

Alternative Building Material in Bangladesh: A Way towards Sustainability

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ABSTRACT

Environment pollution is the most concerned issue in today's world. Construction Industries is one of the largest sectors to pollute the environment. In Bangladesh, burnt clay brick is the most commonly used building material. Which produce a significant amount of greenhouse gasses and also it destroys a huge amount of agricultural land every year. For a better environment alternative sustainable building material is a must. Sustainable Building Material can be defined as the product that uses less energy and less impact on the environment during its lifetime. The study appraises alternative building materials and technologies as a walling material. The researcher use river dredged soil and cement to produce this alternative material. Compressed Stabilized Earth Block (CSEB), Sand Cement Hollow Block, Thermal Block all the material does not produce any harmful gasses during its production. Though a small amount of cement is used where they do not affect the environment as much as firebrick does. Moreover, the use of river dredged soil in these alternative materials save the precious agricultural topsoil. Use of locally available raw material also makes the alternative material cheaper than the conventional firebrick. Transformation from a conventional method is not easy so proper initiative must be taken. Also, the new technology should thoroughly be investigated to minimize future risk when using in the field.

Keywords: Alternative Building material, Sustainable, CSEB, Thermal Block, Concrete Block

INTRODUCTION

Housing is the constitutional right of an individual or a family. Providing housing for all is also significant for ensuring sustainable urban and rural development. Bangladesh is one of the largest densely populated countries in the world. Unplanned rural housing is creating extra pressure on land and making an adverse impact on affordable housing. Building Industries is one of the largest sources of greenhouse gas emission and energy consumption. Fire Brick or burnt clay brick is the most popular building material in Bangladesh. Every year a huge amount of burnt clay brick is used for construction purpose. Firebrick manufacturing plants are responsible for huge land loss and environmental degradation. Every year for construction purpose almost about 40% of natural nonrenewable resources extracted in the industrialized country[1], consuming almost 70% of total electricity and 12% of potable water supplied [2]. The construction activities are producing 45% to 65% of the waste disposed of in landfills[3]. Additionally, they are responsible for a massive amount of harmful emissions, accounting for 30% of greenhouse

gases, due to their operation, and an additional 18% induced indirectly by material exploitation and transportation[4]. Also Building construction consumes 40% of the raw stone, gravel, and sand used worldwide annually, and 25% of the raw timber. From the environmental impact perspective, the building sector has a significant effect on the entire environment[5].

About 17.2 billion bricks are made in Bangladesh every year for housing [6]. Around 240 tons of coal is used for making one million bricks[7]. Each year only in Dhaka region about 23,300 tons of particulate matter, 1.8 million tons of carbon dioxide, 302,000 tons of carbon monoxide also other substances emitted from brick kiln which is extremely harmful to human health [8]. Topsoil that is most important for agriculture is the main raw material of the burnt clay brick. Every year a huge amount of agricultural land lost due to the production of the firebrick.

So, initiatives must be taken by the researcher to find suitable alternative sustainable building materials and low technology method. Adopting green building materials is an excellent

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approach to meet this target. Selection of construction materials which have minimum environmental burdens is useful in the sustainable development of a country.

A study project has taken by the Housing and Building Research Institute, Bangladesh to overcome the situation. The study uses locally available material to find out alternative building materials. Instead of using agricultural topsoil the study uses river dredging soil to produce blocks. Which is available in abundant in Bangladesh. The aim of the study is to explore and find out possible alternative sustainable building material that can contribute to reduce the impact on the environment. Thus creating a sustainable environment.

ALTERNATIVE BUILDING MATERIAL

Sustainable building materials are the materials

Table 1. Component of Sustainable Building Materials

Production Stages	Construction or application stages	Post- construction Stages
Waste Reduction less pollution Recycled less Embodies Energy renewable energy sources	Energy Efficiency Nontoxic Renewable Energy Sources Longer Life	Biodegradable) Recyclable Reusable Others

which are created in locally and decreases transportation costs and CO2 emissions. They could consist of reused materials, they possess a minimum threat to the environment[9].

Sustainable Building material has become a new building philosophy, which insists the application of more environmentally friendly materials, the implementation of strategies to save resources and lower waste consumption, and the improvement of indoor environmental quality, among others[2][10].

The use of low-cost alternate building materials also prevents the rise in construction cost due to the use of scarce building materials. Each stage of a building should be such that they help to conserve the energy. Some components of sustainable building material widely known are listed in table 1 below[9].



Figure1. Compressed Stabilized Earth Block (CSEB)

Compressed Stabilized Earth Block (CSEB)

Housing and Building Research Institute has produced CSEB from the dredged soil of river

mixing with proportionate cement. The production cost of CSEB is near about half of the conventional burnt brick.

