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EXPERIMENTAL INVESTIGATION ON COM-PRESSED STABILIZED EARTH BLOCK

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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, overall contribution 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 This paper presents investigation 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.

Keywords: *CSEB, BCS, Remolding, Batching*

1.INTRODUCTION

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, of 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.

1.1 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 not exceeding 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) define compressed 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 remoulding''. 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.

Figure 1: Earth Blocks

1.1 Advantages of CSEB:

- Due to use of locally available material, it is economical in manufacture.
- It can be used in low-cost housing up to four storey.
- Improve the speed and strength of structure.
- Sizes of all block are uniform and same.
- Less and unskilled labour are required in manufacturing.
- Good architectural view.
- Good sound proofing property.
- Fire resistance property.

1.2 Disadvantages of CSEB

- Difficult to get mortgage from bank or city offices.
- Wind driven rain erosion reduces the durability of block.
- Definite ratio of material is maintained in manufacturing of block.
- Specific soil must be required. Low cost of materials, energy and transportation costs

2.LITERATURE REVIEW

D. K. Soni et.al. (2008) Describes a detailed investigation on the strength behaviour of black cotton soil mixed with different percentage of the additives, ie. 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 open- ended 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**.**

Shivnath Jangid, Milind Darade ,The Present Study is used to analysis the soil which is better for stabilized earth block. The Engineering behaviour 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 favourable 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.

Raju Sathish Kumar (2012) In this paper cement stabilized compressed earth block gave the view of energy efficient cost reduction and environmental friendly building material. Rice husk is commercially available in India, rich in silica content which can be used in supplementary cementetious material. By increasing the cement content reducing clay content this improves dry shrinkage and durable characteristics. Pressed soil block made from red soil have more than 5 % of clay content. Possess to good erosion resistance. The bond strength decreases when saturation increases normally it will be lowered in the case of compressed earth block. Improving compactive stress from 5-20 Mpa and the line content 3-12% it will improve the compressive strength in dry as well as wet state.

Fetra Venney Riza (2011) Have demonstrates the properties and benefit of compressed stabilized earth block compared to conventional brick especially in strength and durability. The compressed earth block is defined as "masonry elements principally made of raw earth, which are small in size and which have regular and virilised characteristic obtained by the static or dynamic compression of earth in a humid state followed by immediate demoulding.

3. PROPERTIES AND MATERIAL USED

3.1 Soil

The Soil sample was collected from malkapur ,Maharashtra, India.from 2 m depth belowthe natural ground level.

The soil classified as 'CH' as per I.S.Classification (I.S: 1498- 1978) .

Figure No.2: Soil sample

Table No. 1 : Some Basic Properties Of Soil sample

S.N.	Properties of soil	Values
1	**Liquid limit**	**41.25 %**
2	**Plastic limit**	**17 %**
3	**Plasticity index**	**24.25 %**
4	**Specific Gravity**	**2.58**
	Compaction Characteristics (Light Compaction)	
5	**(a) Maximum Dry unit weight**	**1.62 g/cc**
	(b) Optimum Moisture Content	**22 %**
6	**Grain size distribution**	
	Sand	**24 %**
	Silt	**34 %**

	Clay	**42 %**
7	**IS Classification**	**CH**

3.2 Fly ash

Fly ash is a finely divided residue made from the combustion of pulverized coal that can be used to increase durability and workability. Fly ash is taken from Paras which is thermal power station producing electricity.

Figure No.3: Fly ash

3.3 Lime

In construction, the dominant use of lime is in soil stabilization for roads, earthen dams, airfields, and building foun
dations. Lime can be combined with certain additives to produce other metals and is also a key ingredient in mortar
and plaster in lime slurry form. Lime is purchased from local help.

Figure No.4: Lime

4. MANUFACTURING OF CSEB BLOCK

4.1. Batching & Mixing

The batching is defined as calculation of amount Weighting and initial blending of raw materials prior to forming operation is known as Batching. In batching process the content of stabilizer are varied from 5% to 15% and up to 30% Lime alone do not give advisable strength, hence lime is added along

with chemical to improve strength of block. Fly ashes itself have cohesive property. So it is use along and also with chemicals to improve strength of block. This all materials according to their proportions are kept in bag and utilize at time of dry mixing process

4.2 Casting

All material batches were packed and numbered according to their proportions. First, the dry mixing process is carried out into a large pan by using trowel and shove. Then water will be added slowly into dry mixing by keeping liquid limit and plastic limit test carried out into laboratory. Later than wet mixture is carry on mould and Hydraulic pressure will apply according to requirement in block are comes out from machine and going further next step.

