International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 3, April 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# Structural Behavior of High Performance Steel Fiber Reinforced Concrete Beams

**M. Vanaja[1], K. Soundhirarajan[2]**

[1]PG Student Civil Structural Engineering, [2]Head of the Department Civil,
[1,2]Gnanamani College of Engineering, Namakkal, Tamil Nadu, India

**ABSTRACT**

An experimental program consisting of checks on HPFRC beams with conventional reinforcement and strengthened concrete beams used to be carried out underneath monotonic loading. Tests on conventionally strengthened concrete beam specimens, containing metal fibers in 1.5% of quantity fraction, have been performed to set up load–deflection curves. The quite a number parameters, such as, first crack load, remaining load, ductility factor, durability and stiffness traits of beams with and except metal fibers have been carried out and a quantitative assessment was once made on vast tiers of loading. It used to be discovered that HPFRC beams confirmed superior houses in contrast to that of RC beams. The quite a number parameters have been got in the experimental investigation of beams.M60 grade concrete combine was once designed as per IS 456 2000. The combine ratio for casting the specimen used is 1:1.2:2.2 and water cement ratio 0.3. Volume fractions of 1.5% are used fibers. Also 10% of cement is changed by means of silica fume intend to make HPC. For HPFRC 70% hooked fibers blended with 30% crimpled fiber have been combined collectively in the required volume of fibers. The concrete specimens had been tested at specific age of 7 days, 14 days,28 days stage for mechanical homes of concrete and find out about the flexural conduct of the High overall performance metal fiber bolstered concrete beams.

***How to cite this paper:*** M. Vanaja | K. Soundhirarajan "Structural Behavior of High Performance Steel Fiber Reinforced Concrete Beams" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-3, April 2020, pp.915-919, URL: www.ijtsrd.com/papers/ijtsrd30735.pdf

IJTSRD30735



## 1. INTRODUCTION

Plain cement concrete is vulnerable in anxiety and has constrained ductility and little resistance to cracking. Micro cracks are existing in concrete and due to the fact of its negative tensile strength; the cracks propagate with the software of load main to brittle fracture of concrete.

Extensive lookup in the subject of concrete science has lead to the improvement of specific sorts of concretes which are succesful of eliminating, to a brilliant diploma these primary deficiencies. For many applications, it is turning into an increasing number of famous to fortify to the concrete with small, randomly disbursed fibers.

High Performance Concrete is used for concrete combination which possess high workability, excessive durability, excessive modulus of elasticity, excessive density, excessive dimensional stability, low permeability and resistance to chemical attack. Reduction of w\c ratio will end result in excessive energy concrete. But discount in w\c ratio to much less than 0.3 will noticeably enhance the features of transition sector to provide inherent features predicted in HPC.

### 1.1. OBJECTIVES

1. To learn about the have an effect on of shapes and geometry of the fiber by way of conducting experiment.
2. To get the greatest fiber content material for every kind of fiber.
3. To find out about the have an effect on of hybrid fiber in HPFRC.
4. To learn about the load deformation conduct of RC beam with hybrid fibers as secondary reinforcement.
5. To decide the load carrying capacity, ductility and power attribute of RC beam.
6. To evaluate the conduct of RC beams with and except fibers.

## 2. EXPERIMENTAL INVESTIGATION

An experimental Investigation have been carried out learn about and examine the conduct of excessive overall performance concrete and excessive overall performance fiber bolstered concrete flexural individuals underneath monotonic loading. Where two distinct kinds of fibers crimpled metal fiber and hooked metal fiber are used in casting FRC beam one by one and combined together. A percentage of 70% hooked fibers and 30% crimpled fibers are adopted in this investigation. The extent fraction of fiber is constant as 1.5% for all the beams.

### 2.1. PHYSICAL PROPERTIES OF CEMENT

**Table 2.1: Physical Properties of Cement**

| S. No | Properties of cement | Result |
|---|---|---|
| 1 | Fines of cement | 320kg/m$^2$ |
| 2 | Grade of cement | 53 |
| 3 | Specific gravity of cement | 3.15 |
| 4 | Initial setting time | 30 min |
| 5 | Final setting time | 600min |
| 6 | Soundness | 0.80% |

### 2.2. PROPERTIES OF COARSE AGGREGATE

| S. No | Properties | Result |
|---|---|---|
| 1 | Specific gravity | 2.75 |
| 2 | Size of aggregate | 10mm |
| 3 | Fineness modulus | 4.82 |
| 4 | Water absorption | 0.7% |
| 5 | Impact test | 15.2% |

### 2.3. STEEL FIBERS

Hooked End fiber and Crimpled fiber are used separately and mixed in the mix proportion of 70% - 30% by volume at a total volume fraction of 1.5%. The length of fibers is 30 and 38. The aspect ratios are 48.4 and 76. The diameter of the fibres is 0.62 and 0.55. The tensile strength is 110MPa and 400-600MPa respectively. The different types of steel fibers are shown in figure 2.1 and 2.2.

