International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-9, Issue-2, April 2022
https://doi.org/10.55524/ijirem.2022.9.2.95
Article ID IJIR-2298, Pages 608-612
www.ijirem.org

Enhancing the Strength Characteristics of Concrete Using Polypropylene Fiber and Steel Fiber in Combination as Partial Replacement of Fine Aggregates

Mohd Anzer Bhat[1], and Shakshi Chalotra[2]

[1]M. Tech Scholar, Department of Civil Engineering, RIMT University Mandi, Gobindgarh, Punjab, India
[2]Assistant Professor, Department of Civil Engineering, RIMT University Mandi, Gobindgarh, Punjab, India

Correspondence should be addressed to Muhammad Anzer Bhat: saifanzer25@gmail.com

ABSTRACT- Structural stability and structural strength is the key component for any structure to withstand heavy loads. The past decade is enforcing the enormous approaches to stabilise the structure in order to meet its shelf life. In India due to increase in the population approaches for high rise structures have paved high demand and key click for the people to get acquainted with. The approaches are quite interesting for durability and sustainability of such high rise structures. In order enforce such quality of work and have such stability approaches have been framed out on the effective use of Polypropylene fibre and Steel fibre in combination with replacement as fine aggregate. This approach is enforced to limit the structural instability thus imparting strength parameters such as Compressive strength, Tensile strength and Flexural strength enhancement.

KEYWORDS- Polypropylene Fibre, Steel Fibre, Siliceous, Argillaceous, Polymer, and Strength.

I. INTRODUCTION

The concept of structural strength evolved with the change in the demographic strata around globe in order to curtail the land requirement the horizon of new globe emerged as Structural strength as it is now necessary for the structure to withstand heavy loads and have high durability in order to sustain the current population demand[1] Structural strengthening approaches have been prioritised so that they could bring ease to the society [3].To broaden the life span of the design for a long time to come, underlying reinforcing is a protected, secure decision[7]. The different types of structural strengthening materials are as under:

- Carbon Fibre Reinforced Polymer (CFRP) Plates: Pre-assembled Carbon Fibre Reinforced Polymer (CFRP) Plates for fortifying of substantial substrates, pre-assembled CFRP plates can be remotely reinforced or close to surface-mounted [10](.L-shape Carbon Fiber Reinforced Polymer (CFRP) Plates: Shear limit of cement footers can be expanded by remotely applying CFRP reinforcing frameworks[9].
- Carbon Fiber Reinforced Polymer (CFRP) Post-tensioning Systems: Post-tensioned frameworks are powerful for control of underlying breaks and diversions and to expand weakness opposition and seismic obstruction[2]..
- Fiber Reinforced Polymer (FRP) Fabrics: Remotely applied textures can be utilized to increment flexural, shear, hub or seismic obstruction of constructions[8].
- Fiber-Reinforced Cementitious Matrix (FRCM): this type includes the imparting fibres as replacement in concrete matrix such as glass, Polypropylene etc[6].
- Carbon Fiber Grid Reinforcement: A licensed carbon fiber network installed in a uniquely planned fix mortar for support of cement or brick work structures[4].

The whole setup was performed in varying the fine aggregates with the combination fibres and among the above techniques FRMC (Fiber-Reinforced Cementitious Matrix) technique was adopted [5].

II. MATERIALS AND EXPERIMENTAL PROCEDURE

A. Material

- *Aggregates*

Crushed siliceous and argillaceous aggregates were accumulated from the dumping yard [11].The level of these aggregates was done in view of IS 383 (1970) with the help of sieve.

