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# Experimental Research on Deep Beam using Hybrid Fiber Reinforced Concrete with M-Sand

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***Abstract:*** ***Concrete is hard but liable to break easily. Hybrid fiber reinforced concrete offers several economical and technical benefits. The use of fibers extends its possibilities. The hybridization of different types of fibers may play important roles in arresting cracks and thus achieve high performance of concrete. The main reason for adding glass ,steel and polypropylene to improve the ductility of concrete.The present research work is aimed at studying, the deep beam using three different types of fibers such as glass 0.3%, steel 0.75% & 1% and polypropylene fibers 0.3% were added to volume of concrete. The mix design has been arrived based on IS code method for M20 grade of concrete. An investigation is carried out to evaluate the fresh Properties and mechanical Properties of Hybrid Fiber Reinforced Concrete (HFRC). The result shows that hybrid fiber reinforced deep beams achieved better performance than the ordinary RC deep beam under application of load.***

***Keywords: Hybrid fiber, flexure behavior, high performance of concrete.***

## I. INTRODUCTION

### A. General

Concrete is a widely used material in construction of buildings concrete is generally made of cement, coarse aggregate and fine aggregate with addition of water. Fresh concrete can be molded into any shape forming as a hard material. The hardening takes place due to good binding of materials. Portland cement is used for construction these material is brittle one and weak in resisting cracks.

Fiber reinforced concrete is a concrete made of fibers which help in converting brittle material to ductile material. Fiber Reinforced Concrete. Fiber reinforced concrete is a concrete made of cement, fine aggregate, coarse aggregate and fibers. Which are uniformly distributed in concrete. Fibers are ductile material which helps in converting concrete from brittle nature .The fibers generally available are glass, steel, polypropylene. Fibers are used as small reinforcement material.

### B.Hybrid Fiber Reinforced Concrete

Hybrid fiber reinforced concrete is nowadays mostly used in civil engineering applications. Hybrid fiber reinforced concrete is defined as the addition of two or more fibers to the concrete to improve the Properties of concrete.

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The optimum results are obtained by combining different types of fibers. In this project glass, steel and polypropylene fibers are used to find the optimum mix and their harden Properties.

### C. Deep Beam

A beam is considered as deep, if the depth of beam is in relation to the span of the beam. According to IS-456 (2000) Clause 29, A simply supported beam acts as a deep beam when the ratio of its effective span (L) to overall depth (D) is less than 2.0 and that for continuous beam when the ratio is less than 2.5. The effective span is defined as the centre to centre distance between the supports or 1.15 times the clear span whichever is less. ACI code 318-95 classifies the beam as a deep beam for flexural if the clear span / Overall-depth ratio is less than 1.25 for simply supported beams and 2.5 for continuous beams.

## II. EXPERIMENTAL INVESTIGATION

### A. Properties of Steel Fiber

The steel fiber is used in concrete in order to improve the properties of the concrete. The steel fiber also acts as reinforcement in concrete. They are used in improving tensile strength of concrete in multi direction. figure I shows the steel fiber

**Fig.1. steel fibers**

### B.Properties of Glass Fiber

Glass fiber is used in concrete in order to increase the durable Properties of the concrete. They are fire and weather resistance. figure 2 shows the glass fiber

**Fig. 2. glass fiber**

### C. Properties of Polypropylene Fiber

Polypropylene fiber helps in increasing resistance against micro cracks. Figure 3 shows the polypropylenefiber

Fig.3 polypropylene fiber

### D.Properties of Cement

Cement is a binding material used in making concrete the Properties of cement are listed in table I.

