Ecological Architecture with Vernacular Character:
Contemporary Mud Architecture Practices in Bangladesh

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ABSTRACT

The vernacular construction technique of mud architecture in Bangladesh has been in practice for a long time and forms a major part of rural buildings. However, a lack of formal practice and patronage has allowed the vernacular techniques to be neglected. Thus the indigenous architecture appears as incompatible with mainstream development and modern knowledge. Therefore, support is necessary to sustain vernacular mud architecture. This paper examines an internationally awarded case study where modern knowledge and ecological building techniques have been initiated as an inter-cultural initiative of mud architecture to improve the current situation. This paper intends to critically investigate how far those initiatives are in line with traditional vernacular architecture. Findings show that modern knowledge and eco-friendly materials in combination with vernacular practices if used in a comprehensive way can pursue an "Ecological Architecture with Vernacular Character" which contains people's aspiration and at the same time looks after the earth.

Key words: *Vernacular architecture, Mud house, Mud Architecture, Ecological Technique, Building material.*

1. INTRODUCTION

In Bangladesh rural architecture has adhered to a tradition of using locally available materials such as mud and bamboo for centuries. It has been found that old mud houses have been sustained for 150-200 years (Doza & Razzaque, 2008). Local masons and construction workers largely built vernacular architecture in rural Bangladesh, communicating design decisions verbally. Despite not being the designed product of a professional, such buildings continue to meet the needs of a great mass of population. In that sense, and being such a significant part of the built environment, such buildings represented a fundamental form of architecture that had evolved according to context-specific characteristics, resources and indigenous techniques. Today in Bangladesh lack of practice

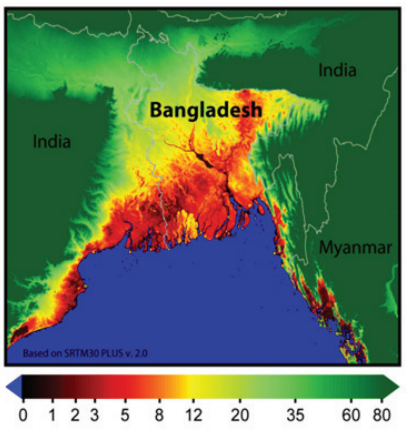
and patronage have allowed these techniques to be neglected (Haq, S., 1994, p.70). From the late nineteenth century, rural architecture began to change both structurally and in the use of materials. The cases studied in this paper are handmade mud architecture of Northern Bangladesh. One is a pure vernacular one, and another done by an NGO 'Base habitat', where inter-cultural knowledge was initiated to enrich the local living environment. Here, although traditional means of construction and local materials were used, the conventional techniques were further improved with the combination of modern knowledge. Several initiatives have occurred to help people to construct durable and comfortable shelter especially for mud walled structures. The intention of this paper is to critically investigate how far the contemporary modern practices are in line with traditional vernacular mud architecture of Bangladesh.

2. BANGLADESH: AN OVERVIEW

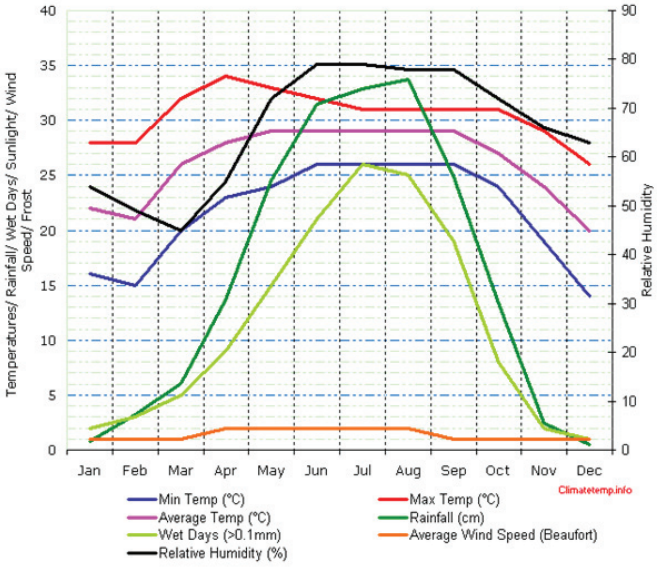
Situated on a low-lying alluvial delta, surrounded by India and Myanmar, Bangladesh is composed of hundreds of rivers. The topographical height above sea level (Figure: 1(a)) is very low. As a result flooding has become a common phenomenon during monsoon. Currently about 71 % people are rural residents (according to World Bank Report 2011). This agro-economy based country is among the most populous in the world, accommodating nearly 160 million people where density is more than 1,000 per square kilometer. Regional climatic differences in this flat country are minor. January is the coolest month with temperatures averaging near 26 deg C (78 d F) and April is the warmest with temperatures from 33 to 36 deg C (91 to 96 deg F) (Figure: 1(b))

3. TRADITIONAL VERNACULAR ARCHITECTURE IN BANGLADESH

Generally the word 'vernacular' refers to an indigenous type of building that is largely untutored in the conventional way of thinking, but which is thought to be of significant quality. Rapoport classified vernacular as part of folk tradition: *"The folk tradition, on the one hand, is the direct . . . translation into physical form of a culture, its needs and values - as well as the desires dreams and passions…. The folk tradition is much more closely related to the culture of the majority and life as it is really lived"* (1969, p.2). According to Turan, vernacular architecture is, "a practical activity pursuing environmental adequacy rather than knowledge; it is a way of acting within the conditions of existence, fulfilling



(a)



(b)

Figure 1:
(a) Height above Sea Level (m); Source: global warming art
(b) Bangladesh Climate Graph (Altitude 9m); Source: Bangladesh climatetemp

Kutcha House *Semi-Pucca House* *Pucca House*

Figure 2:
Traditional House form typologies, Source : ADPC, 2005 , p.3

certain environmental needs for a particular group of people. It is not an isolated phenomenon in society but rather is a total attitude or comprehensive way of environmental response. It is an action taken primarily from necessity, not necessarily from want. In brief, it is *environmental praxis,* it is an action in which people change and restructure nature through cognitive and social activity" (1990).

