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Innovative Construction Solutions: Cement Stabilized Compressed Blocks from Flood Deposited Soil

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ABSTRACT

Kerala was devastated by floods, as a result of the abnormal rainfall during the monsoon seasons of 2018 and 2019, resulting in the deposition of vast quantities of flood soil in numerous places around the state. Instead of discarding these accumulated soils, it would be extremely beneficial if they could be utilised as construction materials. In this work, attempts were made to exploit flood deposits for the production of stabilised compression blocks. This study's purpose is consequently to assess the suitability of the flood deposits for the production of cement stabilised compressed bocks. For the experiment, soil samples were obtained from two distinct locations: Chalakkudy in the district of Thrissur and Anakkal in the district of Palakkad. The compressive strength, water absorption, and weatherability of compressed, cement-stabilized blocks formed from flood-deposited soils were evaluated. The results indicate that flood deposits can be utilised to produce cement stabilised compression blocks.

Keywords: Flood deposited soil; Cement stabilization; compressed blocks; Compressive strength, water absorption, weathering

Introduction

During 2018 and 2019, persistent rainfall in Kerala state ruined hundreds of homes and washed away roads and bridges. Large volumes of debris and sludge were discovered on the impacted areas after the flood incident. Under harsh conditions, the mud was discovered inside homes and along the flooded highways. Slow recovery efforts slowed the removal of flood deposits, resulting in temporary storage beside buildings and highways. In numerous locations, earthmovers were utilised to remove the accumulated muck. Flood debris disposal, removal, and storage pose a significant challenge. The standard way for eliminating these

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deposits is to use them as fill material. Since enormous regions are required for deposition of these flood deposits, it is imperative that they be utilised for some beneficial purpose. It would be advantageous if the flood deposits could be utilised for construction purposes. In addition, the requirement to cut CO_2 emissions and discover more sustainable construction materials is a significant economic and ecological challenge in the present day. Earthen building helps mitigate numerous environmental issues. In fact, earth is one of the most commonly used construction materials in human history.

Significant study has been conducted in contemporary times to develop earth as a sustainable building material. This has resulted in the creation of earth-based technologies, such as rammed earth and unfired bricks known as Compressed Stabilized Earth Blocks (Nagaraj et al., 2014). Mixing admixtures with soil to improve its volume stability, strength, permeability, and durability (Bell, 1993). Stabilization is an essential phase in the production of bricks and is intended to enhance the performance of the soil as a building material. Cement has been the most popular stabiliser utilised in the production of compressed bricks, out of all the various soil stabilisers. In the past, numerous attempts have been made to determine the applicability of cement as a stabiliser in compressed blocks (Venkatarama Reddy and Jagadish (1989); Venkatarama Reddy and Walker (2005), Kiron & Kannan, 2018ab, Kiron & Kannan 2015). Numerous earlier studies have demonstrated the appropriateness of flood deposits as a raw material for the production of bricks. This study analyses the suitability of cement-stabilized flood-deposited soil for the production of compressed blocks.

Materials and Methodology

The flood-deposited soils utilised in the study were taken from Chalakudy in Thrissur district and Anakkal in Palakkad district, both in Kerala, India. The collected dirt is air-dried and powdered, and its weight and characteristics are assessed. Air-dried samples were subjected to index property tests in line with IS 2720. The specific gravity for the Chalakkudy sample was determined to be 2.4, while the specific gravity for the Anakkal sample was 2.6. The Chalakkudy sample consists of 18 percent clay particles, 27 percent silt particles, and 55 percent fine sand, whereas the Anakkal sample consists of 14 percent clay, 32 percent silt, and 54 percent fine sand by weight. The liquid limit, plastic limit, and plasticity index were

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reported as 55%, 37%, and 18% for the Chalakkudy sample and 62%, 36%, and 26% for the Anakkal sample, respectively. In accordance with the IS categorization table, both samples might be denoted as MH or OH. Table 1 displays the physical parameters of flood-deposited soil.

