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COMPARITIVE STUDY OF COMPRESSIVE STRENGTH OF MORTAR CUBES USING RIVER SAND AND M SAND

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ABSTRACT

In the developing countries, requirements for shelter can only be met by using local building materials and relying on do-it-yourself construction techniques. Soil for a long time has been the most important natural building material and thanks to its abundance, in its various forms, it is one of the most widely used building materials known.

This study sought to investigate some of the properties of cement stabilized soil with the aim of showing that soil-based mortars can still be put into use in construction today just as they have been used in the past.

The study involved performing a series of tests on a River sand and M sand that was collected from different places after stabilizing it with ordinary Portland cement. Its most critical properties in both the fresh and hardened state were determined; i.e. setting time and compressive strength respectively.

The conclusions of the investigation affirmed that the use of cement stabilized sand mortar can be applied in construction as far the investigated parameters are concerned.

Keywords: Compressive Strength, Specific Gravity, Cement, Mortar cubes, River Sand and M sand.

I. INTRODUCTION

1.1 Mortar

Mortar is a workable paste used to bind construction masonry blocks of stone, bricks or cinder blocks together and fill the gaps between them. A mortar joint acts as a sealant, a bearing pad, which sticks the masonry units together yet keeps them apart and in this sense performs as a „gap filling adhesive" . Mortar becomes hard when

it sets or dries (in the case of soil-based mortars), resulting in a rigid aggregate structure. Mortar may account for as little as 7% of the volume of a masonry wall; but the role that it plays and the influence that it has on performance are far greater than the proportion it indicates. The selection and use of various mortar ingredients directly affects the performance and bonding characteristics of masonry.

Soil-based mortars are made of earth thinned with fine-grain and/or fine-fibrous additives (though not necessary). Depending upon their usage they are known as earth masonry mortar, sprayed earth mortar or earth plaster mortars or rendering.

1.2 Soil

Soil is the earth material that can be disaggregated in water by gentle agitation. Soil/earth is the result of the transformation of the underlying rock under the influence of a range of physical, chemical and biological processes related to biological and climatic conditions and to animal and plant life. Soil is an earth concrete. Like concrete that contains gravel, sand and cement as a binder, soil contains gravel, sand, and, silt & clay which act as binders as well.

II. SPECIFIC GRAVITY

2.1 Purpose:

This lab is performed to determine the specific gravity of soil by using a pycnometer. Specific gravity is the ratio of the mass of unit volume of soil at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature.

2.2 Equipment:

Pycnometer, Balance, sand, water.

2.3 Test Procedure:

(1) Determine and record the weight of the empty clean and dry pycnometer, W1.

(2) Place 125g of a dry soil sample (passed through the sieve No. 10) in the pycnometer. Determine and record the weight of the pycnometer containing the dry soil, W2.

(3) Add distilled water to fill about half to three-fourth of the pycnometer. Mix it well using glass rod.

(4) Fill the pycnometer with distilled (water to the mark), clean the exterior surface of the pycnometer with a clean, dry cloth. Determine the weight of the pycnometer and contents, W3.

(5) Empty the pycnometer and clean it. Then fill it with distilled water only (to the mark). Clean the exterior surface of the pycnometer with a clean, dry cloth. Determine the weight of the pycnometer and distilled water, W4.

(6) Empty the pycnometer and clean it.

2.4 Data Analysis:

Calculate the specific gravity of the soil solids using the following formula:

$$\text{Specific gravity} = \frac{w2-w1}{(w2-w1) - (w3-w4)}$$

Where: W1 = weight of sample of oven-dry soil,

W2= weight of sample + soil

W3 = weight of pycnometer filled with water and soil

W4= weight of pycnometer + water

Date Tested: 15/03/2018

Tested By: Ranjith , Sandeep ,Sunandha

Project Name: specific gravity

Sample Number: 2

Sample Description: M sand

TABLE 2.1 : Specific gravity of M sand

Sl.no	Description	Trial no 1	Trial no 2	Trial no 3
1	Weight of empty pycnometer (W1) gms	499	499	499
2	Weight of pycnometer + M-sand (W2) gms	991	1007	946
3	Weight of pycnometer + M-sand + water (W3) gms	1838	1841	1812
4	Weight of pycnometer + water (W4) gms	1541	1541	1541
5	Specific gravity of sand (G)	2.52	2.44	2.53
6	Average of specific gravity (G)		2.49	

