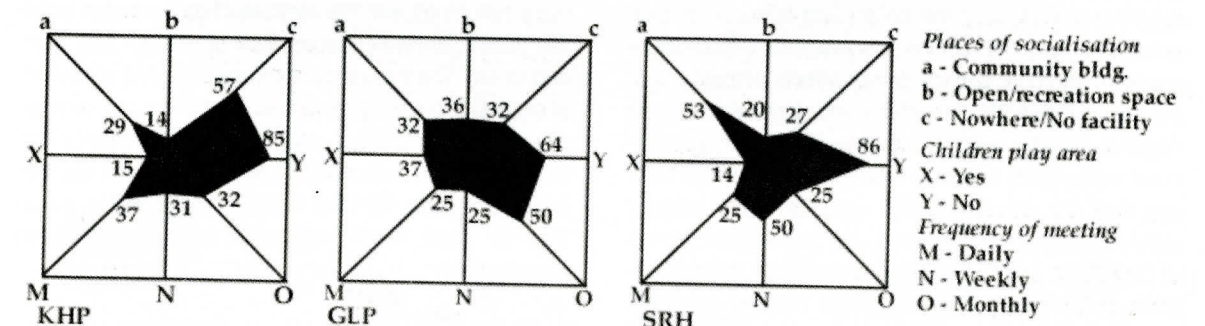
and community support in the newly planned residential neighbourhood on the virgin land. Despite establishments of numerous such institutions (Kuleswore Club, Kuleswore Housing Family Welfare Organisation, Self-help Community Committee, etc. at KHP and Housing Area Improvement Committee at GLP), they are unable to bring social support and strengthen community network due to poor financial and managerial capabilities, low community participation and little support from parental or governmental organisations. The community committee of SRH is basically concerned with the issues of house maintenance and infrastructure services rather than building social network.

Nearly three fourth in the case of GLP and half of the respondents of the remaining neighbourhoods take part 'occasionally' on the programs organised by the local ward office and social institution. About one third of the community of KHP and SRH frequently visit the ward office mainly for their person works. In all the cases, most of the activities organised by social institutions (and ward office) are related to either sports, cleaning of the local area or celebration of New Year, Deepawali festival, and so on.

**Residential Neighbourhood as Meaning – Linking People to Place**

Culture – shared meanings and shared conceptual maps – links the community to the physical built environment so that each member of the neighbourhood develops a strong sentiment with the urban settings, understands the

Fig. 3. Comparative study of residents' responses (in percentages) on places of socialisation, frequency of meeting and available of



**Social network and community institution**

Social network refers to the various persons with whom an individual maintains significant relationship including relatives, friends, fellow workers and neighbours whereas social support is the quality of the relationship – the advice, encouragement and assistance of all kinds that the social network provides to individual. Local Community Based Organisations (CBO) including 'Ward Office' can play a crucial role in building social network

other members of the community, and finally feels the sense of belonging to the neighbourhood culture.

**Sense of place and community**

Distinctive features of the neighbourhoods become significant to local inhabitants over time and this relationship between the material and mental results into human experience that can be remembered, shared and communicated to become social. Numerous site features such as

higher topography, background mountain views, 'Samakhushi' and 'Manohara' rivers are not considered in preparation of master plans. Moreover, few entry points to the neighbourhoods, long unconnected blocks without cross passage, confusing street layout without any reference point and absence of landmark structure are the characters of residential environments at KHP and GLP, which are difficult to map mentally. Narrow long blocks with identical building units, connected by cul-de-sacs with surface parking of SRH also do not offer legible setting. Though changing colour of flowers and plants on the street-side trees and celebration of local festivals and events in public spaces around the religious structures stimulate residents' perceptions in daily activities and provide the clue of passage of time, such is not the case in all the three planned neighbourhoods. In the absence of movement, communication and socialisation, the task of achieving sense of place and building sense of community is too difficult. The social cost of development is very high but the quality of life is low in these residential areas.

#### Daily activities and cultural functions

Provision of resources in terms of services and social amenities and performance of daily activities as well as cultural functions in a safe and secure environment helps to link the community with the built environment. Failure to allocate common land uses (primary school, health post, cultural outlets and so on - except allocation of minimum spaces for open spaces and a grocery shop at SRH) combined with lack of significant religious structures (and places associated with them) have not only failed to achieve the task of taking responsibility and develop the feeling of ownership of community properties but have also reduced the beliefs and faiths on cultural activities among the residents. Inadequate infrastructure provision and poor service deliver affects perceptions of the area in the minds of residents and ultimately develops negative attitudes and behaviour towards the neighbourhood environment and other residents. Residents of KHP and GLP are dissatisfied with insufficient and irregular supply of water, lack of foot path and dilapidated condition of the streets, and poor drainage system, whereas inhabitants of SRH are mainly concerned with the non-availability of telephone lines. In such situation, the question of socialising among the neighbours and sharing of experience, beliefs and values with them is of little relevant. Moreover, numerous features of KHP and GLP - single residential function domination land use, confusing and disorganised street patterns with disconnection from the houses through gates and walls, absence of street lamps and furniture, empty lots and group of young men hanging out on the street corners all have promoted a strong sense of insecurity.

#### Conclusions and Recommendations

The government implemented planned residential neighbourhoods have limited efforts in layout of physical infrastructure (mainly road network and drainage system) and development of regular plot size with vehicular access. The government's concerned line agencies provide infrastructure services such as electricity and telephone, water supply, etc., whereas the individual land owner constructs the building and decides its use based on the existing building bylaws (though there exists few clauses of building setback, height restriction and so on for these planned areas). Guided by economic rate of return rather than by community design principles, the private sector developed residential neighbourhood though comprehensive (with integration of land development and building construction) is also limited to high quality infrastructure provision with poor community environment. In the case of SRH, people buy houses (or flats) alongwith the 'lifestyle' provided by the housing estate, as individual house owners have no control over changing building fabrics and the surrounding landscape.

In all the cases, the needs of identification of distinct features of the site and its contextual study for integration with the surrounding areas, layout of well defined hierarchy of interconnected short streets and open spaces for multiple-functions, continuity of architectural meaning all to achieve legible urban setting and desirable density level, to create socialisation and recreation spaces, and finally to build community in the neighbourhood, are out of vision. On the other hand, residents in these neighbourhoods though generally satisfy with vehicular access to each house (and plot) and good building condition, are more concerned with the services of daily needed activities (insufficient water supply, lack of children play area, and so on). The frequency of socialisation and institutional capability to strengthen social networking and community support including overall sense of community and feeling of neighbourhood belonging is low. Some key recommendations in the form of planning and design guidelines for future healthy residential neighbourhoods are given below.

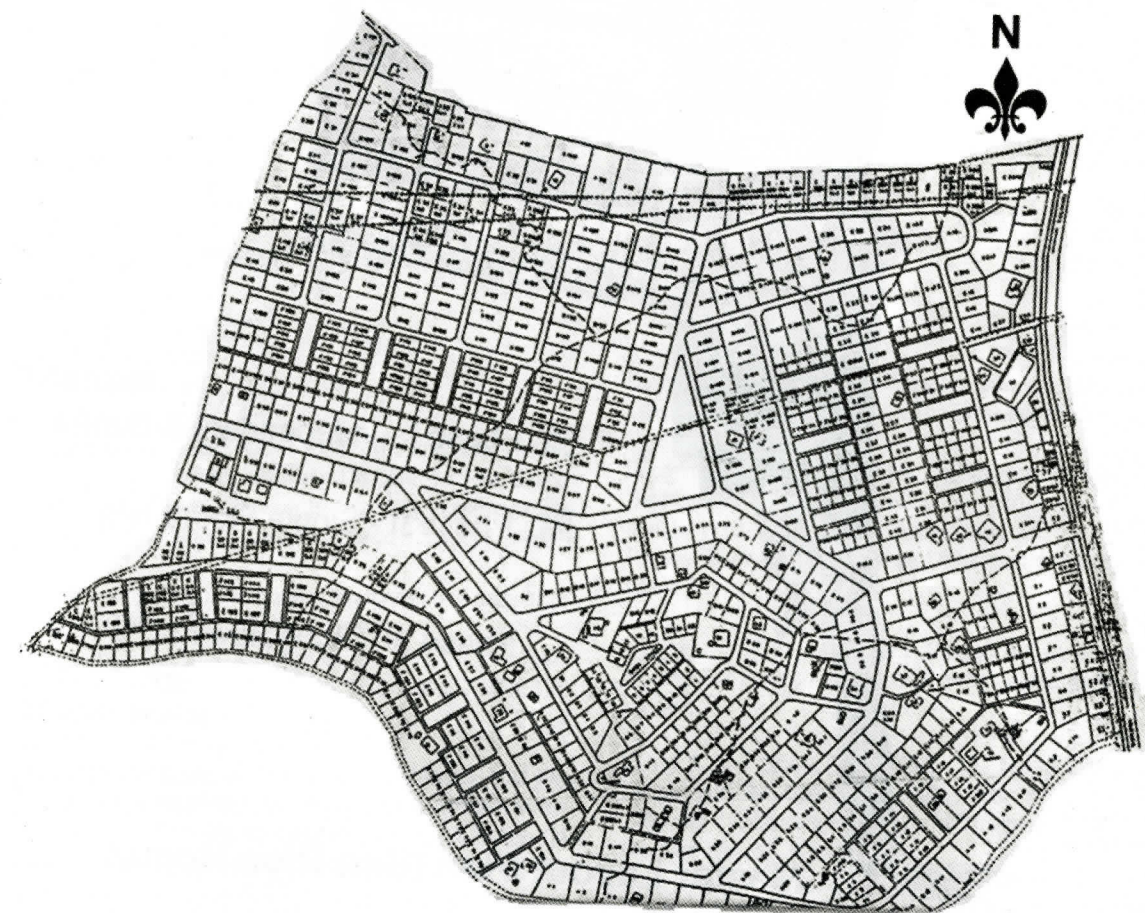
- (a) Identify the natural and historical features of the site that have collective meanings and then, incorporate them in preparing master plan by juxtaposing street and open space network with building design and detailing;
- (b) Design individual buildings that not only respect the traditional architectural vocabulary, but also response to the climate and immediate surrounding buildings and the streets thereby complementing to residential environment;

- (c) Develop community based institutions at local level that enhance the social network and community support;
- (d) Develop a clearly defined spatial hierarchy of spaces: public space - semi public space - semi private space - private space - where residents can socialise, work and relax. Also create functional and human scale spaces for different age groups of the society, which can be used at different times in a variety of ways, thus producing a livelier and safer public realm;
- (e) Promote activities or events where residents can learn the customs and traditions as well as gain the unifying values and beliefs thereby strengthening community ties and mutual dependencies; and
- (f) Ensure the provisions of social, emergency