In Bangladeshi villages, life has always been slow, broken only by changes of season, celebrations of the life cycle, or calamities (Haq,1994, p.63). The tropical monsoon-type climate, with a hot and rainy summer and a dry winter has shaped the traditional vernacular architecture indigenous character. Locally available materials, low-cost, and easy labor has led to the choice of material during building construction. The lack of construction skills had resulted in poor structures making most of the rural shelters less durable and vulnerable to annual natural disasters.

3.1 Traditional House form typologies

Generally the traditional house forms can be seen in the form of mud house, bamboo house, timber house or stilt house. Depending on the use of locally available materials the traditional houses are generally divided in to three types-

1. Kutcha House (Raw building)
2. Semi-Pucca House (Semi –structured building)
3. Pucca House (Structured building)

3.2 Traditional Building materials:

Historically, bamboo had been the most important building material for housing in Bangladesh (Khan, 2006). Even today bamboo is widely used as in the past. Bamboo is still good in making the pillars or crossbars to support roofs and as fences or partitions for rooms. Other materials used in rural areas for making fences for rooms or houses include cane, jute sticks, corrugated iron (CI) sheets, wood and mud or mud bricks.

The house forms, building styles and materials used in construction vary significantly in different areas of Bangladesh. Archeological excavations revealed that houses in almost all of the small townships in ancient Bengal (i.e. Bangladesh) were built with mud bricks. Even today their existence is being found in different dimensions and shapes. Although many elevated places of Bangladesh have evidence of mud walled houses, this has been featured mostly in the districts of the northern part of Bangladesh especially in Rajshahi division.

Structurally there are three parts of a typical house form -Foundation, Walls and Roof. A brief description of it is given next page.

Table 1: Building construction techniques and materials of the traditional house forms:

	Kutcha House	Semi-Pucca House	Pucca House
Foundation	Earthen plinth with bamboo (sometimes timber) posts.	Earthen plinth; brick perimeter wall with earth infill.	Brick and concrete.
Walls	Organic materials – jute-stick, catkin grass, straw, bamboo mats, etc. Split bamboo framing. Earthen walls in some areas.	Bamboo mats; CI (corrugated iron) sheet; Timber (sometimes split bamboo) framing. Earthen walls in some areas. Sometimes part or full brick.	Brick.
Roof	Thatch - rice or wheat or maize straw, catkin grass, etc with split bamboo or sometimes reed stalk framing.	CI sheet with timber framing (sometimes split bamboo).	Reinforced concrete (RC).

Source : ADPC,2005, Chapter 1, p.3.

4. MUD ARCHITECTURE IN BANGLADESH:

Historically, Bangladesh was divided into six divisional states; among those, the northern part, which is known as North Bengal, was famous as the ancient capital of Gaur (Sandy & Ahmed, 1984) named Pundrabardhan or Pundranagar around 1500-2000 years ago. As the Gaur or north Bengal is relatively elevated in comparison to other parts of Bangladesh, flooding is less in this particular region (Doza & Razzaque, 2008,p.5). Mud architecture of North Bengal had developed a vernacular style having a harmonious relationship with nature and people. In this region, soil is comparatively stable and strong, so construction of two storied mud structure is a common phenomenon (ibid.). The cases which are studied in this paper belong to this part of the country.

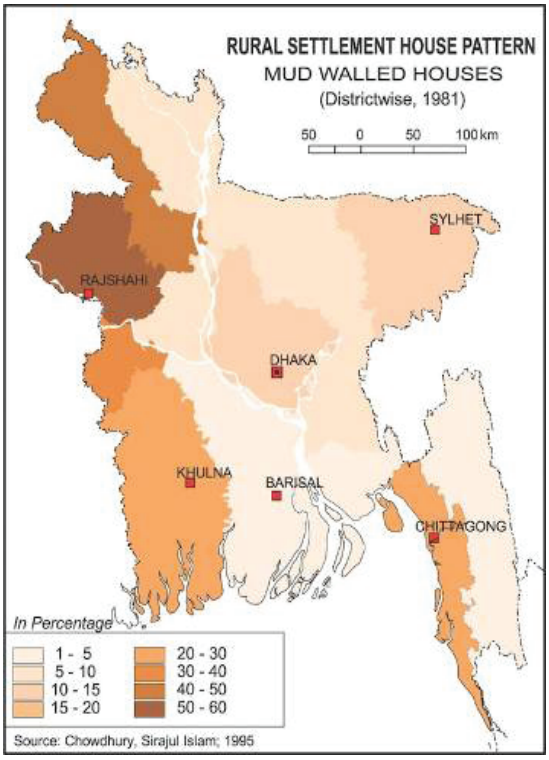


Figure 3:
Locational priority of Mud Walled Houses in Bangladesh.
Source : Chowdhury 1995, Banglapedia 2006.

4.1 Building Configuration

Mud buildings are generally rectangular in plan between 20-30 ft long and between 10-15 ft wide. The mud walls are the main structural elements which carry the load of the roofing. Many houses have open front verandas with a roof supported by posts. The opening area is about 30 % of the total wall area (Das et.al, 2007). A wooden plank is provided over the opening of doors less than the wall height with 6" of support on both sides. Doorframes are provided afterwards.