Table 1: Physical Properties of Aggregates

S.NO	Property	Result (%)	Test Code
1.	Specific Gravity of coarse aggregates	2.65	IS:2386 Part 3
2.	Water absorption of coarse aggregates	0.83	IS:2386 Part 3
3.	Specific Gravity of fine aggregates	2.59	IS:2386 Part 3
4.	Water absorption of fine aggregates	1.49	IS:2386 Part 3
5.	Elongation and flakiness Index	25.78	IS:2386 Part 1

B. Cement

The cement used in the audit was gotten from a local merchant. The grade of cement used in the audit was OPC-53 acclimating to IS:169-1989

Table 2: Physical Properties of Cement

S.NO	Property	Result	Test Code
1.	Specific Gravity	3.11	IS:169-1989
2.	Normal Consistency	28%	IS:169-1989
3.	Initial Setting Time	78 min	IS:169-1989
4.	Final Setting Time	365 min	IS:169-1989

C. Polypropylene Fiber

Polypropylene strands (PPF) are polymer filaments type which EN 14889-2 [13] characterizes as straight or disfigured parts of expelled, situated, and cut polymer material (Fig. 2). Two kinds of PPF can be recognized by EN 14889-2 [12]: microfibers and macrofibers. Basically, they contrast in the length however more significantly in the capacity that they act in the substantial (H Kumar et al.2016). The fibre used in the research was 6mm in size.

D. Steel Fiber

Steel fiber are the fibres made up of steel that are induced in concrete to provide higher tensile strength and reinforcement to the surface (N Van Chanh 2004).

III. METHEDOLOGY

The methodology approached for the research was carried out with M25 grade of concrete and specimen were casted for carrying out research with normal cubes as reference.

A. Mix Table

Table 3: Mix Design of Replacement with Fine aggregate

S. No	Mix Code	Fine Aggregate (%)	Polypropylene Fibre (%)	Steel fibre (%)
1.	N0	100	0	0
2.	N1	99.25	0.375	0.375
3.	N2	98.25	0.875	0.875
4.	N3	97.25	1.375	1.375

IV. RESULT DISCUSSION

A. Compressive Strength Test (IS:516-1959)

The casted cubes were checked with the time duration in the enlisted table given below in a cell dimension of 150*150*150 mm.

Table 4: Effect on Compressive strength of Concrete

S.NO	Average Compressive Strength In N/mm²			
	Concrete Mix	7 days	14 days	28 days
1.	N0	17.66	25.33	27.32
2.	N1	22.32	28.32	32.11
3.	N2	24.32	30.11	34.55
4.	N3	20.26	27.32	29.33

The cubes were checked for compressive strength as per the IS 516:1959 after 7, 14 and 28 days. The graph for compressive strength vs. time is given in Fig 2:

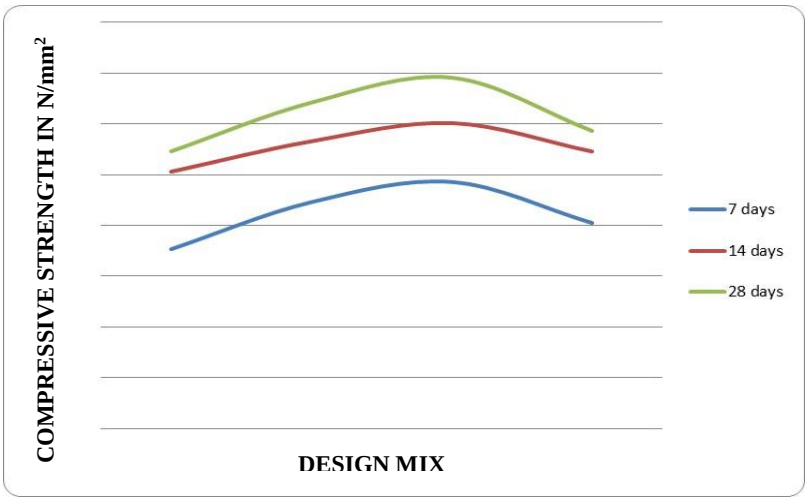

Figure 1: Compressive Strength vs. Time

B. SplitTensile strength Test:(IS: 5816: 1999)

1) Method of Test for Split Tensile Strength of Concrete

The split elasticity of cement is one of the fundamental and significant properties which incredibly influence the degree and size of breaking in structures. The substantial isn't typically expected to oppose the immediate pressure because of its low elasticity and fragile nature.

