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EXPERIMENTAL INVESTIGATION ON CONCRETE BY ADDING WAVED MACRO FIBER

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ABSTRACT

Attempts to find a construction material having increased strength ,toughness, and durability have led to interest in high performance fiber reinforced concrete. The use of such materials increases day by day. When the fibers are distributed in a homogeneous way and used in appropriate quantity inside the concrete they reduce cracks and contribute to tensile strength, toughness, ductility and durability, and improve other mechanical properties. The scope of the current investigation is to examine the mechanical properties of concrete with the addition of Synthetic Macro Fiber – "Waved Macro Fiber". The incorporation of highly engineered Macro-fiber in concrete will result in improving many physical and mechanical properties of the concrete.

Keywords: Strength, Waved macro fiber, durability.

1. INTRODUCTION

Concrete is mostly used construction material in the world. Its consumption is around 22 billion tones annually which comes around two tones per living person. The reason for such a widespread use of concrete are its adaptability, durability, strength, availability and economy. Concrete is a brittle material. Fiber addition has become one of the most prevalent methods for enhancing the tensile behavior of concrete. Fiber reduce cracking phenomena and improve the energy absorption capacity of the structure.

Fiber addition has become one of the most prevalent methods for enhancing the tensile behavior of concrete. Fiber reduce cracking phenomena. There are several benefits by using fibers in concrete.

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. 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 protects damage of concrete structure and prevents spaling in case of fire. 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.

1.1Benefits of fiber

a. Decreases shrinkage cracks in plastic and improves resilience to impact and abrasion.

b. Improving durability can be accomplished by strictly controlling and reducing crack widths.

c. Fibers serve as a multifaceted reinforcement that facilitates the uniform distribution of tensile stress.

d. In event of a catastrophic fire, increase resistance to explosive spalling.

e. Fibers are not water-absorbing by nature; they are hydrophobic.

f. It serves as a supplementary support for concrete.

g. The construction is likewise moving at a fast pace.

h. Fibers are lightweight and simple to work with.

i. Minimizes concrete bleeding during placement, segregation.

1.2 Applications of Waved macro fiber

It is employed in commercial, industrial, and primary reinforcing applications. In places where steel is not permitted, such as footings, foundations, PQC, canals, tunnels, vault structures, parking lots, and pavements.

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2. METHODOLOGY

2.1 Procedure

Step 1: Reviewing the body of material that is currently available and comprehending the review's scope.

Step 2: Following the literature study, a gap analysis is conducted.

Step 3: Gathering of components, such as waved macro fibre and concrete-making materials, etc.

Step 4: Standard tests such as specific gravity of cement, FA, and CA, Vee bee consistometer test, slump test, sieve analysis, and water absorption of Course aggregate and FA.

After completing the fundamental testing, the mix design is determined.

Step 5: Prisms, cylinders, and cubes are among the specimens used.

The specimens utilized have sizes that are

For 150mmx150mmx150mm cube

For 300 mm by 150 mm cylinder.

For 500mm x 100mm x 100mm prism.

Step 6: The specimens are cured for a duration 28 days after being cast according to mix design.

Step 7: Tests on Hardened Concrete is done (Compressive strength test, Split Tensile test, Flexural Test).

Step 8: Results

Step 9: Conclusions.

2.2 Experimental Work

The cubes, cylinder and prisms are used. All these specimens were added with Waved macro fiber with different percentages, i.e., 0.1%, 0.2% and 0.3% and were tested for their compressive strength, split tensile strength and flexural strength.

Material used

2.1.1 Cement

In the present work, cement used is OPC 53 grade conforming to IS: 12269-1987.

2.1.2 Fine aggregate

M-sand was added as fine aggregate.

2.1.3 Course aggregate

The course aggregate used is crushed (angular) aggregate conforming to IS: 383:1970.The course aggregate used were a mixture crushed stone of 20mm and 12mm size in 70:30 proportion.

2.1.4 Admixture

The Admixture used here is Fosroc conplast Super plasticizer 430 DIS.

2.1.5 Water

There were no dangerously high concentrations of oils, acids,

alkalis, salts, sugar, or other organic elements that could damage concrete in the purified water used for adding and curing. When creating reinforced cement concrete, water should have a pH of between 6 and 8.5.

2.1.6 Waved macro fiber

The length of waved macro fiber used is 50mm. Concrete's post-cracking residual strength will be improved by the usage of Waved Macro Fiber's high levels of energy absorption, toughness, and durability. helps stop the formation of concrete shrinkage cracks as well.

Figure 1: Waved Macro fiber

2.3 Mix Design

M30 grade concrete is used and mix design is done as per the IS :10262.

Slump =100mm.

W/C ratio=0.4

Water =158kg/m^3

CA =1223.33kg/m^3

Cement=395 kg/m^3

FA=660.54kg/m^3

2.4 Compressive Strength test:

Strength under compression measured using a cube specimen of 150mmx150mmx150mm. The process and the techniques followed IS 516-1959. The specimen sample was then positioned so that, weight was delivered perpendicular to the casting side. In the compression testing machine, the force was applied on cube is 1000 kg/mm. The specimen's failure load was recorded, and it will automatically be released.

The following formula is used for calculating the concrete's compressive strength.