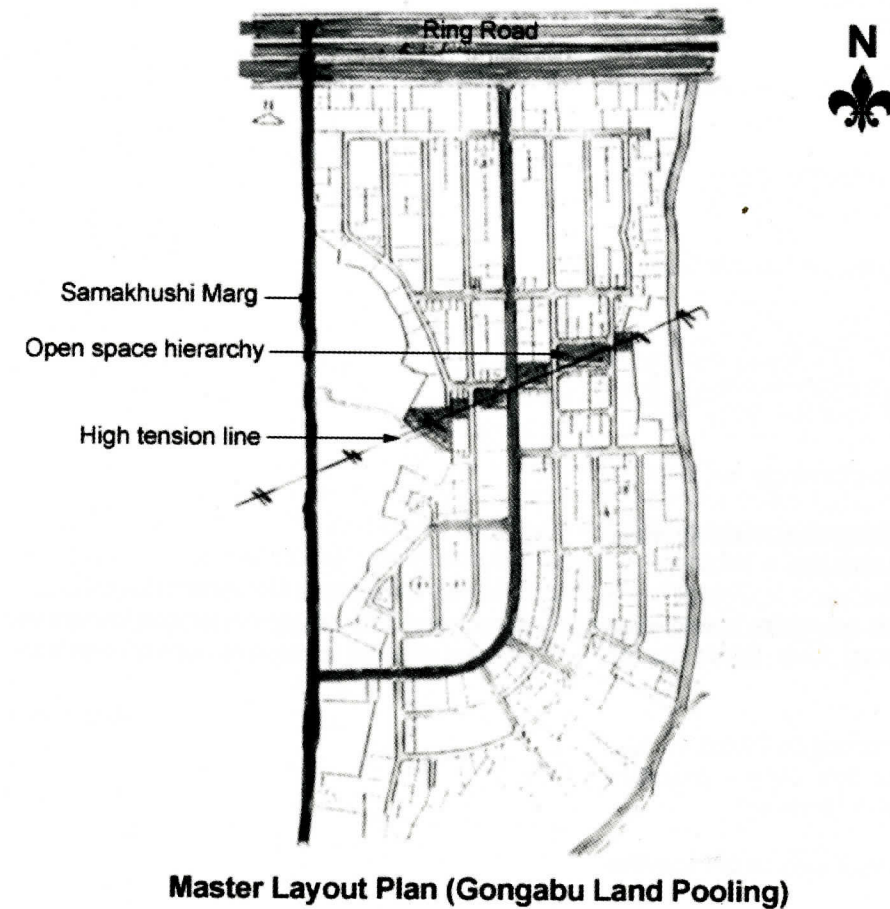
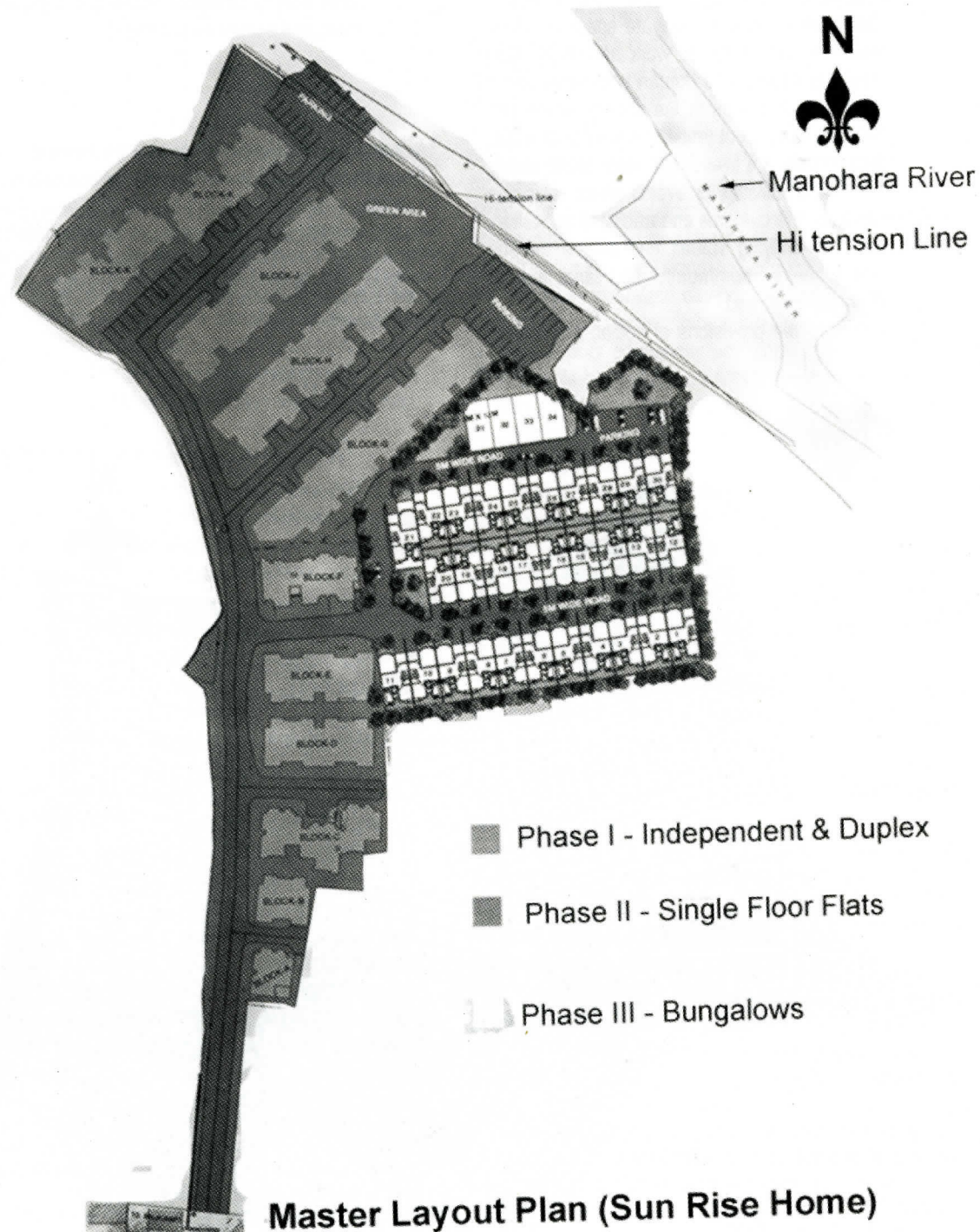
and community amenities in appropriate location both in terms of quality and quantity so that the inhabitants can not only perform conveniently and comfortably their daily activities but also able to celebrate rituals and festivals in a safe and secure environment.

#### End-Note

- <sup>1</sup> An average size of 5 members per household is assumed.
- <sup>2</sup> Few blocks subdivided by pedestrian paths are not considered.
- <sup>3</sup> A resident survey with a 29 item questionnaire focusing on different aspects of neighbourhood is conducted to altogether 25 households of different location in each study area. The responses vary from ninety to hundred percentages. As all the interviewees did not fill up (or answer) all the questions, the percentage is calculated based on the total responded numbers.



Master Layout Plan (Kuleswore Housing Project)



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## Urban Revitalisation through Place making: A Case in Khulna City

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### Abstract

The lack of open spaces has become the common problem for most of the organically developed urban areas in the world. The encroachment of urban land areas is squeezing of the existing urban open spaces. Open urban spaces are considered essential to make an urban environment live. Khulna, the third largest city in Bangladesh is also facing the same problem and which is moving towards a critical condition. But there exist some open spaces scattered in different parts of the inner city area. A big number of them are water bodies that were used for meeting the demands for household needs. Currently, the lack of maintenance and care has turned these water bodies and other open spaces into dilapidated places in the community. But there is also the scope to revitalize the existing water bodies in the inner city to resolve the scarcity of urban open spaces. Empirical studies have been conducted in some portion of Khulna city as a case. Dilapidated water bodies with open spaces have been identified and by physical survey and on the basis of the situation development proposal is proposed. This paper focuses on the scope of developing these dilapidated open spaces for the revitalization of urban environment for public interests.

### Key words

urban revitalization, place making, community development

### Introduction

Providing Open spaces for the urban dwellers is one of the basic factors for improving living environment. A good balance between built and open spaces is considered as one of the essential aspects for a sustainable urban environment. The Achievement of such an environment depends upon several factors. "The elements other than dwelling in a neighborhood are schools, open spaces, large establishments, shops and similar uses, places of assembly of modest scope..." (Kebel, 1969). These elements are serving different purposes for the community where open space is one of the major amenities for improving living environment. In the field of urban design, open space does not refer to simply a piece of vacant land. "Open space is frequently associated with outdoor recreation, it has also significance as a land reserve to introduce relief from what might otherwise become in interrupted development" (Chapin, 1965). Spreiregen (1965) also spoke for "planned open spaces" as one of the basic elements in neighborhood design. "An open space has always been an essential element of urban design and is, indeed, a crucial area of consideration... open space should be considered as an integral part of urban design"(Appleyard,1982).

Urban spaces can be generated in different ways and for different purposes. Historically urban gathering places have been originated from religious architecture (Kostof, 1992). Examples can be drawn from atrium of Christian Basilica or Shan of a Muslim Mosque. In addition to the religious factor, open places were provided for other purposes also such as, trading. Whatever the case is, all the time the need and demand for open spaces for general people for their regular activities transformed open spaces into community places.

The current environmental condition and the status of open spaces in Khulna city  
Khulna is facing the problem with lack of open spaces for its peoples. The total identified open spaces including water bodies is 25.31 ha (6.52 acre). This allocation gives only 0.07 acre per 1000 persons (KDA,1999). This is a far below standard of providing open space if compared internationally. Considering its population this amount is quite insufficient which can be compared with the following standards (Table 1).



Facility	Standards by Chapin	Standards by Keeble
Play ground	1 acre/800 population	2.5 acre/1000 population
Local Parks	1 acre/1000 population	0.5 acre/1000 population
Recreation center or play fields	1 acre/800 population	0.5 acre/1000 children

**Table 1.** General estimating standards for local recreation areas.  
Source: (Chapin, 1965) and (Keeble, 1969)

As being a divisional city, the scopes for business and job facilities are attracting more people to come to the city. Nowadays, the urban development authority is getting pressure for increasing its infrastructure capacity for commercial and residential accommodation specially in the city center. The pressure is forcing the urban authority to extend the city boundary to meet up the needs for housing, commercials, public spaces etc. This extension is the matter of investing a huge budget for providing the necessary infrastructures and land.

Historically in Khulna city there were some water bodies with open spaces, which were excavated for different purposes. Currently these open spaces and water bodies have become unutilized and dilapidated. In most of the cases these open spaces are causing social nuisance like vandalism, settling of unauthorized squatters etc. Spread of unauthorized/illegal settlement has become a common phenomenon in those areas. Crime is one of the negative outcomes from the sites. Most often these unauthorized/overlooked settlements act as the shelter for the criminals and mugging is a common event around those areas. In some cases people has turned these spaces into waste dumping areas. Some times water bodies in these open areas are directly connected with the sewerages from the surrounding residential and commercial buildings.

The water bodies with their surrounding areas have become dilapidated due to the presence of some factors. One of the major factors has been identified as the lack of proper vision and awareness to revitalize or reuse the areas. Developments of these sites are also subject to invest huge amount of money, which is unbearable for the owners. Thus the economic weakness of the owners is acting as another major barrier for the development.

Multi-ownership is also causing obstruction to take any development initiative. Some sites are subject to face critical problems with undisputed factors between the owners. Undisputed problems are also prevailing between government and public for a long time. Lack of properly identified owner, regular maintenance and prop-

er waste disposal facilities has initiated those areas as the waste dumping ground. Most of these open spaces have the connection with urban infrastructures like roads, electricity, drainage etc but it is observed that the current infrastructural facilities are not being properly utilized. Due to this underutilization, City corporation is not getting the proper money back in return of its investments for the infrastructure.

**Statement of the problem**

Urban living is much more than just to use a small room or spaces but to live in a system of spaces where theses rooms are parts. A sustainable urban environment means to have not only some spaces for different purposes but there should be hierarchy within spaces (Correa, 1985)<sup>1</sup>. It has been observed that the hierarchy of spaces is missing in the study area with the absence of smaller community gathering place. Along with the hierarchy, proximity to open space is another major element in a sustainable neighborhood. According to Keeble (1969) "...some open spaces accessible to public should be with in a few minutes walks of every home". Recent researches support that close proximity to green encourages people to come and visit regularly (Maat and De Vries, 2003). Open spaces can act as a point of social inclusion with its capability to bring together the community peoples closer. The absence of open spaces for gathering people of different ages for recreation and sharing, the social bondage is loosing. People specially the younger groups have to go nearby spaces for their social gathering. Children are not getting enough open spaces even for play, older are not getting space for their walks. As a result a relational gap between different age groups is increasing rapidly. This situation is indicating some definite problems which are stated below.

Lack of open public spaces, where 0.07 acre/1000 persons exists. This ratio is far below the standard.

Lack of open spaces is leading to social exclusions of different groups.

Problem with the ownership and that is creating several adverse effects for the healthy urban environment.

**Methodology**

This study has been conducted through physical survey, photographs, interviewing the community people and resource persons. Higher density of population, closer connection to an important urban node, lack of public open spaces were the criteria in selecting the potential sample study areas. The sample study has been selected randomly from the group of sample areas. Closer connection to city center and a major urban node *The Royal Mor*, higher population density with lack of open spaces made the site potential for the study. The following steps have been followed in this study.

- a. The identification of dilapidated water bodies and vacant unused land.
- b. Road networks (major and secondary) that are connecting those spaces with the nearby node.
- c. Identify the primary and secondary benefited zones from the proposed development.
- d. Finally the statement of the proposed revitalization process has been established.

**The proposed revitalization process**

**Present scopes to provide open space and revitalize the inner city**

Several development projects have been performed to address different problems of the city like development of road network, electricity, etc. But less effort has been given to solve the problems of livability due to absence of open spaces. Urban development is a subject, which requires integrated approach, but in this case most of the endeavors were targeted to solve pocket/segmental problems which eventuality got no integrated solutions.

Urban open spaces are of two types i.e. 'positive open space' and 'negative open space'. A way of defining the difference between 'positive' and 'negative' outdoor space is by their degree of enclosure and their degree of convexity (Alexander, 1977). This positive open space is one of essential component for having a sustainable urban community. Most of the open spaces in the study area have the potentiality to become 'positive' as they have enclosure by the surrounding 3-4 storied buildings. For this particular context open spaces can be provided for urban people by any of the following options.

