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An Experimental Study and Performance Comparison of Burnt Clay Brick, Granite Cutting Dust and Coal ash Incorporated Compressed Stabilizes Mud Blocks

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ABSTRACT

The present project work started from studying literature related to a compressed stabilized mud blocks, masonry mortar and masonry construction. Test Conducted on Basic material and comparing substituting material basic property with replacing standard material. The methodology commenced from production of compressed soil blocks in order to evaluate the optimization of all materials like moisture content, (varied from 8 to 12%by weight of soil), GCD percentage (varied from 10 to 100% by weight of soil). Further modifications of soil and GCD combinations have been done by using cement as a stabilizing agent. CSMB are produced by taking both lower and upper limits of water content as well as GCD percentage. Based on maximum dry density achieved three combinations (G2W5, G3W4,G4W4) are selected for further methodology. A mechanical and durability property of newly designed CSMB evaluated according to IS 3495-1992 and compared with commercially available burnt clay bricks. An investigation also carried out according to IS 2250-1981 to examine the suitability of Coal ash and GCD in masonry mortar. A mechanical property of newly designed masonry structure and conventional masonry structure was evaluated according to 1905-1887. A different combination of stabilizer where in cement is replaced with coal ash in various percentage is studied and From that available data conclusion can be taken that newly designed CSEB (G4W4A5) satisfy the requirements of grade 4 bricks and equalize the performance of burnt clay bricks. It is able to substitute 50%cement by coal ash in the preparation of masonry mortar. Finally it is conclude that newly designed masonry structure can be used effectively in place of conventional masonry structure.Problems of disposal of waste material and manufacture of raw material for construction are reduced in present project and give rise to economical, eco-friendly and energy efficient.

Keywords: Compressed Stabilizes Mud Blocks,

I. INTRODUCTION

India is a developing country, especially in developing countries to build house with low cost by giving high quality is a very tough job. For construction mainly depend on burnt brick, cement & steel .The manufacturing process of these materials adversely affects environment & brought this materials from far distance, this give rise to lot of energy consumption &these materials contain lot of embodied energy in them. In order to find best

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alternative technologies, methods etc. It is always intelligence to look back at history so as to know and learn the simpler yet smarter ways of past, Mud blocks have different advantages, locally available, economical, recyclable and eco-friendly, but are also a way towards sustainable development.

Benefits of mud blocks are availability in large quantities, low price, easy to use and good fire resistance than other material etc. Major drawbacks of mud blocks are wall thickness is more compare to concrete walls, strength decreases due to saturation, eroded due to weathering condition, easily destroy from insects and long life of mud blocks is less compare to concrete walls. These drawbacks can be reduced by improving stability, strength, permeability and durability of soil. That is done by stabilization of soil. Stabilized mud blocks can be prepared by compacting a moist mixture of soil and cement in a machine. It is also called the Stabilized Compacted Mud block (SCMB). To increases the quality of SCMB, we must use stabilizing material as cement and to increase the soil or mud property by replacing some proportion of river sand to the soil. Again it leads to emission of greenhouse gases by manufacturing of cement and environmental disturbance of more using of river sand.

Hence our research mainly concentrate on what is the replacement material for cement and river sand, there is lot of industrial waste coming from granite industry while cutting of granites. An answer to the dust pollution generated by the processing of granite slabs, the dust can be put into good use by replacing in soil instead of river sand and burnt brick are produced by burning process they use lot of coal ashes produced is waste and dumping them to open areas and landfills which are harmful for environment, that ashes have some pozzolanic property. So, we can replace cement by coal ash instead of landfills.

Thus we reaching or touching the peak point of decreasing the adverse effect of industrial waste and also use of natural recourses for SCMB are economical and energy saving substitutes materials to the normal burnt bricks used for construction of buildings.

II. OBJECTIVE

- Locally available materials utilization.
- Minimization of skilled labors and modern equipment.
- Comparative study between the performances of conventional masonry structure and newly designed masonry structure.
- One of the main goals was to introduce CSMB as a good unit block for construction field with low cost and eco-friendly.

III. ADVANTAGES OF USING COMPRESSED STABILIZES MUD BLOCKS

- It is possible to eliminate outside or even inside plastering. This will lead to significant material saving.
- Mortar volume in CSMB masonry is about 35% less than that in brick masonry. Thus there are additional cost saving.
- CSMB facilitates self-help construction in rural area.
- Reducing greenhouse gas and environmental impact.