Table 2. Basic Properties of CSEB

Percentage of cement	Compressive strength in psi			Water absorption %
	3 day	7 day	28 day	
10	270	350	550	13.3%
15	390	450	900	8.5 %

Table 3. Basic Properties of Interlocking CSEB

Percentage of cement	Compressive strength in psi			Water absorption %
	3 day	7 day	28 day	

10	270	350	525	13.3%
15	390	450	900	8.5 %

Interlocking CSEB

These types of blocks are prepared with proportionate mixing of dredged soil from river with cement and sand. It is possible to prepare wall without any mortar due to its' interlocking mechanism.



Figure 2. Interlocking Compressed Stabilized Earth Block

Sand Cement Hollow Block

A Sand Cement block is one of several precast concrete products used in construction. Hollow block helps in saving construction materials and therefore use of hollow block reduces

construction cost. Use of larger size concrete block reduces number of joints in work and hence helps in saving mortar. Sand Cement Hollow block masonry can safely withstand the atmospheric action and it requires no protective covering. Hollow block have good insulating properties against sound, heat and dampness. Presence of rough surface on blocks provides good bonding of mortar and plaster.



Figure 3. Sand Cement Hollow Block

Table 4. Basic Properties of Sand Cement Hollow Block

Percentage of cement	Compressive strength in psi			Water absorption %
	3 day	7 day	28 day	
10	420	550	1020	8%
15	500	940	1500	5%

Thermal Block

Thermal Block is produced using EPS Sheet with both side mortar. The advantage of thermal

Block is that it has good thermal and sound insulation properties. Moreover, the weight of the block is almost half of the traditional or fire brick.



Figure 4. Thermal Block

Table 5. Basic Properties of Thermal Block

Percentage of cement	Compressive strength in psi			Water absorption %
	3 day	7 day	28 day	
25	150	350	520	3%
30	390	450	725	2 %

APPLICATION OF ALTERNATIVE BUILDING MATERIAL

The customary building construction trend in Bangladesh usually focuses on the use of burnt clay bricks for the infill and Reinforced Cement Concrete frame structures. Under the study project the researcher try to establish CSEB, Hollow Block, Thermal Block and others material as an infill wall material.



Figure 5. Model House-II using Compressed Stabilized Earth Block and Thermal Block at HBRI campus



Figure 6. Pilot plant shed structure for Compressed Stabilized Earth Block (CSEB) production at HBRI campus

Use of Compressed Stabilized Earth Block (CSEB)

HBRI has been constructed several Model House and other structure in HBRI campus to observe the performance of the CSEB block.

HBRI constructed a model house of 1300 sft area, also a pilot plant has been setup in HBRI campus using CSEB. Most of the model house performs well. The study observe that when use 5% of cement to develop CSEB the product is sensitive to rainfall. Plastering over such type of block wall solve the problem. Again when using a higher percentage of cement for developing CSEB the block is strong enough and performs well.

Use of Interlocking, Compressed Stabilized Earth Block (CSEB)

To find out the performance of interlocking block, HBRI has taken initiatives to complete a one storied building within an area of about 320 sft. The successful implication of interlocking bricks can be proved to be an exceptional substitute to burnt clay bricks.



Figure7. Model house-I with interlocking blocks

Use of Hollow Block

HBRI has Constructed a two stories Building using alternative building material at HBRI campus. Sand Cement Hollow blocks are used in the Model House. The Total area of the building is about 1300 square ft.

Use of Thermal Block

Two Model House has been constructed at HBRI campus under the study project. Thermal block are used in the second story of the Building. The Performance of the Block is pretty well. Another advantage of using thermal block is the properties of thermal and sound insulation.



Figure 8. Model House-II using Compressed Stabilized Earth Block and Thermal Block at HBRI campus

CONCLUSION

Sustainable building materials could be define as the material which are indigenous, locally available in abundance, which require less energy during production, maintenance and transportation and be labor intensive[11]. The application of Alternative green building materials minimizes carbon dioxide emission transportation costs again it also reduce material cost for construction, offers employment and skills development opportunities and the most important thing is it save our agricultural land. The study consider river dredged soil for making alternative building material instead of clay or agricultural top soil. The study found that river dredged soil could be a great raw material to develop alternative product of brick. The alternative product discussed here do not require fire for the production. Thus it does not emit any harmful gases during production. Moreover it save energy and natural resources. The alternative product will help to achieve Sustainable Development Goal of UN. Proper training must be given to Construction worker and professionals to use this product. Again government of Bangladesh and research institute should take measure to investigate the alternative product and technology to minimize the risk of failure of any technology or material in future.

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