Study on Effect of Carbon Steel Fibers and Polypropylene Fibers on Self Compacting Concrete

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Abstract: The effect of carbon steel fibers and polypropylene fibers on self compacting concrete was studied in this paper. The self compacting concrete is a concrete that can be placed and compacted by its own weight. Self compacting concrete provides several economic and technical benefits and the use of fibers in self compacting concrete extents its possibility. Various researchers were performed the slump flow test, compressive strength test and flexural strength test to study the effect of fibers on fresh and harden properties of self compacting concrete.

Keywords: self compacting concrete, carbon steel fibers, polypropylene fibers, workability, compressive strength, flexure strength.

Introduction: self compacting concrete is consider as a concrete that can be placed and compacted by its self weight and at the same time it is cohesive enough to be handled without segregation and bleeding. It can fill all the formworks even in congested reinforcement with little or no vibration effort.

Self compacting concrete is proving desirable achievement to retard the problem associated with normal concrete. Due to its high deformability and resistance to segregation and bleeding, it has the capacity to fill the form work even in formwork with highly congested reinforcement. In traditional concrete due to lack in vibration increase the entrapped air voids and decrease the durability and strength of concrete this phenomena can avoid with use of self compacting concrete.

There are two types of fibers are used in this study: carbon steel fibers and polypropylene fibers. Carbon steel fiber is different than normal steel fibers. The base material of carbon steel fiber is carbon steel wire whereas in normal steel fiber base material is cast iron wire. The tensile strength of carbon steel fiber is two to three times more than that of normal steel fibers. Carbon steel fibers increase the compressive strength, flexure strength and tensile strength of concrete. Whereas polypropylene fibers act as a bridge to retard cracks and cracks propagation.

Literature review: Syal T. et al. [1] were investigated the workability and compressive strength of steel polypropylene hybrid fiber reinforced self-compacting concrete. They conclude that with the addition of 0.5% of fiber content by volume, maximum compressive strength of HyFRSCC was increased by 11.04%. Abbas AL-Ameeri[2] published a paper on effect of steel fibers on self compacting concrete. Here they found that 0.75% to 1% of steel fibers gave best performance for compressive and tensile strength. He was found that 1.5% of steel fibers contain have a best effect on hardened property but the worst effect on fresh properties

Kamal M.M. et al. [3] were studied on effect of polypropylene fibers on development of fresh and hardened Properties of recycled self compacting concrete. They conclude that at optimum volume fraction of polypropylene fibers; the mixes with 25, 50, 75 and 100% of crushed ceramic yields to improve in the compressive strength by 18.4, 26.3, 21.2 and 14.8%, respectively. B. Krishna Rao and Professor V. Ravindra [4] published a paper on steel fiber reinforced self compacting concrete incorporating class f fly ash. They conclude that the optimum volume fraction and aspect ratio of fiber for better performance in terms of strength was found to be 1.0 percent and 25.

Shah D.L. and Modhere C.D. [5] were studied on the influence of steel and polyester fibers in the self-compacting concrete. Polyester fibers did not increased strengths much but reduce micro cracks, and crack propagations. SCC with hooked end steel fibers increased compressive strength 25 %, tensile strength 40% and flexural strength 65 % at 28 days. Jatale V.B. and Mangulkar M.N. [6] show the performance of self compacting high strength fiber reinforced concrete

(SCHSFRC). They conclude that the maximum value of compressive strength gives the WSF and split tensile strength gives FSF at 3.5 % fibers content.

Ganesan N. et al. [7] were investigated on bond stress slip response of bars embedded in hybrid fiber reinforced high performance concrete. They conclude that the combination of 1% volume fraction of steel fibers and 0.10% volume fraction of polypropylene fibers gave better performance with respect to bond strength than the other combinations. Dhiyaneshwaran, S. et al. [8] published a paper on study on durability characteristics of self-compacting concrete with fly ash. They conclude that with the increase in super plasticizer dosage the workability was increase. For 30% use of fly ash the fresh property observed was good. The compressive strength of concrete was decrease with increase in fly ash dosage.

