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Experimental Investigation of M-Sand in Concrete

Dr. Shankar H. Sanni[1], Prabhu Gurunathappa Sheelavantar[2]

[1]Associate Professor, Dept. of Civil Engg., Basaveshwar Engg., College, Bagalkot, Karnataka, India

[2]Dept. of Civil Engg., Basaveshwar Engg., College, Bagalkot, Karnataka, India

ABSTRACT

The natural river sand was the cheapest resource of sand. However the excessive mining of river bed to meet the increasing demand for sand in construction industry has led to the ecological imbalance in the country. Now the sand available in the river bed is very coarse and contains very high percentage of silt and clay. The silt and clay present in the sand reduce the strength of the concrete and holds dampness. A few alternatives have come up for the industry to bank on of which manufactured sand or M-sand (manufactured sand), as it is called, is found to be the most suitable one to replace river sand. M-sand has caught the attention of the construction industry and environmentalists alike for its quality and the minimum damages it causes to nature. Usage of M-Sand can drastically reduce the cost since like river sand, it does not contain impurities and wastages is nil since it is made with modern technology and machinery. Once them-sand becomes more popular in the construction industry, the demand for river sand and illegal sand-mining would come down. M-sand that is available is graded, sieved and washed. The particles are more rounded and granular and do not have sharp edges. Usage of M-Sand can overcome the defects occurring in concrete such as segregation, voids, capillary, etc. The main purpose of this investigation is to replace sand in concrete with M-Sand for both M-30 and M-40 grades. The test results were compared to that of conventional concrete for 7 days and 28 days. Thus from result it is concluded that m-sand can be effectively used instead of river sand in concrete.

Keywords : M-Sand, Compressive strength, Split tensile strength and Flexural Strength

I. INTRODUCTION

Concrete is a building material used in building construction, consisting of a hard and chemically inert substance known as aggregate usually made from different type of sand and gravel that is bonded together by element and water. The wide spread use of concrete in many Roman structures has ensured that aggregates cement and water.

The aggregate is generally a coarse gravel or crushed rock such as limestone or granite along with fine aggregate. Now days due to over exploitation of river sand, which results in shortage of river sand so M-sand helps by substituting the river sand. M-Sand is a substitute of 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 4.75 mm. Usage of manufactured sand prevents dredging of river beds to get river sand which may lead to environmental disaster like ground water depletion, water scarcity, threat to the safety of bridges, dams etc. to make M-Sands more eco-friendly than river sand.

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II. LITERATURE REVIEW

Numerous studies have been reported in the literature in respect of M-sand concrete. Some of the significant contributions are briefly mentioned in the literature.

Yajurved Reddy M et al.[1] describes the feasibility study on concrete made with manufacture sand as fine aggregate. They evaluated the workability characteristics in terms of slump, compaction factor and vee-bee time with addition of manufactured sand as replacement to natural sand ranging from 0-100%. To evaluate the percentage of admixture that should be added to get the required slump of 40mm-80mm. Finally the mechanical properties of concrete were tested for 3, 7 and 28 days by replacing natural sand in proportions of 0%, 20%, 40%, 60% and 100%.

Sachin kumar et al.[2] their study intended to identify the potential of using M-Sand as fine aggregates in concrete manufacturing . For the investigation M-20 grade concrete was considered. MS was replaced by the river sand with different fractions in concrete. Detail experimental investigation was undertaken to examine the physical properties of MS and strength properties of CMS. Outcomes of the results showed promising applications of MS in grade 20 concrete elements.

M.Adams Joe et al. [3] they experimentally investigate the effect of M-Sand in structural concrete by replacing river sand and develop a high performance concrete. It is proposed to determine and compare the differences in properties of concrete containing river sand and M-sand. It is also proposed to use steel fibres and chemical admixtures to increase the strength and workability of concrete respectively. The investigations are to be carried out using several test which include workability test, compressive test, tensile test, and flexural test.

Mani Kandhan. K.U et al.[4] their investigation mainly focused on the m-sand properties and the strength obtained from the both the river sand and m-sand. In order to solve the problem of the granite powder disposal from the industries and also to solve the raw material storage problem for concrete, studies are being made to utilize the m- sand in the manufacture of the varieties of building and ceramic products, this investigation also based on the comparison of compressive strength, split tensile strength, achieved by the cubes and cylinders in normal sand and m-sand

III. MATERIALS

The following materials have been used in the experimental study

a) Ordinary Portland Cement (43 grade) confirming toIS:8112-1989 [5] having specific gravity 3.10
b) Fine aggregate: M-sand confirming to zone-II of IS:383-1970[6] having specific gravity 2.56and fineness modulus of 3.05 the view of sample is given in Fig.1.
c) Coarse Aggregate: crushed granite metal confirm to IS:383-1970[6]having specific gravity 2.75 and fineness modulus of 6.15.
d) Water: clean potable water for mixing.

