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Comparison of Compressive Strength of Steel and Polypropylene Fibres at Different Percentage

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Abstract—This study examines the compressive strength of M_{25} grade fibre-reinforced concrete containing steel and polypropylene fibres at fibre contents of 0%, 0.25%, 0.50%, 0.75% and 1.00% by volume. A control mix without fibres was used for comparison. Concrete specimens were cast, cured and tested to evaluate the influence of fibre type and dosage on compressive strength.The study identifies the optimum fibre content and demonstrates the potential of fibre reinforcement in improving the mechanical performance of concrete.
Keywords— M25 Concrete, Fibre-Reinforced Concrete, Steel Fibres, Polypropylene Fibres, Compressive Strength

I. INTRODUCTION

Concrete is the most widely used construction material due to its high compressive strength, durability, and economic advantages. However, conventional concrete is brittle and prone to cracking, which can reduce its structural performance and service life. To improve these characteristics, fibres are incorporated into the concrete matrix, resulting in fibre-reinforced concrete (FRC), which exhibits enhanced strength, toughness, and crack resistance.

The performance of fibre-reinforced concrete depends not only on the type and quantity of fibres used but also on their percentage. Among the various fibre types, steel fibres and polypropylene fibres are widely used in concrete applications. Steel fibres improve strength, toughness, and energy absorption capacity, whereas polypropylene fibres enhance crack resistance, ductility, and durability. Understanding the influence of different percentage of these fibres is essential for optimizing the performance of fibre-reinforced concrete.

This study aims to compare the compressive strength of M_{25} grade concrete reinforced with steel and polypropylene fibres having various percentage. The experimental investigation evaluates the effect of fibre type and percentage on the compressive strength of concrete and identifies the most effective fibre configuration for improved structural performance.

II. LITERATURE REVIEW

Fibre-reinforced concrete (FRC) has gained considerable attention in recent years due to its improved mechanical properties, durability, and crack resistance compared to conventional concrete. The incorporation of fibres helps control crack propagation, enhances toughness, and improves the overall structural performance of concrete.

- Banthia and Trottier (1994) investigated the influence of steel fibre geometry on concrete performance and reported that fibres with higher aspect ratios exhibited better crack-bridging action and improved strength characteristics. Their study highlighted the importance of fibre aspect ratio in determining the effectiveness of fibre reinforcement.
- Maqbool and Sood (2016)evaluated the effect of polyethylene terephthalate (PET) fibres on the mechanical properties of concrete. Their findings indicated that the inclusion of PET fibres enhanced compressive strength and improved crack resistance compared to conventional concrete, demonstrating the potential of synthetic fibres as reinforcement materials.
- Thakur and Sood (2017) investigated the strength properties of hybrid fibre-reinforced concrete containing sisal and polypropylene fibres. The study reported improvements in compressive strength and overall mechanical performance due to the synergistic action of natural and synthetic fibres. The results highlighted the effectiveness of polypropylene fibres in enhancing concrete behavior when used in combination with other fibre types.

From the reviewed literature, it is evident that both steel and polypropylene fibres positively influence the performance of concrete. The percentage of fibres plays a critical role in determining the bond characteristics between the fibre and concrete matrix, which directly affects compressive strength. While steel fibres generally provide greater improvements in strength, polypropylene fibres contribute significantly to crack control and durability. However, limited studies have directly compared the compressive strength of steel and polypropylene fibres at various percentage under identical concrete conditions.

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Therefore, the present study focuses on comparing the compressive strength of M_{25} grade concrete reinforced with steel and polypropylene fibres having different percentage to identify the most effective fibre configuration.

III. OBJECTIVE OF THE WORK

The main objective of this study is to investigate and compare the compressive strength behavior of fibre-reinforced M25 grade concrete by analyzing the effects of steel and polypropylene fibres at different percentages, evaluating the influence of fibre aspect percentage, comparing their performance under identical mix conditions, and identifying the most effective fibre type and dosage for enhancing the overall mechanical properties compared to conventional concrete.

IV. METHODOLOGY

Themethodologyused regarding theworkis as follow :

1) Identification and specificationofmaterialtobeselected.
2) Collect and identifyingthepropertiesofcollectedmaterials.
3) Various tests were conducted on cement, fine aggregate, coarse aggregate.
4) Preparation of mix design of M25 grade concrete.
5) Cubeswerecasted withcontrol mix using natural aggregate.
6) Preparationoftestspecimenbyadding0.25%,0.50%,0.75% and 1%of steel andpolypropylene fibres in concrete mix.
7) Workabilitytests,compressivestrength,of concrete were conducted.
8) Optimumpercentage of fibre addition in concrete was determined.

