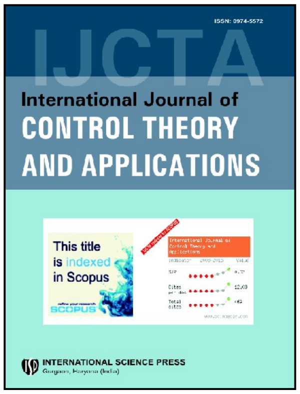

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Flexural Behaviour of Concrete Using M30 & M60 Grade

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Abstract: The paper focuses on the experimental study of using locally available M-Sand as fine aggregate and partial replacement of cement with admixtures in the production of HPC with 28 days strength to the maximum of 60Mpa.The percentage of M-sand added by weight was 0, 25, 50, & 75% as a replacement of sand used in concrete and cement was replaced by adding GGBS with 0, 5, 10, & 15% and the dosage of superplasticizers added 0, 1, 1.3% by the weight of cement. The present paper focuses on investigating characteristics of M30 & M60 concrete with partial replacement of cement with Ground Granulated Blastfurnace Slag (GGBS) and fine aggregate with the Manufactured sand .In the Strength characteristics study, the Flexural strength were determined experimentally for the conventional and M-Sand concrete. The flexural property of concrete is enchanced by partial replacement of sand with 50% of M- Sand substantially compared to normal mix concrete increased the Flexural Strength of High Performance Concrete.

Keywords: Manufactured sand, GGBS, Flexural Strength, Super plasticizers, Workability.

INTRODUCTION

Fine aggregate is an essential component of concrete. The global consumption of natural river sand is very high due to the extensive use of concrete. In particular, the demand for natural sand is quite high in developed countries owing to infrastructural growth. In this situation some developing countries are facing a shortage in the supply of natural sand. The non-availbility of sufficient quantity of ordinary river sand for making cement concrete is affecting the growth of the construction industry in many parts of the country. Therefore, the construction industries in developing countries are under stress to identify alternative materials to reduce the demand on river sand. In order to reduce the dependence on natural aggregates as the main source of aggregates in concrete, artificially manufactured aggregates and artificial aggregates generated from industrial wastes provide an alternative for the construction industry. Some alternative materials have already been used in place of natural river sand. For example,M-sand, slag, ggbs, rockdust, silica fume and quarry waste were used in concrete mixture as a partial replacement of natural sand. Hence the assumption is manufactured sand could be an alternative to natural sand in preparation of concrete. M-sand, one of the by products in crushed stone process, not being used for any applications other than filling-up low lying areas is identified as a replacement material for river sand in concrete.

Concrete made with crushed stone dust as replacement of natural sand in concrete can attain the same flexural strength, comparable strength, modulus of rupture and lower degree of shrinkage as the control concrete. For producing HPC, Industrial wastes, such as silica fume, blast furnance slag, fly ash are being used as supplementary cement replacement materials are also being used as pozzolanic materials in concrete. The super plasticizer Varaplast PC 100 was used as chemical admixtures it is a liquid instantly dispersible in water. It has been specially formulated to give high water reductions upto 25% without loss of workability and produce high quality concrete to enchance strength and durability with low binder ratio 0.26 to 0.4. Increasing dosage of super plasticizers by weight of binder improvement of its workability properties as well as mechanical properties with reduced W/B ratio. This paper presents the study of flexural strength and of M60 conventional concrete be replacing the sand with M-sand and 40% to 60% of cement with GGBS. Tests were conducted on concrete beams to study flexural strengths. The result are compared with the normal conventional concrete.

LITERATURE REVIEW

Shanmugapriya *et al.* 2012 concluded from experimental researchers that compressive and flexural strength of concrete can be improved by partial replacement of cement by silica fume and manufactured sand for natural fine aggregates. They suggested that optimum replacement of natural sand by manufacturedsand is 50%.

