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Experimental study on mechanical behavior of different grade M-sand concrete

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ABSTRACT

In this paper were investigated in the comparison of compression strength and slump strength of M-sand and river sand. M-sand Rock crushed to the required grain size distribution is termed as manufactures sand (M-sand). The natural river sand was the cheapest resources of sand. The size of manufactured sand (M-Sand) is less than 4.75mm. A particle passing 75 microns, Sieve Size/ Granule Thickness IS Codes 150 microns - 4.75 mm and IS - 383: 1970. Then water absorption is 2.2. We are analysed the specific gravity and moisture content of M-sand and river sand of concrete. Then were prepared M-sand concrete moulded with help of mould die. The three grade of concrete we are prepared, they are M-sand grade M25, M-30 and M-35. After we conducted a compression test and slump test. Finally, we obtained in M25 grade of concrete; slump values and compression strength are more in comparison with M-sand till 7 days having 30.01 and 28 days we obtained 43.04. In M30 grade of concrete, slump values and compression strength are more in comparison with river sand. slump values of 170 mm > 150 mm (30 min) slump values of 140 mm > 100 mm (60 min) compressive strength 7 days 37.31N/mm2 > 32.02 N/mm compressive strength 28 days 48.5N/mm2 > 43.16 N/mm2. In M35 grade of concrete, slump values and compression strength are more in comparison with river sand. slump values of collapse is better than 170 mm (30 min) slump values of 150 mm > 110 mm (60 min) compressive strength 7 days 41.21N/mm2 > 37.41 N/mm2 compressive strength 28 days 54.32N/mm2 > 50.55 N/mm2.

Keywords— *M-sand, River sand, Compression, Slump, Specific gravity, Moisture, Concrete*

1. INTRODUCTION

The natural river sand was the cheapest resources of sand. However, the excessive mining of the river bed to meet the increasing demand for sand in the construction industry has led to the ecological imbalance in the state. Now the sand available in the riverbed is very coarse and contains a very high percentage of silt and clay. The silt and the clay presence in the sand reduce the strength of the concrete and hold dampness. The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities are present in the river sand above a certain percentage which makes the sand useless for concrete work. Hence, we undertake this project which given an alternate to river sand. Sand generally composed of rounded particles and may or may not contain clay or other impurities. It is obtaining from the bank's beds of the river. River sand for construction sand is used as fine aggregate in mortars and concrete. Natural river sand is the most preferred choice as a fine aggregate material. River sand is a product of natural weathering of rocks over a period of millions of year. It is mined from the river beds. It widens the bed. Structures behind the beach are protected as long as the added sand remain Most importantly beach nourishment reduces the detrimental impacts of coastal erosion by providing additional sediment which satisfies erosion forces. M-sand Rock crushed to the required grain size distribution is termed as manufactures sand (M-sand). In order to arrive at the required grain size distribution, the coarser stone aggregate is crushed in a special rock crusher and some of the crushed material is washed to remove fines. The slump is a relative measurement in concrete consistency. It is not an indicator of the quality of the material. The slump of a mix with the same aggregate, cement and water can vary significantly by adding an admixture. The admixture does not reduce the quality of the material. First of all, by all ASTM and AASHTO standards, the measurement of a slump is to the nearest 1/4 inch, which is a tight measurement for such a crude test. It is widely accepted that the test procedure itself will not be accurate to within more than 1 inch. The following quote is also from "Concrete".

2. EXPERIMENTAL METHODOLOGY

2.1 Materials

Manufactured sand (M-Sand) is a substitute for river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction

material. The size of manufactured sand (M-Sand) is less than 4.75mm. A particle passing 75 microns, Sieve Size/ Granule Thickness IS Codes 150 microns - 4.75 mm and IS - 383: 1970. Then water absorption is 2.2.

Fig. 1: Image of M-sand and River sand

2.2 Experiment Procedure

Fig. 2: The Image of mould with molding dies

3. PROCEDURE FOR M-SAND

3.1 Specific gravity

Balance to weigh the materials (accuracy 10 gm), Wash bottle with distilled water. Weight a clean dry Pycnometer with its cap (W 1 Kg), Take about 250g of M-sand and find the weight of Pycnometer with fine aggregate (W2 Kg), Fill the Pycnometer with distilled water up to the hole in the conical cap and shake it to remove the air. Then take the weight of Pycnometer with M-sand and water (W3 Kg). Empty the Pycnometer and clean it thoroughly. Then fill it with distilled water up to the hole of the conical cap and weight it (W4 Kg).