Figure 4:
Typical building with thatch roof, tin roof, CI sheet roof supported by wooden purloins and a Two-storied mud house in Muktagacha, Mymensingh , Source : Asraful Alam 2006, Firoza Akter,2007 in Das et.al, 2007 .

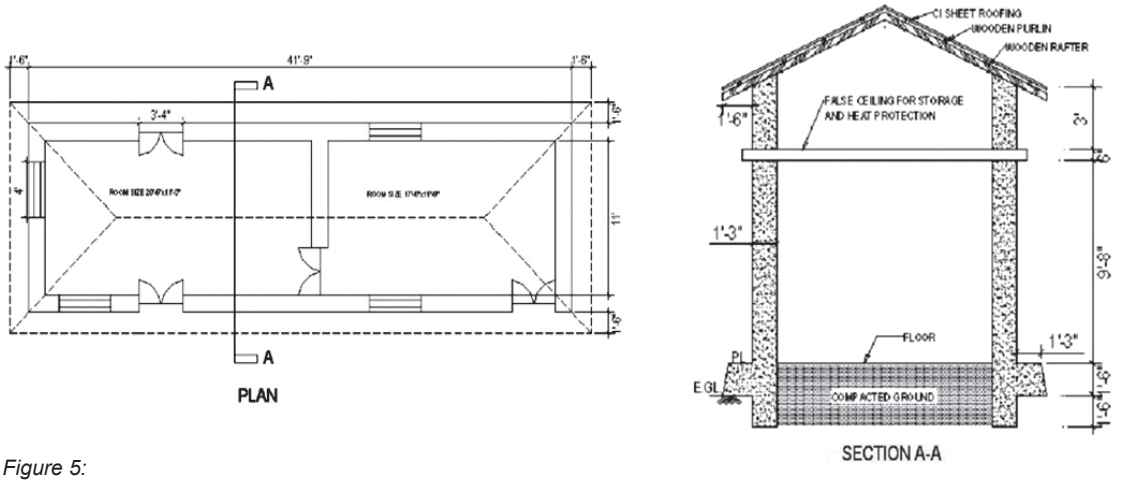


Figure 5:
Typical building dimension. Source : Das et.al, 2007.

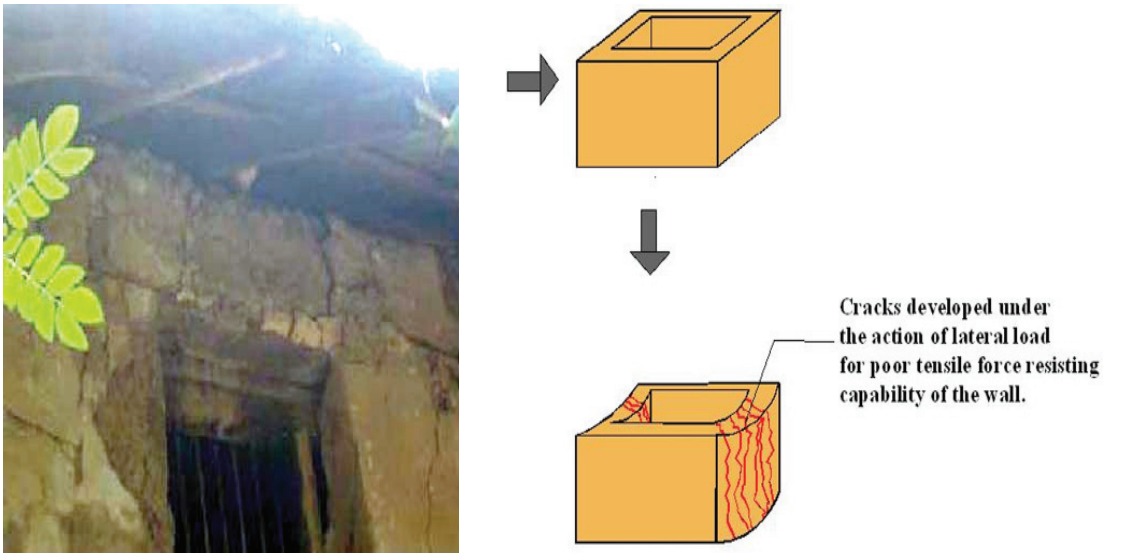


Figure 6:
Cracking pattern of mud wall due to lateral load,
Source : Rebeka Ahsan in Das et.al, 2007.

4.2 Typical Problem of Mud Buildings Structures

Mud building in Bangladesh is typically one or two stories high, and mostly used for single-family housing. It is more predominant in less flood-prone areas. This type of building is highly vulnerable to both seismic forces and pressure if there is high level of rainfall or flood flow.

The main load bearing system consists of mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. There is no monolithic joint between the wall and the roof. Due to this reason, mud buildings behave poorly under any type of lateral load from earthquakes, wind or floods. Clay tiles, thatch or CI sheets are used as roofing materials, as discussed earlier.

4.3 Building cost

The gross national income of Bangladeshi people is 394 US-$/year. The construction costs of such mud buildings is about 1000-1500 USD for a building of 1000 square feet. So, per square feet cost is 1 to 1.50 USD, i.e 123 BDT (Das, et.al 2007).

4.4 An Unique Example of Vernacular Mud Architecture: 'Do Mahela'

'Do Mahela', a generic type of two storied mud architecture in North Bengal located in 'Tanore' upozilla, 20 km away from Rajshahi city (Doza & Razzaque, 2008). The local economy is based on agriculture, which has become a strength for the people. An interesting feature of this area is the traditional attachment of the people with their ancestor's values and prevailing myths which has influenced the two storied mud house construction technique as well. (Figure 7)

Design: Do Mahela is an introvert form developed on the basis of local context and family needs. The plan indicates a regular geometry, which is approximately square in shape. The internal organization of the house is focused on the courtyard. It has been observed that west side is dedicated to the services such as kitchen, store, cow shade and toilets. And the south side is dedicated to the bed rooms to have the southern breeze.

