



# Compressed Earth Block as an Alternative of Wall Building Material

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## **Abstract:**

In the past few years Environment pollution is the foremost concerned issue. Awareness growing to save the environment. In our country, burnt clay brick is the foremost used building material. Which deliver a noteworthy amount of greenhouse gasses and also it destroys a huge amount of agricultural land every year.

Regarding the issue of I am seeking for sustainable and eco-friendly building material. Compressed Stabilized Earth Block (CSEB) provide the opportunity of energy efficient, eco-friendly, agriculture friendly and sustainable development. It does not contribute any harmful gasses during production.

In this study, how soil is used to produce CSEB block, which helps to save the agricultural land. CSEB have been made with the different composition of cement, sand and river dredged soil.

The comparison between the CSEB block and the brick are study with respective with their cost, weight, strength and many other properties.

The compressive strength of different blocks, measured to discover the appropriate composition to create CSEB additionally to compare among them to discover out the ideal composition.

**KEYWORDS** - Sustainability, Environment-friendly, Agriculture friendly, River dredged soil.

## **I. INTRODUCTION**

Earth is one of the oldest building materials ever known. Once the modern building material and methods were discovered building with earth fell out of popularity. When the energy crisis is come to note it again renewal its popularity. Considering environmental and ecological issue in the recent year's scientists try to start earth block again as a building material. Dried earth construction is habitual in some region of the world where the specific climate and economic condition dictate and where the earth construction is aesthetically accepted to all.

Quick improvement of today urbanization and industrialization, the employments of development fixing such as 'brick' is expanding day by day. As of late in some country the demand of Bricks is rising by 5% increment. More often than not brick may be a prevalent thing since it can be effortlessly made without taking after any rules. Expanding the request for bricks each year of urbanization, this emergency is getting more regrettable day by day. Here's one more thing to take note that the expanding request for brick is meet claim by 95 percent of ancient brick kilos and natural pollution bricks innovation is used.

The way bricks coils are running with the soil from agricultural arrive, destroying environment and hurting wellbeing risks, it is the time we have to be think approximately whether it can proceed or not. To diminish the nursery gas emanations, make brick through burning prepare ought to be halted. In spite of the fact that the handle isn't very conceivable, it can be a valuable step to economic advancement indeed in case it can diminish a bit. In this case, utilizing distinctive ventures and innovations for making brick soil collected from distinctive waterways and other sources can be ensuring the environment play a critical role. Not as it were that, making the cement, sand and soil blending brick moderately taken a toll is less. In comparison with another building fabric, CSEB advertised numbers of advantages. Utilizing nearby CSEB minimizes the generation fetched, makes reasonable quality house for everybody.

## Background-

Accommodation is one of the fundamental needs of people. An ideal habit makes a difference in their work habits, comfort, and peace. About 17.2 billion bricks are made every year for housing (World Bank, 2011). Greenhouse gas transmission in the environment from the fixed chimney kiln (FCK) used in the brick kiln. Around 240 tons of coal is utilized for making one million bricks. Each year approximately 23,300 tons of particulate matter, 1.8 million tons of carbon dioxide, 302,000 tons of carbon monoxide and also other substances transmitted from brick kiln which is extremely harmful to human health. A giant amount of agricultural land is destroyed to make bricks per year. If the scenario continues like this then in close future we will going to face a serious food crisis. High demand for clay bricks would result in cost climb of clay bricks in near future and might be reached beyond the affordability of common people. To keep the price of building materials in a reasonable range, it is the time to pick in alternative building materials like compressed stabilized earthen blocks/bricks, hollow or solid masonry blocks. Compressed Stabilized Earth Block (CSEB) prepared of dredged soil and cement expected to be a great alternative to burnt bricks to decrease the use of agricultural topsoil and carbon discharge. It is additionally expected that CSEB will help to improve the quality of life of the population and play an effective part in environmentally friendly management to support to achieve the Sustainable development goal (SDG).

