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A Review on Fiber Reinforced Concrete using Steel Fibers

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Abstract:- Fiber reinforced concrete (FRC) is concrete made primarily of hydraulic cements, aggregates, and discrete fibers. Nowadays, the use of fibers has increased in present constructions in order to increase the strength of concrete for achieving various properties which cannot achieve by conventional properties. Fibers are currently being used in bridge decks, pavements, loading docks, tunneling, concrete pads, concrete slabs and unbounded overlays. Addition of Fiber into the concrete mixture increases the toughness and possesses an ability to resist cracking and improve the tensile strength of concrete. In recent years, several investigations have been reported on the strength and
behavior of concrete reinforced with steel fibers. Steel Fiber reinforced concrete (SFRC) is high performance fiber reinforced concrete with significant behavior under tension. In this paper presents a critical review of the factors that affect the properties and behavior of steel Fiber reinforced concrete (SFRC) on the compressive and split tensile strength of concrete.

Keywords: Aggregates, Fiber Reinforced Concrete, Pavements, Steel Fibers, Compressive Strength and Split Tensile Strength**.**

I. INTRODUCTION:

Cement concrete is one of the most extensively used material for construction in the world and it provides good workability which can be moulded in any shape. Fiber Reinforced Concrete (FRC) is a composite material made primarily from hydraulic cements, aggregates and discrete reinforcing fibers. On the other hand, fiber reinforced concrete (FRC) is Portland cement concrete reinforced with more or less randomly distributed fibers. Nowadays, it is commonly applied in shotcrete, pavements, industrial floors, bridge decks and precast elements. Fibers can control cracking more effectively due to their tendency to be more closely spaced than conventional reinforcing steel bars. The papers published by Romualdi and Batson in the early 1960s brought FRC to the notice of academic and industry research scientists all around the world. At that time there was a significant sense of discovery and enthusiasm that FRC can promise a great future development for Portland cement-based composite material. Since then multiple investigations have been made by the researchers into the development of FRC by incorporating various fibers like glass, polypropylene, plastic, bamboo, carbon, sisal, and jute fibers. The main objective of this paper is to present the effects of adding steel fibers in concrete and investigates the mechanical properties, and behaviour of steel fibre reinforced concrete (SFRC) on compressive and tensile strength of concrete.

II. LITERATURE REVIEW:

Mr. Kolase Pramod K et al. reviews the use of steel fiber in many effective ways improving the strength and an improvement in fatigue life of the pavement together with developing improved resistance to crack and et al., thus be considered as cost effective technology and design of road construction.

R. Vengadesan et al. investigate the flexural behavior of self compacting concrete (SCC) beams using steel fiber along with an addition of super plasticizer as a admixture. Conplast SP 430 was used as water reducing admixture and cera hyperplast XR W40 was used as viscosity modifying agent. Corrugated steel fibers of 50mm length were used in this project. Fibers are added 1%, 2%, 3% and 4% in total volume fraction of cement. Steel fibers were added to increase the strength of concrete. Mix designs were done with reference of EFNARC guidelines. Tests on fresh concrete were done to determine its workability. Simply supported beam reinforced with HYSD bars of dimension 150X150X750 mm was tested in laboratory for determining the flexural strength of beam and load deflection data of Self compacting concrete and Fiber self compacting concrete beam was recorded.

S. Sashmitha et al. studies the different ratios of steel fibre and determine which ratio provides best results of properties of concrete. Fibre ratios of 0.5%, 1%, 1.5% and 2% by volume of concrete were used in the experimental study. Concrete beams of size 500mm X150mmX 150mm and concrete cylinders of 150mm diameter and 300mm length were used for strength test and concrete cubes of size 150mm X150mmX 150mm were used for durability tests. Addition of small amount of fibre to concrete will reduce binder drainage, increase in addition will affect in-service properties such as cohesiveness, stiffness and resistance to deformation. Another property of Steel Fibre reinforced concrete is it will reduce losses during fibre breakouts.

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Mr. Chandrashekharamurthy H. K et al. studies an increase in volume percentage of steel fibres causes an increase in the shear strength for both the grades of concrete. The workability is observed to reduce as the percentage of fibres increases. The compressive strength of concrete is observed to initially increase with an increase in the percentage of steel fibres and then reduce beyond about one percent of steel fibres.

A.G. Dahake et al. deals with the effect of different types of steel fibers on various strengths of concrete are studied. The different fibers at a constant rate of 2.5 % by the weight of cement are used for the experimental work. Various strengths considered for investigation are compressive strength and flexural strength. Results obtained are of different researchers and their experimental comparison of results of steel fiber reinforced concrete with that of normal concrete showed the significant improvements in the results of compressive strength and flexure strength of concrete with different types of steel fiber with various constant volume fractions and different aspect ratio.

