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Experimental Investigation on M-Sand with Steel Fibre in Self Compacting Concrete

Vimal Xavier. I[1], Sarala. P[2], Suresh. R[3]
[1]*P.G.Scholar, Department of Civil Engineering, Prathyusha Engineering College, Thiruvallur.*
[2]*Assistant Professor, Department of Civil Engineering, Prathyusha Engineering College, Thiruvallur.*
[3]*P. G. Scholar, Department of Structural Engineering, Prathyusha Engineering College, Thiruvallur*

Abstract: ***The investigation is to develop a reinforced concrete beam with manufactured sand as partial replacement for fine aggregate with steel fibre. Natural river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale exploitation of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious problems with respect to its availability, increases in cost and environmental impact. In such a situation the Manufacture Sand can be an economic alternative to the river sand and which is cost effective. This study presents the behavior of self compacting concrete (SCC) with the replacements material. The fine aggregate is partially replaced with Manufacture sand. . In addition to that steel fibres are to be added in proper proportion. Suitable dosage of super plasticizers are also should be added for achieving increased workability. The objective of the investigation is to develop a reinforced concrete beam with manufactured sand as partial replacement for fine aggregate. Then the results are to be compared with the conventional beams.***

Index Terms: Self compacting concrete (SCC), Replacement of River sand with M-Sand, Steel fibre.

I. INTRODUCTION

The development of Self-Compacting Concrete (SCC) has recently been one of the most important developments in the building industry. The purpose of this concrete concept is to decrease the risk due to the human factor, to enable the economic efficiency, more freedom to designers and constructors and more human work. It is a kind of concrete that can flow through and fill gaps of reinforcement and corners of moulds without any need for vibrations and compacting during the pouring process. Because of that, SCC must have sufficient paste volume and proper paste reology. Paste volumes are usually higher than for conventionally placed concrete and typically consist of high powder contents and water-powder ratios. The main advantage of using SCC is that it offers high homogeneity, fluidity and less segregation, minimal concrete voids and uniform concrete strength. Since low cement ratio is adopted it is possible to achieve early strength, quicker remoulding and faster use of elements and structures. The impact due to the use of vibrators is eliminated by the use of SCC in construction. Compaction of SCC is carried out in all parts of the formwork, including the hardly accessible parts, without any additional external force and no gravitational force that is as a result of self weight of concrete. The filling ability and stability of SCC in the fresh state can be defined by four key characteristics: passing ability, flow ability, segregation resistance and viscosity. Such properties are achieved by addition of chemical additives to the concrete. The growing use of concrete in special architectural configurations and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability, good structural performance and adequate durability..

II. SELF COMPACTING CONCRETE

A. Properties of SCC

The three main properties of SCC in plastic state as

1) Filling ability (excellent deformability)
2) Passing ability
3) High resistance to segregation

B. Objectives of work

In this experimental study an attempt has been made to evaluate the structural behavior of SCC in beam by partial replacement of Sand with Manufacturing Sand along with steel fibres. The waste Quarry dust which is partially replaced with Sand to produce low cost SCC. In addition to that Viscosity Modification Agent are also used.

C. Materials Used

All materials used in this study are commonly available.

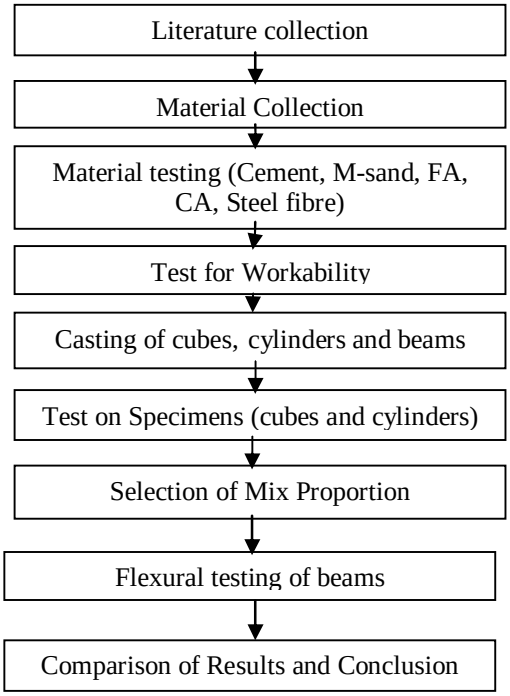
1) Cement – OPC of 53 grade
2) Sand – 4.75 mm maximum size
3) Coarse aggregate – 10 - 12 mm size
4) M-Sand in replacement of sand
5) Steel Fibres and Viscosity Modification Agent.

III. METHODOLOGY

To study the flexural behavior of RC beams with varying proportions of m-sand as fine aggregate. To compare flexural behavior of M-sand reinforced concrete beams with control concrete cast using river sand as fine aggregate.