**Fig 2.1 Hooked end fiber**

**Fig 2.2 Crimpled fiber**

### 2.4. EXPERIMENTAL SETUP

All beam specimens were tested under a loading frame of 500 kN capacity. Beams were simply supported over a span of 1200 mm. The load was applied through screw jack connected to manually operated. The load was distributed as symmetrical to centerline of beam on the top face. Loading arrangement for beam specimens is shown in fig. 2.3.

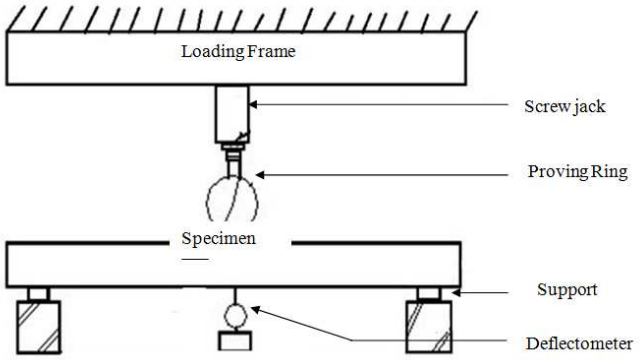


**Fig 2.3 Experimental Setup**

## 3. RESULTS AND DISCUSSIONS

### 3.1. COMPRESSIVE STRENGTH

**TABLE3.1 CUBE COMPRESSIVE STRENGTH**

| S. NO | TYPE OF CONCRETE | COMPRESSIVE LOAD AT FAILURE (N) | COMPRESSIVE STRENGTH (N/mm²) |
|---|---|---|---|
| . | B1 & B2 | 1352 | 60.4 |
| 2. | B3 | 1573 | 69.91 |
| 3. | B4 | 1574 | 69.65 |
| 4. | B5 | 1450 | 64 |

**Fig 3.1 Compressive Test**

### 3.2. TESTING OF BEAM SPECIMENS

Test specimens consist of three RC beams, 4 SFRC beams containing 1.5% of metal fibers via extent of concrete. The go sectional dimensions and span of beams had been constant identical for all sorts of beams. The dimensions of the beams had been 80mm x 120mm x 1200mm. All beams have been bolstered the usage of 4 numbers of 10 mmφ for metal longitudinal bars at backside face as predominant reinforcement and 8mmφ moderate metal closed stirrups have been used @ a hundred mm c/c spacing. Two kinds of SFRC beams have been casted specifically hooked give up fibers and crimpled fibers.

