

Study of Soils Stabilized Using Industrial Waste for Sandbag Shelter



Engineering

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ABSTRACT

Sandbag construction is a flexible form rammed earth technique where in polypropylene bags are filled with appropriate earth mix and barbed wire acting as a mortar between two layers. For the earth mix different properties were tested for black cotton soil, red colour soil and lateritic soil for selection of best soil. Black cotton soil mixed with 40% stone dust gives 5.23 N/mm², compressive strength as compare to red soil and lateritic soil and is suitable as a construction material for Sandbag construction.

1. INTRODUCTION

Sandbag technology is a large, long adobe. It is a simple adobe, an instant and flexible line generator. Long or short sandbags are filled with on-site earth and arranged in layers or long coils (compression) with strands of barbed wire placed between them to act as both mortar and reinforcement (tension). This concept was originally presented by architect Nader Khalili to NASA for building habitats on the moon and Mars, as “Velcro-adobe” (3).

For the construction of sandbag shelter locally available soils are used such as black cotton soil, red colour soil, lateritic soil etc. The black soil is well-known for its capacity to hold moisture. The soil has high shrinkage and swelling characteristics. This type of soil is available in a wide region of our country. The red soil occupies about 10 per cent area of India, mostly in the south-eastern part of the Peninsular India. The lateritic soil is widely spread in India and is mainly found on the summits of the Western Ghats, Eastern Ghats,

2. RESEARCH METHODOLOGY

For construction of sandbag shelter different types of locally available soils were collected. Basic properties of soil were determined like sieve analysis, Atterbergs limit, Optimum moisture content and compressive strength also the basic properties of waste material such as industrial waste stone dust, Foundry sand were carried out. The waste materials were added in proportion to improve the soil properties then to find out best mix proportion for construction of sandbag shelter.

2.1 Collection of Material

For the construction of sandbag shelter soil samples were collected from various places based on abundant availability of materials

1. Black cotton soil sample from 4 lining of NH4 highway at Peth Naka,
2. Red colour soil from Gargoti in Kolhapur district
3. Laterite soil from Devgad, Ratnagiri Maharashtra

The properties of soils been tested as specified in methodology to understand how the soils will behave as construction material.

Waste materials were added to increase the compressive strength and these soils. Materials were chosen on the basis of Small granular size, Uniform size distribution, Nonhazardous and Availability in local area.

2.2 Determination Index properties

Index tests were performed to provide data necessary for classifying the soil and for developing correlations with various soil parameters. The sieve analysis, Atterberg's limits, and Optimum moisture contents were determined in general IS code.

Particle Size Distribution (Sieve Analysis) for Soil: [IS: 2720(Part IV)-1985]

Black cotton soil contains substantial quantity of fine particles hence wet sieve analysis is required. For red colour soil and laterite soil dry sieve analysis is carried out.

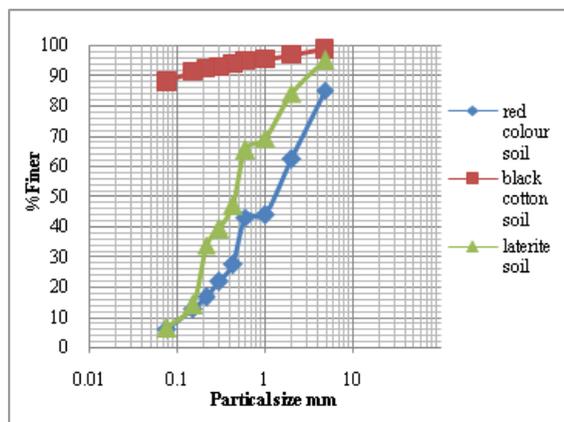


Figure 1. Particle size distribution curve for soil

From the graph black cotton soil is well graded with an excess of fines and for red colour soil and laterite soil graph is uniform in shape so the soil is well Graded soil.⁽⁸⁾

Determination of basic properties of collected soil samples.

