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Self Compacting Concrete using Polypropylene Fibers

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Abstract: *Developments in the construction techniques and population have had opting enormous importance in the development of RCC over last ten years. Opting self compacting concrete (SCC) is mainly depends on site conditions, type of construction (mainly type of columns and beams) and reinforcement allocation. By eliminating the vibration compaction using vibrators the productivity can be achieved to utmost.*

The majorly affected qualities in concrete by adopting SCC are improved performance, hardened properties like quality of surface, strength and durability. Coming to the paper the main focus is on determine the maximum quantity of poly propylene fibers can be possibly used in SCC and the replacement of cement with FLYASH is also done. From earlier studies the maximum replacement can be done up to 40% in SCC with fly ash without affecting the hardened and mechanical properties of concrete. After fixing the amount of poly propylene fibers and fly ash to be added and replaced respectively in SCC. Replacement of cement with fly ash is constant throughout the mixes.

An experimental study on the behavior of mechanical properties of concrete was done which includes compressive and flexural strength. Then the comparison was done for both the mixes with poly propylene fibers and conventional mix. From the research papers the maximum quantity of fiber can be used in SCC was 0.75% to 1% of the total cement content per mix.

Keywords: *Self compacting concrete (SCC), poly propylene fibers, fly ash, hardened properties.*

1. INTRODUCTION

Self compacting concrete (SCC) is also known as self consolidating concrete. SCC is a non segregating concrete due to high binder content and flowable one. It will place or adjusted in any place by its self weight it will spread even in the places where the dense reinforcement is provided. While placing it no need of providing compaction (vibration using mechanical vibrators). If the placement of concrete is done at a distance of one meter above the area of placement with its flowable nature its can be placed without any voids honeycombs. It's an advantage for adopting the SCC.

Development of SCC is a desirable thing and most advantageous for the contractors to overcome problems associated with placement and due to dense reinforcement adoption. SCC is having high flowability and segregation resistance so it can easily fill the form work completely even in congest reinforcement without any skilled work man ship for taking care of avoiding honeycombs and voids. It won't be achieved by the conventional concrete which requires compaction. The presence of air voids and honeycombs in the concrete will reduce the strength of the concrete as well as durability simultaneously. Major thing to be considered while preparing SCC is even if the replacements and additions were done it should retain its fresh properties in all the aspects with includes flowability and binder content.

In this paper five fiber addition mixes and one conventional mix were considered to evaluate the properties of the concrete. mixes are done with the fixed replacement of cement content of 10% with fly ash in all the mixes and fiber is add to all mixes with an increasing in the value of 0.25% in each mix . i.e., the fiber replacement percentages are 0%, 0.25%, 0.5%, 0.75%, 1.0%, 1.25%. And the water cement ratio is fixed to 0.45 % for all the mixes and super plasticizer is used to improve the workability of the concreting without increasing the water content, as the water content increases it will affect the change in strength and durability of concrete. As the increase in water cement ratio will leads to segregation also. The super plasticizer used is glenium g22 was used; its percentage of addition in all the mixes is consistent of 1 %. And the experimental done include compression and flexural strength tests for both 7 and 28 days.

2. MATERIALS

Brief explanation of the materials which are used in this project is given in this section. Portland cement of grade 50 has been used for the production of self compacting concrete with addition of polypropylene fibers. Many researchers have concluded that Portland cement is the adoptable material in most cases, satisfactory and adequate for construction. The chemical composition of Portland cement is shown in the table 1. Both coarse and fine aggregates are used having specific gravity of 2.7 sorted by standard test. the fine aggregate of size less than 4.75 mm sieve is used which comes under zone II, coarse aggregate of sizes both 12.5mm and 20mm are used as 60% and 40% respectively.

Fly ash is used as a replacement of cement, polypropylene fibers is also used which is an additive to the concrete not a replacement material, the amount of replacements and addition is mentioned in the mix design section. Fly ash is a byproduct in thermal industry, fly ash samples are shown in fig 1. Chemical compositions of fly ash are shown in the table1. Specific gravity of fly ash is 2.2. For controlling water cement ratio super plasticizer (chemical admixture) is used and glenium matrix stream-II (High range water reducing agent) is used as super plasticizer in this experiment.

Table1. *Chemical composition of Cement, Fly ash*

Chemical Constituents	Cement	Fly ash
Sio2	21.1	43.4
Al2O3	4.6	18.5
CaO	65.1	4.3
MgO	4.5	0.9
Fe2O3	2.0	29.9
SO3	2.8	1.2
L.O.I	1.4	1.2

Table2. *Properties of Polypropylene fibers*

Fiber type	**Polypropylene**
Length	50 mm
Cross section	Roughly rectangular1,6*0,4m
Density	0,92
Tensile strength	310Mpa
Elastic modulus	4,3 Gpa
Alcali, acid, salts resistance	High

2.1. Mix Design

For finalizing the confined number of mixes no. of trail mixes were done. Based on the results of all the trail mixes the behavior of the concrete with addition of fibers is studied. Finally six mixes were concluded for the further experimental study and the name of the finalized mixes are MF10P0, MF10P25, MF10P50, MF10P75, MF10P100 and MF10P125 includes conventional mix too. For preparing all the mixes both fly ash and polypropylene are used. For all these mixes fly ash replacement is maintained at constant proportion i.e., 10% and polypropylene is varied from 0% to 1.25% i.e., MF10P0, MF10P25, MF10P50, MF10P75, MF10P100 and MF10P125. Using the data/results obtained from the preliminary studies the water cement ratio is fixed to 0.45% for all the mixes. And the material requirement for all the mixes is tabulated as follows.

