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Strength Studies on Carbon Fibre Reinforced Concrete with Coconut Shell as Partial Replacement for Coarse Aggregate

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Abstract - *Concrete is made of cement, water, and aggregates like sand and gravel. Over time, the mixture solidifies into a durable substance. It is used in a variety of building projects because of its affordability, toughness, and capacity to take on nearly any shape. Concrete is the artificial material that is used the most in the world. To explore the properties of concrete, it is suggested that some of the coarse aggregate needed to provide the necessary strength be substituted with coconut shell. It could be advantageous to replace some of the coarse aggregate with coconut shell at percentages of 5%, 10%, and 15%.Fibres possess the properties that increase the durability of concrete. Among them is carbon fibre. These carbon fibres offer superior mechanical properties and could be used more effectively. By examining differences in fibre composition, this study aims to compare the strength of carbon fibre concrete with regular concrete. Concrete containing carbon fibre is tested at 0.5%, 1%, and 1.5% of the total volume of the concrete. The concrete's split tensile strength and compressive strength were evaluated for 28,56 and 90 days.*

KEYWORDS: Coconut shell, Carbon fibres , Compressive strength and Split tensile strength.

I. INTRODUCTION

Concrete is a composite material that dries over time and is made of cement paste and fine and coarse aggregate. The majority of the concert is made of hydraulic cement or concrete with a lime base. Waste products like peanut shell ash are produced by the peanut industry. Usually, it is disposed of outside without considering the advantages for the economy or the environment.

The coconut shell is another material that can be used in place of other elements in concrete. A portion of the coarse material in this project is replaced with coconut shells. As a result, there are fewer land filings related to waste material dumps in barren areas. The impact load resistance of coconut shells is significantly higher than that of ordinary concrete.

Because of its low density, great heat conductivity, superior chemical stability, and remarkable abrasion resistance, carbon fibres can be used to reduce shrinkage and breakage. The structure's tensile and compressive strengths are enhanced by these fibres. Carbon fibres also increase durability and dry shrinkage. Conversely, carbon fibres lessen electrical resistance.

2. OBJECTIVES:

1. To enhance the coarse aggregate with a partial coconut shell substitution.

2. Examining the mechanical properties of carbon fibre reinforced concrete is the primary goal of this study.

3. MATERIALS

3.1 Cement: A binder, often known as a material that hardens, solidifies, and unites other materials to form a bond, is what cement is. Typically, sand and gravel are mixed with cement to create a mixture. Concrete is made by combining cement with sand and gravel, while mortar is made by mixing cement with small particles. In building, cement is utilised; it is typically inorganic, frequently derived from calcium and lime silicate, and available in both hydraulic and non-hydraulic forms.

3.2 Fine Aggregate: In the current experiment, the fine aggregate was river sand that was easily accessible.

3.3 Coarse Aggregate: Aggregate that remains above the IS Sieve 4.75 mm is referred to as coarse aggregate. An incremental size increase of 10–20 mm is the typical maximum, according to IS383:1970.

3.4 Water : The concrete was mixed and allowed to cure using only pure tap water after the aggregates had been cleaned.

3.5 Coconut Shell: The study's findings demonstrate the potential of coconut shell concrete (CSC) as a lightweight

concrete. In addition to being a more affordable and eco-friendly substitute for aggregate, coconut shell can assist address the issue of conventional materials like coarse aggregate running out of source.

3.6 Carbon Fibre: One kind of carbon filament is called carbon fibre, which is created by heating carbon atoms to a particular pressure and joining them with a polymer glue. It's a highly transmissible, light material.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

Compressive strength is a crucial aspect of concrete that ne eds to be evaluated because it serves as a gauge for the qua lity of the material.

Table1: Compressive strength result of concrete with Coconut Shell as partial replacement of Coarse aggregate.

Sl.no	% Of CS	Compressive strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	39.74	43.17	46.47
2	2.5%	53.47	58.25	62.22
3	5%	55.68	60.54	65.04
4	7.5%	33.69	36.71	39.41

Table 2: Compressive strength result by addition of Carbon Fibre Reinforced Concrete

Sl.no	% Of CFRC	Compressive strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	39.74	43.17	46.47
2	0.5%	56.09	61.03	65.61
3	1.0%	63.67	68.77	73.88
4	1.5%	53.48	58.11	62.56

Table 3: Combined compressive strength result with 5% Coconut Shell as partial replacement of Coarse aggregate and by adding 1.0% Carbon fibre reinforced concrete.

Sl.no	% Of CF+CFRC	Compressive strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	39.74	43.17	46.47
2	5% of CS++1.0% CFRC	71.57	77.93	83.02

4.2 Split tensile strength results

Results of the split tensile strength test for the cast and cured specimens, performed in a compressive strength machine, are shown in a table.

Table 4: Split tensile strength of concrete with Waste Foundry Sand as partial replacement of fine aggregate.

Sl.no	% Of CS	Split tensile strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.56
2	2.5%	5.28	5.75	6.14
3	5%	5.45	5.92	6.37
4	7.5%	3.31	3.64	3.85

Table 5: Split tensile strength of concrete by addition of banana fibres.

Sl.no	% Of CFRC	Split tensile strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.56
2	0.5%	5.17	5.63	6.04
3	1.0%	6.17	6.69	7.15
4	1.5%	4.25	4.62	4.93

Table 6: Combined Split tensile result with 15% Waste foundry sand replace with fine aggregate and by adding 0.5% Banana fibre in concrete.

Sl.no	% Of CS+CFRC	Split tensile strength Results (N/mm²)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.56
2	5% of CS++1.0% CFRC	6.91	7.49	8.01

5. CONCLUSION:

1. The Normal Concrete Compressive strength result for 28,56 and 90 days is 39.74 , 43.17 and 46.47 N/mm².

2. At 5% replacement of coarse aggregate by coconut shell the compressive strength of concrete for 28,56 and 90 days is 55.68 , 60.54 and 65.04 N/mm².

3. By addition of 1.0% Carbon fibre in concrete the compressive strength of concrete for 28,56 and 90 days is 63.67 , 68.77 and 73.88 N/mm².

4. Combined replacement of coarse aggregate by coconut shell and 1.0% of Carbon fibre adding on concrete the compressive strength of concrete for 28,56 and 90 days is 71.57 , 77.93 and 83.02 N/mm².

5. The Normal Concrete Split tensile strength result for 28,56 and 90 days is 3.93 , 4.28 and 4.56 N/mm².

6. At 5% replacement of coarse aggregate by coconut shell the Split tensile strength of concrete for 28,56 and 90 days is 5.45 , 5.92 and 6.37 N/mm².

7. By addition of 1.0% Carbon fibre in concrete the Split tensile strength of concrete for 28,56 and 90 days is 6.17, 6.69 and 7.15 N/mm².

8. Combined replacement of coarse aggregate by coconut shell and 1.0% of Carbon fibre adding on concrete the Split tensile strength of concrete for 28,56 and 90 days is 6.91 , 7.49 and 8.01 N/mm².

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