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STABILIZED MUD BLOCK

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ABSTRACT : *Mud block is a construction material made primarily from soil. Types of earth block include compressed earth block (CEB), compressed stabilized earth block (CSEB), and stabilized mud block (SMB). Stabilized mud block is a building material made primarily from damp soil compressed at high pressure to form blocks. If the blocks are stabilized a chemical binder such as Portland cement they are called stabilized mud block (SMB). Creating SMBs differs from rammed earth in that the latter uses a larger formwork in to which earth is poured and manually tamped down, creating larger forms such as a whole wall or more at one time rather than building blocks. SMB uses a mechanical press to form blocks out of an appropriate mix of fairly dry inorganic subsoil, binders and fibers. The compression strength of properly made SMB can meet or exceed that of typical cement or adobe brick. Soil as a building material is available in most areas of world. In developing countries like India, earth construction is economically the most efficient means for house construction with least demand of resources*

INTRODUCTION

Adequate shelter is one of the most important basic human needs. Currently, the majority of developing countries are faced with a problem of providing adequate and affordable housing in sufficient numbers. In the last few decades, shelter conditions have been worsening: resources have remained scarce, housing demand has risen and the urgency to provide immediate practical solutions has become more sensitive. For providing low-cost housing, we must rely on locally available raw materials. However, they have not had a chance to do scientific experimental investigation on the balance of ingredients and the optimization of this production. The fibers provide a better coherence between the mud layers. The stress–strain relation of mud bricks under compression is very important. Furthermore, such materials are abundantly available and renewable in nature. Local soil has always been the most widely used material for earthen construction in India.

LITERATURE REVIEW

Kabiraj K., Mandal U. K. (2012) carried out an investigation to find out a suitable mix proportion to blend locally available materials such as soil, sand, clay, grits, jute, etc. with cement for making compacted earth block for construction of affordable residential buildings. **Vinu Prakash (2016)** carried out an investigation to find the suitable proportion of locally available materials such as soil, coir, straw, etc. with cement as stabilizers for improving the strength of locally available mud blocks and thus to provide affordable housing. Using soil (from areas of Neriamangalam) and stabilizers (cement, lime, straw fiber, coir fiber, plastic fiber), eleven different types of samples were prepared. Tests were conducted on these samples in order to evaluate their performance such as compressive strength and total water absorption on which the durability of the blocks depend. The investigation has revealed that, out of all block samples, blocks which are produced from10% cement (C10), 10% cement with 3% coir fiber (C10C) and 10% cement with 3% plastic fiber (C10P) have compressive strength and total water absorption values above the recommended minimum values for structural work.

Lekshmi Sathya Babu (2016) carried out an investigation to find the suitable proportion of locally available materials such as soil , coir , straw etc. with cement as stabilizers for improving the strength of locally available mud blocks and thus to provide affordable housing. Using soil (from areas of Kulathupuzha, Kerala) and stabilizers (cement, coir fiber, Areca nut fiber), different types of samples were prepared. The effect of altering important variables such as cement, lime, straw fiber, coir and plastic fiber content on the properties and performance of stabilized earth blocks were studied. The percentage of stabilizer and the most effective stabilizer was analyzed. **Alka Rani (2016)** carried out an investigation to find the suitable proportion of locally available materials such as soil, coir, straw, etc. with cement as stabilizers for improving the strength of locally available mud blocks and thus to provide affordable housing. Using soil (from areas of Neriamangalam) and stabilizers (cement, lime, straw fiber, coir fiber, plastic fiber), eleven different types of samples were prepared. Tests were conducted on these samples in order to evaluate their performance such as compressive strength and total water absorption on which the durability of the blocks depend. The investigation has revealed that, out of all block samples, blocks which are produced from10% cement (C10), 10% cement with 3% coir fiber (C10C) and 10% cement with 3% plastic fiber (C10P) have compressive strength and total water absorption values above the recommended minimum values for structural work.

MATERIALS USED

Sand

The sand was collected from different places in thrissur. The places include Chittilapilly and Pudukad. Preliminary tests were conducted to study the basic properties of sand used.

Cement

The Portland cement is to be used to make Stabilized Mud Block.

Fibers

The two fibers are used to construct SMB are coir fiber and areca nut fiber

EXPERIMENTS TO DETERMINE PLASTIC PROPERTIES OF SAND

Specific gravity determination

Specific gravity of soil was conducted as per IS 2380 part 3 section 1.It is determined by using pycnometer. Dry the pycnometer and weigh it with its cap (W1). Take about 200g to 300g of oven dried soil passing through 4.75mm sieve into the pycnometer and weigh again (W2). Add water to cover the soil and screw on the cap. Shake the pycnometer well and fill the pycnometer with water and weigh it (W3). Clean the pycnometer by washing thoroughly. Fill the cleaned pycnometer completely with water up to its top with cap screw on. Weight the pycnometer after drying it on the outside thoroughly (W4).

Specific Gravity, (GS) = (W2-W1)/ ((W2-W1)-(W3-W4))

The apparatus used to determine the specific gravity of soil is given below in Fig. 1.

