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# Strengthening of RC Beam Using Synthetic Fibers and Steel Fibers

[1]P.periyannan, [2]Mrs.K.J.Jegidha, [3]DR.S. Suresh Babu
Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India.
[1]periyannan21@gmail.com, [2]jegi.kj@gmail.com, [3]sunisurp@gmail.com,

**ABSTRACT - The fibers are commonly use to enhance concrete's flexural resilience and ductility, and can even remove the need for traditional reinforcement. Steel fibers are more commonly used in structural applications while synthetic fibers are more frequently used due to shrinkage to reduce crack opening. RC beam specimens were constructed with steel and synthetic fiber groups, based on the investigation. The introduction of admixtures was used in steel fibers of hook ends with 50, 60 aspect ratio and crimped round of 52.85 aspect ratio comprising 0 per cent and 0.6 per cent volume fraction. In the group of synthetic fibres 20 mm cutting thicknes polypropylene fibres. In order to compare the strength aspects of RC beams using synthetic fibers, steel fibers with those of traditional RC beams, this paper validated the positive effect of steel fibers with different aspect ratios and polypropylene fibers with different cut lengths in compression and splitting performance improvement of specimens at 7 and 28 days, examined the sensitivity of different fibers to concrete with flexural strength.**

**Keywords: Steel fiber, Polypropylene fiber, Compressive strength, fiber reinforced concrete.**

## I. INTRODUCTION

The Fibre Reinforced Concrete (FRC), obtained by adding steel or synthetic fibres to RC beam is be coming widely used in civil engineering because of its favourable properties . In particular, the introduction of fibres gives to concrete a significant tensile residual strength in the and reduces the crack propagation. Fibres are also used to improve the flexural toughness and ductility of concrete. FRC may increases the speed of construction and may even eliminate the need for conventional reinforcement . The characteristics of FRC depend on the properties of the concrete matrix but mostly on the type, the amount and the geometry of the fibres; these parameters,in fact, control the bond between fibres and concrete. Nowadays different types of fibres are available to engineers. The Steel-Fibre Reinforced Concretes (SFRC)are widely used in a range of structural applications such as structural facade panels, industrial floors, precast structural elements, tunnel linings, etc., and in general in all those applications in which concrete cracking control is important. Synthetic fibres are usually manufactured in smaller dimensions with respect to steel fibres and most typically used in industrial floors to reduce cracking induced by shrinkage. Recently, Synthetic Fibre Reinforced Concretes (SFRC) have been developed with the aim of substituting steel fibres in structural applications but the level of knowledge on their mechanical behaviour is still limited. This paper describes the results of an extensive experimental campaign performed at Laboratory of Structural Engineering of the University of Bologna.In this campaign several concrete beams were casted using a concrete reinforced with different types and amounts of steel and synthetic fibres and were tested in a three-point bending scheme. All the beams where casted using the same concrete mix design. The mix composition was defined in apreliminary experimental campaign, in order to have the desired tensile strength. Data obtained during the tests were used to calibrate the parameters of a stress crack opening relation bsy means of an inverse analys is procedure. Concrete is characterized by brittle failure, the nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of a small amount of short randomly distributed fibers (steel, synthetic and natural) and can be practiced among others that remedy weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, etc..

## II. SYNTHETIC FIBRE

Synthetic fibres are no substitute for primary reinforcement in concrete because they add little or no strength. But structural reinforcement doesn‟t provide its benefits until concrete hardens. That‟s why some contractors add synthetic fiber to concrete as secondary. Unlike structural reinforcement, synthetic fibers providebenefits while concrete are still plastic. They also enhance some of the properties of hardened concrete.