V. MATERIAL TEST

Table-1:MaterialTestingResults

Test	Material	Equipmentused	Values obtained
Specific gravity	OPC	Density Bottle	3.15
Initial setting time	OPC	Vicat apparatus	88 mins
Final setting time	OPC	Vicat apparatus	370 mins
Specific gravity	Fineaggregate	Pycnometer	2.63
Specific gravity	Coarse aggregate	Pycnometer	2.76
Water absorption	Coarse aggregate	Oven Dry Method	0.18 %
Workability	M25Concrete	Slumpcone apparatus	75mm

VI. MIXDESIGN

Table-2:M25MixProportioning

Cement(Kg/m3)	375
Fineaggregate(Kg/m3)	669.80
Coarseaggregate(Kg/m3)	1256.77
Water(Kg/m3)	166.44
Watercementratio	0.44

Mixratio1:1.79:3.35

VII. EXPERIMENTAL INVESTIGATION

A. TestProcedure

For concretetestspecimensconsistof150x150x150mmcubes. Compressive strength was obtain on the basis of concrete cube specimen tested at 7 and 28 .

B. Testonfreshconcrete

On fresh concrete, workability testapply to check the affects of concrete strengthanddurabilityas wellastheappearance ofthefinishedproduct. For easily placed and well compacted in homogeneously without bleeding and segregation concreteis to be well workable. In this work the workability of concrete is measured by slump test.

C. Testonhardened concrete

To ensure the design strength of hardened concrete various test is to be done and quality of concrete construction is achieved. It includes compressive strength test.

VIII. EXPERIMENTAL RESULTS AND DISCUSSION

A. Testing of specimen

A total of 52 cube specimens (two cubes each for steel and polypropylene fibres at 0.25%,0.50%, 0.75%, and 1%, along with normal concrete) were prepared and tested for compressive strength after 7 and 28 days and the results were carefully recorded for each specimen and tabulated.

Table-3: Mean Compressive Strength test result

Sample	% of Steel fibre	Mean Compressive strength (MPa)	
		7 days	28 days
Sample I	0	16.67	26.88
Sample II	0.25	16.98	26.96
Sample III	0.50	17.1	27.85
Sample IV	0.75	17.55	29.6
Sample V	1	19.45	30.14

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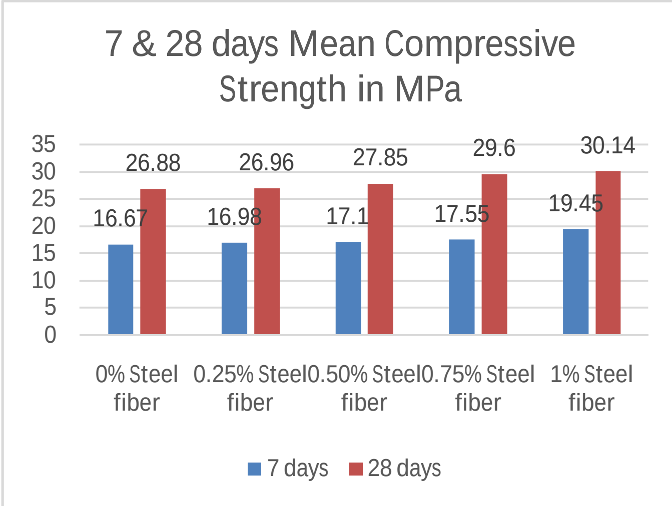
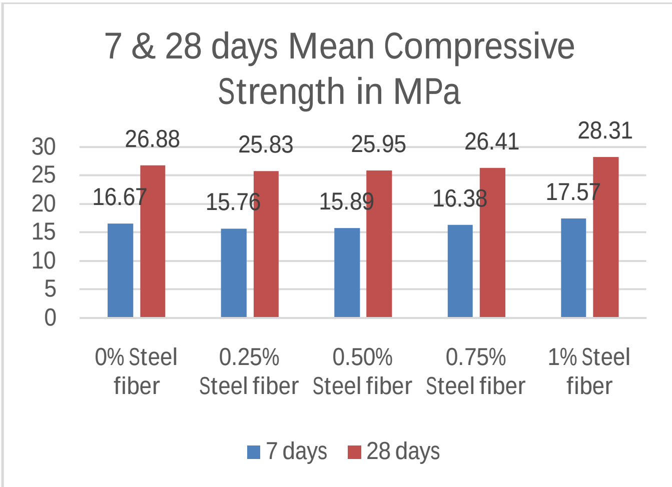


From the above table, We can observed that as the percentage of steel fibre increases from 0% to 1%, at 28 days the compressive strength increases from 26.88 MPa to 30.14 MPa.The highest strength is achieved at 1% steel fibre, it as the optimum percentage among the tested samples.The incorporation of steel fibres significantly improves the compressive strength of concrete, with maximum strength observed at 1% fibre content at both 7 and 28 days.