Table 5: Effect on Split Tensile strength of Concrete

S.No.	Average Split Tensile Strength In N/mm²	
	Concrete Mix	28 days
1.	N0	3.68
2.	N1	3.93
3.	N2	4.53
4.	N3	3.81

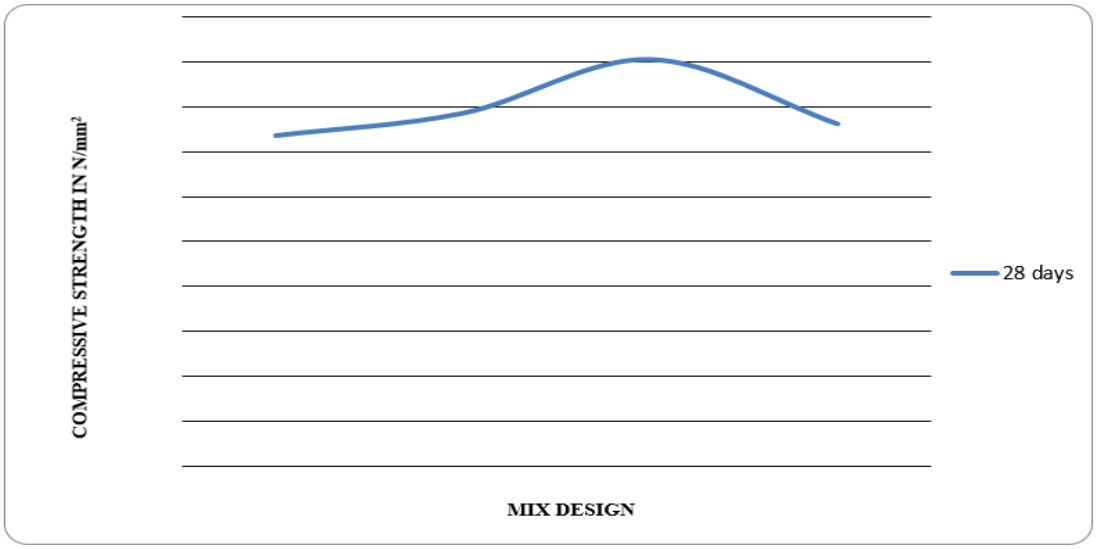

Figure 2: The graphical variation in Split Tensile Strength for different specimen of concrete.

C. Flexural Test: IS: 516 – 2002

Flexural strength of Concrete, otherwise called Modulus of burst, is a circuitous proportion of the elasticity of unreinforced concrete. Modulus of burst can likewise be characterized as the proportion of the outrageous fiber stresses when a part is exposed to bowing. Aside from outer stacking, tractable anxieties can likewise be brought about by twisting, erosion ofsteel.

Table 6: Effect on Flexural strength of Concrete

S.No.	Average Flexural Strength In N/mm²	
	Concrete Mix	28 days
1.	N0	4.64
2.	N1	5.39
3.	N2	5.78
4.	N3	4.87

