

Investigating the Current Features of Sustainable Buildings in Bangladesh

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Abstract: In the era of rapid urbanization and climate change, the adoption of sustainable buildings is a crucial issue. Sustainable buildings can play a mentionable role in mitigating urban heat island effect, increasing energy efficiency, and enhancing the health and productivity of the occupants. Taking the buildings of the University of Liberal Arts Bangladesh as examples, this study analyzed the major features of the sustainable buildings in Bangladesh. Sustainability features of the buildings like site environment, use of natural daylight, natural ventilation, use of climate sensitive construction materials, green roof, air quality, and noise level were examined through onsite field visit. Results indicate buildings' varying degree of compliances with the sustainable building characteristics. Furthermore, major challenges and opportunities of promoting sustainable building throughout the country were also identified from the findings of key informant interviews. Some measures regarding the adoption and promotion of sustainable buildings are also suggested to attain further benefits of the building users.

Keywords: climate change, sustainable building, climate sensitive design, energy efficiency, Bangladesh

1. INTRODUCTION

Over the last century, the world is becoming predominantly urban (UN-Habitat, 2013). Considering the rapid growth of urban population, the global built-up area is also expected to be increased proportionately (World Bank, 2010). The urban texture in Bangladesh is characterized by high density building blocks without the provision of open space and greenery. These buildings are deprived of natural ventilation and lighting provisions and affect the thermal comfort (Haider & Ahmed, 2016). Almost 32% of the primary energy is consumed by these commercial and residential building blocks for operation (Deng, Wang, & Dai, 2014). Furthermore, due to rapid population growth, industrialization, expansion in grid connection and increase in the use of electrical appliances energy demand is growing at over 10% per year. The energy supply of the country is largely dependent on natural gas (over 72%). It is anticipated that the gas supply will reach its peak in 2018 and gradually decrease thereafter as proven reserve of gas is depleting progressively and thereby lead to energy crisis in near future (SREDA & Power Division, 2015; GOB, 2015).

In these circumstances, a comprehensive study is required on sustainable buildings considering a reasonable solution to global warming, environmental degradation, and energy security. Apart from climatic considerations, the intended use of a given building contributes a significant role in the design of energy-efficient buildings whether it is an office building, school, recreational facility or industrial building (Bauer, Möhle, & Schwarz, 2010). Sustainable design seeks not only to reduce negative impacts on the environment but also to preserve the health and comfort of building occupants, thereby improving building performance (Deng, Wang, & Dai, 2014). This study, therefore, aims to examine the key features of sustainable buildings and identify major challenges and prospects of sustainable buildings in Bangladesh. We ask that authors follow some simple guidelines. This document is a template. An electronic copy can be downloaded from the journal website. For questions on paper guidelines, please

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2. METHODS

Initially, relevant literatures were reviewed on the research topic, especially for conceptual understanding and gathering updated ideas and information on sustainable buildings, key features of sustainable buildings, environmental conservation implication of sustainable buildings etc.

Literature review was done on different types of sustainable buildings e.g. industrial, institutional, and residential. A checklist was prepared to check the features of sustainable buildings based on literature review. Among the elements of sustainable infrastructure, site and its environment, energy efficiency, water efficiency, material efficiency and waste reduction, and indoor air quality were prioritized in the checklist. Then field visit was conducted to identify the major features of selected sustainable buildings through checklist. The buildings of University of Liberal Arts Bangladesh (ULAB), Dhaka were selected for this study.

Key Informant Interview (KII) was carried out with the concerned person of sustainable buildings, architect, planners, and environmental expert to identify the major challenges and opportunities of sustainable buildings in Bangladesh.

3. RESULTS AND DISCUSSION

3.1 Profile of the Study Area

For this study, the buildings of University of Liberal Arts Bangladesh (ULAB), Dhaka have been selected (Figure 1 & 2). There are three buildings in the Mohammadpur campus of ULAB (Figure 3, 4, & 5). Sustainable features of these buildings have been identified and analyzed. Among the buildings, Building 2 and Building 3 were constructed earlier than Building 1. Building 1 has four floors, where half of the

4th floor has been kept as an open roof space. The other two buildings are four stories and smaller in size than Building 1.

