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# A Study on the Flexural Behaviour of Fibre Reinforced Panels Made of Bamboo

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**Research Article**
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**Abstract**
The distribution and placement of the reinforcing components in ferro cement differ from typical reinforced concrete, which is a novel technology. The substance consists of a cement mortar blend that incorporates many layers of closely spaced wire mesh. For a long time, steel was the go-to material for reinforcing concrete buildings. However, with rising prices and limited supply, finding a suitable substitute has become a pressing worry. The majority of countries' energy and material consumption is concentrated in the construction industry. Because it is natural, eco-friendly, cheap, and readily available, bamboo may be used to strengthen Ferrocement structures instead of wire meshes. This research describes the results of testing Ferrocement beams reinforced with different numbers of layers of bamboo mesh and different spacing of the reinforcement. The main objective of these experimental studies is to determine how different numbers and spacing of bamboo mesh layers affect the flexural strength of ferro cement beams.

**Keywords:** Ferrocement, Bamboo reinforcement, Construction material, wire mesh, Flexural strength.

## I. INTRODUCTION

Consistent with the development of a novel material known as "Ferrocement," a novel approach to construction is also introduced. It has made a homogeneous and ductile composite out of RCC and other brittle heterogeneous materials. The change from steel bars to continuous meshes of thin steel wires was a little tweak that caused this. Ferro cement has several potential uses, including construction of walls, floors, roofs, and even shells. Perfect in every way: long-lasting, lightweight, and with very thin walls. In addition, shuttering and formwork are not required for casting it. Ferrocement, domes, dams, boats, structures to retain water and soil, building components and a host of other civil construction projects are all possible with this multipurpose material. For thin-wall structures, ferro cement is a good choice due to its impact resistance, ductility, and high tensile strength-to-weight ratio. It also has reinforcement that is evenly distributed and dispersed. Because most of the expense in typical ferrocement goes into the wire mesh material, the only real limitation on ferrocement structures is the total cost of construction. Bamboo has several possible use as a construction material since it is eco-friendly, grows quickly, and occurs naturally. Bamboo has the potential to have a very high tensile strength of 125 Mpa. This opens the door for the possibility of using bamboo in ferrocement structures instead of wire mesh.

## II. LITERATURE REVIEW

In order to evaluate the flexural behaviour of forty-eight ferrocement slab panels, Darshan G. Gaidhankar et.al. [1] conducted experimental work. The flexure-test panels have dimensions of 550 mm x 200 mm and thicknesses of 20, 30, and 40 mm. The materials employed were expanded metal mesh with an aperture size of 15 mm x 30 mm, a water-cement ratio of 0.4, and a cement-sand ratio of 1:1. Based on their experimental findings, the authors conclude that the amount of reinforcing mesh layers used in ferrocement panels determines the flexural load at first fracture and ultimate loads. rises in ductility and panel energy absorption capacity are seen when the number of wire mesh layers rises from 2 to 4.
Various forms of bamboo, including wet, dry, solid, and hollow specimens, were investigated for strength attributes in a series of experiments conducted by T. Gutu [2]. The testing included

physical and mechanical tests. The author has discovered that the strength features of bamboo make it an ideal supplementary material. The author made the observation that bamboo is a popular building material in industrialised nations, particularly for large-scale projects like bridges and bamboo corridors in Europe.
The experimental study on 138 slab panels with M20 grade of concrete and integrated bamboo mesh as reinforcement was conducted by Dr. Patel Pratima et.al. [3]. The flexure test panels were 900 mm x 250 mm x 75 mm in dimensions. The authors came to the conclusion that the steel reinforcement is justified by the load-bearing capability of the bamboo strips with concrete. Using bamboo as a bonding ingredient in concrete may be a viable alternative to steel reinforcement.