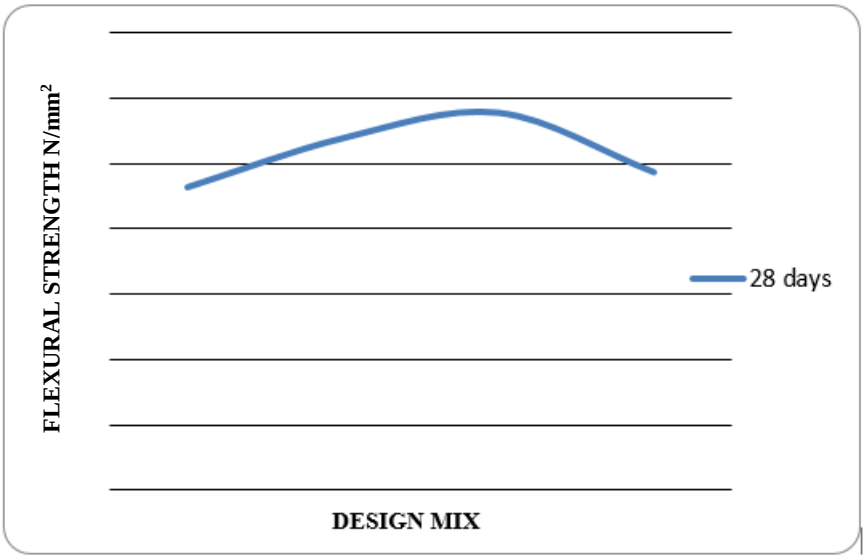

Figure 3: The graphical variation in Flexural Strength for different specimen of concrete

V. CONCLUSION

The combination fibre of steel and polypropylene showed a drastic effect on strength, flexure and tensioning properties of concrete thus signifying the suitability of such material for future approaches. The main conclusion drawn from the research will be summarised as follows:

- The compressive, split tensile and flexural strength of concrete increased at 0.875 % each of polypropylene and steel fibre and then decreased.
- Thus it is significant to compact the study that up to certain limit that is in between 1.5-2% addition of these fibres would result in significant increase in strength and after that it would abruptly fall.

Thus for fulfilment and sustainability of building structures such approach is fruitful and productive for society in future.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

ACKNOWLEDGEMENTS

There are people without whom this dissertation might not have been possible and to whom I am greatly thankful. Therefore, I would like to acknowledge.

My supervisor Er. Sakshi Chalotra, Assistant Professor and Project Guide, Department of Civil Engineering, RIMT University who was not simply supervisors, but also friends and mentors. Without him and his wealth of knowledge, patience and reliability; I could not reach this far. I express my heartfelt gratitude to Dr Sandeep Singla, Professor and Head, Department of Civil Engineering, RIMT University for his consistent encouragement in completing the project. The administrative technical and academic staff of the Departments of Civil Engineering, RIMT University for their valuable support. I express my deep love and warm regards to my parents and my friends for their support, constant encouragement and timely help.

REFERENCES

[1] Harkamal singh,2019, ijert, compressive strength and durability increases with the addition of abp and polypropylene fabric.

[2] Divya s dharan,aswathy lal 2016,ijert,study the effect of polypropylene fiber in concrete.
[3] Milind v. Mohod,2012, ijes, by using steel fibre increases the resistance and compressive strength of concrete.
[4] Jacek katzer, 2014, rg, increases the tensile strength of concrete.
[5] Pramod kawdae, 2017, abhijit varudkar, ijesrt, improves the mechanical properties, durability and serviceability of structure.
[6] mukilan k,2019, ramesh babu c chitambar ganesh a, ijeat, steel fibre increases the tensile and compressive strength of concrete at different proportions.
[7] Shrikanth m.harle, 2019, ijsrnsc, it provides good durability and workability of concrete.
[8] V. Ramadevi, and d.l. Venkatesh babu, "flexural behavior of hybrid (steel and polypropylene) fibre reinforced concrete beams," european journal of scientific research, vol. 70 no. 1, pp. 81 – 87, 2012.
[9] Is: 4031, "indian standard specification for physical test for hydraulic cement–determination of compressive strength, bureau of indian standards, new delhi, 1988.
[10] Is: 12269 "indian standard specification for 53 grade ordinary portland cement," bureau of indian standards, new delhi, 1987.
[11] Is 383, "indian standard specification for coarse and fine aggregate for natural sources for concrete," bureau of indian standards, new delhi, second revision, feb. 1997.
[12] Is: 516 (1959), "indian standard methods of tests for strength of concrete," bureau of indian standards, new delhi, india.
[13] patodi, s. C. And kulkarni, c. V., (2012), "performance evaluation of hybrid fiber reinforced concrete matrix," international journal of engineering research and applications (ijera), vol. 2, issue 5, september-october, pp.1856-1863.