Experimental Investigaton on High Performance Fibre Reinforced Self Compacting Concrete Using Robo Sand

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Abstract— **When it comes to building materials, concrete is among the most useful. The primary objective of this research is to produce high strength SCC by varying the quantity of mineral admixtures added to concrete of grades M75 and M85. In accordance with IS:10262-2019, the Mix Design for SCC M75 and M85 grade is being prepared. There is increasing evidence that SCC can be made more affordable by partially replacing Portland cement with a substantial quantity of mineral admixtures and fillers. Small quantities of steel fibers are tested in SCC to create high strength SCC, which enhances mechanical qualities when concrete samples are cast. This is done to further improve SCC's performance. The report includes a thorough experimental analysis of the most current concrete characteristics.**

Index Terms: M75 and M85 self compacting concrete, Robo sand and steel fiber

1. INTRODUCTION

With the advancement of technology, the products we use undergo modifications and changes in response to time and industry developments. This leads to overall improvements in the product's qualities. One such product is self-compacting concrete (SCC). In 1980, SCC originally began at the University of Tokyo in Japan. Because of its exceptional deformability, CC is a unique kind of concrete that can be replaced and consolidated under its own weight without requiring any vibration effort. At the same time, it is cohesive enough to be handled without segregation or bleeding. By adding steel fibers and substituting part of the cement with mineral admixtures including fly ash, metakoaline, GGBS, and silica, high strength can be achieved in SCC.

i) Mehta and Neville have recommended an easy approach to prevent segregation: adding more sand and reducing the amount of coarse aggregates by 4%–5%. Because SCC has a high flow ability requirement, mineral admixtures such coal fly ash are used in its production. Particle packing density can be increased and inner particle friction and viscosity can be decreased by adding one or more mineral additives or powder minerals with varying morphologies and grain sizes. As a result, it increases SCC's deformability, self-compaction, and stability.

.ii)Yehia et al. Have observed a decrease in the super plasticizer doses when mineral additions are used in SCC. By using fly ash as a filler ingredient in SCC, the well-known positive benefits of utilizing fly ash in concrete—such as enhanced rheological qualities and less concrete cracking as a result of lower heat of hydration—can also be included.

iii)Vanakuri et al. totally replaced out the natural river sand for robot sand. In this instance, the nonstop method was used in the design process. The percentage of cement replaced by GGBS was 10%, 20%, 30%, and 40%, and the percentage of fine aggregate replacement was 0%, 25%, 75%, and 100%. The maximum compressive strength was achieved by replacing 30% and 100% of the river sand with robo sand. They added that using GGBS lessens the chance of alkali silica reactions, resistance to sulphate attack, and the entry of chloride ions, all of which contribute to the reduction of reinforcement corrosion.

iv) Saikumar et al. It is advised that the ideal dosage of steel fibers be 2% of the weight of cement. Flexural and split tensile strength diminishes as the fraction of steel fiber replacement rises above 2% of the compressive strength.

2.OBJECTIVES OF THE PROJECT

i) To produce and analyze hybrid fiber concrete that self-compacts with exceptional strength.

ii) To produce a high strength concrete by achieving the mix proportion for >M60 grade of concrete with different mineral admixtures.

iii) To determine, in accordance with IS 10262, the HSHFRSCC's various conventional concrete qualities.

iv) To examine the mechanical qualities and consistency of the fresh concrete stage using steel and polypropylene fibers (Micro & Macro).
v) Analyzing the impact of various fiber kinds (in terms of size and shape)
vi) To examine the high strength concrete's durability characteristics.

