Review on: Steel Fiber Reinforced Concrete

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Abstract: **The purpose of present paper is to summarize the experience available today within the field of concrete. The construction of any industry or structure there is a common material used as concrete, and concrete is employed in very huge amount within the construction and industries. Many property of the concrete like brittleness sometimes fails in contact tensile load which is the reason of brittle failure. Since the fiber have the property to extend the toughness of the concrete. In many experiments it's found that, steel fiber reinforced concrete have high resistance to cracking that the reason behind the increasing uses of steel fiber reinforced concrete to extend the hardness or toughness and to reduce the crack deformation characteristics. In this era, RCC constructions have their own structural and durability requirements, every structure has its own intended purpose and hence to fulfill this purpose, modification in traditional cement concrete has become mandatory. It's been proved that different fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. As compared to other fibers it's now established that one in all the important properties of steel fiber reinforced concrete (SFRC) is its superior resistance to cracking and crack propagation. During this paper past studies supported steel fiber concrete is studied in very well.**

Index Terms: Steel fibers, Fiber reinforced concrete, Cement, Ductility, Strength, and Toughness

1. INTRODUCTION

The most important construction materials are cement based materials and it's most likely that will continue to have the identical importance in future. Construction industry could be a major contributor to economic development of the country. Infrastructure development through network of roads, bridges, tunnels, rail lines, air-ports, sea ports facilitates the easy transportation. To satisfy the increasing demand for energy, hydro power, thermal power, nuclear power & solar power generation facilities will be required. A common and basic factor in all above activities is concrete and concrete structures. Looking at a huge investment required in building up these facilities, durability of concrete structures will be a focus point. Over the period of time, concrete technology has also undergone a tremendous change. During this era of world concrete is most used material for compressive strength for building construction. Tensile load carrying capacity is very low of concrete. This leads to brittle failure of concrete components. To increase the performance of Concrete under tensile loading or dynamic loadingvarious types of the fibers are added to concrete.

Concrete is characterized by brittle failure which tends for the entire loss of loading capacity, once failure is initiated. The application of the material will be overused by the inclusion of a little amount of short randomly distributed fibers (steel, glass, synthetic and natural) and might be practiced among others that remedy weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, etc. mainly Steel fiber reinforced concrete

(SFRC)has the ability of excellent tensile strength,flexural strength, shock resistance, fatigue resistance, ductility and crack arrest. Therefore, it's been applied abroad in various professional fields of construction, irrigation works and architecture. Mostly steel fibers are seen to be performing well as compared to the other random fibers. Fibers are made from steel, glass and polymers for from natural materials and it's utilized in cement based composites. As compared of conventional reinforcing steel bars fibers behave strong and control cracking more efficiently and effectively due to their tendency to be more closely and spaced. Steel fiber are utilized in plastic and drying shrinkage control or prevent in concrete. During this paper we are reviewing the effect of steel fiber binding in concrete investigates the chemical and mechanical properties and steel fiber reinforced concrete's application. One more thing that when we added steel fibers in mortar, portland cement concreteaura factory concrete depending on the proportion of fibers add and mix design, its flexural strength of the composite is increase from 26% to 100%. This technology (steel fiber) prawns forms in more ductile material from brittle material. Because the fiber continue supporting the load after cracking occurs therefore catastrophic failure of concrete is virtually eliminated. The steel fibers are available in many lengths like from 31mm to 60 mm and aspect ratio between 21 and 100 and it manufactured either deformed or hook. The steel fiber concrete is the material which is castable or sprayable material and it is of fine and coarse aggregates, fine aggregate, hydraulic cement with the rectangular cross section of discrete steel randomly dispersed throughout the matrix. The main work of the steel fiber are to strengthen the concrete in tensile tracking for registering such type of cracks. In comparison of without reinforcement concrete and 'concrete with reinforcement' with welded wire fabric, the fiber reinforcement concrete has a higher flexural strength. But unlike conventional reinforcement which strengthen in one or two direction, steel Fiberreinforced isotropically, improve the resistance of concrete to fragmentation, spalling, cracking and fatigue. When any beam which is on reinforced is stressed by bending, the deflection, deflection increases as the load increases by which failure occursand the beam breaks apart. In the beam where the first crack acres is called the first crack strength. The first crack strength is depend on concrete mix design and the amount of fiber in the mix, and is directly proportional to the amount of fiber in mix design and concrete mix design. There are two theories have been proposed and to explain the strengthening mechanism.The first proposes the fiber are better to stop thepropagation of micro cracks in the matrix. The second theory said that the strengthening mechanism of reinforcement fiber makes the bond between the fiber and the cement. By this it is shown that by the small loads microcracking of the cement matrix comes into existence. The steel fibers feel and extended across the tracks. Show the bond between the fiber and cement matrix combined and steel fiber can carry the tensile load. One more bond strength is the surface area of the fiber. In many variety of sizes the steel fibers can also been enhanced with the use of deformed steel fibers.