By allowing new open spaces out side the inner city area. But it will not be sustainable in terms of proximity for the inhabitants. Getting an open space in a distance point is

not supportive if sequence of space is considered. Evacuating some existing buildings in the community can ensure open spaces. This evacuation may subject to face a big protest from the inhabitants whether the buildings are in deteriorated condition or not.

By reusing the existing open spaces; this approaches intend to reuse the existing dilapidated open spaces of urban areas without hampering other functions. Among the approaches the last one i.e. reusing of open spaces has higher potentiality for the revitalization. This paper proposes an urban revitalization process by reusing the urban open spaces.

**The process**

The revitalization process will go for the enhancement/develop the inherent qualities of the site so that it can contribute to the whole community. These qualities are for the improvement of urban ecological aspects including provision of enough green for community people. Only the provision is not enough but a safe and secured accessibility to the site should be the prime concern (Nefs, 2006). Accessibility will ensure the next approaches/steps further more. From experiences of different revitalization projects it can be said that no single authority whether public or private can make the whole development alone. Lack of information about ownership is a big problem for any urban development project. Information about the ownerships and control of the land and other necessary aspects are not available to all stakeholders in the development process. So a revitalization process for this particular context needs an associative work of all interested stakeholders. The revitalization process has been proposed as follows.

- a. *Determination of the dilapidated open spaces and their corresponding catchments areas.*

This includes the proper identification of the urban open spaces that are dilapidated or unused. The relative locations and their catchments zones of those areas will be marked (Fig 2.). During this process the possible public accessibility to the site and existing infrastructural facilities will be assessed and marked.

- b. *Identification the ownership pattern.*

With the help of City Corporation and physical survey data will be retrieved from different sources in order to get the real situation of ownership patterns. The illegally encroached land and undisputed problems will also be identified during the survey. A proper government intervention is a must to recover those lands and to take control immediately for the development. Future development plans (if any) will be collected from the owners whether it is privately or government owned land.

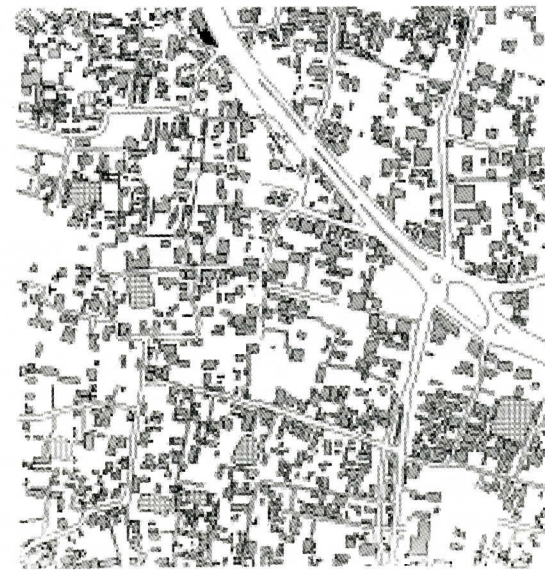


Figure 1. Existing land use map.

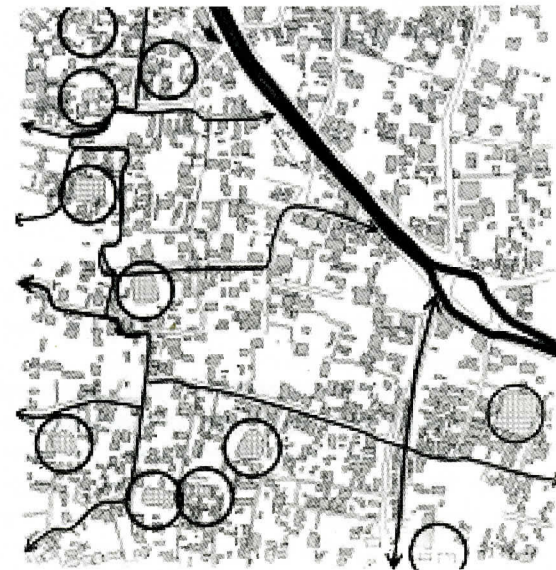


Figure 2. Locations of the dilapidated vacant land and the relative positions with road networks.



Figure 3. Immediate benefited area from the development.

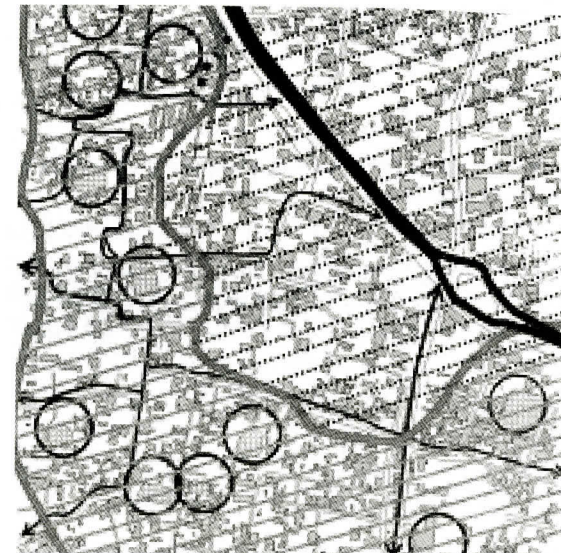
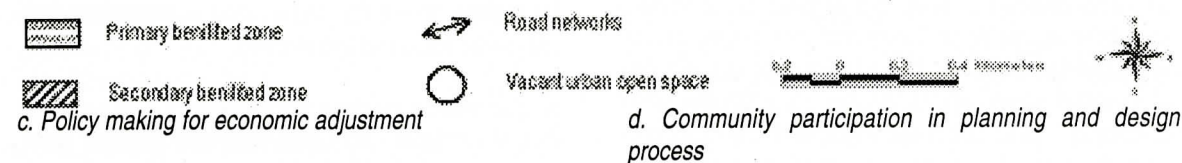


Figure 4. Secondary benefited area from the development



A proper compensation policy will be formulated for acquiring the privately owned open spaces. In the development process primary resistance/protest may come from the owner groups. In policy making; representatives from the owner groups must be included. Compensation will/may vary from site to site depending on their location, accessibility, site condition etc.

A program for increasing public awareness regarding the benefits of urban regeneration must be conducted. For more acceptances; representatives from local people, N.G.Os, government authority will form a body to run the public awareness programme. Information about the scopes and potentialities in revitalizing those underutilized areas will be delivered through this body.

The design team for the development will include different professionals like architects, planners, sociologist, economists and obviously the local representatives. Public participation in the stages of decision making will ensure the acceptability and thus sustainability of the development program.

*e. Formation of a maintenance body, clarification distribution of the responsibilities*

The implementation, management and maintenance body will be formed jointly by the different development partners like community people, NGOs and City Corporation. Local people will be directly incorporated at the implementation stage for getting a greater social acceptability. For the security purpose 'community policing'<sup>2</sup> can be adopted in this type of context. Local and the municipality workers can jointly do maintenance work. The best option will be to give priority and incorporation of the local poor people in the maintenance works. Government's responsibility will be to check the further grabbing of the land. Municipality authority may have the right to intervene and check the all programs periodically to avoid further unnecessary delay, mismanagement, illegal encroachments etc.

Local authority may take action to reduce tax for the revitalization program. Initially the development cost may be arranged by NGOs or the City Corporation. Later on the community people will form a common fund for the maintenance where the community people will be charged for a small amount of money. If someone is not at the stage of depositing money for the common fund then they have to do different physical and other official jobs for the community.

**Conclusion**

This study proposes the development process of urban areas by revitalizing existing dilapidated open spaces that are scattered through out the city. It is expected that if the proposed revitalization program can be implemented then the following outcomes will be ensured. It is also expected that the outcomes will achieve open space for urban dwellers, more security, and thus a strong community bondage that are the key issues of any urban revitalization project.

*The expected outcomes*

The opportunity of mixing up different groups of people in the developed open spaces will ensure a strong social bondage and a healthy social environment. Newer developments will provide open spaces that are needed for the sustainable urban environment. This

developed environment will attract people come back for living in the inner city area who intended to leave for the better.

Through the development of dilapidated vacant lands into open green spaces, an integrated network of green within the community will be ensured.

This type of development will ensure more economic return from the existing infrastructures. More income of different authority from the same infrastructure will ensure a better development and maintenance in the inner city area.

Development will not only attract people to come but also some other commercial activities will be interested to come in. These newer provisions of mix mode activities will ultimately turn into a vibrant urban community.

Public participation in every step of decision making will ensure the mass public acceptability which ultimately goes for the sustainable community through urban revitalization.

**End Note**

<sup>1</sup> According to Charles Correa ..there are four elements of hierarchical spaces in a sustainable urban environment.

1. **Private contacts**(cooking, sleeping etc in the house hold),
2. **Intimate contact** ( Chat with neighbours etc)
3. **City neighbourhood meeting places** (Where one can become a part of a city)
4. **The principal Urban area** ( for the whole city).

<sup>2</sup> Community policing is a concept of engaging local people for maintaining security. This system has been proved as fruitful as they know the local people better than others. So an intruder can easily be identified by them.

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## An Observation on Daylight Inclusion in the Lighting of Offices in Dhaka

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### Abstract

This paper reports the findings of a study of existing office buildings in Dhaka City aimed at an understanding of their luminous environments. It was found that artificial light is the main contributor to the visual environment, even though there is an abundance of daylight during office working hours. Daylight should be encouraged in office spaces because, not only would it save on lighting energy, but it would also carry immense physiological and psychological benefits. This paper highlights the findings of the study and compares them with internationally accepted lighting standards for office activities. Measurements of illumination levels were taken in the surveyed offices and found to be much lower than international standards. Space usage by users seemed to indicate their unawareness of light issues. Design strategies to improve the luminous environment under daylight, artificial lighting and supplementary lighting have been discussed explaining design strategies to achieve standards, followed by a discussion of the extent these practices are followed in the surveyed offices of Dhaka.

### Key words

Daylighting, Luminous environment, Supplementary lighting, Office lighting

### 1. Introduction

Daylight is one of the most important natural forces available to architects in their quest to enhance the visual quality of interior spaces. It is an abundant resource in the tropics, indispensable both as a primary source of illumination as well as an ingredient of drama, excitement and dynamism in the architecture and aesthetics of spaces.

Among the advantages of daylight are physiological as well as psychological benefits for users (Robbins, C.L, 1986, Ch 1). Not only does daylight allow one to save on electricity consumption for lighting, but some studies show that provided glare can be controlled, people perform better when exposed to daylight (Boyce, P, et al; 2003; p65).

The question of daylight inclusion in office buildings is extremely important for energy efficiency, as it reduces dependence on artificial lighting sources, and being day-

use buildings, a significant portion of the use of these spaces coincides with times of substantial outdoor lighting.

At the same time, it must also be recognised that all the effects of daylight may not be beneficial for the users. In the tropics, with the daylight may enter unwanted heat. Too much or unguided daylight may cause glare (Bell, J; Burt, W, 1995). All these negative effects have energy implications, ie electricity consumption may be required to rectify these adverse effects. Therefore an informed balance must be struck between energy saved from artificial lighting use by daylight inclusion, and that spent to get rid of excess heat by air-conditioning (Ahmed, Z.N; 2006). Likewise, there will be other balances to be taken into account, related to ventilation, acoustic and other subjective concerns of privacy and view.

This paper examines the existing state of the lighting environments of typical office spaces in Dhaka city and

the issue of daylight inclusion within the lighting schemes surveyed. The findings have been compared with internationally accepted practices and standards, and some general guidelines and recommendations have emerged from the exercise.

2. Aims / objectives

One of the aims of this paper is to present an understanding of the nature of, and influencing factors of, the luminous environment found within office buildings, under the dense conditions found in Dhaka city. Lighting research in general, and daylight research in particular, is a very neglected field of research in Bangladesh, but this state of affairs cannot continue if we want to use our limited energy resources optimally. Through this paper, Architects will be able to develop awareness regarding issues relevant to lighting design in offices of Dhaka, and to improve consideration for daylight inclusion in these spaces.

3. The Investigation

This paper is based on a study<sup>1</sup> conducted for evaluating the visual environments in typical offices of Dhaka city, to investigate the lighting practices and to establish lighting levels under which users work and experience comfort. Typical examples, representing three trends of office layouts noted during the study, were chosen for a physical survey. The case studies were:

Type A: A corporate office in a high-rise building inserted within a commercial block, without any setback on the sides: represented by Anwar Group of Industries located in Baitul Hossain Building (Fig.1), 27 Dilkusha Commercial Area (size 630m<sup>2</sup>, 14<sup>th</sup> floor, top floor).

