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EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE WITH OPTIMUM PERCENTAGE OF M-SAND

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Abstract

Indian construction industry today is amongst the five largest in the world. The demand for new construction is ever increasing with the rise in population. Hence the non-renewable aggregate supply has emerged as a problem in India. With the limitation being seen today, the future of construction industries seems to be in dark. Seeking alternate aggregates for concrete, new materials have been used in the construction field. Focusing on the environment and safeguarding natural resources, alternate materials have been used in the construction industry. In India, due to growing population the quantity of solid waste is increasing rapidly The fine aggregates or sand used is usually obtained from natural sourcesspecially river beds or river banks. Now-a-days due to constant sand mining the natural sand is depleting at an alarming rate. Sand dragging from river beds have led to several environmental issues. Due to various environmental issues Government has banned the dragging of sand from rivers. This has led to a scarcity and significant increase in the cost of natural sand. There is an urgent need to find an alternative to river sand. The only long term replacement for natural sand is M-sand. The main components of this project is M-sand which is a partial replacement for natural sand. Replacement will take place with 65%. After casting of concrete mould, all specimen were cured for 7days, 14days, 28 days and compressive strength has obtained accordingly

Keywords: *M-sand/Artificial sand, Natural sand, Compressive strength, Workability*

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1. INTRODUCTION:-

Concrete is the most widely used composite material. The constituents of concrete are coarse aggregate, fine aggregate, binding material and water. Rapid increase in construction activities leads to acute shortage of conventional construction materials. It is conventional that sand is being used as fine aggregate in concrete.The function of the fine aggregate is to assist in producing workability and uniformity in the mixture. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and very costly. Hence we are forced to think of alternative material. The quarry dust or artificial sand may be used in the place of river sand partly. A comparatively good strength is expected when sand is replaced fully or partially with or without admixtures. This paper represents the experimental investigation on compressive strength and workability of concrete by partial replacement of natural sand by M-sand in varying proportion. The results prove that concrete with M-sand shows higher compressive strength and workability by partial replacement of natural sand

2. LITERATURE REVIEW:-

Nimitha Vijayaraghavan et al. [1] concluded from experimental researchers that compressive and flexural strength of control mix concrete can be improved by partial

replacement of natural sand by M-sand, They suggested that optimum replacement of natural sand by M-sand is 50%.

Halesh Kumar B T et al. [2] have found that compressive strength of various mix ratios increased from 0% to 25%, shows increased in compressive strength at 15% of partial replacement

K. Suseela et al. [3] have resulted that the compressive strength of various mixes from 1% to 30%, shows increase in compressive strength at 19% of partial replacement of natural sand by M-sand in concrete mix

Shreyas. K [4] concluded from experimental investigation that of various mixes from 0% to 50% shows increase in compressive strength at 30% of partial replacement of natural sand by M-sand

3. EXPERIMENTAL INVESTIGATION:-

3.1 Materials

3.1.1 Cement: Ordinary Portland cement (OPC) is the most common type of binder used for concrete production and hence, OPC 53 Grade conforming to Indian Standard IS 12269:1987 was used as a binder. Specific gravity of cement was found to be 3.15. The physical properties of cement aregiven in Table 1.

Table no.1 Physical Properties of Cement

Component	Results	Requirement
Fineness	1.5%	<10%
Initial setting time	145 min	Minimum 30 min
Final setting time	315 min	Maximum 10 hours
Standard consistency	34%	
Soundness	2.5 mm	<10 mm

3.2 Fine Aggregate

3.2.1 Natural Sand: River sand was used throughout the investigation as the fine aggregate conforming to grading zone II as per IS 383:1970. Fine aggregate with a fineness modulus 4.48 with specific gravity of 2.68

3.2.2 M-sand (Manufacture sand): It is a M-sand substitute of river sand for concrete construction. It is produced from hard granite stone by crushing. M-sand is well graded and falls within limit grading zone-II sand, grading limit specified in IS code 383 code. Code allows 20% fines less than 150 microns for crusher stone sand, Confirming to IS 9142-1979. The specific gravity and fineness modulus was found to be 1.75 and 5.58 respectively

3.2.3 Coarse Aggregate: According to IS 456-2000 the nominal size of coarse aggregate should be as large as possible within the limits specified but in no case greater than one-fourth of minimum thickness of member, for most work 20mm aggregate is suitable. The specific gravity and fineness modulus was found to be 2.89 and 21.72 respectively

3.3 Water: Water is an essential component of concrete for mixing and curing. It should be free from harmful impurities. The pH value of water shall not be less than 6.