Date Tested: 15/03/2018

Tested By: Ranjith , Sandeep ,Sunandha

Project Name: specific gravity

Sample Number:3

Sample Description: River sand

TABLE 2.2: Specific gravity of River sand

Sl.no	Description	Trial no 1	Trial no 2	Trial no 3
1	Weight of empty pycnometer (W1) gms	497	497	497
2	Weight of pycnometer + River sand (W2) gms	810	825	893
3	Weight of pycnometer + River sand + water (W3) gms	1718	1730	1768
4	Weight of pycnometer + water (W4) gms	1539	1539	1539
5	Specific gravity of sand (G)	2.33	2.39	2.37
6	Average of specific gravity (G)		2.36	

III. COMPRESSIVE STRENGTH

3.1 Introduction

This test is used to give the strength in compression of hardened mortar. The standard procedure of cube tests according to BS 1881-116 was used. Load at failure of the specimens gives the compressive strength of the mortar.

3.2 Apparatus

- Vibrating machine confirming to IS: 10080 – 1982.
- Poking rod confirming to IS: 10080-1982.
- Cube moulds shall be of 70.60mm size confirming to IS: 10080-1982.
- Gauging trowel having steel blade 100 to 150mm in length with straight edge weighing 210 + 10gms.
- Balance of capacity 10Kg and sensitivity 1gram.

3.3 Preparation of cube specimens :

70.5x70.5x70.5mm moulds cleaned and oil applied evenly in them. The mortar was then filled into the moulds and compacted using a standard vibrating table until adequate compaction was achieved. Cubes for formulation A however, were prepared in 70.5x70.5x70.5mm moulds due to inadequate number of moulds in the lab. The top surface of the mould was then leveled and smoothened with a trowel. The test specimens were then stored in moist air for 24 hours then removed from their moulds. Due to the nature of the cubes (presence of soil), curing could not be done by immersion in water since the soil would fail to cure. The specimens were placed in the

water tank for curing. Therefore cured by immersion in water for the entire 3 & 7 days. After 3 & 7 days, the specimens were ready for the cube crushing tests.

3.4 Procedure:

- Unless otherwise specified this test shall be conducted at a temperature 270 + 2 0C.
- Weigh the material required for each cube separately.
- The quantity of cement, standard sand and water required for each cube are as follows: Cement = 200gms 2mm to 1mm - 200gms Standard Sand = 600gms 1mm to 500mic - 200gms Conforming to IS: 650 –1991. 500mic to 90mic - 200gms

Water = (P/ 4+ 3) Percentage of combined mass of cement and sand. P is the consistency of cement as per IS: 4031 (Part 4) 1988.

- Place on a nonporous plate, a mixture cement and standard sand.
- Mix it dry with a trowel for one minute and then with water until the mixture is of uniform colour.
- The time of mixing shall in any event be not less than 3 minutes and should be the time taken to obtain uniform colour exceeds 4 minutes.
- In assembling the moulds ready for use, cover the joints between the halves of the mould with a thin film of petroleum jelly and apply a similar coating of petroleum jelly between the contact surface of the bottom of the mould and base plate in order to ensure that no water escapes during vibration.
- Place the assembled mould on the table of the vibration machine and hold it firmly in position by means of suitable clamp, attach a hopper of suitable size and shape securely at the top of the mould to facilitate filling and hopper shall not be removed until the completion of vibration period.

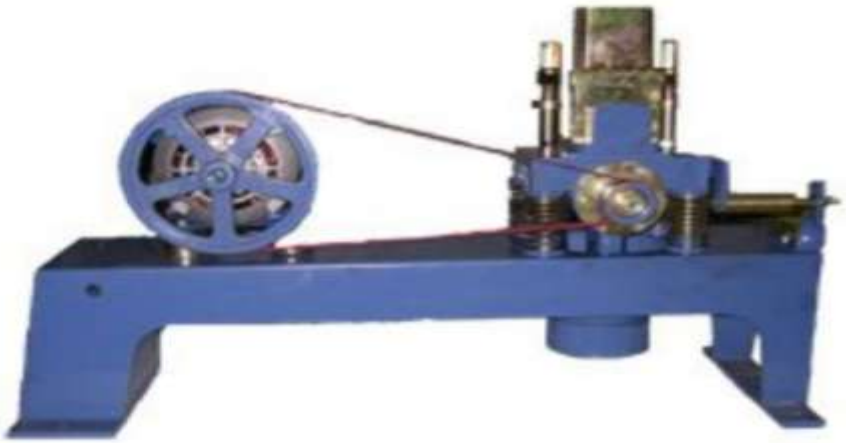

Fig 3.1: Casting of Cement Mortar Cubes

- Immediately after fixing the mould in the vibrating machine, place the mortar in the cube mould and prod with the rod.
- Prod the mortar 20 times in about 8 seconds to ensure elimination of entrapped air and honey combing.
- Place the remaining mortar in the cube mould and prod again as specified for the first layer and then compact the mortar by vibration.
- The period of vibration shall be three minutes at the specified speed of 12000 + 400 vibrations per minute.
- Remove the mould from the vibrating machine and cut of the excess mortar with a straight edge.
- Store the test specimens in a place free from vibration, in moist air of at least 90 percent relative humidity and at a temperature of 27 + 20C for 24 + 1/2 hours from the addition of water to the dry ingredients.