**Table I Properties of cement**

| *Properties* | *Values* |
|---|---|
| Specific gravity | 3.15 |
| Initial Setting time | 32 minutes |
| Final Setting time | 3 hours |

### E.Properties of Fine Aggregate

Since there is a demand in natural sand the M-sand is used as fine aggregate. The Properties of fine aggregate are given below in table II

**Table II Properties of fine aggregate**

| *Properties* | *Values* |
|---|---|
| Specific gravity | 2.53 |
| Fineness modulus | 2.86 |
| Water absorption | 1% |

### F.Properties of Coarse Aggregate

Coarse aggregate used are of size passing through 12 mm and retaining in 10mm for mixing of concrete .The Properties of coarse aggregate are given below in table III

**Table III Properties of coarse aggregate**

| *Properties* | *Values* |
|---|---|
| Specific gravity | 2.7 |
| Fineness modulus | 7.5 |
| Water absorption | 0.5% |
| Size of aggregate | 10 mm |

## III. MIX DESIGN AND CASTING

### A.Mix Proportion

Cement = 362 kg/m$^3$
Water (to be added) = 212 kg/m$^3$
Fine aggregate(Dry) = 664 kg/m$^3$
Coarse aggregate(SSD) = 1114 kg/m$^3$
Water cement ratio = 0.55
Mix ratio : 1 : 1.8 : 3.0 : 0.5

### B.Casting

$M_{20}$ grade of concrete is casted for hybrid fiber reinforced concrete the mix is divided into 4 such as glass 0.3% + steel 0.75%, glass 0.3% + steel 1%, polypropylene 0.3% + steel 0.75%, polypropylene 0.3% + steel 1%.The concrete is placed in mould and damped in three layers and smoothly finished at the end. The demoulding is done and cured for 7, 14 and 28 days and taken for testing.

## IV. TESTING

### A.Compressive Strength

The specimens are placed in compression testing machine. The load is applied and values are calculated and listed. Table IV represents the compressive strength

**Table IV Compressive strength**

| *MIX* | *COMPRESSIVE STRENGTH (N/mm^2)* | | |
|---|---|---|---|
| | **7 days** | **14 days** | **28 days** |
| Control | 19.61 | 23.54 | 24.63 |
| Glass 0.3% + steel 0.75% | 22.66 | 24.41 | 28.99 |
| Glass 0.3% +steel 1% | 22.67 | 23.32 | 24.41 |
| Polypropylene 0.3% +steel 0.75% | 20.71 | 25.03 | 27.46 |
| Polypropylene 0.3% +steel 1% | 27.33 | 28.99 | 31.17 |

### B.Split Tensile Strength

In this test the cylinder specimens are casted and cured for 28 days. After curing the element is placed on the testing machine and load is applied. Table V represents the split tensile values .

**Table V Split tensile strength**

| *MIX* | *TENSILE STRENGTH (MPA)* |
|---|---|
| Control | 1.84 |
| Glass 0.3% + steel 0.75% | 1.96 |
| Glass 0.3% + steel 1% | 2.83 |
| Polypropylene 0.3% + steel 0.75 % | 2.46 |
| Polypropylene 0.3% + steel 1 % | 2.57 |

### C.Flexure Strength

The test should be conducted on the specimen immediately after taken out of the curing condition so as to prevent surface drying which decline flexural strength. Place the specimen on the loading points. Place the element in the loading system and apply force. The load shall be applied and maximum load is noted. Table VI shows flexure strength.

**Table VI Flexure strength**

| **MIX** | **MODULUS OF RUPTURE (N/mm^2)** |
|---|---|
| Control | 3.5 |
| Glass 0.3% + steel 0.75% | 3.7 |
| Glass 0.3% + steel 1% | 4.5 |
| Polypropylene 0.3% + steel 0.75 % | 6.25 |
| Polypropylene 0.3% + steel 1 % | 6.75 |

E.Testing of Deep Beam

The following procedure is adopted to conduct the flexural strength test. Turn the beam to its position as moulded, and place it in the breaking machine. Set the bearing plates with the beam and adjust the distance. Set the dial after contact is made adjust the needle on the dial gauge to "0". Figure 4 shows the testing of the beam.

