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An Investigation on Squander Nylon Fiber in Concrete

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Abstract - *Concrete is a resourceful material for civil engineering construction. It has many properties such as compressive strength, durability and fire resistance. Concrete is made up of aggregates, cement, water and various admixtures. This article is about the study of waste fishing nets. Normally fish nets (made up of plastics) are adding 1%, 2%, 3% in concrete and compared the fibre concrete with the conventional concrete with the mechanical properties. By using the fibre in concrete as 10 mm length and the diameter is to fix as per the aspect ratio. This has been done in order to reduce the disposal of waste plastics that are hazardous to environment. This study give a contribution to the effective use of domestic wastes (plastics) in concrete as fibre in order to prevent the environmental strains caused by them, also to limit the consumption of natural resources.*

Key Words: **Waste fish nets, Fiber concrete, Mechanical Properties, Aspect Ratio, Compressive Strength.**

1. INTRODUCTION

1.1 General

Concrete is a development material made out of concrete, fine totals and coarse totals blended in with water which solidifies with time. Fiber fortified cement (FRC) is concrete containing stringy material which builds its basic respectability. Fiber is a little bit of fortifying material having certain qualities properties. They can be roundabout or level. The fiber is frequently portrayed by a helpful parameter called "viewpoint proportion". The perspective proportion of the fiber is the proportion of its length to its breadth.

Filaments are generally utilized in cement to control plastic shrinkage splitting and drying shrinkage breaking. They additionally bring down the penetrability of cement and in this manner decrease seeping of water. Nylon is a nonexclusive name that distinguishes a group of polymers. Nylon fiber's properties are bestowed by the base polymer type, expansion of various degrees of added substance, producing conditions and fiber measurements. As of now just two kinds of nylon fiber are promoted for concrete. Nylon is heat steady, hydrophilic, generally idle and impervious to a wide assortment of materials. Nylon is especially viable in granting sway obstruction and flexural strength and continuing and expanding the heap conveying limit of solid after first split. Nylon has great perseverance and the quality isn't lost with age. Nylon has a high solidarity to weight proportion. It is one of the lightest material filaments is simultaneously likewise one of the most grounded. Nylon has amazing scraped spot obstruction. The purpose behind utilizing nylon fiber is that it has great hardness, versatility and solidness; is promptly accessible in various hues, can be colored, impervious to soil and earth, great scraped area and wearing trademark, accessibility in various cross-segment.

The nylon filaments generation, however, influences nature and the transfer of these fiber present increasingly extreme danger. In such manner, utilization of nylon fiber as fixing in concrete cement is promising as it gave an elective strategy for transfer and strands, inferable from their additionally improve quality and solidness of cement. The expansion of nylon fiber has additionally been accounted for to improved toughness of cement, the strands shield solid spread from spalling because of holding character.

1.2 Benefits of Nylon fibers

- Improve mix cohesion over long distances.
- Improve freeze-thaw resistance.
- Improve resistance to explosive spalling in case of a severe fire.
- Improve impact resistance.
- Increase resistance to plastic shrinkage during curing.

1.3 Fishing Net

Previously, angling nets were made of biodegradable common materials, for example, cotton and cloth, these days the nets are normally made of plastics. Angling net plastics are commonly non biodegradable and in this way it is critical to improve their reusing so as to discard waste and lower the expense of coming about item.

These waste nets have been solid calls for reusing. It merits nothing that ongoing investigations have demonstrated a few waste materials can be beneficially utilized to produce minimal effort fortification strategies of basic and nonstructural materials in the ventures. The nets have been additionally utilized in structural designing field as a reused fiber so as to fortify or reinforce solid, mortar and soil. In any event, during the previous three decades, the utilization of different polymer filaments has been focused and it is effective in essentially improving mechanical properties, for example, flexural quality, break durability and effect opposition and furthermore increment first split quality and flexibility.

2. Objective and Scope

2.1 OBJECTIVE

The objective of this study is to observe the strength and durability properties of concrete reinforced with Waste Nylon fibers.

2.2 SCOPE

- To investigate the properties of concrete with waste nylon fibers.
- In addition to this research several tests will be included such as compressive strength, split tensile strength of concrete with waste nylon fiber.
- For this research the percentage of the volume of waste nylon fibers normally used in concrete will be varied. This replacement will be done from 1% to 3% thus compared with conventional concrete. Thus utilization of waste nylon fiber in concrete would lead to considerable environmental benefits and would be economical.

3 Materials and properties

3.1GENERAL

The basic preliminary tests for the materials are carried out in order to calculate mix design. The materials used in the study are cement, M sand, Coarse aggregate, Waste Nylon Fiber. The properties of these materials are given in this chapter.

3.2 CEMENT

In this study the ordinary Portland Cement (OPC) of 53 grade conforming to IS: 12269 - 2013 is used. Various tests were performed on cement they are: Consistency test, Specific gravity test and the results are obtained in Table 1.