Saeed Ahmaed *et al.* 2008 have found that compressive strength of various mix ratios increasd from 7% to 33% whereas workability decreased from 11% to 67% with increasing proportion of manufactured sand.

Shyam Prakash *et la.* 2007 says that manufactured sand satisfies the requirements fine aggregates such as strength, graduation, shape angularity. It is also possible to produce manufactured sand falling into the desired grade. They say that the mechanical properties of manufactured sand depend upon the source of its raw material, i.e., parent rock. Hence the selection of the quarry is very important to quality fine aggregate.

Mahendra R Chitlange *et al.* 2010 experimentally proved that due to addition of steel fiber to natural sand concrete and manufactured sand concrete there is a consistent increase in flexural and split tensile strength whereas there is only a marginal rise in compressive strength.

Historically, a large percentage of a sand has been produced from alluvial deposits. However we are now experiencing a global shortage of natural sand, and environmental pressures, costs and a shortage of this type of deposit has necessitated the manufactured sand from quarried material. One of the problems often experienced with natural sand is the presence of contaminants, which can be very difficult to remove. These contaminants may be silt, organic matters and sometimes, harmful chemicals, such as sulphates and chlorides, all of which can have significant detrimental effects on the performance of structural concrete. Manufactured sand, on the other hand, comes directly from good quality virgin rock, and thus very few, if any contaminants are present.

Crushed rock fines also tend to have higher water absorption rate due to surface roughness, higher surface area and presence of higher amount of fines content. Attempts are made to remove the microfines by washing but obviously, washing does not change other properties like flakiness, surface roughness, higher surface area and poor particle size distribution.

The purpose of this study is to conduct a systematic comparison of the effects of natural and manufactured sand exert on strength and durability properties. This paper presents the mechanical behavior of the selected fine aggregate, followed by the durability behavior of conventional and M-sand concrete.

RESEARCH SIGNIFICANCE

Normal concrete lacks required strength and durability which are more often required for large concrete structures such as high rise buildings, bridges and structures under severe exposure condition. Due to booming construction activities natural sand is becoming scarce due to excessive non scientific methods of mining from the river beds.

For these reasons it it necessary to produce a concrete with improved strength and performance, with suitable materials. This research shows the effective utilization of by product GGBS & M – sand in High Performance Concrete.

EXPERIMENTAL INVESTIGATION

Materials

a) **Cement :** Ordinary Portland cement of 53 Grade conforming to IS 8112 – 1989, and the specific gravity of cement was found to be 3.15. The physical properties of cement given in Table 1

Table 1
Physical Properties of cement

Component	*Results(%)*	*Requirements of IS : 8112*
Fineness, m²/kg	320	Minimum 225
Initial setting Time,minutes	65	Minimum 30
Final setting Time, minutes	250	Maximum 600
Standard Consistency	26.4	-
Soundness, Le Chatelier, mm	1.0	Maximum 10

b) Fine Aggregate: **Natural Sand**: Locally available River Sand having bulk density 1860 kg/m³ was used and the specific gravity is 2.56. The fineness modulus of river sand is 2.64.

Manufactured sand: M- Sand was used as partial replacement of fine aggregate. The bulk density of manufactured sand was 1860 kg/m³, specific gravity and fineness modulus was found to be 2.56 and 3.10 respectively.

Table 2
Sieve analysis of River sand & M – Sand

Sieve Size	*River sand % Passing*	*M- Sand & Passing*
4.75mm	98	99.78
2.36mm	96	87.14
1.18mm	78	63.12
600µm	51	45.75
300µm	26	25.50
150µm	7	7.98

c) Super Plasticizer: In order to improve the workability to high performance concrete, superplasticizer in the form of Sulphonated Napthalene Polymers complies with IS 516 – 1959 and ASTM C 642 type F as a high range water reducing admixture (VARAPLAST PC 100) was used . This had 40% active solids in solution. The specific gravity is 1.22. It is a liquid instantly dispensable in water.

