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Enhancing Compressive Strength of Concrete Using Coconut Fiber

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Abstract: This study looks at how adding natural coconut fiber affects the strength of M25 concrete. Concrete mixes with 1%, 2%, and 3% fiber (by weight of cement) were tested after 7 and 28 days. The results show that the right amount of fiber can improve strength and help use waste materials in a useful way.

Keywords: *Coconut Fiber, Fiber Reinforced Concrete (FRC), Compressive Strength, M25 Grade, Sustainable Construction.*

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I. INTRODUCTION

Concrete is the most widely used construction material due to its versatile properties and economic availability. However, it is inherently brittle and weak in tension. To overcome this drawback, fiber reinforcement has been introduced into concrete mixes. While synthetic fibers have shown promising results, the environmental impact of their production and disposal calls for the use of natural alternatives. Coconut fiber, an agricultural by-product, presents an eco-friendly and cost-effective solution. The primary aim of this research is to study the compressive strength of M25 grade concrete mixed with varying percentages of coconut fiber.

➢ *Aim*

The aim of this project is to enhance the compressive strength of M25 grade concrete by incorporating **natural coconut fiber** as a reinforcing material, and to evaluate its effectiveness by comparing it with conventional concrete through 7-day and 28-day compressive strength tests.

➢ *Objective*

- To determine the effect of coconut fiber on the compressive strength of M25 grade concrete.
- To compare compressive strength results for different fiber contents (1%, 2%, and 3%) at 7 and 28 days.
- To identify the optimum percentage of coconut fiber for maximum strength.

II. METHODOLOGY

➢ *Collection of Materials:*

- **Cement:** PPC (Grade 25)
- **Coconut Fiber:** Collected from temples

➢ *Material Property Analysis*
➢ *Concrete Mix Design with Coconut Fibers*
➢ *Casting and De-mouldin*

Fig 1: Coconut Fiber

➢ *Analysis of Properties of Materials*

- *Material Properties*

✓ **Fiber Treatment**: Coconut hair fibers were cleaned using a coconut oil and water mix.
✓ **Water**: Fresh tap water from the concrete lab was used.

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✓ **Fine Aggregate**: Locally available sand passing a 4.75 mm sieve.
✓ **Coarse Aggregate**: 20 mm size crushed stone.

- *Mix Details*

✓ **Mix Ratio**: 1:1.704:2.94 (cement:sand:coarse aggregate)
✓ **Water-Cement Ratio**: 0.57

- *Casting Procedure*

Concrete was placed in moulds, compacted to remove voids, and leveled. Moulds were removed once the mix had set adequately.

Fig 2: Concrete Setting

➢ *Compressive Strength Test*

III. RESULT

The compressive strength of both conventional concrete and coconut fiber reinforced concrete (CFRC) was tested at **7 days** and **28 days** of curing. The results demonstrate the effect of fiber inclusion on the mechanical performance of M25 grade concrete.

- **Mould Size:** Square mould with an area of **150 cm²**
- **Concrete Mix Ratio** (Cement: Fine Aggregate: Coarse Aggregate): 1: 1.704: 2.94.

Fig 3: Testing Compressive Strength of Cubes

Table 1: Conventional Concrete

SR. NO.	DAYS	COMPRESSIVE STRENGTH IN MPa
1	7	19.25
2	28	29.62

Table 2: Coconut Fiber (1%)

SR. NO.	DAYS	COMPRESSIVE STRENGTH IN MPa
1	7	25.18
2	28	29.11

Table 3: Coconut Fiber (2%)

SR. NO.	DAYS	COMPRESSIVE STRENGTH IN MPa
1	7	26.66
2	28	37.19

Table 4: Coconut Fiber (3%)

