Experimental Study on Flexural Strength of Concrete Using Different Types of Fibres

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Abstracts

Concrete is one of the most widely used construction materials globally due to its high compressive strength, durability, and versatility. However, its inherent brittleness and low tensile strength often lead to cracking and structural deficiencies under flexural loads. To address these limitations, the incorporation of fibers into concrete has emerged as a promising solution, enhancing its mechanical properties and performance. This project investigates the effects of incorporating different types of fibers such as steel, glass and polypropylene on the flexural strength of concrete.

The primary objective of this study is to assess the impact of these fibers on the flexural behavior of concrete. The research methodology involves preparing multiple concrete specimens with varying fiber types and concentrations, followed by a series of standardized flexural strength tests. These tests are conducted using a four-point bending test setup to accurately measure the flexural strength and ductility of the fiber-reinforced concrete specimens. Data analysis will involve comparing the flexural strength of fiber-reinforced concrete to that of conventional concrete, identifying the optimal fiber type and dosage that offer the best improvement in flexural properties.

Keywords: *Flexural Strength, Durability, Fibres*

1. Introduction

Fibre reinforcement involves the addition of discrete fibres to the concrete mix, which helps to improve its overall performance characteristics. Various types of fibres such as steel, polypropylene, glass, and synthetic fibres have been utilized to address specific challenges in concrete applications. These fibres contribute to enhanced toughness, ductility, and resistance to cracking, thereby improving the material's flexural strength. As the demand for high-performance concrete increases, understanding how different fibres influence flexural properties becomes crucial for both structural integrity and longevity. The use of Fibre-Reinforced Concrete has led to a lot of debate in the engineering community. Many studies support FRC because it can significantly improve properties like tensile strength, help reduce cracks, and increase durability and some studies point out that not all types of fibres are appropriate for every situation. Plus, the absence of standardized testing methods can result in varying outcomes, making it hard to compare results across different studies. There’s also a question about whether the performance improvements justify the additional costs and complexities that come with using FRC. This project aims to provide our perception on FRC. We’re conducting an experimental study that focuses specifically on how different types of fibres affect the flexural strength of concrete.

2. *Aim and Objectives*

Aim-To evaluate the impact of different types of fibres on the flexural strength of concrete using standardized tests.

Objectives

- To compare the flexural strength of plain concrete and with fibre-reinforced concrete.
- To compare the performance of different fibres in enhancing the flexural properties of concrete.
- To determine the optimal dosage for maximizing flexural strength of concrete.
- To identify the most effective fibre type that provides best improvement in flexural strength.

3. *Literature Review*

H. B. Ali & A. A. Adesola (2023)

This recent study evaluates engineered fibre-reinforced concrete's performance, focusing on flexural strength compared to traditional mixes. The results indicate substantial improvements in mechanical properties, suggesting its potential for innovative construction methods.

K. M. F. Bakar (2022)

The research discusses the optimization of fibre content in concrete mixtures to achieve maximum flexural strength. Experimental designs and statistical analyses led to the identification of optimal fibre dosages that enhance strength while being cost-effective.

M. A. J. Abed (2020)

This study examines how the aspect ratio of fibres influences flexural strength. . Higher aspect ratios contribute to improved flexural performance due to better crack control and load transfer mechanisms. The research underscores the importance of selecting appropriate fibre types and aspect ratios in the design of fibre-reinforced concrete for various structural applications.

F. L. Almeida & P. M. Teixeira (2019)

This research investigates the effects of fibre reinforcement on both shear and flexural strengths of concrete beams. The findings reveal that fibre inclusion enhances overall structural performance under various loading conditions.

S. S. Mahmud (2019)

This research evaluates the flexural strength of high-performance fibre-reinforced concrete, highlighting its superior mechanical properties. The study suggests that the combination of high-performance materials and fibre reinforcement leads to exceptional structural capabilities.

