A REVIEW STUDY ON USE OF STEEL FIBER IN THE CONSTRUCTION OF LOW VOULME TRAFFIC ROAD

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***Abstract* – Fibers are commercially available and manufactured from steel, plastic, glass and other natural materials. Steel fibers can be defined as discrete, short length of steel having ratio of its length to diameter (i.e. aspect ratio) in the range of 20 to 100 with any of the several cross-sections, and that are sufficiently small to be easily and randomly dispersed in fresh concrete mix using conventional mixing procedure. The random distribution results in a loss of efficiency as compared to conventional bars, but the closely spaced fibers improve toughness and tensile properties of concrete and help to control cracking. In many situations it is prudent to combine fiber reinforcement with conventional steel reinforcement to improve performance. The critical investigation for M-20 grade of concrete having mix proportion 1:1.5:3 with water to study the compressive strength , flexural strength of steel fiber reinforced concrete (SFRC) containing 0%,0.5%,0.75%,1% volume fraction of steel fibers .The study focus on the compressive strength performance of the blended concrete containing different percentage of steel fiber. Concrete cubes are tested at the age of 7, and 28 days. Finally the result data obtained has been analyzed and compared with a control specimen (0% fiber).**

***Keywords* — Compressive strength, ductility, flexural strength, Fiber Reinforced Concrete, Steel fiber, Split tensile strength, toughness, workability.**

1. INTRODUCTION

Application of Fiber Reinforced Concrete (FRC) is continuously growing in various application fields.FRC is widely used in structures. Due to the property that fiber enhances toughness of concrete, FRC is used on large scale for structural purposes. The fiber is described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter. The principle motive behind incorporating fibers into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. 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. It improves fatigue resistance makes crack pattern distributed. By making crack pattern distributed, it is meant that it decreases the crack width. Underground tunneling has a very vast and profound application of SFRC and there is growing interest in SFRC as compared to plain concrete. Rehabilitation of conventional rock bolt and wire mesh support can be very disruptive and expensive. The excavations being shotcrete immediately are increasing. The incorporation of steel fiber reinforcement into the shotcrete is an important factor in this escalating use, since it minimizes labour intensive process of wire mesh installation. Trials and observations suggest that shotcrete can provide effective support in mild rock burst conditions.

1.1 Reinforcement Mechanisms in Fiber Reinforced (FRC)

In the hardened state, when fibers are properly bonded, they interact with the matrix at the level of micro-cracks and effectively bridge these cracks thereby providing stress transfer media that delays their coalescence and unstable growth. If the fiber volume fraction is sufficiently high, this may result in an increase in the tensile strength of the matrix. Indeed, for some high volume fraction fiber composite, a notable increase in the tensile/flexural strength over and above the plain matrix has been reported. Once the tensile capacity of the composite is reached, and coalescence and conversion of micro-cracks to macro-cracks has occurred, fibers, depending on their length and bonding characteristics continue to restrain crack opening and crack growth by effectively bridging across macro-cracks. This post peak macro-crack bridging is the primary reinforcement mechanisms in majority of commercial fiber reinforced concrete composites.

2. LITERATURE REVIEW

To purpose and defend the research work, a number of research papers are analyzed. Following are the excerpts from the different research work performed by number of academicians and researchers.

Milind V mohod (2012) et al in this experimental investigation for M30 grade of concrete to study the compressive strength and tensile strength of steel fibers reinforced concrete containing fibers varied by 0.25%, 0.50%, 0.75% 1% 1.5% and 2% by volume

of cement cubes of size 150mmX150mmX150mm to check the compressive strength and beams of size 500mmX100mmX100mm for checking flexural strength were casted. All the specimens were cured for the period OF 3, 7 and 28 days before crushing the result of fibers reinforced concrete 3 days, 7 days, and 28 days 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 10% 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 increase the strength of concrete.

Vikrant Vairagade et al (2012) presented the applicability of previously published relation among compressive strength tensile strength flexural strength of normal concrete to steel fibers reinforced concrete was evaluated and mechanical properties of steel reinforced concrete were analyzed in this experimental study cement sand coarse aggregate water and steel fibers were used for compressive strength test both cube specimens of dimensions 150mm × 150mm × 150mm and cylindrical specimen of length 200mm and diameter 100mm were cast for M20 grade filled with 0% and 0.5% fibers after 24 hours the specimens were to curing tank where in they were allowed cure for 7 days and 28 days. Finally result of compressive strength for M20 grade of concrete on cube and cylinder specimens with 0% and 0.5% steel fibers for aspect ratio 50 and 53.85 is it observed that for addition of 0.5% fibers shows slightly more compressive strength than normal concrete.