The formal elements of the house with local terminologies and their corresponding functions are as follows:

a. Aksaali- Pre Function Space Or Foyer
b. Bahir Pash – Courtyard
c. Kua Tola – Well Shaft Room
d. Heshel – The Main Kitchen
e. Dining
f. Goola Ghar – Granary And Store
g. Chowki – Bath Space
h. Dhaap – Wooden Single Flight At The Verandah
i. Pira Sajanee – A Common Gallery And Cantilevered Verandah

Construction method: First of all, the ground is excavated down about 2.5 feet for a 48 inch foundation. For construction, earth is prepared by mixing of straw, dry leafs, paddy chip with dust and jute. Then the mix of mud is well rammed to gain strength and well bonding. The wall is constructed vertically about 4 feet high at a time and then shortened about 6 inches on both sides in order to avoid lateral pressure. The outer wall is 22 feet high and the upper side thickness is 12 inches. Wooden planks and bamboo are tied with ropes and then

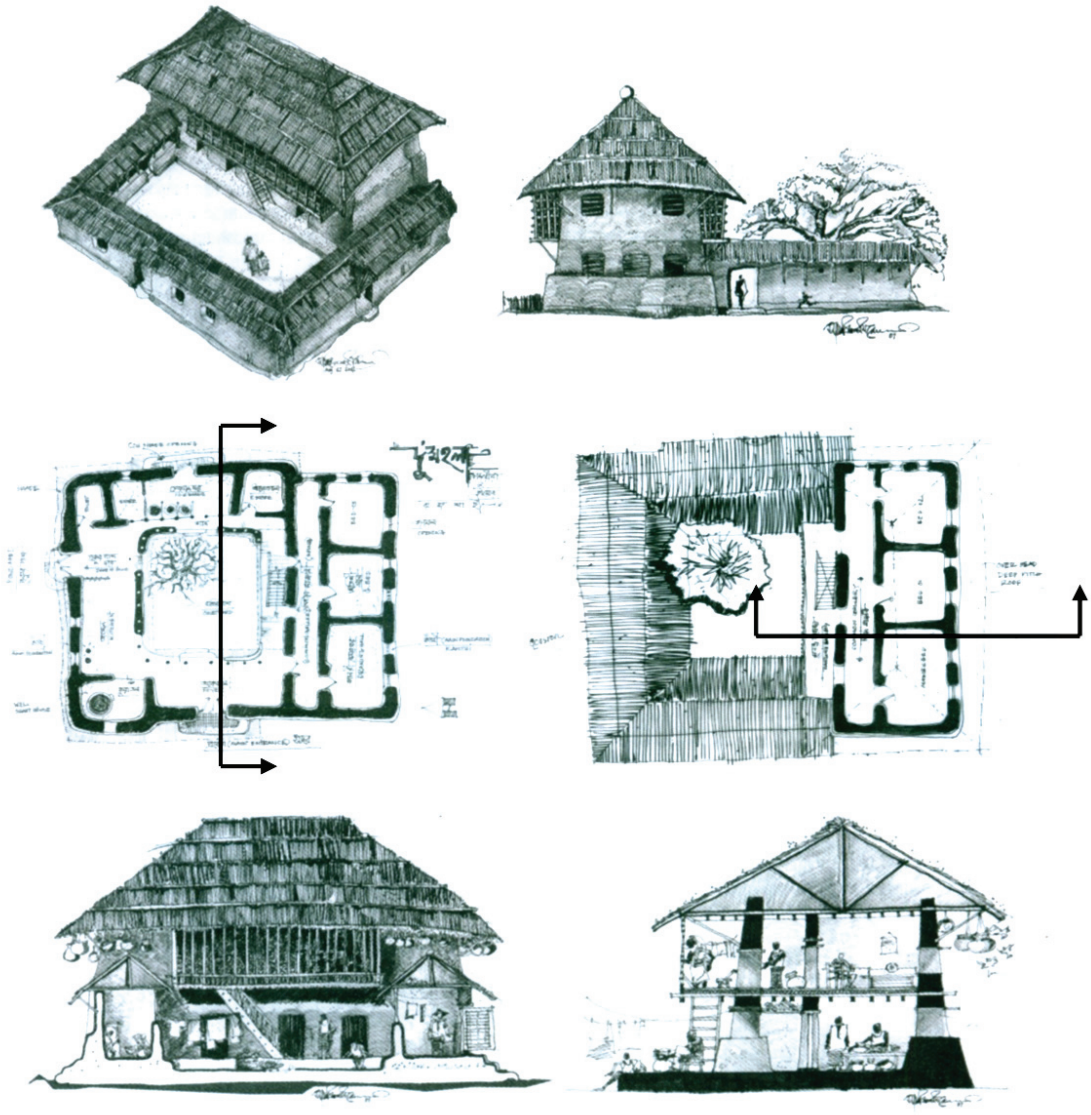


Figure 7:
Axonometric, Plan, Sectional and Elevation of Do Mahela , Hand Sketch by Doza, 2008.
Source: Doza & Razzaque, 2008, p.9.

Figure 8:
Different Spaces of Do Mahela,
Source: Doza & Razzaque, 2008,p.7.

thick tiled mud is used to cover the floor. Average floor height is around 10 feet. The triangular pitch roof forms a void space for grain storage. To keep a balance of the lateral loads and the structure itself the door height is kept 5 feet – 5 feet 6 inches.