3.5 Casting of Cement Mortar Cubes:

- ❖ After this period, mark the specimens and remove from the moulds and unless required for test within 24 hours.
- ❖ Immediately submerge the cubes in a clean, fresh water or saturated lime solution and keep there until taken out just prior to test.
- ❖ Renew the water or solution in which the specimens are submerged for every three and seven days, and the temperature of water is maintained with the specified limits.
- ❖ Conduct testing at recognized ages of the specimens, the most usual being 3 and 7 days.
- ❖ When it may be necessary to obtain the early strength, tests may be conducted at the age of 72 + 2 hours.
- ❖ Calculate the ages from the addition of water to the dry ingredients.
- ❖ Test at least three specimens preferably from different batches at each selected age.

3.6 Calculations:

$$\text{Compressive strength} = \frac{\text{load}}{\text{Cross sectional area of the specimen}} \text{ N / mm}^2$$

3.7 Tabular Column:

TABLE 3.1: Compressive strength of M sand for 3 days test

M-sand			
0.5%WC (3 days strength)		0.4%WC (3 days strength)	
Load (KN)	Strength (N/MM^2)	Load (KN)	Strength (N/MM^2)
120	24.14	58	11.66
127	25.55	56	11.26
129	25.95	53	10.66

TABLE 3.2: Compressive strength of M sand for 7 days test.

M-sand			
0.5%WC (7 days strength)		0.4%WC (7 days strength)	
Load (KN)	Strength (N/MM^2)	Load (KN)	Strength (N/MM^2)
184	37.02	65	13.07
170	34.20	70	14.08
162	32.59	69	13.88

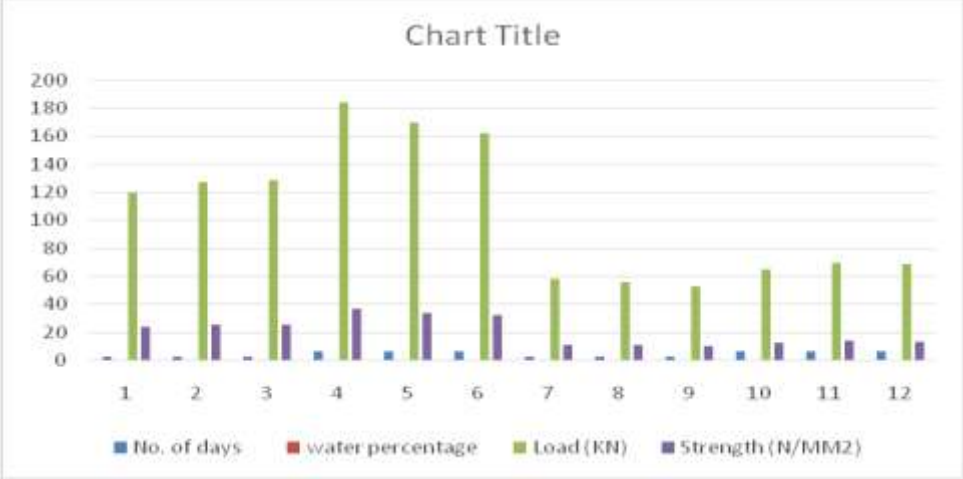

Fig 3.2: Compressive strength of M sand for 3 days and 7 days test.

TABLE3.3: Compressive strength of River sand for 3 and 7 days test.

River sand			
0.5%WC (3 days strength)		0.4%WC (3 days strength)	
Load (KN)	Strength (N/MM^2)	Load (KN)	Strength (N/MM^2)
55	11.06	65	13.07
58	11.66	69	13.88
63	12.67	68	13.68
River sand			
0.5%WC (7 days strength)		0.4%WC (7 days strength)	
Load (KN)	Strength (N/MM^2)	Load (KN)	Strength (N/MM^2)
100	20.11	130	26.15
105	21.12	126	25.35
113	22.73	156	31.38

