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STUDY THE EFFECT OF POLYPROPYLENE FIBER IN CONCRETE

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Abstract - *India leading developing country in world. In future high strength high performance concrete required for construction work .Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. The character of fiber-reinforced concrete changes with varying concretes fiber materials, geometries, distribution, orientation, and densities. Polypropylene fiber is a light weight synthetic fiber. It prevents crack formation and provides reinforcement to the concrete structure. In this project work polypropylene fibers (Blended type) of different percentage (0.5%, 1%, 1.5%, and 2%) added in concrete. Tests on workability, compressive strength, flexural resistance, split tensile strength and modulus of elasticity were conducted on specimens.*

Key Words: Polypropylene Fiber, workability, compressive strength, flexural resistance, split tensile strengths etc

1. INTRODUCTION

The fiber dispersion into concrete is one of the technique to improve the building properties of concrete. Polypropylene fibers are synthetic fibers obtained as a by-product from textile industry. These are available in different aspect ratios and are cheap in cost. Polypropylene fibers are characterized by low specific gravity and low cost. Its use enables reliable and effective utilization of intrinsic tensile and flexural strength of the material along with significant reduction of plastic shrinkage cracking and minimizing of thermal cracking. It provides reinforcement and protects damage of concrete structure and prevents spalling in case of fire. The fibers are manufactured either by the pulling wire procedure with circular cross section or by extruding the plastic film with rectangular cross-section. They appear either as fibrillated bundles, mono filament. The fibrillated polypropylene fibers are formed by expansion of a plastic film, which is separated into strips and then slit. The fiber bundles are cut into specified lengths and fibrillated. In monofilament fibers, the addition of buttons at the ends of the fiber increases the pull out load.

Cracks play an important role as they change concrete structures into permeable elements and consequently with a high risk of corrosion. Cracks not only reduce the quality of concrete and make it aesthetically unacceptable but also make structures out of service. If these cracks do not exceed a certain width, they are neither harmful to a structure nor to its serviceability. Therefore, it is important to reduce the crack width and this can be achieved by adding polypropylene fibers to concrete. Thus addition of fibers in cement concrete matrix bridges these cracks and restrains them from further opening. In order to achieve more deflection in the beam, additional forces and energies are required to pull out or fracture the fibers. This process, apart from preserving the integrity of concrete, improves the load-carrying capacity of structural member beyond cracking.

In this project polypropylene fibers of blended (24mm, 40mm, 55mm) type is used. The project deals with the effects of addition of various proportions of polypropylene fiber on the properties of concrete in fresh and hardened state. An experimental program was carried out to explore its effects on workability, compressive, flexural, split tensile strength and modulus of elasticity of concrete.

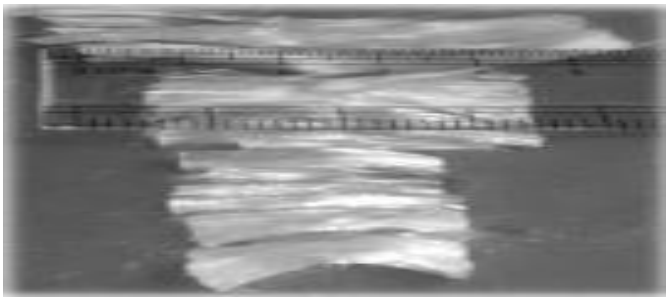

Fig-1: Blended (24mm, 40mm, 55mm)Polypropylene fiber

2. LITERATURE SURVEY

[1] Kolli.Ramujee (2013)

The interest in the use of fibers for the reinforcement of composites has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fibers. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been presented. The compressive strength, splitting tensile strength of concrete samples made with different fibers amounts varies from 0%, 0.5%,1% 1.5% and 2.0% were studied. The samples with added Polypropylene fibers of 1.5 % showed better results in comparison with the others.

[2] Milind V. Mohod (2015)

This paper presents an experimental study on performance of polypropylene fiber reinforced concrete. In this study

deals with the effects of addition of various proportions of polypropylene fibers on the properties of High strength concrete (M30and M40 mixes). An experimental program was carried out to explore its effects on compressive, tensile, flexural strength under different curing condition. The main aim of the investigation program is to study the effect of Polypropylene fiber mix by varying content such as 0% ,0.5%,1%,1.5% & 2% and finding the optimum Polypropylene fiber content. A notable increase in the compressive, tensile and flexural strength was observed. However, further investigations were highly recommended and should be carried out to understand more mechanical properties of fiber reinforced concrete.

3. OBJECTIVE OF THE WORK

The objective is to study the effect of polypropylene fiber in concrete. To conduct a comparative study on fiber in concrete and conventional concrete.

4. METHODOLOGY

The methodology of the work consist of
1)Identifying the specification of material to be selected.
2)Collection of materials.
3)Identifying the properties of collected materials. Various tests were conducted on cement, fine aggregate, coarse aggregate.
4)Selection of concrete grade.
5)Preparation of mix design of M30 grade concrete.
6)Cubes, cylinder and beams were casted with control mix using natural aggregate.
7)Preparation of test specimen by adding 0.5, 1,1.5and2% of polypropylene fibres in concrete.
8)Workability tests,compressive strength, tensile strength, flexural strength & modulus of elasticity of concrete were conducted.
9)Optimum percentage of fibre addition in concrete was determined.

