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Experimental Investigation on Concrete by Adding Recron 3S Fibre

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Abstract - This study investigates the impact of Recron 3S fiber addition on the mechanical properties of M20 grade concrete, aiming to enhance its strength, durability, and crack resistance. Recron 3S, a synthetic micro-fiber, was incorporated into concrete mixes at varying percentages (0%, 0.25%, 0.50%, 0.75%, and 1% by weight of cement), and the resulting properties were compared with conventional concrete. Fresh and hardened properties, including workability, compressive strength, split tensile strength, and flexural strength, were evaluated through laboratory testing on casted cubes and cylinders at 7, 14, and 28 days of curing. The results demonstrate that the inclusion of Recron 3S fibers significantly improves the tensile and flexural strength of concrete, effectively reducing crack formation and enhancing impact resistance. Notably, the split tensile and flexural strength showed considerable improvements with the addition of fibers. However, an increase in fiber content slightly reduced the workability of the concrete mix, necessitating potential adjustments in water content or admixture dosage. The study concludes that incorporating Recron 3S fibers is an effective method to enhance the mechanical performance of concrete, making it suitable for applications demanding enhanced durability and crack resistance, such as pavements, bridges, and industrial floors. This research contributes to the development of high-performance fiber-reinforced concrete, offering a cost-effective solution for improving the properties of conventional concrete and promoting sustainable and durable construction practices, supporting the growing trend of utilizing fibers for composite fortification due to their high strength and thermal resistance.

Keywords:*Recron 3S fibers, fiber-reinforced concrete, compressive strength, tensile strength, flexural strength, durability, crack resistance, workability, M20 concrete, sustainable construction*.

INTRODUCTION

Concrete, a ubiquitous and versatile construction material, forms the backbone of modern infrastructure. Its composition, a carefully engineered blend of a binding medium, typically Portland cement and water, and aggregates of varying sizes, allows for adaptability across diverse structural applications. However, despite its compressive strength, concrete's inherent brittleness and low tensile strength present significant challenges. This disparity in strength characteristics renders plain concrete susceptible to cracking, particularly under tensile stresses, limiting its overall durability and longevity. The presence of internal micro-cracks, which propagate under stress, further exacerbates this issue, leading to brittle fracture and compromising structural integrity.To mitigate these limitations, the concept of fiber reinforcement has emerged as a transformative approach. By incorporating small, closely spaced, and uniformly dispersed fibers into the concrete matrix, a network of crack arresters is created, significantly enhancing both static and dynamic properties. This modified material, known as Fiber Reinforced Concrete (FRC), represents a paradigm shift in concrete technology, offering improved tensile strength, ductility, and resistance to cracking. The efficacy of FRC hinges on the efficient transfer of stress between the matrix and the fibers, a process influenced by factors such as fiber type, geometry, orientation, mixing and compaction techniques, and aggregate size.

The need for fiber reinforcement stems from the inherent deficiencies of traditional concrete, including its low tensile strength, high susceptibility to cracking, poor impact resistance, and shrinkage-induced cracks. These limitations not only compromise structural performance but also necessitate costly repairs and maintenance. The introduction of fiber reinforcement, particularly with engineered fibers like Recron 3S, addresses these shortcomings by enhancing ductility, reducing micro-cracking, and improving load-bearing capacity.

Recron 3S fibers, designed to optimize crack control and enhance concrete's overall performance, exemplify the advancements in fiber reinforcement technology. Their inclusion in concrete mixes aims to substantially improve the strength parameters, as supported by numerous studies. The benefits of Recron 3S fiber reinforcement extend beyond mere strength enhancement; they contribute to increased durability, reduced maintenance costs, and extended service life of concrete structures. This research explores the effects of incorporating Recron 3S fibers in concrete, aiming to quantify the improvements in mechanical properties and demonstrate the practical advantages of this innovative approach in contemporary construction practices.

Role of Recron 3S Fibre in Concrete

Recron 3S fibers act as micro-reinforcement within the concrete mix. Their benefits include:

i. ***Reduction in shrinkage cracks:*** The fibers distribute stresses evenly, reducing crack formation.

ii. ***Increased tensile and flexural strength:*** They enhance load-bearing capacity, making concrete more durable.

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iv. ***Improved impact and abrasion resistance:*** The presence of fibers prevents surface wear and damage.

v. ***Better workability and cohesion:*** They improve the bonding between aggregates and cement, reducing segregation.