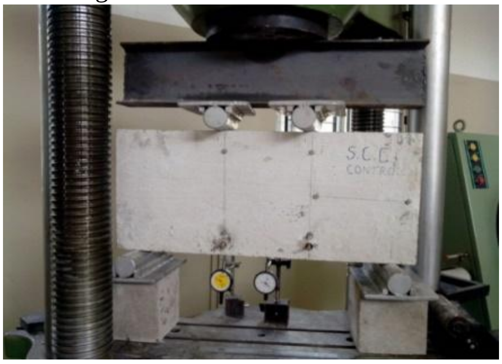

**Fig.4 shows the testing of the beam**

The testing of deep beam is done for various proportions the results are represented below. Table VII and Figure 5 shows graph representing load vs deflection.

**Table VII Flexure strength**

| LOAD (kN) | DEFLECTION (mm) | | | | |
|---|---|---|---|---|---|
| | Control | G 0.3+ S 0.75 | G 0.3+ S 1 | P 0.3+ S 0.75 | P 0.3+ S 1 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0.01 | 0 | 0 | 0.01 |
| 20 | 0.03 | 0.03 | 0.01 | 0.03 | 0.05 |
| 30 | 0.07 | 0.12 | 0.03 | 0.05 | 0.07 |
| 40 | 0.11 | 0.24 | 0.07 | 0.09 | 0.11 |
| 50 | 0.23 | 0.37 | 0.11 | 0.14 | 0.16 |
| 60 | 0.33 | 0.48 | 0.19 | 0.26 | 0.19 |
| 70 | 0.42 | 0.62 | 0.26 | 0.28 | 0.26 |
| 80 | 0.53 | 0.74 | 0.38 | 0.35 | 0.38 |
| 90 | 0.62 | 0.91 | 0.45 | 0.45 | 0.44 |
| 100 | 0.72 | 1.08 | 0.55 | 0.56 | 0.6 |
| 110 | 0.82 | 1.17 | 0.69 | 0.78 | 0.69 |
| 120 | 0.92 | 1.24 | 0.84 | 0.99 | 0.85 |
| 130 | 1.01 | 1.39 | 1.01 | 1.21 | 1.01 |
| 140 | 1.11 | 1.45 | 1.21 | 1.37 | 1.14 |
| 150 | 1.21 | 1.69 | 1.52 | 1.52 | 1.4 |

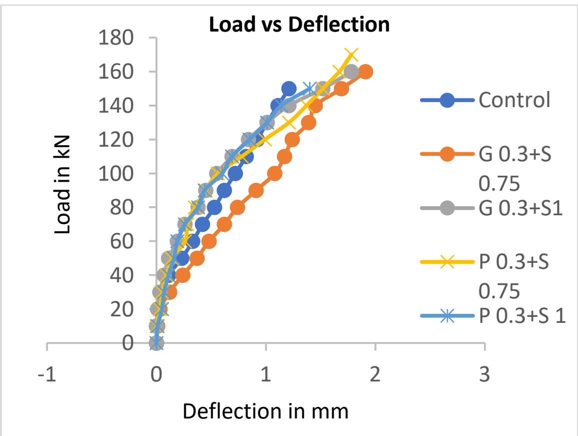


**Fig.5 Graph representing load vs deflection**

## V. CONCLUSIONS

The testes were carried out to evaluate fresh properties of a hybrid fiber reinforced concrete and to investigate flexure behaviour and performance of deep beams. Fresh and hardened properties of normal concrete are evaluated. The use of fibers improves the mechanical properties of concrete, especially the first crack strength and the toughness. The hybrid fibers can be considered as a promising concept and the replacement of a portion of fiber can significantly reduce the density, enhance the flexural strength and toughness.

1. From the above results we can consider that the cube made of P 0.3+S 1% are better in compressive strength when compared with other proportions.
2. The cylinder made of G 0.3+S 1% are better in split tensile strength and young's modulus when compared with other proportions.
3. The prism made of P 0.3+S 1% is better in flexure strength when compared with other proportions.
4. From the above results of deep beam we can consider that the deep beam made of G 0.3+S 1% are better in bearing load and reducing the bending moment when compared with other proportions.

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