5. MATERIAL TEST

Table-1: Material Testing Results

Test	Material	Equipment used	Values obtained
Specific gravity	Ramco cement (OPC 43 grade)	Le Chatelier flask	3.2
Specific gravity	Fine aggregate	Pycnometer	2.61
Specific gravity	Coarse aggregate	Wire basket	2.77
Water absorption	Coarse aggregate	Vessel	0.6%
Workability	M30 Concrete	Slump cone apparatus	100mm

6. MIX DESIGN

Table-2: M30 Mix Proportioning

Cement (Kg/m3)	438
Fine aggregate (Kg/m3)	695
Coarse aggregate (Kg/m3)	1107
Water (li/m3)	197
Water cement ratio	0.45

Mix ratio 1 : 1.59 : 2.52 : 0.45

7. EXPERIMENTAL INVESTIGATION

7.1 Test Procedure

Concrete test specimens consist of 150x150x150mm cubes, Cylinders of 150mm diameter and 300mm height and 100x100x500 beams. Concrete cube specimens were tested at 7 and 28 days to obtain the compressive strength of concrete. Cylindrical specimens were tested at 28 day to obtain the split tensile strength and modulus of elasticity of concrete. Beam specimens were tested at 28 day to obtain the flexural strength of concrete.

7.2 Test on fresh concrete

Workability is one of the physical parameters of concrete which affects the strength and durability as well as the cost of labour and appearance of the finished product. Concrete is said to be workable when it is easily placed and compacted homogeneously i.e. without bleeding or Segregation. The workability of concrete is measured by compaction factor test and slump test.

7.3 Test on hardened concrete

Various tests on hardened concrete is done to ensure the design strength of concrete and quality of concrete construction is achieved. It includes compressive strength test, flexural tensile strength test, split tensile strength test and modulus of elasticity.

8. EXPERIMENTAL RESULTS AND DISCUSSION

8.1 Optimization of polypropylene fiber in concrete

In this section polypropylene fiber (blended type- 24mm, 40mm, 55mm) of different percentage added in concrete.

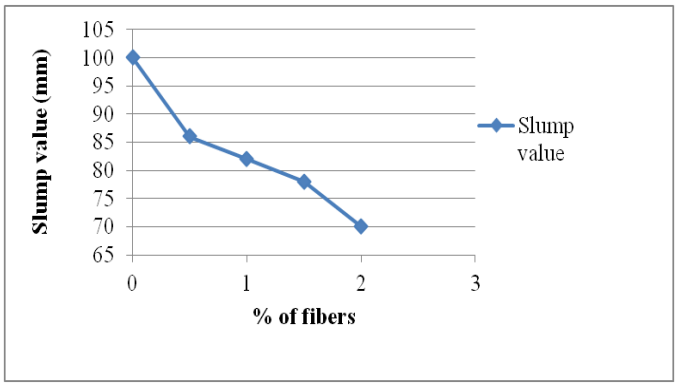

Fig-2: Slump value

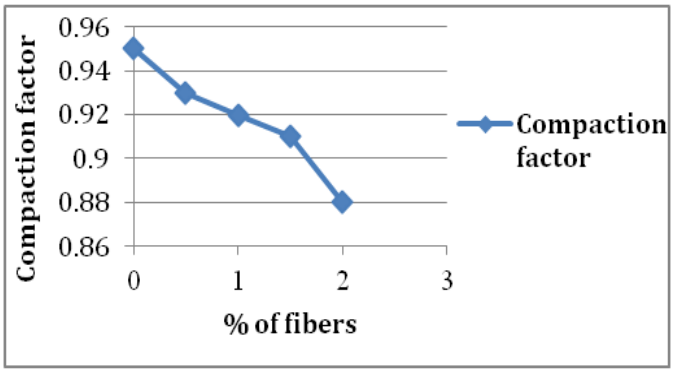

Fig-3: Compaction factor value

Workability decreases due to more addition of fibers, there is increases in amount of entrapped air voids due to the presence of fibers and therefore increase in air content attributes in reducing workability.

Table-3: Compressive strength of the specimens

S.No	% of fibers	7days Compressive strength (N/mm²)	28days compressive strength (N/mm²)
1	0	25.20	38.50
2	0.5	27.90	42.14
3	1	28.83	44.61
4	1.5	29.91	46.00
5	2	27.12	41.72

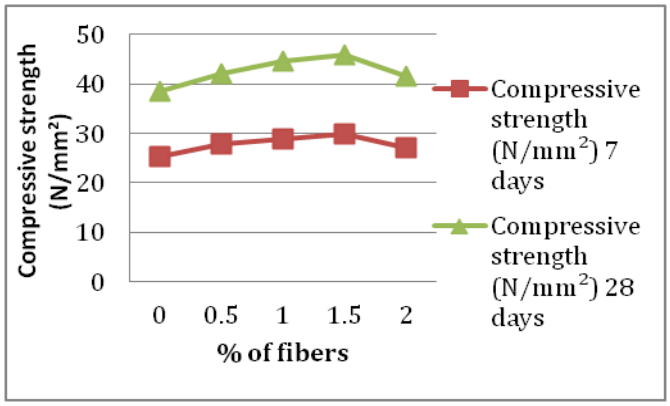

Fig-4: Compressive strength of concrete

Compressive strength increases for all dosages of fibers due to confinement provided by fiber increases bonding characteristics of concrete.