OBJECTIVES

Objective points for the study described:

- To investigate the influence of varying Recron 3S fiber percentages (0%, 0.25%, 0.50%, 0.75%, and 1% by weight of cement) on the compressive strength of M20 grade concrete.
- To evaluate the impact of Recron 3S fiber inclusion on the split tensile strength of M20 grade concrete at 7, 14, and 28 days of curing.
- To determine the effect of Recron 3S fibers on the flexural strength characteristics of M20 grade concrete.

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- To assess the workability of fresh concrete mixes incorporating different percentages of Recron 3S fibers.
- To analyze the enhancement in crack resistance and ductility of M20 grade concrete resulting from the addition of Recron 3S fibers.
- To compare the mechanical properties of Recron 3S fiber reinforced concrete with those of conventional M20 grade concrete.
- To establish the optimal Recron 3S fiber content for achieving improved strength and durability in M20 grade concrete for practical construction applications. .

SCOPE OF THE STUDY:

Material Characterization: The study focuses on evaluating the effects of Recron 3S synthetic micro-fibers on M20 grade concrete.

Fiber Dosage Variation: The scope includes investigating the impact of varying fiber percentages (0%, 0.25%, 0.50%, 0.75%, and 1% by weight of cement) on concrete properties.

Workability Assessment: The study encompasses the measurement and analysis of concrete workability using slump, compaction factor, and Vee-Bee time tests.

Compressive Strength Evaluation: The scope involves determining the compressive strength of fiber-reinforced concrete at 7, 14, and 28 days of curing.

Tensile Strength Analysis: The study includes evaluating both flexural and split tensile strengths of the concrete mixes at the same curing periods.

Comparative Analysis: The scope entails comparing the mechanical properties of Recron 3S fiber reinforced concrete with those of conventional M20 grade concrete.

Optimal Dosage Identification: The study aims to identify the optimal Recron 3S fiber content that maximizes strength parameters while maintaining acceptable workability.

Laboratory-Based Investigation: The scope is limited to laboratory experimental testing and analysis of the concrete mixes, focusing on the specified strength and workability parameters.

METHODOLOGY:

Material Selection:

Procurement of standard Portland cement (OPC), fine aggregate, coarse aggregate, and Recron 3S fibers.

Characterization of aggregates (grading, specific gravity).

Mix Design:

- Design of M20 grade concrete mix as per standard specifications.
- Preparation of concrete mixes with varying Recron 3S fiber percentages (0%, 0.25%, 0.50%, 0.75%, 1% by weight of cement).

Sample Preparation:

- Casting of concrete cubes for compressive strength testing.
- Casting of concrete cylinders for split tensile strength testing.
- Casting of concrete beams for flexural strength testing.

Workability Tests:

- Conducting slump tests to assess concrete consistency.
- Performing compaction factor tests to determine workability.
- Conducting Vee-Bee time tests to determine workability.

Curing:

Curing of concrete specimens in a water tank at controlled temperature for 7, 14, and 28 days.

Strength Testing:

- Performing compressive strength tests on cube specimens at specified curing ages.
- Conducting split tensile strength tests on cylinder specimens at specified curing ages.
- Performing flexural strength tests on beam specimens at specified curing ages.

Data Analysis:

- Recording and tabulating test results.
- Analyzing the effects of fiber content on workability and strength parameters.
- Comparing the properties of fiber-reinforced concrete with plain concrete.
- Graphical representation of results.

Conclusion and Recommendations:

- Drawing conclusions based on the experimental results.

RESULTS AND DISCUSSIONS

SLUMP CONE TEST:

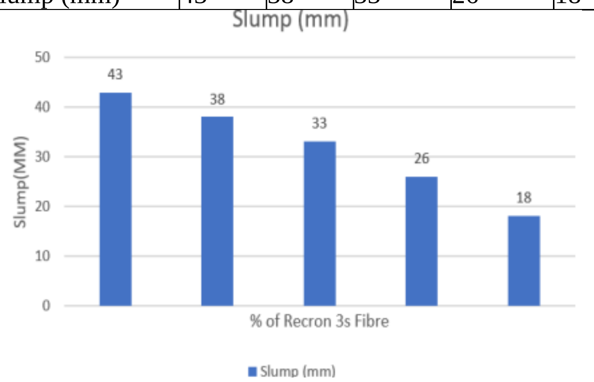
The slump test is a standard method used to measure the workability or consistency of fresh concrete.