Waziri et al. (2013) noted that the building soil's characteristics can be enhanced by stabilising it with cementitious admixtures. In this study, cement is chosen based on its accessibility, affordability, and construction-friendliness. Alam et al. (2015) demonstrated that cement contents between 5 and 10 percent yield positive effects. Table 2 displays the various cement percentages utilised to stabilise flood-deposited soil in this investigation.

Table-1: Properties of Flood Deposited Soil

Properties	Chalakkudy Sample	Anakkal Sample
Specific Gravity	2.6	2.4
Liquid Limit (%)	55%	62%
Plastic Limit (%)	37%	36%
Classification (ISC)	MH	MH

In this investigation, a standard 30 cm x 15 cm x 12 cm mould was utilised to create compressed bricks. The compressive strength is the most frequently acknowledged measure of brick quality. However, compressive strength is highly dependent on soil type and stabiliser concentration. Different ages of stabilised compressed blocks were subjected to compression tests to determine the rate of strength gain and the strength at a given period (Waziri et al., 2004). (2013). Using a universal testing equipment, the crushing strength of cement stabilised compression blocks was evaluated in this study. The compressive strength of compressed blocks stabilised with various cement percentages was evaluated to determine the optimal cement percentage. The compressive strength of stabilised bricks with various cement percentages is provided and compared in order to determine the most suitable, cost-effective, and long-lasting mixture for producing stabilised compression blocks from flood-deposited soil.

The absorption test provides an indication of the blocks' resistance to water damage. During flooding, stabilised blocks may disintegrate if infiltrated by water, which can be assessed with an absorption test. The water absorption of blocks with maximal compressive strength after 28 days of curing was evaluated. The weight of oven-dried blocks that were submerged in water for 24 hours and then weighed again was reported.

The weathering test can measure the sturdiness of stabilised blocks subjected to strong rains. For this test, blocks with optimal stabilisers (highest compressive strength) were chosen. The thickness of each stabilised compression block is measured, and the depth of penetration was determined by applying a constant water jet to each block for 60 seconds at a rate of 15mm/hr.

Results and Discussions

After conducting compressive strength, water absorption, and weathering tests on cement stabilised compression blocks, the findings were analysed and discussed below.

Cement Stabilized Blocks' compressive strength

Compressed blocks stabilised with various percentages of cement were cured and tested for compressive strength after seven days to determine the optimal percentage of stabiliser. According to numerous research, the optimal proportion of cement in cement stabilised compressed bricks is between 5 and 10 percent. In this investigation, therefore, flood-deposited clay was stabilised with variable percentages of cement ranging from 0% to 10%. Table 2 presents the results of 7-day compressive strength versus cement % for samples from Chalakkudy and Anakkal.

Table-2: 7 day compressive strength of cement stabilized compressed blocks

Percentage Of cement	**Compressive Strength (N/mm^2)**	
	Chalakkudy Sample	**Anakkal Sample**
0 %	1.30	2.57
2.5 %	1.75	3.40
5 %	2.30	**4.42**
7 %	**2.80**	4.30
8 %	2.55	4.17
10 %	2.45	4.00

For a curing age of 7 days, the Anakkal sample stabilised with 5% cement content exhibited the highest compressive strength of 4.42 N/mm2 with a cement content of 5%. The compressive strength of the samples rose with increasing cement content from 0% to 5%,

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with an average increase of 1.85 N/mm2. The optimal cement percentage for the Chalakkudy sample is 7 percent, with a maximum compressive strength of 2,80 N/mm2. Initially, both samples' compressive strength rose with increasing cement amount (Fig. 1). For the Anakkal sample, the optimal cement content is 5 percent, resulting in the highest compressive strength. After the optimal amount of stabiliser has been applied to the soil, the strength may decrease due to the formation of weak connections between the soil particles and the cementation compoun