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IV. MATERIALS

- **Soil:** Soil used in the design of CSMB was collected from the premises of government engineering college, Hassan. Geotechnical properties of soil represented in terms of moisture content, grain size analysis, liquid & plastic limit, specific gravity and standard proctor test. Geotechnical properties of soil was analyzed according to IS 2720-1965(PART II-V).
- **Granite Cutting Dust (GCD):** Large quantity of granite cutting dust generated from the granite industries, for the current research work GCD procured from the Uma Maheshwari granites located in the industrial area, Hassan. Physical properties of GCD investigated consubstantial to the natural river sand.
- **Cement:** Ordinary Portland cement (53 grade) used as the crucial stabilizer, cementations material in the production of CSEB and masonry mortar respectively. Physical properties of cement examined according to IS 4031-1988(PART 2 TO PART 6) and its propriety inspected according IS 12269-1987.
- **Coal ash**: The coal ash is dried and sieved in 90 micron, it also has good pozzolonic property helps to stabilize the brick. Thus by utilization of coal ash green concept comes to mind. It indirectly helps environmental problem and saves money or economy.
- **Sand:** Natural or river sand utilized as an inert material for the preparation of masonry mortar. Before being used in the mortar the properties of sand examined according to IS 2386-1963
- **Water:** Water is an essential component in the production of masonry units. Water reacts with cement and helps to ful fill the hydration process of cement. For the current research work the potable water is used for mixing the ingredients of masonry units and masonry mortar.

V. STAGES INVOLVED DURING PREPARATION OF CSMB

Quantity of dry materials (4720grams) required for the production of CSMB was found on basis of dry density (1.90g/cc) and size of the CSMB (230X108X100mm) to be produced. Trowel used as a tool for mixing of all ingredients. Mixing is done on water tight platform..Mixing of ingredients has been done in four stages.

- Mixing raw materials separately
- Mixing stabilizing agents separately
- After obtained uniform mix, encompasses sprinkling measured quantity of water to the dry mix and entire mixture remixed several times until the homogeneous mixture is obtained.
- Filling of Mould and Casting of Blocks

Before being used, the Mardhini block pressing machine must be calibrated and sides of the mould slightly oiled. Wet soil composition is than placed into the mould and the lid of the machine is now levelled then closed and toggle liver is now moved on to the lid after unlocking it. The liver is now pulled down by 2 persons till the compaction stroke is completed. Ejected CSMB kept free from direct sun light and rain (shaded area) for about an 24 hours and hydration process of stabilizers have been achieved by curing the CSMB in a wet gunny bags for about 28day.