To investigate the performance of concrete beams cast with different combinations of M-sand and river sand as fine aggregate so as to compare the respective cracking load and modulus of rupture..To examine the strength of beam cast with different combinations of M-sand and river sand by replacement of river sand with M-sand as fine aggregate in varying percentage as 0%, 250%, 50%, 75%..And varying percentage of steel fibres from 0% to 1% of the total volume.

The methodology worked out to achieve the above-mentioned objectives is followed as shown in the flow chart below:



IV. MATERIAL TESTING

A. Tests for Cement

1) Standard Consistency Test
2) Initial Setting and Final Setting Time Test
3) Specific Gravity Test
4) Compression Strength test for Mortar Cube

B. Test s for Fine Aggregate

The following experiments were conducted to find out the properties of fine aggregate as per IS-2386: 1963(Part-3)

1) Sieve Analysis Test
2) Specific Gravity Test
3) Water Absorption Test

C. Tests for Coarse Aggregate

The following experiments were conducted to find out the properties of coarse aggregate as per IS-2386: 1963(Part-1)

1) Water absorption Test
2) Impact Test
3) Specific Gravity Test
4) Sieve Analysis Test

V. MIX DESIGN

In the design of self compacting mix, the relative proportions of the key components may be considered by volume rather than by mass, the mix design is obtained by trial and error method from fresh concrete test. Indicative properties of materials are for self compacting concrete are,

1) Water ratio by volume is to be 0.80 to 1.00
2) Total content to be 160 to 240litres (400-600kg)/ m^3
3) The sand content may be more than 38% of the mortar volume.
4) Coarse aggregate content should normally be 28 to 35% by volume of the mix.
5) Water/cement ratio is selected based on strength. Water content should not exceed 200liters/m^3.
6) In this mix viscosity modification agent of 0.3% of Glenium B233 is added for flow ability of concrete.

A. Fresh Concrete Properties

The concrete composition is now determined and the viscosity modification agent is finally selected on the bases of trial and error test on concrete. The fresh concrete flow ability tests are,

1) Slump flow test,
2) V – funnel test,
3) L – Box test.

B. Hardened Concrete Properties

1) Compressive Strength Test,
2) Split Tensile Test

C. Mix Design Proportion Of Concrete

1) The below table shows the mix design proportion for M_{30} grade concrete for SCC and it has passed all the fresh concrete flow ability and passing ability tests.
2) The viscosity modification agent (VMA) used in this project is Glenium B233.
3) Mix ratio obtained for the proportion 1: 1.64 : 2 (M_{30}) for SCC.

Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (Kg/m^3)	W/C	VMA (%)
462.93	759.45	928.21	208.3	0.45	0.3%

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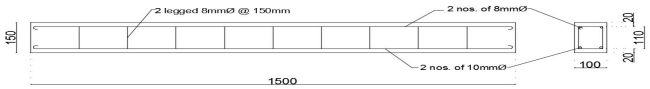
VI. SUMMARY OF MATERIAL TESTING RESULTS

S.No	Name of Test	Value	Codal Standard
1	Specific Gravity of Cement	3.13	IS:4031(Part-3)1988 Range 3.15
2	Standard Consistency of Cement	32%	IS:4031(Part-4)-1988 Penetration 5-7mm
3	Initial Setting Time of Cement	69 min	IS 12269-1987 Should not be less than 30 mins cl 5.3
4	Test on final setting time of cement	369 min	IS 12269-1987 Should not be more than 600mins cl 5.3
5	Compressive strength test of cement mortar cube (28days)	54 N/mm^2	Not less than 53 N/mm^2 as per IS 12269-1987
6	Specific gravity of FA	2.65	2.6-2.7
7	Sieve analysis of FA	FM=2.78	Medium sand 2.6-2.9
8	Water absorption test on FA	0.89%	IS:2386(Part-3)1963
9	Specific gravity of FA(M-Sand)	2.69	2.6-2.7
10	Sieve analysis of FA(M-Sand)	2.789	Medium sand 2.6-2.9
11	Water absorption test on FA(M-Sand)	0.869%	IS:2386(Part-3)1963
12	Specific gravity test for CA	2.69	FOR C.A 2.7
13	Water absorption test for CA	0.2%	5%
14	Sieve analysis of CA	FM=7.5	IS:2386(Part-1)1963
15	Impact test of CA	7.72%	IS:2386(Part-4)1963 Range-7-12.5%

A. Design Of Beam

1) Calculate Self weight, Moment acting (Msw,MLL,Mu),
2) Check for Mu,lim ($0.138fckbd^2$)
3) Check for Shear stress.
4) Calculate Balance shear, Reinforcement & Spacing.

B. Reinforcement Details



C. Specimens Casted

The wooden formworks required for casting the reinforced beam are fitted and the required reinforcement is being tied up as per the beam calculation. The covers are being provided to avoid the formworks contact with reinforcement.