Type B: A corporate office in a low-rise converted building at a corner plot of a residential area, represented by Parvin Properties & Technologies Ltd (Fig.-2), House no-4, Road no-6, Block- D,

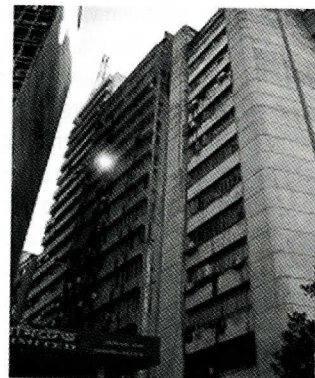


Fig : 1 Type A , Dilkusha



Fig : 2 Type : B , Lalmatia

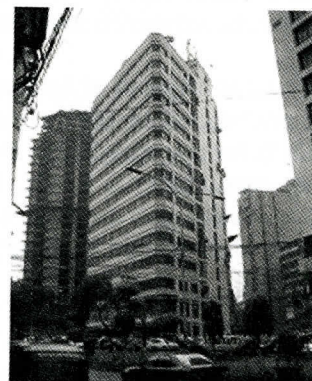


Fig : 3 Type : C , Gulshan

Lalmatia (size 406 m<sup>2</sup>, Ground floor).

Type C: A corporate office in a high-rise building surrounded by wide roads and with shaded glass window façade, represented by Delta Brac Housing Finance Corporation Ltd, Landmark Tower (Fig.3), Gulshan (size 735 m<sup>2</sup>, 11<sup>th</sup> floor)

The plans of the three surveyed offices, along with measured values of illumination at relevant points, are shown in the Appendices at the end of the paper. These offices were surveyed to determine:

- the physical dimensions of the different spaces and characteristics of the various features which affect the luminous environment, like window size and detailing, wall surface, space and furniture layout, etc
- measurements of illumination levels at three points in each area (see Plans shown in the Appendix), one near the window, the second one in the centre of the space and the third, furthest from the window. The measurements were taken using a Lux-meter<sup>2</sup>, both in presence and absence of artificial light, at a height of 0.75 m above and parallel to floor level, signifying the work plane.

Once the existing details of the surveyed offices were recorded, they were compared with internationally accepted practices in lighting design.

4. Findings of the Survey

A study of the plans of the surveyed offices revealed that each of the offices includes the following major activity spaces/zones:

- lobby, with reception and waiting spaces
- large open office spaces for general desk work
- individual office rooms for key executives
- a conference room for meetings and consultations
- corridors for circulation between the zones

Table 1a: Illumination level measured in the Surveyed Offices in Dhaka (lux)

		Lobby		Corridor		Individual office Room		Large open office space		Conference Room	
		i	ii	i	ii	i	ii	i	ii	i	ii
Type A	1	185	18	570	570	620	620	170	7	75	30
	2	275	12	290	20	200	115	170	6	250	25
	3	120	8	130	4	45	25	170	4	62	17
Type B	1	72	15	26	26	950	900	30	30	600	600
	2	112	5	48	10	88	35	65	15	170	105
	3	38	2	37	4	40	20	40	5	31	22
Type C	1	190	60	260	55	1500	1500	3200	3200	1700	1700
	2	275	45	180	35	227	170	380	220	270	180
	3	120	28	60	20	250	87	155	95	120	58

i - with Artificial Light  
1 - near the window

ii - without Artificial Light  
2 - centre of the space

3 - furthest from the window

The different zones within offices have different lighting requirements. Measured illumination levels of these zones (shown in the Appendix) are compared in Table 1a. One set of measurements were taken with the artificial lights switched on (i) and another with them off (ii), to test the daylight penetration and its contribution to the illumination of the space during the day. In the absence of task lighting, only ambient lighting data could be obtained.

The comparison reveals that near the window, illumination levels are often equal, or close to equal, with and without artificial lights (Corridor in Type A; individual office rooms and open office space in Type A and C; Conference Rooms in Type B and C). The implication of this is that near the window it is natural light that is the dominant lighting source, and artificial light often has no contribution under these circumstances. In other spaces it

Table 2: Dimensions of Activity Spaces in Surveyed Offices (m)

		Lobby	Corridor	Individual office Room	Large open office space	Conference Room
Type A	Space dim	8x3	22x1.5	6x4	18x4	6x4
	window	nil	4.5x1.25	6x1.25	nil	nil
	Window: Floor ratio	0.00	0.17	0.31	0.00	0.00
Type B	Space dim	3x5.5	16x1.25	4.5x4	5.5x5.25	7x4
	window	2x2.25	4x2.25	2x2.25	2.5x2.25	1.25x2.25, 1.25x2.25, 2.5x2.25
	Window: Floor ratio	0.27	0.45	0.25	0.19	0.40
Type C	Space dim	6x8	12x2	8x10	5.5x6	5.5x4
	window	nil	nil	10x1.5	10x1.5	5.5x1.5
	Window: Floor ratio	0.00	0.00	0.19	0.45	0.37

Table 1b: Measured Outdoor Illumination level during Survey (lux)

During Survey of:	Av. Outdoor illumination	Max. Outdoor illumination	Min. Outdoor illumination
Type A	31,500	47,000	16,000
Type B	19,960	44,000	5,500
Type C	14,030	18,500	9,600

is seen that there is a sharp drop from measured artificial lighting level to daylight level. This is when the effect of daylight is extremely low, due to distance or lack of openings.

Outdoor daylight level data during the measurements at 2:30 pm in the afternoons of three separate days of the survey, in September and October, are shown in Table 1b. Relating Tables 1a and 1b, clearly very little of this abundant resource penetrates the interior even near windows. Calculating the Daylight Factor<sup>3</sup> using the average outdoor illumination of Table 1b and measured illumination data from Table 1a, it is seen that only the large office and conference room of Type C, with three sides open uses this daylight near the window, and it falls sharply as distance from the window increases.

Spaces	International standards (Lux)	BNBC standards (Lux)	Range of average illumination in Survey (Lux)
Lobbies and hallways	100-200	150	100-200
Typical offices	400-600	300	35-200
Computer work with task lighting	200-400	Not specified	50-150
Paper tasks with task lighting	400-600	Not specified	50-150
Specific tasks (fine details)	600-1200	Not specified	50-200
Conference and meeting	300-500	300	150-230

Table 3: Comparison of Standards<sup>4</sup> and Actual illumination levels for different activity zones (lux)

The main dimensions of the different activity spaces surveyed, of the three case studies are presented in Table 2, along with window size and the ratio of window: floor of the different spaces.

Most of the installed lighting is overhead and there is almost no instance of artificial lateral lighting, which to a limited extent only, is provided by the windows.

The main light types used in these offices are:

- Imported Louvered Shade Light: 2'x2' (four 2' tubes making a square fixture, total 80W) or 4'X1' (two 4' tubes in a rectangular box, total 80W) fitted into the false ceiling.
- Energy Saving Down Lights (CFLs): ceiling mounted concealed type light shade 18W/20W each.
- Halogen Down Spot Lights: ceiling mounted conceals type light shade, 100W each.
- Single Tube Light: 2' (20W) and 4' (40W) used in toilets, tearooms and storerooms.

### 5. Comparison with internationally accepted practices and standards

One of the aims of the study was to evaluate the lighting conditions in these existing offices in terms of nationally and internationally accepted practices and standards. Whether using daylight or artificial light separately or in conjunction with each other, lighting in offices in the developed world distinguishes between the ambient component and the task lighting. Ambient lighting gives the space its general operable illumination by which people can move around freely. The ambient lighting is usually relatively uniform, giving the space a well-lit appearance without patches that are overly bright (thus energy intensive) or under-lit and gloomy (which create the illusion of low lighting even under functional/standard levels of aver-

age illumination). Table-3 gives comparison between international illumination standards (Architectural Graphic Standards, 2000) and local recommendations (BNBC; 1993; p8-7) for the different zones and illumination measured in the surveyed offices. These values include ambient as well as task lighting.

The illumination level comparison shows that in the surveyed cases the highest levels are reached in Conference/meeting rooms and in lobbies, though standards require higher lighting in other task areas, eg where desk work is likely to be more intensive.

### 6. Lighting Design Strategies as found in Case Studies

Whether a space is lit exclusively by daylight or by artificial light, or whether by a combination of the two, ie, by supplementary lighting, some general design strategies can help to make the visual environment comfortable,



Fig: 4 Lower False Ceiling, Type A

glare free and energy efficient. These strategies are discussed separately in this section explaining design strategies to achieve standards, and to what extent these practices are followed in the surveyed offices of Dhaka.

#### 6.1 Daylighting strategies as found in Case Studies

Daylight penetration will be greater if, among factors like large window size, light coloured internal surfaces, regular maintenance and a large angle of open sky can be seen from the window (Bell, J; Burt, W; 1995; p31).

Strategies available to architects to achieve good daylight distribution are:

- *Positioning windows high on the walls:* Windows placed high in the wall near the ceiling provide the most daylight for any given window area, permitting daylight to penetrate more deeply into the interior (Egan, M.D; Olgyay, V.W, 2002). But introduction of false ceiling in almost all the surveyed office interiors terminates this option, allowing only low level windows. (Fig.4)

- *Sizing windows according to orientation and use:* as high sky areas may create sky glare (Evans, M; 1980), especially from non-polar orientations, glazing should be kept to a reasonable minimum. Separate windows may be designed for needs such as view, visual relief, ventilation, etc, which may be positioned low in the walls at level with activity areas, and for daylighting, higher up. In the surveyed offices, such consideration is not given to the design of windows, where apertures are provided on the exposed wall, regardless of orientation, or of daylighting possibilities (Fig.5). These windows are mainly designed with geometric and aesthetic considerations.

- *Considering the window: floor area ratio:* The ratio between window: floor area is a significant factor in the spread of daylight. Many countries around Europe use



Fig: 5 Glazed Windows

this ratio as minimum requirement just to ensure daylight provision, eg. in Greece it is 0.1 depending on the building type. In France designers tend to use the rule of 1/6 = 0.17 as a way to size correctly the windows in a space to be well daylighted, and the rule of 1/8 = 0.12 for the minimum size (Fontoynt, M, et al; 2004). The survey shows that the highest value of this ratio was found to be 0.45 in Type C, in the general office space where there are windows on three sides (Table 2). Such a high ratio should be treated with caution, as the incoming daylight is likely to have high heat content. In all spaces with windows, the ratio was found to be larger than standards require.

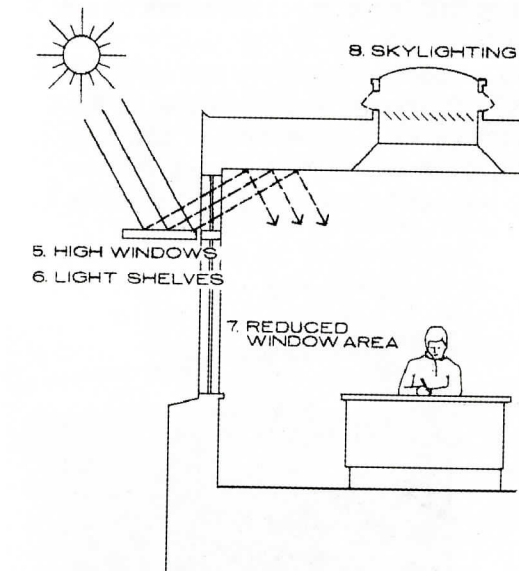


Figure 6: Daylight Options. (Source: Architectural Graphic Standards, 2000)

- Utilizing sunshades to act as light shelves: Light shelves can be used to reflect daylight onto the interior ceiling, making it a light-reflecting surface (Fig.6). A light shelf shades the lower portion of any window, reducing the amount of light near the window, which typically has much

floors is not a new one even for Bangladesh and can be found on atriums around the city. More research needs to be conducted on the balance between energy saved from daylighting and that expended in cooling the space because of the additional solar radiation.

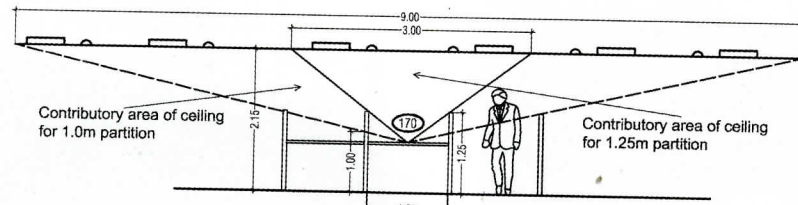


Figure 7: Light fixtures contributing over partitions, Type A.

higher illumination than the deeper parts of spaces, while allowing in light from higher levels to penetrate deeper into the space. The result is a balanced luminous environment, with less contrast and glare. In Dhaka, consideration for shading is only given to protect from sun and rain. The concept of glare control and ceiling illumination using reflections off a light shelf is not practiced consciously.