Ravindra V. Solanki et al. reviews the use of steel fiber in many effective ways improving the strength and an improvement in fatigue life of the pavement together with developing improved resistance to crack and et al., thus being considered as cost effective technology and design of road construction.

D Neeraja also studies the strength characteristics of steel fibre reinforced concrete. Tests were conducted by adding Ground Granulated Blast furnace Slag (GGBS) and steel fibres to concrete in an amount equivalent to approximately 0%, 20%, 40%, 60% and

80% to the weight of cement content and that for steel fibres from 0 to 2% with an increment of 0.5%. The test results proved that the compressive strength of concrete increases with per cent increase in GGBS up to 40%. Beyond 40%, there is marginal decrease in strength of concrete. In addition, tests were conducted, taking the combinations of GGBS and steel fibres. From the test results, it was found that there is improvement in the strength of concrete by addition of GGBS and steel fibres.

Majid Jaral et al. reviews the application of fibers in concrete due to its enhancement resistance to cracking. Now–a-days steel fibers in concrete increase intensively as an engineering demand. From the present scenario it is not only essential to provide safe, efficient and economical design, but it also provide as balanced base for future application. The energy consumption and cost associated with concrete pavements can be reduced through the use of recycled materials with more effective construction techniques. In many developed countries like India, anxiety over resource conservation, reduced material cost and waste production have paying attention on recycling of materials. This recycling of materials from industrial wastes either helps to conserve natural resources or propose environmental profits. Steel fiber reinforced concrete (SFRC) is composite material made of hydraulic cements containing fine and coarse aggregate and using discontinuous discrete steel fibers as raw material. Concrete have poor tensile strength propagate micro cracks and leading concrete to the brittle fracture. This paper presents a review study to utilization of steel scrap in the rigid pavement.

Satyashiva Prasad Nannuta et al. studies the effect of steel fibers on compressive strength, split tensile strength of high strength concrete and testing of cubes of size (150mm x 150mm x 150mm), cylinders of 150mm diameter, height 300mm.the mix proportion for M30 grade of concrete 1:0.91: 2.41 with w/c ratio 0.37 was obtained.

Then the steel fibres were added in the volume fraction of 0%, 0.25%, 0.5%, 0.75%, 1.0%, and 1.25%. The experiential results shown that the addition of steel fibre improves the crack arresting capacity of concrete. The addition of steel fibre prove that there is significantly enhancing the energy absorbing capacity of specimens.

Abuh Ojochonu et al. studies how concrete behave when steel fibre is added in different percentages. A total of 135 concrete specimens (cubes, cylinder and beams) were cast and evaluated with varying percentages of steel fibre. Concrete possess a very low tensile strength and has little resistance to cracking; steel fibre is generally used to improve the strength of concrete. With reference to literature survey, the hooked end steel fibre is mixed in the concrete with various percentages (0.25, 0.5, 0.75, and 1%). M25 concrete mix is used in the experiment, and the strength properties of the specimen are determined after 3, 7 and 28 days of curing. Conventional and modified concrete specimens are being compared for their strength properties (compressive, split tensile and flexural) with various percentages. Evaluation is carried out by analysing the test methods with the help of graphs that were drawn based on the outcomes of various tests as mentioned above.

Vinod H. Kashid et al. reviews the various mechanical properties like compressive and tensile strength of steel fibre reinforced concrete. Fibres are used as cracking resistance and strengthening of concrete. According to various research papers it has been found that steel fibre carry considerable strength more than normal concrete. In this paper, some research shows compressive and tensile strength are increase linearly but also some research shows that the compressive and tensile strength increase non-linearly with increasing of steel fibre. In another one research, shows that such mentioned mechanical strength of concrete increases up to a certain volume fraction in fibre and get reduces after increasing the fibre volume fraction in the concrete.

III. CONCLUSIONS:

The steel fibre reinforced concrete (SFRC) changes the property of concrete from brittle to ductile, which allows the concrete to resist micro cracks and thus increase the strength behaviour of concrete. After studying the above papers, the following conclusions were drawn:

a) The addition of steel fiber at different ratios in concrete mixes were studied.
b) The addition of steel fiber into the concrete mixes increases the compressive strength, tensile strength of concrete as compare to the conventional concrete and the brittleness of concrete could be improved.

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c) The studies concluded that the steel fibre content in concrete not only improves the strength but also prolongs the durability of structures.
d) With increase in percentage of fibre, the workability of concrete mix is low.
e) The studies concluded that fiber reinforcement in a cement bound road base has the potential to improved fatigue life of the base and improved resistance to reflective cracking of the asphalt. Thus, the use of steel fiber for pavement construction could be improved.

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