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MECHANICAL BEHAVIOUR OF REINFORCED CEMENT CONCRETE WITH ADDITION OF NYLON FIBRE

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Abstract - The purpose of this research is to find the suitability of Nylon fibre with Reinforced Cement Concrete M35 grade. The experimental studies were divided into preliminary test were conducted to find the properties of materials used in concrete to carry out the Mix design. A fresh concrete test was made to study the workability properties of Nylon fibre with Reinforced cement concrete and Conventional Concrete. Hardened concrete test on cubes, prisms and cylinder were made to study the strength of the concrete made of Nylon fibre with Reinforced cement concrete and Conventional Concrete. The Mix Design carried out using IS 10262-2009.The Nylon fibre has been added in different proportion(1%,2%,3%) .Hardened concrete properties such as Compressive Strength, Split tensile Strength and Flexural Strength of the concrete on 7,14 and 28 days has been achieved. About 28.57% increase in Compressive Strength is attained when Nylon Fibre is added with 3% Mix proportion. About 22% increase in Split Tensile Strength is attained when Nylon Fibre is added with 3% Mix proportion. About 23.99% increase in Flexural Strength is attained when Nylon Fibre is added with 3% mix proportion.

Key words: Nylon Fibre and Sand, Portland cement, Consistency, Setting time, Mechanical properties.

1. INTRODUCTION

Concrete an extraordinary and key structural material in human history. It is no doubt that with the development of human civilization, concrete will continue to be a dominant construction material in the future Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers which are uniformly distributed and were randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers of which lend varying properties to the concrete. Character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities.

In the 1900s, asbestos fibers used in concrete. In the 1950s, the concept of a composite materials and fiber-reinforced concrete was one of the topics of interest. The health risks associated and asbestos were discovered, there was need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic (such as polypropylene) fibers were used into the concrete. Research into new fiber-reinforced concretes continues today.

Fibers in concrete was used to control cracking due to plastic shrinkage and to drying shrinkage. They reduce the permeability of concrete and thus reduce bleeding of water. Some of fibers produce greater impact, abrasion, and shatter resistance in concrete.

2. MATERIALS USED

2.1 Cement

The Cement used in Project Work is the Portland Pozzolana Cement.

Fig -1: Portland Pozzolana Cement

2.2 Sand

In this study, Grade I of particle size less than 2 mm and greater than 1mm for testing the strength of mortar was chosen. The zone of the fine aggregate is based on the percentage of passing through the IS sieves. In this project work is zone II fine aggregates were used.

2.3 Nylon Fibre

Nylon fibers are used in many applications, including clothes fabrics, package paper, carpets, musical strings, pipes, tents, and rope. These two types of fibers can complement each other and further improve the engineering properties of concrete. In this project work nylon 6 fiber is used and it has a length 10mm and diameter 10 micron.

Fig -2: Nylon Fibre

2.4 Water

A water available in the concrete laboratory was used in preparation of the mortar. The qualities of water samples are uniform and potable. The pH of water value lies between 6 to 8 and the water is free from organic matter and the solid content should be within permissible limit.

2.5 Reinforcement

Steel is an alloy of iron and carbon. In that carbon by adding small percentage of manganese, sulphur, phosphorus, chrome nickel and copper special properties can be imparted to iron and variety of steels can be produced. Fe500 grade steel rods are used during the casting of beams. The diameter of main rod 12mm. Stirrups used in beams is 8mm in diameter.

3. PROPERTIES OF MATERIALS

Table -1: Properties of Cement

S.NO.	Property	Result
1	Initial setting time	42 minutes
2	Final setting time	450 minutes
3	Consistency	31%
4	Specific Gravity	3.15

Table -2: Properties of Nylon Fibre

NO.	Property	Value
1	Length	10mm
2	Diameter	10Micron
3	Specific Gravity	1.13
4	Colour	White