Table3. *Compositions of selected mixes*

MIX	MF10P0	MF10P25	MF10P50	MF10P75	MF10P100	MF10P125
CEMENT(Kg/m^3)	432	432	432	432	432	432
FLYASH(Kg/m^3)	62.28	62.28	62.28	62.28	62.28	62.28
FINE AGGREGATE (Kg/m^3)	890	890	890	890	890	890
COARSE AGGREGATE (Kg/m^3)	810	810	810	810	810	810
SUPER PLASTICIZER (%)	1	1	1	1	1	1
W/C RATIO	0.45	0.45	0.45	0.45	0.45	0.45
FIBER CONTENT (%)	0	0.25	0.50	0.75	1.00	1.25

2.2. Casting, Test Specimens and Curing

For calculating both compressive strength and flexural strength of the mixes at 7 and 28 days both cubes and beams are prepared. The dimensions of cube and beam moulds are 150x150x150 mm^3 and

100x100x500 mm^3 are adopted. Revolving paddle mixer is used for mixing the concrete for all the mixes and while filling the concrete in to the moulds no compaction is adopted compaction is done only using a tamping rod because the concrete is self compactable. Further demoulding is done after 24 hours and the cubes and prisms are kept for curing under room temperature. Testing is done for both 7 days and 28 days.

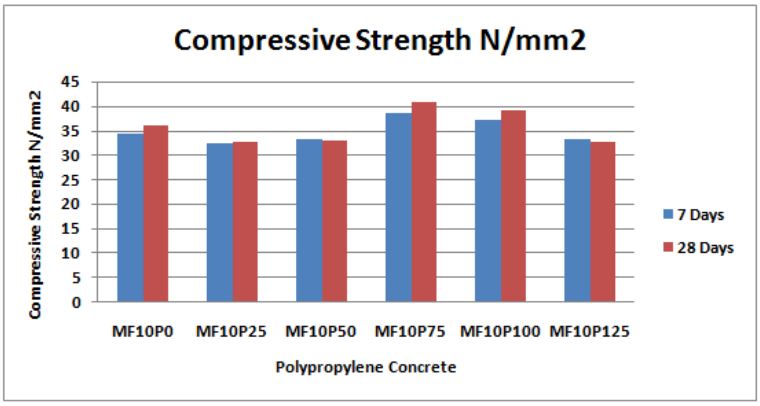
3. Results and Discussions

3.1. Compressive Strength

The compressive test results for both 7 and 28 days are tabulated as follows; there is a slight decrement in compressive strength as increase in fiber content for both 7 and 28 days.

Table4. *Compressive Strength at 7 and 28 days*

Compressive strength (N/mm^2)	MF10P0	MF10P25	MF10P50	MF10P75	MF10P100	MF10P125
7 days	33.5	31.5	32.8	38.3	36.5	33.0
	34.0	31.1	32.9	40.9	37.2	32.8
	35.5	34.5	33.9	36.5	38.0	33.5
Avg	34.3	32.3	33.2	38.5	37.2	33.1
28 days	35.5	29.2	28.8	39.5	36.8	33.5
	34.3	32.8	33.0	42.0	39.5	28.0
	38.5	35.4	37.0	41.0	40.6	36.0
Avg	36.1	32.5	33.0	40.8	39.0	32.5

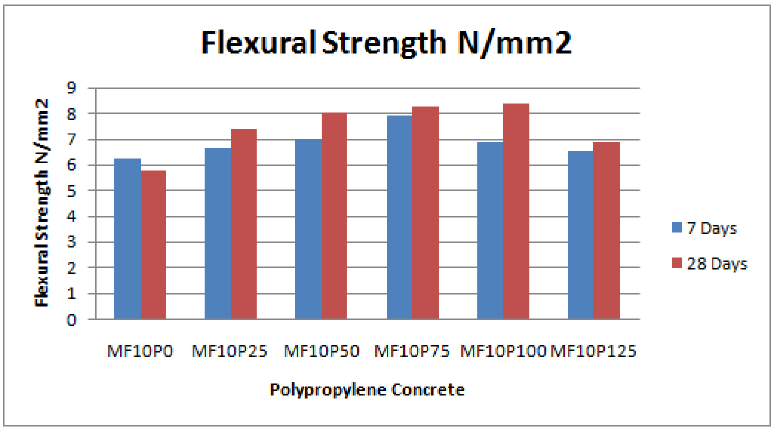


3.2. Flexural Strength

Results of flexural strength for 7 and 28 days are tabulated as follows; the flexural strength is increased as the percentage addition of polypropylene fibers is increased in both 7 and 28 days testing.

Table5. *Flexural Strength at 7 and 28 days*

flexural strength (N/mm^2)	MF10P0	MF10P25	MF10P50	MF10P75	MF10P100	MF10P125
7 days	6.0	6.5	7.5	8.0	6.75	7.0
	6.5	6.75	6.5	7.75	7.0	6.0
Avg	6.25	6.63	7.0	7.88	6.88	6.5
28 days	6.0	7.75	8.5	8.5	9.0	7.0
	5.5	7.0	7.5	8.0	7.75	6.75
Avg	5.75	7.38	8.0	8.25	8.38	6.88



4. CONCLUSION

- From the results it has been concluded that addition of fibers to the concrete (SSC) will affect positively on both compressive and tensile strengths at different proportions.
- At 0.75% addition the mix (MF10P75) attains the maximum compressive strength of 40.8 N/mm^2.
- The compressive strength increases from 0.25% to 0.75% addition of polypropylene fiber.
- Mix MF10P100 attains maximum tensile strength i.e., the percentage addition of fiber is 1%.
- So that from the complete experimental study it is feasible to add polypropylene fibers up to the maximum extent of 1% in production of SCC.
- The fibers in contact with fibers will produce ductility to the mix which will impart tensile strength to the concrete.

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