A review on effect of different types of fibers on properties of self-compacting concrete (Fibers used basal and polypropylene)

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ABSTRACT: It is a basic fact of structural engineering that concrete has very low tensile strength so it needs to be reinforced with some other material which is strong in bearing tensile load. Various types of fibers like polypropylene fiber, steel fiber, carbon fibers, glass fibers are used now days to enhance the tensile strength of concrete. Self-compacting concrete is a special type of concrete which floe and settle under its own weight and does not requires any compaction or vibration, which leads to considerable reduction in labor cost and enhancement in productivity. In this project we will analyze the mechanical properties of Self compacting concrete reinforced with different fibers – fibers basalt fiber, polypropylene fiber.

KEYWORDS: Self compacting concrete, basalt fiber, polypropylene fiber, compressive strength, tensile strength.

INTRODUCTION:

Self-compacting concrete:

Self-compacting concrete or SCC is a special type of concrete developed in japan in 1980s its specialty is that it is able to flow under its own weight completely filling whole formwork and achieving full compaction, it does not require any external compaction or vibration.

Basalt fiber:

Basalt is an igneous rock formed from the rapid cooling of magnesium-rich and iron-rich lava exposed at or very near the surface of a terrestrial planet or a moon. More than 90% of all volcanic rock on Earth is basalt. Basalt lava has a low viscosity, due to its low silica content, resulting in rapid lava flows that can spread over great areas before cooling and solidification. The manufacture of basalt fiber requires the melting of the crushed and washed basalt rock at about 1,500 °C (2,730 °F). The molten rock is then extruded through small nozzles to produce continuous filaments of basalt fiber.

Polypropylene fiber:

Polypropylene fiber is a synthetic fiber formed by polypropylene melt. Polypropylene (PP), also known as polypropene, is a thermoplastic polymer used in a wide variety of applications. It is produced via chain-growth polymerization from the monomer propylene.

LITERATURE REVIEW:

Anvaj, G.Senthil, S.Manuel (2018) 0.2% of the weight of cement is found to be optimum dosage. With increase in basalt fiber content workability is decreased. The compressive, tensile, split tensile strength, and flexural strength of basalt fiber reinforced SCC is found to be more than the conventional SCC. Initial deflection is found to be more in the beginning in reinforced SCC than normal SCC and it gradually decreases with increase in load. With addition of fibers initial cracks are delayed.

Amal Krishna, Prof. Sarah Anil (2018) Almost All the mechanical properties of the concrete like shear strength, modulus of elasticity, compressive and tensile strength were found to be enhanced. However the workability, viscosity and passing ability was less compared to normal SCC.

Sateshkumar.K , Gobinath.R , Ramachandran.V (2017) The filling ability, passing ability and segregation resistance values of BFRSCC mixes does not have pronounced effect up to 0.5%. Durability test conducted by acid

attack test on standard cube of 150*150*150cm indicated incorforation of basalt fiber into SCC mix increases the durability.

S. Paulraj, Dr. N. Balasundaram, K. Sates Kumar, M. Dharshna Devi (2017) The variation of 7 days, 14 days, and 28 days splitting tensile strength of self-compacting concrete with basalt fiber percentage are similar to compressive strength. Addition of basalt fiber increases the 7 days compressive strength compared to the reference mix. The 7, 14 and 28 days compressive strength of self-compacting concrete with basalt fibers are maximum at a fiber percentage = 0.3% . The 7, 14 and 28 days split tensile strength of self-compacting concrete with basalt fibers are maximum at a fiber percentage = 0.4% . The 7, 14 and 28 days flexural strength of self-compacting concrete with basalt fibers are maximum at a fiber percentage = 1.4%.

K.Sathes Kumar, K.Tamilarasan, N.Sathish Kumar, Shirpy Thangam, Saranya, Vaisnavi (2017) Compressive strength increase with the introduction of 0.5% basalt fiber , it further increases at 1% but gradually decreases as we increase fiber content to1.5%. Flexural strength increase as we increase fiber percentage til 1.5% and then it gradually decreases.