- Installing skylights where possible: Skylighting, when properly sized and oriented, is an efficient and cost-effective source of daylighting. Cost-effective, energy-efficient skylights can be small, spaced widely, with "splayed" interior side walls that help reflect and diffuse the light. (Fig.6). White-painted ceiling and walls further improve the efficiency of daylighting (by as much as 300% if compared with dark interior finishes) (Architectural Graphic Standards, 2000). However, in tropical areas, because of the high heat content of daylight, skylights should be carefully evaluated for the additional solar radiation gains. Moreover, this option is not available unless the space is on the top floor with a roof available for such manipulation. This option was not found in any of the surveyed offices. However, the trend of adding skylights on top

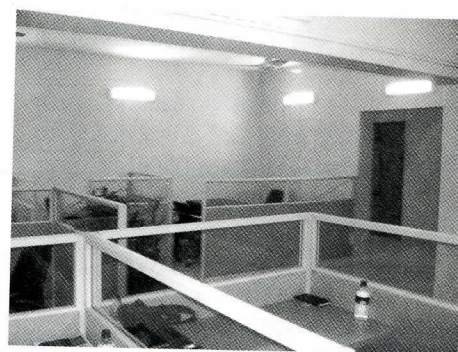


Figure 8: Lower Partitions with glass, Gulshan 1.

### 6.2 Artificial Lighting strategies as found in Case Studies

Early in the history of lighting, illumination systems were designed for minimum use of interior space at night. Today, however, electric illumination systems generally are often designed to be used in place of natural light, even during the day. Among aspects affecting the general lighting condition of an office space are room dimensions, geometry and reflectances, type, number and height of source/fixtures above work plane, etc. (Architectural Graphic Standards, 2000) These aspects are discussed in this section with reference to the Case Studies.

- Room dimensions, geometry and reflectances: In the surveyed offices, dimensions and geometry of which are given in Table 2, all surfaces were found to be light in colour, having high reflectances. Fixtures were almost all overhead, attached to the ceiling, with hardly any task lighting. However, the shades often increase the light loss factor, as their design concentrates more often on aesthetics and economy of manufacture, rather than luminance distribution.



Figure 9: Equidistant lights, Type A.

- Source type and position: In the developed world, different types of lamps are available to meet various viewing purposes, ranging from the incandescent lamp invented in nineteenth century, to the more recent discharge lamps of neon, high pressure mercury, low pressure sodium, metal halides, fluorescent tubes, compact fluorescents, etc (Phillips D, 2000). While the position of light can be from overhead or from lateral directions.

But in Bangladesh only a few types of lamps are popularly used, although numerous types of lighting shades are available. The survey revealed only three types of electric lamps being used for electrical lighting in the office interiors, irrespective of activity and work. These types were fluorescent tubes, compact fluorescent energy saving down lights and halogen spot lights. According to the local and international lighting appliance supplies, 60-80 million units of lamps are sold in Bangladesh each year, of which 90 percent are incandescent lamps, 9 percent are fluorescent tubes, while only about 1 percent are Compact Fluorescent Lamps(CFL) (Haq, A.S.M.B; 2005). But because CFLs use only about a quarter of the electricity used by incandescent bulbs of similar illumination outputs, their use for artificial lighting should be encouraged. Regarding position, only ceiling mounted lights were found in the surveyed offices, with no examples of lateral artificial lighting.

- Partitioning the space: Partitions influence the distribution of light within large open office spaces, as they are capable of cutting off light from overhead fixtures to workstations. In the Type A office in Dilkusha, workstations are contained within 1.25 m high panels. Extending "sight-lines" (as if the desk top could "see" the ceiling) from the centre of the station out to the ceiling over the top of the panels, it can be seen that in a 1.25 m by 1.25 m workstation, a ceiling area of 9 m<sup>2</sup> (3m x 3m) has the potential for contributing light to the workstation. In this area of ceiling, four pairs of lighting fixtures were installed 2m apart, each containing one 2'x2' Louvered Shade Light (each of 80W) and one Energy Saving Down Light (20W). The illumination level on the desktop from these fixtures was measured to be 170 lux (Fig.7). If the same 1.25 m by 1.25 m workstation had lower partitions of 1.00 m, the projected lines would enclose a ceiling area of 81 m<sup>2</sup> (9m x 9m). This area includes another 32 pairs of lighting fixtures. This inclusion would cause significant increase in incident light, the exact amount depending on distance of lighting fixture from the desk top, and its angle of incidence (Fig.7). The effect of partitions can be minimised by making them transparent, thus increasing the illumination level, as seen in Fig.8 in a Gulshan office.

### 6.3 Supplementary Lighting strategies as found in Case Studies

When artificial lighting is used in conjunction with daylight, it is better known as supplementary lighting (Hopkinson, R.G; 1963), and results in energy savings. This form of lighting is extremely relevant for tropical areas like Bangladesh, despite the abundance of daylight, to cut down heat input and to avoid glare. Window areas can thus be kept to a minimum, allowing greater noise, dust and rain protection, while plans can be deeper. In spaces with supplementary lighting, natural light can provide ambient illumination, reducing the use of electric light, which can be used for task lighting.



Figure 10: Windows are blocked with furniture, Type A.

The general characteristics of supplementary lighting are (Robbins, C.L; 1986)

- the daylight character of the space should be maintained so that occupants far from windows do not feel deprived of daylight
- total illumination levels should decrease away from window, to keep the impression of daylight penetration, even though illumination from artificial lighting increases with distance from the window
- the colour of artificial lighting should give good daylight rendition and sources should be unobtrusive
- there should not be uneven patches of brightness in the space, and blending of levels should be aimed for
- separate daytime and night-time switching should be provided
- automated controls should be installed to minimise waste and save energy (Energy Research Group; 1994; p12). Manual controls to dim lights when daylight contribution rises, and to increase levels when outdoor light falls, is not practical, as in general offices rarely would anyone be sufficiently interested enough, or aware enough, to consider these aspects. Thus lights would remain at a high level for visual performance and continue at the same level irrespective of daylight increase outside.

In the surveyed offices, almost no indication was found that the installed lighting system was designed with consideration of daylight. For instance:

a. It was found that the overhead lights were equally spaced, whether near the window or far from it, controlled through general switching (Fig.9) Moreover, the illumination levels measured in many of the spaces were found lower than international or local standards, showing that the numbers of fixtures are not based on calculations related to functional lighting requirements.

b. Users seem unaware of the need for outdoor light in their visual tasks, as they use spaces with curtains drawn, working under artificial lighting conditions. Similarly cabinets and other furniture are placed adjacent to window walls, blocking daylight penetration (Fig.10)

The supplementary lighting strategies discussed in this section are not followed in the lighting design of surveyed offices, despite the fact that daylight is available and should be considered in such day-use buildings.

### 7. Conclusive Remarks

Surveys show that lighting design in general is a neglected aspect of the overall design of spaces in Bangladesh. From the measured illumination levels, it is clear that lighting levels are well below acceptable standards, indicating that lighting levels are not considered during design in an organised way, to fit the function or to satisfy any standards. And even rarer is any consideration given to including the available daylight to supplement the scheme.

However, the importance of trying to save on energy consumption by including this abundance of daylight that exists in Bangladesh cannot be disputed. Other than energy savings, daylight is also preferred due to the physiological and psychological benefits it can impart to users.

It has been one of the aims of this paper to present an overview of the luminous environment found within different types of office buildings that exist in Dhaka city, where aspects of the interior that affect this environment have been examined in a limited number of case studies. Daylight and artificial lighting research is a relatively neglected field in Bangladesh, and this paper attempts to highlight the need for such research, and to create awareness among Architects regarding the myriad issues that affect the luminous environment.

### End Notes

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- 2 TES 1332 Digital Lux Meter; range 0-200,000 lux
- 3 The ratio of indoor illumination to the simultaneous outdoor value expressed in percentage.
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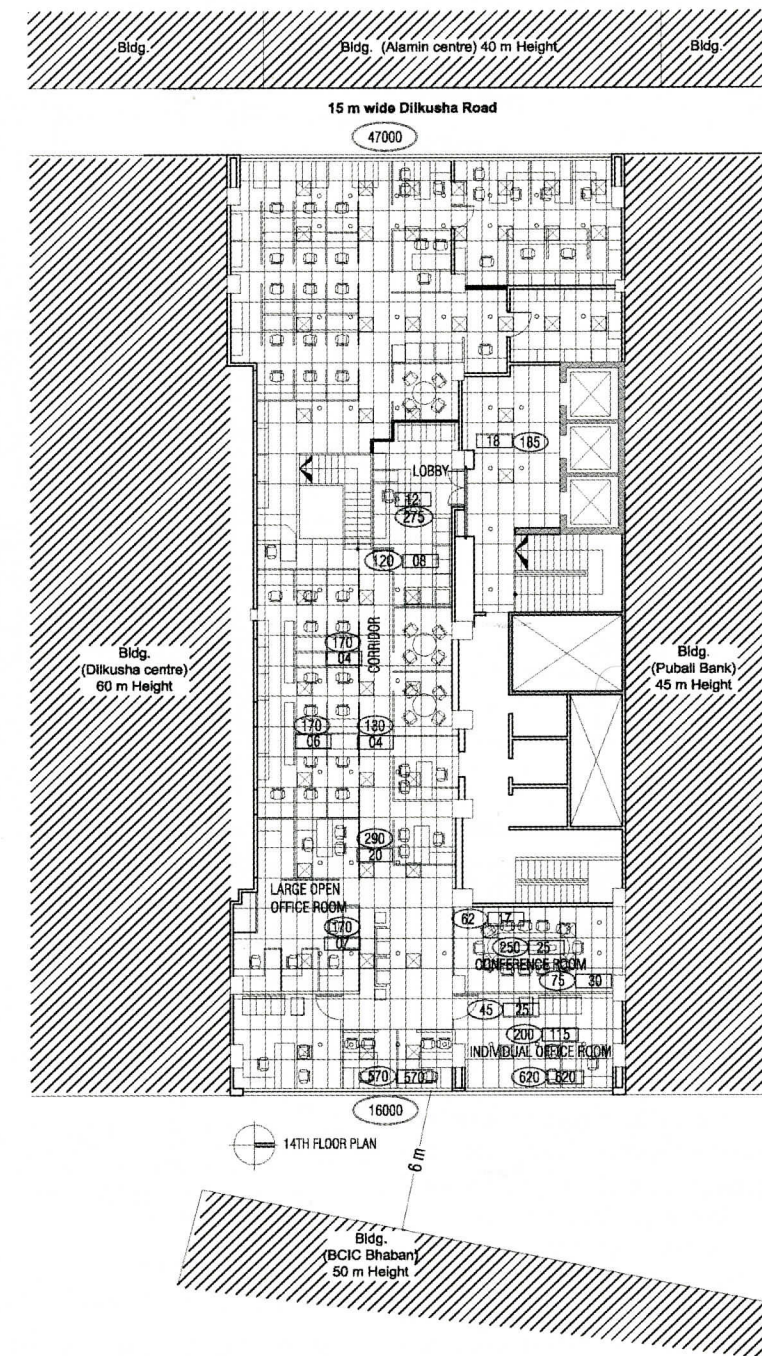
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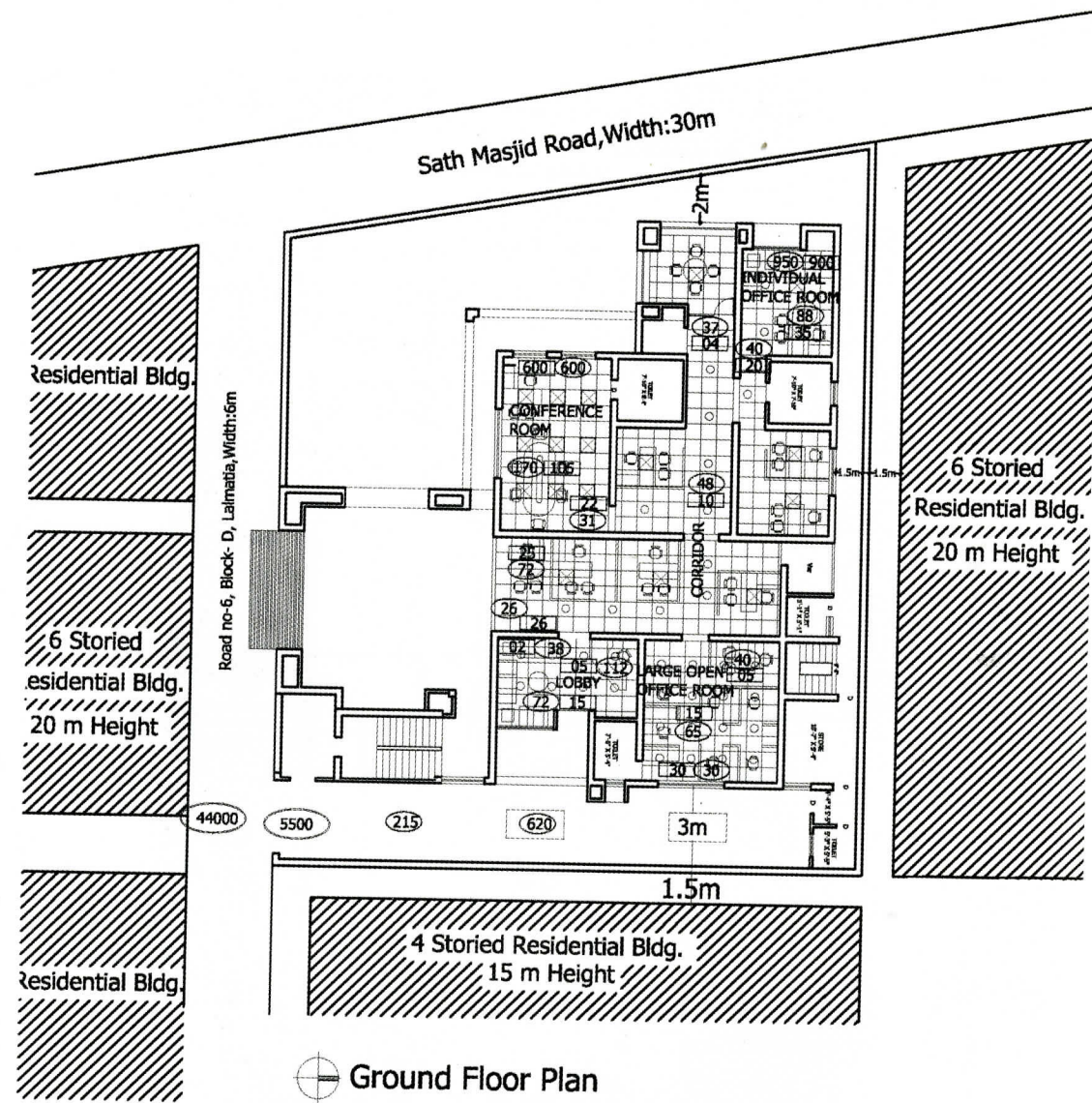
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**Note:** Values in ellipse are measured by lux Meter with the artificial lights switched on (i) and in rectangle are measured