Compressive Strength= Load in N /Area in mm^2.

2.5 Split Tensile Strength

Specimen in the shape of cylinder of diameter .150m height 300mm is casted. The methods and procedure were according to IS 5816-1999. At constant rate of 250 kg/mm, the load was applied in the compression testing machine. The specimen will be automatically unloaded and the failure load is noted.

Split Tensile strength of the concrete- was determined by the below formula.

Tensile strength = $2P/\pi L$D

P = Maximum applied load indicated by testing machine.

D, L = diameter and length.

2.6 Flexural Test

The beam casted of size 100X100X500mm and tested for flexural strength of the concrete. Three-point test is done on Flexural testing machine by referring IS 516-1959. The formula used to find Flexural Strength is

Flexural Strength= PL/bd2

Where,

P=maximum applied load indicated by testing machine (N)

d,l,b=length,width,depth of specimen.

3. RESULTS AND DISCUSSION

The purpose of study is to evaluate the Compression Split, Tensile and Flexural Test at various fiber content.

2.1 Compressive Strength Test

Table 1 Compressive strength of cube

% of fiber	Compressive strength (N/mm²)
0	30.51
0.1	44.472
0.2	54.5
0.3	34.88

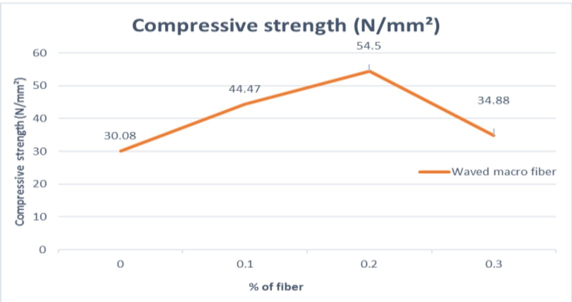

Figure 2: Compressive strength results

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Figure 3: Testing of specimen

2.2 Split Tensile Test

Table 2 Split tensile test

% of fiber	Split tensile strength (N/mm²)
0	2.56
0.1	2.77
0.2	3.05
0.3	2.63

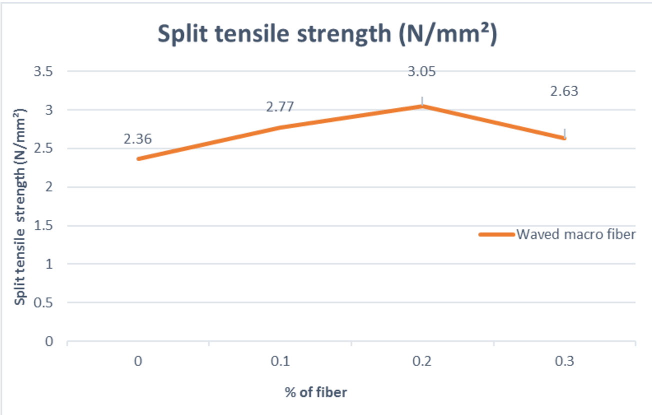

Figure 4 : Split tensile test results

Figure 5: Split tensile test results

2.3 Flexural Test

Table 3 Flexural strength test results

% of fiber	Flexural strength (N/mm²)
0	4.2
0.1	5.6
0.2	6.2
0.3	5.2

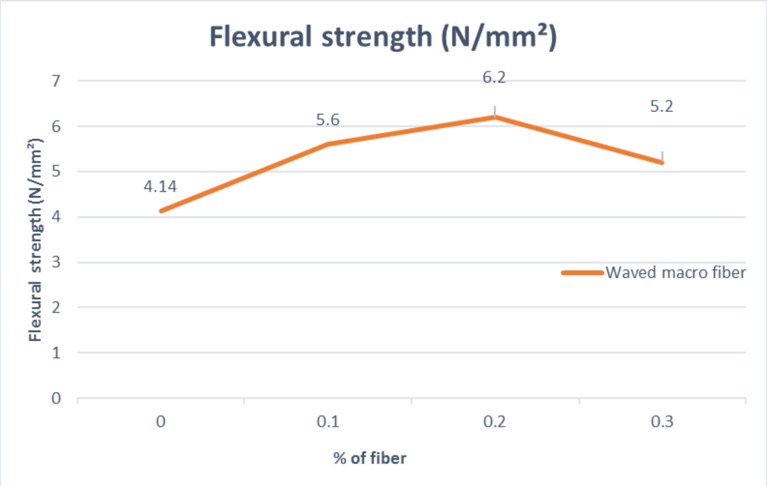

Figure 6: Flexural test results

Figure 7: Flexural test results

4. CONCLUSION

1. It is observed that 0.2% of fiber addition shows the optimum value for Waved Macro fiber.

2. Compressive strength of 0.1%,0.2% and 0.3% of Waved macro fiber has found to be increased by 33% ,45% and 14% when compared with Conventional concrete.

3. Split tensile strength of 0.1%,0.2%and 0.3% of Waved macro fiber has found to be increased by 15%, 23% and 11% when compared with Conventional concrete.

4. Flexural strength of 0.1%,0.2% and 0.3% of Waved macro fiber has found to be increased by 26%, 33% and 20% when compared with Conventional concrete.

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