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Effect of Micro Steel Fibre on Properties of Concrete

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Abstract: Fibers are generally used as resistance of cracking and strengthening of concrete. Ordinary cement concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks, leading to brittle failure of concrete. According to various research papers, it has been found that steel fibers give the maximum strength in comparison to glass and polypropylene fibers and also different type of fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. It has been proved that different type of fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. As compared to other fibers it is now established that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) is its superior resistance to cracking and crack propagation. Fiber reinforced concrete has been successfully used in slabs on grade, shotcrete, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. This review study is a trial of giving some highlights for inclusion of steel fibers especially in terms of using them with new types of concrete.

Key Words: Concrete, steel, fibre, reinforced concrete.

1. Introduction

Fiber reinforced concrete (FRC) is the composite material obtained after mixing of Portland cement concrete with more or less randomly distributed fibers. Fiber is a small short cut piece of reinforcing material possessing certain characteristics properties. They can be circular, triangular or flat in cross-section. The fibre is described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter. Steel fiber reinforced concrete has the ability of excellent tensile strength, flexural strength, shock resistance, fatigue resistance, ductility and crack arrest. It improves fatigue resistance makes crack pattern distributed. By making crack pattern distributed, it is meant that it decreases the crack width. The incorporation of steel fibre reinforcement into the shotcrete is an important factor in this escalating use, since it minimizes labour intensive process of wire mesh installation. For FRC to be a valuable construction material, it must be able to compete economically with existing reinforcing system. FRC composite properties, such as crack resistance, reinforcement and increase in toughness are dependent on the mechanical properties of the fiber, bonding properties of the fiber and matrix, as well as the quantity and distribution within the matrix of the fibers. Therefore, it has 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.

2. MATERIALS USED

2.1 Cement

Cement acts as a binding agent for materials. Cement as applied in Civil Engineering Industry is produced by calcining at high temperature. It is a mixture of calcareous, siliceous, aluminous substances and crushing the clinkers to a fine powder. Cement is the most expensive materials in concrete and it is available in different forms. When cement is mixed with water, a chemical reaction takes place as a result of which the cement paste sets and hardens to a stone mass. Depending upon the chemical compositions, setting and hardening properties, cement can be broadly divided into following categories.

1. Portland Cement
2. Special Cement

Storage of cement requires extra special care to preserve its quality and fitness for use. To prevent its deterioration it is necessary to protect it from rain, winds and moisture.

Table 3.1 Chemical composition of O.P.C

Oxide	% content
CaO	60-67
SiO2	17-25
Al2O3	8-Mar
Fe2O3	0.5-6.0
MgO	0.1-0.4
Na2O+K2O	0.1-1.3
SO3	1.0-3.0

2.2 FINE AGGREGATE

The impurities were removed by sieve analysis. It had cubical or rounded shape with smooth surface texture. Being cubical, rounded and smooth texture it give good workability. Sieve analysis is to be done to find out fineness modulus which comes out to be 3.14% which is under limit as per IS 383-1970.

2.3 COARSE AGGREGATES

The material whose particles are of size as are retained on I.S Sieve No.480 (4.75mm) is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of work. The coarse aggregate should be of 20mm and below sizes, crushed angular in shape. The aggregates should be free from dust before used in the concrete.

2.4 WATER

Water to be used in the concrete work should have following properties:

1. It should be free from injurious amount of soils
2. It should be free from injurious amount of acids, alkalis or other organic or inorganic impurities.
3. It should be free from iron, vegetable matter or any other type of substances, which are likely to have adverse effect on concrete or reinforcement.
4. It should be fit for drinking purposes.

The function of water in concrete

1. It acts as lubricant
2. It acts as a chemically with cement to form the binding paste for coarse aggregate and reinforcement
3. It enables the concrete mix to flow into formwork.

2.5 FIBRE

The brass coated micro steel fibre used in the experiment is obtained from Fibre Zone Ahmadabad Gujarat**.** Micro brass coated steel fiber is a new type of additive for reinforcing concrete, which has the high tensile strength, and improve the concrete's unity obviously.