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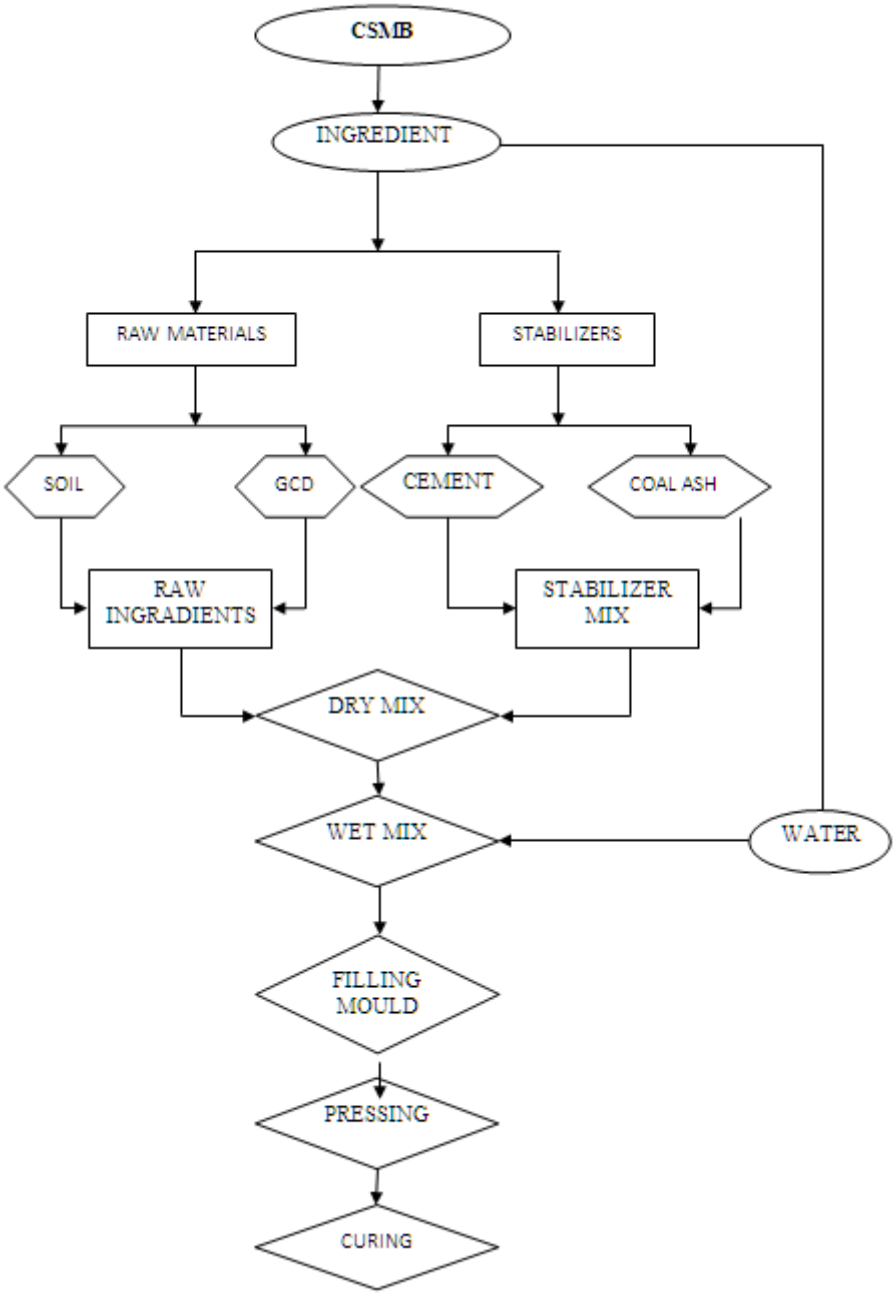

Fig.1 Work Flow for Manufacture of CSMB

VI. RESULTS

Table 1. Water Content Optimization

Percentage of water added by dry mass of soil	Fresh mass of blocks in grams	Wet density g/cc	Dry mass of blocks(after 24hours)in grams	Dry density of soil g/cc
8	4860	1.95	4680	1.88
9	4880	1.96	4660	1.87
10	4980	2	4840	1.95

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11	4920	1.98	4700	1.89
12	5020	2.02	4820	1.94

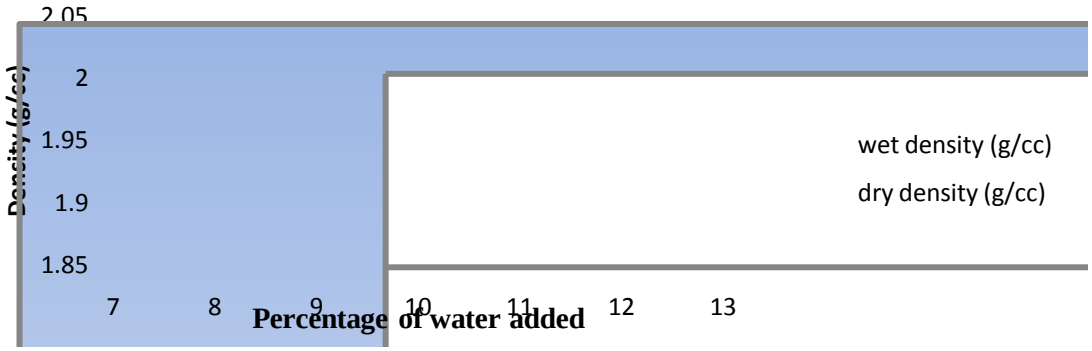

Fig.2 Density v/s water content

- Wet as well as dry density from density v/s water content curve clearly indicates that the 10% water content is optimum for the production compressed mud block made with constituent materials such as only soil without stabilizer.