When Recron 3S fiber is added to the concrete mix, it influences workability, reducing s lump due to its ability to bind water and enhance cohesion. Below is the step-by-step process of performing a slump test on concrete with Recron 3S fiber

The slump test results demonstrate a clear decrease in workability with increasing Recron 3S fiber content, as shown in the table below.

Table : Workability in terms of slump test

S. No	1	2	3	4	5
Mix Design	M20				
% of Recron 3s fiber	0	0.25	0.50	0.75	1
Slump (mm)	43	38	33	26	18

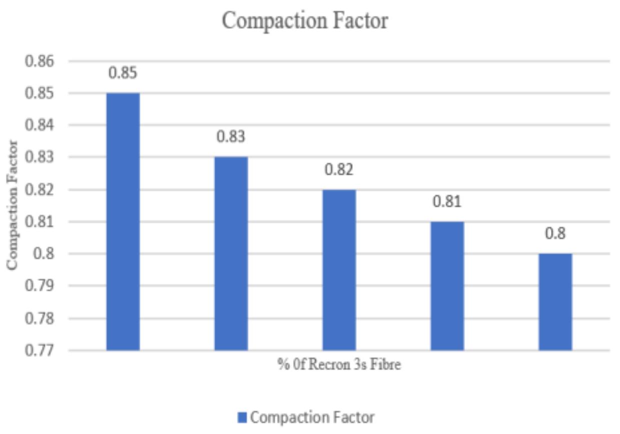


COMPACTION FACTOR TEST:

Compaction Factor Test for M20 Concrete with Recron 3S Fiber. The Compaction Factor Test is used to measure the workability of fresh concrete, especially low and medium workability mixes (like M20). When Recron 3S fiber is added, it affects the workability by increasing cohesion and reducing segregation, which can influence the compaction factor.

The compaction factor test corroborated the slump test findings, showing a reduction in workability with increased Recron 3S fiber content. The following table illustrates the decrease in compaction factor values as the fiber percentage increased.

S. No	1	2	3	4	5
Mix Design	M20				
% of Recron 3s fiber	0	0.25	0.5	0.75	1
Compaction Factor	0.85	0.83	0.82	0.81	0.80



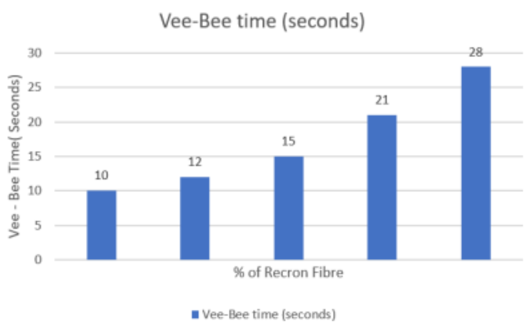
Graph : Workability in terms of compaction factor test

VEE-BEE TEST

The Vee-Bee time test further confirmed the trend of reduced workability with increasing fiber content. As shown in the table, the Vee-Bee time, which indicates the time required for concrete to be fully compacted, increased proportionally with the addition of Recron 3S fibers.

Table : Workability in terms of Vee-Bee time

S. No	1	2	3	4	5
Mix Design	M20				
% of Recron 3s fiber	0	0.25	0.50	0.75	1
Vee-Bee time (seconds)	10	12	15	21	28



Graph : Workability in terms of Vee-Bee time

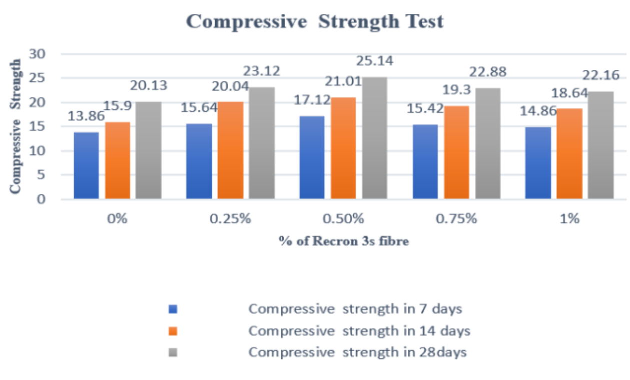
COMPRESSIVE STRENGTH:

This table presents the compressive strength of M20 concrete at 7, 14, and 28 days of curing for varying percentages of Recron 3S fibers. Notably, the compressive strength increases with curing time across all fiber percentages. The highest compressive strength at 28 days is observed at 0.50% fiber content, indicating an optimal dosage for strength enhancement. Beyond this percentage, the compressive strength decreases, suggesting a negative impact of excessive fiber addition on concrete strength.

