Experimental Investigation based on Natural Fibres Banana and Jute in Concrete

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Abstract—generally concrete is good in compression and weak in tension. The fibre in concrete generally increases both compression and tension in concrete. In this project we are composite two different natural fibres it is that jute fibre and banana fibre in concrete to know the better results. The different ratios of composite fibres such as 0.5%, 1% and 1.5% are added in concrete to determine the strength ratios and also the behaviour of concrete. Totally the study deals with comparisons and differences between the composite natural fibres in concrete.

Key words: Natural Fibres Jute in Concrete, Natural Fibres Banana in Concrete

I. INTRODUCTION

Fibers are threaded like materials which having high tensile strength can be used for different purposes. Generally concrete are characterized by low tensile strength and low tensile strain capacity. By the inclusion of fibers in concrete will increase tensile strength, flexural strength and fracture toughness. Natural fibers are abundantly available in different forms such as from plants, animals and geological processes. Natural fibres have good mechanical strength, low weight and low cost. Natural fibers are classified into two types they are natural inorganic fibers like asbestos, shells etc. and natural organic fibers like jute, banana, hemp, sisal,…etc. They are low cost, biodegradability, flexibility, minimal health hazards, high tensile strength and flexural modulus. In this project studied the properties of composite fiber it’s that jute fiber and banana fiber in the same concrete with same proportions to determine the strength variations compared with control concrete.

II. EXPERIMENTAL PROGRAMME

In this experimental programme involves various processes of material testing, mix proportioning, mixing, casting and curing of test specimens. All the testing on materials was done in material testing laboratory, Valliammai engineering college Chennai.

A. Materials Used

The materials used in the preparation of concrete mix include cement, fine aggregates, coarse aggregates, banana fibres and jute fibres. All the materials were tested and its physical properties are described below.

1) Cement

Ordinary Portland cement of 43 grade was used, conforming to recommendations stated in IS 403(1999). The normal consistency and initial setting time of cement was 30% and 30 minutes respectively.

2) Fine Aggregate

Coarse sand locally available is taken as fine aggregate. The test procedures as mentioned in IS-383(1970) were followed to determine the physical properties of fine aggregate as shown in Table 1.

3) Coarse Aggregate

The aggregates were tested in accordance to IS:383(1970). The results obtained are tabulated in Table 2.

4) Jute Fibre

Jute is a long, soft, shiny fibre that can be spun into coarse, strong threads, spun into coarse, strong threads. Both the fibre and the plant from which it comes are commonly called jute. They are commonly called jute. Jute fibre is often called hessian. Jute fibre is also known as Golden fibre. China, India, and Bangladesh are the main producers of jute. The specification of the jute fibres are presented in Table 3.

5) Banana fibre

Banana fibre is the one of the cheapest material available in the agricultural countries like India. Large quantities of banana plants are cultivated in the southern part of India. They are very well resistant against moist. These fibres have a good tension resistance or tensile strength. Large quantity of banana fibre is available from Fashion accessories industries. The banana fibres were collected from the local industries. The banana fibres are transported to the laboratory. The specifications of the banana fibre are presented in Table 4.

6) Water

As per recommendation of IS: 456(2000), the water to be used for mixing and curing of concrete should be free from deleterious materials. Therefore potable water was used in the present study in all operations demanding control over water quality.

<table>
<thead>
<tr>
<th>Physical properties</th>
<th>Observed Values</th>
<th>Recommended Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading Zone</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Fineness Modulus</td>
<td>2.70</td>
<td>2.9-3.2</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>2.54</td>
<td>2.3-2.67</td>
</tr>
</tbody>
</table>

Table 1: Physical properties of Fine aggregate

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Observed Values</th>
<th>Recommended Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fineness Modulus</td>
<td>2.58</td>
<td>2.3-2.67</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>6.87</td>
<td>6.5-8.0</td>
</tr>
<tr>
<td>Aggregate crushing value (%)</td>
<td>34.5</td>
<td>Not more than 45%</td>
</tr>
</tbody>
</table>

Fig. 1: Jute fiber  Fig. 2: Banana fiber
### B. Methodology

As per IS 10262: 2009 the mix proportion of concrete was done. To achieve specified characteristics at specific age, workability of fresh concrete and durability requirements proportioning is carried out. Grade M 20 was proportioned according to the procedure as mentioned in the code.

### C. Mix Proportioning

The basic mix proportion for M 20 grade of concrete is cement, fine aggregate, coarse aggregate and water: 1:2.01:3.34 respectively. Mix 1 contains 0% composite fiber and Mix 2, 3 and 4 contains 0.5%, 1% and 1.5% of combined jute and banana fibers equally by weight. Totally 4 mixes were studied. Details of the mixes were represented in Table 5.

### III. RESULTS AND DISCUSSION

The results obtained are presented in Table 5. Results shows that increase in percentage of composite fiber there will be decrease in strength.