## Block Preparation:

### I. Materials-

- Cement-** The cement utilized in all the mixes was manufactured by Premier Ordinary Portland Cement (OPC) CEM-I 42.5N and 52.5N Grade and contains.
  - 95-100% clinker
  - 0-5% gypsum
- Soil-** The soil utilized in this consideration was brought from Turag Waterway, which is around 10km from Dhaka. The soils used for making the pieces were evaluated a few tests for classifying and recognizing the sorts of soils. The tests performed were as takes after: Testing and field Classification, Sieve Examination test, Moisture Content Test, Specific gravity test and finest modulus. All the soil tests were done at AUST geotechnical research facility. After classifying the soils, compressed stabilized earth blocks were made from the soils. The physical properties of the soil are given in Table 1. The detail test comes about are given below:

**Table 1: Soil properties**

	Physical properties	Values
1	Specific gravity	2.693
2	Natural moisture content	2.36
3	Fines content	6.2
4	Sand content	93.6
5	Finest modules	1.91

- Water:** Fresh tap water free from all forms of organic is utilized, which is provided by the Dhaka water supply system of the city.
- Mixing proportion:** Water is blended with the soil until it is plastic sufficient to form. Water substance should be less than optimum dampness substance of the soil by weight. The water and soil must be altogether blended. In arrange to analyse the impacts of substance of cement and soil three distinctive blend extent arrangement were arranged. The CSEB blocks were arranged and casted at Housing and Building.

- **Compressed Earth Block Production:**

An earthen block arrangement machine Cinvaram was borrowed from HBRI for preparing CSEB piece which form measure is around (240mm x 110mm x 70mm). CSEB square should be uniform size and thickness. Mould should be filled with the same amount of mix for each compaction by utilizing measuring weight gadget. For good flawless surface the inside faces of the machine form with oil which can be connected with a brush. The ram is a steel box with a foot that moves up and down. The soil mix is set within the box, and a steel cover is put on top. A lever is pulled to one side and the foot moves up, compressing the soil mix against the fixed top. The lever is discharged, the beat expelled, and as the lever is pushed into the inverse direction, the foot moves indeed further up, and the block is ejected. The machine can be worked by one or two individuals. Soil and cement were mixed with water until it was plastic sufficient to shape.

The soil mix was put in CINVA Smash form and compacted by hand and wooden bar in to begin with layer. Moment layer was at that point set and compacted once more physically. Finally, lever was used to press the mixture within the designed shape. By the mechanical lever physically compacted soil was compacted once more and its volume was decreased to 85% of original volume. This method to plan CSEB was repeated for each composition of soil. The soil arrangement and pressing operation can be best described by the pictures below



Fig 1: Collect Cement Sand



Fig 2: Mixing Cement & Sand, Water



Fig 3: Mould



Fig 4: Input Mixing & Tempting



Fig 5: Filling Mould



Fig 6: Giving Pressure by Hand



Fig 7: CSEB Block



Fig 8: Collecting CSEB Block

- Curing:** For increasing compressive quality and great production curing is one of most vital factor for CSEB. After preparing these pieces they were kept in shaded range. Following day the bricks were move to the AUST. These blocks were cured for 28 days. Blocks were secured with damp jute pack and showering water twice daily (morning and evening). Figure 9 shows the blocks after 1 days of production at the time of curing.

