Enhance Properties of Concrete using Fly Ash or Coconut Fiber for Paving

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Abstract— Saravana Raja Mohan, and co-workers carried out experiment investigation to evaluate the properties of fly ash based coconut fiber composite cement was replaced with five percentages (10%, 15%, 20%, 25%, & 30%) of class C fly ash. Four percentages of coconut fibers (0.15, 0.3, 0.45 & 0.60%) having 40mm length were used. The fly ash based coconut fiber reinforced concrete shows a better performance than ordinary concrete.

Keywords: Strength, Flexural, Strength, Concrete Blocks, Workability, Fiy Ash, Coconut Fiber, Paving, Concrete

I. INTRODUCTION

The utilization of fly ash (instead of dumping it as a waste material) can be both on economic and environmental grounds and also because of its beneficial effects of lower water demand for similar workability reduced bleeding and lower evolution of heat. The proportion of fly ash used as a cementations component in concrete depends on several factors: The design strength workability of concrete, water demand and relative cost of fly ash compared with cement are particularly important in mixture proportioning of concrete.

Concrete in general is brittle with increase in strength. This is a major drawback since brittleness can cause sudden & catastrophic failure, especially in structures which are subjected to earthquake, blast, suddenly applied loads and impact. This serious disadvantage of concrete can at least be partially overcome by the

Incorporation of fibers. The incorporation of fiber can cause a change in the failure mode under compressive deformation from brittle, thereby imparting a degree of toughness to concrete.

The test result showed that the maximum compressive strength was obtained for a mix having a fiber length of 40mm 10% fly ash & fiber content of 0.15% by weight and increase in strength over plain cement concrete was found to be 27.51 Mpa. The 7 day compressive strength of fly ash based fiber concrete was found to be as high as 18.95 Mpa which is about 25.91% more than ordinary concrete. Similarly 28 day compressive strength was found to be about 27.51 Mpa and is 45.81% more than the ordinary concrete.

The maximum value of splitting tensile strength obtained is 4.75Mpa which is about 35.71% more than ordinary concrete the maximum strength was obtained for a mix with fiber length 40mm, fiber content 0.3% by weight & 15% fly ash replacement of cement.

A. Fly Ash Based Innovative & Commonly Produced Building Products & available in India

1) Cellular lightweight concrete (CLC) blocks.
2) Fly ash based polymer composites as wood substitute.
3) Fly ash based Portland pozzolana cement.
4) Ready mixed fly ash concrete.
5) Fly ash sand lime gypsum (cement) bricks/blocks.
6) Clay fly ash bricks.

B. Coconut Fiber

Coconut fiber is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fiber is Coir, Cocos nucifera and Arecaceae (Palm), respectively. Coconut cultivation is concentrated in the tropical belts of Asia and East Africa.

There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts.

II. METHODOLOGY

Workability of concrete test like slump cone test and compaction factor test.

Mechanical properties like Compressive strength, Split Tensile strength, Flexural strength test and Modulus of Elasticity.

A. Experiment

Sl. No.	Particular	Mix Design	Code	No. of Specimen	Curing period in Days	Remark
1	Cube	M20	S6	9	7, 14,28	Cube size 150X150X 150mm
2	Cylinder	M20	S6	3	28	Cylinder size 200x100mm
3	Prism	M20	S6	3	28	Prism size 500x100x100mm

Table 1: Casting & Curing of M20 GRADE of Concrete with 20% Cement Replaced by Fly Ash and 0.25% of Coconut Fiber of 20mm

Sl. No.	Particular	Mix Design	Code	No. of Specimen	Curing period in	Remark

					Days	
1	Cube	M20	S7	9	7, 14,28	Cube size 150X150X 150mm
2	Cylinder	M20	S7	3	28	Cylinder size 200x100mm
3	Prism	M20	S7	3	28	Prism size 500x100x100mm

Table 2: Casting and Curing of M20 GRADE of Concrete with 30% Cement Replaced by Fly Ash and 0.25% of Coconut Fiber of 20mm

III. Results & Discussion

Compressive strength of concrete mixes made with and without fly ash and coconut fiber with different percentage and variation in length of fiber were determined at 7, 14, and 28 days of curing. The test results are given in table and shown in figure. The maximum compressive strength was obtained for a mix having a fiber length of 40 mm, 10% fly ash and fiber content of 0.25% by weight and increase in strength over plain concrete and fly ash concrete without fiber content.

The 7 day compressive strength of fly ash based coconut fiber concrete was found to be high as 17.9 Map. Which is more than ordinary concrete and fly ash concrete? Similarly 28 day compressive strength was found to be about 27 Map which is more than that of ordinary concrete and fly ash concrete.

The effect of replacement of cement with three percentages of fly ash and addition of coconut fibers on the compressive strength of concrete is shown figure. It is clear that the replacement of cement with 30 % of fly ash reduced the compressive strength of concrete. And for a particular percentage of fly ash there was a decrease in compressive strength of fly ash concrete, as the percentage of fiber increased from 0.25% to 0.5%. However, this reduction in strength with addition of fibers continued to decrease with an increase in the percentage of fly ash content. Generally, presence of fibers induces porosity and reduces compressive strength depending upon fly ash content.

IV. Conclusions

- It has been observed that as the percentage of fly ash increases the compressive strength increases initially, on further increase in its percentage reduces its compressive strength.
- The splitting tensile strength of concrete decreased with replacement of cement with 20% and 30% fly ash. Addition of coconut fibers increased the fly ash concrete as the percentage of fiber increased from 0.25% to 0.5%.
- The maximum splitting tensile strength of the cylinder obtained was 3.9 Mpa for the mix 10% fly ash with fiber length of 40mm and fiber content of 0.25%.
- Replacement of cement with fly ash reduced the flexural strength. However, addition of coconut fibers marginally increased the flexural strength of fly ash concrete as the percentage of fiber increased from 0.25 to 0.5%.
- The maximum value of flexural strength obtained was 4.2Mpa, for the mix with fiber length of 40mm, 10% fly ash and fiber content of 0.25%.
- The maximum value of modulus of elasticity obtained was 2.7 Mpa x 10^4, for the mix with fiber length 20mm, 10% fly ash and fiber content of 0.5%.
- Results of this investigation suggest that Class F fly ash could be very conveniently used in structural concrete.

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