To study the flexural behaviour of folded ferrocement panels, Vincent Prabakar Rajaiah[4] conducted an experiment. The wire mesh was positioned halfway down the panel for panels with a single wire mesh and on each side of the skeleton steel for panels with two wire meshes. For mortar, you need a cement-to-sand ratio of 1:1 and a water-to-cement ratio of 0.3. In particular for folded panels, the author found that the quantity of wire mesh layers had no discernible effect on the cracking stress.
Using high-strength polyvinyl acetate as an adhesive, James Kariuki[5] has cast laminated bamboo beams. We set out to assess the performance of cypress and laminate bamboo beams when subjected to two-point flexure stress. In all, three cypress beams and six laminated beams measuring 45 mm x 95 mm x 600 mm were evaluated. Laminate bamboo beams outperform cypress beams in terms of load bearing capability, according to the authors' testing results. Bamboo has the potential to be used as a reinforcement in concrete, according to an 7. assessment by Jigar K. Sivalia et.al. [6].Without treatment or stirrups, this research employed bamboo as a reinforcing material. Concrete has recently surpassed all other building materials in global use. Research has shown that concrete's tensile strength is low, despite its high compressive strength. In this research, we consider bamboo's potential as a flexural element structural member. Using flexural stress as an example, this research shows how effective bamboo mesh is in ferrocement panels.The flexural load, number of mesh layers, and opening size are used to compare the same to traditional wire mesh ferrocement panels.

## III. Material And Specifications

In this present study following materials are used for casting the specimen.

1. Cement: PPC, 53 grade cement was used having fineness of 4 %.
2. Fine aggregate: River sand used as fine aggregate in mortar mix. The river sand passing through 4.75mm sieve having specific gravity 2.42 and water absorption 1.9 %.
3. Wire mesh: Steel wire mesh having 1.45mm diameter i.e. 15 gauge and 15mm X 15mm opening and 25mm X 25mm opening area respectively for conventional ferrocement panels casting.
4. Bamboo strips: Seasoned Bamboo strips of 740mm length were used as a reinforcement mesh in panels.
5. Water: used potable water which satisfies requirements of IS 456-2000.
6. Sample mould: Sample mould for specimen casting was prepared having dimensions 750mm X 125mm with 35mm thickness.Sample mould is shown in figure no.1.



Figure No. 1. Sample Mould For Casting

## IV. Experimental Programme And Results

The program was conducted for understanding the behavior of bamboo mesh as reinforcement in ferrocement panels under flexural loading. The testing carried out on panels of size 750mm X 125mm with 35mm thickness with single layer and double layer bamboo mesh with variation in spacing as 15mm X 15mm opening and 25mm X 25mm opening area. The cement sand proportion for casting used was 1:3 with water cement ratio of 0.4. For this experimental program 24 numbers of panels were casted using conventional wire mesh as reinforcement. And 48 panels were casted using bamboo mesh as reinforcement. The specimens were cured for 7 days and 28 days in potable water.

**A. Flexural strength test- IS 516(1959):**

The panels were tested under flexural testing machine with loading cell of 100 KN capacity. The specimen was placed for uniform loading. The load was applied to uppermost part of specimen along with two loading points. for applying loads two steel rollers were used in the assembly.

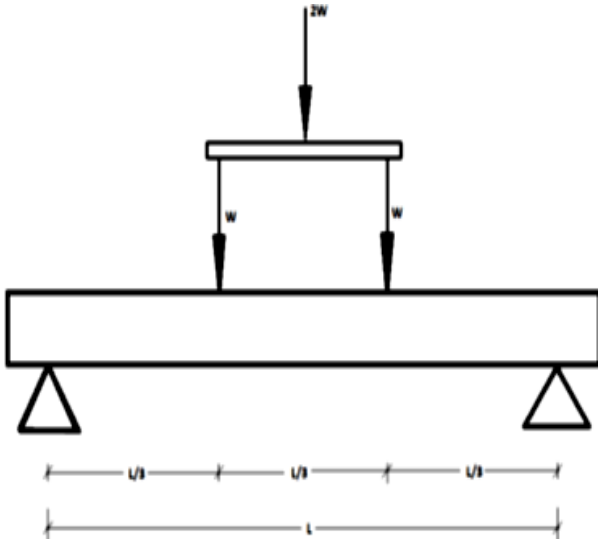


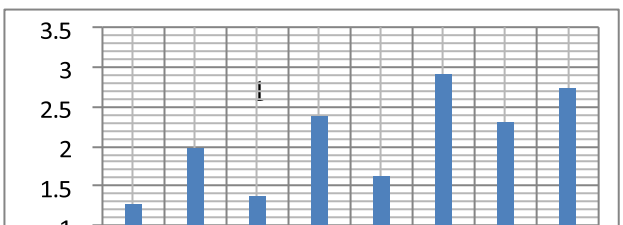

Figure No. 2.Typical Two Point Loading Arrangement.

