Study of Compressed Stabilised Earth Block

B. N. Patowary[1], N. Nath[2], I. Hussain[3], H. J. Kakoti[4]

[1]*Assistant Professor, E-mail: bhaskarendra@gmail.com*
[2]*Under-Graduate Student, E-mail: nitiznath@gmail.com*
[3]*Under-Graduate Student, E-mail: imranhussain0792@gmail.com*
[4]*Under-Graduate Student, E-mail: cikukakoti@gmail.com*

Department of Civil Engineering, Assam down town University, Guwahati, Assam- 781026.

Abstract- In the growing concern of awareness regarding sustainable building material and environmental issue, Compressed Stabilized Earth Block (CSEB) gives the view of energy efficient, cost reduction and environmental friendly building materials, overall contribution on the sustainable development. Different research workers have contributions on the Compressed Stabilized Earth Blocks in terms of different parameters. CSEBs are eco-friendly and as these blocks are un-burnt products, during production no coal or burning material is needed. So, it does not produce any harmful gases during production. In this paper, result of test of soil that has been used in the production of CSEB is shown. Highly compressed un-burnt blocks have been prepared in the laboratory with different composition and varying proportions of sand, clay and stabilizers such as lime, cement etc. Fly ash is also used as stabilizer in replacement of cement. The strength of different blocks are determined and compared to find the composition which gives highest strength and also to compare between different blocks to get the optimized composition and proportion in terms of economy and strength.

Keywords- *strength, economy, un-burnt, lime, cement, fly-ash*

I. INTRODUCTION

Earth, undoubtedly is the oldest building material known. Even though building with earth once fell out of popularity when the modern building materials and methods were discovered, but then it gains its revival time following the energy crisis. Moreover, growing concern and interest about environmental and ecological issue globally also increased the use of earth as a building material.

The compressed earth block is the modern descendent of the moulded earth block, more commonly known as the adobe block. The idea of compacting earth to improve the quality and performance of moulded earth blocks is, however, far from new, and it was with wooden tamps that the first compressed earth blocks were produced. This process is still used in some parts of the world. The first machines for compressing earth probably date from the 18th century.

Compressed Stabilised Earth Blocks (CSEB) represents a considerable improvement over traditional earth building techniques. When guaranteed by quality control, CSEB products can very easily bear comparison with other materials such as the fired brick. Hence the allegiance it inspires amongst decision-makers, builders and end-users alike.

II. METHODOLOGY

A. Soil Identification

Soil identification can be performed with sensitive analyses.

The main points were examined as:

1. Grain size distribution to know quality of each grain size
2. Plasticity characteristics to know the quality and properties of each of the binders
3. Sample Details : Red Earth
4. Plastic Limit =56%
5. Liquid Limit=66%
6. Plasticity Index = 10 =Slightly plastic
7. LI= 1, hence the remoulded soil is at the liquid limit and it has un-drained shear strength of about 2KPa.

B. Procedure for Making CSEB (Compressed Stabilized Earth Blocks)

1. Collected the soil sample.
2. Test for soil classification.
3. Various mixing of ingredients/stabilizers with clay soil and sand varies in percentage of mixing.
4. The various mixes are placed in the proposed brick mold.
5. The mold is compressed in a process (manually compress).
6. Then it is dried for 28 days.
7. Strength determination on UTM/CTM.

(**N.B**: since it is not burned, it was not cured)

Figure 1: Mix of sand, clay & OPC

Figure 2: Mix of lime, sand &clay

Figure 3: Compressed Earth Block without Stabilizer

III. MIX PROPORTIONS

Soil samples have been mixed in various proportions and stabilizers are also mixed in various proportions with the mixed quantity of soil samples to find the strength of Compressed Stabilized Earth Blocks (CSEB) with different composition and at different proportions.

The table below shows the proportion of different models of CSEB prepared along with different composition.

Table 1: Mix proportion with varying percentage of soil and stabilizers

Block Serial No. ⇩	Quantity of Stabilizer/ingredients					
	Lime %	**Clay %**	**Sand %**	**OPC %**	**Fly ash %**	**PPC %**
CSEB 1	-	20	70	10	-	-
CSEB 2	-	30	70	-	-	-
CSEB 3	10	20	70	-	-	-
CSEB 4	-	20	70	-	-	10
CSEB 5	5	20	70	-	-	5
CSEB 6	-	20	70	-	10	-
CSEB 7	-	20	70	5	5	-
CSEB 8	5	20	70	-	5	-

(**N.B.:** Percentages has been taken in total weight of 5kg)

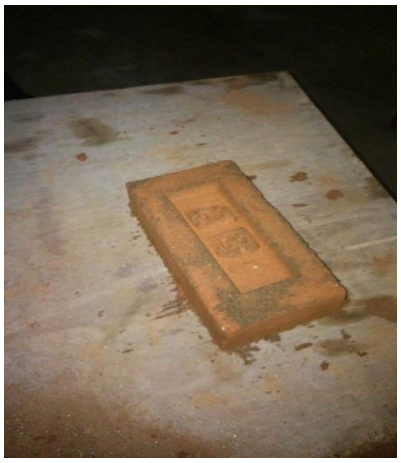

Figure 4: CSEB with Sand (70%) + Clay (20%) + Lime (10%)

Figure 5: CSEB with Sand (70%) +Clay (30 %)

Figure 6: Breaking of CSEBs in CTM

The table below shows the strength of CSEB obtained from test.