Prof. Ram Meghe et al (2014) presented the experimental study of the steel fibers reinforced self compacting concrete by addition of different content of steel fibers the result showed that the split tensile strength found to be increased with the addition of steel fibers and the optimum fiber content for increasing the split tensile strength was found to be 1.75% it was been observed that the steel fibers are used in the concrete to give the maximum strength as compared to other fibers such as glass fibers polypropylene fibers. The compressive strength and the flexural strength observed to be increased as the percentage of steel fibers are increased in the steel fibers reinforced concrete.

Elson John et al (2014) in this study it was observed that the physical properties of the concrete after adding the different volume fractions of fibers are used in the concrete. In the mix design is carried out as per 10262:2009 the proportioning is carried out to achieve strength at specified age, workability of fresh and durability requirements. The materials selected for this experimental study includes normal natural coarse aggregate, manufactured sand as fine aggregate, cement ,Super plasticizer both end hooked steel fibers and portable drinking water. The physical and chemical properties of each ingredient has considerable role in the desirable properties of concrete like strength and workability finally the test result of compressive strength split tensile strength and flexural strength it can be seen that in the presence of steel fiber there is an increase in compressive strength split tensile strength and flexural strength the small in fiber specimen compared to the non fibers specimens.
Ahsana Fathima et al (2014) presented the experimental study on the effect of steel fibers and polypropylene fibers on the mechanical properties of concrete, experimental program consisted of compressive strength test, split tensile strength test and flexural strength test on steel fiber reinforced concrete polypropylene fiber reinforced concrete three types of fibers used of length 30mm crimped steel fibers of length 25mm and endure 600 polypropylene of length 50mm with aspect ratio 50. The main aim of this experiment is to study the strength properties of steel fibers and polypropylene. Fibers reinforced concrete of M30 grade with 0%, 0.25%, 0.5% and 0.75% by volume of concrete.

V. T. Babar et al investigated the shear strength and ductility of fiber reinforced concrete beams by using hooked steel fiber without stirrups. In this investigation, the test beam specimens of 125 mm in width, 250 mm in depth, and 1150 in length are cast and steel fibers are varied from 0.5 % up to 2 % volume fraction The longitudinal steel is kept constant, while shear span-to-depth ratio (a/d) is varied in the range 1, 1.25, and 1.5. All the beam specimens are tested under two-point loading up to failure, and failure load, first crack load, and central deflection are recorded concisely and precisely. The test specimens were cast using cement, fine aggregate, coarse aggregate, water, and Hooked steel fibers. The materials, in general, confirmed to the specifications laid down in the relevant Indian Standard codes. For grading of fine and coarse aggregate, sieve analysis was carried out. Ordinary portland cement of 53-grade confirming to IS 12269:1987 was used throughout the experimental work. The maximum size of coarse aggregate used was 20 mm along with 12.5 mm of same parent rock in 60-40 % fraction. Locally available Krishna river sand was used as fine aggregate. The specific gravity of sand was 2.85 and fineness modulus was 2.7.Hooked end steel fibers of length 60 mm and diameter 0.75 mm were used throughout the experimental work. Reinforcing steel of grade Fe 500 was used as tensile reinforcement.

Nitin Kumar et al (2015) presented the use of steel fibers as reinforcement material with concrete. In this study, the mixing of various materials weather chemicals natural or official for improving the strength and durability of parent substance. Critical investigation for M 40 grade of concrete having mix proportion 1:4:3 with water cement ratio 0.35 to study the compressive strength flexural strength, split tensile strength of steel fibers reinforced concrete containing fibers of 0%, 1%, 2% and 3% volume fraction of hooks the result shown that steel fiber reinforced concrete increase strength toughness ductility and flexural strength of concrete.

CONCLUSIONS

The addition of fibers into concrete mixes improves the Compressive strength, Split tensile strength and Flexural strength at 28 days for fibre mixes when compared with that of control mix. The volume fraction of fibre concrete mix gives better strength values on per with control mix. The capillary absorption coefficient and porosity increases with addition of fibres. Industrial

waste materials were found to be performing better than normal concrete, in properties such as workability, durability, permeability and compressive strength.

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