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# Experimental Investigation of Strength of Concrete Using Polypropylene Fiber

Mrs Varsha Takalkar

Lecturer, Department of Civil Engineering, Pimpri Chinchwad Polytechnic College, Nigdi, Pune, India

**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 compressive strength were conducted on specimens.Reinforcements offer a number of advantages such as corrosion resistance, non-magnetic properties, high tensile strength, lightweight and ease of handling.

## I. INTRODUCTION

Concrete is strong in compression, as the aggregate efficiently carries the compression load. However, it is weak in tension as the cement holding the aggregate in place can crack, allowing the structure to fail. Reinforced concrete adds steel reinforcing bars, steel fibers, polymer fibers, glass fibers, or plastic fibers to carry tensile loads. Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. While concrete brittleness to a large extent can be compensated with steel reinforcements on a structural scale in Fiber Reinforced Concrete resulting in improved structural durability, safety as well as improved performance in infrastructure sustainability The polymer fiber which gives the best results after its addition to concrete is polypropylene fiber. Polypropylene fibers are adapted version to modern technology of the use of natural micro equipment, straw and animal hair, which is as old as humanity . Polypropylene fibers are widely used in concrete, plaster, mortar, and shotcrete applications. The addition of fibers to concrete considerably improve its structural characteristics such as static flexural strength, impact strength, tensile strength, ductility and flexural toughness. Polypropylene fibers are made up of 100% polypropylene, and they do not require additional labor, being easy to apply, improving the quality of concrete and plaster and not decay. A polypropylene fiber forms a three- dimensional micro network of reinforcement in concrete, improving some of the mechanical properties of concrete. These fibers intended to improve the mixture to be the lightest micro-reinforcement system, compared with alternative reinforcement systems, such as iron mesh, metal fiber and poultry net. Its weight per square meter is in the range of 90 g to 200 g. Therefore, it doesn't bring dead reinforcement weight to the structure, as in the case of other reinforcement systems. Polypropylene fibers are produced from 100% homo polypropylene, in two types, including F and M type. F fibrillated fibers represent multifilament fibers. M type fibers are very fine and can provide good results for indoor screeds, as they are not visible on screed surface. F type fibers are better suited for durable and tough concrete in industrial floor applications and heavy duty floors. Density of polypropylene fiber raw material is 0.9 kg/l so the recommended amount of fiber should be at least 0.9 kg/l. These rates range between 0.05% and 2% and even go up to 5% . Polypropylene fibers do not absorb water, therefore they do not affect water/cement ratio of concrete and mortars so they do not require a new mixture design or a change in mixing ratio.

## II. RELATED WORK

The use of fibers to reinforce concrete materials is a well-known concept. It has been practiced since ancient times, with straw mixed into mud bricks and horsehair in mortars. Straw was used to reinforce sun-baked bricks and horsehair was used to reinforce masonry mortar and plaster (ACI 544). The concept of fiber reinforcement of cement based materials using asbestos started with the invention of the Hats chek process in 1898. Later, glass fibers were proposed as reinforcement of cement paste and mortar (Biryukovich et al., 1965). In modern times, the choice of fibers can vary from synthetic organic materials such as polypropylene or carbon, synthetic inorganic such as steel or glass, natural organic such as cellulose or sisal to natural inorganic asbestos.Using fibers in concrete matrices addresses the issue of cracking in cement based materials. Concrete is considered to be a relatively brittle material with a low tensile strength



compared to its compressive strength. When subjected to tensile stresses, unreinforced concrete will crack and fail. The use of fibers modifies properties of concrete both in plastic and hardened stages and results in a more durable concrete. Fiber-reinforced concrete (FRC) has become an important material in the construction of buildings and other structures. Reinforcing fiber's ability to support load after cracking (Figure 3.1) and to reduce the brittleness of concrete has positive effects on the structural performance of concrete. This section describes the general role of fibers in improving concrete performance and the involvement of polypropylene fibers, in particular. The properties of polypropylene material and the production process of the fiber are also presented. Finally, studies incorporating polypropylene fiber in concrete applications are reviewed.

### III.METHODOLOGY

The materials used in this study were cement, sand, aggregates (both fine and coarse) and water. The mixing procedures were divided into three stages. In the first stage, all the binders (cement) were weighted accordingly and mixed by hand until all the constituents mixed uniformly. This was to make sure that all the binders were mixed thoroughly to produce a homogenous mix. The second stage involves mixing the binders with the aggregates for about 5 minutes. At the final stage, measured water was added into the concrete mix. This step was crucially important to make sure that the water was distributed evenly so that the concrete will have similar water-binder ratios for every specimen. After that, the concrete was then poured into the mould. In this study, the specimens were cured by placing in water for about 7 and 28 days. The specimens were cured until they were ready to be tested at the designated ages. The test specimens shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar material for 24 hours ± ½ hour from the time of adding the water to the other ingredients.