Chanrashekhar C. and Dr. Ramamoorthy N.V. [9] were studied on a comparative study of flexural behavior of solo and hybrid fibers concrete. They found that for both solo and hybrid concrete the compressive strength was below the plain concrete strength. And load carrying capacity has increasing value in compare to plain concrete. Karthik M.P. and Maruthachalam D. [10] were studied on mechanical properties of hybrid reinforce concrete with available of ruler fibers. They show that the compressive strength of the HyFRC can improve 19% than the control mix, the tensile strength of the HyFRC can improve 10% than the control mix and the flexural strength of the HyFRC can improve 13.80% than the control mix.

Karamoozian A.and Karamoozian M. [11] presented a paper on fresh and hardened properties of polypropylene fiber added self-consolidating concrete. They concluded that polypropylene fibers tend to reduce the flow ability and passing ability but will increase viscosity and segregation resistance of SCC. N. Bozkurt et al. [12] studied on the effect of single and hybrid fibers on fibers reinforced self compacting concrete produce with high level of fly ash usage. Their test results show concrete mixes including macro fibers gave the higher tensile strength properties, although they gave the lower fresh concrete properties.

Gencel O. et al. [13] presented a paper on fuzzy logic model for prediction of properties of fiber reinforced self-compacting concrete. They found that inclusion of fly ash, an industrial waste material, lowers environmental pollution and has a positive effect on economy. Benaicha M. et al. [14] investigated the rheological and mechanical characterization of fiber-reinforced Self compacting concrete. They investigate that with a mix of metallic fibers that respects the rheological characteristics of SCC, the flexural strength is only slightly affected.

Selvi M.T. and Thandavamoorthy T.S. [15] studied on the properties of steel and polypropylene fiber reinforced concrete without any admixture. The concrete with shorter fiber has better workability as compared to longer fiber. The compressive strength of PPFRC was observed to increase between 10 per cent and 18 per cent for 7 and 28 days. Rana Amit[16] investigated the some studies on steel fiber reinforced concrete. He was found that with increase in steel fiber content in concrete there was a tremendous increase in Flexural strength. Patel U. R. et al. [17] were studied on comparative study of engineered cementations composites & self compacting engineered cementations composites on response under impact loading.

Sharmila S. and Dr. Thirugnanam G.S. [18] published a paper on behavior of reinforced concrete flexural member with hybrid fiber under cyclic loading. They show that instead of adding single fiber, the combination of different types of fibers (Hybrid fibers) increases the energy absorption capacity substantially. Dr.Arivalagan S. [19] was investigated on engineering properties of hybrid fiber and (steel fiber and silica fume) reinforced self compacting concrete member. He concludes that the ultimate strength, stiffness found to be increased by the addition of the steel fiber to the SCC mix retaining the Self Compatibility of the mix. Peng Zhang and Qingfu Li. [20] published a paper on fracture properties of polypropylene fiber reinforced concrete containing fly ash and silica fume. The results indicate that the addition of polypropylene fiber has greatly improved the fracture parameters of concrete.

Critical Remarks : Following critical remarks has been drawn from this literature review.
Literature shows that polypropylene fibers cannot improve the strength of concrete but retard the cracks and crack propagation.

It is found that the use of polypropylene fibers more than 0.3 % use in SCC have worst effect on workability of concrete.
It is depicted from this study that the carbon steel fibers improves the all harden properties of concrete up to the 1.5 % use of it and further addition of carbon steel fibers reduce the workability of concrete.
Combine use of carbon steel fibers and polypropylene fibers improve the harden properties and retard the crack and crack propagation.
Research on combined use of polypropylene fibers and carbon steel fibers in self compacting concrete are very little so further study is required

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