Compressive Strength Effect on Steel Fiber Reinforced Concrete (SFRC): A Review

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Abstract - *During the last four decades, fiber reinforced concrete has been increasingly used in structural applications. It is generally accepted that addition of steel fibers significantly increases tensile toughness and ductility, also slightly enhances the compressive strength. Although a few examinations have revealed beforehand, the great properties of steel fiber reinforced concrete (SFRC), minimal general information is related to performance modeling.*

Key Words SFRC, Compressive strength, Novotex, Dramix, shear test, cracking, shear

1. INTRODUCTION

Conventional concrete can be considered as a composite material in which the sand and aggregates are the scattered particles in a multiphase grid of concrete paste. Concrete varies from most basic composites in that its quality isn't more noteworthy than that of its components. The explanation behind this is the interface between the components is the weak link in the composite and plays a major part in deciding various properties of concrete. Usually, the aggregates are stiffer and stronger than the paste, and the non-linearity of the concrete stress-strain response is caused by the interaction between the paste and the aggregate.

Normal concrete is characterized by excellent load carrying behavior in compression but also by brittle failure in tension. Tension failure can often be characterized by rapid propagation of single relatively small flaw or crack. It is a common design practice to ignore the resistance of cracked concrete, although it is known that concrete subjected to uniaxial tensile behavior is qualitatively similar to the response of concrete subjected to uniaxial. The concept of using fibers to improve the characteristics of matrix is as old and well established as adding straw or horsehair to mud bricks. The fiber reinforced matrix can continue to carry a considerable amount of load after cracking has occurred. The principal role of fibers is to bridge cracks and resist their formation. The advantage of adding fibers into a matrix include enhancement of compressive strength, tensile strength, flexural toughness, shear strength, durability and resistance to impact. The physical properties of composites depend on the type and the dosage of the added fibers.

Steel fiber reinforced concrete (SFRC) are the improved flexural toughness, impact resistance and flexural fatigue performance. For this reason SFRC has found applications in flat slabs on grade where it is subject to high wheel loads and impact. SFRC has also been extensively used in shotcrete applications for ground support, rock slope stabilization, tunneling and repairs. The ease of placing SFRC into awkward formwork shapes has also seen its application in the manufacture of precast concrete products.

2. LITERATURE REVIEW

Some research has already been done on the material characteristics of SFRC, but most of this research has concentrated on one aspect of the characteristics.

2.1 Modeling of compressive behavior of SFRC

Only a few equations of complete stress-strain curves are published for SFRC. The SFRC lead to a slight improvement in compressive strength ranging from 0 to 15 percent at best, the strain at peak stress is also increased by the presence of fibers. An increase in the volume fraction of fibers generally leads to a milder slope of the descending branch of the stress-strain curve.

Milind V. Mohod gets to know that the results of fiber reinforced concrete for 3days, 7days and 28days curing with varied percentage of fiber were studied and it has been found that there is significant strength improvement in steel fiber reinforced concrete. The optimum fiber content while studying the compressive strength of cube is found to be 1% and 0.75% for flexural strength of the beam. Also, it has been observed that with the increase in fiber content up to the optimum value increases the strength of concrete. Slump cone test was adopted to measure the workability of concrete. The Slump cone test results revealed that workability gets reduced with the increase in fiber content

A.M. Shende, A.M. Pande, M. Gulfam Pathan investigated for M-40 grade of concrete having mix proportion 1:1.43:3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, Split tensile strength of steel fibre reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook tain. Steel fibers of 50, 60 and 67 aspect ratio were used.

A result data obtained has been analyzed and compared with a control specimen (0% fiber). A relationship between aspect ratio vs. Compressive strength, aspect ratio vs. flexural strength, aspect ratio vs. Split tensile strength represented graphically. Result data clearly shows percentage increase in 28 days Compressive strength, Flexural strength and Split Tensile strength for M-40 Grade of Concrete

R. D. Neves and J. C. O. Fernandes de Almeida performed experimental study to investigate the influence of matrix strength, fibre content and diameter on the compressive behaviour of steel fibre reinforced concrete is presented. Two types of matrix and fibres were tested. Concrete compressive strengths of 35 and 60 MPa, 0.38 and 0.55 mm fibre diameter, and 30 mm fibre length, were considered. The volume of fibre in the concrete was varied up to 1.5%. Test results indicated that the addition of fibres to concrete enhances its toughness and strain at peak stress, but can slightly reduce the Young's modulus.

R.P. Dhakal, C. Wang and J.B. Mander performed Standard compression tests are conducted on concrete cylinders made with concrete having different amount of steel fibres to investigate compression behaviour of steel fibre reinforced concrete. The effect of volumetric ratio of steel fibres on compressive strength, corresponding peak strain and the compressive stress-strain curve is explored. The test results show that the more the amount of fibres the higher the compressive strain the cylinder can sustain. It is also observed that both compressive strength and the strain corresponding to the peak stress increase with the addition of steel fibres.

Result: Standard cylinders made of steel fibre reinforced concrete with different amount of Novotex fibres (ranging from 0.5% to 2.0% by volume) were tested under axial compression. The influence of fibre content on the compressive strength, corresponding peak strain and the shape of the stress-strain curves were investigated. Based on the data obtained from the compression tests of these SFRC cylinders, an analytical constitutive model is developed to predict the complete stress-strain curve of SFRC in monotonic compression.

Nguyen Van CHANH studies that the transformation from a brittle to a ductile type of material would increase substantially the energy absorption characteristics of the fibre composite and its ability to withstand repeatedly applied, shock or impact loading. Fibres do little to enhance the static compressive strength of concrete, with increases in strength ranging from essentially nil to perhaps 25%. Even in members which contain conventional reinforcement in addition to the steel fibres, the fibres have little effect on compressive strength. However, the fibres do substantially increase the post-cracking ductility, or energy absorption of the material.

3. CONCLUSIONS

1. Addition of steel fibers to a concrete will enhance its flexural and compressive strength.
2. The strength increments altogether with fiber content.
3. The flexural strength increments extraordinarily while containing 3-10 wt.% SBR. The ideal utilization of SBR is 5 wt.%, which accomplishes the most astounding flexural strength.
4. Presence of fibers reduces the workability therefore use of plasticizers is compulsory to make the concrete workable.
5. With increase in grade of concrete and percentage of fibers, though strength increases but in post cracking zone response of higher percentage of fibers is comparatively poorer.

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BIOGRAPHIES

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