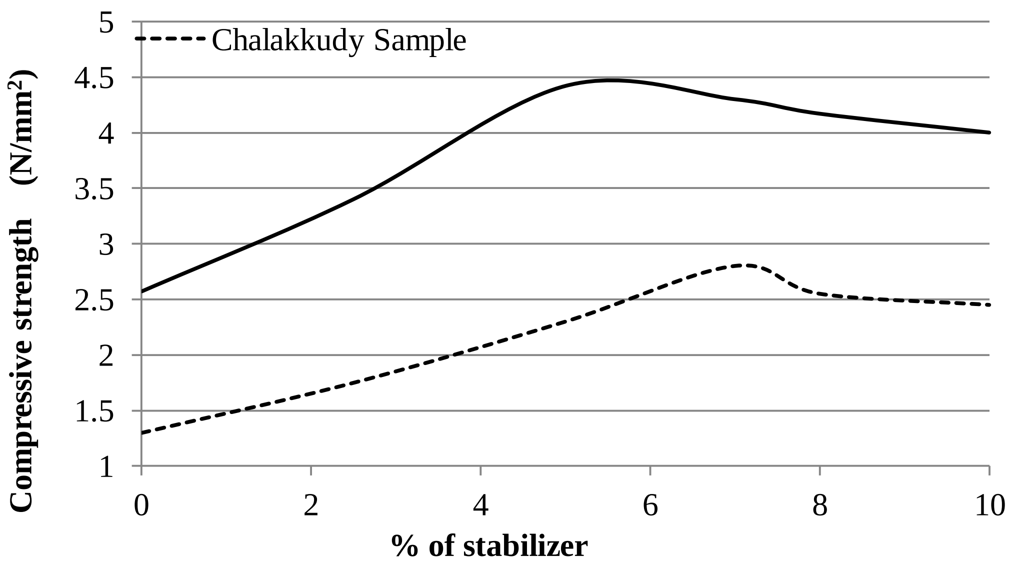

Fig.1 Variation of 7-day compressive strength of cement stabilized compressed blocks with different % of stabilizer

From 7 days to 28 days, compressive strength also rose progressively (Turkmen et al., 2017). Consequently, the compressive strength at 28 days of bricks constructed from Chalakudy and Anakkal flood deposits stabilised with optimal cement content is analysed, and the results are presented in Table 3. The binding of sand particles and the products of the cement's self-hydration contribute to the strength of cement-stabilized blocks.

Table-3: 28 days compressive strength of cement stabilized compressed blocks with optimum percentage of cement

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Sample	Compressive Strength (N/mm^2)			
	Trial 1	Trial 2	Trial 3	Average value
Chalakkudy Sample (7% cement)	3.09	3.08	3.10	3.09
Anakkal Sample (5% cement)	4.86	4.89	4.85	4.86

The 28 day compressive strength of the Anakkal sample shows an increase of 10% when compared with 7 day compressive strength. The Chalakkudy sample also shows an increase of 10% for the same period.

Water Absorption of Cement Stabilized Blocks

The results of 24 hour submersion tests on cement stabilised compression blocks are presented in Table 4. The absorption test serves as a measure of the bricks' resistance to flooding. It is possible for earth blocks to crumble when permeated by water; therefore, the water absorption rate should be as low as possible. Anakkal samples strengthened with cement were more submersible resistant than Chalakkudy samples. This may explain the high water absorption of the Chalakkudy sample, as void ratios are typically higher for organic soils. The excessive water absorption may be caused by the presence of holes in the soil matrix or by chemical interactions between soil particles and water-consuming stabilisers.

Weathering of Cement Stabilized Blocks

The depth of penetration was determined by applying a constant-pressure water jet to stabilised blocks. Both Chalakkudy and Anakkal samples produce cement-stabilized blocks with less than 1 percent penetration.

Table-4: Water Absorption (%) of compressed bricks with optimum percentage of cement stabilizer.