Fig.1 M-sand

Tests were conducted on specimen of stand a size as Per IS:516-1959 [7] Details of tests conducted and specimens used are given in Table.1

Table 1 Tests carried out as per Indian Standards

Type of tests Conducted	Size of specimen(mm)	No of specimen
Compressive strength (cube)	150x150x150	3
Split tensile Strength (cylinder)	100x200	3
Flexural strength (Beam)	100x100x500	3

IV. MIX DESIGN

The process of selecting suitable ingredients of concrete and determining their relative proportion with the object of producing a concrete of required strength, work ability as economical as possible is termed as mix design. In the present investigation M-30 and M-40 grades are taken for study. and design is done according to IS:10262-2009 [8]. The details of mix proportions are given in Table 2.

Table 2 Mix design details

Grade of concrete	water	Cement (kg/m^3)	F.A (kg/m^3) (M-Sand)	C.A (kg/ m^3)	W-C
M-30	161.41	420	600.1	1231.2	0.38
M-40	197.47	430	707.8	1053	0.36

V. RESULTS AND DISCUSSION

A. Workability

The tests on fresh concrete was done using slump cone. From Fig. 2 it is clear that flow of concrete with river sand is more as compared to M-sand. The slump values are average in case of M-sand so it is good for strength of concrete.

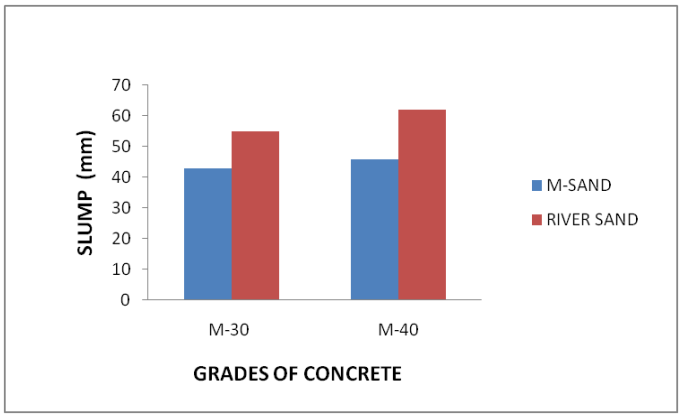

Fig. 2 Slump v/s Grades of concrete

B. Compressive strength

The compressive strength is one of the most note worthy properties of hardened concrete and is considered as the characteristic material value for the classification of concrete. Here the comparison of compressive strength of river with M-sand is done for both 7 days and 28 days curing as given in Fig.3 and Fig.4 respectively. By observing the Fig's we can say that for both 7 days and 28 days the compressive strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

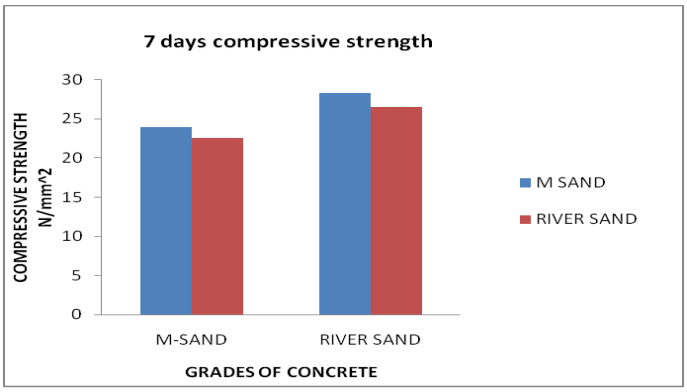

Fig. 3 Comp. strength Vs Grades of concrete (M-30)

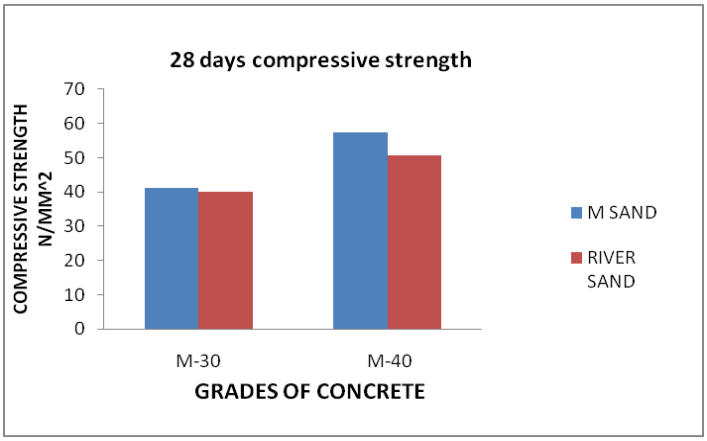

Fig. 4 Comp. strength Vs Grades of concrete (M-40)