1.1 Different Types of Fibers

On the basis of modulus of elasticity there are two types of fiber in basic categories first one is soft intrusion. Those fibers having lower elastic modulus then the concrete mix is known as "soft intrusion". The second one is "hard intrusion" in this there are those fiber which have higher elastic modulus than concrete mix. Some low elastic modulus fibers like glass, carbon and steel have higher elastic modulus than polypropylene, cement mortar matrix and vegetable fibers and we can improve the impact resistance of concrete but do not contribute so long in its flexural strength whereas high elastic modulus fibers simultaneously can improve both impact resistance as well as flexural. Fibers can be classified into three categories according to the origin of fibers, first one is metallic fibers (such as steel, stainless steel and carbon steel), the second one is mineral fibers (such as glass fibers and asbestos), and the third one is organic fiber. The organic fiber can be divided into two parts natural fiber and man-made fibers.

Steel Fiber R/f Concrete-

1) Is a composite material comprised of portland cement, aggregate, and fibers.
2) Steel fiber-reinforced concrete is basically a cheaperand easier to use form of rebar reinforced concrete.
3) Steel fiber-reinforced concrete uses thin steel wires mixed in with the cement. This imparts the concrete with greater structural strength, reduces cracking and helps protect against extreme cold.
4) The function of the irregular fibers distributedrandomly is to fill the cracks in the composite.

2. LITERATURE REVIEW

Jun.Mo yang et.al. (2017)

Examined the effects of implication of the amorphous metallic fibers showing on the mechanical and long term sustainability of the concrete pavements. In the study two different types of amorphous metallic fibers were been considered and incorporated in the concrete and has been compared with the conventional concrete without fibers. The results have shown that all the mechanical properties (i.e. compressive, flexural, and tensile and toughness) were being increased with the increase in the amorphous metallic fibers. The flexural strength as well as the flexural ratio was being much higher by using 5 and 10kg/m³ amorphous metallic fibers which results in decrease in the thickness of the concrete pavement when designed for the airway runways. There was an increase in the resistance cracks occurrence for the pavement designed for the repetitive wheel loading by using the amorphous metallic fiber which gives longer service life about 1.2 to 3.2 times of the pavement when 5 to 10kg/m³ fibers were being considered. The initial construction cost of the pavement including the amorphous metallic fibers was high but significantly decreased the maintenance cost and work zone delay therefore it is concluded pavement with these type of fibers exhibits the lower life cycle cost for high volume of traffic as compared to the plain concrete pavements.

Abdulaziz Alsaif et. al. (2019)

Have been investigated the mechanical and fatigue performance of steel fiber reinforced concrete (SFRC) and steel fiber reinforced rubberized concrete (SFRRC) as both are the particles end of life of tires and have the potentiality to improve the flexibility and ductility of the concrete pavements. Specimens were casted and tested by using the rubber particles as replacement of the natural aggregates in the proportions of 0%, 30%, and 60% by the volume and blending of manufactured and recycled tire steel fibers (40kg/m³). The results have shown that as compared to the plain concrete the blending of the steel fibers enhances the compressive strength by 20% and improves the fatigue stress resistance of concrete by 11% (at 25% probability of failure) , while the flexural strength, elastic modulus of remains the same. Replacement of natural aggregates with the rubber particles improves the flexibility but at the same time reduces the compressive strength, static flexural strength ,elastic modulus of SFFRUC and fatigue stress resistance by 42% (at 25% probability of failure). However the combination of both improves the tensile strength capacity of (SFFRuC).

A.M. Shende (2012)

Experimental study on steel fiber reinforced concrete for M-40 grade. It is observed that compressive strength, split tensile strength and flexural strength areon higher side for 3% fibers as compared to that produced from 0%, 1% and 2% fibers. All the strength properties are observed to be on higher side for aspect ratio of 50 as compared to those for aspect ratio 60 and 67. It is observed that compressive strength increases from 11 to 24% with addition of steel fibers. It is observed that flexural strength increases from 12 to 49% with addition of steel fibers.It is observed that split tensile strength increase from3 to 41% with addition of steel fibers.

Dr. Th. Kiranbala Devi T. Bishworjit Singh (2013)

Effects of steel fibers in reinforced concrete, the insulation of fibers, for the herein used fiber type and amounts, had no effect on the initial from transversal reinforcement. The tension stiffening effect was markedly improved by fiber reinforcement. The crack spacing was reduced and the characteristic crack widths turned out to be significantly reduced by the fibers it was found that the insulation of fibers reduced the initial sudden crack opening (caused by elastic unloading) the herein used fiber type, and fiber amounts, did not affect the bond properties at the interface layer, no effect on the peak bond stress and the ascending part was observed, after cracking the fibers provided a confining effect (for splitting cracks), which could be compared with the one from transversal reinforcement, from the self-compactingconcrete, there were indications of an increased initial bond stiffness. The favorable effects of steel fibers on the cracking behavior and the toughness of concrete make SFRC an ideal construction material for many fields.

