A REVIEW ON BRICKS AND COMPRESSED STABILIZED EARTH BLOCKS

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ABSTRACT: Building with earth is one of those ancient technologies which still remain alive in the place untouched by industrialization. Innovation, however, has evolved in strength of compressed stabilised earth block with more strength gained. Mounted interest in searching sustainable green building material has created compressed earth stabilized brick which attract people for its low carbon emission especially in the production stage. This paper demonstrates the properties and benefit of CSEB compared to conventional brick especially in strength and durability. Past researchers has shown that with proper used of stabilizer and with right compressibility will improve the performance of CSEB. The result showed that compressed stabilized earth bricks are comparable with every respect of compressed stabilised earth block.

KEY WORDS: Stabilization; Lime; Long-term strength; Sustainability

1. INTRODUCTION

1.1 CEB

The soil, raw or stabilized, for a compressed earth block (CEB) is slightly moistened, poured into a steel press (with or without stabiliser) and then compressed either with a manual or motorized press. CEB can be compressed in many different shapes and sizes.

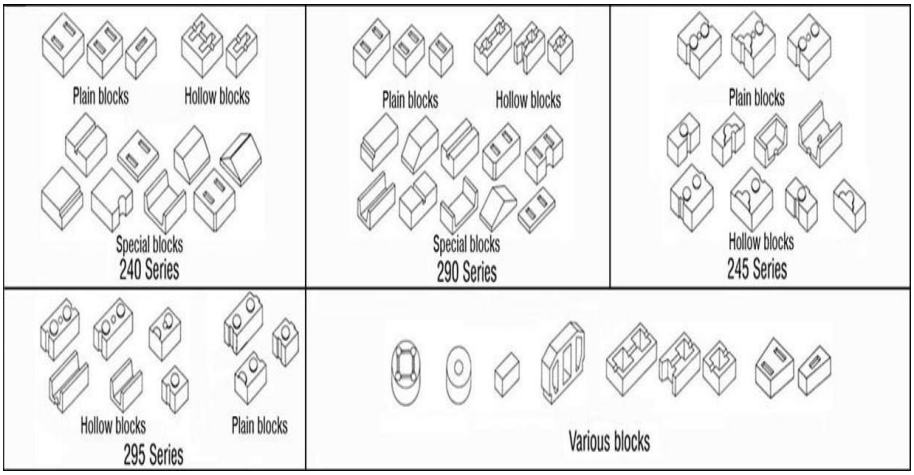

Fig. 1 Different *types of compressed earth blocks*

1.2 COMPRESSED STABILISED EARTH BLOCKS (CSEB).

The input of soil stabilization allowed people to build higher with thinner walls, which have a much better compressive strength and water resistance. With cement stabilization, the blocks must be cured for four weeks after manufacturing. After this, they can dry freely and be used like common bricks with a soil cement stabilized mortar. Since the early days, compressed earth blocks are most of the time stabilised.

Fig. 2 Auram hollow interlocking block 295

2. SUSTAINABILITY AND ENVIRONMENTAL FRIENDLINESS OF CSEB

- Earth is a local material and the soil should preferably extracted from the site itself or not transported too far away.
- Earth construction is a labour-intensive technology and it is an easily adaptable and transferable technology.
- It is a cost and energy effective material.
- It is much less energy consuming than country fired bricks (about 4 times less).
- is much less polluting than country fired bricks (about 4 times less).

3.1 SOIL IDENTIFICATION

A very few laboratories can identify soils for building purposes. But soil identification can be performed by anybody with sensitive analyses. The main points to examine are:

- Grain size distribution, to know quantity of each grain size.
- Plasticity characteristics, to know the quality and properties of the binders (clays and silts).
- Compressibility, to know the optimum moisture content, which will require the minimum of compaction energy for the maximum density.
- Cohesion, to know how the binders bind the inert grains. Humus content, to know if they are organic materials which might disturb the mix.

3.2 SOIL SUITABILITY

3.2.1 THE RAW MATERIAL

Soil is the result of the transformation of the underlying parent rock: it is transformed into smaller components and aggregates by the weather, the water, biological processes and by animal and plant life.

3.2.2 REMOVE THE TOPSOIL AND USE IT FOR AGRICULTURE

- A soil is an earth concrete**,** Soil contains gravel, sand and binders which are silt and clay.
- Silt and clay are the cement of the earth but they are not stable under water.
- They can be stabilized.
- Almost every soil can be used, as such or after improvement to get the best proportions.
- A good soil for CSEB is more sandy than clayey or silty.

3.3 FOUR TYPICAL SOILS

According to the proportion of the different components (gravel, sand, silt, clay) the soil will have different properties and behaviour, according to these categories. It will be named: Either: gravely (if more gravel), sandy (if more sand), silt (if more silt) or clayey (if more clay).

Fig.3 Different types of Soil

4. ROLE OF STABILIZERS USED IN CSEB

Stabilization is considered to be an important step in the manufacture of CSEBs, and is aimed at improving the performance of a soil as a construction material. Amongst the variety of soil stabilizers used, cement has been the most popular stabilizer in the manufacture of CSEBs. However, compared to cement, utilization of lime as a stabilizer in the preparation of CSEBs has not found popularity.

Bell and Coulthard, 1990; Little, 1995; Mallela et al., 2004; Amu et al., 2011; Herrier et al., 2012 reported Lime has been used in stabilizing clayey soils, and has been found to impart long-term strength gain.