Table.2 Optimization of Granite Cutting Dust Percentage

Combination	Combination of Soil+GCD	Fresh mass of block in grams	Wet density (g/cc)	Dry mass of block (after 24 hour)in grams	Dry density of soil (g/cc)
G1	90+10	4990	2	4760	1.91
G2	80+20	4960	1.99	4710	1.89
G3	70+30	5020	2.02	4760	1.91
G4	60+40	4960	1.99	4710	1.81
G5	50+50	4970	2	4710	1.81

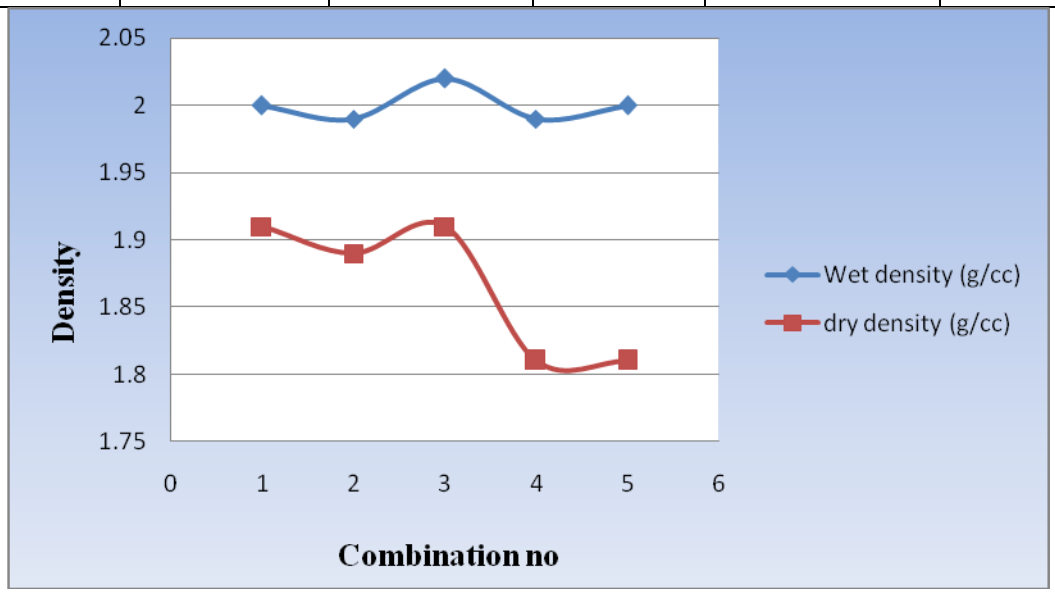

Fig.3 Density V/s Water content (optimization of GCD percentage)

- Soil is replaced by granite cutting dust by varying percentage from 10 to 100% water content required to achieve maximum compaction is kept 10% and stabilized mud blocks are casted.

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Table.3 Finding the Optimum Moisture Content and Maximum Dry Density of Compressed Stabilized Mud Block

Percentage of water	G1	G2	G3	G4	G5
8	1.9401	1.9611	1.9401	1.9655	1.9681
9	1.9632	1.9784	1.9781	1.9813	1.9792
10	1.9795	1.9926	2.0125	1.9934	2.0124
11	1.9932	2.0100	2.0113	2.0051	1.9792
12	2.0020	2.0153	2.0054	1.9913	1.9600