Table 1. Basic properties of soils

Properties	Sample1	Sample 2	Sample3
Type of soil	Black cotton soil	Red colour soil	Laterite soil
Colour	Black	Red	Red
Specific Gravity	2.43	2.32	2.70
Grain size distribution;			
Coarse sand (%)	0.6	37.6	15.8
Medium sand (%)	3.1	34.9	37.3
Fine sand (%)	7	21.3	40.5
Silt and clay (%)	89.3	6.2	6.4
Atterberg's limit;			
Liquid limit, LL (%)	49	36.7	25.2
Plastic limit, PL (%)	36.86	33.96	24.83
Plasticity index, PI (%)	12.14	2.74	0.37

IS Classification	MI (Inorganic Silt of medium plasticity)	OI (Organic Silt of medium plasticity)	ML (Inorganic Silt of low plasticity)
Maximum dry density (gm./cm ³)	1.29	1.48	1.62
Optimum moisture content (%)	26.6	20.5	19.15
Compressive strength (N/mm ²)	5.99	3.13	0.81

2.3 Properties of industrial wastes

Two waste materials foundry sand and stone dust were used in this project to improve the compressive strength of soil. These waste materials were easily available in local area.

Foundry sand has uniform grain size per source and high structural integrity. The foundry sand used in this work was obtained from Miraj MIDC, Maharashtra.

In Maharashtra, large numbers of crusher units are available, which produces huge quantity of stone dust. Stone dust not only pollutes water, air or land but also their disposal is a great problem. The Stone dust used in this work was obtained from Chikurde road, Vaghwadiphata, Sangli, Western Maharashtra. The properties of foundry sand and Stone dust are in table 2 below.

Table 2. Basic properties of Foundry sand and Stone dust

Sr.no	Physical parameter	Foundry Sand	Stone Dust
1	Colour	Reddish brown	Grey
2	Specific gravity	2.6	2.78
3	Liquid limit	Non plastic	Non plastic
4	Plastic limit	Non plastic	Non plastic

Particle Size Distribution (Sieve Analysis) for industrial wastes: [IS: 2720(Part IV)-1985]

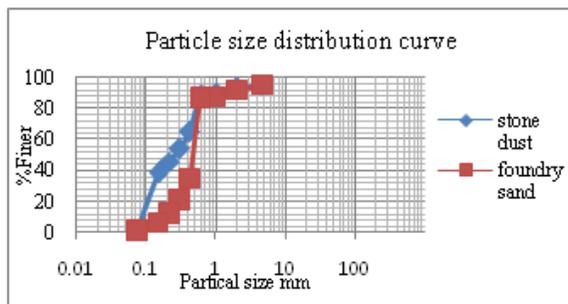


Figure 2. Particle size distribution curve for industrial wastes

Graphical representation shows stone dust and foundry sand contains poorly graded particles.(8)

2.4 Mix Proportions

2.4.1 Black Cotton Soil

The compressive strength required for the construction of sand-bag shelter is near about 4 N/mm². From the table no. 2 the compressive strength of black cotton soil is 5.99 N/mm², but black cotton is clay soil and it has silt and clay contain 89.3 %. Due to this the settlement of black cotton soil is more. To change the behaviour of black cotton soil the waste materials are added and tests are carried out.

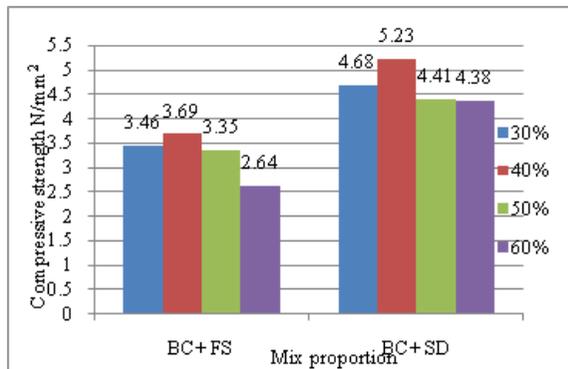


Figure 3. Comparison of compressive strength for black cotton soil

From this graph mixture of 40% foundry sand gives 3.69N/mm² compressive strength. And mixture of 40% stone dust gives 5.23N/mm² compressive strength which is suitable for the construction.

