

# Shear Behavior of Concrete Beam Reinforced with Carbon Coated Steel Fiber



V. Sureshvel, S. Suchithra, B. Ponnankumar

**Abstract:** The project discussing concrete shear behavior analysis with varying percentage of steel fiber. D6, The fibres of hooked end steel fibre, which are used at varying proportions, namely 1%, 1.5% and 2%. The strength tests show that the addition of fibre used better result when compared with conventional concrete. Various analyzes were conducted, such as compressive strength, split tensile strength, and flexural strength. The outcome of the experimental study shows, that incorporating carbon coating steel fibre enhances the properties of plain concrete.

**Keywords :** Steel fibers, Concrete, Reinforced, Shear, Carbon steel fibers.

## I. INTRODUCTION

Concrete is the most widely used for construction of buildings and infrastructures. Nevertheless, its brittleness and poor ability to absorb energy, extreme loadings such an earthquake, impact, blast, etc., To this drawback in the structure to adding the steel fiber generally increases the flexibility of concrete. A reinforcement concrete component is a composite material that achieves compression and tensioning of steel through the strength of the pavement; The fiber is added through the concrete mix to improve the specific strength and flexibility. Using these steel fiber has high stiffness, better concentration and together with a reduced cost of the concrete mix, mostly used the material in industrial buildings. Beton's mechanical properties through the use of steel fibre to boost strength, by using this fiber to increase concrete's compressive, flexural, tensile strength, high elasticity modulus, the post was cracking performance and Poisson's ratio [1-3]. By producing the recycled aggregate the shear action of the reinforced concrete beam to be used in the concrete and the steel fiber added through the various percentage to improve the mechanical properties. The specimen applied the four-point bending test.

The steel fibre various percentage added through the provided various strength in different specimen [4-9]. The steel fiber and coarse aggregate maximum size have a different dimension to change the strength and toughness [10]. The fiber RC beam included the mixing of short and long hooked end steel fiber has been used.

These two types of long hooked fiber end steel fibre better strength compare to short hooked end steel fiber. The intensity varies in size, shape, aspect ratio, volume and fiber distribution [11-14]. They included two types of steel fiber is added in the concrete; they are the hooked end and crimped steel fiber. The varying shape is to adjust the load-deflection curve that was obtained using the two fiber form test results. We show that the strength of the fracture was apparently no different [15]. The reinforced concrete used the two types of profiles, such as the hooked end, and spiral fiber was proposed to improve structural performance as a hybrid steel fiber reinforcement technique [16-17] — The bonding properties of reinforced concrete between then Micro steel fiber amorphous and steel fiber hooked to the end. The bond strength test mortar showed that the maximum load extracted from amorphous micro steel fiber was greater than the hooked end steel fiber. The amorphous micro steel fiber has excellent toughness and bond strength [18]. Steel fiber the type of profile is arch style steel fiber used on the bonding properties for cementitious shotcrete. The small radius of steel fiber of the arch form is used to withstand higher maximum load and without fiber fracture or pulling out [19-20]. By using Reinforced concrete beams with and without stem hooked end-stain fibre, the simply supported concrete beams subject the vertical load placed symmetrically at two points. The concrete beam with stirrups, they carried the heavy load then compare to the without stirrups — better strength carried with stirrup of shear strength of SFRC based in Aoude's method [21-23].

The corroded stirrups the shear action of reinforced recycled aggregate concrete RC beams using carbon fibre-enhanced polymer. The strengthened corroded beam has full deflection increased by 30% compared with the strengthened uncorroded shaft [24-25]. The corrosion resistance of reinforced concrete strain-hardening steel fiber; they have a different type of the steel fiber which is hooked end and twisted end. All specimen was exposed to cyclic wetting in a 3.5% chloride solution following by drying process. They are reduction mechanical resistance of the steel fiber cross-section and great team performance of steel fiber reinforced concrete in marine environments [26-27].

Manuscript received on February 10, 2020.

Revised Manuscript received on February 20, 2020.

Manuscript published on March 30, 2020.

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The impact resistance of fiber reinforced concrete, we added the different profile of steel fiber. Same length and aspect ratio of both fiber, we added different percentage fiber included in the concrete under the impact load, thus improve resistance [28].

## II. MATERIALS PROPERTIES

### A. CEMENT

Cement is a binder that is broadly utilized in production because of its adhesive and cohesive residences. Cement is functioned to bind the fine aggregates and coarse aggregates together and fill the voids in between each aggregates debris to form a compact mass. The OPC of 53 grades conforming to IS 12269 – (1987) turned into used in this observe.