Building organization and climatic consideration and Ecological Technique: The built forms are mostly north-south orientated, that is elongated towards east west. The bedrooms are placed at the south side to capture the south wind flow. The ecological technique has been considered here in a traditional way, by designing a courtyard. Courtyard houses are very attractive for providing a comfortable living environment. Courtyards keep the house cool and the massive thick walls provide thermal insulation. As a result the interior remains cool in the summer and warm in winter, and above all the courtyard remains vibrant and lively all the year round. During the rainy season the projected eves help to protect from the driving rain, and the sharp-pitched roof helps the rainwater to run quickly. Passive cooling and heating takes place naturally and the technique is being practiced for thousands years.

5. CONTEMPORARY PRACTICES: AN INTER-CULTURAL INITIATIVE

NGOs work in the rural areas of Bangladesh to strengthen the poor's capability and skill. 'Dipshikha' (Non-formal Education Training and Research Society for Village Development) is such an NGO in Rudrapur, situated in the northwestern part of Bangladesh, whose intention is to give the rural population perspectives and to help people learn about the value of the village in all its complexity. Part of their activity is the project, 'Meti'- School Handmade, that instills self-confidence and independence in children with the aim of strengthening their sense of identity.

As an extension of this project two other initiatives were also taken, one is a vocational school for electrical training called 'Desi', and three houses from a shelter concept called 'Home made' i.e. hand-built houses. All the buildings for these three purposes was conceptualized and designed by Anna Heringer who has known Bangladesh for years and devoted her diploma thesis to a school building for Rudrapur that was carried out in 2005. Later on the project won many awards including the 'Aga khan' award 2007 and became known globally. Various photographs are available online.

A brief description of the project:

- Meti, Desi, Homemade- Rudrapur, Bangladesh
- Planning phase: 03/2004 – 10/2004
- Construction: 09/2005 – 12/2005, 02/2006 – 03/2006
- Concept and design- Anna Heringer
- Construction supervision: Eike Roswag
- Solar simulation: Oskar Pankratz
- Bamboo construction: Emmanuel Heringer, Uwe Seiler
- Earthbuilding: Martin Rauch, Christof Ziegert
- Partner: Dipshikha, Habitat for Humanity Bangladesh, Technische Universität Berlin

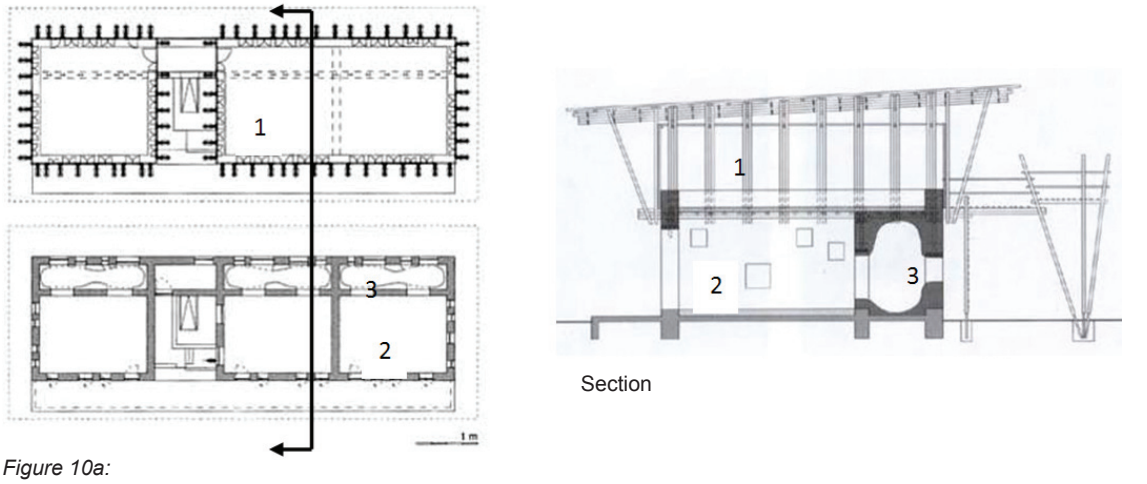
Figure 9:
Meti, Desi and Homemade at Rudrapur, Dinajpur; and site plan, Bangladesh. Source: Base Habitat

- Awarding Authority : The building owners and Dipshikha (Non-formal Education Training and Research Society for Village Development)
- Location: Rudrapur and Vishnupur, Dinajpur district, Bangladesh
- Awards: GEA Award, Emerging Architecture Award, Architectural Review Honorable Mention, Architectural Association & EES's Environmental Techtonics Competition 2006.
- Cost: 20400 USD. Per square feet cost is .83 USD.

5.1 Description of the Projects

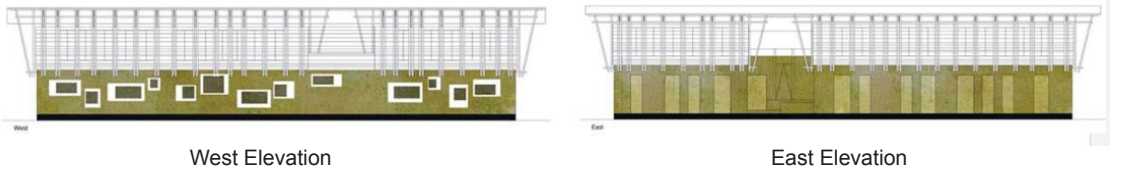
5.1.1 Design

Meti- School Handmade: After making a preparatory analysis of the village and the development, with the help of local and non-local students in 2002, the architect's starting point was her 1st project 'school handmade'. The intention was to link the inhabitants of the village, school pupils and teachers with



Section

Figure 10a:
Plan and Section of Meti, Handmade School. Source: Base Habitat, Open Architecture Network.



