



COMPARATIVE ANALYSIS OF STRENGTH OF CONCRETE BY USING VARIOUS MATERIALS COIR FIBRE , PLASTIC FIBRE AND NYLON FIBRE

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Abstract— Concrete structures are subjected to aggressive influence of environment during their lifetime. Concrete structures can get damaged by many hazards like overloading, action of fire, natural disasters etc .The purpose of this research is to find the suitability of coir, nylon and plastic fibres for reinforcing conventional concrete of M20 grade by replacing 0.5% of coarse aggregates from it. Experimental study includes preliminary test 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 fibre reinforced concrete and conventional concrete .Hardened concrete test on cubes, cylinders and beams were made to study the strength of concrete .The test includes compressive strength test, split tensile test and flexural strength test .The presence of fibres has a positive effect mainly on the strength of concrete .The results of the study indicate that nylon reinforced concrete is good in tension, whereas plastic reinforced concrete is good in compression .The present work has good scope for future research .Durability test can be conducted in future.

Keywords—Coir fibre; Plastic fibre; Nylon fibre;Fibre reinforced concrete; replacement of coarse aggregate;

I. INTRODUCTION

Concrete is the one of the most widely and commonly used building material in civil engineering around the world. Concrete is strong in compression, however, is a very brittle material, and has low strain capacity in tension and consequently low toughness. As a result cracks develop whenever loads give rise to tensile stresses exceeding the tensile strength of concrete. Adding concrete to concrete matrix has been long recognized as a way to enhance the energy absorption capacity and crack resistance of the plane concrete. In fibre reinforced concrete , by bridging fibres across the cracks a post cracking ductility is provide and consequently the toughness of concrete considerably enhanced consideration of toughness in concrete is considerably enhanced. Consideration of toughness and the fracture energy is important since it determines the ductility and crack resistance of the structure assuring the safety and integrity of the structural element prior to its complete failure.

Concrete is typically reinforced with steel or synthetic fibres like carbon, glass, or aramid. Despite of their advantages, the high material costs, the high energy – consuming process by the production and their adverse environmental impact has initiated the search of new environmental friendly and sustainable alternatives. In the framework of international research, a considerable effort is going on in the exploitation of fast growing, annually renewable, cheap agricultural crops and crop residues as possible fibre reinforcement in concrete. The basic advantage of natural fibre is that they are low cost and widely available resource in many agricultural areas. They are bio – degradable, non – abrasive and there is no concern with health and safety during handling.

Coir derived from the Tamil word “kayiru” is a natural fibre obtained from the husk of coconut. It possess about 48% of lignin increasing strength and elasticity of fibre. It also reduced the biological degradation with average life nearly 20 years. Coir is produced in India at a large scale. Nylon is generic name that identifies a family of polymers. Nylon fibers are impacted by the base polymer type, addition of different levels of additive manufacturing condition and fibre dimensions. Currently only two types of nylon fiber are marketed for concrete. Nylon is heat stable, hydrophilic, relatively inert and resistance to 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. Plastic is also a waste and this waste is using for many works as recycle products. Among the plastic family Polyethelene Terephthalate (PET) is one of the major products using by the society in the form of various articles.

II. METHODOLOGY FOR EXPERIMENTATION

A. Materials and its listing

The various materials used are cement, coarse aggregate, fine aggregate, coir fibre, nylon fibre, plastic fibre. The various experimental results of the materials are shown in the table below.

TABLE 1 – TEST RESULT OF MATERIALS

S.No	Title of the Experiment	Result
1	Specific gravity of cement	3.15
2	Fineness of cement	5%
3	Consistency of cement	35%
4	Initial setting time of cement	40 min
5	Specific gravity of fine aggregate	2.513
6	Fineness modulus of fine aggregate	4.543
7	Specific gravity of coarse aggregate	2.55
8	Fineness modulus of coarse aggregate	5.513
9	Bulk density	1.621g/cc

B. Casting of conventional concrete specimen

3 cubes of sizes 150x150x150mm, 3 cylinders of size 150mm diameter and 300mm height, 3 beams of size 500x100x100 mm were casted .Mix design for M₂₀ grade concrete obtained as 1:2.04:3.08 as per IS 10262:2009.