Fig: Compressive strength

Table : Compressive strength for 7, 14 and 28 days

% of fibres	Compressive strength in days		
	7 days	14 days	28days
0%	13.86	15.90	23.13
0.25%	15.64	20.04	23.12
0.50%	17.22	21.01	25.14
0.75%	15.42	19.30	22.88
1%	14.86	18.64	22.16



Graph 5.4 :Compressive strength for 7, 14 and 28 days

Graph: Compressive strength for 7, 14 and 28 days

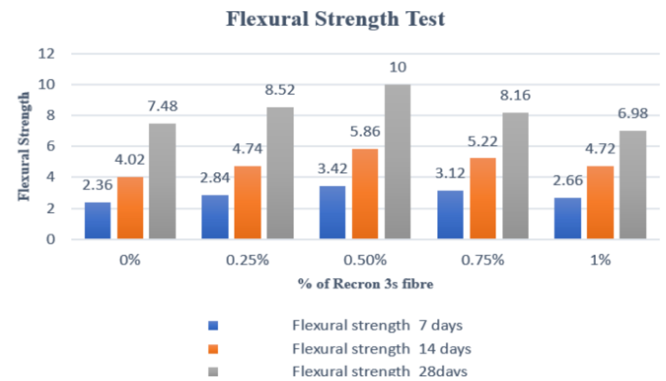
FLEXURAL STRENGTH

This table details the flexural strength of M20 concrete at 7, 14, and 28 days of curing, corresponding to different percentages of Recron 3S fibers. Similar to the compressive strength results, flexural strength improves with curing time for all fiber percentages. The maximum flexural strength at 28 days is achieved with 0.50% fiber content, signifying an optimal fiber dosage for enhancing flexural performance. Fiber percentages above 0.50% lead to a reduction in flexural strength, indicating that excessive fiber addition negatively impacts the concrete's bending resistance.

Fig: Flexural strength

Table : Flexural strength for 7, 14 and 28 day

% of fibres	Flexural strength in days		
	7 days	14 days	28days
0%	2.36	4.02	7.48
0.25%	2.84	4.74	8.52
0.50%	3.42	5.86	10
0.75%	3.12	5.22	8.16
1%	2.66	4.72	6.98



Graph : Flexural strength for 7, 14 and 28 days

SPLIT TENSILE STRENGTH

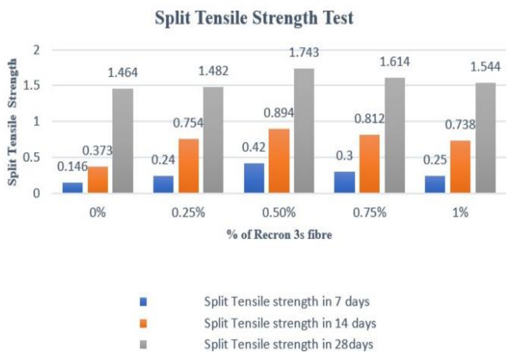
This table shows the split tensile strength of M20 concrete at 7, 14, and 28 days of curing for varying percentages of Recron 3S fibers. Consistent with the compressive and flexural strength trends, the split tensile strength increases with curing time.

Fig: Split Tensile Strength

The highest split tensile strength at 28 days is observed at 0.50% fiber content, highlighting the optimal fiber dosage for enhancing tensile resistance. Beyond this percentage, the split tensile strength decreases, indicating that excessive fiber addition reduces the concrete's ability to withstand tensile stresses.

Table: Split Tensile strength for 7, 14 and 28 days

% of fibres	Flexural strength in days		
	7 days	14 days	28days
0%	0.146	0.373	1.464
0.25%	0.24	0.754	1.482
0.50%	0.42	0.894	1.743
0.75%	0.30	0.812	1.614
1%	0.25	0.738	1.544



Graph: Split Tensile strength for 7, 14 and 28 days

CONCLUSION:

This study provides valuable insights into the impact of Recron 3S fiber inclusion on M20 grade concrete. Through rigorous testing, it identifies the optimal fiber content for maximizing strength while acknowledging the trade-off with workability. The research highlights the potential for cost-effective, high-performance concrete, offering practical guidance for construction applications.

