Evaluation of Strength Properties of Hybrid Fiber (Plastic + Coir + Areca nut Husk) Reinforced Concrete

Manjunath Itagi, B.P. Annapurna.

Abstract- In construction industry, concrete is used entirely in the world. The production of waste increases as the development of infrastructure increases. The waste disposal is becoming waste management problem. This targets to promote recycling of waste and energy recover is one of the significant applications of the work in the construction industry. In the present investigation, the influence of plastic + Coir + Areca nut husk fibers are studied. the fiber varying percentages are 0.5% to 3.0% at interval of 0.5% by weight of cement. M-20 fiber reinforced concrete is studied for various strength like flexural, compressive and split tensile strengths. Tests are determined as per Indian Standard codes. The tested results are compared with normal concrete. From the results, it is observed that strength of concrete increases due to addition of fibers. Addition of Fiber of 1.5% shows the best increase in strength. It was found that the proposed waste plastic + Coir + Areca nut husk fiber can be used in construction industry leading to safe and economical disposal of the wastes.

Keywords: Plastic + Coir + Areca nut husk fiber, Hybrid fiber reinforced concrete (HFRC), Flexural, Compressive and split Tensile strengths

I. INTRODUCTION

In developing and developed countries, concrete is used entirely in the world. The quality of concrete are important for its performance in the mix. We knew that concrete is brittle in nature. Addition of fibers controls cracks in concrete. The fibers were cheap and waste material, which can be used in concrete to develop strength. The organic and inorganic fibers are added in concrete and its different strengths are determined by many researchers in the world. The present investigation, an attempt has been put in this paper is to control the cracks due to addition of plastic and natural fibers in normal concrete.

Scope and objective of work
1. To introduce plastic + Coir + Areca nut husk fiber in conventional concrete.
2. To vary the percentage of plastic + Coir + Areca nut husk fiber in conventional concrete.
3. To compare conventional concrete with plastic + Coir + Areca nut husk fiber reinforced concrete in terms of different strengths of concrete.
4. To find out optimum % of fiber content Description of concrete specimen is presented in

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test</th>
<th>Results</th>
<th>Requirements as per IS 12269:1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific Gravity</td>
<td>3.10</td>
<td>3.15</td>
</tr>
<tr>
<td>2</td>
<td>Fineness of cement</td>
<td>6.15%</td>
<td>Less than 10%</td>
</tr>
<tr>
<td>3</td>
<td>Standard Consistency</td>
<td>29%</td>
<td>Not Specified</td>
</tr>
</tbody>
</table>

Table 1 Description of concrete specimen

<table>
<thead>
<tr>
<th>Designation of concrete</th>
<th>% of fiber</th>
<th>No. of specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>cubes</td>
<td>prism</td>
<td>cyliner</td>
</tr>
<tr>
<td>Conventional concrete</td>
<td>CC</td>
<td>0</td>
</tr>
<tr>
<td>concrete with plastic + Coir + Areca nut husk fiber for varying % of fiber (0.5% to 3.0%)</td>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>HFRC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II. EXPERIMENTAL INVESTIGATION MATERIALS

Cement
The character of concrete depends the quality and quantity of cement. In this paper, Birla super cement 53 grade was used for the present research. Tests are carried out according to IS-12269:1987. Cement properties are as tabulated in Table 2.

Table 2 Cement Properties

Fine aggregate
The character of concrete depends the quality and quantity of M-sand. In this paper, locally available M-sand was used for the present research. Tests are conducted according to IS. M-sand properties are presented in Table 3.

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Table 3 Fine Aggregate Properties

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Physical properties</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific Gravity</td>
<td>2.65</td>
</tr>
<tr>
<td>2</td>
<td>Fineness Modulus</td>
<td>2.73</td>
</tr>
<tr>
<td>3</td>
<td>Bulk density (kg/m³)</td>
<td>1445</td>
</tr>
</tbody>
</table>

Coarse aggregate

The character of concrete depends the quality and quantity of coarse aggregate. In this paper, coarse aggregate was used and tests are conducted according to IS - 23861963. Coarse aggregates properties are tabulated in Table 4.