Nayan Rathod , Mukund Gonbare , Mallikarjun Pujari (2013) Flexural strength is maximum when 2% basalt fiber is used. About 40% to 50% increase in strength is observed. Average compressive strength is maximum when 2% fibers are used. About 83% & 92% increase in compressive strength than the design strength, when the basalt fibers are introduce in concrete.

Fathima Irine I.A (2014) Workability of concrete decreases with the addition of Basalt Fibers, But it can be overcome by use of plasticizers or super-plasticizers. The percentage increase of compressive strength of basalt fiber concrete mix compared with 28 days compressive strength of Plain Concrete is observed as 14% .The percentage increase of split tensile strength of basalt fiber concrete mix compared with 28 days compressive strength of Plain Concrete is observed as 62%. The flexural strength of basalt fiber concrete is also found have a maximum increase of 54% at 4kg/m3 of fiber content. It was observed that, the percentage increase in the strength of basalt reinforced concrete increases with the age of concrete. Presence of basalt fibers also prevents development of cracks.

Serin V Kurian, Sarah Anil (2017) With the increase of polypropylene fiber content properties like flowability and passing ability is reduced. The fibers do not have prominent effect on compressive strength of SCC, increasing fiber content over 0.1% the strength tends to decrease. Split tensile strength has increased significantly, no structural failure can occur due to crushing.

B. Sandhya Rani, N. Priyanka (2016) The fibers in contact with fibers will give ductility to mix and hence impart tensile strength. At an addition of 0.75% fiber the concrete will have maximum compressive strength. While the tensile strength is maximum on addition of 1% of fiber.

Faiz A. Mirza and Ayman G. Abdel-Rhaman(2016) The Polypropylene fibers have no detectable effect on mechanical properties of hardened concrete like compressive strength, modulus of elasticity, the change in these properties is irregular and insignificant as the volume percentage of fibers is increased .However 0.4% addition of polypropylene fibers in concrete mixes increases both the flexural and tensile strength.

Hawra Alradhawi (2018) Polypropylene Fibers decrease workability but it can be maintained using mineral and chemical admixtures. Fly ash content in self-compacting concrete helps to reduce cement requirement up to certain extent and improves workability. Chemical admixture gives flowable concrete and increases segregation and bleeding. Adding polypropylene fibers to concrete has increased the compression strength of concrete. When polypropylene fibers are used the maximum increased of Split tensile strength is for specimen have 1% polypropylene fibers length (12) mm. The polypropylene fibers beams have increased flexural resistance to maximum at shorter length fibers at 1%. Flexural strength is reduced at the addition of 2% of fibers.

Najilah Farouk, I.Padmanaban (2017) The addition of fibers into the concrete mixture marginally improves the strength properties at 28 days. In this experimental study with 0.15% of fiber the maximum strength of concrete is achieved. Polypropylene fibers reduce the water permeability, plastic shrinkage and settlement. Polypropylene fibers enhance the strength of concrete. The compressive strength, split tensile strength and flexural strength increase with the addition of fiber. The polypropylene fiber dose not contributes on compressive strength much better but it reduce the cracks and crack propagation.

Mustapha Abdulhadi (2014) Addition of basalt fiber addition and polypropylene fiber resulted in a decrease of compressive strength. It was observed that the incorporation of fibers in the concrete matrix greatly increases splitting tensile strength. Addition of 0.3% and 0.6% volume of basalt fiber increase the splitting tensile strength of concrete by 2.6% and 22.9% respectively; while for 9% and 1.2% volume, the splitting tensile strength of concrete decreased by 11.3% and 19.8% respectively; therefore, the optimum dosage for the splitting tensile strength of basalt fiber is in the vicinity of 0.6%. Also, addition of 0.3%, 0.6%, and 0.9%, volume of polypropylene fiber increase the splitting tensile strength of concrete by 15.1%, 7.8%, and 5.6% respectively; therefore, the optimum dosage for the splitting tensile strength of polypropylene fiber is in the vicinity of 0.3%.
Salahaldein Alsadey, Muhsen Salem (2016) Slump is reduced with increase in polypropylene fiber content, especially beyond 2 % dosage, the mix become fibrous which results in difficulty in handling. The compressive strengths were increased proportionately with the increase in volume ratios of polypropylene fiber with reference to the control mix without fiber. The samples with polypropylene fiber content of 2 % showed maximum increase in compressive strength.

