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# Experimental Study of Polypropylene Fibre Concrete with Admixture

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**Abstract -** This paper describes a study of behavior of polypropylene fibre reinforced concrete in the modern constructionindustry. The study of the influence of addition of polypropylene fibres at increasing dosage from 0.5% to 2.5% of total weight of cement was carried out. Its use in concrete makes effective utilization of tensile and flexural strength of the material along with reduction of plastic shrinkage cracking and thermal cracking. Experiment was done using M-30 mix and Compression test; Split Tensile test and Flexural Strength test were carried out at 7 and 28 days as per standard procedures by relevant codes. The result was compared with conventional concrete andit was observed that concrete with 1.5% by weight of polypropylene fibre as additive, showed highest strength of concrete with decreased self weight. The strength decreased gradually with further increase in percentage of polypropylene fibre.

***Key Words***: *Polypropylene fibre, compressive strength test, split tensile test, flexural test.*

## 1.INTRODUCTION

The consumption of concrete is increasing day by day all over the globe since it is the most important building material. Combination of high strength along with stiffness and thermal resistance effectively results in the use of fibres. The compressive strength and splitting tensile strength increases with the increase in percentage of polypropylene fibres. Researchers have comparatively studied the use of polypropylene, recron and steel fibres in concrete and have found good results with polypropylene fibres . It was studied by researchers that the increase in compressive strength is due to percentage of fibre and aggregate bonding and is not due to cement paste bonding. The fibres act as anchors between the cement paste and the fine and coarse aggregates which help in increasing the durability of concrete . Concrete is a widely used construction material. It also replaces the old construction materials such as brick and stone masonry.

The use of polypropylene reinforced concrete results in the improvement of all properties related with cracking, such as tensile strength, exural strength, shear strength, sti ness, ductility, and the resistance to freeze-thaw damage, impact and fatigue. The property of bres has following e ects on the behaviour of hardened concrete.

## 2. Experimental Study

The chapter describes the details of experimental programs for the measurements of fresh properties, strength properties (compressive strength) of s concrete mixes made with varying percentages of polypropylene fiber. The basic tests carried out on concrete samples are discussed in this chapter, followed by a brief description about mix deign and curing procedure adopted. At the end, the various tests conducted on the specimens are discussed.

The materials that were used for polypropylene fiber reinforced concrete (PFRC) throughout the experimental work are (cement, sand, gravel, water and polypropylene fiber).

### 2.1 Mix Design

**Table -1:** Mix Design

| Cement (kg) | Water ( kg) | F.A (kg) | C. A. (12.5 mm) | C.A. (20 mm) | GGBS | Density of fresh concrete (kg) |
|---|---|---|---|---|---|---|
| 290 | 176 | 935 | 385 | 715 | 60 | 2561 |

Various tests were conducted on cement, ne aggregate and coarse aggregate as per the suitable code provisions and the experimental results are tabulated in Tables. Mix design of concrete for M-30 grade was carried out as per IS 10262:2009 and the mix design is tabulated in table.

**Table -1:** Mix Proportion for M-30 Grade Concrete

| Grade of concrete | Cement | Fine aggregate | Coarse Aggregate | W/C ratio |
|---|---|---|---|---|
| M 30 | 1 | 1.576 | 2.8 | 0.45 |

One trial each for 7 and 28 days curing was taken for compressive and split tensile strength test. And one trial each 7 and 28 days was taken for exural strength test. The concrete materials were weighed and kept ready as per calculations. The Polypropylene bre is soaked in water prior to addition with the concrete in order to soak in water so that it does not absorb water from the mix. First thorough dry mixing of concrete materials is carried out followed with addition of water as per design. Then polypropylene bre is added and mixed thoroughly until uniform composite is obtained. Mechanical concrete mixer along with super-plasticizer is preferable in order to obtain a better homogeneous mix. The concrete mix is then poured into moulds kept ready followed with ramming with standard rod in layers and leveling the surface after placing moulds on vibrating table. Later all the moulds are placed in a level surface without disturbance.

The specimens of concrete are taken out of moulds after twenty four hours, numbered for identification and then placed for curing. Corresponding to 7 and 28 days of curing, the cubes, cylinders and beams are taken and then tested in testing machines and the results are tabulated. Once after all the trials are completed, graph is plotted to nd out the optimum results. Then variation in results is studied comparing with the normal concrete. With the variation in results, the conclusion is then reported.

