Earth Architecture of Bangladesh and Future Directions for its Conservation and Upgrading

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Abstract

In the deltaic environment of rural Bangladesh thrive splendid examples of earth architecture Different methods of construction have evolved in the three major physiographic zones which comprise the alluvial land of Bangladesh. Bamboo technology is prevalent in the **Lozoen Caze** where different techniques of wattle-and-daub are evident. In the **Tertiary Hills** buildings built on stilts are mostly of timber and bamboo, but the use of earth blocks can also be observed in this area. Most earth buildings are located in the **Pleistocene Uplands** where buildings built in the layering technique and with large earth blocks are common. The base of earth buildings are susceptible to deterioration by water and various methods of protecting the raised earth plinth and the use of time-pozzolanic cement have been explored in this paper. Earth structures represent living cultural traditions; their maintenance and preservation are vital for the cultural continuity of architecture in this region.

INTRODUCTION

Bangladesh is mostly comprised of a large riverine delta formed by alluvial sedimentation deposited by rivers and their myriad branches. The fertile soil, abundance of water and warm climate support a principally agricultural and rural mode of living. The life of rural inhabitant is intricately linked with the water and soil of the land. Water flows throughout the delta depositing annual endowments of alluvial earth. The gift of the rivers is used ingeniously to build remarkable earthen buildings. But the annual riverine floods, the incessant monsoons and the insidious humid air gnaw away these buildings- as if the generous donors demand the return of their gifts. A continuous battle is waged against the adverse elements to preserve the earthen buildings , the same buildings which protect the rural inhabitant from those elements.

This paper is about architecture that uses earth as the main building material. In environmental conditions of extreme wetness, the use of earth as a building material faces serious constraints. Yet it is one of the most readily available resources in the alluvial land. For this reason examples of earth architecture abound here and adaptive ways of using earth have evolved over time. Earth architecture typologies can be classified on the basis of three major physiographic zones based on altitude or relief: Recent Plains, Tertiary Hills and Pleistocene Uplands. The variety of earth building types have evolved largely in relation to topographical conditions, macro-climate and availability of resources in each zone.

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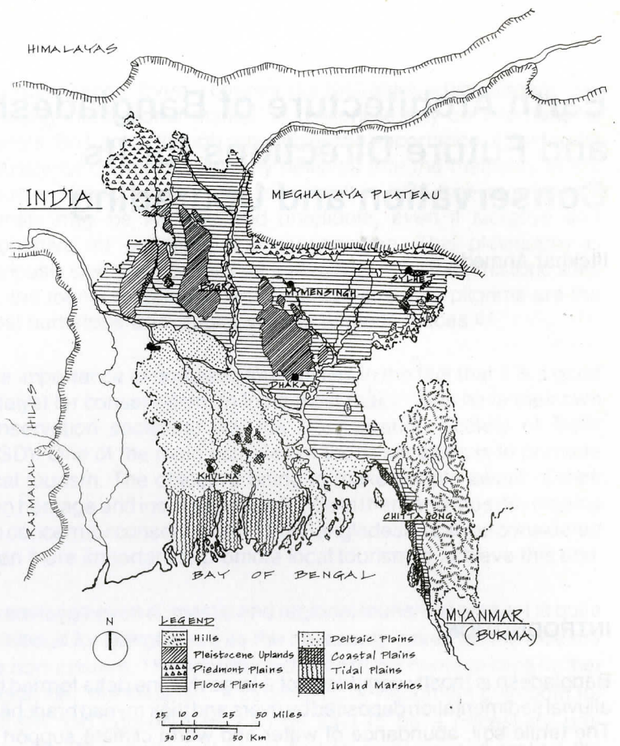


Fig. 1 Map of Bangladesh showing physiography

Figure-1

Physiographic Zones and Earth Architecture

A. Recent plains

This area comprises a major part of Bangladesh. It is mostly coastal and has been formed by successive sedimentation of alluvial deposits. Locally available bamboo is used extensively and in a variety of ways for building in this region However earth is also often used in combination with bamboo and this combination has created a local vernacular idiom. Soil in these riverine plains is generally clayey[1] and due to its properties of shrinkage during drying, it is difficult to build monolithic walls with clayey soil as the walls develop serious cracking.[2] For this reason earth is used with a reinforcing frame work , made of bamboo and reeds which is a form of wattle-and-daub.