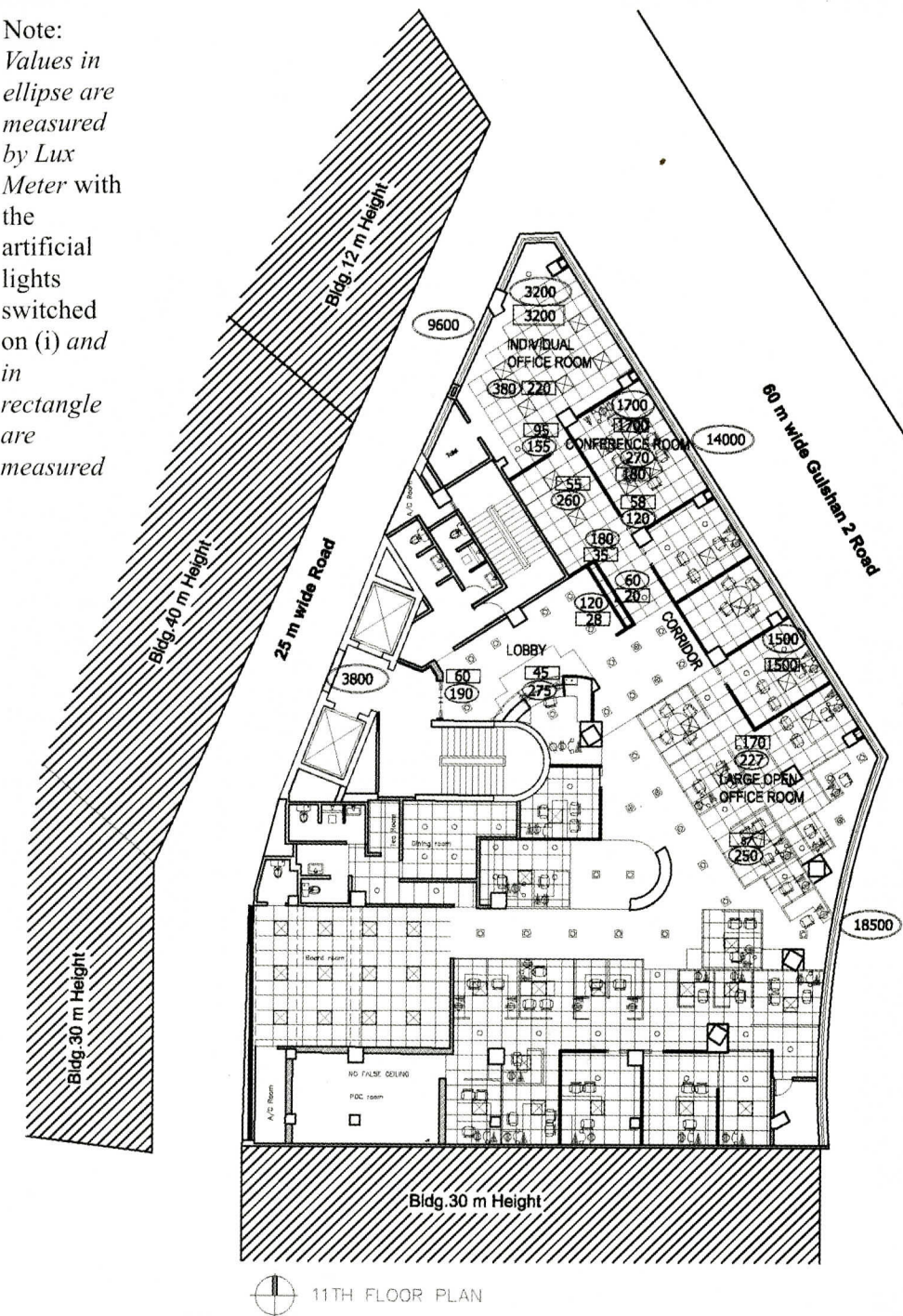
Appendix (1) : Layout plan of Anwar Group of Industries (Type : A)

Note: Values in ellipse are measured by Lux Meter with the artificial lights switched on (i) and in rectangle are measured with switched off (ii) as shown in Table 1a of the paper.



Appendix (2) : Layout plan of Parvin Properties and Technologies Ltd (Type : B)

Note: Values in ellipse are measured by Lux Meter with the artificial lights switched on (i) and in rectangle are measured



Appendix (3) : Layout plan of Delta Brac Housing Finance Corporation Ltd (Type : C)



## **Destruction of Natural Resources as a Consequence of Human Interventions: Case of Fishermen Community Living along Karachi's Mangrove Forests**

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### **Abstract**

It is a grave reality that humans have always over utilized the natural resources in the name of development and caused its destruction. It is imperative to evaluate the actions of humans while they utilize a natural resource because the nature of human activities always varies to greater extent and the community living near natural resources always has a direct or indirect dependency on it. There are various indicators which imply that the poverty and inaccessibility to services and infrastructure may lead to destruction of mangroves ecosystem in the form of its misuse or commercial exploitation. However; appropriate input and interventions may lead to conservation of this natural resource. An aware community that realizes the significance of mangroves can be a useful catalyst in this task. The objective of this paper is to comprehend the realities of fishermen community living along mangrove forests at Kakapir village Novanall Island, Karachi. The scope of findings includes the documentation of the physical realities of the built environment, socio-economic conditions of the community, perception of the community regarding mangroves, its significance and use and their dependency on the mangroves ecosystem.

**Key words:** Community perception, Destruction of natural resources, Formal and informal sector development, Human Interventions, Kunda System.

### **1. Introduction:**

The aim of this paper is to investigate and report the destruction of natural resources as a consequence of human interventions. Basically it's a case study of a fishermen community of Kakapir village living along the Mangrove forests at Novanall Island in Keemari town Karachi. The concept behind this paper is the assumption that, we humans always over utilized our natural resources in the name of development and the communities living near natural resources has a direct or indirect dependency on it. There are various indicators which imply that the poverty and inaccessibility to services and infrastructure may lead to destruction of mangroves

ecosystem in the form of its misuse or commercial exploitation. However; appropriate input and interventions may lead to conservation of this natural resource with an enlightened community that realizes the significance and protection of mangroves rather than its destruction.

#### **1.1. Objective:**

The objective of this paper is to understand the realities of fishermen community living along Mangrove forests at Kakapir village Novanall Island, Karachi. The scope of findings includes the documentation of the physical realities of the built environment, socio-economic conditions of the community, perception of the community regarding mangroves, its significance and use and their dependency on the mangroves ecosystem.

1.2. Methodology:

The method by which this study is conducted includes; preparation of an original map of Kakapir village so that the physical layout of the study area and its architectural character may be determined and further investigation could be conducted. The second step was a house-to-house questionnaire survey conducted during May-August 2003 in Kakapir village to document community's socioeconomic conditions and its relationship to the mangroves ecosystem. The third and final step was the analysis of questionnaire survey, identification of the potential threats to Mangroves Ecosystem and interventions in the context with an explanation of the learned lessons.

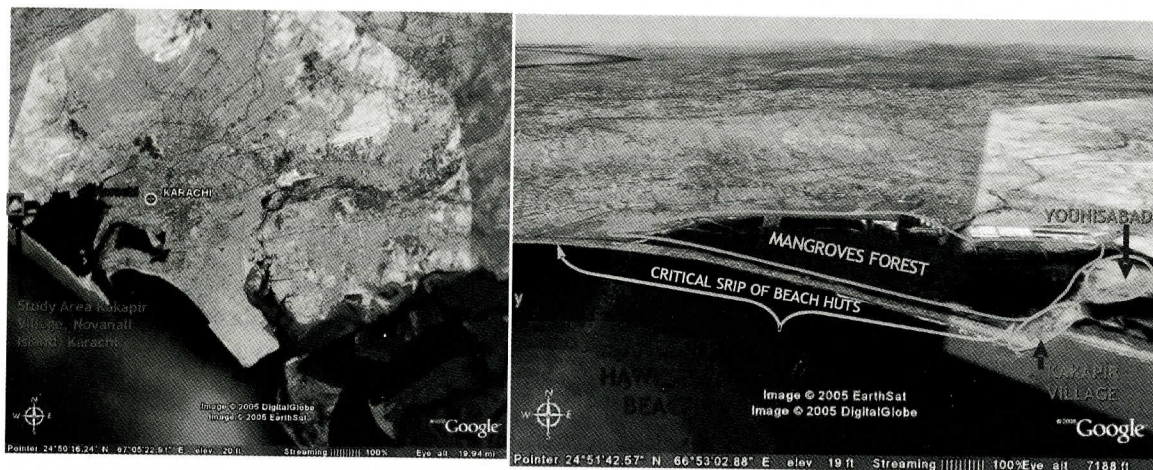


Fig. 1: Location of study area on the satellite image of Karachi on the left and the details of the context on the right.