4.3 Drying

After making block, it places in shed for drying process because crack are take place on block. This crack arises due to rapid loss of water from block and quick shrinkage.

4.4 Proportion of block casting

4.4.1 BCS with fly ash

Table No 2. Various Properties of Black Cotton Soil and fly ash

S.N.	Soil	Fly ash
1	90%	10%
2	80%	20%
3	70%	30%
4	60%	40%
5	50%	50%

4.4.2 BCS with Lime

Table No 3. Various Proportion of Soil, Lime and Chemicals.

S.N.	BCS	Lime
1	95%	3%
2	92%	6%
3	87%	9%
4	84%	12%
5	79%	15%

4.4.3 Stone dust with Fly ash and Chemical

Table No 4. Various Properties of Stone Dust, Fly ash, Chemical

Stone Dust	Fly ash	Chemicals
87.5 %	10 %	2.5 %
75 %	20 %	5 %
62.5 %	30 %	7.5 %
50 %	40 %	10 %

The stone dust Bricks are currently manufactured by the bricks industries in Jalgaon. This bricks are also tested just to get a brief idea about its properties. It is seen that bricks made by using combination of stone dust, fly ash, and lime has less strength compared to manufactured CSEB bricks and also effort were made to replace lime by chemicals and this increase the compressive strength of bricks prepared by stone dust, fly ash and chemicals. New technique developed by industries was manufacturing of gypsum bricks. So gypsum bricks are also examined for their engineering properties and found that Gypsum bricks have good compressivestrengthcomparedtoLimebrick

4.5 Machine

Many machines and manufacturing procedure of different block are examined .Out of these, a Hydraulic pressure of Rakesh Bricks Industries, 192 V-sector, MIDC, Jalgaon was chosen. This machine can impart pressure of 3 tonne and manufacture six blocks at a time. The machine is an indigenous type, make of Karmyog Manufacturing Industries, Gujarat.

Fig. 5 Hydraulic Compression Machine

5 Test & Results

5.1. Compressive strength Of Different CSEB Brick

1) BCS with fly ash

Compressive strength of bricks is important as an indicator of masonry strength and as a result brick has become an important brick de sign. AS per IS 1325-1992 pages number 1, the Compressive strength of bricks should be 3.5N/mm2

Table No. 4. Compressive Strength for Varying % Of Fly ashIn Bricks

S.N.	BCS	Fly ash	Compressive strength in N/mm2
1	90%	10%	140.26
2	80%	20%	127.00
3	70%	30%	112.33
4	60%	40%	111.67
5	50%	50%	48.33

2) BCS with lime

Table No. 5. Compressive Strength for Varying % Of lime In Bricks

S.N.	BCS	Lime	Compressive strength in N/mm2
1	95%	3%	140.26
2	92%	6%	127.00
3	87%	9%	112.33
4	84%	12%	111.67
5	79%	15%	48.33

6 Conclusion

The following conclusion is drawn based on the current investigation:

- The compressive strength of CSEB bricks decrease as the percentage of fly ash is increase when mixed with black cotton soil.
- When black cotton soil was mixed with lime and the bricks underwent compressive but did not fail by crushing like convectional burnt clay bricks.
- Stone dust+20% fly ash +5% chemical showed almost 4 times the compressive strength as compared to convection bricks and manufactured Bricks. This proves that convectional practice of using lime can be replaced by using chemicals for better compressive strength.
- When black cotton soil is mixed with different stabilizer, the water absorption test could not be conducted on such types of CSEB bricks. Hence, the resistance to water of CSEB bricks, when manufactured using Black cotton soil as basic material, as questionable and needs further research and experiments.

- Finally, it can be said that when black cotton soil is stabilized with different stabilizers for manufacturing compressed stabilized earth block, its compressive strength increase but water resistance is negligible. Although, such bricks will gives better compressive strength when compared with different types of convectional as well as compressed stabilized earth blocks.

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