1. Material: low carbon cold drawn steel wire Tensile strength :> 2850Mpa
2. Length: 6mmm
3. Diameter:0.2+/-0.02mm Aspect ratio: 35-100.)

Micro steel fibers have the advantages comparing with steel bars in the fields below:

1. Ultra high performance concrete
2. Reactive powder concrete
3. Reinforcing mortar

Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve its Compressive and flexural strength properties. This type of concrete is known as fiber reinforced concrete. The straight steel fibers are used. The length of the steel fibers is 6mm and diameter is 0.18mm.

3. Literature Review/Ongoing Research

3.1 Tensile behavior of high performance hybrid fiber reinforced concrete

P.R. Kannnan Rajkumar et al. summarizes the actions of fibers at various volumes of fractions in high strength concrete have achieved a good tensile strength. Based on the experimental investigation carried out the following conclusions are drawn.

It is possible to produce fiber concrete composites using steel fibers (micro steel), with an enhanced tensile performance compared to concrete without fibers. Fiber inclusion of all types increased compressive strength, although this increase was not that significant and could have been obtained with simpler and more economical methods like reducing water-cement ratio. Micro steel fiber proved to be efficient in strengthening the matrix.

3.2 Performance of steel fibre reinforced concrete

***Milind V. Mohod*, concludes:**

1. It is observed that the workability of steel fibre reinforced concrete gets reduced as the percentage of steel fibres increases.
2. Compressive strength goes on increasing by increase in steel fibre percentage up to the optimum value. The optimum value of fibre content of steel fibre reinforced concrete was found to be 1%.
3. The flexural strength of concrete goes on increasing with the increase in fibre content up to the optimum value. The optimum value for flexural strength of steel fibre reinforced cement concrete was found to be 0.75%
4. While testing the specimens, the plain cement concrete specimens have shown a typical crack propagation pattern which leaded into splitting of beam in two piece geometry. But due to addition of steel fibres in concrete cracks gets ceased which results into the ductile behavior of SFRC.

3.3 Effect of addition of steel fibers on strength and durability of high performance concrete

B. Siva et al. the HPC studied in this research program has displayed an impressive set of material properties and the conclusions are drawn as follows:

1. Addition of steel fibers to plain concrete increased the compressive strength and tensile strength of Concrete by 8% & 9% respectively.
2. Addition of steel fibers to HPC increased the resistance to chloride ion penetration.

3.4 Comparative study on Steel fibre reinforced cum control concrete under flexural and deflection

Shende. A.M. et al. summarizes the following conclusions could be drawn from the present investigation.

1. It is observed that flexural strength from steel fibres are on higher side from 3% fibres as compared to that produced from 0%, 1% and 2% fibres.
2. It is observed that flexural strength increases from 13 to 48.35% through utilization of steel fibres. And through utilization of 1% steel fibres flexural strength increases from 13.35 to 23.35%.Through utilization of 2% steel fibres flexural strength increases from 18.35 to 31.65%.Through utilization of 3% steel fibres flexural strength increases from 20.80 to 48.35%.
3. The addition of fibers has significantly enhanced the performance of beam in flexural. During the test it was visually observed that the SFRC specimen has greater crack control as demonstrated by reduction in crack widths and crack spacing.
4. It is observed during testing that when specimen is tested for split tensile strength and flexural strength the control concrete specimen has broken into two pieces while the SFRC specimen retained the geometric integrity .It reveals improved ductility of SFRC due to the addition of steel fibers over control concrete.
5. It is observed that for higher percentage of steel fibre deflection of beam is very less as compare to control beam.

4 Conclusion

A lot of review study has to be conducted to see the effect of mixing steel fiber as reinforced material with concrete as parent material. A large number of minor and major investigating tests should be conducted like Compressive, flexure and tensile strength test with steel fiber mixed with concrete at various percentages of steel fiber. Research over the years have shown that fiber reinforcement has sufficient strength and ductility to be used as a complete replacement to conventional steel bars in some types of structures; foundations, walls, slabs. The technology that is available today has made is possible to consider fiber reinforcement without the

use of conventional steel bars in load carrying structures. In SFRC, thousands of small fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties. SFRC is being increasingly used to improve static and dynamic tensile strength, energy absorbing capacity and better fatigue.

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