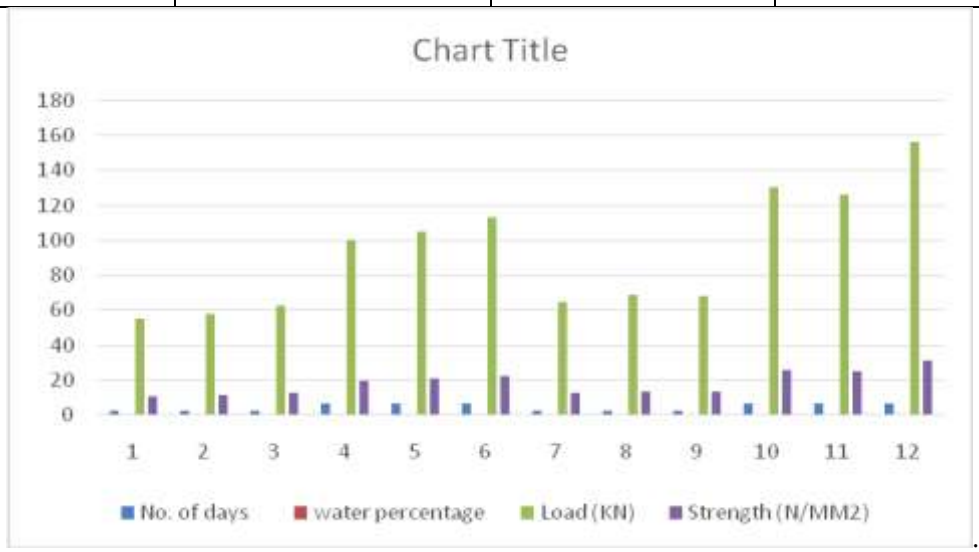

Fig 3.3: Compressive strength of M sand for 3 days and 7 days test.

IV CONCLUSION

1. All the details are mentioned above as per Indian standard code.
2. When the water cement ratio is 0.5%, The compressive strength of M-Sand is lesser than River Sand.
3. When the water cement ratio is reduced to 0.4%, The result got reversed as above, The compressive strength of M-Sand is greater than River Sand.
4. The compressive strength varies with water cement ratios.

REFERENCE

1. Mohammad, S.Z. and Dr. Lee, A., (2008). Contemporary Earth Construction in Urban Housing – Stabilised or Unstabilised? University of Salford, United Kingdom.

2. Licker, M.D., (2nd Edition), (2003). Dictionary of Engineering, USA.

3. Zinn, A.W., (2005). Cement Modified Earthen Mortar: An Investigation of Soil-Cement Performance Characteristics at Three Southwestern National Monuments. University of Pennsylvania, USA.

4. www.mjenzii.kbo.co.ke

5. Minke, G., (2006). Building with Earth. Design and Technology of a Sustainable Architecture, pp 11-18, Basel.

6. American Society for the Testing of Materials Standards. "C 191-99: Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle."

7. Copsey, N., Gourley, B. and Allen, R., (2010). Mud Mortars in Masonry Construction: Malton, North Yorkshire. University of York, United Kingdom.

8. http://www.practicalaction.org – Mud as a Mortar; Clay as a Binder.

9. Morton, T., (2008). Earth Masonry Design and Construction.

10. Walker, P., (2001). The Australian Earth Building Handbook, pp 2-11, Sydney.

11. Azeredo, G., Morel, J. and Barbosa, P.N., (2007). "Compressive Strength Testing of Earth Mortars", Journal of Urban and Environmental Engineering, (March): pp 26-35.

12. Dwiantoro, D., Zhang, M. and Warkentin, K., (2013). Mortars for Earthen Masonry Construction. University of Florida, USA.

BIOGRAPHAICAL DATA:

I **Prof. Manjunath S,** working as an Assistant Professor in the Department of Civil Engineering in SPCE from past three years. I have a total of 9 years of teaching experience. I have done my **B.E in Civil Engineering and M.Tech in Structural Engineering** from VTU. I am a research scholar, pursuing my **P.hd** in VTU and my area of research is water Resources, GIS and its applications.

Prof. Mahadeva M is working as Assistant Professor in Civil Engineering Department form last 3 years in Shri Pillappa College of Engineering and he also worked as Assistant Professor in K S Institute of Technology. He received is **B E in Civil Engineering** and **M.Tech** with specialization in **CAD Structures** from Visvesvaraya technological university. He is national advisory board member and Conference Convener for international conference and he secured "***Active Young Research Award"*** in international journals for his continuous contribution in research field. He is Indian Institute of remote sensing outreach program college coordinator. He is member of AMIE, MIRED,MNG,MISTE. His research interest is in the field of soil structure interaction, structural engineering, earth quake engineering.

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