J. K. V. Prakash & R. N. S. Rao (2018)

The paper employs finite element modelling (FEM) to analyse the flexural behaviour of fibre-reinforced concrete, comparing experimental data with simulation results. The findings confirm that FEM can accurately predict flexural strength in fibre-reinforced applications.

R. S. Ranjbaran & M. A. Keshavarz (2017)

This study focuses on the effects of various fibre types (steel, polypropylene, and glass) on the flexural strength of concrete. Experimental results reveal that steel fibres provide the highest enhancement, while polypropylene fibres improve ductility.

4. Methodology

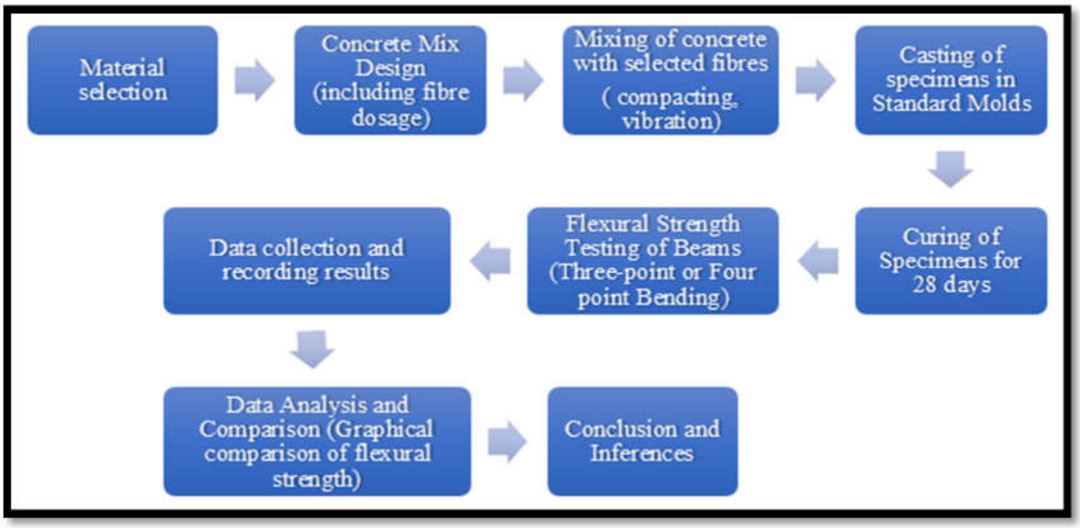

Fig.4.1 Experimental study procedure

Fig.4.2 Mixing of Concrete

Fig.4.3 Casting of Concrete

Fig.4.3 Curing using air compressor

Fig.4.3 Finished Specimen of Beams

5. Results & Discussions

The control sample, which contains no fibers, serves as a baseline for comparison, allowing us to quantify the enhancements provided by each type of fiber. Additionally, we will compare the performance of the different fiber-reinforced concrete mixes against each other to determine the most effective fiber type and content for improving flexural strength.