Table 4: Split tensile strength of the specimens

S.No	% of fibers	28days Split tensile strength (N/mm²)
1	0	3.42
2	0.5	3.86
3	1	3.98
4	1.5	4.38
5	2	3.66

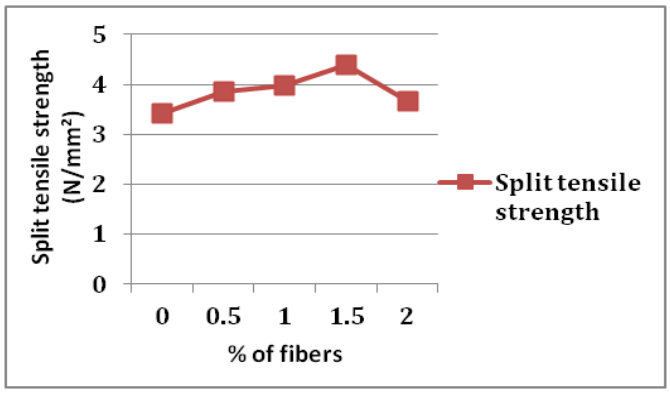

Fig-5: Tensile strength of concrete

Failure patterns of splitting tensile test indicate that specimens after first cracking do not separate unlike the concrete failure. Large damage zone is produced due to closely spaced micro cracks surrounding a splitting plane.Fiber bridging mechanism is responsible for such enhanced ductile failure pattern.

Table 5: Flexural strength of the specimens

S.No	% of fibers	28days Flexural strength (N/mm^2)
1	0	4.34
2	0.5	5.21
3	1	5.48
4	1.5	5.71
5	2	4.82

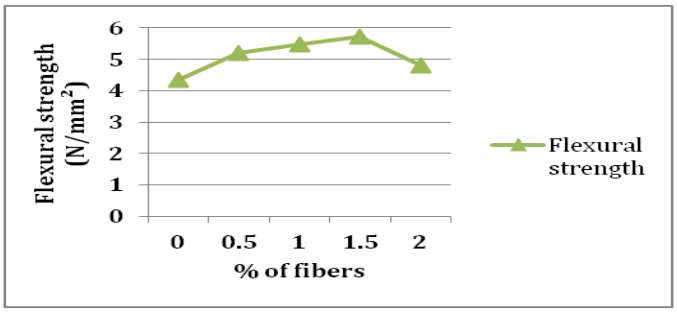

Fig-6: Flexural strength of concrete

The enhancement in flexural strength is achieved due to improvement in mechanical bond between the cement paste and fiber. As amount of fiber increases in mix, it greatly helps to reduce widening of cracks more effectively.

Table 6: Modulus of elasticity of the specimens

S.No	% of fibers	Young's Modulus (GPa)
1	0	36.2
2	0.5	38.4
3	1	39.8
4	1.5	40.6
5	2	36.8

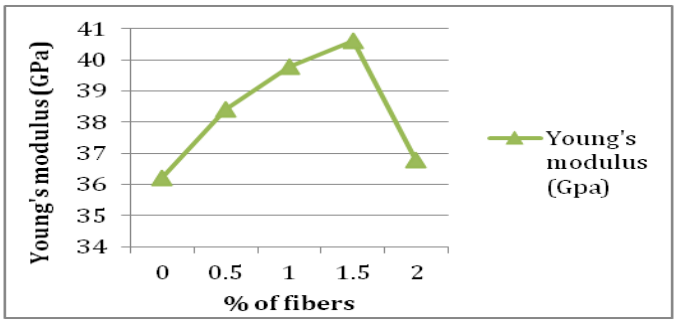

Fig-7: Modulus of elasticity

1.5% fiber in concrete yields maximum strength.

9. CONCLUSIONS

Compressive strength of 1.5% of blended length polypropylene fiber reinforced concrete has found to be 17% increase in strength, when compared to that of Conventional concrete. Strength enhancement in split tensile strength is 22%, flexural strength is 24%and modulus of elasticity is 11% compared to that of Conventional concrete. The experimental studies proved to be the best method or way in providing strong and durable concrete. It is observed 1.5% fiber in concrete yields max. strength.

10. SCOPE OF FUTURE STUDY

Investigation on the flexural and shear crack pattern of fiber reinforced concrete. Comparative study on blended type, micro and macro length polypropylene fibers.

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