Amsa M, Ariyannan P (2018) The use of polypropylene fibers, increase in bond strength especially for the mixtures with 8% silica fume. The slump flow of concrete is decreases, when use of 0.3% and 0.5% polypropylene fiber in concrete. Split tensile strength is increased as volume percentage of polypropylene fibers in increased. Compressive strength decreased with the increase of Polypropylene Fiber content above 0.2%. The strength of specimen increases with the increase in silica fume content. The experimental result shows that silica fume can strengthens the transition zone and reduces crack initiation, and therefore, improves the failure strength of polypropylene fiber concretes.

Archana P, Ashwini N Nayak, Sanjana R Nayak, Harshita Vaddar, Dinesh S Magnur (2017) The Compressive strength, Tensile strength and Flexural strength properties of polypropylene fiber reinforced concrete increase as the percentage of polypropylene fiber increase up to 0.8% increasing strength and thereafter at 1.2% all strength parameters start decreasing.

S.Brundha, Dr. B.G Vishnuram (2015) The addition of fiber and its increased percentage in SCC decreased the flow ability, passing ability, segregation resistance. However polypropylene fiber in SCC up to 0.1% by Volume of concrete still meet the requirements of Flow ability, Passing ability, Segregation resistance. The compressive strength of concrete was increased with an increase the amount of fiber up to 0.1 percent by concrete volume and then addition of fiber 0.15 percent by concrete volume decreases the compressive strength. From the Sorptivity test result the addition of fiber up to 0.15% into SCC decreased the rate of absorption of water in concrete.

C.G.Konapure and P.T.Kalyankar (2015) Higher density mixes gives higher compaction factor& lower slump. Lower density mixes gives lower compaction factor & higher slump. On addition of 0.5% Fibers results is marginal increase in Compressive & Flexural Strength of Concrete. Addition of hybrid basalt fiber and polypropylene fibers results in reduction of compressive & Split tensile strength. The flexural strength is improved for 0.5% fiber & decreased for 1%.

Sami Elshafie, Gareth Whittleston (2015) The slump decreases as the content of basalt fibers increases. Maximum compressive strength is reached when the basalt fiber content is 0.25%; this drops as the fiber content increases. The maximum compressive strength using different basalt fiber lengths was achieved when using basalt fiber lengths between 10 and 20 mm. Adding different basalt fiber content to improve the tensile strength of concrete has a significant effect. The longer the basalt fibers used in the mixture, the higher the tensile strength achieved. Increasing both content and length of basalt fibers in reinforced concrete increases the flexural strength, elastic modulus, and crack resistance of concrete.

Abhijeet B. Revade (2017) The concrete with basalt fiber content of 0%, 0.5%, 1.0%, and 1.5%, the split tensile strength increases from 0% to 1.5%.The optimum value of compressive strength is obtained for 0.5% and then it is decreases for 1.0% and 1.5% of fiber content. For maximum Split tensile strength, optimum fiber content is 1.5%.

CONCLUSION From the above work the following conclusion may be drawn:
Workability of concrete in every case is reduced but it can be maintained by effective use of admixtures, superplasticizers. With the introduction of fibers in the concrete compressive strength , tensile strength , and flexural strength all are increased but the percentage at which strength parameters are maximum are different in each case and depends on conditions in which experiment is performed.

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