**2.1 SYNTHETIC FIBRE TYPES -** The number of synthetic fibre has grown in recent years, the primary types of synthetic fibres commercially available in the

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India are polypropylene, polyester, and nylon. Though the fibres within each type come in various lengths, thicknesses, and geometries, synthetic fibres provide similar benefits when used as secondary concrete reinforcement. Polypropylene- The synthetic fibers available in the United States, polypropylene is the most widely used in ready mixed concrete .Polypropylene fibers are hydrophobic, so they don"t absorb water and have no effect on concrete mixing water requirements. They come as monofilaments.

**STEEL FIBER-**The presence of fibers may alter the failure mode of concrete, but the fibers effect will be minor on the improvement of compressive strength values (0 to 15 percent). The strain of SFRC corresponding to peak compressive strength increases as the volume fraction of fibers increases. As aspect ratio increases, the compressive strength of SFRC also increases marginally. As the load increases, the deflection also increases. However the area under the load–deflection curve also increases substantially depending on the type and amount of fibers added.

### 2.2 OPC CONCRETE

The materials required to render OPC concrete. The minimum concrete strength to be used for building is M 20 degree as per I.S: 456- 2000.In this analysis, therefore, the nominal mix needed for M 20 degree 1:1.5:3 is tried. The same blend ratio is also attempted in the concrete geopolymer. The constituents of 8 Molarity sodium hydroxide geopolymer concrete for M 20 grade concrete (1:1.5:3.0) is shown in Table 1.

Table 1 Constituents Of SY fiber steel fiberConcrete

| Description | Quantity |
|---|---|
| Cement | 440kg/m3 |
| synthetic fibre | 0.5% |
| Steel fiber | 0.5% |
| Water | 0.45 |
| Grade | M 20 |
| Coarse aggregate <20mm | 1350kg/m3 |
| Fine aggregate | 710kg/m3 |
| Curing | 28 days |

## III. EXPERIMENTAL INVESTIGATION

The test program consists of casting two beams, and testing them. Beam scale 150 X150 X100 mm, two of which are cement concrete control beams and geopolymer concrete beams.The beam were planned as reinforced under part. Using 8 mm diameter stirrups @ 150 mm c / c, it is reinforced with 2-12 # at bottom, 2-10 # at top. Control cement concrete beams cast with water cement ratio of 0.5 using M 20 grade ( 1:1.5:3) and Fe415 grade steel. Ordinary Portland cement, natural river sand, and maximum size 20 mm crushed granite are used for concrete power. Using high yield deformed bars (HYSD) with a diameter between 12 and 10 mm and the Poisson ratio is found as 0.12. The respectively known as reinforced cement concrete .

## IV. TEST SETUP

The test specimen is mounded onto a 500kN capacity beam test frame. The beams are simply supported over a span of 3000 mm and subjected to symmetrically mounted two combined loads on the base. The load distance is 1000 mm. The load is applied to the support at two points each 500 mm away from the middle of the beam. Mindset 0.001 mm dial gages are used to measure deflections below the load points and to measure deflection at the mid- span. The reading on the dialgauge are reported at different loads . A demac scale is used to measure the strain in concrete. An automatic data acquisition unit is used during the test to collect the data.The first loads of crack are obtained through visual exam. The control beam crack patterns (RCC) figure 6.

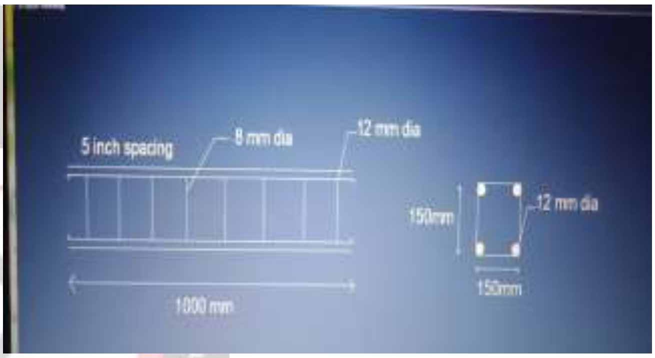


**Figure 1. Reinforcement Details**

PRELIMINARY TEST IN MATERIAL

**Preliminary Test In Materials**

- Fineness modulus of course aggregate = 3.75
- The specific gravity of course aggregate = 2.7
- Fineness of cement = 2.33%
- Specific gravity of cement = 3.10
- Fineness modulus of sand = 2.45
- Specific gravity of sand=2.5
- Aspect ratio steel fiber and SY fiber 250