West Elevation

East Elevation

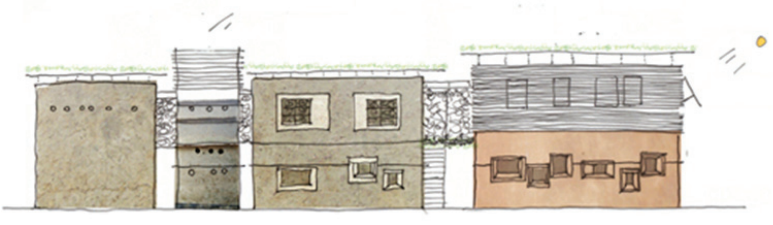
Figure 10b:
Elevations. Source: Base Habitat, Open Architecture Network.

Figure 10c:
Interior spaces of Meti, Handmade School. Source: Base Habitat, Open Architecture Network.

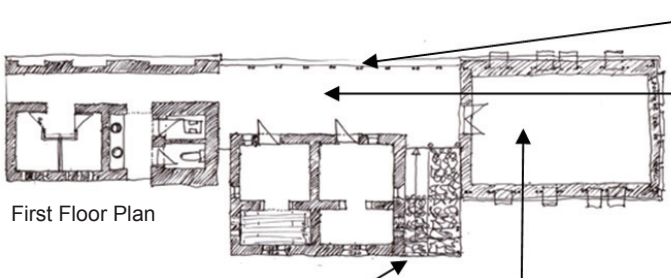
the project. Traditional building techniques were adopted and developed further. Locally available and inexpensive materials such as clay and bamboo, which have excellent qualities for coping with the sub-tropical climate, were used extensively. After a brief discussion and training, the local workers were involved in the construction work. Earth building and bamboo construction experts were also involved throughout. The school consists of a six-classroom house, of 325 m^2 or 24700 ft^2 area, constructed avoiding the implementation of imported constructional or technical complexities. The two storied structure is a fusion of rammed earth and bamboo architecture.

On the ground floor, three classrooms with their thick earthen walls are located with individual access opening towards an organically shaped organization of 'caves' to the rear of the classroom. Therefore, the spaces are dedicated for informal exploration or concentration on studies, on one's own or in a group. The upper floor is comparatively light and open. The openings in the bamboo walls offer sweeping views at all sides, and its large interior provides space for multipurpose activities and movement. The view expands across the vast greenery and village life. A play of light and shadow from the bamboo strips across the earth floor is also observed that makes a contrasting scene with the colourful materials of the saris on the ceiling.

DESI (Dipshikha Electrical Skill Improvement) Vocational school for electrical training: The design is focused toward a lifestyle that is linked with the rural context and culture. The Desi building accommodates two classrooms, two offices, and two residences for the school instructors. There is a separate bathroom with two showers and two toilets for the teachers and a bathroom facility with toilets and sinks on the ground floor for the students.



West Elevation



First Floor Plan

Figure 11:
DESI, Plan & Elevation, Source : Anna Heringer

Figure 12:
Exterior and interior views of Desi, Source: Author.

Figure13:
A Typical Plan of a House and Some Spaces
Source: Anna Heringer, Open Architecture Network

Houses Homemade, Building Together With A Village Community: Three two storied family houses were built with the essence of vernacular architecture. The houses have been found to conform to both the traditional and contemporary lifestyles of rural low-income families. At the same time, they have incorporated design and construction features that improve comfort, safety, durability, and privacy. The kitchens and bathrooms are housed in separate structures as can be found in traditional vernacular Bangladeshi architecture. The land saved by adding the second story can be used for vegetation and other household purposes.

The traditional vernacular architecture and locally available materials inspired the design conceptualization in the handmade project. The goal of the project was to improve the human spirit, increase awareness of the environment, respond to growing need for clean water, power, shelter, healthcare, education, and address a humanitarian crisis. Each of the rooms in the houses has its own openings along with ventilators, made from hand-made terracotta. In the house a bamboo-supported staircase was designed with its steps made from wood where a nice sitting place adorns the first floor landing. To cover and protect the mud surface against strong rainfall a strip of bamboo screen cladding was used in the building's perimeter which eventually provides a wide green screen. The corrugated pitch roof on top of the mud structure rests like a hat.

5.1.2 Construction method:

The structure of the building construction rests on a 50cm deep brick masonry foundation made with a facing Ferro cement plaster. No technical machinery was used, except for the mixing of the earth, water and rice straw with the help of cows. Almost all the works were done by hand.

Local earthen construction techniques were improved to provide structural stability and protection against rain and rising damp. Apart from the foundation, the damp-proof course was the other most essential addition to local earthen building construction techniques. The short lifespan (about 8-10 years) of local buildings was found to be due to the fact that, usually, they did not have foundations or a damp-proof course, which has been reconsidered very seriously in this project. The damp-proof course in this building is a double layer of locally available polyethylene film. To help prevent rats and other vermin from nesting in the walls, brickwork masonry foundation, the damp-proof course, compacting methods, and a Ferro cement technique were used.

Figure 14:
Construction Technique, and Bamboo joint Detail, Source: Anna Heringer, Open Architecture Network

The upper storey is a frame construction of four-layer bamboo beams and vertical and diagonal members arranged at right angles to the building. The end of the frames at the short ends of the building and the stair also serve to stiffen the building. These are connected via additional structural members with the upper and lower sides of the main beams and equipped with additional wind bracing on the upper surface of the frame. A series of bamboo rafters at half the interval of the frame construction beneath provides support for the corrugated iron roof construction and are covered with timber panelling and adjusted in height to provide sufficient run-off.

5.2 Post occupancy evaluation

In this study post occupancy evaluation has been formulated on the basis of author's site visit (2011), observation and interviews with users and one of the authorized person involved in the project. Some of the members, who were involved from the very beginning of construction, informed that they sometimes pay a visit to Rudrapur for 10 to 15 days and observe the post occupancy problems, difficulties and solve the problem. Such a member named Tumpa, an architect, who was a student of BRAC University during the construction phase. Her involvement in the construction process of all handmade projects has helped post occupancy observations through an informal interview.

