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An experimental investigation of reinforced cement concrete beam by using polypropylene fiber

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ABSTRACT

The paper deals with the addition of various proportions of polypropylene fiber on the properties of High strength concrete (M25 mixes). An experimental program was carried out its effect of compressive, tensile, flexural strength. In this project the overall aim is to utilize and evaluate the performance of polypropylene fiber in the concrete. By the utilization of Polypropylene fiber in concrete not only optimum utilization of material is achieved but also the cost reduction is achieved. There also have been several advanced made in the development of fiber reinforced concrete to control cracking and to increase the overall ductility of the material. However, there are now many types of fibers with different materials and geometric properties, but the exact fracture behavior of fiber reinforced Concrete material is not clearly understood. Majorly, synthetic fiber has played a dominant role for a long time in a variety of applications for their high specific strength and modulus. The optimum percentage of polypropylene fiber in the concrete was found out with respect to cube compressive strength, flexural strength and spilt tensile strength at the age of 28days. The specimen was casted for different percentage such as 0.05%, 0.25%, 0.5%, and 0.75 (by volume fraction) by the mass of the concrete. The result of this present investigation indicates by adding 0.5% of polypropylene fiber show maximum compressive and tensile strength.

Key words: Polypropylene fiber, M-Sand

1. INTRODUCTION

Concrete is a tension weak material which often affected by cracks in hardened state. These cracks are developed with relative to time and stresses. These exposures tend to deteriorate the concrete, also with steel corroding. To counteract these cracks, an important method has come existence that is addition of blended fibers. These fibers can help the concrete to become crack formation from developing into macro cracks and causing troubles. By the addition of these fibers, it can act as a bridge between cracks and does not allow the cracks to form quickly. The study proceeded with usage of Polypropylene Fibers in concrete with increasing 0.05% up to 0.75% to total volume of concrete Along with the usage of M-Sand replacement based on literature study. The cubes and cylinders will be casted with varying Polypropylene fibers& M-Sand ratios to obtain the optimizing mix ratio based on which the flexural beam member of sizes 1000mm×300mm×100mm will be casted and 2 point load test was conducted to study the behaviour of Polypropylene & Conventional Concrete are compared. The fibers like Polypropylene fibers shows great performance not only to compression, tension and flexural but also to impact loads. Polypropylene is a type of thermoplastic polymer resin. It is a part of both the average household and is in commercial and industrial application. The chemical designation is C3H6. One of the benefits of using this type of plastic is that it can be useful in numerous applications including as a structural plastic or as a fibers type plastic. Polypropylene fibers (alternatively low volume fractions <0.3%) are used for: secondary temperature shrinkage reinforcement, overlays and pavements, slabs, flooring systems, crash barriers, precast pile shells and shotcrete for tunnel linings, canals and reservoirs. According to the researches, the increase of formability and bending strength are the extra advantages of adding the fibers to the concrete. Adding fibers to concrete greatly increases the toughness of the material. The use of fibers also alters the behavior of the fibers matrix composite after it has cracked, thereby improving its toughness. Fiber volume greater than 2.0 percent normally involves the use of continuous fibers, which are not usually considered for paving applications due to constructability problems.

Volume up to 0.5 percent can be used without major adjustments to the mixture proportions. As volume levels

approach 0.5 percent, air-entraining and water-reducing admixtures are required.

2. LITERATURE REVIEW

Song et al (2004), Investigated the 'strength properties of nylon-and polypropylene-fiber-reinforced concrete'. The strength potential of nylon-fiber-reinforced concrete, at a fiber content of 0.6kg/m3. The compressive and splitting tensile strength and modulus of rupture(MOR) of the nylon fiber concrete improved by 6.3%, 6.7% and 4.3% respectively, over those of the polypropylene fiber concrete. The compressive strength of nylon-fiber reinforcement concrete improved by 12.4% over the non-fibrous control counterpart, followed by the polypropylene fiber reinforced concrete at 5.8%. The shrinkage crack reducing potential of the nylon-fiber in mortar went moderately ahead of that of the polypropylene fiber. Compared to the plain concrete base, the improvement to the PINPB of nylon-fiber, reinforced concrete had an advantage over those to first crack and failure strength, but the advantage narrowed for the polypropylene fiber reinforced concrete.

Noumowe.A,(2005), investigated the mechanical properties and microstructure of high strength concrete containing polypropylene fiber exposed to temperature up to 200˚C. This investigation develops some importance data on the mechanical properties and microstructure of high strength concrete incorporating polypropylene fiber exposed to elevated temperature up to 200˚C. The tests were carried out on 160X320mm and 110X220mm concrete cylinders. Scanning electron microscopy gave clear indication of the fiber melting and supplementary porosity creation. There was a significant difference between the porosity of polypropylene fiber high strength concrete and the reference high strength concrete after exposure at 200˚C. This may result in lower vapor pressure in the polypropylene fiber high strength concrete in the early stage of heat exposure.

3. OBJECTIVES OF THE STUDY

1. To determine the properties of the materials.
2. To examine the workability of the fresh concrete by addition of fiber and M sand.
3. To evaluate the mechanical properties of hardened concrete.
4. To arrive the addition of optimum content of the fiber and fly ash in concrete.
5. To find out the behavior of Beam with and without addition of fibers and M sand.

4. MATERIAL SPECIFICATIONS

Cement: Ordinary Portland cement of 53 Grade conforming to IS 12269-1987, and the cement should be clean, dry and free from impurities

Fiber: Polypropylene fiber has been used which is made from thermoplastic polymer. Polypropylene fiber chips are converted to fibers. It has high working temperature and tensile strength.