### IV.SCOPE

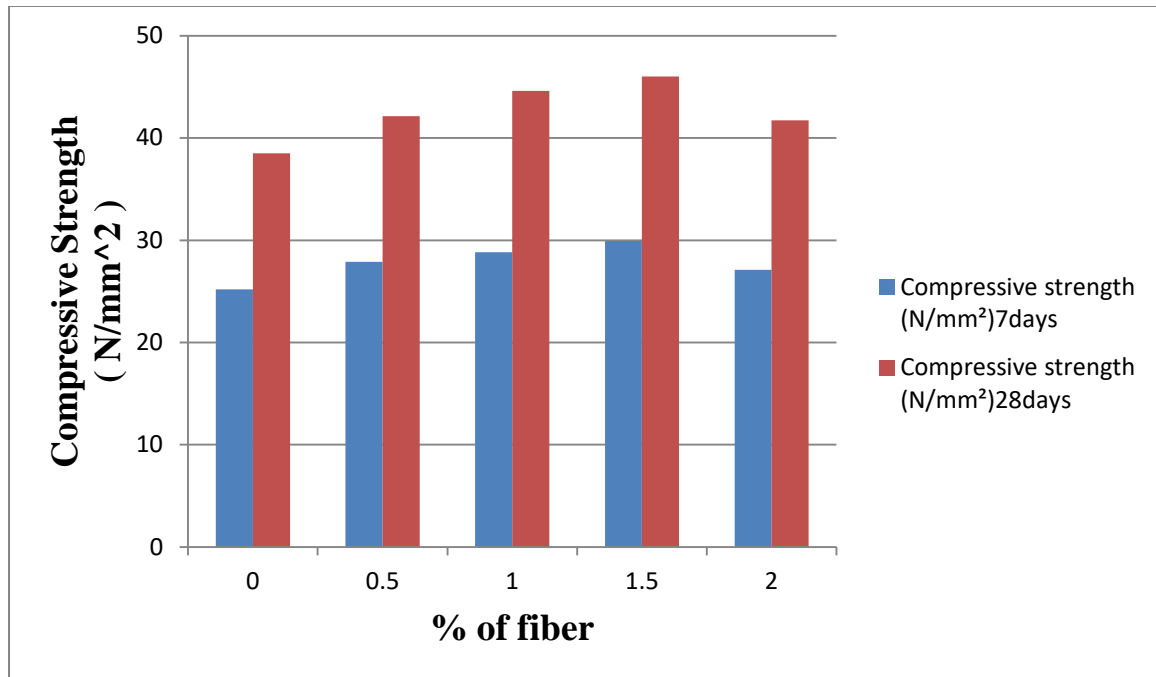
The adequate and economic application of any material to field problems demands extensive knowledge of its performance under different loads. An extensive application of FRC can be seen in both industrial structures and civil engineering fields. Therefore, the thorough knowledge of the properties of FRC is quite essential. A lot of work has been carried out on FRC using low strength concrete like M20, M30, and M40 etc. A little work has been done on FRC high strength concrete. Here in this work an attempt has been made to bring out certain characteristics of high strength FRC using M30, grades of concrete. The characteristics studied are compressive strength (cube strength)

### V. RESULTS

In this section, the main concern is to study the compressive strength of concrete containing various percentages of hair fibers in combination. Control specimens are concrete with 100% cement which is compared with the strength performance of concrete containing 0.5% , 1.0%, 1.5% and 2.0% of Polypropylene Fibers . The compressive strength of concrete is regarded as the primary quality of good concrete. For testing of compressive strength cubes of size 150×150×150 mm were cast for M30 grade of concrete. After curing, the cubes were surface dried and placed on compression testing machine centrally over the bottom plate. Loading was done uniformly and continued till the failure occurred. Cubes with the size of 150mm X 150 mm X 150 mm were tested at the ages of 7 and 28 days. The results of the compressive strength test are shown in Table. Where each value from the results of the cubes. From the graph, specimens are concrete with 100% cement which is compared containing 0.5% and 1.0% Polypropylene Fibers, (normal mix , 0.5% and 1.0% Polypropylene Fibers) has been observed as an optimal strength than other proportions at 7 and 28 days. Compressive strength increases for all dosages of fibers due to confinement provided by fiber increases bonding characteristics of concrete.

S.No	% of fibers	7days Compressive strength (N/mm <sup>2</sup> )	28days compressive strength (N/mm <sup>2</sup> )
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

Compressive strength of the specimens



Compressive strength of concrete

The graph represents the compressive strength of concrete cube with 0-2% of Fibre to weight of cement with 0% as standard concrete. With the addition of fibre the compressive strength of concrete cube increased by 2.7% at 0.5 % fibre content, 3.63 % at 1 % fibre content, 4.71% at 1.5 % fibre content and 1.92 % at 2 % in 7 days .The optimum dosage for maximum fibre content was 1.5 % giving compressive strength of 29.91 with 4.71 increase from control specimen. The minimum compressive strength was 27.12 with 1.92 % increase from control specimen.the compressive strength of concrete cube increased by 3.64% at 0.5 % fibre content, 6.11 % at 1 % fibre content, 7.5% at 1.5 % fibre content and 3.22 % at 2 % in 28 days .The optimum dosage for maximum fibre content was 1.5 % giving compressive strength of 46.00 with 7.5 increase from control specimen. The minimum compressive strength was 41.72 with 3.22 % increase from control specimen.

## VI. CONCLUSION AND FUTURE WORK

Fiber reinforced concrete and high strength concrete are being widely used as important constructional materials due to their excellent properties. An extensive knowledge of the properties is necessary in order to make best and economic use of the material. In this context, present experimental investigation aims to find the different strength characteristics of high strength . (M30)The present work leaves a wide scope for future investigators to explore many other aspects of Polypropylene Fibers reinforced concrete composites.

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