TABLE 1. PROPERTIES OF CEMENT

S.No	DESCRIPTION	RESULT	REQUIREMENT AS PER IS:12269 - 2013
1	Consistency	32%	NOT SPECIFIED
2	Specific gravity	3.12	2.9-3.15

3.3 FINE AGGREGATE

M Sand is utilized as fine total in this investigation. Fine total is acquired from a nearby provider. The fine totals were tried according to Indian Standard Detail May be: 383-2016. Different tests were performed on Fine totals are: Explicit gravity test and Evaluating of total . Explicit gravity of M Sand is seen as 2.66. The sifter investigation results are given in Table 2. The sand is fitting in with Zone II and fineness modulus is seen as 3.9 .

TABLE 2. SIEVE ANALYSIS OF FINE AGGREGATE

IS SIEVE DESIGNATION	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSING	SPECIFICATION AS PER IS 383 - 2016 FOR ZONE II
10mm	0	100	100
4.75mm	0.6	99.4	90 - 100
2.36mm	6.1	93.9	75 - 100
1.18mm	43.6	56.4	55 - 90
600 microns	61.3	38.7	35 - 59
300 microns	82.6	17.4	8 – 30
150 microns	95.6	4.4	0 - 10
Pan	100	0	0

3.4 COARSE AGGREGATE

Coarse total utilized is locally accessible squashed rakish total size of 20mm and 12.5mm are utilized for this exploratory work. Different tests are completed in the total like strainer investigation and explicit gravity. Explicit gravity Coarse total of is seen as 2.66. The sifter examination results are given in Table 3 Table 4 shows the properties of total.

TABLE 3. SIEVE ANALYSIS OF COARSE AGGREGATE

IS SIEVE DESIGNATION	CUMULATIVE PERCENTAGE RETAINED	CUMULATIVE PERCENTAGE PASSING	SPECIFICATION AS PER IS 383 - 1970 FOR 20mm AGGREGATE
40mm	0	100	100
20mm	9	91	85 - 100
10mm	99.67	0.33	0 - 30
4.75mm	100	0	0- 5

TABLE 4. TEST RESULTS OF AGGREGATE

S.No	PROPERTY	RESULT
1	Specific gravity of Fine aggregate	2.66
2	Specific gravity of Coarse aggregate	2.76
3	Fineness modulus of Fine aggregate	3.9

3.5. WATER

Portable water is considered fit for making concrete. In this study portable water from sump is used for mixing purpose.

3.6. WASTE NYLON FIBER

The Waste Nylon fibers in Fig1 was collected from the Marine region. After collecting , it is totally cleaned and reused for the concrete. The properties of the Nylon Fibers are given in Table 5 .

FIG 1 NYLON FIBERS

TABLE 5. PROPERTIES OF NYLON FIBERS

PROPERTY	RESULT
Specific Gravity	1.14
Length	10mm
Diameter	0.19mm
Aspect Ratio	35 to 55

4. CONCRETE MIX DESIGN AND CASTING

4.1.GENERAL

This section clarifies the blend configuration, throwing and compressive quality testing of M30 grade concrete with different extent of Fiber to acquire the ideal measure of Fiber for greatest compressive quality. Solid blend configuration is characterized as the fitting choice and proportioning of constituents to create a solid of the necessary quality, solidness and usefulness as monetarily as could be expected under the circumstances. Concrete blends are structured so as to accomplish a characterized functionality, quality and solidness. The quality and choice proportioning of materials rely upon auxiliary prerequisite.

4.2MATERIALS USED

The materials used in this study are of good quality and are obtained from local stores. The total quantity of materials needed is estimated from mix design. Cement of OPC 53 grade is used in this study. Aggregates used are from local source. Fine aggregate confirming to zone II and coarse aggregate of size 20mm are used. Water used for mixing is of portable quality obtained from sump. Nylon fibers are used to improve strength.

4.3MIX DESIGN

The design mix obtained is based on IS 10262 – 2019 which provides the guidelines for proportioning concrete mixes as per requirement using concrete making material. The exposure condition is assumed to be mild and the design is done for 75mm slump for better workability. Detailed design mix is given in the Annex 1. Mix proportion for M30 grade concrete is given in the Table 6.

TABLE 6. MIX PROPORTION

CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER
1	1.55	2.7	0.45

This mix proportion is taken as base for control mix. The percentage addition of fibers by weight in cement is given in Table 7.

TABLE 7. PERCENTAGE ADDITION OF NYLON FIBER

SYMBOL	GRADE	% NYLON FIBER
CM	M30	0
NF1	M30	1

NF2	M30	2
NF3	M30	3

4.4. BATCHING

In this study weight Batching is done. Cement and aggregate are measured with accuracy of 1% of required mass.