Ricardo chan et.al. (2019)

Have analyzed the technical and environmental feasibility for using the fiber reinforced recycled aggregate concrete (FRRAC) in the pavements by conducting an experimental program to assess the mechanical behavior of (FRC and FRRAC). In the experimental program a case of study was being performed for evaluating the feasibility of using the FRRAC in the pavement design, in which the fiber content as well as CO2 emission (CE) was also being estimated. It was shown in the case study that the pavement slab higher than 0.22m requires the similar fibers if they were not being produced by the FRC and FRRAC. The results have shown that the compressive strength, modulus of elasticity, flexural and tensile strength are higher with nominal aggregates as compared to recycled ones but with the increase in the fiber content there is an increase in the modulus of elasticity and residual flexural strength for FRC and FRRAC.

Abdulaziz Alsif et.al. (2018)

Have investigated the effect of the recycled steel fibers upon the fresh and mechanical properties of the rubberized concrete (RuC) comprised of waste tire rubber (WTR) as well as the free shrinkage was being examined by using ten different mixes using the waste tire rubber and fiber contents. The results have shown that by the replacement of the natural aggregates by the rubberised particles decrease the workability, unit weight as well as the mechanical properties such as compressive strength, flexural strength and modulus of elasticity but increases the air content of the fresh concrete. When the steel fibers are being included in the conventional concrete there is an increase in the compressive strength by 30% and a slight increase in the modulus of elasticity as well as free shrinkage strain increases with the increase in rubber particles due to the lower stiffness of rubber particles. The inclusion of steel fibers in the rubberized concrete decreases the flexural strength (from 50% to 9.6%) compared to the conventional concrete but improves the compressive as well as modulus of elasticity up to 12.5% to 28.4% respectively.

N. Shireeshal, G. Nagesh Kumar (2015)

Experimental studies on steel fiber reinforced concrete, the major conclusions derived from the research study are it is observed that compressive strength, split tensile strength, flexural strength, are onhigher side for 1.5% fibers as compared to that produced from 0%,0.5% and 1% fibers. It is observed that compressive strength increases from 14 to 36% for 7 days and 15 to 39% for 28 days and flexural strength increases 13 to 37% for 7 days and 17 to 55% for 28 days. With a fiber volume fraction 1.5% the absorbed energy by the specimens during the tests was 8 times for 7 days and 10 times for 28 days higher than flexural toughness of plain concrete, the post peak value increases 0 to 28 times in 7 days and 0 to 98 times in 28 days increases with increase in percentage of steel fiber, and 0 to 16 times in 7 days and 0 to 86 times in 28 days increases with increase in percentage of steel fiber in below neutral axis. By the above conclusions we can also adopt steel fiber in below neutral axis, because this method results also will give post peak value which will not occur in plain concrete.

3. CONCLUSION

The following concluded were drawn from a broad overview of the literature review.

1) Compressive strength, flexural strength and split tensile strengths were slightly increased as percentage of steel fiber content increased in the concrete and it is observed that the workability of steel fiber reinforced concrete gets reduced as the percentage of steel fibers increases and the experimental work also showed that the workability of SFRC gets reduced as we increased the fiber amount.

2) SFRC is a sustainable improvement inside the present technology. SFRC is used for foremost, high budget tasks only because steel fibers are value effective.

3) The studies concluded that the steel fiber content present in concrete not only improves the strength but also prolongs the durability of structures.

4) Fibers are superior crack resistance.

5) Steel fiber have better post cracking ability.

6) SFRC have high capacity of taking shear stress, bending moment, tensile strength than conventional concrete.

7) Workability decreases with increase in fiber content ductility of concrete is found to increase with inclusion of fibers at higher fiber content.

8) The width of cracks is found to be less in SFRC than that in plain cement concrete beam.

9) The workability of SFRC is low, but the durability of structure is very high.

10) Steel fiber reinforced concrete (SFRC) is defined asconcrete made with hydraulic cement containing fine and coarse aggregate and discontinuous discrete fiber.

11) In SFRC, thousands of small fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties.

12) SFRC is being increasingly used to improve static and dynamic tensile strength, energy absorbing capacity and better fatigue. They concluded that the addition of steel fiber increases the ultimate strength and ductility.

13) The plain structure cracks into two pieces when the structure is subjected to the peak tensile load and cannot with stand further load or deformation.

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