International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. 08 Special Issue 01 | 2023

Review On Compressed Stabilized Earth Material

Prof. S. S. Pawar[1], Kunal P. Chaudhari[2], Pallavi V. Kolte[3], Pragati N. Angait[4], Prasad S. Chopade[5]

[1]*Assistant Professor, Civil Engg Department, VBKCOE, MH, India*
[2,3,4,5] *Student, Civil Engg Department, VBKCOE, MH, India*

ABSTRACT

Earth as a building material has already known for centuries started with plain mud and straw utilized sun dried producing brick adobe with low strength and durability until its evolved to become fired clay brick with mass rapid production in the kiln. In the growing concern of awareness regarding sustainable building material and environmental issue,

Compressed Stabilized Earth Brick (CSEB) give the view of energy efficient, cost reduction and environmentally friendly building materials, overallcontribution on the sustainable development. It turned out that CSEB properties can be very easy bear comparison with other materials such as concrete block or normal fired brick.

Keyword: ***CSEB, Concrete block, Fired block***

1. INTRODUCTION

1.1 : Earth: An ancient but valuable construction material.

Earth is an ancient building material that has been used in many different ways around the world for thousands of years. A large part of the world's rural population still lives in earth building. but earth building is not a phenomenon only of the developing world. Many developed countries like France, Australia, and many other European as well as Asian countries, a remarkable percentage of rural population still prefer to live in earthen buildings. Building with earth materials can. Be a Wey, helping with sustainable management of the Earth's resources. They can be put in place using simple machinery and human energy. Earth buildings avoid deforestation and pollution, and can achieve low energy costs throughout their lifetime — in the initial manufacture and construction, in their use as homes, and eventually in their recycling back to the earth. Earth is more time- consuming than conventional design and construction, but for those who are providing their own labor, the time involved in earth construction may be less significant than the money cost of modern materials. Many people also value earth construction for its aesthetic qualities.

1.2: Advantages of Earth Building: -

1. Low cost of materials
2. Low energy and transportation costs
3. Easy to built
4. Thermal mass for natural heating by the sun
5. Earthen building maintains a balanced indoorclimate without extremes of temperature.
6. Earth is a renewable non-toxic resourcewhich can be readily recycled.
7. Earthen material is a low fire risk, non-combustible
8. Earth is virtually soundproof
9. Earth has natural warm texture and colors
10. Earth as building materials allows forexpression of personal creativity using traditional crafts and skills
11. Earth can be shaped by hand into attractivelyrounded forms and niches

1.2 : Disadvantages of Earth Building: -

1. Time and expense required for soil testing, calculations, and reports
2. Earthen construction requires morecustomized design effort
3. Design limitations, e.g., wall heights, the size of openings for windows and doors, or necessary roof overhangs to provide weatherdependent
4. Construction with earthen materials make construction period longer and also weather dependent

5. Higher overall contract cost unless you use your own labor
6. Because earth lacks the consistency andhardness of many manufactured building materials, you need to protect it from theelements. Generally, this means by design elements of the building like generous roofoverhangs. While earth construction has reasonable compressive strength, it hasrelatively low tensile strength to resist the sort of tearing apart forces that occur in anearthquake.

Fig-1 Earth Block

Fig-2 Hollow Bricks

1.3 : Compressed Stabilized Earth Blocks & (CSEB) Bricks

In everyday conversation the word brick and block sometimes refer to the same object and has ambiguity. The definition of brick and block depend the country of origin but British Standard BS 3921: 1985 Clay brick define a brick as a “a masonry unit notexceeding 337.5mm in length, 225mm in thickness(referred to as width in one of the standards) or 112.5 mm in height”. As for block BS 6073: 1981 pre-cast concrete masonry units defines a block as “a masonry unit which when used, in its normal aspect exceeds the length or width or height specified for brick” (Thomas).

CDI (Compressed Earth Block, 1998) definecompressed earth block as “masonry elements principally made of raw earth, which are small in size and which have regular and verified characteristic obtained by the static or dynamic compression of earth in a humid state followed by immediate remolding’’. Morton (Morton, 2008) even gives lighter definition for brick and block as a small masonry unit, lift able with one hand and a large masonry unit lift able with two hands, for the latter. The soil, raw or stabilized, for a compressed earth block is slightly moistened, poured into a steel press (with or without stabilizer) and then compressed either with a manual or motorized press.