C. Casting of coir reinforced concrete specimen

3 cubes of sizes 150x150x150mm, 3 cylinders of size 150mm diameter and 300mm height, 3 beams of size 500x100x100 mm were casted with M₂₀ mix. 0.5% coarse aggregate is replaced by coir fibres of 50mm length.

D. Casting of plastic reinforced concrete specimen

3 cubes of sizes 150x150x150mm, 3 cylinders of size 150mm diameter and 300mm height, 3 beams of size 500x100x100 mm were casted with M₂₀ mix. 0.5% coarse aggregate is replaced by plastic fibres of 50mm length.

E. Casting of nylon reinforced concrete specimen

3 cubes of sizes 150x150x150mm, 3 cylinders of size 150mm diameter and 300mm height, 3 beams of size 500x100x100 mm were casted with M₂₀ mix. 0.5% coarse aggregate is replaced by nylon fibres of 50mm length.



FIG.1. Conventional specimen



FIG. 2 Nylon reinforced specimen



FIG. 3 Nylon fibre



FIG. 4 Coir reinforced specimen



FIG. 5 Coir fibre



FIG.6 Plastic reinforced concrete



FIG. 7 Plastic fibre

F. Experimental study

The specimens are tested in the universal testing machine and compression testing machine. After the curing period of 7 days and 28 days test were conducted.

The flexural strength is calculated using the equation, $F_b = 3PL/2bd^2$

The compressive strength is calculated by the equation, $F=P/A$

The split tensile strength is calculated by the equation, $F= 2P/\pi DL$

The load arrangements for testing of concrete specimens is as shown in figure,



Fig. 8 Compressive strength test on cubes



Fig. 9 Split tensile strength test on cylinders



Fig.10 Flexural strength test on beams

III. RESULTS

TABLE 2 – COMPRESSIVE STRENGTH TEST RESULT ON CUBIC SPECIMENS

S.No	MIX	7 th day compressive strength(N/mm ²)	28 th day compressive strength(N/mm ²)
1	Conventional concrete	23.556	24.4
2	Coire fibre reinforced concrete	19.55	21.33
3	Nylon fibre reinforced concrete	24.4	25.33
4	Plastic fibre reinforced concrete	28.8	31.11

TABLE 3 – SPLIT TENSILE STRENGTH RESULT TEST ON CYLINDRICAL SPECIMENS

S.No	MIX	7 th day compressive strength(N/mm ²)	28 th day compressive strength(N/mm ²)
1	Conventional concrete	2.13	2.97
2	Coire fibre reinforced concrete	2.546	2.83
3	Nylon fibre reinforced concrete	3.4	3.82
4	Plastic fibre reinforced concrete	3.112	3.45

TABLE 4 – FLEXURAL STRENGTH TEST RESULT ON BEAM SPECIMENS

S.No	MIX	7 th day compressive strength(N/mm ²)	28 th day compressive strength(N/mm ²)
1	Conventional concrete	4	4.8
2	Coire fibre reinforced concrete	4.8	5.2
3	Nylon fibre reinforced concrete	5.6	6
4	Plastic fibre reinforced concrete	4.8	5.4