There are two main variations of this technique. The most prevalent method is that of mats made of interwoven split bamboo plastered with earth. Such bamboo mats (Chatai or bera) are quite common

1. Sowers George B. and George, F. Introductory soil mechanics and foundations The Macmilan Company New York 1970, pp. 45-48, where the soil composition in flood-plains have been described.

2. Bergland, Magnus. Stone, Log and Earth Houses The taunton Press, Inc, Connecticut 1986, p 103. The author has discussed the properties of sandy, silty ad clayey soils.

in Bangladesh and are made in a variety of weaving styles. Cowdung is used as a binder, which is considered suitable for clayey soil. plastering is usually done on one side but sometimes both sides are plastered, especially near the base[3] which is prone to deterioration by water. Quite often the top of the matted walls are left unplastered to allow ventilation and it is common to find buildings which are part earthen and part bamboo-screened. Bamboo buildings in coastal areas are subject to strong wind and stormy weather. Even the high tensile strength of the bamboo frame cannot always with stand these environmental stresses. Possibly for this reason plastering is done to provide sturdiness to the structure. In this form of construction buildings are built on a raised plinth of compacted earth resulting in a bare, hard earthen floor inside. In fact, this plinth is characteristic of most areas of Bangladesh and is a typical feature in the Recent Plains as well as in the Pleistocene Uplands.

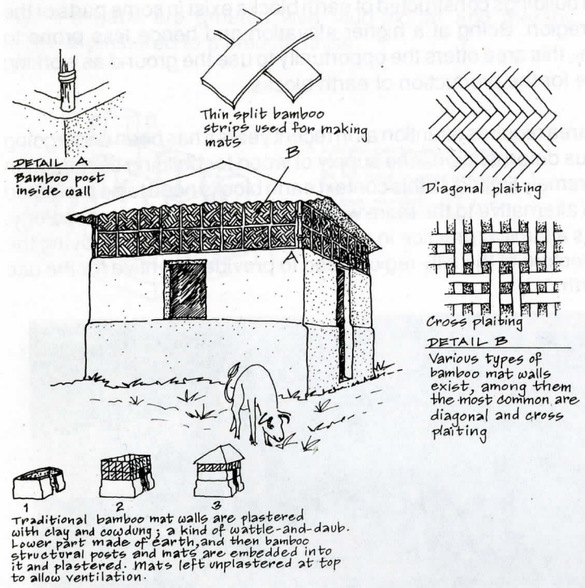


Fig. 2 Wattle-and-daub with bamboo mat walls

Fig. 3 Wattle-and-daub wall

The other type of wattle-and-daub technique is the well developed system known as Ekra a kind of half- timbered construction. This technique is prevalent in the marshy areas of Sylhet. A timber frame is built and the gaps between the framework are filled in with interwoven bamboo laths. Each bamboo is split in half and the split members arealigned horizontally or vertically. Then mud plaster is

3. Hasan, Dewan M. A. Study of Traditional House Forms in Rural Bangladesh M. Arch. thesis, BUET, Dhaka 1985, pp 60-62.

applied on the surfaces. To resist the annual heavy rainfall in this area, the wattle-and-daub system here consists of a heavy and substantial bamboo wattle or framework. During heavy rains the entire wall cannot be washed away and after the rainy period subsides, the walls can be re-plastered and easily repaired.