Beam Specimen	No. of Beams
SCC control beam	2
25% of M-Sand	2
25% of M -Sand and 0.2% of S.F	2
25% of M- Sand and 0.4% of S.F	2
25% of M- Sand and 0.6% of S.F	2

VII. SUMMARY AND CONCLUSION

A. General

In this project the study on flexural strength of SCC beam with M Sand and Steel Fiber beams are investigated. The ultimate load, Deflection and flexural strength are obtained from the results which may increase the strength of the concrete structure and the investigations are summarized and the following conclusions are made.

B. Conclusion

A clear idea has been obtained for providing low cost Self Compacting Concrete by replacing Sand with M-Sand and additional Steel Fiber in Reinforced concrete beam which may increase the strength of the concrete structure.

This study is all about the replacement of river sand by m-sand and by adding fiber in self compacting concrete has been investigated. The experimental investigation is based on tests of fresh concrete tests and compression test Hence the following conclusions are derived from this study. By adding the manufactured sand in the self-compacting concrete with higher percentage increases the compressive strength of the concrete. It can be avoiding cracks and gives high durability. Self-compacting concrete (SCC) offers several economic and technical benefits; the use of steel fibres extends its possibilities.

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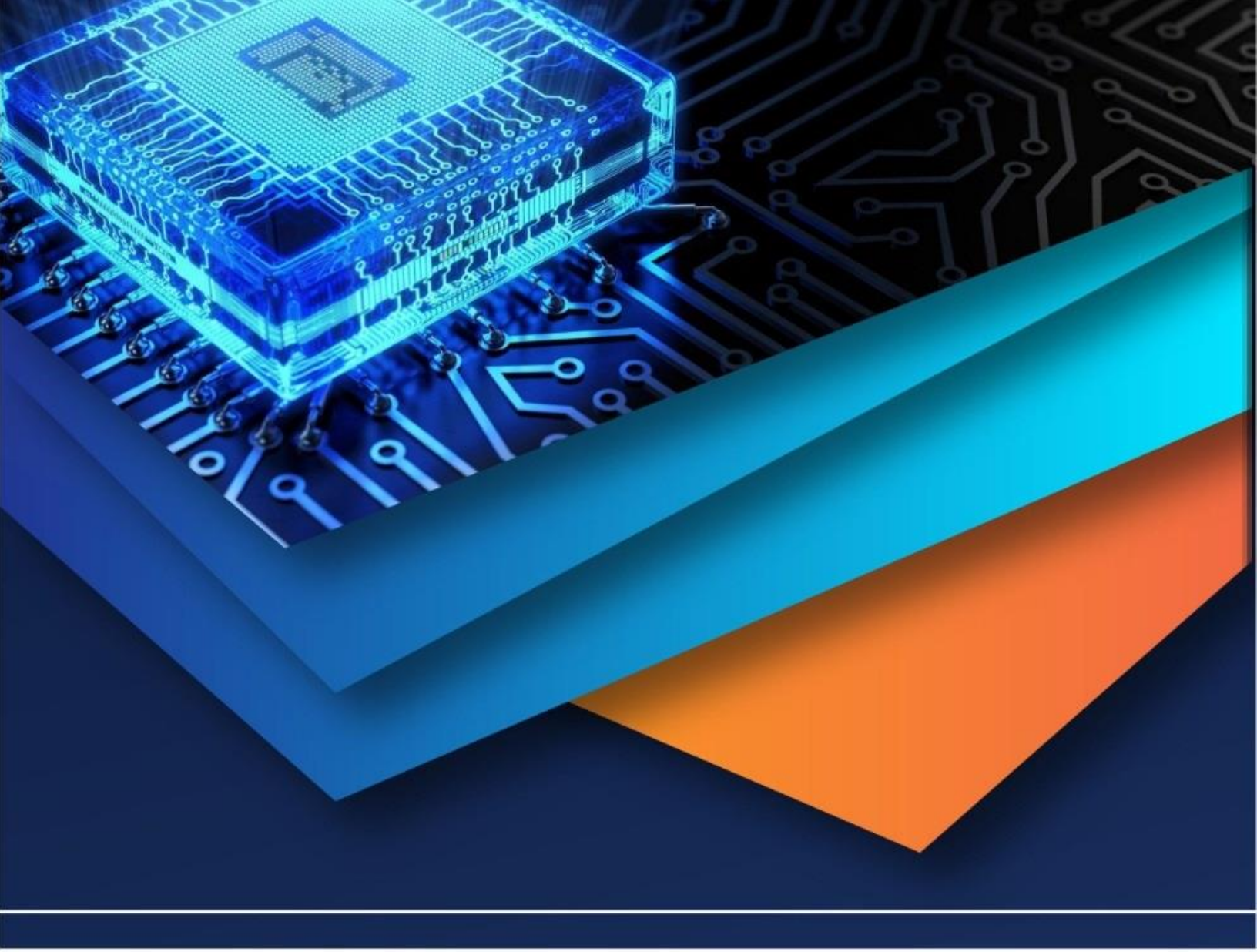

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