<table>
<thead>
<tr>
<th>Mix No</th>
<th>Grade of Concrete</th>
<th>% of Composite Fiber</th>
<th>Cement (Kg/m³)</th>
<th>Fine Aggregate (Kg/m³)</th>
<th>Water content (liters)</th>
<th>Coarse Aggregate (Kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>M 20</td>
<td>0</td>
<td>338.18</td>
<td>680.12</td>
<td>186</td>
<td>1130.78</td>
</tr>
<tr>
<td>M-2</td>
<td>M 20</td>
<td>0.5</td>
<td>338.18</td>
<td>677.21</td>
<td>186</td>
<td>1130.78</td>
</tr>
<tr>
<td>M-3</td>
<td>M 20</td>
<td>1</td>
<td>338.18</td>
<td>673.81</td>
<td>186</td>
<td>1130.78</td>
</tr>
<tr>
<td>M-4</td>
<td>M 20</td>
<td>1.5</td>
<td>338.18</td>
<td>670.41</td>
<td>186</td>
<td>1130.78</td>
</tr>
</tbody>
</table>

### Table 6: Compressive and Tensile strength of Composite Fiber Reinforced Concrete

<table>
<thead>
<tr>
<th>Mix No</th>
<th>Grade of Concrete</th>
<th>% of Composite Fiber</th>
<th>Mean Compressive Strength (Mpa)</th>
<th>Mean Tensile Strength (Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>M 20</td>
<td>0</td>
<td>24.85</td>
<td>3.74</td>
</tr>
<tr>
<td>M-2</td>
<td>M 20</td>
<td>0.5</td>
<td>25.51</td>
<td>3.97</td>
</tr>
<tr>
<td>M-3</td>
<td>M 20</td>
<td>1</td>
<td>24.98</td>
<td>3.82</td>
</tr>
<tr>
<td>M-4</td>
<td>M 20</td>
<td>1.5</td>
<td>24.93</td>
<td>3.76</td>
</tr>
</tbody>
</table>

### A. Effect of percentage of Fibers in compressive strength of concrete

The compressive strength of concrete was observed to be initial increase but decrease as the inclusion of fiber increases. The addition of 0.5% of composite fibers by weight of fine sand increases the strength to 2.58% for concrete. On addition of 1% and 1.5% of fiber will attains 0.52% and 0.32% increase in strength which is decrease in strength when compared to addition of 0.5% in concrete. Fig. 3 shows the effect of percentage of Fibers in compressive strength of concrete.

### D. Mixing of Concrete, Casting and Curing of test Specimens

The machine mixing was done during the entire process of casting. First the dry mix contains cement, coarse aggregate and fine aggregate was mixed for 2 minutes and with the addition of water again it will mix for 2 minutes until the mixture attains the homogeneous. Compaction was achieved by means of damping rod manually. All the specimens were demoulded after 24 hours and stored in curing tank until the age of testing.

### E. Test Methods

The fresh concrete was tested for slump. Then the hardened concrete was tested for compressive strength and split tensile strength discussed below.

1) Workability Test

As per IS 1199-1959 slump test was done to find the workability. Slump cone test is the quick measure of workability of concrete mixes.

2) Compressive Strength Test

As per IS 516: 1959 compressive test was performed. Cubes of size 150mm x 150mm x 150mm were prepared. After 24 hours the specimen was demoulded and curing in the water tank for 28 days until testing. The compressive strength value is the average of three tested specimens.

3) Split Tensile Strength Test

As per IS 5816: 1999 splitting test was performed. Splitting test is an indirect test for determining the tensile strength of concrete. In this test applying a compressive line load along the opposite generators of a concrete cylinder placed with it axis horizontal between the compressive planes. Cylinders of specimen size 150mm x 300mm were prepared. The splitting strength value is the average of three tested specimens.
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concrete. Further addition of 1% and 1.5% of composite fiber will show 2.09% and 0.54% increase in which is less when compared to 0.5% of fiber in concrete. Fig. 4 shows the effect of percentage of Fibers in Tensile strength of concrete.

Fig. 4: Compressive strength results of concrete specimen

Fig. 5: Split tensile strength results of concrete specimen

IV. CONCLUSIONS

Based on the experimental study on natural composite fiber in concrete, the following conclusions could be made:

1) 1. The use Jute fiber and Banana fiber significantly improves the compression as well as tensile strength in initial stage but addition of more fiber decreases the strength when compared to initial stage.

2) 2. The compressive strength of concrete shows 5.7%, 2.09% and 0.54% of strength increases for 0.5%, 1% and 1.5% of fibers in M 20 grade concrete.

3) 3. The tensile strength of concrete shows 5.7%, 2.09% and 0.54% increase in strength for addition of 0.5%, 1% and 1.5% of fibers in M 20 grade concrete.

4) 4. Initial increment of composite fibers will increase the strength but addition more fibers will rapidly decrease the strength then the initial increment strength.

ACKNOWLEDGEMENT

The inception and the rudimentary concepts of project are ascribable to my guide Mr. S. KARThICK, M.E., Assistant Professor, Department of Civil Engineering, without whose invaluable guidance, patient and encouragement, anything would have materialized. I owe my gratitude to him.

REFERENCES