B. Tertiary hills

In Bangladesh hilly terrain is largely limited to the south-eastern low hills comprising the Tertiary Hills zone. There is a prevalence of various tribal cultures in these areas. Because of the uneven terrain, buildings are raised on stilts in order to place them on the steep slopes of the hills. The typical raised earth plinth is not very common in this area. Raised platforms of mud-plastered wood or bamboo planks serve as floors. Earth is not used extensively: rather a variety of vegetable-matter, or organic materials, such as reeds, thatch, bamboo and wood are utilized as building materials. Examples of earth buildings constructed of earth blocks exist in some parts of the hilly region. Being at a higher elevation and hence less prone to floods, this area offers the opportunity to use the ground as working space for the production of earth blocks.

This area requires attention as in recent years it has been undergoing serious deforestation. The supply of wood for building construction is extremely limited. In this context earth blocks need to be promoted as an alternative to the more widespread use of timber technology. This is a familiar practice in many areas; attempts at improving the architecture of the hilly region need to provide incentive for the use of earth.

Fig. 4 Houses on stilts in the hilly region

C. Pleistocene uplands

This region in the north was formed earlier than the other deltaic land and is relatively dry and at a higher elevation than the coastal

areas. The somewhat dry environment has supported the widespread prevalence of earth buildings. In fact, the majority of earth buildings of Bangladesh are located in this region which has a long tradition of earth architecture. Even examples of two-storied, large earth buildings exist in some places. Early descriptions of travellers confirm the existence of this continued tradition. Captain Thomas Williamson in1810 has specifically described earth construction as "mud laid in strata of 18-20 inches in depth, each stratum being allowed to dry before the next was added"[4]. Examples of the wattle-and-daub technique can also be seen, but it is less common than building with large earth blocks or the layering technique.

When building with blocks earth is shaped into blocks of about 1 cu. ft. (0.025 cu. m) and then lifted into place to be laid in successive layers. As each layer dries the next one is built. Vertical gaps are kept between the earth blocks which gradually become larger as the earth dries and shrinks. After the walls have been completed and dried, the gaps are grouted with mud-mortar and thereby the surface is plastered to a smooth finish.

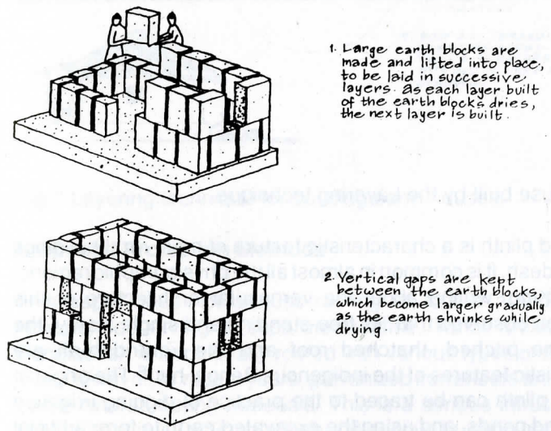
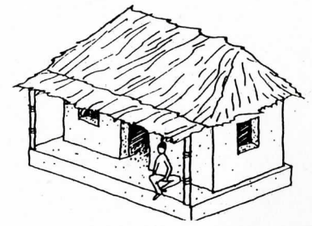


Fig.5 Construction with Large earth blocks

The majority of earth buildings in Bangladesh are built in the layering technique, which is similar to the "pise" technique. [5] In most cases a mound of earth is shaped and compacted to form a plinth, on top of which the walls are built in successive strata of 1-1.5 ft (30-40 cm.). No finish is applied on the surface of the plinth, except for a layer of mud slurry to achieve smoothness. Otherwise the plinth is left bare and serves as the floor inside. Also in some cases shallow foundation trenches are dug and walls are built from within the trenches. Even in this type of construction the floor is of bare, compacted earth on a raised plinth.



4. King, Anthony D, The Bungalow. Routledge and Kegan Paul, Boston. U.S.A. 1984, p 20. King has provided accounts of the indigenous architecture of pre-colonial and colonial Bengal, based on the reports of travellers in the region, such as, Comte du Modave, Francis Buchanan. Captain Thomas Williamson and Nilsson.