Table -3 Physical properties of Sand

S.NO.	Property	Result
1	Specific Gravity	2.6
2	Fineness Modulus	2.68

Table –4: Physical properties of Coarse Aggregate

S.NO.	Property	Result
1	Specific Gravity	2.7
2	Fineness Modulus	7.16

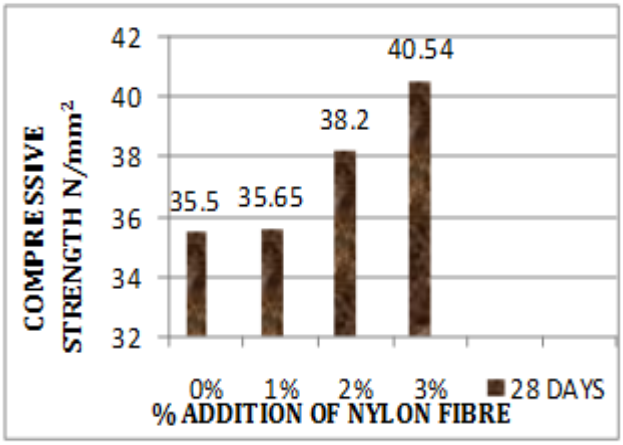
4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test of Concrete cube

The compressive strength of the concrete was tested under 28 days curing period and their values are shown in following Table 5

Table -5: Compressive Strength of Concrete

% Of Addition Of Nylon Fiber	Compressive Strength (f_{ck}) N/mm²
	28th day
0%	35.50
1%	35.65
2%	38.20
3%	40.54



In 28th day curing the Compressive Strength value for the conventional mix was 35.50 N/mm2 , for 1% addition of Nylon Fibre was 35.65 N/mm2 and beyond this percentage of addition of Nylon Fibre, the strength was gradually increasing. Strength increment is 28.57% more than the nominal mix when Nylon Fibre is added upto 3%.

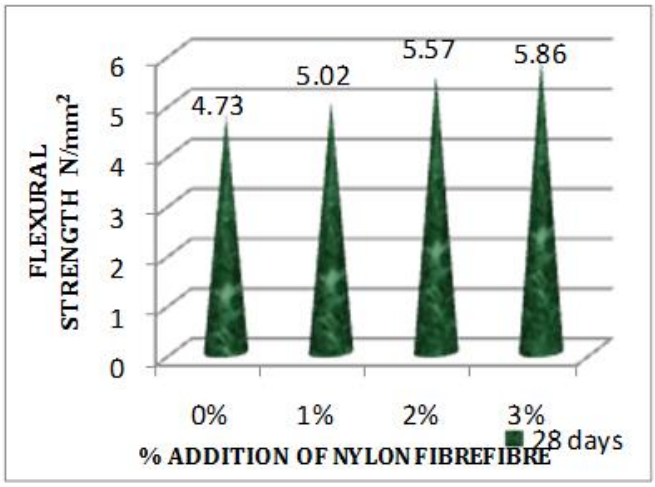
Hence the optimum amount of Nylon Fibre is 3%.The difference in the strength development of the mixtures can be attributed to pozzolanic reaction. Strength enhancement of SiO2 can be attributed to reduction in the content of Ca(OH)2 which has not any cementing property and production of hydrated calcium silicate (CSH) that plays a vital role in mechanical properties of concrete

4.2 FLEXURAL STRENGTH OF CONCRETE

The Flexural strength of the concrete was tested under 28 days curing period and their values are shown in following Table 6

Table -6: Flexural Strength of Concrete

% Of Addition Of Nylon Fiber	Flexural Strength (f_{ck}) N/mm²
	28th day
0%	4.73
1%	5.02
2%	5.57
3%	5.86



In 28th day curing the Flexural strength value for the conventional mix was 4.73 N/mm2, for 1% addition of Nylon Fibre was 5.02N/mm2 and beyond this percentage of addition of Nylon Fibre, the strength was gradually increasing. Strength increment is 23.8% more than the nominal mix when Nylon Fibre is added upto 3%.

Hence the optimum amount of Nylon Fibre is 3%.The difference in the strength development of the mixtures can be attributed to pozzolanic reaction. Strength enhancement of SiO2 can be attributed to reduction in the content of Ca(OH)2 which has not any cementing property and production of hydrated calcium silicate (CSH) that plays a vital role in mechanical properties of concrete role in mechanical properties of concrete

5. CONCLUSIONS

Based on the test results and discussions, the following conclusions could be drawn for the current study as follows:

This project work primarily focused on studying the properties of the materials used, adopting Proper Mix proportions, Preparation of Concrete Specimens, Curing and Testing the Hardened Concrete.

On performing the various tests its Mechanical properties, are studied and the following conclusions are arrived.

About 28.57% increase in Compressive Strength is attained when Nylon Fibre is added with 3% mix proportion.

About 23.99% increase in Flexural Strength is attained when Nylon Fibre is added with 3% mix proportion.

Hence it is concluded that the Optimum amount of Nylon Fibre is 3% which shows improved Mechanical Strength.

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