**Figure 2. opc concrete**

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Figure 3. opc casting process

Figure 4. synthetic fibre& steel fiber concrete mix

Figure 5. test setup

| Sl No | Beam | Initial Crack Load (kN) | Service Load (kN) | Yield Load (kN) | Ultimate Load (kN) | Max. Deflection(mm) |
|---|---|---|---|---|---|---|
| 1 | RCC Beam | 14 | 28.5 | 43 | 45 | 60 |
| 2 | SY&STEEL FIBER Beam | 19 | 35 | 47.50 | 48,5 | 65 |

**Figure 5. crack pattern of GPC beam**

**Figure 6. crack pattern of rcc beam**

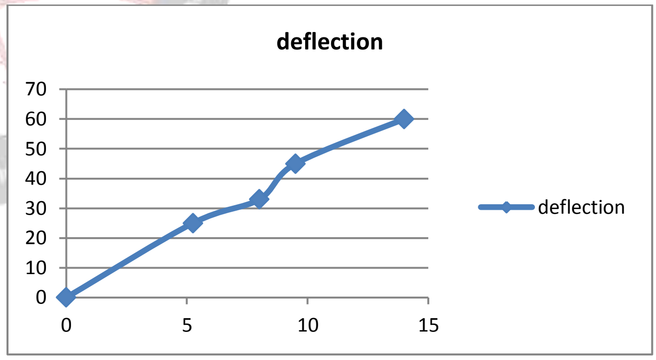



**Figure 7. RCC beam deflection**

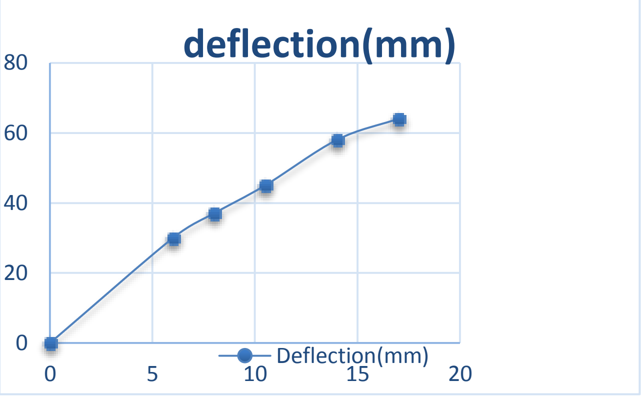



Figure 8. SY &STEEL FIBER beam deflection

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## V. CONCLUION

The reinforcement cement concrete and steel fiber concrete have a compressive strength of 28.5N/mm2. sThe geopolymer concrete slump is obtained as 120mm even without water adding. The characteristics of load deflection obtained for the RCC beams and GPC beams are curvature that is almost identical. Compared to RCC beams(15kN), the first cracking and duty loads (19kN) of steel fiber beams show slightly greater. synthetic fibre concrete beam flexural activity is more powerful than ordinary beams. The total efficiency of synthetic fibre beams is greater than RCC beams

1. SFRC beam, the strength increasing 30% comparing to conventional RC beam.
2. Combination of raw materials (synthetic fibers & SF ) results in significant strength gaining characteristics.
3. synthetic fibers such as steel fibers and polypropylene fibers are used as a secondary reinforcement to obtain the strength of steel fiber for compressive strength and synthetic fibers for tensile strength
4. steel fibers used in concrete were result in increase in compressive strength of concrete especially 1% steel fiber added to the volume of cement is found to be optimum.

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