5. "Pise" is another name for the technique more commonly known as "rammed earth". There are various types of pise construction methods. Descriptions of these techniques can be found in the book by Jean Dethier, Down to Earth (New York: Facts on File, Inc, 1983) and also the article by Jeffery W. Cody, "Earthen Walls from France and England for North American Farmers, 1806-1870", 6th International Conference on the Conservation of Earthen Architecture (New Mexico: Getty Institute for Conservation, 1990), pp. 35-43. Pise is somewhat different from the layering technique in the fact that no forms are used in the latter. They are similar because in both techniques the walls are built in longitudinal strata, each stratum drying before the next is added.

Fig. 6 House built by the Layering technique

The raised plinth is a characteristic feature of most rural buildings in Bangladesh. It is common in almost all the physiographic regions. Anthony King, writing about the vernacular architecture of this region, has observed that "its free-standing and single storey, the plinth., the pitched, thatched roof and the verandah-all are characteristic features of the indigenous Bengal hut"[6] The origin of the earth plinth can be traced to the practice of digging irrigation canals and ponds, and using the excavated earth to form artificial mounds.[7] In most area this is done to protect the buildings from floods, but its widespread prevalence also in relatively dry area may be an indication that its use is not only a functional one, but is rooted in stylistic adaptation due to cultural precedence.

At the time that the earth walls are erected in layers, openings for doors and window are retained. The soil is taken from the site, or if suitable soil is not available, it is brought to the site and a cohesive mixture is prepared, using straw or rice-husk additives to provide strength during drying and shrinkage. The surface of the earth walls are plastered with a layer of mud slurry mixed with cowdung to achieve a smooth finnish. This plaster is regularly maintained and requires frequent attendance in the rainy season.

6. King, ibid p. 28.

7. Hasan, ibid pp. 32-35.

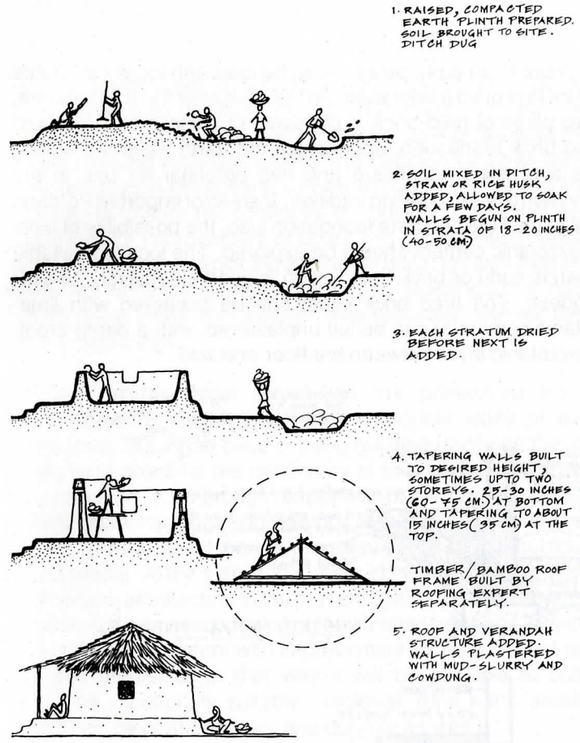


Fig 7 Layering technique for building earth houses.

Proposed Protection Methods

This paper does not discuss roofing as this is a wide area of research deserving a separate treatise. Rural architecture in Bangladesh is traditionally roofed with various types of thatch and tiles. However, in recent years, galvanized iron sheets are replacing these natural roofing materials. This is a serious intrusion in the cultural continuity of Bangladeshi indigenous building tradition, and attempts at incorporating this material or developing alternatives have to be made at this stage.