C. Split tensile strength

Here the comparison of split tensile strength of river v/s m-sand is done for both 7 days and 28 days curing as given in Fig.5 and Fig.6 respectively. By observing the Fig's we can say that for both 7 days and 28 days the split tensile strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

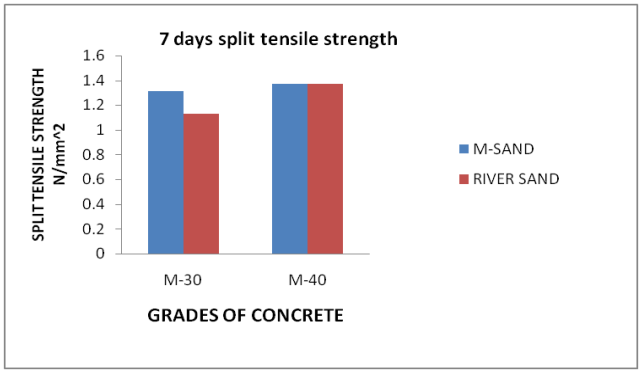

Fig. 5. Split tensile strength Vs Grades of concrete (M-30)

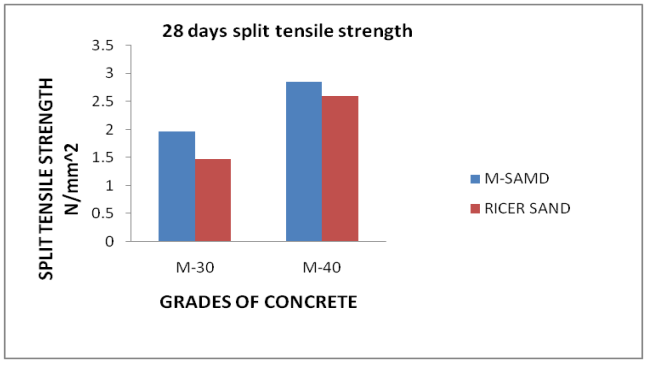

Fig. 6. Split tensile strength Vs Grades of concrete (M-40)

D. Flexural strength

The IS:456-2000[12] represents the relationship between the concrete flexural tensile strength (ft) and the compressive strength (fck) by $f_t = 0.7(fck)^{0.5}$ Here the comparison of flexural strength of river v/s m-sand is done for both 7 days and 28 days curing as given in Fig.7 and Fig.8 respectively. By observing the Fig's we can say that for both 7 days and 28 days the flexural strength is higher in m-sand concrete, which is good for us. so that it will easily replace the river sand and helps in reducing dependency on river sand.

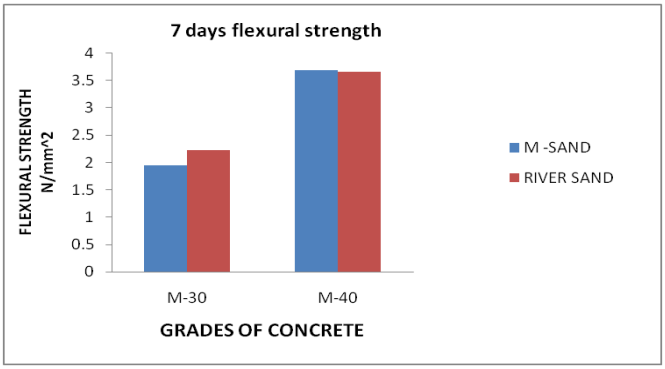

Fig. 7 Flexural strength Vs Grades of concrete (M-30)

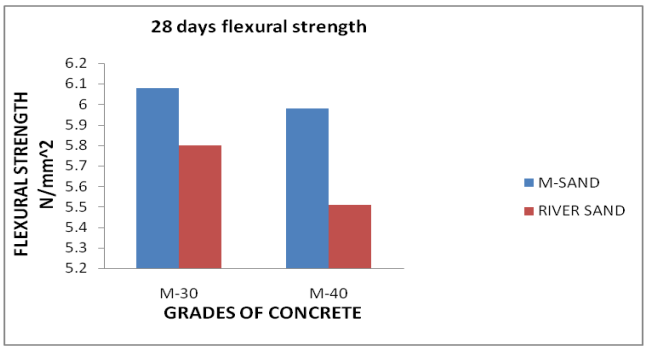

Fig. 8 Flexural strength Vs Grades of concrete (M-40)

VI. CONCLUSION

Based on the experimental investigations carried out, it can be concluded that replacing river sand with that of M-sand provides most effective result in reduction of dependency on river sand.

The workability of M-sand concrete was low compared with river sand, apart from that when we looked at the mechanical properties these concretes gave higher strength in compression, tension and flexural also. Hence in today's construction, it can be stated that M-sand can be effectively used.

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