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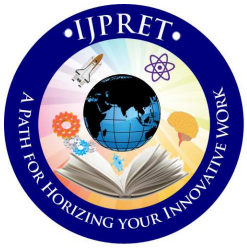

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A PATH FOR HORIZING YOUR INNOVATIVE WORK

COMPACTED STABILIZED EARTHEN BLOCK

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Abstract

This Paper investigates the possibility of making compacted earth block for construction of affordable residential buildings using locally available materials such as soil, sand, grits, jute etc. and blending them appropriately. The local soil was mixed with local sand and stone grits (gravel) to make a composite gravel soil 15 percent, Sand 40 percent, soil 35 percent approximately for compacted stabilized earth blocks (CSEB). This mixture blended with Ordinary Portland Cement (5.0 percent, 7.5 percent, and 10 percent), jute fibers of different sizes (1 cm, 2.5 cm and 5.0 cm) and compacting manually to the standard proctor density. They were cured and tested for compressive strength, water absorption as well as density.

INTRODUCTION

Providing affordable housing is a challenge around the world, especially in developing countries. Local soil has always been the most widely used material for earthen construction in India. Approximately, 55 % of Indian homes still use raw earth for wall constructions.

Major limitations in using earth construction are

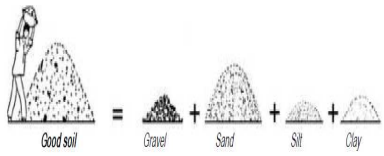
1. Water penetration
2. Erosion of walls at the plinth level/ lower level by splashing of water from ground surfaces.
3. Attacks by termites and pests
4. High maintenance requirement
5. Low durability

Compressed or compacted earth blocks overcome these limitations. Mechanical compaction of soil improves the block density.

WHAT IS COMPRESSED STABILISED EARTH BLOCKS (CSEB)?

Compressed Stabilized earth block (CSEB) is a compressed block of mixture of sand, cement, gravel with soil and locally available materials. Good soil is a proper mixture of gravel, sand and soil which mix with cement for construction of CSEB blocks (Fig.1). [3]

Fig.1 Mixture of Good soil



OBJECTIVES OF CSEB

Technical needs - Use of local soil, sand and other resources minimizes the need for importing building materials, reducing transportation cost and ensuring product availability.[1]

Social requirements- Application of existing or easily transferable skills, avoids costly training, minimizing displacement of labor and social cultural disruptions.

Economic requirements- Reduced dependence on outside sources, ensuring low cost alternatives and requiring limited capital investment.

One of the main objectives was to promote CSEB building constructions as a tool for sustainable development for affordable housing. [1]

SIEVE ANALYSIS OF MATERIALS

Individual materials first sieved and then blended in proportion that was found to give a good soil.

Blended soil is a mixture of nearly gravel 15 percent, 40 present sand, silt and clay 35 percent.

Sieve used for test- 40 mm,22.4 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µ, 425 µ, 300 µ, 150 µ, 75 µ.

Table. 2 Result of sieve analysis for individual samples.

Sieve Size	Percentage Finer			
	Sand	Soil	Stone chips	Blended soil
40 mm	100	100	100	100
22.4 mm	100	100	100	100
10 mm	99.34	99.39	82.32	93.57
4.75 mm	80.62	83.43	2.66	75.8
2.36 mm	56.42	66.12	0.56	63.4
1.18 mm	17069	46.62	0.35	44.45
600 µ	6.53	36.75	0.28	32.35
425 µ	3.02	20.44	0.21	22.25
300µ	1.685	6.64	0.14	16
150 µ	0.5	0.51	0.07	8.4
75 µ	0.4	0.13	0	2.85
Pan	0	0	0	0

METHODOLOGY AND RESULTS

Blocks of 254mm×127mm×76mm size were prepared by blending the soil with ordinary Portland cement.

This blended soil mixed with different quantity of cement (5 percent, 7.5 percent, 10 percent) for testing.