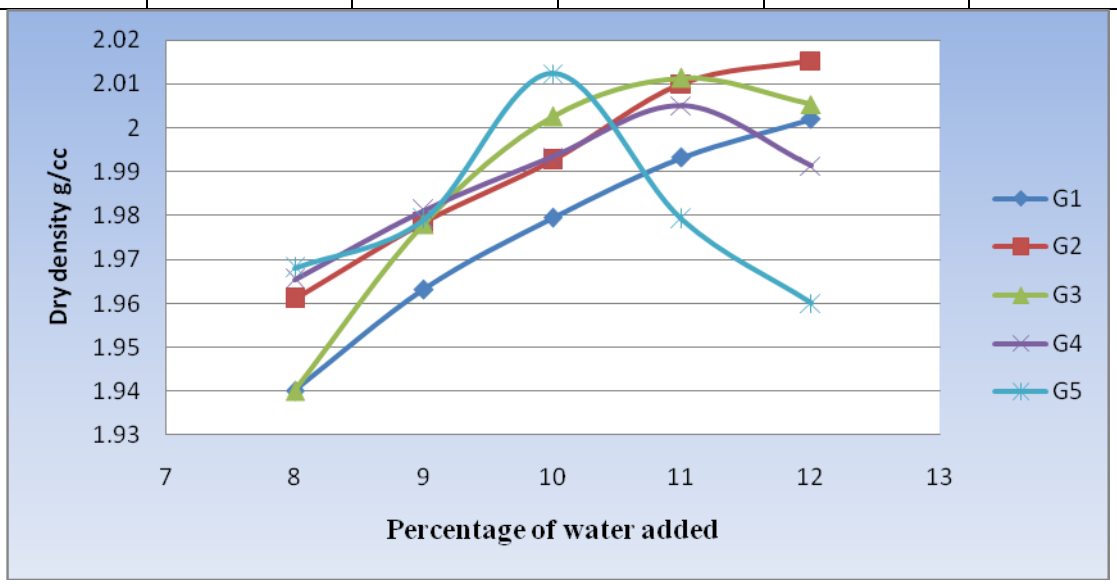

Fig.4 Density vs. water content (maximum dry density)

- Depending upon maximum dry density achieved the following three combinations are selected for further methodology

G2W5

G3W4

G4W4

- Combination M5W3 even after showing good maximum dry density was not selected due to difficulty encountered during pressing of blocks and blocks and blocks becoming fragile when freshly casted.

Table.4 Optimum Replacement of Cement with Coal Ash

Combination	Trial no.1 load(N)	Trial no.2 load (N)	Trial no 3 load (N)	Average Failure Load (N)	Area mm^2	Compressive Strength N/mm^2
G2W5 **1) 3 days**	54.5	55	55	54.83	230x108	2.21

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2) **3)**	**7 days** **28days**	80 125	75 120	75 130	76.67 125		3.13 5.03
G3W4							
•	**3 days**	55	45	50	50		2.01
•	**7 days**	65	70	75	70	230x108	2.82
•	**28days**	115	110	125	116.67		4.70
G4W4							
•	**3 days**	45	45	45	45		1.81
•	**7 days**	55	65	70	63.33	230x108	2.55
•	**28days**	115	110	110	111.67		4.5

Table.5 Mix Proportion for Optimum Combination (G4W4A5)

Ten Number Of CSMB					
Notations	**Raw Materials in Grams**		**Stabilizers in Grams**		**Water in ml**
	Soil	**GCD**	**Cement**	**Coal ash**	
G4W4	26054	17370	3780	0	5664
G4W4A1			3402	378	
G4W4A2			3024	756	
G4W4A3			2646	1134	
G4W4A4			2268	1512	
G4W4A5			1890	1890	

VII. CONCLUSION

- Current research work analyzes the use of coal ash, GCD as substituting materials for a cement& natural or river sand in the design of masonry structure. This minimizes the waste generated from the industries.
- Blocks with GCD as replacement for soil and coal ash as stabilizer were found to have good surface finish with straight edges and well defined corners.
- Granite cutting dust and coal ash incorporated compressed stabilized mud blocks show density around 2 g/cc and water absorption of 8.6%.Higher value of density reduces porosity in blocks and hence reduced water absorption. Water absorption was found within the limits
- Dimensionality and expansion on saturation test results are within the limits indicating that adequate stabilization has been obtained.
- With the increase in percentage of coal ash in stabilizer, wet compression strength and dry compression strength of blocks goes on decreasing. Coal ash up to 50% by weight of stabilizer (cement) can be

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substituted for production of compressed stabilized mud blocks. Selected combination C5A5 gives a wet compression strength of 4.063N/mm^2. And dry compression strength of 8.037 N/mm^2.Blocks produce using this combination specification for grade 4 of soil based blocks as specified in IS: 1725.

- Alternate wetting and drying test for durability shows decrease in wet compressive strength of 9% and dry compressive strength of 6%.Decrease in weight upon alternate wetting and drying was found within limits.
- According to IS 3495, Mechanical and durability properties of newly designed CSMB are well within limits and can be balanced with the commercially available burnt clay bricks.

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