## 3. Performance Analysis

3.1 Effect of Polypropylene Fiber on Workability of Concrete

| Mixture | Fiber content % | Slump (mm) | Flow (mm) |
|---|---|---|---|
| M1 | 0 | 180 | 580 |
| M2 | 1.0 | 185 | 560 |
| M3 | 1.5 | 175 | 400 |
| M4 | 2.0 | 75 | 370 |
| M5 | 2.5 | 65 | 350 |

3.2 Result and Discussions of Hardened Concrete

**Table 4:** Variation In Density for 7 And 28-Days with Increasing of Fiber Content.

| % of Fibre added | 7-days | | 28-days | |
|---|---|---|---|---|
| | Density (kN/m$^3$) | Increase/ decrease in density (%) | Density (kN/m$^3$) | Increase/ decrease in density (%) |
| 0 | 24.12 | 0 | 24.49 | 0 |
| 0.5 | 24.1 | -0.083 | 24.32 | -0.699 |
| 1 | 24.05 | -0.291 | 24.25 | -0.99 |
| 1.5 | 23.9 | -0.92 | 24.2 | -1.2 |
| 2 | 23.7 | -1.772 | 24 | -2.04 |
| 2.5 | 23.65 | -1.987 | 23.46 | -4.4 |

**Table 5:** Variation in compressive strength for 7 and 28 days with increasing Fibre content.

| % of Fibre added | 7-days | | 28-days. | |
|---|---|---|---|---|
| | Compressive Strength (MPa) | Increase or Decrease in compressive Strength (%) | Compressive Strength (MPa) | Increase or Decrease in compressive Strength (%) |
| 0 | 48.44 | 0 | 52 | 0 |
| 0.5 | 52.15 | 7.11 | 57.04 | 8.83 |
| 1 | 55.7 | 13.03 | 62.07 | 16.22 |
| 1.5 | 61.33 | 21.01 | 68.3 | 23.86 |
| 2 | 58.96 | 17.84 | 65.19 | 20.23 |
| 2.5 | 40.3 | -20.198 | 45.33 | -14.71 |

**Table 6:** Variation in Split Tesile strength for 7 and 28 days with increasing Fibre content.

| % of Fibre added | 7-days | | 28-days | |
|---|---|---|---|---|
| | Split tensile strength (MPa) | Increase/ Decreasein split tensile strength(%) | Split tensile strength (MPa) | Increase/ Decreasein split tensile strength |
| 0 | 3.4 | 0 | 3.87 | 0 |
| 0.5 | 3.44 | 1.162 | 3.91 | 1.023 |
| 1 | 3.49 | 2.578 | 4.1 | 5.6 |
| 1.5 | 3.54 | 3.954 | 4.15 | 6.746 |
| 2 | 3.02 | -12.582 | 3.54 | -6.779 |
| 2.5 | 2.69 | -26.394 | 3.35 | -15.522 |

Table 6: Variation in Flexural strength for 7 and 28 days with increasing Fibre content.

| % of Fibre added | 7-days | | 28-days | |
|---|---|---|---|---|
| | Flexural strength (MPa) | Increase/ Decreasein Flexural strength(%) | Flexural strength (MPa) | Increase/ Decreasein Flexural strength |
| 0 | 5.16 | 0 | 6.22 | 0 |
| 0.5 | 5.33 | 3.189 | 6.4 | 2.812 |
| 1 | 5.69 | 9.314 | 6.76 | 7.988 |
| 1.5 | 6.4 | 19.375 | 7.11 | 12.517 |
| 2 | 5.33 | 3.189 | 6.22 | 0 |
| 2.5 | 5.16 | 0 | 5.16 | -20.542 |

## 4. CONCLUSIONS

- The reduction of slump is noticed with increase in polypropylene fiber content, especially beyond 2 % dosage, the mix become fibrous which results in difficulty in handling.
- The specimen with 1.5% polypropylene fibre as additive was found to be good, which has compressive strength of 23.86% more than that of conventional concrete.
- Better split tensile strength was observed which showed upto 6.75% increase in strength than normal concrete. Further, on adding the polypropylene fibre, the flexural strength increased by 12.52% over that of the conventionalconcrete.
- The density of concrete decreases with fibre addition compared to normal concrete specimen. Hence, when it is used in construction, it can reduce the self weight of different concrete elements in a building considerably, thus reducing the total dead load on the footing.
- Further, it is observed that the concrete with polypropylene fibre has higher yield point than normal concrete.
- It does not fail suddenly as in the case of flexural testing on beam with normal concrete due to its brittle nature; instead, fibre added concrete behaves like a ductile member and then undergoes failure after yield point.
- This study indicates that the mechanical properties of concrete are enhanced by addition of the polypropylene fibre (1.5% by weight of cement) as an additive.

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