Table. 3 Variables of study [1]

		Cement content by weight	
No.	Mix	of dry blended soil & percent of jute fibre used	Maturity age, Days
1	M1	5.0 percent	7,28
2	M2	7.5 percent	7,28
3	M3	10.0 percent	7,28
4	M4J	5.0 percent + 1 percent Jute(2.5 cm)	7,28
5	M5J	5.0 percent + 0.5 percent Jute(2.5 cm)	7,28
6	M6J	5.0 percent + 0.25 percent Jute(2.5 cm)	7,28

STANDARD PROCTOR DENSITY TEST

About 3 kg air dried soil sample passing through 425 mm sieve is mixed with about 150 ml water and compacted in three layers by hammer in mould.

This soil extracted from mould and determined water content by oven drying method.

This soil is broken up and again addition of 150 ml of water and soil is mixed.

Table.4 Standard procter density test

Mix	OMC	MDD gm/cc	Binders/ Jute Fibre
M1	12.00%	1.928	5% cement
M2	12%	1.92	7.5 % cement
M3	12%	1.954	10 % cement
M4J	16%	1.862	5 % cement + 1.0 % Jute(2.5 cm)
M5J	15.70%	1.86	5% cement + 0.5 % Jute(2.5 cm)
M6J	15%	1.78	5% cement + 0.25 % Jute(2.5 cm)

COMPRESSIVE STRENGTH

Compressive strength of blocks for maturity age of 7 days and 28 days for different mix are presented in Table.

The specimen with 5 percent cement did not satisfy the BIS requirements (IS 1725) of maximum strength of 2.0 to 3.0 N/mm² whereas those with 7.5 percent and 10.0 Percent cement content did.

Adding jute fibre to the blended soil increased compressive strength as well as ductility.

The length of jute fibres also increases the compressive strength.

Table. 5 Result of compressive result

				Compressive Strength (7days)		Compressive Strength (28days)	
Mix	Cement Content	Jute Fibre	Fibre Size	Individual	Average	Individual	Average
				N/mm^2	N/mm^2	N/mm^2	N/mm^2
				0.97		1.187	
M 1	5.00 %	_	_	0.98	0.98	1.3	1.236
				1		1.252	
				1.9		2.35	
M 2	7.50 %	_	_	2.02	1.937	2.45	2.376
				1.95		2.35	
				2.65		3.10	
M 3	10.00%	_	_	2.55	2.55	3.02	3.048
				2.45		3.02	
				4.01		4.34	
M 4J	5%	1.00%	2.5 cm	3.85	3.95	4.28	4.288
				3.95		4.24	
				3.25		3.42	
M 5J	5%	0.50%	2.5 cm	3.35	3.331	3.57	3.46
				3.40		3.40	
				1.65		2.35	
M 6J	5%	0.25%	2.5 cm	1.90	1.78	2.41	2.35
				1.75		2.30	

WATER ABSORPTION

The CSEB block satisfies the average water absorption criteria as per IS recommendations.

Different soil specimen taken in container and weight. This container put into oven for oven drying and finally weight of sample is taken. From that water content is found out.

Table. 6 Result of water absorption test

Mix	Proportion	Water absorption (percent) at 28 days	Average water absorption (percent) at 28 days
		16.67	
M1	5.0 % cement	18.55	18.69
	only	17.85	
		12.13	
M2	7.5 % cement	12.56	12.20
	only	11.91	
		9.14	
M3	10 % cement	9.20	9.48
	only	10.10	
		20.53	
M5J	5 % cement +	19.76	20.13
	0.5% jute fibres	20.10	

CONCLUSION

The results of sieve analysis, standard proctor density test, block density, compressive strength, water absorption, are presented in table

No significant change in optimum moisture content due to increase in cement content. However, maximum dry density increases with increase in cement content. Compressive strength- The compressive strength increases with increasing cement content and maturity age as 80 percent of full strength was achieved at 7 days.

Water absorption- Block having 5 percent cement failed to satisfy the water absorption criteria. Blocks having 7.5 percent seemed to be the most acceptable alternative.

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