**Fig 3.2 Testing of beam**

### 3.3. RELATIVE ENERGYABSORPTION

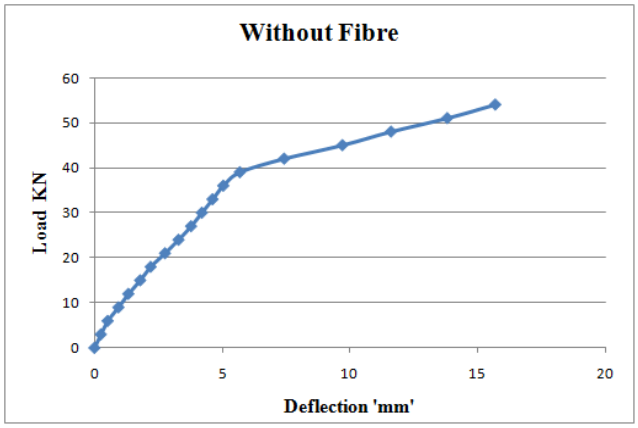


**Fig 3.3 Energy Absorption Without fiber**

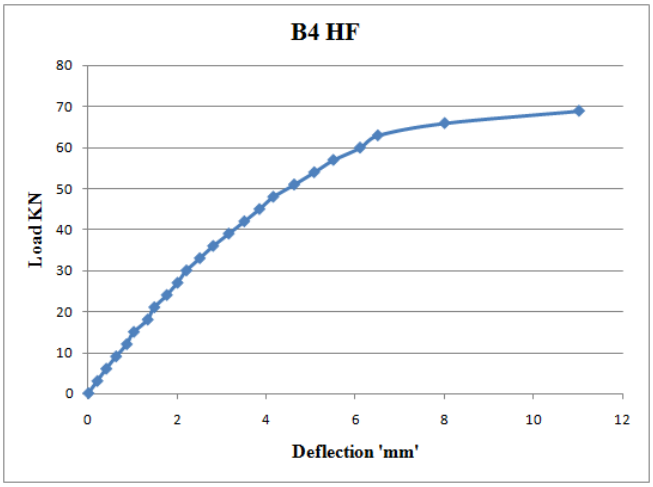


Fig. 3.4 Graph for Hooked End Fibre RC Beam

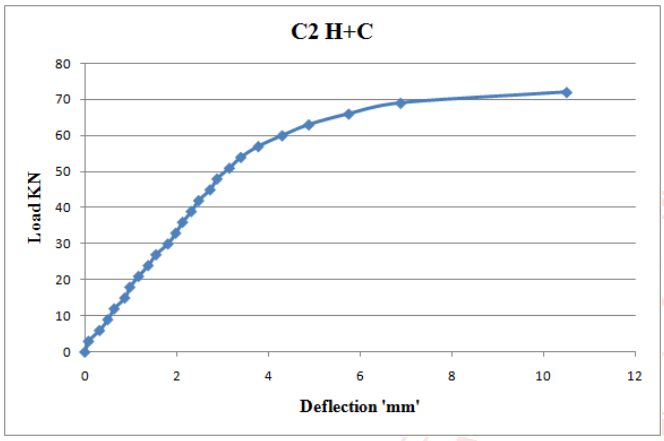


Fig.3.5 Graph for Hybrid Fiber RC Beam

## 4. COMPARISON OF TEST RESULT

### 4.1. COMPARISON OF CUBE COMPRESSIVE STRENGTH

Table 4.1 Comparison of Cube Compressive strength

| S. NO | TYPE OF CONCRETE | COMPRESSIVE LOAD AT FAILURE (N) | COMPRESSIVE STRENGTH (N/mm²) |
|---|---|---|---|
| 1. | B1 & B2 | 1352 | 60.4 |
| 2. | B3 | 1573 | 69.91 |
| 3. | B4 | 1574 | 69.65 |
| 4. | B5 | 1450 | 64 |