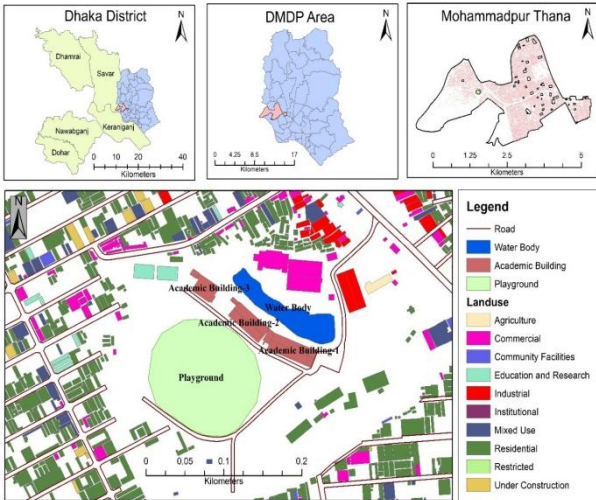


Figure. 1 Location Map of the Study Area



Figure. 2 University of Liberal Arts, Bangladesh



Figure. 3 Building 1, ULAB



Figure. 5 Building 3, ULAB

3.2 Major Features of Sustainable Building in Bangladesh

The recently completed (2020) new campus building (6206 sq m) for the University of Liberal Arts Bangladesh (ULAB) in Dhaka was designed by Kashef Chowdhury and his Dhaka based studio URBANA. He designed a number of climate-sensitive buildings in the deltaic landscape of Bangladesh and had already attracted international attention among others with the award-winning Friendship Centre in Gaibandha (Aga Khan Award 2016) and the Friendship Hospital in Sathkhira (RIBA International Prize 2021) (ArchDaily, 2022).

One of the striking features of the ULAB Building 1 is its high porosity and a wealth of un-programmed spaces (Figure 6, 7, & 8). In a hot and humid climate that has made the permeable building type of the bungalow a fundamental element of the building, spatial openness is always welcome to facilitate natural cross-ventilation. Thus, air circulation of the building is being augmented.