2. Context of Study Area and the Physical Realities of Its Built Environment:

The city of Karachi is the major urban center and a mega city of Pakistan with a variety of natural resources. Karachi's coastline is more than 60 km long. Along the coastline there exists a natural resource known as the Mangroves Ecosystem. Along the beach of Sands Pit and Hawkes Bay at the western edge of Karachi, a Mangrove Forest is popular for nurturing precious marine species such as green turtles and other habitat that survives there. Just at the southeastern edge of these Mangrove forests there is a settlement known as Kakapir Village in Novanall Island. Basically in Novanall Island there are two settlements i.e. Younisabad and Kakapir Village and there is only one approach road to the Novanall Island which passes through salt ponds where the salt is extracted and sold. These saltpans have special significance with respect to biodiversity in the mangrove forest because the

area inhabits various vertebrate and invertebrate species. The settlement of Younisabad is located on the northeastern part of Novanall Island and Kakapir Village is located on southwestern part. Both settlements have varying characteristics. The major activity in Younisabad is boat manufacturing and there is a natural jetty where small boats are brought for repair and refueling. Younisabad health center is located at the edge of settlement which is the only health center for both the settlements and inadequate to cater the needs of the community. [Fig: 1]

3. Kakapir Village Profile:

3.1. Physical and Morphological Character:

The settlement of Kakapir village is a low rise medium density housing which is divided into two clusters. The main institutional buildings are located in northern cluster which include a mosque, primary school, police station and a commercial center. The southern cluster consists of a large jetty for fishing in the open sea. This jetty is used only for eight months a year whereas for four months it remains closed. The Mangrove forests of Kakapir village consist of one major species i.e. *Avicenna marina* which extends over 400 hectares. [Fig: 2]

3.2. Housing and Living Conditions:

A detailed survey was undertaken on the houses and their living condition in Kakapir village during 2003. (Dholandas, 2003) There are a total of 119 households in Kakapir village. Poor housing conditions are quite evident; for instance only 7.56% houses are constructed with

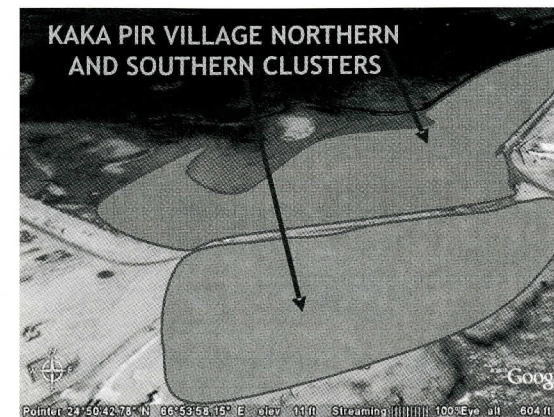


Fig. 2: The Physical Limits and Morphology of Kakapir Village

permanent materials i.e. RCC frame structure, whereas; 84.03% structures are of semi permanent materials i.e. load bearing block masonry with poor workmanship and remaining 8.41% are made up of temporary materials. The living conditions of the community is also worse i.e. 80% people live in one to two rooms house, with average family size of 8 persons per house, whereas; remaining 20% households live in three to four rooms house. The poor housing and living conditions clearly establish that the Kakapir village is a low income settlement.

3.3. Infrastructure:

A deprived condition of infrastructure is also quite evident in Kakapir village. There are numerous unpaved streets inside the village which always remain filthy with heaps of waste which show the absence of a proper solid waste management system. As a repercussion all the waste ultimately disposed in the Mangrove forests. Similarly the paved road connecting the village with rest of the city is seldom maintained. In Kakapir village many residents have access to electricity, however very few have any legal connection. Mostly they obtain electricity by illegal means through "Kunda System" from available power lines. The inadequacy of fresh water supply is another major problem of Kakapir Village. Though the water is supplied through pipelines, however; the piped water sup-

ply is available to only ten houses; whereas the remaining one hundred nine houses obtain water through community taps. The water supply through pipelines is also not regular. The water is supplied two hours a day and usually on alternate days. The other source of water supply is through commercial water tankers. The water supply through tankers is bought and stored in community water storage tanks twice a week. These water storage tanks were constructed in 1983 with the community contribution. Regarding sewerage disposal in Kakapir Village, there is no system of underground sewerage lines or its treatment. Instead, at surface sewerage drain pipes are made which discharge all the sewerage of this settlement into Mangrove forests. Most of the time these sewerage lines also get choked and the area get very filthy. These sewerage lines were laid by people themselves on self help basis. It shows that if the community is mobilized it may bring a better change in the context.

3.4. Socioeconomic Conditions of the Community:

The total population of Kakapir village community is more than 1000 persons mainly they are fishermen. The majority fishermen belong to *Sindhi* and *Lasi* ethnic group while few belong to *Jat* tribe with a consanguine family structure of 8 to 11 family members. Only 48% families send their children to school which shows that majority are illiterate and they require an input for education initiative. From these families 88% children study at primary level, 9% at secondary level and only 3% at graduation level. This reinforces the argument that an education initiative is quite necessary.

In Kakapir village majority are fishermen and belong to low income group (Refer table.1 and 2). The reason of this poverty is the 4 months off season for fishing whereas during off seasons people engage themselves in other occupations whereas; quite a few people possess a decent job in government service. As the community is at poverty threshold and lives near Mangrove forests so there is a great potential for commercial exploitation of the forest.

Table 1: Employment Areas					
Sector	Fishing	Government Service	Private Service	Night Watchmen	Labour / factory worker
%age of Households	70.6	4.2	10.9	12.7	1.6
Table 2: Income Levels					
Monthly Income PKR	1500-2500	2501-3500	3501-4500	4501 & above	
%age of Households	73.1	7.6	4.2	15.1	

Source: Questionnaire survey at Kakapir Village conducted by Saveeta Dholandas for her MA Sociology Thesis in 2003.

Table 1: Employment Areas

#### 4. Community Perception Regarding Mangrove Forests:

The socio-economic conditions of the community clearly indicated a potential threat to Mangrove forests, however; when the community was surveyed between June-August 2003 it designated a totally different perspective. For instance; 90% of the community perceived plants in sea or at land as necessary for human survival and only 10% persons has no perception about necessity of plants. It is also identified in house-to-house survey that, Mangroves Ecosystem is a major natural resource for the community. Because 97% community identified the significance of Mangrove forests in their life as a source of firewood for cooking, 1% as fodder for animals and only 2% says that Mangrove forests may be utilized as an income source by selling its wood. The community dependency on Mangrove forests may seem to be a very natural phenomenon because they are poor and had no alternate source for cooking like natural gas and especially because they live adjacent to it in close proximity. Regarding community perception about protective functions of Mangrove forests it is also found that, 89% of the community perceived that Mangrove forests can protect the coastline from erosion and 10% community perceived that 'Mangrove forests can protect the coastline from storms. This result indicates that majority community at Kakapir Village has traditional wisdom which they learned from their forefathers because majority is illiterate. Whereas; it was also evident that, 93% community had clear idea that Mangrove forests are breeding grounds for Prawns, Shrimps, Lobsters and other Fish species, however; 7% of the community had no idea about it. Thus these results clearly specify that being a fishermen community they had conventional knowledge about Mangroves. In house-to-house survey it is also identified that, 81% community perceived that, if Mangrove forests become less; then fishermen will be affected, whereas; 19% people have no perception regarding this notion. Hence it is quite evident that the community living at Kakapir village realizes the significance of Mangrove forests. It is also an amazing fact that community had the perception about the danger of overuse of Mangrove forests. The survey indicates that, 52% people believed that Mangrove forests have danger of overuse, whereas about affecting aspects to growth of Mangroves 87% community consider that cutting wood from Mangrove forests is affecting its growth; and only 13% believed that eating/grazing by animals is affecting its growth. Thus one can clearly ascertain that community living at Kakapir village perceives that Mangrove forests are more threatened by people who cut the wood from Mangroves than animals that eat/consume them. The survey also identified that, 53% community believed that Mangroves can be replanted, whereas 47%

have no concept about re-plantation. Regarding Mangroves replanting initiative at Kakapir Village the survey also acknowledged that, 60% of the community was willing to help in Mangroves replanting initiative, whereas; 40% refused to help in any such initiative. The analysis of general community responses clearly shows that, the majority of the community living at Kakapir Village have interest in the initiative of Mangroves re-plantation and would help in any such endeavor.

#### 5. Dependency of Community on Mangrove Forests:

With relation to dependency of Kakapir village community on Mangroves Ecosystem, the survey indicated that, 89% community is dependent on firewood as a source of cooking, 9% community depends upon cylinder gas and only 2% depends on kerosene oil as a source of cooking. Simultaneously from that 89% firewood dependent community only 2% obtain firewood by purchasing from the market and 98% obtains firewood by cutting the Mangrove forests. The survey also identified that all of the firewood dependent community is cutting only dry wood from Mangrove forests and none of them cut wet wood or leaves. The cutting dry wood is also simply for cooking and not for any other commercial purpose. The analysis also showed that from the entire community 25% men, 67% women and 8% children participate in cutting wood from Mangrove forests. This means the community chiefly depends upon women and children for cutting of wood.

#### 6. Destruction of Mangroves Ecosystem:

The analysis of house-to-house questionnaire survey and empirical documentation of the context, which was conducted during 2003, had clearly indicates that there are various threats to mangroves ecosystem at Kakapir village. [Fig: 3] For instance; the dependency of community for cutting firewood from Mangrove forests is the first and foremost threat which required intervention in the form of community awareness and provision of alternate source for cooking. Another major threat is the destruction of mangroves by domestic animals that use it as a fodder. The next major threat is the disposal of all the sewerage of the community living in Kakapir village in the Mangrove forests. This sewerage disposal affects the growth of mangroves because it increases the brackish water.

The other major threat is the natural jetty in northern cluster of Kakapir village which is used by fishermen for fishing within the Mangrove forests and for visitors to enjoy the forest. As the Mangrove forests are breeding grounds for various species there are strict restrictions for fishing in them. However; this intrusion and fishing in



Fig. 3: Threats to Mangroves Forest in the form of cutting firewood for cooking. This picture is taken in May 2003 by authors during empirical study of Mangroves Forest.

backwater may cause the reduction in the biodiversity. The next major threat to mangroves ecosystem are the beach huts that exist in between the Mangrove forests and the sea. (Refer fig. 1) This three kilometer strip of beach huts blocks the way of green turtles to sea and pose major threat to habitat in the Mangrove forests. The problem of these beach huts is complex. The land where these beach huts exist belongs to Karachi Port Trust (KPT) and the people who own these huts are quite influential and use these huts for recreational purposes. At the same time these huts are also an income generating source for the community of Kakapir village who work as watchmen in these huts. While the huts create employment for locals they are also a regular threat for the Mangrove forests. The fact that removal of these huts from the area is near to impossible is another problem.



#### 7. Interventions in the Context by 'WWF-P':

##### 7.1. Development of Wetland Center:

WWF-Pakistan was established in 1970 and works under the aegis of WWF-International based in Switzerland. WWF started work in Sindh province on Conservation of Nature since mid 90's. In order to protect and conserve the Mangrove forests, the World Wide Fund for Nature (WWF-Pakistan) decided to establish a Wetland Center within the forest in 1996 with funding from WWF-International. The Karachi Port Trust (KPT) had donated 500 square yards of land at Sands pit to WWF-Pakistan to establish the Wetland Center in the middle of the Mangrove forests opposite the turtle nesting beach. [Fig: 4] The construction of the Wetland Center took place from January 1999 and officially it was inaugurated in February 2001. This Wetland Center not only monitors the degradation of the Mangrove forests and its habitat but also tries to improve the existing conditions in the forest and in Kakapir village. Furthermore it also works for education and awareness regarding mangroves ecosystem and habitat.

##### 7.2. Development of a CBO and their Initiatives:

The second most important intervention of WWF-Pakistan in Kakapir village was the support in development of a community based organization (CBO) and awareness of the community about the significance of Mangroves Ecosystem. In this respect, community meetings were held in December 2003, at Kakapir Village and community decided to develop a CBO. In January 2004 the CBO came into existence which is then registered with the Social Welfare Wing Community Development Department City District Government Karachi in April 2005. With the establishment of a CBO the community was provided with a platform to identify their issues, discuss them and try to solve them on self help basis. The CBO formed three committees on environment, health

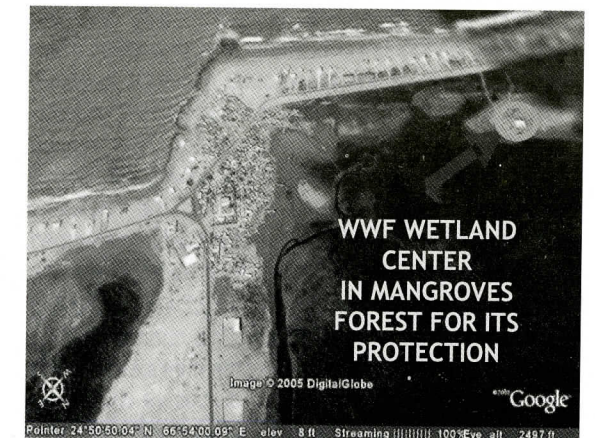


Figure # 4: WWF-PAKISTAN'S WETLAND CENTER IN MANGROVES FOREST

and education, respectively. Then a series of meetings were held by WWF with these committees to guide them to identify their roles and responsibilities. The Environment committee worked for controlling fishing in the Mangroves backwaters. The Health committee formed a one room health center where a paramedic works on volunteer basis and a doctor also visits on a regular basis from Younisabad to look after the community health center. The education committee supported the initiative of school for girls and motivated the community in this respect.