Table-4: Mean Compressive Strength test result

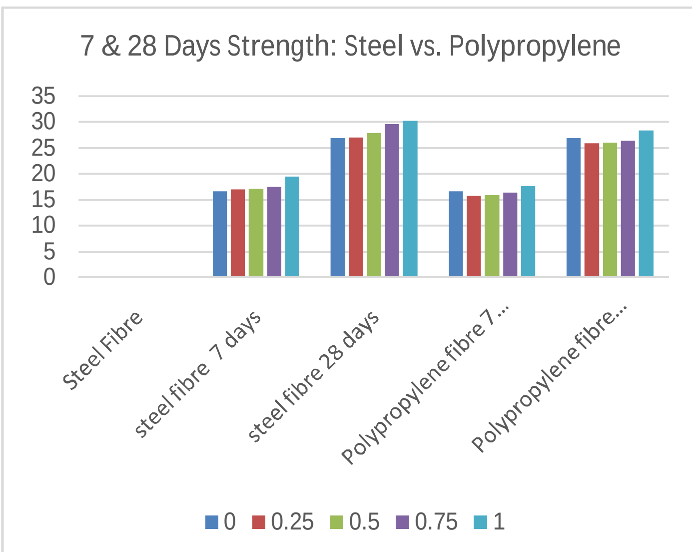
Sample	% of Polypropylene fibre	Mean Compressive strength (MPa)	
		7 days	28 days
Sample I	0	16.67	26.88
Sample II	0.25	15.76	25.83
Sample III	0.50	15.89	25.95
Sample IV	0.75	16.38	26.41
Sample V	1	17.57	28.31



From the above table, We can observed that at 0% polypropylene fibre at 28 days the compressive strength is 26.88 MPa, and as the fibre content increases from 0.25% to 1%,at 28 days the compressive strength increases from 25.83 MPa to 28.31 MPa.
At 0.25% and 0.50%, the compressive strength decreases compared to normal concrete (0%), indicating that small amounts of polypropylene fibre may reduce bonding efficiency.

Table-5: comparison of Mean Compressive Strength test result

Sample	% of fibre	Steel fibre		Polypropylene fibre	
		Mean Compressive strength (MPa)		Mean Compressive strength (MPa)	
		7 days	28 days	7 days	28 days
Sample I	0	16.67	26.88	16.67	26.88
Sample II	0.25	16.98	26.96	15.76	25.83
Sample III	0.50	17.1	27.85	15.89	25.95
Sample IV	0.75	17.55	29.6	16.38	26.41
Sample V	1	19.45	30.14	17.57	28.31



IX. CONCLUSIONS

- Steel fibre concrete provides good improvement in compressive strength. Polypropylene fibre concrete gives least improvement, but still performs better than normal concrete.
- Steel fibre concrete also performs well, offering good strength and ductility, making it suitable for structural applications where higher load resistance is required.
- Polypropylene fibre concrete shows comparatively lower load carrying capacity, but it is highly effective in controlling cracks and improving durability, making it suitable for non-structural and durability-focused applications.

X. ACKNOWLEDGMENT

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REFERENCES

[1] N. Banthia and J. Trottier, “Concrete reinforced with deformed steel fibers, part I: Bond-slip mechanisms,” *Journal of Materials in Civil Engineering*, vol. 6, no. 3, pp. 435–446, Aug. 1994.

[2] R. Bagherzadeh, A. H. Sadeghi, and M. Latifi, “Utilizing polypropylene fibers to improve physical and mechanical properties of concrete,” *Textile Research Journal*, vol. 82, no. 1, pp. 88–96, Jan. 2012.

[3] R. Kumutha and K. Vijai, “Effect of steel fibres on the strength properties of concrete,” *Journal of Reinforced Plastics and Composites*, vol. 29, no. 8, pp. 1193–1199, 2010.

[4] V. S. Solanki and U. K. Dave, “Strength of normal concrete using metallic and synthetic fibers,” in *Proc. International Conf. on Advances in Concrete and Construction*, 2013, pp. 145–152.

[5] L. Xu, Y. Jiang, and J. Chi, “Stress-strain relation of steel-polypropylene-blended fiber-reinforced concrete under uniaxial cyclic compression,” *Advances in Materials Science and Engineering*, vol. 2018, Article ID 9174943, pp. 1–12, 2018.

[6] A. M. Brandt, “Fibre reinforced cement-based composites: A review,” *Materials and Structures*, vol. 41, no. 2, pp. 221–243, Feb. 2008.

[7] S. P. Shah and B. V. Rangan, “Fiber reinforced concrete properties and applications,” *ACI Journal Proceedings*, vol. 68, no. 2, pp. 126–135, Feb. 1971.