Broad roof eaves generally protect the earth walls from rain and the minimal damage caused is amended from time to time. The earth plinth requires more maintenance than the walls, as it is exposed to accumulated rainwater on the ground during the rainy season. While the walls generally perform well, they are susceptible to deterioration at the base. Walls of most earth buildings are built directly from the ground or from the raised, earth plinth. Due to the capillary action of dampness rising from the ground into the walls, the structure can be greatly weakened. The floor also admits rising moisture from the ground and can became quite wet.

Where there is an earth plinth, it can be clad with locally available fired brick to protect it from water. In the houses of the rural affluent, a raised plinth of fired brick is constructed using a concrete and stepped brick foundation, upon which the earth walls are builds. This is a practical technique and has potential for use in the preservation of earth building tradition. Instead of imported Portland cement to cast the concrete foundation slab, the possibility of local lime-pozzolanic cement should be explored. The locally available pozzolan is surki or brick dust, which is used extensively all over Bangladesh. The fired brick plinth can be plastered with lime-Pozzolanic cement or can be left unplastered, with a damp-proof, lime-pozzolanic layer between the floor and wall.

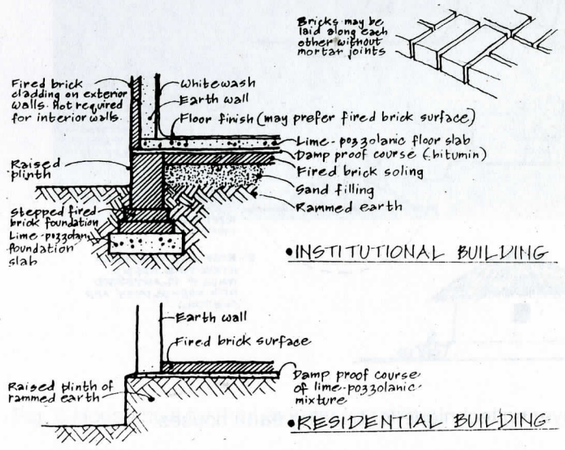


Fig.8 Some proposed methods of damp-proofing floors of earth building.

The problem of avoiding a moist floor in the raised earth plinth is a serious one. Instead of a cement floor, which can be quite expensive for most rural inhabitants, the alternative would be to cover the floor on the raised plinth with fired brick bonded together in place without any mortar. A layer of lime-pozzolanic cement laid under the brick surface would protect the floor from rising dampness. Even in cases where fired brick is unaffordable, the lime-pozzolanic cement layer would mitigate the capillary action to a large extent.

CONCLUSION

The issue of maintenance has become more important in recent years. Due to the advent of factory-produced and imported building materials, earth is losing popularity rapidly. International commerce and national poverty have greatly weakened the economic status of the rural Bangladesh. The traditionally rooted construction and maintenance practices have been disrupted and replaced by industrial products; in many places it has led to neglect and apathy.

Is tradition destined to perish this way? Even if it can be deemed acceptable that tradition should not stand in the way of development, total insensitivity to tradition cannot be the alternative. New forms and materials derived from tradition can have relevance; their success in the cultural context depends on the way they are devised to ensure the continuity of tradition. Traditional buildings often require improvement or upgrading to cope with demands of the age. However, replacing traditional buildings with modern ones does not necessarily lead to progress. Buildings that disrupt or totally break away from tradition may culturally alienate the users of such buildings.

Historic monumental structures are preserved for visual contemplation, spatial experience, historical study or even for recreation, But in the case of living building traditions the issue at stake is to preserve the continuum of their development. What is now required is a thorough reappraisal of the intrinsic values of the great cultural traditions of indigenous architecture on various national levels: in rural development programs, educational curricula and mass media. At the same time, some of the technical drawbacks of indigenous architecture in the present context deserve professional attention. While a recognition of the building traditions is necessary it should be consistent with improvement techniques that address present problems. In that way it will be possible to build and preserve a culturally suitable., regional, rural earth architecture which will be contemporary and durable as well.

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