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EXPERIMENTAL INVESTIGATION ON NYLON FIBER REINFORCED CONCRETE

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ABSTRACT:

This project deals with experimentally on study of nylon fiber concrete using M25 grade. Nylon was the first truly synthetic fiber to be commercialized. All nylon absorbs moisture depends on temperature, crystalline & humidity. It provides secondary reinforcement that is always positioned in compliance with building codes. Savings time and money be eliminating the purchase, storage handling, cutting & placing of wire mesh. Allows concrete to reach its designed strength and integrity without the used for welded wire .It inhibits plastic shrinkage. Compatible with all other admixtures, surface treatments and finally finishes like regular concrete. In the designed concrete the sand was admixture with 2%, 4%, 6% of nylon fiber. The mechanical properties such as compressive strength, splitting tensile strength, flexural strength were tested for conventional concrete.

Key words

Cement, Fine aggregate, Coarse aggregate, Nylon fiber, Minimize the cracks.

1. INTRODUCTION

Fiber reinforced concrete (FRC) is a composite material consisting of cement, sand, coarse aggregate, water and fibers. In this composite material, short discrete fibers are randomly distributed throughout the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of equal cost. Due to this benefit, the use of FRC has steadily increased during the last two decades and its current field of application includes: airport and highway pavements, earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays, hydraulic structures, rock-slope stabilization, etc.

Extensive research work on FRC has established that addition of various types of fibers such as metallic and non-metallic fiber like (steel), glass, synthetic, and carbon, in plain concrete improves strength, toughness, ductility, post-cracking resistance, etc. cementious materials are generally quite brittle, with relatively low strength and strain capacity under tension. Hence a hand-laid steel bar reinforcement is usually necessary to increase tensile strength. For low reinforcement levels, the partial or even complete replacement of this conventional reinforcement by fibers is an advantageous alternative. Fibers may also be applied to control the detrimental effects of shrinkage.

A significant reduction in crack width and crack spacing is possible, especially at early ages. They possess a high tensile strength and a high elastic modulus these are available at relatively low costs. The high modulus, which is much higher than the one of concrete or cement paste prevents the Fiber from stretching or cross contraction upon load, which hence leads to a good Fiber–matrix bond and smaller crack widths.

It is obvious that the behavior of HFRC depends on the orientations, distributions, aspect ratios, geometrical shapes and mechanical properties of Fibers in concrete mixtures. The orientations and distributions of Fiber affect the properties of FRC such as toughness, strength, ductility and crack width

2.MATERIAL PROPERTIES

MATERIAL USED

2.1.Cement
2.2.Coarse aggregate
2.3.Fine aggregate
2.4.Nylon fiber
2.5. Water

2.1. CEMENT

Locally available Ordinary portland cement (OPC) of 53grade has been used physical properties are mentioned table in below.

2.2. COARSE AGGREGATE

Locally available crushed stone aggregate are used which have the size of 20mm used for the project. The properties of coarse aggregate are tabulated below (TABLE 2) compared to demolished concrete aggregate.

2.3. FINE AGGREGATE

Sand was collected from nearby river zone-III is used as affine aggregate is passed through the sieve of 4.75mm. IS 383 (1970) is followed for fine aggregate. The various properties of sand are tabulated in table (3).

2.4. NYLON FIBER

Nylon is generic name that identifies a family of polymers. Nylon fibers are imparted by the base polymer type, addition of different levels of additive, manufacturing condition and fiber dimensions. currently only two types of nylon fiber are marketed for concrete . Nylon is heat stable, hydrophilic, relatively inert and resistance to a wide variety of materials. Nylon is particularly effective imparting impact resistance and flexural toughness and sustaining and increasing the load carrying capacity of concrete following first crack.

Table (1) PROPERTIES OF NYLON FIBER

USE	**1/BAG YARD CONCRETE**
MateriaL	100% virgin fiber
Tensile strength	130-140ksi
Modulus (young's)	750ksi
Melt point	435 F (225 C)
Chemical resistance	Good
Alkali resistance	Excellent
Acids &salts resistance	Good
Electrical conductivity	Low
Thermal conductivity	Low
Ultra violent resistance	Excellent
Specific gravity	1.16
Fiber length	¾"
Form	Monofilament
Color	White
Ultra violent resistance	Excellent

2.5. WATER

Water cement ratio (w/c) of 0.45 was used in the preparing of concrete and for this purpose portable water used for mixing and curing purpose.

3. EXPERIMENTAL METHODOLOGY

The concrete mix design was done in accordance IS: 10262 (1982). In this project M25 grade are used the mix ratio is 1:1:2.2. By using this proportion value the volume of cement , fine aggregate, and coarse aggregate are estimated. The Ordinary Portland cement (OPC 53 GRADE),Good stone aggregate and natural sand of Zone III was used as coarse aggregate and fine aggregate. For this study cubes (150×150×150mm),Cylinder (150mm dia & 300 mm height) and beam (100×100×500mm) were casted by replacement of fine aggregate by Nylon fiber (2%,4%,6%) .Then further tested are conducted such as workability then it will be casted.