Table 2: Result of Strength of the built CSEB (un-burnt)

Block Serial No.	Stabilizers & Ingredients	Strength (N/mm^2)	Load (KN)
1	Sand (70%) + Clay (20%) + OPC (10%)	3.11	97.30
2	Sand (70%) + Clay (30%)	0.62	19.40
3	Sand (70%) + Clay (20%) + Lime (10%)	1.68	52.80
4	Sand (70%) + Clay (20%) + PPC (10%)	1.216	38.00
5	Sand (70%) + Clay (20%) + Lime (5%) + PPC (5%)	0.995	37.10
6	Sand (70%) + Clay (20%) + Fly ash (10%)	0.9088	28.40
7	Sand (70%) + Clay (20%) + Fly ash (5%) + OPC (5%)	0.832	26.00
8	Sand (70%) + Clay (20%) + Fly ash (5%) + Lime (5%)	1.05	32.50

- The strength of standard fired brick is found to be 3.984 N/mm^2

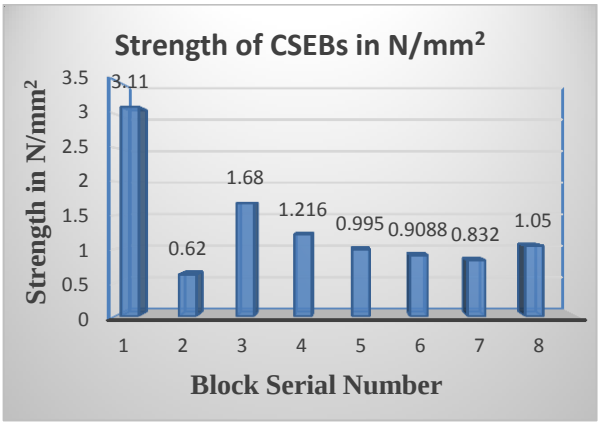

Figure 7: Chart showing strength varying per CSEB

IV. DISCUSSIONS

1. The Compressed Stabilized Earth Blocks (CSEB) was taken for strength determination after 28 days.
2. The blocks were un-burnt
3. After breaking the blocks strengths for various CSEBs were determined as shown on the Table 4.2 above.
4. The maximum strength obtained was 3.11 N/mm^2 for CSEB 1 i.e. Mix of Sand (70%), Clay (20%) &OPC (10%)
5. The minimum strength obtained was0.63 N/mm^2 (CSEB 2) i.e. the block without stabilizer. But if we see the CSEB 7, with stabilizer and mix with Sand (70%), Clay (20%), Fly ash (5%) & OPC (5%), strength obtained was 0.832 N/mm^2.
6. The standard block which was brought from manufactured factory and which was also burnt and used for construction of building, the strength for that block was found to be 3.21 N/mm^2.

V. CONCLUSION

From the results obtained from different tests, it can be concluded that:

1. 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 un-burnt products, during production no coal or burning material is needed. So, it does not produce any harmful gases during production
2. Comparing the strength of the standard block (the block brought from the manufacturing brick factory) with CSEB 1 [i.e. Mix of Sand (70%), Clay (20%) & OPC (10%)], the strength of burnt brick obtained is higher than the un-burnt CSEB. The strength obtained from CSEB1 is 3.11N/mm^2. If CSEB 1, CSEB 3 [Sand (70%) + Clay (20%) + Lime (10%)], CSEB 4 [Sand (70%) + Clay (20%) + PPC (10%)] are burnt, it is obvious that the strength of the blocks will increase eventually, but un-burnt bricks are more economic than the standard fired one as the production of CSEBs require less labour and does not require coal.

3. Without utilization of stabilizer, the strength of CSEB obtained is very less or negligible. So, mixing of stabiliser with sand and clay in CSEB is must.
4. Use of OPC as stabilizer in place of PPC gives more strength to the CSEB with same proportion of sand, clay and stabilizer.
5. Use of lime in place of OPC at constant proportion of sand, clay and fly ash increases the strength of CSEB.
6. Introduction of Fly ash as a replacement to lime at constant proportion of sand and clay does not contribute to the increase in strength of CSEB, rather it decreases the strength of CSEB.
7. Introduction of PPC in place of lime does not contribute to the increase in strength of the CSEB, rather it decreases the strength.

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AUTHORS

First Author – Bhaskarendra Nath Patowary, *B.E(Civil).*, *M.E(Soil Mechanics and Foundation Engineering), Assistant Professor, Department of Civil Engineering, Assam down town University, Guwahati, Assam- 781026,*
E-mail: bhaskarendra@gmail.com
Second Author – Nitish Nath, *Under-Graduate Student, Department of Civil Engineering, Assam down town University, Guwahati, Assam- 781026,*
E-mail: nitiznath@gmail.com
Third Author – Imran Hussain, *Under-Graduate Student, Department of Civil Engineering, Assam down town University, Guwahati, Assam- 781026,*
E-mail: imranhussain0792@gmail.com
Fourth Author: Hirak Jyoti Kakoti, *Under-Graduate Student, Department of Civil Engineering, Assam down town University, Guwahati, Assam- 781026,*
E-mail: cikukakoti@gmail.com