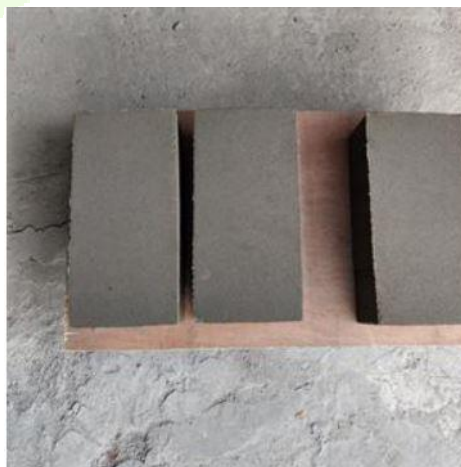


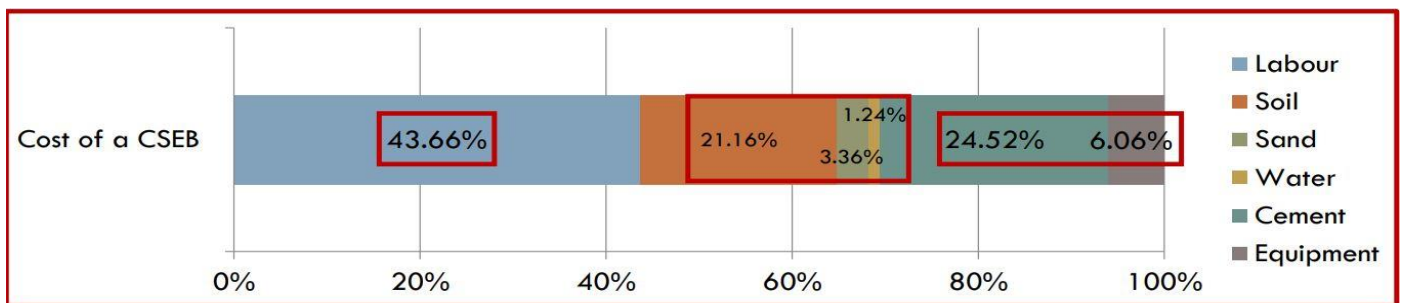
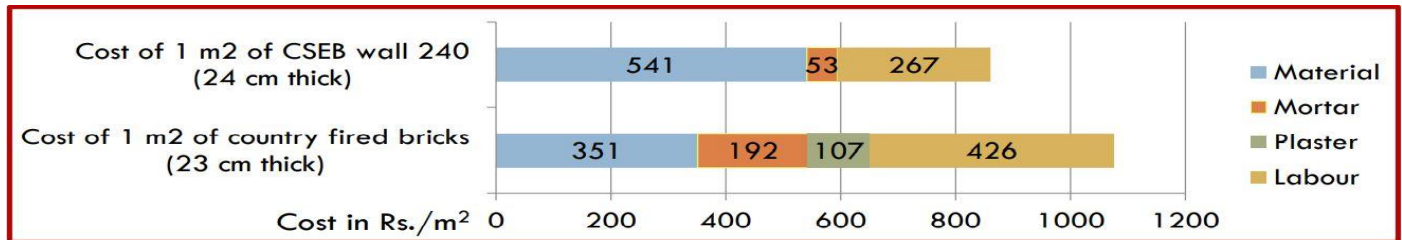
Fig 9: Curing of CSEB

- Water Absorption:** Water retention was conducted by immersing blocks into the water. Water absorption was calculated for different percentage of cement and for the different soil sample. This water absorption test was aiming to discover out the behaviour of CSEB with water. The test appears that for different percentage of cement water absorption fluctuated but with the alter of sand ratio with river dredged soil, water absorption did not differ much.

- **Cost Calculation:**
  - a. CSEB are generally cheaper than fired clay bricks.
  - b. No plaster is needed in most of building cases.
  - c. 5% of waste against 10% for clay bricks

Cost Comparison per sq.m of CSEB and clay brick wall-

- CSEB wall 24 cm thick= 861 rs/sq.m
- Fired clay brick wall 23 cm thick = 1076 rs/sq.m



### COMPARISON BETWEEN COMPRESSED STABILIZED EARTH BLOCK & BRICKS

Properties	CSEB Block	Brick
<b>Made from</b>	A mix of soil, sand, a stabilizer, and water.	Clay soil.
<b>Size</b>	300mm x 150mm x 90mm	230 mm x 110 mm x 70 mm
<b>Shape</b>	More uniform shape as they are cast in machine mould.	Do not uniform shape as they are hand mould made.
<b>Colour</b>	Varying shades of earth	Red to light light brown depending upon the type of clay used.
<b>Compressive Strength</b>	14.68 N/mm.sq	< 12.5 N/mm.sq
<b>Water Absorption</b>	6-12%	20-25 %
<b>Thermal Conductivity</b>	0.75 W/mK	0.6 to 1 W/mK
<b>Cost</b>	20-22 rs	10-12 rs