4.5. MIXING

It is the process of mixing ingredients obtained either by volume or mass batching and introducing them into the mixture. In this study mixing is done by standard mixer of 200 liter capacity.

4.6CASTING

Mould is lubricated with sufficient amount of oil for easy demoulding. Concrete is filled in mould in 3 layers with proper tamping of 25 blows to avoid voids. The top surface is leveled and smooth for good finish.

4.6.1. CASTING OF CUBES

The cube moulds are removed properly cleaned, assembled and all the bolts are fully tight. A thin layer of oil is applied on all the faces of the mould. After taking concrete samples and mixing them, the cube is cast instantly. The concrete sample is then filled into the cube mould in 3 layers tampered 25 times using standard tamping rod to avoid voids. Then cube is removed from the mould at the end of 24 hours and immersed in clean water for curing. Then the cubes are tested in surface dry condition. Totally 24 cubes were casted of Four Fiber content . After initial mixing of concrete only fibers are added additionally in the mixer. Table 8 gives the details of various cube specimen.

FIG 2 CASTING OF CUBES

TABLE 8. DETAILS OF CUBE SPECIMEN

SYMBOL	CEMENT	M SAND	COARSE AGGREGTE	% NYON FIBER	NO.OF CUBES
CC	10.34	16.09	27.90	0	6
NF1	10.34	16.09	27.90	1	6
NF2	10.34	16.09	27.90	2	6
NF3	10.34	16.09	27.90	3	6

4.6.2CASTING OF CYLINDERS

The cylinder mould was removed properly cleaned, assembled and all the bolts are fully tight. A thin layer of oil is applied on all the faces of the mould. After taking concrete 24 samples and mixing them, the cylinders was cast instantly. The concrete sample was then filled into the cylinder mould in 3 layers tampered 25 times using standard

tamping rod to avoid voids. Then cylinder was removed from the mould at the end of 24 hours and immersed in clean water for curing. Then the cylinders are tested in surface dry condition. Totally 12 Cylinders were casted for testing 28th day Split Tensile strength of 4 different Proportions of Fiber content. Table 9 gives the details of various cylinder specimen.

TABLE 9. DETAILS OF CYLINDER SPECIMEN

SYMBOL	CEMENT	M SAND	COARSE AGGREGTE	% GLASS FIBER	NO. OF CYLINDER
CC	6.77	10.53	18.27	0	3
NF1	6.77	10.53	18.27	1	3
NF2	6.77	10.53	18.27	2	3
NF3	6.77	10.53	18.27	3	3

FIG 3 CASTING OF CYLINDER

4.7. COMPRESSIVE STRENGTH TEST

Compressive strength have been carried out in 200T capacity compression testing machine Fig 2. Cube specimens of 150 x 150 x 150mm were tested. The loading rate was applied manually till the specimen fails .Record the maximum load. Failure load divided by the contact area gives compressive strength of cubes.

4.8. SPLIT TENSILE STRENGTH TEST

The specimen shall consist of concrete cylinders of 150mm in diameter and 300mm in length. The same compression testing machine was used for finding tensile strength also. The specimens was kept in dry condition for 24 hours before testing. Steel rod of 16mm diameter was placed along the center at axis perpendicular to the loading direction. The split tensile strength test was done for concrete with different percentage of fiber to obtain the optimum amount of fiber and the split tensile strength is calculated from the following equation 4.1,

$$Split\ tensile\ strength = \frac{2P}{\pi dl} \quad \text{------ (4.1)}$$

Where,

P= maximum load, N

d= diameter of specimen, mm

l= length of specimen, mm

5. RESULTS

5.1. COMPRESSIVE STRENGTH TEST

The compressive strength after 7 days and 28 days of curing of specimen was determined for all the specimens and the results are given in Table 10.

TABLE 10. COMPRESSIVE STRENGTH OF CONCRETE

GRADE	% Fiber	Compressive strength at 7 days(N/mm²)	Compressive strength at 28 days(N/mm²)	% Increase in strength
M 30	0	29.43	43.89	-
M 30	1	32.73	50.49	15%
M 30	2	35.93	55.69	27%
M 30	3	34.20	53.80	23%

The bar graph in Fig 4. describes about the compressive strength of concrete with Waste Nylon Fibers. The strength of concrete increase with the ages and percentage at the proportion of **3%** the strength drops down.