Mix Proportions and Mix Details

There were two type of mix considered of which one control mixture (Without M-sand) and other one concrete mix was made by replacing the fine aggregates with 65% by m-sand for M25 grade concrete as per Indian Standard Specification IS: 10262-2009 to achieve target mean strength. The proportions of mix ingredients for $1m^3$ of concrete are tabulated below (Table no.2)

4. EXPERIMENTAL PROCEDURE

4.1 WORKABILITY:

The workability of the mixes was determine during a slump cone test having separate water cement ratio for all the two mixes.

Table 4: Table Showing Slump Values

Mix	slump
100% Natural Sand	90
65% M-sand 35% natural sand	93

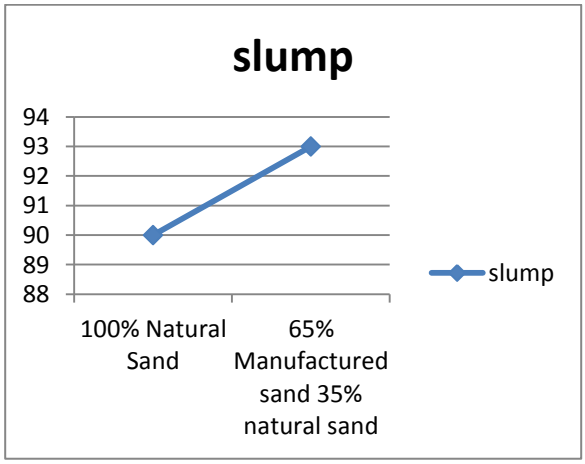

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Fig-1 Slump M-sand

Fig-2 Slump Control mix

4.2 Compressive Strength:

The specimen of standard cube of (150 mm x150 mm x 150 mm) was used to determine the compressive strength of concrete. Two specimens were tested for 7, 14 and 28 days with varying proportion of M-sand replacement. The constituents were weighed and the materials were mixed by hand mixing. The mixes were compacted with the help of needle vibrator. The specimens were demolded after 24 hour, cured in water for 7, 14 and 28 days, and then tested for its compressive strength as per Indian Standards.

Table no.2 Mix Proportion		
	100% Natural Sand	65% M-sand 35% natural sand
Materials		
Cement	1	1
Natural sand	2.13	0.74
M-sand	-	1.38
Coarse Aggregate	2.89	2.89
Water/cement ratio	0.50	0.55

Table no.3 Table Showing Compressive Strength Readings		
	100% Natural Sand (N-mm^2)	65% M-sand 35% natural sand (N-mm^2)
7 days	21.96	24.48
14 days	26.35	34.79
28 days	42.01	45.02

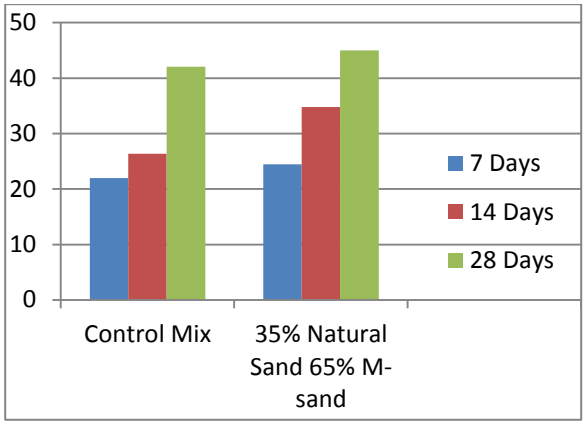

Fig-3 Control mix

Fig-4 35% Natural sand 65% M-sand

6. RESULTS AND CONCLUSION:

1. Higher compressive strengths, were obtained by partial replacement of natural sand by M-sand i.e., 65% replacement when compared to control mix.
2. With M-sand the compressive strength of 28 days increases by 3.01 N/mm^2
3. Concrete becomes harsh when there is increase in percentage of M-sand..
4. Results shows that the natural sand can be partially replaced by M-sand.

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