Fig. 1 Pycnometer Bottle

Grain size analysis

This test is done to determine the particle size distribution of soil as per IS 2720 (part 4) _ 1985. Take a representative oven dried sample of soil that weighs about 500g. (This is normally used for soil samples the greatest particle size of which is 4.75mm) Prepare a stack of sieves. Sieves having larger opening sizes are placed above the ones having smaller opening sizes. After the very last sieve a pan is placed under it to collect portion of soil passing through 75micron sieve. Here is a full set of sieves 4.75mm, 2mm, 1mm, 600micron, 300micron, 212micron, 150micron and 75micron. Make sure sieves are clean; if many soil particles are stuck in the openings try to poke them out using brush. Weigh all sieves and pan separately. Pour the soil into the stack of sieves from the top and place the cover, put the stack in the sieves shaker and fix the clamps, adjust the time on 10 to 15 minutes and get the shaker going. Stop the sieve shaker and measurethe mass of each sieve plus retained soil.

Coefficient of uniformity, Cu = D60/D10Where,

The apparatus used to conduct sieve analysis test is given below in Fig. 2.

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Fig. 2 Sieve Shaker

Atterberg's limit

Atterberg's limit is basic measure of the critical water content of a fine –grained soil: its plastic limit and liquid limit. The liquid limit (LL) is conceptually defined as the water content at which the behavior of a clayey soil changes from plastic to liquid. However, the transition from plastic to liquid behavior is gradual over a range of water content, and the shear strength of the soil is not actually zero at the liquid limit. The precise definition of the liquid limit is based on standard test procedures described below. The original liquid limit test of Atterberg involved mixing a pot of clay in a round –bottomed porcelain bowl of 10-12 cm diameter. A groove has to be cut through the pat of clay with a spatula, and the bowl is then struck many times against the palm of one hand. Soil is placed the metal cup portion of the device and a groove is made down itscenter with standardized tool of 2 millimeter (0.079in) width. The cup is repeatedly dropped 10mm onto a hard rubber base at a rate of 120 blows per min, during which the groove closes cup gradually as the result of impact. The number of blows for the groove to close is recorded. The number of blows for the groove to close is recorded. The moisture content at which it take 25 drop of the cup to cause the groove to close over a distance of 12.7 millimeters (0.50 in) is defined as the liquid limit. The test is normally run at several moisture content which requires 25 blows to close the groove is interpolated from the result. The apparatus used to determine the liquid limit of soil is given below in Fig. 3.

Fig. 3 Casagrande Apparatus

Plastic limit

The plastic limit (PL) is determined by rolling out a thread of the fine portion of a soil on a flat, non-porous surface. The procedure is defined in ASTM Standard D 4318.If the soil is at moisture content where its behavior is plastic, this thread will retain its shape down to a very narrow diameter. The sample can then be remolded and the test repeated. As the moisture content falls due to evaporation, the thread Plasticity Index, IP = WL-WP

The Fig. 4 shows the thin thread of plastic soil of size 3mm.

Fig. 4 Plastic Limit

METHODOLOGY

PREPARATION OF MOULD

The compression machine have a box type part which is having a dimension of 254X127X76mm and handle which gives compression to the block to get stabilized. These both parts as well as the whole machine was prepared by using stainless steel.

Fig. 5 Compression machine

SOIL USED

The grain size analysis was conducted to determine the best soil composition. Here the stabilized mud block must have the standard soil composition of gravel as 10% - 15%, sand as 50% -75%, silt and clay as 15% - 30%.

PREPARATION OF MIX

The mix was prepared in different proportions for the tests as given below,

Soil+10% Cement+3% Coir fiber +13% Water Content

Soil+10% Cement+3% Coir fiber +15% Water Content

Soil+10% Cement+3% Coir fiber +17% Water Content

Soil+10% Cement+3% Areca nut fiber +13% Water Content

Soil+10% Cement+3% Areca nut fiber +15% Water Content

Soil+10% Cement+3% Areca nut fiber +17% Water Content

PREPARATION OF BLOCKS

The blocks were prepared by using areca nut as well as coir as incorporating agents. The mixes prepared by using coir and areca nut as fibers having three different water contents are made into blocks by compressing this wet mixture in the SMB machine. The compression provided was about the effect of load that can be given by two healthy persons. The size of the block obtained was 254X127X76mm.

Fig. 6 Stabilized Mud Blocks

TESTS CONDUCTED

The compressive strength test and water absorption test of each brick were conducted for the corresponding day after sufficient curing. The compressive strength tests were conducted after a period of 7 days, 14 days and 28 days of curing and the water absorption test was conducted after a period of 28 days of curing.

CONCLUSIONS

Building with earth is definitely appropriate and cost and energy efficient technology that has a great future. By using appropriate structural techniques and stabilization methods, stabilized mud block can be in used in almost all climates. In this type of construction locally available materials are used and are cost effective. By incorporating agents such as coir and areca nut fibers, the strength of the block increased than that of standard brick. In this context stabilized mud block can be considered as an alternative housing technology.

By using areca nut as fiber, the greatest strength was attained by the brick having 17% moisture content.

By using coir as fiber, the greatest strength was attained by the brick having 17% moisture content.

In the above mentioned two high strength bricks, the brick with areca nut as incorporating agent has maximum strength than that of brick with coir as incorporating agent.

The brick with areca nut as incorporating agent and having 17% moisture content reached the required range of water absorption value.

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