METI: The bamboo used as a structural material was not treated enough before construction. The reason was limited time; the deadline was too short to finish the project. As a result, very often, defected bamboo needs to be replaced in the roof and as structural members for the structural safety of the project. Even the joinery were not galvanized, and as a result frequent replacement takes place whenever observed by the users or management. Although these jobs are done very neatly by the trained workers, the jobs are time, energy and cost consuming. The case is not the same for Desi and the three houses. Time was not a constraint at those projects so bamboo used in these projects was treated before use.

Students who are willing to sit for scholarship exam are allowed to stay at night as well. As the toilet is not attached or inside the building, but rather far away from the school, this generates fear among the students when they study late at night. In winter it becomes very cold at nighttime because the cold wind flows from outside through the cave windows. Thus in the winter students do suffer from cold while studying. Moreover, in the winter season this area becomes the coldest part of Bangladesh. Otherwise, the wind flow captured inside the building is sufficient as the local wind and cool air flow from east to west.

DESI: The overhang at roof level of the Desi building was not enough to protect from rain, that is why few layers of small overhangs were added later on for rain protection.

Three Houses: The owner of the houses are Rohini, Shepal and Hemanto. All the houses have long overhangs for sun and rain protection. However, Hemanto's house showed water leakage at one side as there are paddy fields at that side, and driving rain hits this side naturally due to the absence of tall trees. While the other houses are running well without this problem. Here it is worth mentioning that house one and two is situated in the middle of tall trees that protect from driving rains.

The brick foundations of all the projects are covered with a layer of Ferro cement at all sides at the ground level. The result is protection of the base from rats and termites. On the other hand, termites (locally known as 'ulu') attack the walls, which eat straw and mud regularly. Whenever holes are observed, pesticides with mud-plaster are used to prevent the termite attack regularly derived from local knowledge.

6. DISCUSSION AND FINDINGS

6.1 Ecological technique = comfort + energy efficiency

An ecological architecture technique combines building comfort and energy efficiency. According to Lori McElory (Edwards, 1996) the three factors in providing comfortable and energy-efficient buildings are climate, energy and material. Proper awareness of the designer is necessary for the potential impact of climatic considerations, daylight, solar gain and natural ventilation. The sun has to be designed 'out' as well as 'in'. A low-energy solution that produces a successful building in one location may not generally be applied to other buildings. The relative heating, cooling, lighting and equipment energy requirements, and potential heat gains from people, equipment, lighting and the sun, for example, have to be examined in relation to a building's

form, orientation, fabrics, occupancy patterns and environmental requirements in order to ensure that the full picture emerges prior to embarking on major design decisions (Edwards,1996,p.61). In this section the eco-architectural techniques of the projects discussed are analyzed.

Handmade projects: The built forms are east west orientated, that is elongated towards north-south. Generally the wind flows from south and south east. However, in this part east-west orientation has been especially observed in many local houses. Due to this orientation buildings gain cool breeze inside.

The school building provides large openings for ample light and ventilation. The extended roof eves help cut down sunlight. The thermal masses on the ceiling, helps to protect the class room from extra heat. In the ground floor the cave like play/study area at the west provides, a cool environment at day time. However, winter nights become intolerable due to cold.

The Desi building is passively heated and cooled which optimizes natural light and ventilation, and the relatively small solar panel and battery system provides all of the power the building requires. The Solar panels produce 100% of the building's energy needs. A solar thermal heating system provides warm water. The power generated from Solar panels regulates a motor which pumps water from a well into the water tank.

In the three handmade houses there are roof thermal masses, coconut fiber insulation, glass windows, and openings designed for cross ventilation assuring that the indoor temperature is comfortable all the year round. The slop roof of these three projects helps to run off the heavy rainfall. The extended roof and hand operated shading devices are used for protecting sun.

6.2 Findings

The intention of the hand-made project was to create an inter-cultural exchange with the expectation that the young assisting architects will be able to carry their knowledge and skills to other regions of Bangladesh and the trained labor will be able to use their skills to build other modern mud houses in the region. In contemporary society there is growing need of technical knowledge to support the traditional practices in architecture. The major findings observed are:

a. Vernacular architectural practices have formed through necessity not merely from aesthetics or style. Therefore the solutions produce a more permanent result.
b. On the other hand, modern practices are consisting of diversified knowledge which might save time but if the proper way is not followed it may cost more in the long run. For instance, in local construction method bamboo is always treated before use. Here in Meti-school the deadline of the project led to using the bamboo without any treatment, and which ultimately is affecting the long-term maintenance cost.
c. Local masons training before construction have increased the confidence level to carry on maintenance work at any time. However, this knowledge has to be transferred to the next generation as well.
d. Mud and bamboo are flexible enough to accommodate contemporary as well as traditional lifestyle requirements. Therefore, any repair work can be done very quickly.