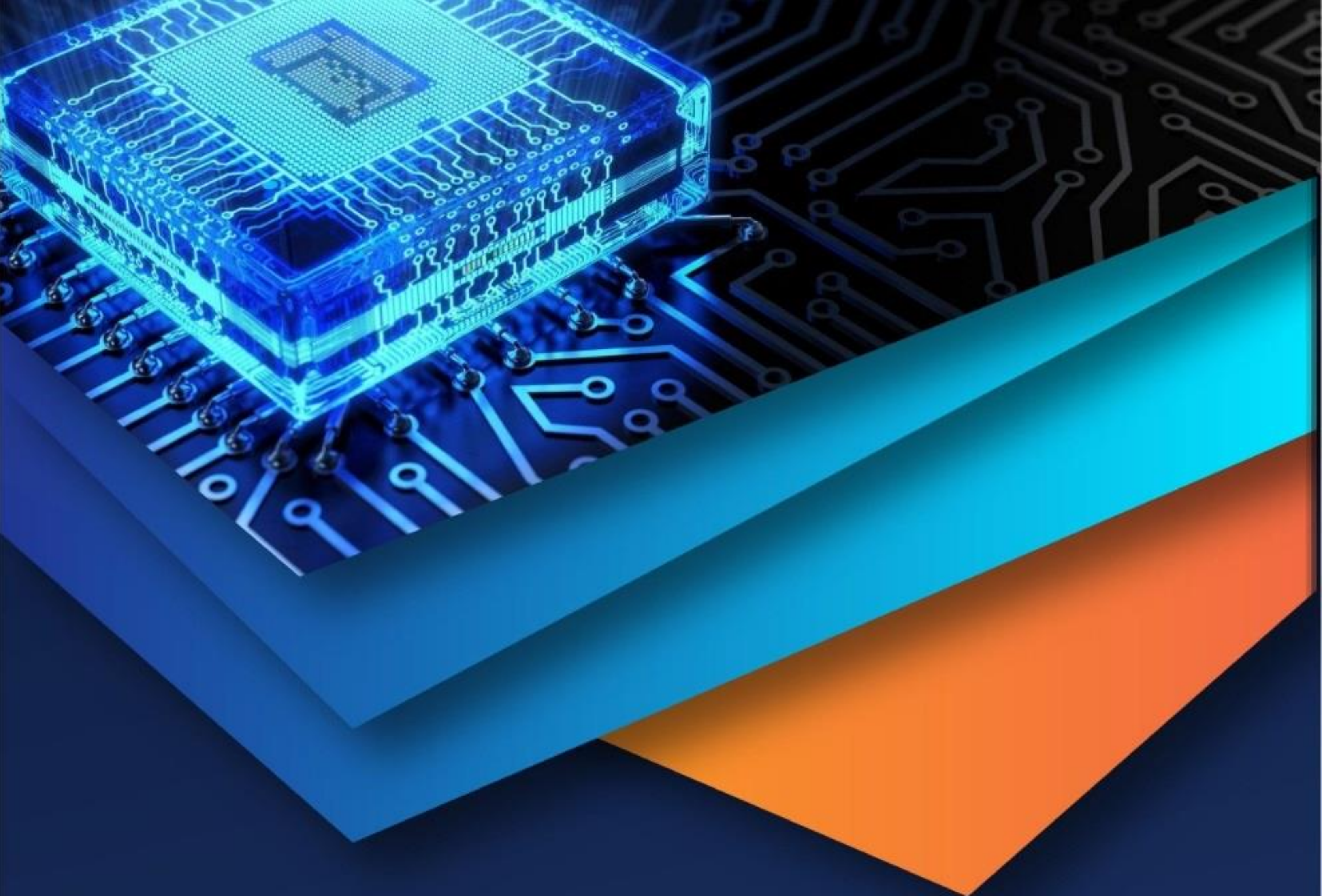
[8] P. S. Song and S. Hwang, “Mechanical properties of high-strength steel fiber-reinforced concrete,” *Construction and Building Materials*, vol. 18, no. 9, pp. 669–673, Nov. 2004.

[9] M. Nili and V. Afroughsabet, “The effects of silica fume and polypropylene fibers on the impact resistance and mechanical properties of concrete,” *Construction and Building Materials*, vol. 24, no. 6, pp. 927–933, Jun. 2010.

[10] A. Bentur and S. Mindess, *Fibre Reinforced Cementitious Composites*, 2nd ed. London, U.K.: Taylor & Francis, 2007.

[11] S. Maqbool and H. Sood, “Effect of PET Fibers on the Mechanical Properties of Concrete,” *SSRG International Journal of Civil Engineering*, vol. 3, no. 12, pp. 1–6, Dec. 2016.

[12] A. Thakur and H. Sood, “Study of Strength Properties of Hybrid Fiber Sisal/Polypropylene Reinforced Concrete Using PPC,” *International Journal for Research in Applied Science & Engineering Technology*, vol. 5, pp. 1770–1777, 2017.



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