d) GGBS: GGBS is obtained by quenching molten iron slag from a blast furnance in water or steam, to producea glassy, granular product that is then dried and ground into a fine powder. GGBS is used to make durable concrete structures in combination with ordinary port land cement and other pozzolanic materials. The fineness modulus of GGBS using blaine' fineness is 320m²/kg and other properties of GGBS.

e) Water: Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. In general, water fit for drinking is suitable for mixing concrete. Impuritiew in the water may affect setting time, strength, shrinkage of concrete or promote corrosion of reinforcement. Locally available drinking water was in the present work.

f) Mix Design: The concrete mix is designed as per IS 10262 – 1982, Is 456 – 2000 and SP 23 for the conventional concrete and finally river sand has been replaced by M – Sand cement replaced with GGBS by volume. The water cement ratio and The mix proportions of M30 & M60 concrete.

Test Specimens and Test procedure

Flexural Strength Test: The concrete beam size 500 x 100 x 100mm length were used as test specimens to determine the flexural strength of concrete for the both cases i.e. normal concrete and modified concrete. The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The beam were compacted on a vibrating table. Tests are conducted at the end of 7 & 28 days. The properties of fresh concrete were measured according to IS 1199 – 1959.

Work ability

Table 3
Slump Flow Test

M – Sand % age	*At One Hour*
0%	500mm
25%	525mm
50%	550mm
75%	575mm

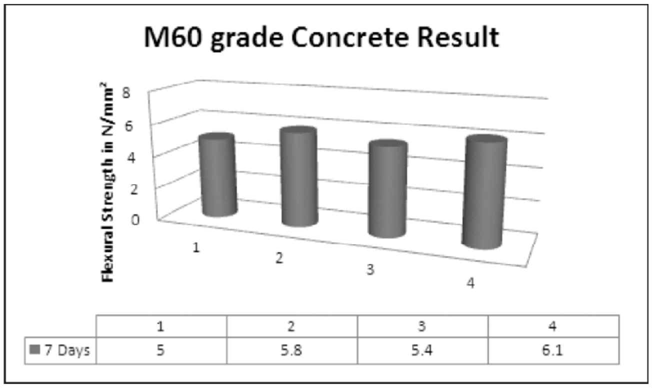
RESULTS AND DISCUSSIONS

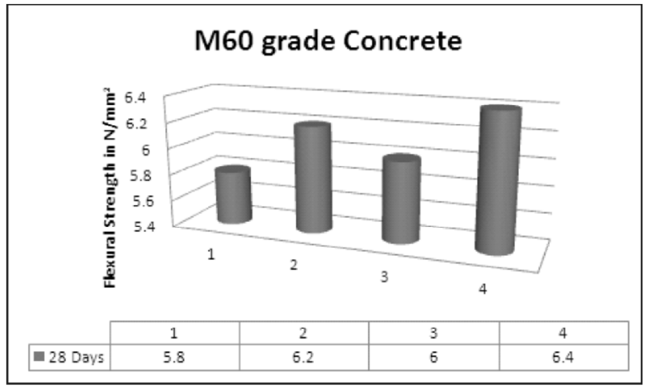
Table 4
Flexural Strength of the conventional concrete are presented in Table for M60 Grade of concrete

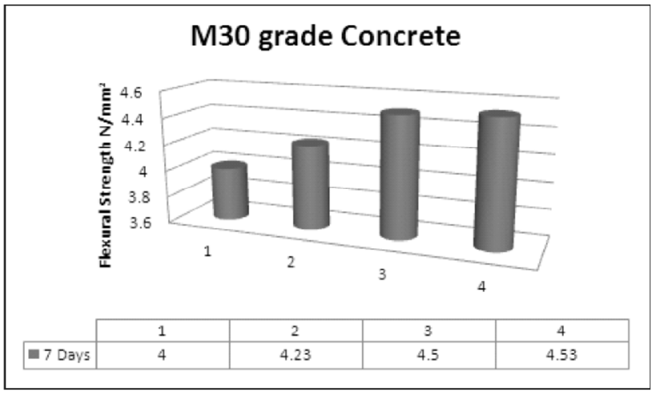
Replacement of Fine Aggregate		*FlexuralStrength in N/mm²*	
M-sand%	*River Sand%*	*7 Days*	*28 Days*
0	100	5	5.8
25	75	5.4	6.1
50	50	5.8	6.2
75	25	6.0	6.4