The new development of earth construction really started in the nineteen fifties, with the technology of the Compressed Stabilized Earth Blocks (CSEB): research programmed for affordable houses in Colombia proposed the first manual press — the Cinram. Since then, considerable scientific researches have been carried out by laboratories. The knowledge of soil laboratories concerning road building was adapted to earth construction. Since 1960 — 1970, Africa has seen the widest world development for CSEB. India developed CSEB technology only in the nineteen eighties, but sees today a wider dissemination and development of CSEB.

1.4 : Energy Efficient and Eco-friendly Technique

CSEB has excellent thermal properties and lowenergy input required for production which makes this finished product of earth as an energy efficient and eco-friendly technique respectively. High thermal mass external walls in domestic buildings are considered to be more energy efficient than walls of lightweight construction, mainly on account of their high thermal capacity, that is, their ability to store heatand then to release it slowly when heat source is removed, in much the same way as a night storage heater. Earth is ideally suited to this form of construction because although its density is lower than that of concrete block work, its thermal characteristics are not dissimilar to those of fired bricks. Earth may be used to construct solid, cavity or cellular walls and may be mixed with lightweight aggregates to improve its thermal characteristics.

1.5 : Advantages of Compressed Stabilized EarthBlocks

1. Due to use of locally available material, it iseconomical in manufacture.
2. It can be used in low-cost housing up to fourstores.
3. Improve the speed and strength of structure.
4. Sizes of all block are uniform and same.
5. Less and unskilled labour are required inmanufacturing.

1.5 : Disadvantages of CSEB

1. Difficult to get mortgage from bank or cityoffices.
2. Wind driven rain erosion reduces thedurability of block.
3. Definite ratio of material is maintained inmanufacturing of block.
4. Specific soil must be required.

1.6 : Objective of Project

The current investigation proposes to study the engineering properties of Compressed Stabilized earth block bricks when stabilized with different materials mixed with different percentages with locally available soil, Considering the adaptability of the CSEB bricks for rural housing needs, the present study is conducted to achieve following characteristics:

a. To experimentally establish the suitability CSEB bricks.
b. To obtain the engineering properties of CSEB bricks when mixed with different stabilizers
c. To compare the performance of CSEB bricks with standard coal fired brick and with different stabilizers.
d. The present report will also give the cost analysis of the CSEB and its comparison with conventional coal fired standard bricks.

1.7 : Aspects of utilization

The position of compressed stabilized Earth block relative to other imaginary material can be stabilized according to aspects of use of the material

1. Technical aspects: it is its mechanical, static, hydrous, physical, etc. characteristic
2. Economic aspects: unit production cost,capital investment, etc.
3. Health and safety aspects: the emission of dangerous fumes, radioactivity etc.
4. Psychological aspect: the nature of thematerial, surface texture, colour, shape, luminosity, etc.

5. Ecological aspects: deforestation the following out of hill sites as a result of quarrying, use of water and energy sources, production of pollution and Waste material etc.
6. Social aspect: economic and social spin-off resulting from job creation, social culture acceptability, etc.
7. Institutional aspect: legislation, insurance, norms and development politician linked to the setting up of productive industries etc.
8. Taking these various aspects into account leads directly back to the need to carry out a preliminary technique-economic feasibility study before setting up a production system for this consideration weigh heavily in the choice of system. This should not over shadow the importance of these various aspects of utilization of the material.

2.

3. LITERATURE REVIEW

D. K. Soni et.al. (2008) Describes a detailed investigation on the strength behavior of black cotton soil mixed with different percentage of the additives,
i.e., lime and fly ash. When lime is added to a clayey soil, certain chemical reactions take place, which contribute to the strength gain of the soil. When a pozzolanic material such as fly ash is added to soil the reaction will take place rapidly. The 28-day cured specimens have been subjected to 14 cycles of freezing
-thawing and wetting drying in an opened system to study the durability characteristics of stabilized soil. It is found that tensile strength and durability of soil increase substantially by addition of lime and fly ash, Maximum strength gain is obtained when the lime-fly ash ratio varies in black cotton soil-lime-fly ash mixture.
The use of soil in housing is old method which strength should be loss due to saturation of soil. This will produce by mixing of cement as binding material in soil the water absorption property is estimate by keeping block in water 5 hrs. boiling and 24 hrs. cold emulsion test. They also use ground granulated blast furnace slag which will reduce the use of cement in block manufacturing which is also environment friendly. The laboratory tests which carried out on blocks are compression, density, and water absorption test. Construction by using this block required less energy consumption and no emission of co2 in manufacturing process of block. Effectiveness of fly ash and cement for compressed stabilized earth block construction.