### B. FINE AGGREGATE

Aggregate is a granular material used with a hydraulic cementing medium for the supply of concrete or mortar such as sand, gravel, crushed stone or iron blast-furnace slag. Such particles which pass through the sieve of 9.5 mm (3/8 in.) almost completely pass the sieve of 4.75 mm. Increases concrete volume, thereby reducing size. Provide balance across dimensions. Influence hardness, abrasion resistance, elastic modulus, and other concrete homes to make it more sturdy and cost-effective.

### C. COARSE AGGREGATE

Coarse aggregate of the mixture is defined because the particle size of stone which is greater than 4.75 mm (retained on sieve 4.75 mm). It should be hard, strong, dense and durable. Coarse mixture commonly comes from crushed gravel or stone, uncrushed gravel or stone, and in part crushed gravel or rock. There are several researchers suggested that the size and types of aggregate have a large impact on the strength and workability of concrete.

### D. WATER

Tap water is selected for the concrete blending and curing method. Water is taken into consideration as the main ingredient required for concrete mixing. Impurities in the water and the pH cost might also have an effect on the setting time, compressive energy of the concrete and also might also cause staining on the concrete surface.

### E. CARBON STEEL FIBER

Carbon Steel Fibers (CSF) are commonly distributed during a given cross-section while reinforcing bars or wires are positioned only where required. CSF is relatively quick and carefully spaced in comparison with non-stop reinforcing bars of cables. CSF is generally brought to concrete in low extent dosages (often much less than 1%), and were shown to be powerful in reducing plastic shrinkage cracking. Carbon Steel Fibers typically do not substantially regulate free shrinkage of concrete; however, at high enough dosages, they could improve the resistance to cracking and reduce crack width. Various types of fibers which have been used to reinforce concrete are metallic, carbon, asbestos, polypropylene and glass. In the present research hooked end carbon steel fibres of around 50mm length with the aspect ratio of 50 are used.



Fig. 1. Hooked End Carbon Steel Fiber

## III. MIX DESIGN

Mix value has prepared as per the codebook, IS 10262 – 2009, and we are adding the number of materials to be calculated. The specimens were cast by adding 1.0% 1.5% and 2% of carbon steel fiber to a concrete mix of M40 grade. Various mix proportion using carbon steel fiber the values are given below on Table I quantity of materials.

Table I: Quantity of materials

| Mix name | Cement (kg/m <sup>3</sup> ) | Fine Aggregate (kg/m <sup>3</sup> ) | Coarse Aggregate (kg/m <sup>3</sup> ) | Water (lit/m <sup>3</sup> ) | Steel fiber % |
|----------|-----------------------------|-------------------------------------|---------------------------------------|-----------------------------|---------------|
| Mix 1    | 491                         | 603.1                               | 1073.7                                | 197                         | 1             |
| Mix 2    | 491                         | 603.1                               | 1073.7                                | 197                         | 1.5           |
| Mix 3    | 491                         | 603.1                               | 1073.7                                | 197                         | 2             |

### A. TEST ON FRESH CONCRETE

Fresh concrete or concrete made of plastic is a freshly mixed material that can be molded into any form. The relative amounts of cement, aggregates and water combined, both in the wet state and in the hardened state govern the properties of the concrete. The fresh concrete test gives the concrete workability as well as durability.

### B. TEST ON HARDENED CONCRETE

Compressive strength is carried out as per IS code the specimen of dimension 150mm x 150 mm x 150mm. The sample is allowed to cure for 7, 14 and 28. Illustration. 2 Displays the compressive strength result for 3 mixtures [28].

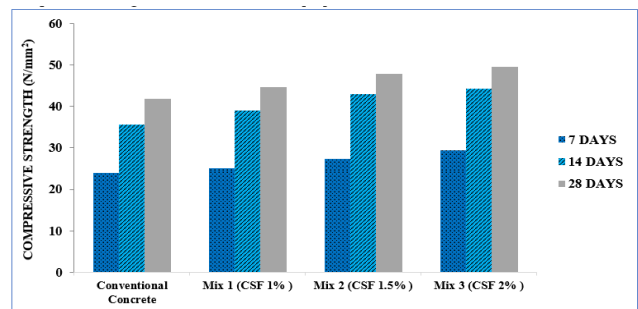


Fig. 2. Compressive strength test

The tensile strength using specimen of the dimension dia 150mm and 300 mm length is subjected to loading as the cylinder placed in a horizontal position, and compressive load is applied. Illustration.