3.METHODOLOGY

I MATERIALS
i) Cement: Throughout the project, OPC 53 grade cement that complies with IS 12269-1987 is used.
ii) Fly ash: The current study utilized fly ash from the Raichur Thermal Power Plant in Karnataka. Fly ash is included in classes C (20% and 25%).
iii) GGBS: GGGBS, or ground granulated blast furnace slag, is a byproduct of the iron industry. The furnace is filled with iron ore, coke, and lime stone. The resultant molten slag, which is between 1500 and 1600 degrees Celsius in temperature, floats above the molten iron.
iv) Silica fume: Micro silica 920d procured from Astra chemicals, Chennai conforming ASTM 1240-14, DOSAGES OF 10% & 5%was used in this present investigation.
v) Fine Aggregate: Robo sand confirming to Zone II
vi) Coarse aggregate: 20mm downsize (Rounded shape).
vii) Fibers: carbon steel fibers (hooked end and crimped, straight steel fibers of aspect ratio of 60), Polypropylene fibers (Micro & Macro)
viii) Super plasticizer: ROOFPLAST HS 200
ix) Viscosity Modifying Agent: ROOF PLAST VMA 2

Table-1:PROPERTIES OF ROBO SAND

SL NO	PROPERTY	VALUES	TEST METHOD
1	Specific gravity	2.61	IS 2386 (Part III)-1963
2	% of bulking of aggregates	25.24	IS 2386 (Part III)-1963
3	Fine particles less than 0.075mm (%)	13	IS 2386 (Part III)-1963
4	Moisture content Water Absorption	Nil	IS 2386 (Part III)-1963
6	Sieve analysis	Zone II	IS 383-1970
7	Density (kg/m3)	1570	IS 2386 (Part III)-1963

II TEST METHODOLOGIES

FRESH CONCRETE
1) V funnel test
2) J ring test
3) L box test
4) U box test

HARDENED CONCRETE
1) Compressive strength
2) Flexural strength
3) Split tensile strength

DURABILITY TEST
1) Water absorption

MIX ANALYSIS TO THE GRADES OF CONCRETE

MIX DESIGNATIONS	M65	M70	M75	M85
Cement, C (kg/m3)	429	374.5	315	247.5
Mineral admixtures (kg/m3)	85.8	160.5	135	202.5
Robo sand (kg/m3)	1015.59	612.74	820	750
Coarse aggregates(kg/m3)	744.12	1315.66	850	925
Water	150.15		200	195
Super plasticizer (lit/m3) Viscosity Modifying agent	3.08 1.280	2.64 1.020	3.24 1.030	2.7 1.020
% of steel fibers	1	1	1.5	1.5
W/C	0.35	0.29	0.25	0.23
W/P	1.0	0.9	1.1	1.03
Mix proportions	1: 2.36: 1.12	1: 1.14: 2.46	1: 1.82: 1.88	1: 1.66: 2.05

MECHANICAL PROPERTIES OF CONCRETE

Table-2: COMPRESSIVE STRENGTH OF HPFRSCC

SL No.	GRADE OF CONCRETE	7DAYS	14DAYS	28DAYS
1	65	59	70	79
2	70	73.20	85.62	90.52
3	75	76.40	85.50	92.68
4	85	78.80	89.54	99.82

Chart-1: Graph Showing Compressive Strength Of Concrete At 7, 14 And 28 Days Of Curing.

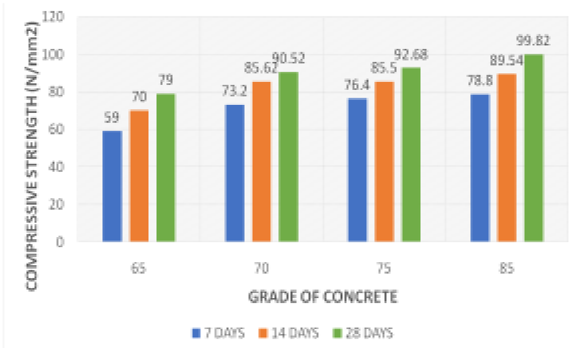


Table-3: FLEXURAL STRENGTH OF HPFRSCC

SL No.	GRADE OF CONCRETE	7 DAYS	14 DAYS	28 DAYS
1	65	8.01	14.1	19.2
2	70	6.47	13.2	20.42
3	75	7.15	15.90	21.4
4	85	8.4	15.4	22

Chart-2: Graph showing Flexural strength of concrete at 7, 14 and 28 days of curing.