2.4.2 Red Colour Soil

The compressive strength of red colour soil is 3.13 N/mm². To improve the strength of soil the waste materials were added in various proportions.

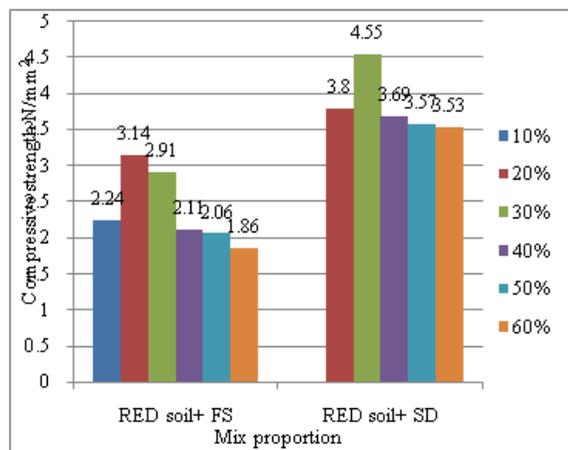


Figure 4. comparison of compressive strength for Red soil

From above graph it is observed that Addition of 20% foundry sand the compressive strength is 3.14 N/mm². And addition of 30% stone dust compressive strength is increased up to 4.55 N/mm².

2.4.3 Laterite Soil

The compressive strength of laterite soil is very low i.e. 0.81 N/mm². This soil can't use for the construction of sandbag shelter.

3. CONCLUSION

The compressive strength required for the construction of sand-bag shelter is near about 4 N/mm², the compressive strength of black cotton soil is 5.99 N/mm², but black cotton is clay soil and it has silt and clay contains 89.3 %. Due to this the settlement of black cotton soil is more. Compressive strength red colour soil is 3.13 N/mm², and laterite soil is 0.81 N/mm² improving the strength of soil waste materials were added in various proportions, addition of 40% stone dust in black cotton soil gives compressive strength is 5.23 N/mm², which is suitable for the construction.

REFERENCE

- [1] J. C. Morel, A. Mesbah M. Oggero and P. Walker, (2000), "Building Houses with Local Materials: Means to Drastically Reduce the Environmental Impact of Construction", *Building and Environment*, (36), 1119–1126. | [2] Qiao Dong, Ph.D., Vicki Huang; and Baoshan Huang, Ph.D. (2014), "Laboratory evaluation of utilizing waste heavy clay and foundry sand blends as construction materials", *American Society of Civil Engineers*. | [3] Dr. Owen Geiger,(2013),"Why build with earthbag". | [4] Mir SohailAli, Shubhada Sunil Koranne.(2011) "Performance Analysis of Expansive Soil Treated With Stone Dust and Fly Ash", Vol. 16 [2011], *Bund. E]GE* | [5] K Suresh, V Padmanathi,Apsar Sultana,(2009), "Experimental study on Stabilization of Black Cotton Soil with Stone Dust And Fibers" , IGC 2009, Guntur, INDIA | | [6] Indian Standard - IS: 2720 (Part 5) – (1985); Methods of test for soils, determination of liquid and plastic limit of soils. New Delhi, India. | | [7] India, Indian Standard - IS: 2720 (Part 7) – (1980); Methods of test for soils, determination of water content and dry density using light compaction. New Delhi, India. | [8] Indian Standard - IS: 2720 (Part 4) – (1985); Methods of test for soils, determination of grain size analysis of soil. New Delhi, |