3.2 Moisture content

Clean the container with lid dry and weigh it (W1), Take a specimen of the sample in the container and weigh with lid (W2). Keep the container in the oven with the lid removed. Dry the specimen to constant weight maintaining the temperature between 1050 C and 1100 C for a period varying with the type of soil but usually, 16 to 24 hours Record the final constant weight (W3) of the container with the dried soil sample. Peat and other organic soils are to be dried at a lower temperature (say 600) possibly for a longer period. Certain soils contain gypsum which on heating loses its water if crystallization. If it is suspected that gypsum is present in the soil sample used for moisture content determination it shall be dried at not more than 800 C and the possibility for a longer time.

4. PROCEDURE FOR RIVER SAND

4.1 Specific gravity test

Weight a clean dry Pycnometer with its cap (W_1 Kg) Take about 250g of sand and find the weight of Pycnometer with fine aggregate (W_2 Kg) Fill the Pycnometer with distilled water up to the hole in the conical cap and shake it to remove the air. Then take the weight of Pycnometer with sand and water (W_3 Kg) Empty the Pycnometer and clean it thoroughly. Then fill it with distilled water up to the hole of the conical cap and weight it (W_4 Kg).

4.2 Moisture content

Clean the container with lid dry and weigh it (W1). Take a specimen of the sample in the container and weigh with lid (W2). Keep the container in the oven with the lid removed. Dry the specimen to constant weight maintaining the temperature between 1050 C and 1100 C for a period varying with the type of soil but usually 16 to 24 hours. Record the final constant weight (W3) of the container with the dried soil sample. Peat and other organic soils are to be dried at a lower temperature (say 600) possibly for a longer period. Certain soils contain gypsum which on heating loses its water if crystallization. If it is suspected that gypsum is present in the soil sample used for moisture content determination it shall be dried at not more than 800 C and the possibility for a longer time.

5. RESULTS

5.1 Test for M-sand

5.1.1 Specific gravity test: The knowledge of specific gravity is needed in the calculation of soil properties like void ratio, the degree of saturation etc... Specific gravity G is defined as the ratio of the weight of an equal volume of distilled waters at that temperature both weights taken in air.

Fig. 3: Specific gravity test

Table 1: Data and Observation Sheet for specific gravity of fine aggregate for M-SAND

S. no	Sample	Specific gravity of fine aggregate (M-Sand)
1	Weight of empty Pycnometer (W_1 Kg)	0.473
2	Weight of Pycnometer + dry M-sand (W_2 Kg)	0.723
3	Weight of Pycnometer + M-sand + water(W_3 Kg)	1.438
4	Weight of Pycnometer + water(W_4 Kg)	1.280
$G = [(W_2-W_1) / ((W_4-W_1)-(W_3-W_2)$ $= [(0.723-0.473)/(1.280-0.473)-(1.438-0.723)]$		2.59

5.1.2 Moisture content test: The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. This ratio is usually expressed as percentage. In almost all soil tests natural moisture content of the soil is to be determined. The knowledge of the natural moisture content is essential in all studies of soil mechanics. To sight a few, natural moisture content is used in determining the bearing capacity and settlement. The natural moisture content will give an idea of the state of soil in the field.

Table1 2: Data and Observation Sheet for Water Content for M-SAND

S. no.	Sample	Moisture content
1	Weight of container with lid W1 gm	342.5
2	Weight of container with lid+ wet soil W2 gm	642.5
3	Weight of container with lid+ dry soil W3 gm	633
4	Water/Moisture content W={(W2-W3)/(W3-W1)}*100	2.5

5.2 Test for river sand

5.2.1 Specific gravity test: Specific gravity G is defined as the ratio of the weight of an equal volume of distilled waters at that temperature both weights taken in air. The knowledge of specific gravity is needed in calculation of soil properties like void ratio, degree of saturation etc.

Table 3: Specific gravity of fine aggregate for River-Sand

S. no	Sample	Specific gravity of fine aggregate (River-Sand)
1	Weight of empty Pycnometer (W_1 Kg)	0.473
2	Weight of Pycnometer + dry sand (W_2 Kg)	0.723
3	Weight of Pycnometer + sand + water(W_3 K	1.432
4	Weight of Pycnometer + water(W_4 Kg)	1.280
$G = [(W_2-W_1) / ((W_4-W_1)-(W_3-W_2)$ $= [(0.723-0.473)/(1.280-0.473)-(1.432-0.723)]$		2.57

5.2.2 Moisture content test: The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. This ratio is usually expressed as percentage.

