A Study on Self Compacting Concrete using synthetic fiber

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Abstract: This experiment is conducted to investigate effect of polypropylene fiber addition on four main characteristics of SCC in the fresh state: flow ability, viscosity, passing ability and segregation resistance and also find an alternative material for cement. Effect of polypropylene fiber granite powder and fly ash addition on compressive strength and splitting tensile strength of SCC also wanted to be known. Based on the results of fresh hardened SCC test, prediction of optimum volume fraction polypropylene fiber and percentage replacement of cement with granite powder in SCC mixes can be determined

Keyword: SCC, Polypropylene fibre, Tensile strength

I. Introduction

Self-consolidating concrete is a highly flow able type of concrete that spreads into the form without the need for mechanical vibration. Self-compacting concrete is a non-segregating concrete that is placed by means of its own weight. The importance of self-compacting concrete is that maintains all concrete's durability and characteristics, meeting expected performance requirements. In certain instances the addition of superplasticizers and viscosity modifier are added to the mix, reducing bleeding and segregation. Concrete that segregates loses strength and results in honeycombed areas next to the formwork. A well designed SCC mix does not segregate, has high deformability and excellent stability characteristics

Okamura (1996) reported about the uses of transparent polymer leads to stimulate the movement of aggregate in SCC and he found that high w/c ratio, addition of super plasticizer and control of coarse aggregate content minimizes shear stress and ensure good filling ability. Okamura (2000) discussed the procedure for adjusting w/c and super plasticizer dosage to achieve desired properties. He found for mortars, the ratio of slump flow index to funnel flow index to almost constant with respect to volume of water to cement ratio for a given value of super plasticizer to cement ratio

Foroughi Asi, S. Dhlmaghani, H.Famili (2006) in this paper, the bond between self-compacting concrete steel reinforcement was investigated. the bonding strength of reinforcing bars were measured using cubic specimen of self-compacting concrete and the normal concrete .the self-compacting concrete specimens were cast without applying compaction, whereas the specimen normal concrete were cast by conventional practice with substantial compaction and vibration.

In this study the fresh properties of SCC was explained in detail and some of the hardened properties on SCC was also been mentioned. In some literature the effective use of granite dust in SCC as a replacement material was explained. Similarly the effect of polypropylene fiber in fresh and hardened properties of SCC was shown. Therefore in this project it has been planned

to replace cement with granite dust and to study the effect of addition of polypropylene in this replacement mix on SCC

II. Materials

Fly ash is kept as a substitute for cement, polypropylene fibers is also taken which is an additive to the concrete not a substitute material, the amount of replacement and addition is tabulated in the mix design column. Fly ash is a by-product of thermal industry, fly ash samples are given in chemical compositions of fly ash in table1. Specific gravity of fly ash is 2.4. 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
SiO_2	21	43.4
Al_2O_3	4.6	18.5
CaO	65.1	6.1
MgO	4.5	0.9
Fe_2O_3	2	29.8
SO_3	2.8	1.3

Table2. Properties of Polypropylene fibers

Fiber type	Polypropylene
Length	60 mm
Cross section	Roughly rectangular1.6*0.4m
Density	0.90
Tensile strength	315Mpa
Elastic modulus	4.1 Gpa
Alcali, acid, salts resistance	High

III. Design and Casting

In order to find out the appropriate number of mixes required to, are calculated and tabulated as follows. Based upon the values and results obtained from the trial mixes I have,

behaviour of concrete with the addition of fiber is studied. Finally six mixes were concluded for the further experimental study and the name of the finalized mixes are SA10P0, SA10P25, SA10P50, SA10P75 and SA10P100 includes conventional mix too. For the preparation of all mixes both flyash and polypropylene are used. For all these mixes fly ash replacement is maintained at constant proportion i.e., 11% and polypropylene is varied from 0% to 1.25% . Using the data's and results obtained from the studies the water cement ratio is fixed to 0.43% for all the mixes.

For calculating both compressive strength and flexural strength of the mixes cast at site at 7, 14 and 28 days both cubes and beams. The dimensions of cube and beam moulds are as follows: 150x150x150 mm^3 and 100x100x500 mm^3. Machine mixer was used for mixing the concrete for all the mixes and filling the concrete into the moulds were done with no compaction. Further demoulding is done after 24 hours and the cubes and prisms are left for curing under room temperature. Testing is done for 7 days, 14days and 28 days respectively.

IV. Results of Polypropylene Fibre Concrete

Compressive Strength:

The compressive strength values of the cube specimens at the age of 28 days gave better strength. It was observed that the compressive strength of concrete for the cubes with polypropylene fiber 0.1%, 0.2%, 03%, 0.4% and 0.5% is more than that of cubes without polypropylene fiber. This may be due to the fact that the polypropylene fiber were effectively hold the micro cracks in concrete mass. From the observations the maximum percentage increase in compressive strength was obtained from the cubes with polypropylene fiber 0.5%. Thus it's recommended to use polypropylene fiber 0.5% to get maximum compressive strength.

Tensile Strength:

It was observed that for addition of 0.3% of polypropylene fiber is optimum which gives maximum tensile strength of 3.63 N/mm^2 and there is continuous drop of splitting tensile strength after 0.3% of polypropylene fibre.

Flexural Strength:

From graphs plotted for varying polypropylene fibres content (0%, 0.1%, 0.2%, 0.3%, 0.4%, and 0.5%) shown continuous drop of strength after 0.3% fibre content. Flexural strength has come out to be more only for 0.3% fibre content and a continuous drop was observed for increased fibre content. Hence I conclude that the optimum value of fibre content is 0.3% for flexural strength

Water Absorption:

Water absorption characteristics of the concrete plays an important role for the durability of the rigid pavement. Ingress of water deteriorates concrete which results in cracking and spalling of the concrete and ultimately reduce the life span of the structure. The result indicates that the water absorption of polypropylene fibre concrete is increased consistently from 0.1% to 0.3% compared to conventional concrete. This may be due to the dispersion of fibres in the concrete. As the volume of fibre increases the porosity gets increased and so the water absorption rate increased greatly above 0.4%.

V. Conclusion

In this project, fibres are added in volume fractions (0%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%) to the concrete to improve the shrinkage properties, mechanical properties and flexural strength. All the tests were conducted as per the codal provisions and the results were tabulated and discussed in the previous chapter and the following conclusions are made.

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