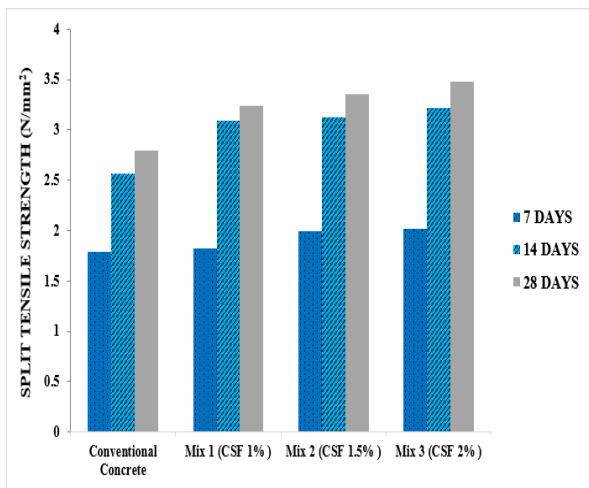


Fig. 3. Split tensile strength

Standard size specimen of 500 mm x 100 mm x 100 mm over a span of 400 mm, under symmetrical two-point loading is used to create a constant bending moment between load points in such a way that the span is subjected to maximum stress and therefore cracking is likely to occur there [29-30]. Fig. 4 shows the flexural strength of concrete and their corresponding values for the three mixes.

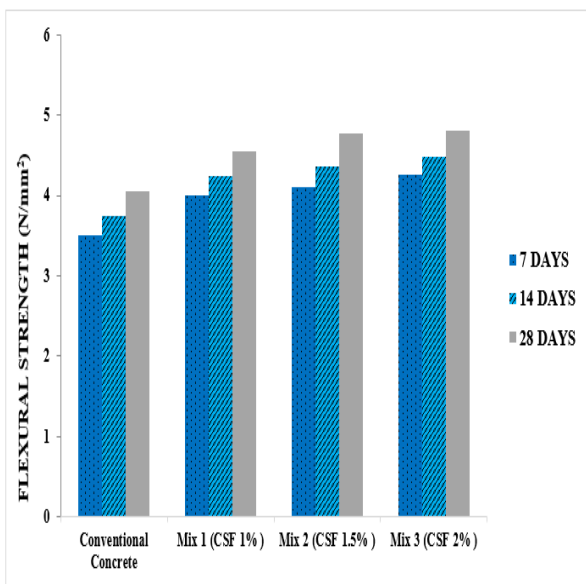


Fig. 4. Flexural strength of concrete

C. SEM ANALYSIS

The development and dispersion of hydration results of hydrated concrete glue of various blend extents are presented beneath. The microstructure of the blends were inspected and contrasted and the ostensible blend. The microstructure and quality properties of all the blends were related dependent on the hydration items framed following 28 days. The purpose for the quality of the solid was broke down and clarified dependent on the development of hydration items in the microstructure of cement blends.

WITHOUT FIBER

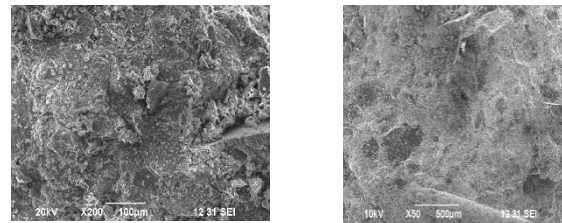


Fig. 5. Normal mix of concrete

WITH FIBER

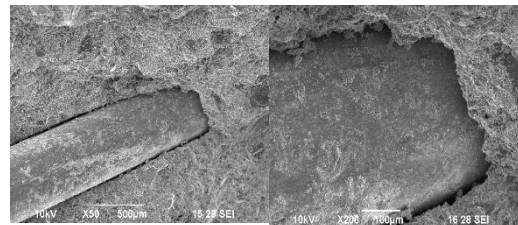


Fig. 5. Fiber mix of concrete

IV. RESULT AND DISCUSSION

- The concrete performance has been increased as we expected, this is because of the addition of steel fiber (1%, 1.5% and 2%) which makes them improve the strength of concrete.
- And it founds that decreases in strength of the concrete, by adding the 2.5% and more of steel fiber.
- The curing period is also one of the reasons to get high strength at 28 days when compared with 14 days of curing, as the curing time increases strength of concrete.

V. CONCLUSION

- As observed in the mechanical properties of various mix proportion, mix 3 gives the maximum optimum value in the trial of three mix proportions.
- Mix 3 is considered as an optimum value for introducing the fibers, and the properties of fibers are studied in the application of adding in the optimum value.
- Adding fibers at a percentage of 1%, 1.5% and 2% respectively gives 8% more strength compared to other mix proportion.
- The compressive strength the cast specimen with adding fiber is 40 N/mm<sup>2</sup>, which is 5% higher than the conventional concrete.

ACKNOWLEDGEMENT

Would like to express sincere thanks to faculty members who support us to carry out this experimental research work. Would also like to acknowledge the Kongu Engineering College for guiding to complete the paperwork. Sincere thanks extend to the people who provide us with aggregate.

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