Sample	Water Absorption (%)			
	Trial 1	Trial 2	Trial 3	Average value
Chalakkudy Sample (7% cement)	34	38	36	36
Anakkal Sample (5% cement)	25	24	26	25

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Conclusions

In this work, the influence of cement on the stabilisation of compressed blocks made from Chalakkudy and Anakkal flood-deposited soil was examined. The optimal cement content was determined for both samples. At a curing age of 28 days, the highest compressive strength of 4.86 N/mm2 was reached when flood-deposited soil from the Anakkal region was stabilised with optimal cement concentration of 5 percent. After 28 days, the compressive strength of the Chalakkudy sample with the optimal cement content of 7 percent is 3.09 N/mm2. For both samples, the compressive strength increases throughout a curing time of 28 days. In comparison to the Anakkal sample, the Chalakkudy sample had a higher water absorption rate. For both samples, the weathering test reveals a penetration rate of less than one percent.

The cement-stabilized compressed blocks formed from flood-deposited dirt in the Anakkal region are appropriate for the construction of low-cost, environmentally-friendly structures. The stabilised compressed bricks made from flood-deposited dirt in the Chalakkudy region fall short of expectations. The qualities of flood-deposited soils differ from region to region, so a thorough examination is required to determine the viability of flood-deposited soil as a building material in a particular region.

References

1. Alam, I., Naseer, A. and Shah, A. A., (2015), Economical stabilization of clay for earth buildings construction in rainyand flood prone areas,*Construction and building materials, 77 (1), pp154-159.*
2. Bell, F.G., (1993), Engineering Treatment of Soils: Soil Stabilization,*E and FN SPON, London, UK.*
3. KR Kiron, K Kannan, (2015) Prioritizing the factors affecting innovation capability of steel manufacturing SMEs using fuzzy logic, *Journal of Scientific & Industrial Research, vol.74, pp.665-669*
4. KR Kiron, K Kannan (2018a) , Innovation capability for sustainable development of SMEs: an interpretive structural modelling methodology for analysing the interactions among factors- International Journal of Business Innovation and Research, Vol.15, No.4,pp.514-535.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper **UGC CARE Listed (Group -I) Journal Volume 11, Issue 2, 2022**

5. K.R. Kiron and K. Kannan (2018b) Application of fuzzy analytical network process for the selection of best technological innovation strategy in steel manufacturing SMEs International Journal of Services and Operations Management, Vol.31, Issue 3 pp 325-348
6. Nagaraj, H.B., Sravan, M.V., Arun, T.G. and Jagadish, K.S., (2014), Role of lime with cement in long-term strength of Compressed Stabilized Earth Block,*International Journal of Sustainable Built Environment,*
7. Turkmen,I., Evincing, E.,Kantarci, F. and Sarici, T., (2017), The mechanical and physical properties of unfired earth bricks stabilized with gypsum and Elazıg Ferrochrome slag, *International Journal of Sustainable built environment, 30(6), pp130-169.*
8. Venkatarama Reddy, B.V., (1991), Studies on static soil compaction and compacted soil cement blocks for walls, *(Ph.D. thesis), Department of Civil Engineering, IISc, Bangalore.*
9. .Venkatarama Reddy, B.V. and Jagadish, K., (1995), Influence of soil compositionon the strength and durability of soil cement blocks, *Indian Concrete. Journal, 69 (9), pp517–524.*
10. Venkatarama Reddy, B.V.and Walker, P., (2005),Stabilised mud blocks:problems, prospects, *In: Proc., Int. Earth Building Conf. Earth-Build2005, Sydney, Australia, pp. 63–75.*
11. Waziri, B.S., Lawan, Z.A. and Mustapha., *(2013),* Properties of Compressed Stabilised Earth Block for low-cost housing construction-A preliminary investigation, *International Journal of Sustainable Construction Engineering & Technology, 2(4), pp32-45.*