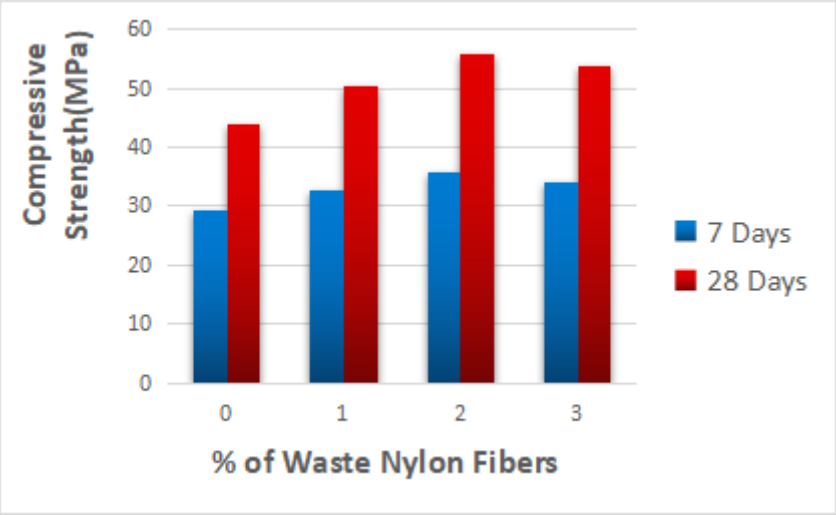

FIG 4 COMPRESSIVE STRENGTH OF CONCRETE WITH FIBERS

5.2. SPLIT TENSILE STRENGTH TEST

Split tensile strength after curing of specimen was determined for all the specimens and the results are given in Table 11.

Table 11. SPLIT TENSILE STRENGTH OF CONCRETE

GRADE	% FIBER	Maximum load at 28 days (×10³kg)	Split tensile strength at 28 days(N/mm²)	% Increase in strength
M30	1	27.5	3.82	-
M30	2	32.1	4.45	16%
M30	3	33.5	4.65	22%
M30	4	33	4.58	20%

The bar graph in Fig 5. describes about the split tensile strength of concrete with Waste Nylon Fibers. The strength of concrete increase with the ages and percentage at the proportion of **3%** the strength drops down.

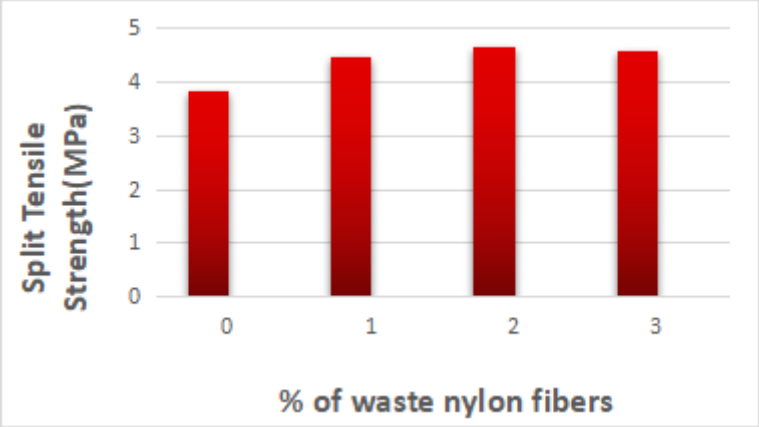

FIG 5 SPLIT TENSILE STRENGTH OF CONCRETE WITH FIBERS

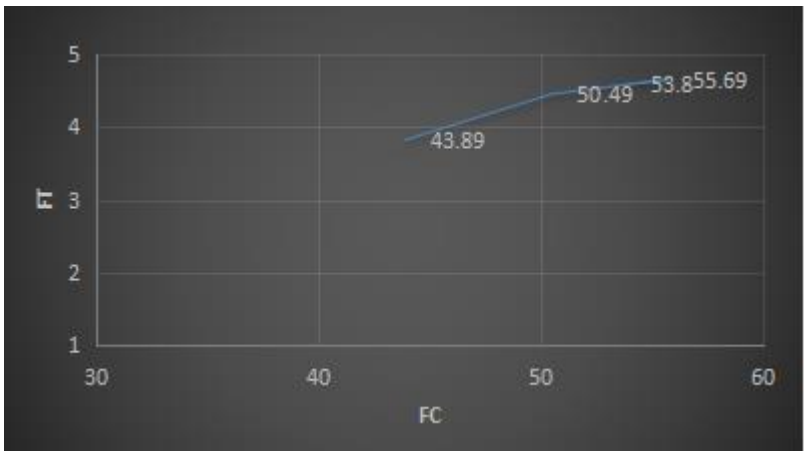

FIG 6 COMPRESSION VS SPLIT TENSILE

6. CONCLUSION

Based on the extensive experimental investigation, the salient conclusions

- The compressive strength of concrete increases by **27**% with 2% addition of nylon fiber. Further increase in fiber content, decreases the compressive strength.
- The split tensile strength of concrete increases by **22**% with 2% addition of nylon fiber. Further increase in fiber content, decreases the split tensile strength.
- Based on the compressive strength and split tensile strength results, it can be concluded that **2%** of addition of Nylon fiber is optimum.

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