S.No	Properties	Obtained values
1	Length	10mm
2	Diameter	40µm
3	Density	900kg/m^3
4	Tensile strength	600-700N/mm^2
5	Aspect ratio	250

Fine aggregate: Locally available river sand conforming to grading zone III of IS: 383-1970 is completely washed. M-Sand was used as fully replacement of fine aggregate. The bulk density of manufactured sand was 1.75kg/m^3, specific gravity and fineness modulus was found to be 2.73 and 4.66, respectively. The percentage of particles passing through various sieve were compared with natural sand and it was found to be similar.

M-Sand: Manufactured sand is a substitute of river for construction purposes sand produced from hard granite stone by crushing. The crushed sand is of cubical shape with

grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm.

Coarse Aggregate: Crushed angular aggregate with maximum grain size of 20 mm and downgraded was used and having bulk density 1.38 kg/m3. The specific gravity is 2.72.

Water: According to IS 3025, Water to be used for mixing and curing should be free from injurious or deleterious materials. Potable water is generally considered satisfactory. In the present investigation, available water within the campus is used for mixing and curing purposes.

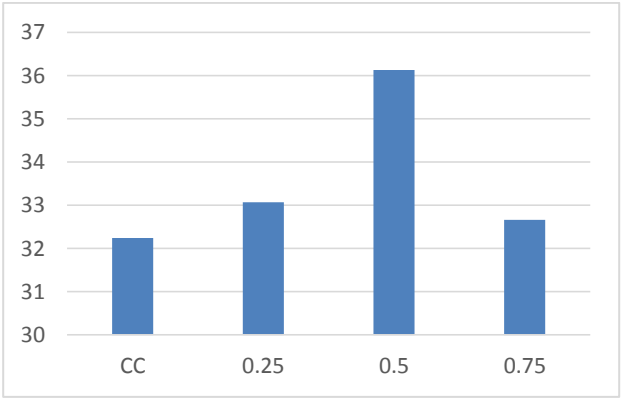
5. CONCRETE MIX PROPORTION

The mixes were designed in accordance with IS 10262-2009 mix design method. Based on the result, the mix proportions M25 was designed. Concrete mix with the W/C ratio of 0.45 was prepared. The details of mix proportion and materials required for 1m^3 of concrete.

6. COMPRESSIVE STRENGTH

Compressive strength of concrete is tested on cube at different percentage of polypropylene fiber content in concrete. The strength of concrete has been tested on cube at 28 days. Compression testing machine is used for testing the compressive strength test on concrete. At the time of testing the cube is taken out of water and dried and then tested keeping the smooth faces in upper and lower part. The strength of concrete is very much dependent up on the hydration reaction. In this experiment, in all cases, i.e. for 0.5 % adding of cement by polypropylene fiber the test results, as shown in Table and show that twenty Eight days compressive. The reduction of the strength increased with increasing percentage of polypropylene fiber after some specific limit (after 0.5%)

S.No	Fiber	Compressive Strength at 28 days (N/mm^2)
1	CC	32.24
2	0.25%	33.07
3	0.5%	36.12
4	0.75%	32.66

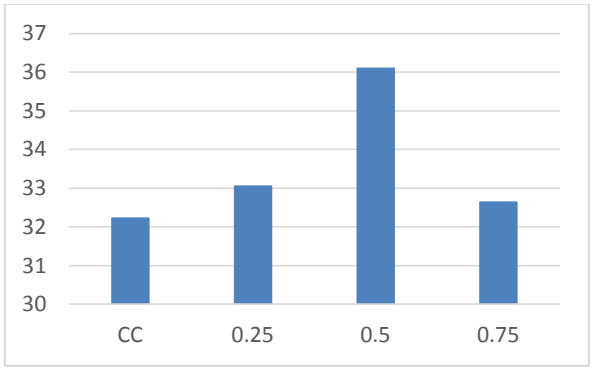


Grade	Cement (kg)	FA (kg)	CA (kg)	Water
M25	437.7	620	1080.2	197
Mix ratio	1	1.4	2.46	0.45

7. SPLIT TENSILE STRENGTH

Split Tensile strength of concrete is tested on cylinders at different percentage of polypropylene fiber Content in concrete. The strength of concrete has been tested on cylinder at 28 days. Compression testing machine is used for testing the Split Tensile strength test on concrete along with two wooden boards. At the time of testing the cylinder taken out of water and dried and then tested.

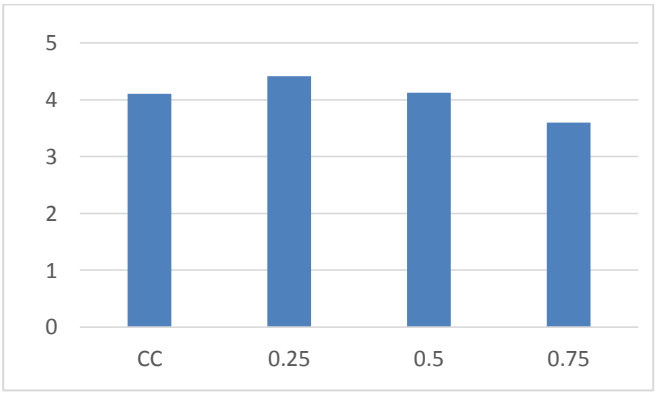
S.NO	Fiber %	Spilt tensile strength at 28days(N/mm^2)
1	CC	2.153
2	0.25%	3.860
3	0.5%	4.485
4	0.75%	4.312



8. FLEXURAL STRENGTH

Flexural strength of concrete is tested on prism at different percentage of polypropylene fiber content in concrete. The strength of concrete has been tested on prism at 7 days. Testing machine is used for testing the flexural strength test on concrete along the two point load.

S.NO	Fiber	Flexural strength at 28days(N/mm^2)
1	CC	4.105
2	0.25%	4.410
3	0.5%	4.120
4	0.75%	3.60



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