Table 4 Coarse Aggregates Properties  (12.5mm down size)

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Particulars</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fineness Modulus</td>
<td>4.2</td>
</tr>
<tr>
<td>2</td>
<td>Specific Gravity</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Water

Clean potable water was used for mixing and curing of concrete.

Plastic fiber

The waste plastic fiber is obtained from LM Wind Power Blades (India) Pvt. Ltd Bangalore- 562111.

Coir fiber

The fiber is obtained from coir industry.

Areca nut husk fiber

The fiber is obtained from areca nut industry. Fiber properties are tabulated in Table 5.

Table 5 Fiber Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Plastic fiber</th>
<th>Coir fiber</th>
<th>Areca nut husk fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>0.234</td>
<td>0.240</td>
<td>-0.017 to 0.394</td>
</tr>
<tr>
<td>Tensile Strength (N/mm²)</td>
<td>226</td>
<td>189</td>
<td>--</td>
</tr>
</tbody>
</table>

Design Mix

M-20 was designed according to IS-10262-2009. The concrete mix ratio obtained is 1:2.12:2.15.

III EXPERIMENTAL PROGRAMME

M-20 mix design is prepared by addition of plastic fibers. The cube size 100*100*100mm, cylindrical size length-300 and dia-150mm and prism size 100*100*500mm specimens were casted with Plastic fiber(FRCP) of 0.5%, 1.0%, 1.5%, 2%, 2.5% and 3.0% and without fibers.

Testing of specimen

Concrete specimens were tested for different fibers and various strengths like compression, split and flexural strengths respectively according to IS specification after curing 28 days.

Compressive strength

Compressive test is conducted according to IS – 516:1959.

Flexural strength

Flexure test conducted according to IS – 516:1959.

Split tensile strength
Compression test conducted according to IS – 5816:1999.

**IV RESULTS AND DISCUSSIONS**

**Strength of cubes**
The figure 3 inference that compressive strength increases compared to conventional concrete up to 2.5% fiber content of concrete with addition of Plastic + Coir + Areca nut husk fiber(HFRC) with further increase in fibre decreases the compressive strength. For an addition of fibre of 0.5% to 2.5% with an interval of 0.5%, the increase in strength compared to conventional concrete is observed to be 10%, 14%, 20%, 23.5% and 15% respectively, for an addition of 3% of fiber the strength decreases by 2.5%.

**Results and Discussion**

**Strength of prisms**
The figure 4 explains that with the addition of Plastic + Coir + Areca nut husk fiber(HFRC) the flexural strength increases compared to conventional concrete. However increase in prism strength is higher than cube strength.

**Strength of cylinders**
The figure 5 inference that with the addition of fibers the cylinder strength increases compared to conventional concrete. For concrete due addition of Plastic + Coir + Areca nut husk fiber (HFRC) of 0.5% to 2.5% the increase in strength compared to conventional concrete is observed to be 22%, 25%, 29%, 30.7% and 17% respectively, for addition of 3% of fiber strength decreases by 1.8%.

**V CONCLUSIONS**

- With the addition of Plastic + Coir + Areca nut husk fiber in the concrete (HFRC) compared to conventional concrete (CC), the cube, prism and cylinder strengths increase.
- The strength of (HFRC) increases up to 2% of fiber which is optimum further increase in percentage of fiber (up to 3%) decreases the strength, however the strength is higher than CC up to 2.5% of fiber content.
- The presence of fiber increases the prism strength of concrete than the cube and cylinder strengths.
- Wastes can be effectively utilized in increasing the strength of concrete efficiently, instead of destroying its useful inherent properties. Also in turn reducing the problem of disposal.
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REFERENCES


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