Herrier et al. (2012) as reported that An outstanding testimonial of the durability of the lime-stabilized soils is the Friant-Kern irrigation canal in California .

In the recent past, attempts to independently utilize lime instead of cement in the preparation of CSEBs and compare their properties with those prepared with cement has been reported in the literature ***(Guettala et al., 2002; Raheem et al., 2010; Miqueleiz et al., 2012). Guettala et al. (2002)*** have tried to use various quantities of lime namely, 5%, 8% and 12% to improve the durability of the blocks. The evaluated dry strength of blocks reported by them is around 9.4, 14.2 and 16.2 MPa respectively for 5%, 8% and 12% of lime. Similarly, when tested under humid state, the strength of the blocks was found to be 4.4, 8.2 and 9.8 MPa respectively for 5%, 8% and 12% lime. From their study, it is clear that after an optimum value of lime content, any further increase in lime will not be so beneficial in the strength gain of the blocks. ***Raheem et al. (2010)*** have reported the 28 days wet compressive strength of compressed stabilized interlocking earth blocks prepared with lime and cement alone as stabilizers added in varying quantities from 5% to 25%, with an increment of 5%. For maximum amount of stabilizer content namely 25%, the strength gain of the blocks is found to be 3.2 MPa and 1.2 MPa for blocks prepared with cement and lime respectively. Very recently ***Miqueleiz et al. (2012)*** have reported the advantage of using lime towards the development of unfired clay bricks. From the results of tests conducted on cylindrical specimens of 65 mm diameter and 30 mm height prepared with use of 18% lime, they have found that, at the end of 90 days of ageing the maximum compressive strength of the cylindrical specimens was nearly 13 MPa, and the strength of cylindrical specimens prepared with 18% of cement were around 18 MPa. However, attempts to utilize lime in combination with cement as a stabilizer to achieve desirable properties of CSEBs have not been studied and reported. As lime is known to impart strength in the long term, its utilization in some proportion as a replacement to cement may be beneficial. This paper reports the attempts made to understand the role of lime in combination with cement as a stabilizer in improving the long-term properties of CSEBs, optimize the use of stabilizers and maximize the strength of the blocks. Any effort to optimize the quantity of stabilizers used in combination would help in reducing the cost of the blocks.

This work is thus aimed at contributing towards improvising the existing technology of manufacture of unfired earth blocks. This would be a good contribution towards sustainable development.

5.1 ADVANTAGE OF COMPRESSED STABILIZED EARTH BLOCKS (CSEB)

- Ideally, the production is made on the site itself or in the nearby area. Thus, it will save the transportation, fuel, time and money.
- The strength and durability has been proven since half a century. But let's imagine a building fallen down and that a jungle grows on it: the bio-chemicals contained in the humus of the topsoil will destroy the soil cement mix in 10 or 20 years… And CSEB will come back to our Mother Earth!
- Firewood is not needed to produce CSEB. It will save the forests, which are being depleted quickly in the world, due to short view developments and the mismanagement of resources.
- Requiring only a little stabilizer the energy consumption in a m3 can be from 5 to 15 times less than a m^3 of fired bricks. The pollution emission will also be 2.4 to 7.8 times less than fired bricks.
- Produced locally, with a natural resource and semi skilled labour, almost without transport, it will be definitely cost effective! More or less according to each context and to ones knowledge!

- Being produced locally it is easily adapted to the various needs: technical, social, cultural habits.
- It is a simple technology requiring semi skills, easy to get. Simple villagers will be able to learn how to do it in few weeks. Efficient training centre will transfer the technology in a week time.
- CSEB allow unskilled and unemployed people to learn a skill, get a job and rise in the social values
- According to the local context (materials, labour, equipment, etc.) the final price will vary, but in most of the cases it will be cheaper than fired bricks.
- Produced locally by semi skilled people, no need import from far away expensive materials or transport over long distances heavy and costly building materials.

5.2. LIMITATIONS OF CSEB

- Proper soil identification is required or unavailability of soil.
- Unawareness of the need to manage resources.
- Ignorance of the basics for production & use.
- Wide spans, high & long building are difficult to do.
- Low technical performances compared to concrete.
- Untrained teams producing bad quality products.
- Over-stabilization through fear or ignorance, implying outrageous costs.
- Under-stabilization resulting in low quality products.
- Bad quality or un-adapted production equipment.
- Low social acceptance due to counter examples (By unskilled
- People, or bad soil & equipment).

6. CONCLUSION

Major usage in the world for construction is clay bricks; many researchers are presently looking for newer options because they need low cost materials, which are also environmentally friendly. Stabilized compressed earth blocks include; uniformed building component sizes, use of locally available materials and reduction of transportation. Uniformly, sized building components can result in less waste, faster construction and the possibility of using other pre-made components or modular manufactured building elements. Such modular elements as sheet metal roofing which can be easily integrated into a CEB structure.The process of manufacturing clay bricks also requires high energy to burn due to the emission of CO2 gas from this process. The earth used is generally subsoil, leaving topsoil for agriculture. Building with local materials can provide employment for local people, and definitely considered more sustainable in times of civil economic difficulties. People can often continue to build good shelters for themselves regardless of the political situation of the country. The reduction of transportation time, cost and attendant pollution can also make CEB more environmentally friendly than other materials.

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