### 4.2. COMPARISON OF FIRST CRACK LOAD

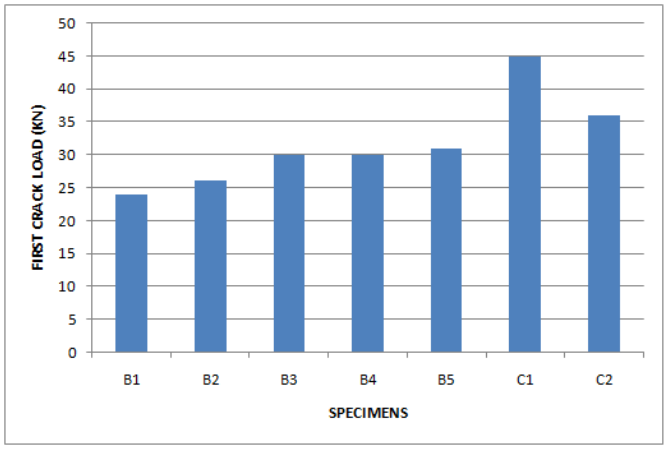


Fig 4.1 Comparison of First Crack Load

### 4.3. COMPARISON OF ULTIMATE LOAD

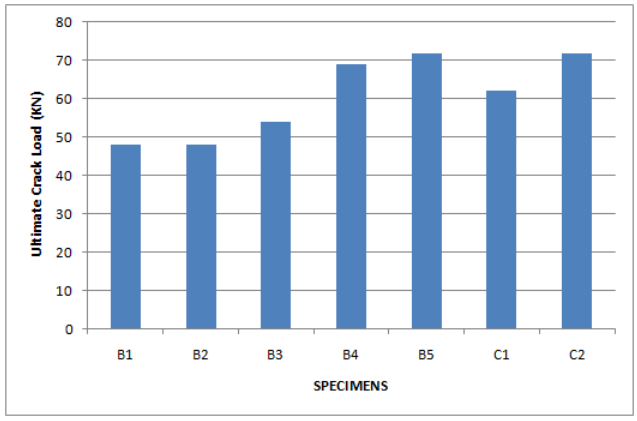


Fig 4.2 Comparison of Ultimate Crack Load

### 4.4. COMPARISON OF STIFFNESS

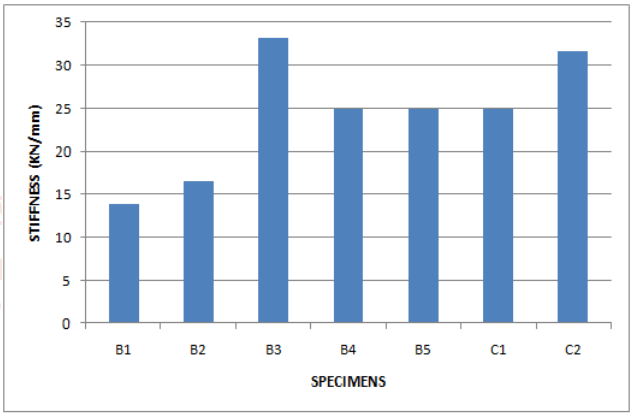


Fig 4.3 Comparison of Stiffness

### 4.5. COMPARISON OF DUCTILITY FACTOR

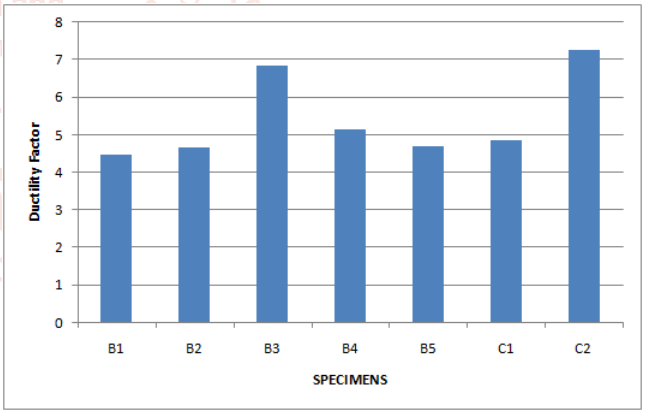


Fig 4.5 Comparison of Ductility Factor

### 4.6. COMPARISON OF ENERGY ABSORPTION

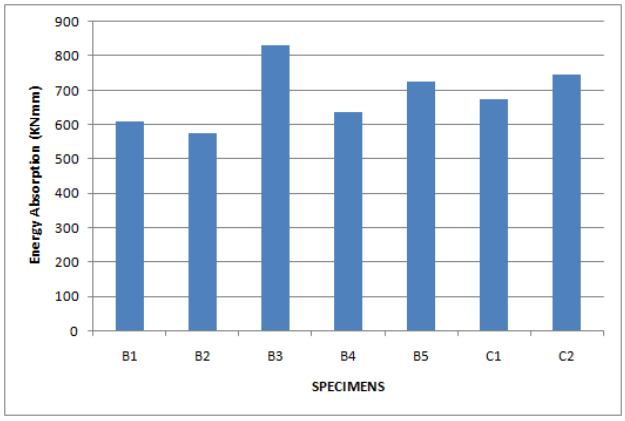


Fig 4.6 Comparison of Energy Absorption

### 4.7. MODE OF FAILURE


**Fig 4.7 Mode of Failure**

## 5. CONCLUSION

The experimental investigation is carried out to find out about the conduct of High Performance Fiber Reinforced Concrete Beam. The check effects are in contrast with that of the Conventional excessive overall performance strengthened concrete beam. It based totally on find out about parameters such as first crack load, remaining load, ductility factor, electricity absorption, stiffness and longevity we evaluate all the beams with that of traditional concrete beam.

The following commentary has been inferred from the experimental programme.