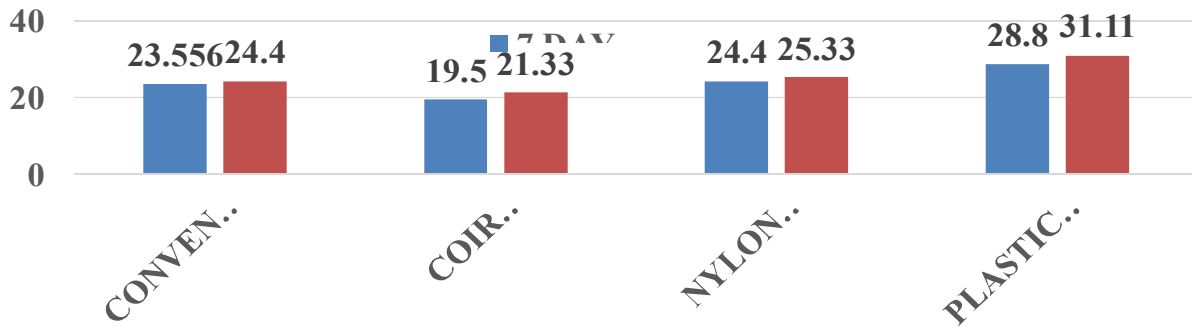


Fig. 8 Comparison of compressive strength

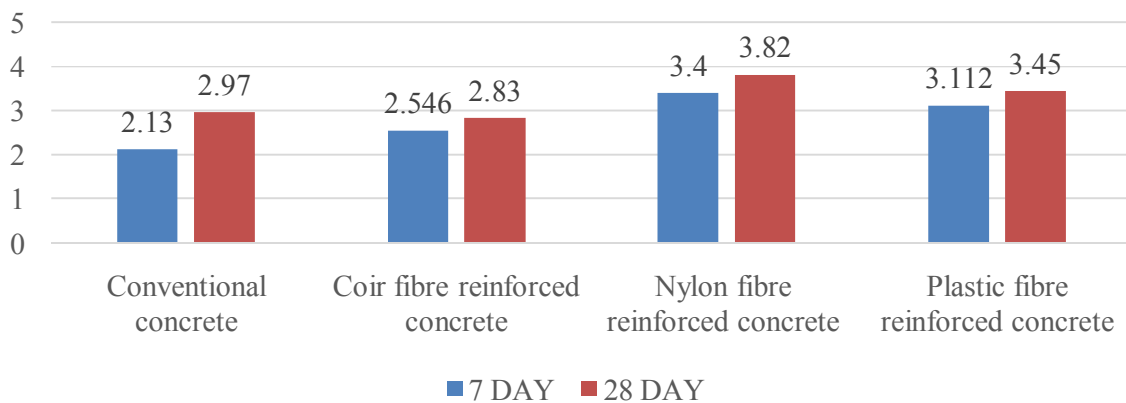


Fig.11 Comparison of Split tensile strength

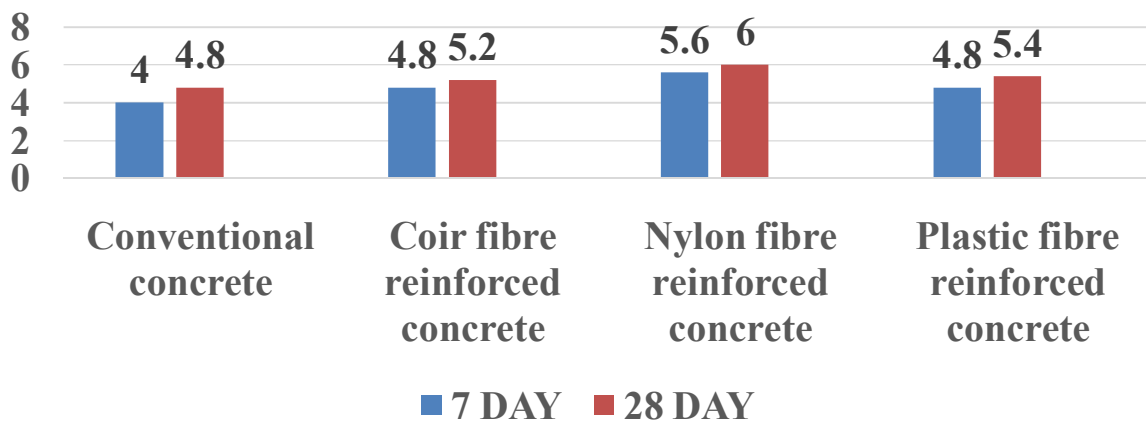


Fig. 12 Comparison of flexural strength

IV. CONCLUSION

The main objective of the present investigation was comparative analysis of strength of concrete by using coir, nylon, and plastic fibers. From the present investigations, various mixes of concrete reinforced with coir, nylon & plastic fibres were prepared. The fresh and hardened properties of the mixes were also studied. The conclusion from the present investigation based on the limited observations made during the period as presented in the following section.

1 .COMPRESSIVE STRENGTH

Strength of plastic reinforced concrete is more than that of conventional, coir, nylon reinforced concrete.

2 .SPLIT TENSILE STRENGTH

Strength of nylon reinforced concrete is more than that of conventional, coir, plastic reinforced concrete.

3 .FLEXURAL STRENGTH

Strength of nylon reinforced concrete is more than that of conventional, coir and plastic reinforced concrete

SCOPE OF FUTURE WORK

The present work has good scope for future research

- 1 .Since nylon fibres are good for tension; they can be used for the construction of beams.
- 2 .Plastic fibres are good for compression; they can be used for the construction of columns

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