Mohammad Shariful Islam, Tausif E Elahi, Azmayeen Rafat Shahriar, Nashid Mumtaz Construction and Building Materials 255, 119392, 2020. For saving natural resources, reducing pollution and increasing energy efficiency, Compressed Stabilized Earth Block (CSEB) can serve as a suitable alternative to conventional Fired Clay Brick (FCB). In this study, suitability of industrial waste, Fly Ash (FA) is assessed along with cement as stabilizers for producing CSEBs with coarse grained soil. Different combination of cement and FA (5–10% cement and 5– 25% FA; by weight of dry soil) was considered to prepare CSEBs for finding the optimum mix composition in terms of strength, durability, deformation characteristics and cost effectiveness. Furthermore, strength and durability test results are compared to the design criteria reported in Indian Standard, Sri Lankan Standard, Standard Australia, British Standard and Malaysian Standard for assessing its viability as construction material. With the increase in cement content, strength of the blocks gradually increases; however, at a definite cement content, addition of FA increases strength up to a certain limit and then begins to drop. Inclusion of 7–8% cement and 15–20% FA is found to provide adequate dry compressive strength (>5 MPa), wet-to-dry compressive strength (>0.33) and enough durability in terms of water absorption (<20%) as recommended by British Standard and Standards Australia. The behavior of the CSEBs were also analyzed through microstructural investigation, where SEM images were taken to ascertain the morphologic and anatomic changes that occurred at different fly ash contents. At a definite cement content, with the increase of FA, peak strain and failure strain increase; thereby indicating an improved straining capacity of the blocks due to inclusion of FA. Moreover, modulus of elasticity improves with increasing amount of cement and FA for both dry and wet state. Furthermore, economic analysis of a typical house constructed with CSEBs and FCBs was performed and compared with literature. Considering all the parameters it can be concluded that CSEBs prepared with cement and fly ash as stabilizers can be used as a sustainable construction material.

Shivnath Jangid, Milind Darade the Present Study is used to analysis the soil which is better for stabilized earth block. The Engineering behavior of Compress stabilized sand block (CSSB) such as compression strength, durability, water absorption etc. are depends on the types of soil and stabilized material as binder. Here the soil will be mixed with suitable proportion of stabilized such as lime, fly ash, cement, coir and Chemicals will be compressed manually or mechanically from literature review it find that by adding different stabilizer in soil up to some fixed proportion will increase technical properties of soil block. The Block produced will have more strength than conventional burnt clay brick. Soil tested and regarded as favorable for CSSB on the basis of density index which manufacture by Block Cotton Soil. It Concluded that the soil has more Compressive strength than normal brick but cannot satisfy the Condition of water absorption.

Giuffrida Giada, Rosa Caponetto, Francesco Nocera Sustainability 11 (19), 5342, 2019 Raw earth historic and contemporary architectures are renowned for their good environmental properties of recyclability and low embodied energy along the production process. Earth massive walls are universally known to be able to regulate indoor thermal and hygroscopic conditions containing energy consumptions, creating comfortable interior spaces with a low carbon footprint. Therefore, earth buildings are de facto green buildings. As a result of this, some earthen technologies have been rediscovered and implemented to be adapted to the contemporary building production sector. Nevertheless, the diffusion of contemporary earthen architecture is decelerated by the lack of broadly accepted standards on its anti-seismic and thermal performance. Indeed, the former issue has been solved using high-tensile materials inside the walls or surface reinforcements on their sides to improve their flexural strength. The latter issue is related to the penalization of earth walls thermal behavior in current regulations, which tent to evaluate only the steady-state performance of building components, neglecting the benefit of heat storage and hygrothermal buffering effect provided by massive and porous envelopes as raw earth ones. In this paper, we show the results of a paper review concerning the hygrothermal performance of earthen materials for contemporary housing: great attention is given to the base materials which are used (inorganic soils, natural fibers, and mineral or recycled aggregates, chemical stabilizers), manufacturing procedures (when described), performed tests and final performances. Different earth techniques (adobe, cob, extruded bricks, rammed earth, compressed earth blocks, light earth) have been considered in order to highlight that earth material can act both as a conductive and insulating material depending on how it is implemented, adapting to several climate contests. The paper aims to summarize current progress in the improvement of thermal performance of raw earth traditional mixes, discuss the suitability of existing measurement protocols for hygroscopic and natural materials and provide guidance for further researches. Effectiveness of saw dust ash and cement for fabrication of compressed stabilized earth blocks.