- The first crack load for the hybrid fiber bolstered concrete beam was once 1.25 instances larger than traditional RC beam. The first crack load for hybrid, crimpled and hooked cease beams are about 20%, 22.58% and 20% respectively extra than that of traditional beam.
- The closing load carrying potential for the hybrid fiber strengthened concrete beam was once 1.125 instances higher than that of traditional RC beam. The final load for hybrid, crimpled and hooked stop beams are about 12.5%, 50% and 43.75% respectively greater than that of traditional RC beam
- The stiffness for the hybrid fiber bolstered concrete beam used to be 2.427 instances increased than that of traditional RC beam. The stiffness for hybrid, crimpled and hooked give up beams are about 142%, 82% and 82% respectively greater than that of traditional RC beam
- The ductility fee of hybrid fiber RC beam is about 1.526 instances than that of traditional RC beam and 1.149 instances than that of hooked stop RC beams.
- The strength absorption of hybrid fiber RC beam is about 1.36 instances than that of traditional RC beam and 1.04 instances than that of crimpled RC beams.
- The durability index of hybrid fiber RC beam is about 1.39 instances than that of traditional RC beam and 1.73 instances than that of hooked RC beams.
- Moreover the presence of hybrid fiber consequences in greater load carrying capability aside from improved ductility and power absorption.

## REFERENCE

[1] Barros, J. A. Figueiras, "Flexural Behavior Of Steel Fiber Reinforced Concrete: Testing And Modeling"

[2] Chote Soranakom and Barzin Mobasher, "Flexural Design of Fiber-Reinforced Concrete". Title no. 106-M52

[3] Damgir. R. M, "Compressive Strength for FRC Member Using Silica Fume". International journal of engineering sciences and technology, vol.3 No.1 Jan 2011

[4] Jamal Shannag, Nabeela Abu-Dyya, "Lateral load response of high performance fiber reinforced concrete beam–column joints". Jordan Received 25 February 2004.

[5] Katherine G. Kuder, Surendra P. Shah, "Processing Of High-Performance Fiber-Reinforced Cement Based Composites". Brazil. October 15 - 18, 2006

[6] Mohammadi. Y, "Flexural fatigue strength of steel fibrous concrete containing mixed steel fibers". J Zhejiang Univ Science A 2006 7(8): 1329-1335

[7] Mukesh Shukla, "Behavior of Reinforced Concrete Beams with Steel Fibres under Flexural Loading". International Journal of Earth Sciences and Engineering ,ISSN 0974-5904, Volume 04, No 06 SPL, October 2011, pp 843-846

[8] Mansur and Rashid, "Reinforced High-Strength Concrete Beams in Flexure". ACI Structural Journal, V. 102, No. 3, May-June 2005.

[9] Neves & J. C. O. Fernandes de Almeida "Compressive Behavior of Steel Fiber Reinforced Concrete".

[10] Nguyen Van Chanh, "Fiber reinforced cements and concretes" Advances in concrete technology volume 3 – Gordon and Breach Science publishes – 2001.

[11] Perumal, B. Thanukumari, "Behavior of M60 Concrete Using Fiber Cocktail in Exterior Beam-Column Joint under Reversed Cyclic Loading". Asian journal of civil engineering (building and housing) vol. 11, no. 2 (2010) pages 263-273

[12] Prashant Y. Pawade, Nagarnaik P.B, Pande A.M, "Performance of steel fiber on standard strength concrete in compression". International Journal Of Civil And Structural Engineering Volume 2, No 2, 2011

[13] Raikar R.V, Karjinni V.V, "Study on Strength Parameters of Steel Fiber Reinforced High Strength Concrete". Journal of Applied Sciences & Engineering Research, Vol. 1, Issue 4, 2012

[14] Ramadoss. P and K. Nagamani "Tensile Strength & Durability Characteristics of HPFRC". The Arabian Journal for Science and Engineering, Volume 33, Number 2B.

[15] Ramli, Thanon Dawood, "High-Strength Flowable Mortar Reinforce d by Steel Fiber". Vol. XIX, 2011, No. 3, 10 – 16

[16] Shende. A. M, Pande. A. M, "Comparative study on steel fiber reinforced cum control concrete under flexural and deflection". International journal of applied engineering research, volume 1, no 4, 2011

[17] Vikrant S. Vairagade, Kavita S. Kene, "Investigation of Steel Fiber Reinforced Concrete on Compressive and Tensile Strength". (IJERT) Vol. 1 Issue 3, May - 2012

[18] Vinayagam.P, "Experimental Investigation On High Performance Concrete Using Silica Fume And Super plasticizer". International journal of computer and communication engineering, vol.1, No.2, July 2012

[19] Xue-mei zhao, Yu-Fei Wu, A.Y.T. Leung, "Analyses of Plastic Hinge Regions in Reinforced Concrete Beams under Monotonic Loading". Engineering Structures 34 (2012) 466-482

[20] Yusa Sahin "Combined Effect of Silica Fume and Steel Fiber on the Mechanical Properties of High Strength Concretes". Construction and building materials 22 (2008) 1874-1880.