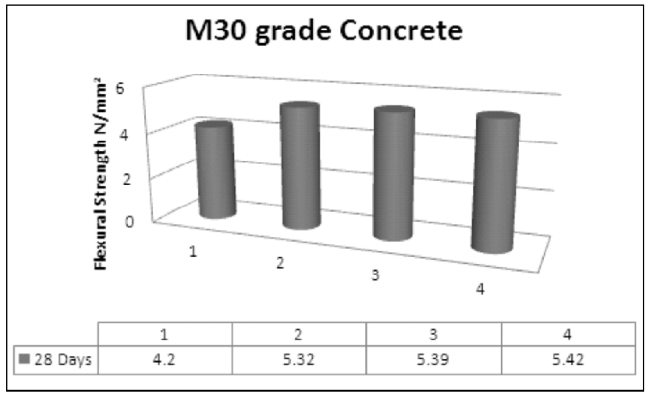
Table 5
Flexural Strength of the conventional concrete are presented in Table for M30 Grade of concrete

Replacement of Fine Aggregate		*FlexuralStrength in N/mm²*	
M-sand%	*River Sand%*	*7 Days*	*28 Days*
0	100	4	4.2
25	75	4.23	5.32
50	50	4.50	5.39
75	25	4.53	5.42









The Flexural strength of conventional concrete and modified concrete i.e with the replacement of Fine Aggregate with M –Sand at the age 7 and 28 days of Flexural Strength with adding the Super Plasticizers 0, 1, 1.3 respectively. The Flexural strength is increase as the percentages of M – Sand increases with 1.3% of SP 100 when compares to 1% of Super plasticizers.

The flexural strength of conventional concrete and modified concrete i.e. Fine aggregate replaced with M – Sand and cement replaced with GGBS with 1.3% of SP. Flexural strength of concrete is increased as the percentages of M – Sand and Percentage of GGBS increases. The Maximum compressive strength of concrete is achieved at the combinations of 50% M – Sand and GGBS.

CONCLUSIONS

- It is observed that the Flexural Strength of concrete can be improved by partial replacement of GGBS for cement and M – Sand for Fine Aggregate.
- Flexural strength of concrete can be improved by using Super Plasticizers.
- From the above experimental results it is proved that, M – Sand can be used as alternative material for the fine aggregate i.e.sand. Based on the results the flexural strength Test are increased as the percentages of M – Sand increased.
- The present experimental programme indicated that the properties of the concrete could enchance the effect of utilization of M-Sand ontained from the place of river sand in concrete.
- The percentages increases of Flexural strength M60 concrete is 6.1N/mm² at the age of 7 days and the 6.4N/mm² 28 days by replacing 10% of cement with GGBS and 75% of fine aggregate with M – Sand.

- The percentages increases of Flexural strength M30 concrete is 4.5N/mm²at the age of 7 days and the 5.39N/mm² 28 days by replacing 10% of cement with GGBS and 50% of fine aggregate with M – Sand.
- When the percentage of replacement of M-sand goes beyond 50%, the strength is considerably reduced.
- Hence this research concluded with a remarks of the optimum percentage of M-sand to obtain high flexural strength when replaced with natural sand with 50% & 75% of M-sand.
- The use of M-Sand in the Construction Industry helps to prevent unnecessary damages to the environment and provide optimum exploitation of the resources.

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