SR. NO.	DAYS	COMPRESSIVE STRENGTH IN MPa
1	7	25.18
2	28	33.78

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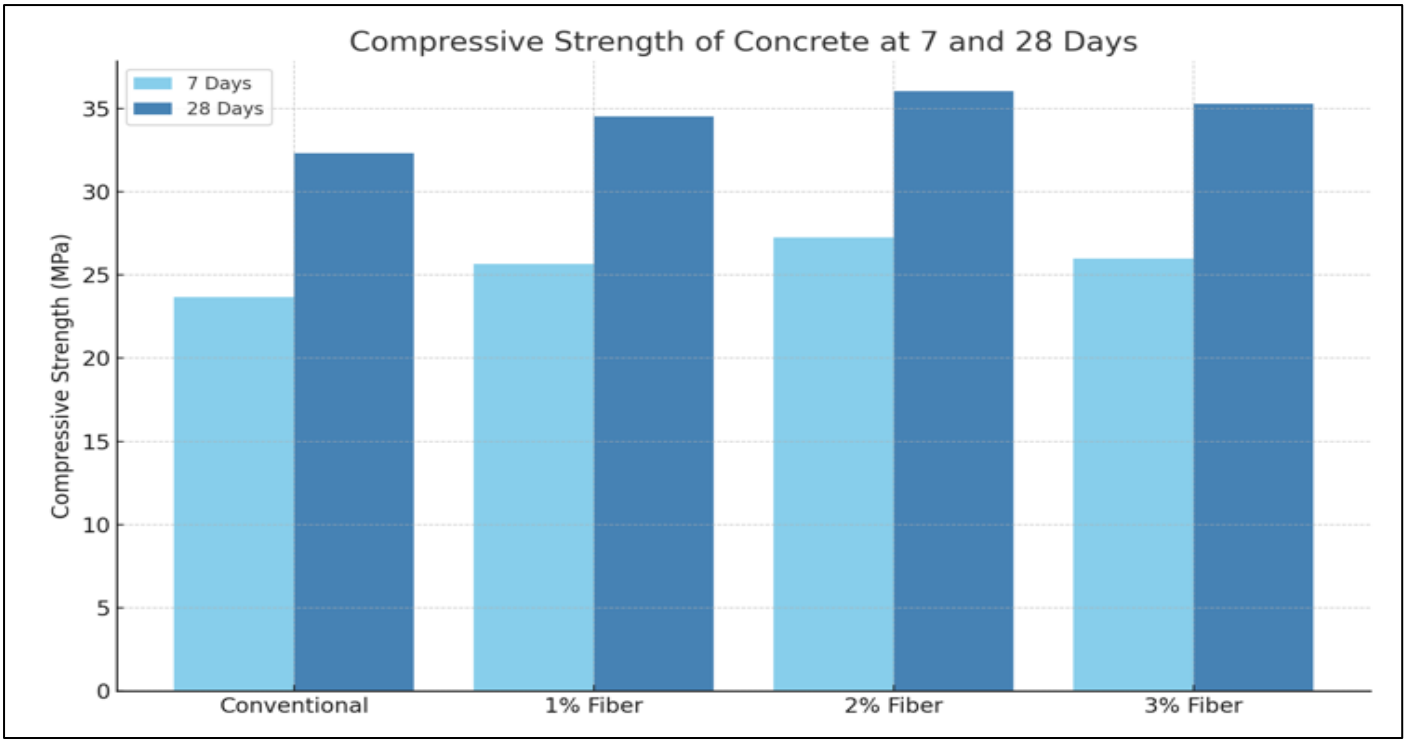

Fig 4: Graphical Representation of Compressive Strength at 7 and 28 Days

IV. CONCLUSION

The incorporation of coconut fiber into M25 concrete improves its compressive strength up to an optimal level of 2%. This study shows that:

- Coconut fiber enhances concrete strength due to improved crack-bridging and energy absorption.
- The optimal fiber percentage is 2% by weight of cement for maximum compressive strength.
- Beyond this limit, excess fibers may hinder compaction, reducing strength.
- The use of natural fiber promotes sustainable construction practices and reduces environmental impact.

This investigation encourages further research into long-term durability, flexural behavior, and cost analysis of natural fiber reinforced concrete.

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