Optimal Fiber Content Identified: The study precisely determined that 0.50% Recron 3S fiber addition yields the maximum compressive, flexural, and split tensile strengths.

Significant Strength Enhancement: Concrete with 0.50% fiber content showed a substantial 25.14% increase in compressive strength and a 1.743% increase in split tensile strength.

Demonstrated Improved Mechanical Properties: The research effectively quantified the improvement in flexural and split tensile strengths, crucial for structural applications.

Potential for Cost Savings: The findings suggest Recron 3S fibers can act as a secondary reinforcement, potentially reducing the need for traditional steel reinforcement and leading to cost-effective construction.

Clear Correlation Between Fiber Content and Workability: The study established a clear inverse relationship between fiber content and workability, providing practical guidance for mix design.

Comprehensive Testing and Analysis: The study utilized standard tests (slump, compaction factor, compression, flexural, and split tensile) to provide a robust evaluation of concrete properties.

Practical Applicability: The research provides valuable insights for optimizing concrete mixes in real-world construction scenarios, enhancing durability and performance

REFERENCES:

1. Aïtcin, P. C. (1998). High-performance concrete. CRC press.
2. Mehta, P. K., & Monteiro, P. J. M. (2014). Concrete: microstructure, properties, and materials. McGraw-Hill Education.
3. Mindess, S., Young, J. F., & Darwin, D. (2003). Concrete. Prentice Hall.
4. Neville, A. M. (2011). Properties of concrete. Pearson Education.
5. ACI Committee 544. (1996). State-of-the-art report on fiber reinforced concrete. American Concrete Institute.
6. Bentur, A., & Mindess, S. (2007). Fibre reinforced cementitious composites. CRC press.
7. Ramakrishnan, V. (1988). Fibre reinforced concrete. In Advanced concrete technology (pp. 307-369). Elsevier.
8. Song, P. S., & Hwang, S. (2004). Mechanical properties of high-strength steel fiber-reinforced concrete. Construction and building materials, 18(9), 669-673.
9. Naaman, A. E. (2003). Reinforced concrete analysis and design. McGraw-Hill.
10. Trottier, J. F., Forgeron, D., & Pigeon, M. (1992). Workability of fibre-reinforced concrete. Cement and Concrete Research, 22(4), 679-687.
11. Balaguru, P. N., & Shah, S. P. (1992). Fiber-reinforced cement composites. McGraw-Hill.
12. Kansal, P., Singh, G., & Kumar, S. (2016). Effect of Recron 3s fiber on mechanical properties of concrete. International Journal of Engineering Research and Applications (IJERA), 6(3), 108-113.
13. Kumar, A., & Sharma, A. (2018). Experimental investigation on mechanical properties of concrete reinforced with Recron 3s fibers. Materials Today: Proceedings, 5(2), 4880-4887.
14. Lee, B. Y., Kim, J. K., & Kim, J. H. (2010). Mechanical properties of high-performance hybrid steel-fiber-reinforced concrete. Cement and Concrete Research, 40(1), 66-73.
15. Altun, F., Hakan, G., & Yilmaz, I. (2007). Effects of steel fiber addition on mechanical properties of concrete and reinforced concrete beams. Construction and building materials, 21(3), 654-661.
16. Soroushian, P., & Bayasi, Z. (1991). Fibre reinforced concrete under direct shear. ACI Materials Journal, 88(1), 100-105.
17. Fanella, D. A., & Naaman, A. E. (1985). Stress-strain properties of fiber reinforced mortar in compression. ACI Journal, 82(1), 47-56.
18. Khuntia, M., Stojadinovic, B., & Goel, S. C. (1999). Shear strength of steel fiber-reinforced concrete beams without stirrups. ACI Structural Journal, 96(2), 282-289.
19. Easawy, A. A., & Najm, H. (2014). Effect of steel fibers on mechanical properties of high strength concrete. Alexandria Engineering Journal, 53(3), 699-705.
20. ACI Committee 544. (2010). Design recommendations for specifying and constructing fiber-reinforced concrete structures. American Concrete Institute.