### 7.3. Incentive for Female Education:

Another significant intervention of WWF-P in the local context was the awareness and education campaign for community women regarding the Mangroves Ecosystem and its significance. Additionally an incentive was offered to the community to educate their girls and various trainings were conducted for women to learn about income-generation methods other than fishing. For that purpose a vocational training center was also developed in the Kakapir village. This vocational training center is empowering and training women to become economically self-sufficient. The skills imparted through this vocational center include sewing, embroidery and social forestry. A one room school was established for girls by voluntary contribution of a community member who gave a room in her house for the community. However, when the number of children increased it was shifted in a government primary school by taking their two rooms and hiring two teachers from the community.

### 7.4. Community Involvement in Mangroves Nursery Establishment:

The community women in Kakapir village were motivated to participate in the development of a nursery for re-plantation of Mangroves. For this matter financial incentives were offered to community and training workshops were conducted to involve the community. Once the community got trained in Mangroves plantations they motivated each other to work towards Mangroves protection. There were six stages of the Mangroves nursery's establishment in which the community has participated and contributed with hard work and enthusiasm. They include: Seed collection, Seed sorting, Seed sowing, Monitoring, Plant growth and Re-plantation. Once the realisation about the significance of mangroves ecosystem emerged, the community planted 30000 plants in just one month in June-July 2004. After the involvement of women the men were also motivated to participate in the nursery development and re-plantation. Especially the men's involvement in protection and re-plantation activities of Mangroves Ecosystem was really a big task that was achieved. Thus men, women and children of the community were all

involved in the protection and conservation of the Mangroves and all this happens because of community's own interest and involvement with the small efforts of a community mobiliser.

### 7.5. Development of Infrastructure:

Another intervention in the context was the involvement of formal sector through installation of gas pipelines and provision of Gas for cooking. The request for gas lines was made in June 2003 and the gas pipes laid by November 2004. The local Nazim and Sui Southern Gas Company (SSGC) were approached by CBO members. The WWF-Pakistan supported the community in this endeavor and provided them with all the technical support.

### 7.6. Training Regarding Solid Waste Management and Plantation:

A training regarding solid waste management was also held with the community so that awareness can be generated and people can be motivated to take care of this issue on a self help basis. Similarly the community is also trained for plantation of mangroves. Separate trainings were held for both males and females and now the community is totally aware regarding protection and conservation of the Mangroves ecosystem.

## 8. Conclusion:

Finally the lessons learned through the experience of Kakapir village community can be summarized as follows:

**8.1.** The hard work of WWF-P in the local context leads to a profound impact on the community in the form of awareness as well as a sense of belongingness towards a natural resource. Especially by setting up the wetland center, monitoring of the degradation in the Mangrove forests, helping in formation of a CBO, female education, mangroves nursery establishment, serving for development of infrastructure and the training of the community regarding solid waste management and plantation. All these labors of WWF-P diverted the community from destruction to edifice of the natural resource with minimized human interference.

**8.2.** The efforts towards the conservation of natural resources require an in-depth understanding of a community's legitimate needs and aspirations. As evident from the case of Kakapir village community where the empirical evidence shown that community is destroying the natural environment by cutting wood, whereas; it was utter need for survival because they required firewood only for cooking. There was no visual evidence available during the survey of Kakapir village that the community has consumed natural resources for dwelling purpose, however;

it is recommended that a detailed investigation should be carried out in this respect.

**8.3.** It's the inadequacy or unjust distribution of resources that lead to destruction of natural resources, whereas; in actual terms they required an alternate energy source like natural gas to cook their meals. But as its availability was denied to the poor villagers by the formal sector institutions so they were compelled to take firewood from Mangrove forests. Now as the alternate fuel is available the community is protecting the natural resources.

**8.4.** Each community possesses a traditional wisdom regarding protection of environment and its just little pains and humble efforts required to revive their wisdom by carefully listening and understanding their problems and issues and to solve them with the involvement of the community. As a repercussion the community may do wonders and start working on self help basis for the betterment and protection of natural resources. Then they work as watchdogs to stop any misuse to occur in their natural resources.

**8.5.** In traditional societies like Kakapir village community women play a pivotal role and community is dependent on women participation for development as well as for survival. Without involving the females of the community successful natural resource conservation is also not possible. As established through Kakapir case studies that when women were involved and motivated to participate in CBO formation, education program and nursery establishment they motivated their men to participate in these endeavors. As a result whole community worked together for Mangroves re-plantation.

**8.6.** The role and responsibility of formal sector is very crucial and instrumental in protection of natural resources. As evident in Kakapir village in the form of natural gas supply lines laid for the community which results in reduction of cutting firewood from Mangrove forests.

**8.7.** The elites and influential people of the society shall always remain an unavoidable threat to the growth and development of the natural resource its protection and conservation. As evident in the case study that the beach huts on 3km long critical strip in between the Mangrove forests and the sea that hinders the pathway of turtles to the beach may never be removed and there is no mechanism yet established to influence the influential elites.

Thus finally it is recommended that, "A balance should be maintained between development and natural resource management otherwise destruction is inevitable."

## Glossary of Local Terms Used In the Paper:

**Community** referred in the paper used for the community of Kakapir Village

**Context** means the physical setting, framework or milieu  
**Development** means physical, social and economic growth of the community.

**Formal Sector** means public and private sector institutions working under the framework of Government.

**Informal Sector** means people and organizations neither working under the framework of Government nor recognised by the Government.

**Interventions** mean initiatives of community Based Organisations (CBO's) and NGO's in the context.

**Natural Resources** mean Mangroves Ecosystem.

**Kunda System** is basically a local phrase which means a system of illegal electric connections develops informally by people themselves through the help and support of informal electric suppliers.

**Sindhi, Lasi and Jat** is the names of ethnic groups of Kakapir village.

**Nazim** means Mayor.

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<http://www.wfpak.org/>  
<http://www.wfpak.org/wetlandcentre.php>  
The satellite images are taken from freely accessible demo version of [www.google.earth.com](http://www.google.earth.com)

## Workshop on Research in Architecture

Department of Architecture,  
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.  
January 27, 2007

A day-long workshop on Research in Architecture was organised by the Department of Architecture, Bangladesh University of Engineering and Technology, on January 27, 2007. The Workshop, the first of its kind to be held in Bangladesh, was inaugurated by the Vice Chancellor, BUET, Prof. Dr. M.M. Safiullah, in an opening session, chaired by the Head, Department of Architecture, Prof. Dr. Nizamuddin Ahmed.

Recognising that research questions pertinent to architecture are inherent in many day-to-day situations, the Workshop aimed to instill in the participants an understanding of the importance of research, both in the academic pursuit of architecture, as well as in its practice. The objective of the Workshop, was to address these questions that are seen to challenge present-day practices, and demand settlement for achieving wholesome, appropriate and contextual architecture. Application of such research, it is strongly believed, can enrich architecture to help fulfill the social responsibilities of Architects and to improve overall impact and performance of the built environment.

The Workshop attended by a full-house of 30 participants, among whom were practicing architects, aspirant and enrolled M.Arch students, as well as fourth and fifth year undergraduate students of Architecture. The Workshop Instructors, Prof. Dr. Zebun Nasreen Ahmed, Dr. Farida Nilufar, Dr K. Shabbir Ahmed and Dr. Shayer Ghafur, divided the sessions into three distinct modules; Introduction to Research (Module A), State of the Art Research in Architecture (Module B) and Exploring Research Problems (Module C).

The first Module, conducted by Dr. Ghafur and Dr. Z.N Ahmed, gave an introduction to research in architecture by sequential discussion of key concepts of research, research problems, research methodology, discussing briefly the scientific method, before expanding on architecture and research methods pertinent to its pursuit. Module A further addressed the need for research in Architecture, on research methodology pertinent in architecture and on the need to create focus in framing research questions. The factual problem existing in architecture, and the urgent need for a reliable theoretical basis in its practice, was highlighted. The discussions explaining types of resources for architecture research,

ways of gathering data, organising resources and analytic methods available for architecture research, led to the process of identifying research problems, with interactive participation of workshop participants.

In Module B, research applications were highlighted by the Instructors, in two separate fields; environmental issues and architectural morphology studies. Dr. K.S. Ahmed expounded on the state of the art research on architecture and the environment, showing examples of international and national efforts in this vast field, focussing also on the applications of such research. Dr. F. Nilufar continued the discussion into research in the field of architectural morphology, explaining ways in which such research evolved and its applications in enhancing understanding of space-human responses.

The purpose of Module C was to give the participants a glimpse of research problems existing in everyday situations, and to demonstrate the way the problems are approached to produce different research questions. During this last session, the participants were divided into four groups, two consisting of Architects, two of undergraduate students, and a practical scenario was described from which each group, engaging their understandings of the preceding Modules A and B were to formulate an identified research problem from the set field. Each group was assigned one of the Workshop Instructors as facilitator.

For this exercise, the groups were presented with a series of advertisements for urban real estate development. The examples (taken for academic purposes only) were those commonly advertised in newspapers and the four groups after lively and heated discussions responded with varied research questions, displaying that different perspectives nurture different lines of enquiry.

In a concluding session the Workshop participants presented their identified research problem, stating the research objectives and rationale behind selection, and also the methodology to be employed for the research and modes of analysis. Each presentation was to conclude with stating ways in which the group envisages applicability of the outcomes of the identified research. In the concluding session of the Workshop, the President of the Institute of Architects, Bangladesh (IAB) Ar.

Mobashher Hussain was present as special guest and the four Workshop groups presented their research questions in presentations of ten minutes each. The identified research titles are as follows:

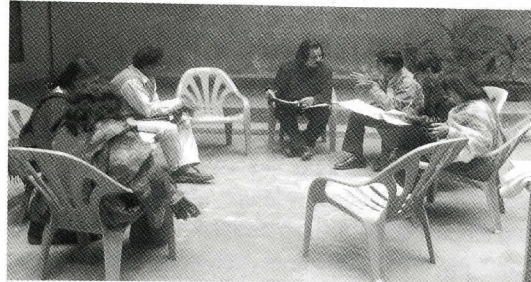


Group discussions

**Group 1:** Feasibility study of FAR (Floor:Area Ratio) in the context of open spaces for high rise apartment buildings in private sector developments

The objective of this group was to give a guideline for future development in high rise apartment buildings in terms of open spaces through FAR

**Group2:** Satellite City: a friend or a foe ?



Group discussion

The stated rationale for this investigation was that the concept of satellite city/town is a growing trend for Dhaka. If not analyzed and researched, it can give rise to environmental problems.

**Group 3:** Impact of "Model Towns" on the Sustainability of a Mega City

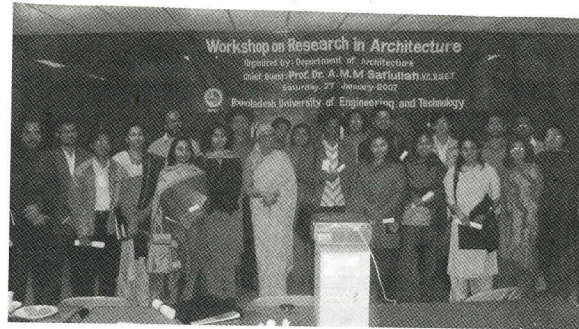
This group stressed the need of assessment of communities in terms of sustainability and to identify the threats that challenge this notion. The research aimed at evaluating infrastructure development in model towns as they relate to the mega city.



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**Group 4:** Study of Community Life in Multi-storied Real Estate Housing in Dhaka

Recognizing that absence of social interaction in real estate development (in the urban context) does not promote community life, this group aimed to investigate the nature and extent of social interaction among the people living in multi-storied real estate buildings in Dhaka city.



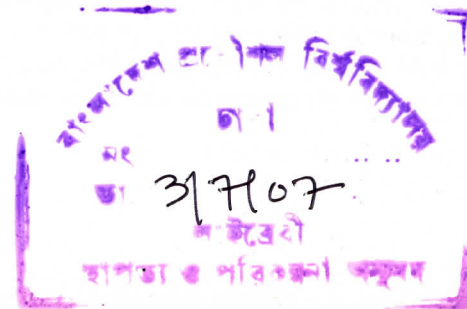
Participants of the Workshop

In general the multiple approaches to the set context by the different Workshop groups demonstrated how research questions vary depending on angle of investigation and focus. The Workshop on Research in Architecture concluded with comments from the President, IAB, the Head of the Department of Architecture, BUET and the Convenor of the Workshop, while the participants expressed their interest in furthering such workshop initiatives with longer workshop hours.

Prof. Dr. Zebun Nasreen Ahmed,

Convenor,  
Workshop on Research in Architecture  
Organized by :  
Department of Architecture,  
Bangladesh University of Engineering and Technology,  
Dhaka,  
Bangladesh.

January 27, 2007



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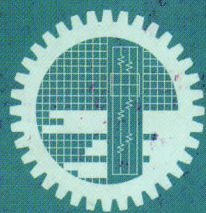
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