Wastage	2-5 %	Is more than 10%
<b>Environmental Impact</b>	Compressed Stabilized Earth Block (CSEB) give the opportunity of energy efficient, eco-friendly, agriculture friendly and sustainable development. It does not produce any harmful gasses during production. In this study, river dredged soil used to produce CSEB, so it also helps to save the agricultural land	Brick utilise clay which is naturally available. This production hence depletes the top fertile soil. Bricks also emits more carbon dioxide during manufacturing

- **Advantages of using CSEB block over the clay brick.**

1. **Inexpensive & Energy Efficient-**

CSEBs are made in-situ, decreasing the carbon-footprint. This also decreases the cost of manufacturing. CSEBs are around 40% cheaper than ordinary materials such as clay bricks. Due to their thermal mass quality, CSEBs can save anywhere between 10-15% on cooling and heating costs. Also, the time required to make these blocks is negligible.

2. **Structural Strength-**

CSEBs are endorsed construction material and broadly popular in numerous countries like France, UK, Germany etc. The testing of these blocks proved that their structural strength is more than that of adobe-earth which makes it a secure material that can be used for construction.

3. **Top of From Toxin Free-**

The materials which go into making CSEBs come from nature. No chemicals are utilized within the making of these blocks. subsequently CSEBs release no destructive or harmful gasses. CSEBs can be left exposed without any coating of paints and mortar which is an included advantage. Most of the paints that we utilize contain substances called Volatile Organic Compounds which can influence our well-being.

4. **Bio-Degradable –**

Whereas CSEBs are strong-enough to resist great loads, heavy rains and snow, on the off chance that demolished and disposed-off appropriately in soil, the humus can break CSEBs down and hence giving back soil to the earth.

5. **Sound proof & Resist to fire & pests-**

If you reside in the noisy neighbourhood, CSEBs are just the right material to construct walls within. They cut down the sound transmission and you don't need to spend much on a sound-proofing material. The lack of cellulose does not allow the mold-growth and the density of the blocks discourages pests and insects to make their way through!

6. **Aesthetics & Adaptability-**

The common colour and surface of the squares gotten from the soil opens the door to a modern world of conceivable outcomes in terms of design and imagination. Being a locally-produced item, they can adjust to different social, technical and social aspects.

7. **Reducing Deforestation-**

Most of the fired clay bricks are fired the using timber. CSEBs do not require the fire for their manufacturing process. This can be reducing the large number of trees being cut down.

8. **Responsibility towards society-**

CSEB manufacturing can provide the employment opportunities to the poor people while inculcating social values in them.

## Conclusion

- Major utilization within the world for construction is clay bricks; many researchers are presently seeking out for newer options because they require low cost materials, which are also environmentally friendly. The method of manufacturing clay bricks also requires high energy to burn due to the emission of CO<sub>2</sub> gas from this process.
- Stabilized compressed earth blocks incorporate; uniformed building component sizes, utilize of locally available materials and reduction of transportation. Uniformly, sized building components can result in less waste, faster construction and the possibility of utilizing other pre-made components or measured manufactured building elements. Such modular elements as sheet metal roofing which can be effortlessly coordinates into a CEB structure.
- The utilize of normal, locally-available materials makes good housing accessible to more individuals, and keeps money within the neighbourhood economy instead of investing it on imported materials, fuel and replacement parts.
- The soil utilized is by and large subsoil, taking off topsoil for agriculture. Building with neighbourhood materials can provide employment for neighbourhood individuals, and definitely considered more maintainable in times of civil economic difficulties.
- Individuals can frequently proceed to construct great covers for themselves in any case of the political situation of the country.
- The reduction of transportation time, taken a toll and attendant pollution can to make CEB more environmentally inviting than other materials.
- It is basic to ensure great distribution of particles amid the mixing and compacting forms of creating CSEB. Well-mixed blend of little and large totals can be accomplished when the littler ones filled up the empty spaces in between the larger aggregates.
- Subsequently, blend proportion of 1:8:2 (cement: soil: sand) was deemed appropriate to deliver laterite soil CSEBs with 2000 Psi compaction. At this optimum compaction, the total blend remained in its unique condition without changing its form.
- Moreover, all the comes about of the compressive strength (N/mm.sq) and water absorption rate (%) are found to be in accordance with the measures as indicated in MS 76:1972

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