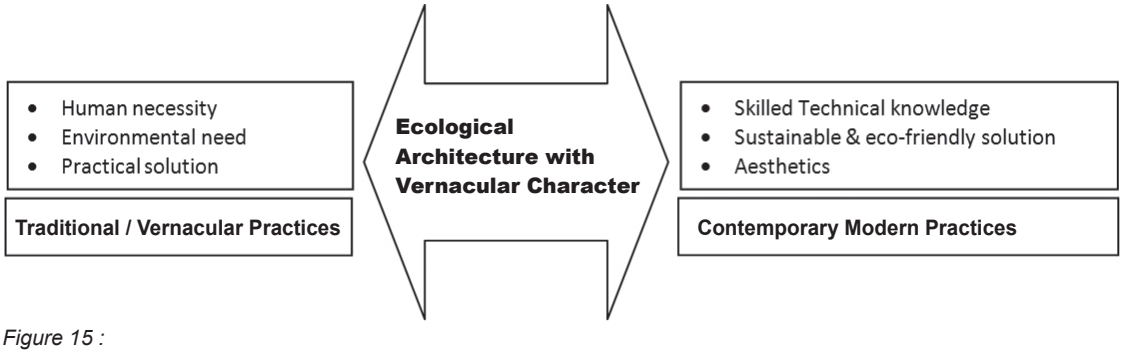


Figure 15 :
A conceptual diagram of 'Ecological Architecture with Vernacular Character' derived by authors.

7. CONCLUDING REMARKS:

The ecological value of a particular building or house cannot always be found applicable to other buildings. For the case of Do Mahela, the construction technique and spatial organization are generated from local culture and craftsmanship. This vernacular development has been inherited by the inhabitants. The skills and traditional techniques are adapted to climate. Therefore careful investigation is needed so that the architectural features can be conserved through generations and the inhabitants can look after the buildings. On the other hand the Handmade project was a sharing platform for skill and knowledge. Despite some post occupancy difficulties, the initiative was quite successful, as it has brought awards and appreciation later on, and the work done still provides lessons for young minds. The purpose of such construction was to strengthen the infrastructure, setting an example of how local skills can be used and therefore showing a promising future for the rural region. The new initiative has improved the living condition of the people and that is the major thing they are happy about. The project has proved that mud and bamboo are flexible enough to accommodate contemporary as well as traditional lifestyle requirements. This initiative and fusion of local and non-local has created a new living environment in the village which represents Ecological Architecture with Vernacular Character.

The intention of this paper was to critically investigate on how far contemporary practices are in line with the traditional vernacular architecture with special focus on mud architecture in Bangladesh. Although none of the projects discussed here embody total ecological building, the techniques followed in the recent initiatives tend to enrich the vernacular architecture through exchange of skill, knowledge and ecological techniques.
The following approaches are recommended for further exploration -

- More intensive practical research is required for any kind of experimental development, and the research should be completed before realization or construction of the project.
- A small scale live mockup can be a good solution for research and development.
- Micro level feasibility analysis with more focus on climatic consideration as well as immediate site surroundings can be considered
- More effort should be given to reduce the maintenance cost in the post occupancy period of buildings.

Ecology, comfort, modern techniques, local practices are important for modern vernacular architecture practices. So, action is needed to go for buildings that “look after” people. Changes and improvements should be done with proper sensitivity so that local materials and skills can be used to revive the vernacular architecture with ecological technique and the process of learning can remain continuous. Ecological architecture is one of the major solutions to provide buildings that look after people, because “*buildings that look after people can also be the ones that look after the earth”* (Phyllis Richardson 2007).

REFERENCES

Doza, S.B & Razzaque, M.Z.I., 2008 ,‘ “DO MAHELA” An Enlightenment about Two Storied Mud Architecture Chanduria, Tanore, Rajshahi, Bangladesh,’ *Protibesh*, *Journal of Department of Architecture, BUET*; Vol.12, Issue 1,pp.5-11.

Edwards, B.,1996,Towards Sustainable Architecture, Butterworth-Heinemann Ltd, UK.

Haq, S.,1994, “Architecture Within the Folk Tradition: A Representation from Bangladesh”, Vol. no. 11, pp 61-71, Field Report by TDSR.

Rapoport. A., 1969, *House Form and Cultllre,* p.2, New Jersey: Prentice Hall.

Richardson, P., 2007, *XS Green : Big Ideas, Small Buildings*, Thames and Hudson Ltd. London .

Sandy, J.& Ahmed, N., 1984,*Discover the Monuments of Bangladesh*, The University Press Limited, Dhaka.

Turan, M. (ed), 1990, *Vernacular Architecture*, Ethnoscapes – Current Challenges in the environmental Social Sciences, Vol. 4, Avebury Publication.

Online articles and sources:

Asian Disaster Preparedness Center (ADPC), 2005, *Handbook on Design and Construction on Housing For Flood-Prone Rural Areas Of Bangladesh,* available at: http://www.adpc.net/audmp/library/housinghandbook/handbook_complete-b.pdf.

Bangladesh Climate Graph (Altitude 9m);Available at : http://www.bangladesh.climatetemp.info/

Chowdhury, S. Islam, 1995; Banglapedia 2006, *Mud walled houses*, Rural settlement House Pattern 1981. available at: http://www.banglapedia.org/httpdocs/HT/R_0276.HTM

Das, Amrita, et.al., 2007, *Housing report :Mud house of Bangladesh* ,World Housing Encyclopedia *:an Encyclopedia of Housing Construction in Seismically Active Areas of the World,* an initiative of Earthquake Engineering Research Institute (EERI) and International Association for Earthquake Engineering (IAEE), available at:http://www.world-housing.net/whereport1view.php?id =100161

Height above Sea Level (m); Available at : http://www.globalwarmingart.com/wiki/File: Bangladesh_ Sea_Level_ Risks_png.

Khan, Sadat Ullah,2006, National encyclopedia of Bangladesh, Banglapedia online, available at: http://www.banglapedia.org/httpdocs/HT/H_0178.HTM

METI, DESI & HOMEmade plans and Photographs available at, http://www.annaheringer.com/, http://www.basehabitat.ufg.ac.at/pro_H.html,http://www.openarchitecturenetwork. org.

World Bank Report 2011, available at http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/EXTANNREP/EXTANNREP2011/0,,contentMDK:22969490~menuPK:8121330~pagePK:64168427~piPK:64168435~theSitePK:8070617,00.html