Tausif E Elahi, Azmayeen Rafat Shahriar, Md Kausar Alam, Md Zoynul Abedin Construction and Building Materials 259, 120568, 2020 This study focuses on investigating the effectiveness of Saw Dust Ash (SDA) and cement for fabricating strong and durable Compressed Stabilized Earth Block (CSEB) using coarse-grained soil. CSEB is a viable alternative to traditional Fired Clay Brick (FCB) as warranted by reduced associated pollution and increased energy efficiency. Four different cement contents (4%, 6%, 8% and 10%) and different SDA contents (0–10%) are considered to discern optimum combination to fabricate satisfactory CSEB in terms of compressive strength, shear strength, deformation behavior and durability. For a particular cement content, addition of SDA increases the compressive strength gradually, reaches a maximum value which is identified as optimum content and thereafter begins to drop. Optimum amount of SDA was found 4% for 4% cement, 6% for 6–8% cement and 8% for 10% cement. Addition of cement-SDA is found to increase the compressive strength of the blocks by 21–147% compared to that of unsterilized earth blocks. Moreover, optimum combination of cement-SDA provides CSEBs with maximum density and minimum porosity. Inclusion of cement-SDA is found effective in increasing angle of internal friction, ϕ of the stabilized mix. With addition of optimum SDA (4–8%) with cement, mixtures were found to exhibit ϕ> 58 o. CSEBs with optimum amount of cement-SDA is found to provide maximum modulus of elasticity, peak strain and failure strain. Addition of 6 – 8% SDA with 6–10% cement is found durable in terms of water absorption (< 15%), wet compressive strength (> 700 kPa) and wet-to-dry strength ratio (> 0.33). Based on all the parameters and obtained test results, it can be concluded that cement- SDA stabilized earth blocks can be efficiently considered as a suitable construction material. Compressed stabilized earth block shell housing: performance considerations

Ryan A Bradley, Mitchell Gohmert Practice Periodical on Structural Design and Construction 23 (3), 04018009, 2018 The adoption of structurally superior forms, such as domes and vaults, in combination with cheap, locally available materials is an efficient solution to low-cost housing. Earthen building materials, in particular, offer many benefits, such as sustainability, excellent climatic performance, low cost, and low carbon footprint. Furthermore, earthen masonry shells are typically designed as pure- compression structures, thus eliminating the need for expensive and energy-intensive materials, such as steel. However, although these shells are designed for compressive stress only, many show substantial cracking damage, which may become hugely problematic because these pathways enable water to enter and saturate the underlying material. This is concerning because moisture can severely compromise the strength and durability of earthen masonry. In this paper, the advantages and difficulties associated with adopting unreinforced compressed stabilized earth block (CSEB) masonry shells for low- cost housing are reviewed, particularly from a South African context. Of particular focus are issues with the performance (e.g., strength and durability) of these structures. Subsequently, considerations are presented to improve the longevity of CSEB shells, which are based on a review of the literature as well as an evaluation of several full-scale masonry shells built in South Africa. The case studies considered in this paper reveal that cracking may be detrimental to the performance of CSEB shell housing structures, particularly in low-cost settings where maintenance and repairs are often deficient.

3. METHODOLOGY

It is proposed to mix soil with different stabilizer in different percentage by weight of dry soil. The materials that would be used as stabilizer in present study are lime, coir, fly ash and rice husk.The block shall be produced by compressing the stabilized soil into a block in a machine.