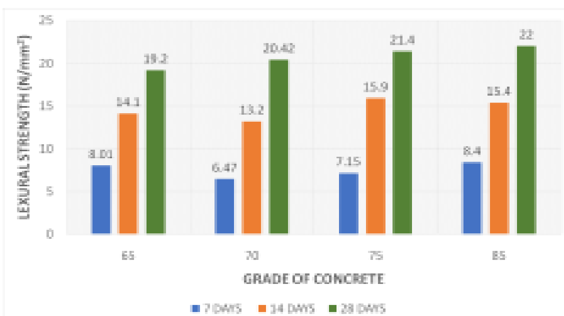
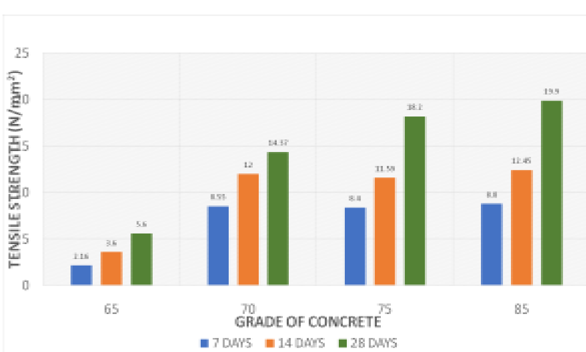


Table-4: SPLIT TENSILE STRENGTH OF HPFRSCC

SL No.	GRADE OF CONCRETE	7 DAYS	14 DAYS	28 DAYS
1	65	2.16	3.6	5.6
2	70	8.55	12	14.37
3	75	8.4	11.59	18.2
4	85	8.8	12.45	19.9

Chart-3: Graph showing Split tensile strength of concrete at 7, 14 and 28 days of curing.



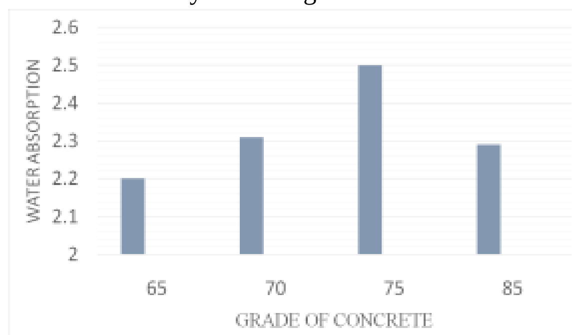
DURABILITY TEST

Table-5: WATER ABSORPTION TEST OF HPFRSCC

SL No.	GRADE OF CONCRETE	DRY WEIGHT OF SPECIMEN	WET WEIGHT OF SPECIMEN	WATER ABSORPTION (%)	AVERAGE OF WATER ABSORPTION
1	65	8456	8642.03	2.2	2.33
2	70	8478	8689.95	2.31	
3	75	8586	8800.65	2.5	
4	85	8612	8792.85	2.29	

The average water absorption of concrete is 2.33 and thus the quality of concrete is good.

Chart-4: Graph showing the water absorption of concrete at 28 days of curing.



3. CONCLUSIONS

i) Excellent quality has been demonstrated by self-compacting concrete reinforced with fibers.
ii) All of the mechanical qualities of concrete are improved by the addition of mineral admixtures.
iii) When fibers and mineral admixtures are used, concrete's water absorption is greatly reduced.
iv) The use of fibers in concrete helps to strengthen and prolong the structure's strength while reducing cracks.
v) When 0.5% to 2% of fibers are added to hybrid fiber reinforced concrete, the compressive strength of the material improves by up to 80%.
vi) The addition of fibers to hybrid fiber reinforced concrete improves its flexural strength by 30% to 70%.
vii) Split tensile strength rises with an increase in the percentage of fibers.

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