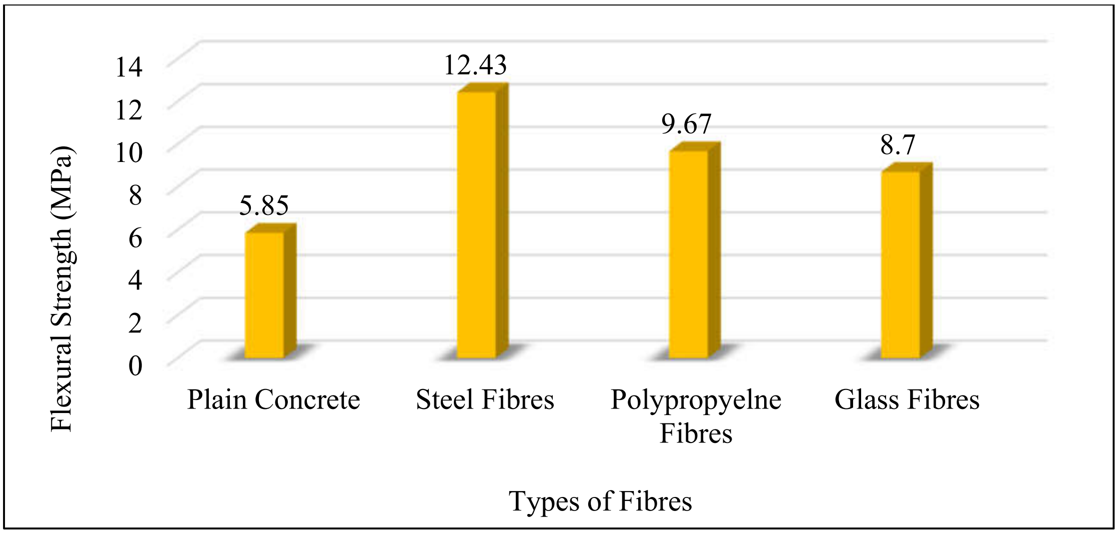

Fig.5.1 Comparison between plain concrete and fibre reinforced concrete

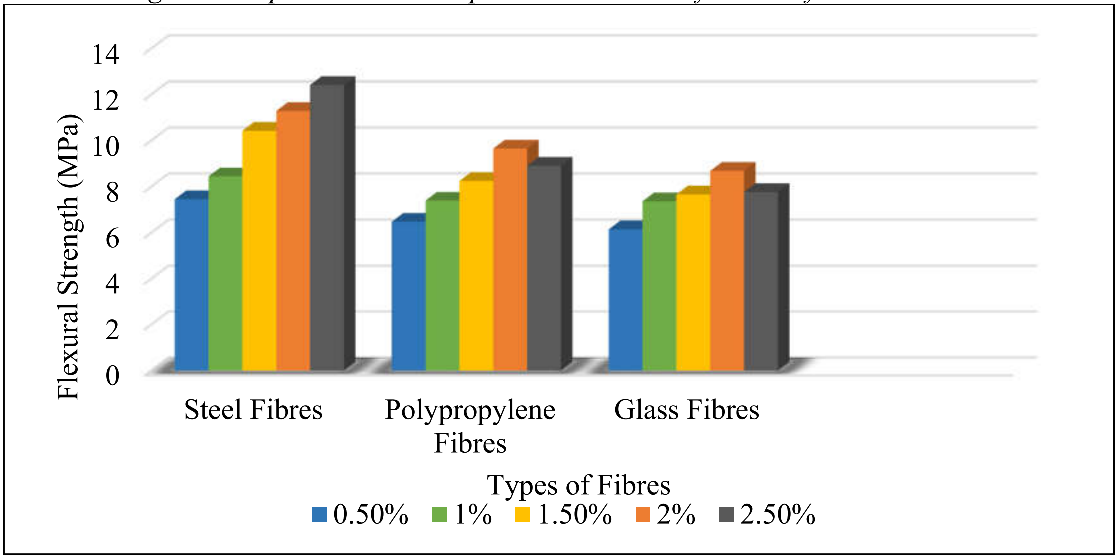

Fig.5.2 Comparison between different types of fibres

6 Conclusions

The results indicate that each type of fiber significantly influences the flexural strength of the concrete. Steel fibers consistently demonstrated the highest enhancement in flexural strength across all percentages, peaking at 2.5% fiber content, where the interaction of high tensile strength and ductility provided optimal performance. Glass fibers, while effective, showed slightly diminishing returns beyond 2% fiber content, likely due to their brittleness. Polypropylene fibers exhibited a notable increase in flexural strength at 2% but were less effective compared to steel and glass fibers.

Overall, steel fibers at 2.5% emerged as the most effective reinforcement, providing the best balance between strength and ductility, while the optimum dosage for glass and polypropylene fibers was identified at 2%, where they also contributed positively to the material's structural integrity.

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