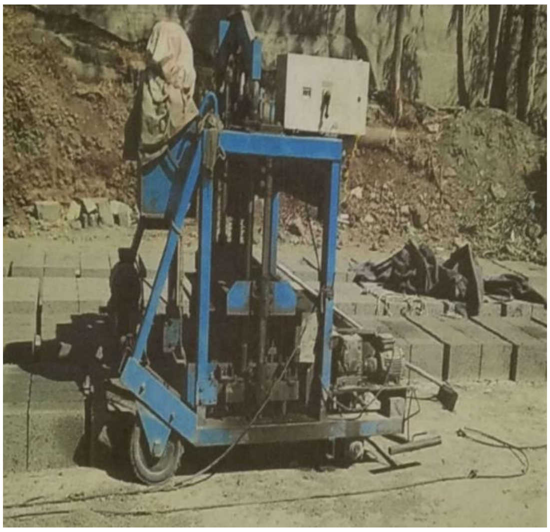

Fig-3 Manufacturing of Compressed StabilizedEarth Blocks

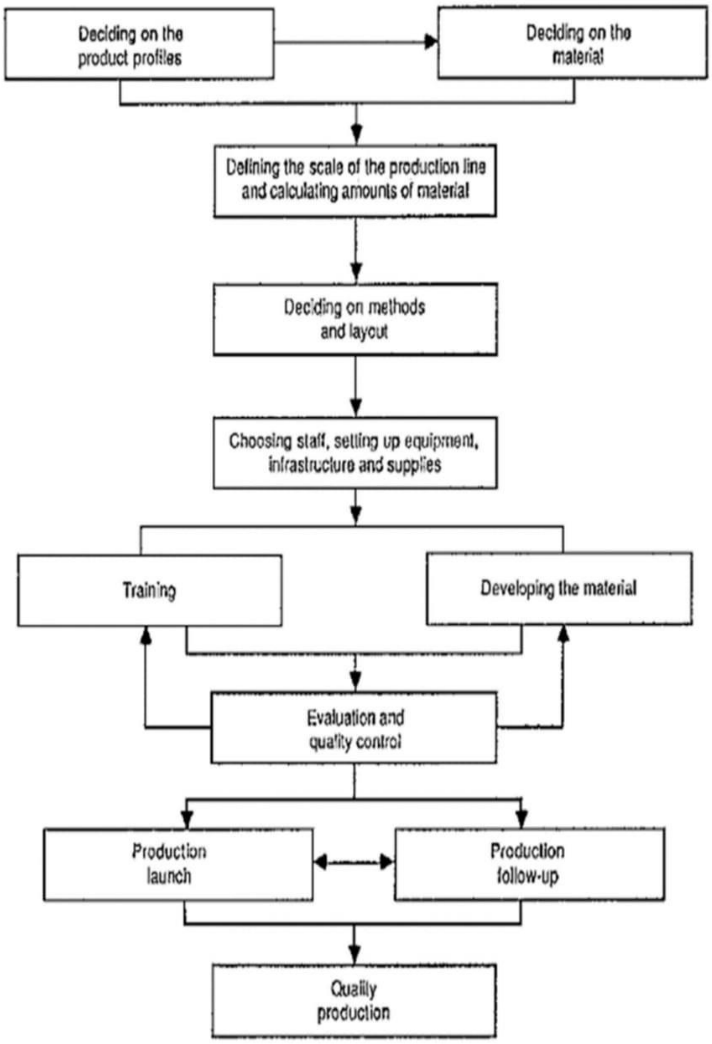

Chart -1

3.1 : Manufacturing of CSEB bricks

The CSEB bricks shall be made by performingthe following steps:

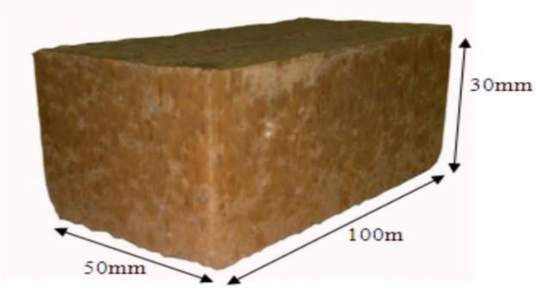

Fig-4 Standard Brick

1. A total of 140 CSEB samples size 100×50×30 mm (as shown in above figure) was produced with different mixture ratios and compaction pressures.
2. The process started with preparing all the raw materials such as laterite soil, sand, OPC and water.
3. The particle sizes must be 2 mm for sand and less than 5 mm for laterite soil in order to ensure the binding between all materials when mixed together.
4. The three different mix proportion ratios of cement:sand:laterite soil employed in this study were 1:1:9, 1:2:8, 1:3:7. The added water should not be more than 15% by the ratio.
5. The CSEB mixture was poured into a mould and then compacted using a hydraulic compaction machine.
6. To maintain or avoid the water content in the CSEB samples from draining quickly during curing process, they were placed under covered area or protected from direct sunlight and rain, for two different time periods of 7 days and 28 days

Fig-5 Manufacturing a Of Earth Block

3.2: Test on soil

1. Moisture content test
2. Atterberg limits test
3. Specific gravity of soil
4. Dry density of soil
5. Compaction test (proctor's test)

3.3 : Test on CSEB

The performance specification of CSEBs is based on B. I. S. 1725-1982 and tested accordance withI.S 3495-1992

a. Dimension variation
b. Compressive strength
c. Water absorption
d. Erosion

It is proposed to make the block using soil using with different material in different proportion. For this purpose, four types of tests on soil i.e., liquid limit, plastic limit, shrinkage limit, and gradation test shall be performed. The observation and result obtained from this test will be analysis as per I. S. code part (IV).

4. CONCLUSIONS

1. 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.
2. When the soil is stabilized with 10% of cement and Algiplast 210N, Conplast SD110 is of 1.0% & 0.3% respectively, the highest compressive strength of 4.949N/mm2and water absorptionof 21.54% was achieved.
3. The investigation of this thesis has revealed that many different factors are responsible forensuring a good bond between the cement,chemicals and particles mix together. These requirements not only affect the components of the mixture used, how it prepared, deliveredinto its final state, but also environmental conditions of the finished product.
4. Different research workers have contributions on the Compressed Stabilised Earth Blocks in terms of different parameters. CSEBs are eco- friendly and as these blocks are unburnt products, during production no coal or burning material is needed. So, it does not produce any harmful gases during production Without utilization of stabilizer, the strength ofCSEB obtained is very less or negligible. So, mixing of stabiliser with sand and clay in CSEBis must.
5. Use of OPC as stabilizer in place of PPC gives more strength to the CSEB with same proportion of sand, clay and stabilizer.
6. Use of lime in place of OPC at constant proportion of sand, clay and fly ash increases the strength of CSEB.

5. REFERENCES

1. Hubert Guillaud, Thierry Jaffory, Pascal Odul, ‘Compressed stabilized Earth Block: Manual of Design & Construction, vol. II, pg. no. 10, 1985.
2. Kabiraj.K., Mandal.U.K. ‘Experimental investigation and feasibility study on stabilized compacted earth block using local resources’ IJCSE vol. 2, e.g., no. 838, 2012.
3. Fetra Venny Riza, Ismail Abdul Rahman & Ahmad Mujahid Ahmad Zaidi (2011), “Preliminary Study of Compressed Stabilized Earth Brick (CSEB)”, Australian Journal of Basic and Applied Sciences, 5(9): 6-12, 2011.
4. Sadek Deboucha & Roslan Hashim (2011), “A review on bricks and stabilized compressed earth blocks”, Scientific Research and Essays Vol. 6(3), pp. 499-506, 4 February, 2011.
5. Properties of Compressed Stabilized Earth Blocks (CSEB) For Low-Cost Housing Construction: A Preliminary Investigation by Baba Shehu Waziri, Zanna Alhaji Lawan, Mustapha, Maaji Mala, International Journal of Sustainable Construction Engineering &Technology (ISSN: 2180-3242) Vol 4, No 2, 2013, page no. 39-44
6. Compressed Stabilized Earth Blocks by using Lime by Abhijeet D. Patil, Dr. A. C. Attar, International Journal of Engineering Research& Technology (IJERT)ISSN: 2278 - 0181 (Vol. 4Issue 09, September-2015
7. Study on bricks and stabilized compressed earth blocks by Sadek Deboucha and Roslan Hashim, Scientific Research and Essays Vol. 6(3), page no. 499-506, February, 2011.