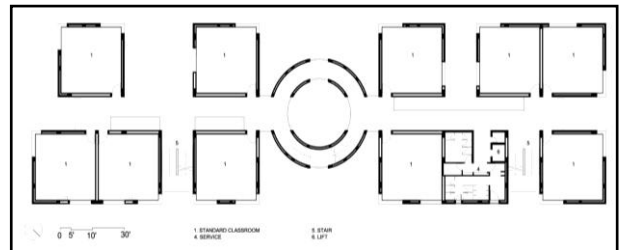


Figure. 6 Plan of Building 1, ULAB



Figure. 4 Building 2, ULAB



Figure. 7 Front View of Building 1, ULAB

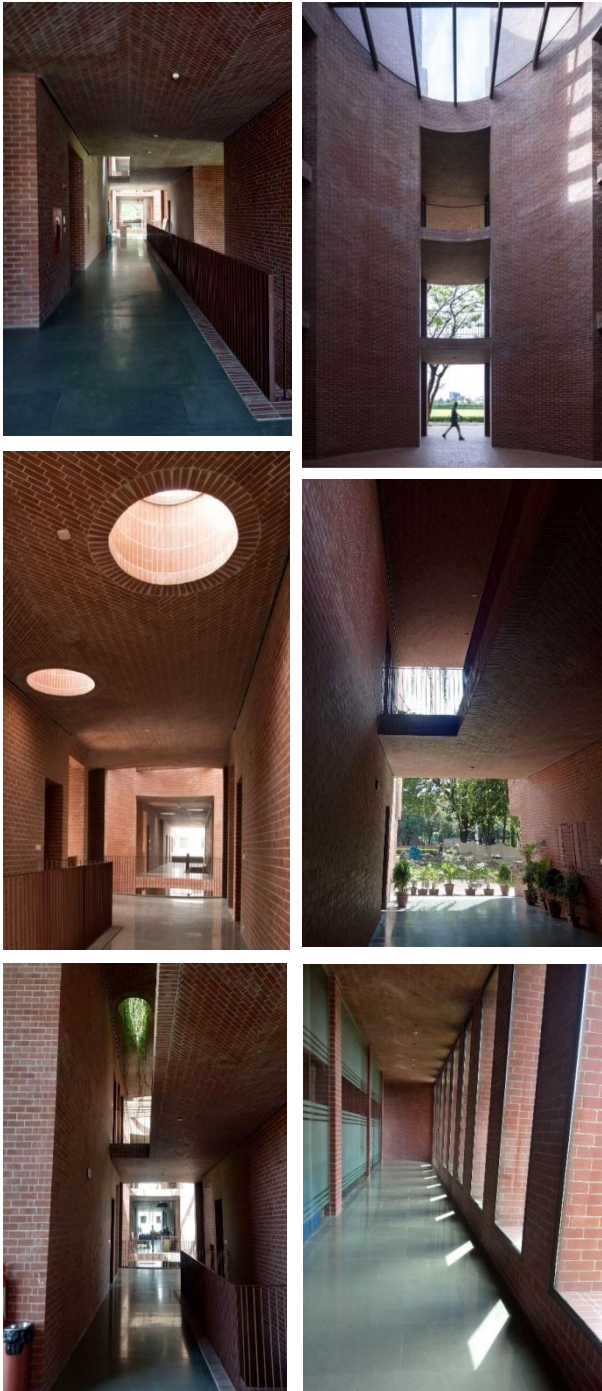


Figure. 8 Porosity of Building 1, ULAB

The linear basic disposition of the new building is kept simple and pragmatic, in accordance with the restricted budget and especially with the narrow site between a canal and a row of large spread trees. An articulated cooling effects from the tree shade and water feature is being expected for the building (Figure 9 & 10). By stacking the extensive building program vertically, the tall shading trees could be kept. Although the volume is compact, its sophisticated distribution of mass and emptiness reveals a spatial wealth that goes beyond all hermetic.



Figure. 9 Building 1 Shaded by Trees



Figure. 10 Lake Adjacent to Building 1

Apart from its spatial porosity that increases natural ventilation and illumination, also the construction of the building comes up with a set of innovative measures. The entire building, including the ceilings, is made of locally produced ceramic bricks (Figure 11). The walls are thick cavity walls that reduce thermal conductivity and the windows of the teaching wings are proportioned in a balanced way, taking into account the reduction of solar heat gain. Besides plants (Figure 12) have been placed in the porous spaces of Building 1. These features will certainly ensure the indoor thermal comfort as well as reduce energy consumption.



Figure 11. Use of Local Materials

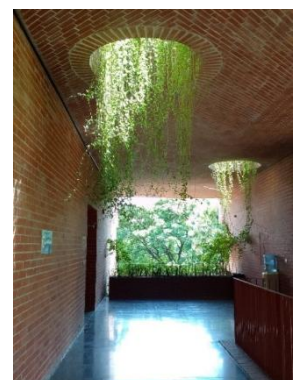


Figure 12. Usage of Plants (Cont.)



Figure. 12 Usage of Plants

Natural daylight has been exploited to reduce dependency on artificial lighting (Figure 13). Circular skylights in the deep circulation zones provide additional lighting and allow hot air to escape upwards. The roof is covered with a thermal mass of earth and green which also has a positive effect on the internal thermal environment and comfort (Figure 14). The plants that hang down from the roof and penetrate the circular skylights like green lampshades are as much an integral part of the building as the screens of overflowing greenery that protect stairways and semi-open gathering areas from driving rain. The green shimmering in the dimmed light contrasts with the bright red of the brick and immerses the building in a cheerful stimulating atmosphere. Besides, the presence of green spaces within and outside of building area had a notable role in decreasing run off loads.