4. CURING OF CONCRETE

Casting of concrete after the completion of 24 hours mould will be removed then cured by using portable water. The specimen is fully immersed in portable water for specific age 7,14, 28, days. After the completion of curing it will be tested.

5 .TESTING OF HARDENED CONCRETE

1. Compressive strength test.
2. Split tensile strength test.
3. Flexural strength test.

6. RESULT AND DISCUSSION

1. THE COMPRESSIVE STRENGTH

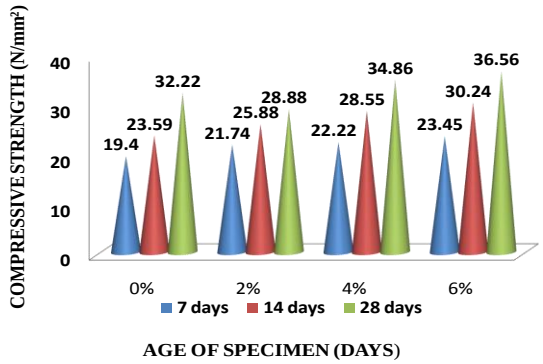
The compressive strength is determined by dividing the maximum of failure load of the specimen during the test by the cross sectional area of the specimen. The normal concrete and the percentage of replacements in special concrete are crushed at different days (7, 14, 28 days) are show in table & graph details.

Compressive strength = $\frac{P}{A}$ (N/mm^2)

Table1. Compressive strength test

S.NO	MIX	Avg. compressive strength (N/mm^2)		
		7 days	14 days	28 days
1	0%	19.40	23.59	32.22
2	2%	21.74	25.88	33.88
3	4%	22.22	28.55	34.86
4	6%	24.45	30.24	36.56

CHART (1) COMPRESSIVE STRENGTH



2.SPLIT TENSILE STRENGTH

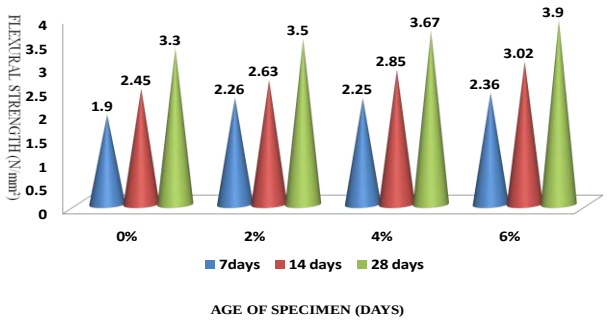
A measure of the ability to resist a force that tends to pull it part. It is expressed as the minimum tensile stress needed to split the material apart.

Split tensile strength = $\frac{2P}{\pi DL}$ (N/mm^2)

Table2. Split tensile strength

S.NO	MIX	Avg. split strength (N/mm^2)		
		7 days	14 days	28 days
1	0%	1.90	2.45	3.3
2	2%	2.26	2.63	3.5
3	4%	2.25	2.88	3.67
4	6%	2.36	3.02	3.9

CHART (2) SPLIT TENSILE STRENGTH



3.FLEXURAL STRENGTH

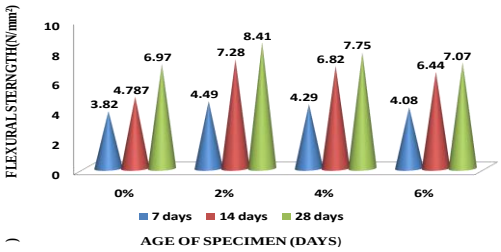
The flexural strength is stress at failure in bending. Flexural strength ,also know as modulus of rupture, or bend strength, or transverse rupture is a materials property , defined as the stress in material just before it yields flexural test.

Flexural strength = $\frac{3Pa}{bd^2}$ (N/mm^2)

Table 3. FLEXURAL STRENGTH

S.NO	MIX	Avg. flexural strength (N/mm^2)		
		7days	14 days	28 days
1	0%	3.82	4.78	6.97
2	2%	4.49	7.28	8.41
3	4%	4.297	6.82	.75
4	6%	4.08	6.44	7.07

CHART (3) FLEXURAL STRENGTH



7.CONCLUSION

The following conclusion can be drawn from the results obtained from the experimental investigations.

The specimen cast with 2% Nylon fiber replacement by fine aggregate gives better compressive strength of 1.1% increased, split tensile strength of 1.06% increased, and flexural strength of 1.29%. when to compare to conventional concrete.

The specimen cast with 4% Nylon fiber replacement by fine aggregate gives better compressive strength of 1.18% increased, split tensile strength of 1.11% increased, and flexural strength of 1.22%. when to compare to conventional concrete.

The specimen cast with 6% Nylon fiber replacement by fine aggregate gives better compressive strength of 1.13% increased, split tensile strength of 1.18% increased, and flexural strength of 1.13%. when to compare to conventional concrete.

Comparison to three different percentages of replacements, the strength will not reduce when compare to conventional concrete.

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