Table1 4: Data and Observation Sheet for Water Content for River-Sand

S. no.	Sample	Moisture Content
1	Weight of container with lid W1 gm	342.5
2	Weight of container with lid+ wet soil W2 gm	642.5
3	Weight of container with lid+ dry soil W3 gm	638.5
4	Water/Moisture content W={(W2-W3)/(W3-W1)}*100	1.7

5.3 Compressive test and slump test

Fig. 4: Slump test image

Table 5: Compressive Strength of M25 Concrete Grade

S. no	Days	Concrete grade	Mould ID	Load (KN)	Compressive strength (N/MM^2)	Cube size in (mm)	Average N/mm^2
1	7	M25	302	675.5	30.02	150	30.01
			325	670.8	29.81	150	
			614	679.4	30.2	150	
2	28	M25	633	970.4	43.13	150	43.04
			312	969.8	43.1	150	
			516	965.2	42.89	150	
Slump value							
Grade	**W/C Ratio**		**0 min**		**30 min**	**60 min**	
M25	0.5		Collapse		160	110	

In M25 grade of concrete, slump values and compression strength are more in comparison with river sand .i.e in Si.no 1&2, slump values of 180 mm > 160 mm (30 min) slump values of 140 mm > 110 mm (60 min) compressive strength 7 days 30.01N/mm2 > 26 N/mm compressive strength 28 days 43.04N/mm2 > 38.21 N/mm2.

Table 6: Compressive Strength of M30 Concrete Grade

S. no	Days	Concrete grade	Mould ID	Load (KN)	Compressive strength (N/MM^2)	Cube size in (mm)	Average N/mm^2
1	7	M30	619	839.8	37.32	150	37.31
			302	840.1	37.34	150	
			621	838.6	37.27	150	
2	28	M30	620	1096.5	48.73	150	48.5
			331	1094.1	48.62	150	
			530	1089.5	48.42	150	
Slump value							
Grade	**W/C Ratio**		**0 min**		**30 min**	**60 min**	
M30	0.45		Collapse		150	100	

In M30 grade of concrete, slump values and compression strength are more in comparison with river sand. i.e in Si.no 3&4, slump values of 170 mm > 150 mm (30 min) slump values of 140 mm > 100 mm (60 min) compressive strength 7 days 37.31N/mm2 > 32.02 N/mm compressive strength 28 days 48.5N/mm2 > 43.16 N/mm2.

Table 7: Compressive Strength of M35 Concrete Grade

S. no	Days	Concrete grade	Mould ID	Load (KN)	Compressive strength (N/MM^2)	Cube size in (mm)	Average N/mm^2
1	7	M35	456	845.4	37.57	150	37.47
			333	843.2	37.47	150	
			101	840.9	37.37	150	
2	28	M35	675	1138.4	50.60	150	50.55
			901	1137.1	50.53	150	
			761	1136.7	50.52	150	
Slump values							
Grade	**W/C Ratio**		**0 min**		**30 min**	**60 min**	
M35	0.42		Collapse		170	110	

In M35 grade of concrete, slump values and compression strength are more in comparison with river sand. i.e in Si.no 5&6, slump values of collapse is better than 170 mm (30 min) slump values of 150 mm > 110 mm (60 min) compressive strength 7 days 41.21N/mm2 > 37.41 N/mm2 compressive strength 28 days 54.32N/mm2 > 50.55 N/mm2.

6. CONCLUSIONS

From the results shown above, the following conclusion is made.

- In M25 grade of concrete, slump values and compression strength are more in comparison with river sand .i.e in Si.no 1&2, slump values of 180 mm > 160 mm (30 min) slump values of 140 mm > 110 mm (60 min) compressive strength 7 days 30.01N/mm2 > 26 N/mm compressive strength 28 days 43.04N/mm2 > 38.21 N/mm2
- In M30 grade of concrete, slump values and compression strength are more in comparison with river sand. i.e in Si.no 3&4, slump values of 170 mm > 150 mm (30 min) slump values of 140 mm > 100 mm (60 min) compressive strength 7 days 37.31N/mm2 > 32.02 N/mm compressive strength 28 days 48.5N/mm2 > 43.16 N/mm2.
- In M35 grade of concrete, slump values and compression strength are more in comparison with river sand. i.e in Si.no 5&6, slump values of collapse is better than 170 mm (30 min) slump values of 150 mm > 110 mm (60 min) compressive strength 7 days 41.21N/mm2 > 37.41 N/mm2 compressive strength 28 days 54.32N/mm2 > 50.55 N/mm2.
- The test results clearly show that both workability and compressive strength of M-sand is better than river sand. Hence we conclude that M-sand can be used for all construction work in place of river sand.

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