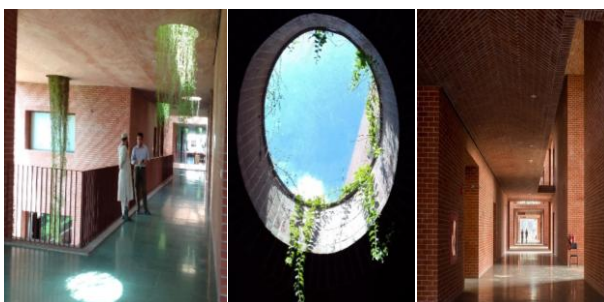


Figure. 13 Exploitation of Natural Daylight



Figure. 14 Green Roof, Building 1, ULAB

A balancing act between compactness and porosity has been achieved through the design of ULAB Building 1. The open and permeable effect of the building, despite tight local and financial constraints, shows that pragmatism and poetry can co-exist when it comes to creating sustainable educational buildings. It also demonstrates a contemporary intertwining with Bengal's building history and its wonderful brick tradition. In the river landscape of the delta, in a country without natural stone deposits, everything seems to float. Brick, extracted locally from the moist soil brought in by seasonal floods, has always been the appropriate material to create identity, durability, and permanence. The building looks back into the future, so to speak. Furthermore, the site location along with its surrounding land use and infrastructural development created an opportunity to be less exposed to a considerable level of noise pollution.

The other two buildings (Building 2 and 3) of the ULAB campus possessed relative very low compliance with the features of a standard sustainable building. These two buildings were constructed at an earlier stage of the university establishment when the concept of sustainable building was not so highlighted. Therefore, features like usage of natural ventilation, light, green roof, construction of external wall, sustainable construction materials were not incorporated adequately in those buildings.



Figure. 15 Green Space around Building 2 & 3, ULAB



Figure. 16 Outdoor Green Space in ULAB Campus

However, green spaces created outside of those building provide a soothing feeling with nature (Figure 15). The overall green spaces seem sufficient as well as well-organized within the ULAB campus boundary which can provide better air quality to the users (Figure 16). Waste management system also looks impressive with adequate firefighting measures. Overall noise level of the ULAB campus found acceptable to the users in the campus.

3.3 Opportunities and Challenges of Sustainable Building

The concept of sustainable building is now becoming a critical issue in the era of climate change. In Bangladesh, the opportunities to promote sustainable building is also wide. Traditional vernacular architecture has been practiced from the ancient period in this country. Besides, building orientation considering sun path and wind direction is also been taken into account. Locally available construction materials are found climate sensitive. Integration of solar panel and rainwater harvesting system are now widely found throughout the country. The practice of roof top gardening and the usage of indoor plants have been looked emerging. The promotion of sustainable buildings will contribute in the reduction of carbon emission, mitigation of urban heat island impact, increase energy efficiency as well as enhance indoor environment for the occupants.

Despite such opportunities, there are enormous challenges to promote sustainable buildings. In case of promoting sustainable building, cost is a major challenging issue. The initial cost of sustainable building is relatively higher. There is misperception on the cost and space utilization of the sustainable building among the clients. A major portion of the clients considered these issues like a wastage of money and space. Surrounding land use and infrastructure is another critical issue. In many cases, the maximum benefits of a sustainable building cannot be achieved properly due to incompatible adjacent land use and infrastructure. The elements of sustainable building like site and its environment, energy efficiency, water efficiency, material efficiency and waste reduction, indoor air quality, and thermal comfort are not integrated in the national building code. There is shortage of skilled professionals in the sector of sustainable buildings in Bangladesh. Lacking in research on various aspects of sustainable buildings is another challenging issue for Bangladesh.

4. CONCLUSION

In the era of climate change and environmental concern, the concept of sustainable building is critical for Bangladesh. This study, taking the buildings of the University of Liberal Arts Bangladesh, Dhaka as examples, examine the features of sustainable buildings. Results indicate the site environment, use of natural daylight, adequate air circulation through cross ventilation, use of climate sensitive construction materials, green roof, air quality, and noise level of one selected building is better. The other two buildings suffer from inadequate ventilation, energy efficiency, and indoor environment. Mass awareness among the building users, real estate developers, construction agencies, integration of the sustainable building elements into the national building codes, development of skilled professionals such as planners, architects, engineers, rigorous research on façade design, and construction materials are essential to promote sustainable buildings in Bangladesh. Promotion of sustainable buildings is critical in enhancing energy efficiency, mitigation of urban heat island impact, and upgrading indoor environment for the occupants as well.

5. ACKNOWLEDGMENTS

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