Load was increased until the specimen fails, and the maximum load applied to the specimen during the test was recorded. Results are shown in following table I and table II.

Where BS means bamboo mesh with single layer and BD means bamboo mesh with double layer. WS means wire mesh single layer and WD means wire mesh double layer. Number infront indicates opening size provided.

TABLE NO. I 7 DAYS CURING FLEXURAL LOAD CARRYING CAPACITY

| Sr.No. | Specimen | Mesh Type | Opening Size (mmxmm) | No. of Specimen | Flexural Load (KN) |
|---|---|---|---|---|---|
| 1 | BS-15 | Bamboo | 15 X 15 | 6 | 1.26 |
| 2 | BD-15 | Bamboo | 15 X 15 | 6 | 1.97 |
| 3 | BS-25 | Bamboo | 25 X 25 | 6 | 1.37 |
| 4 | BD-25 | Bamboo | 25 X 25 | 6 | 2.39 |
| 5 | WS-15 | Wire Mesh | 15 X 15 | 3 | 1.63 |
| 6 | WD-15 | Wire Mesh | 15 X 15 | 3 | 2.92 |
| 7 | WS-25 | Wire Mesh | 25 X 25 | 3 | 2.30 |
| 8 | WD-25 | Wire Mesh | 25 X 25 | 3 | 2.74 |

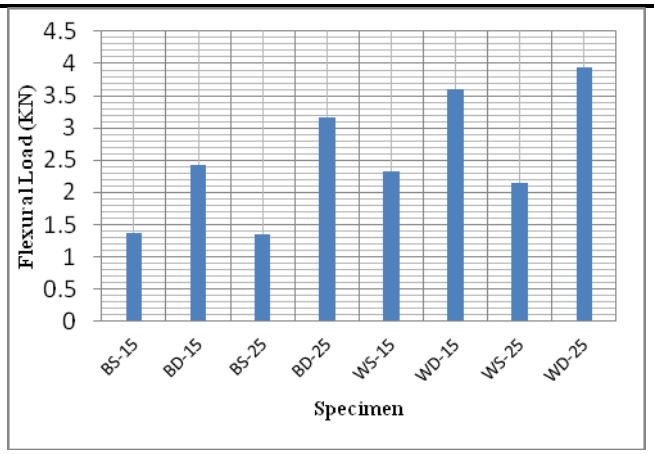





Graph No.1. 7 Days Curing Flexural Load Carrying Capacity

TABLE NO. II 28 DAYS CURING FLEXURAL LOAD CARRYING CAPACITY

| Sr. No. | Specimen | Mesh Type | Opening Size(mm xmm) | No. of Specimen | Flexural Load (KN) |
|---|---|---|---|---|---|
| 1 | BS-15 | Bamboo | 15 X 15 | 6 | 1.36 |
| 2 | BD-15 | Bamboo | 15 X 15 | 6 | 2.42 |
| 3 | BS-25 | Bamboo | 25 X 25 | 6 | 1.35 |
| 4 | BD-25 | Bamboo | 25 X 25 | 6 | 3.16 |
| 5 | WS-15 | Wire Mesh | 15 X 15 | 3 | 2.32 |
| 6 | WD-15 | Wire Mesh | 15 X 15 | 3 | 3.61 |
| 7 | WS-25 | Wire Mesh | 25 X 25 | 3 | 2.15 |
| 8 | WD-25 | Wire Mesh | 25 X 25 | 3 | 3.94 |




Graph No.2.28 Days Curing Flexural Load Carrying Capacity

## V. CONCLUSION

Results from an experiment using ferrocement laminates reinforced with bamboo showed the following.

After seven days of curing, panels with a double layer of bamboo mesh have a flexural strength that is 56% more than that of single-layer panels and 20% greater than that of single-layer panels made of ordinary wire mesh with an aperture of 15 mm x 15 mm. When compared to single-layer conventional wire mesh panels with a 25 mm x 25 mm hole, the flexural strength of panles fabricated from double-layer bamboo mesh is almost double that of single-layer panels after seven days of curing. For a 15 mm × 15 mm aperture, the flexural strength of a panel made of double-layer bamboo mesh is 77% more than that of a panel made of single-layer conventional wire mesh after 28 days of curing, whereas the flexural strength of a panel made of single-layer wire mesh is almost same.

The flexural strength of panles cured for 28 days with double-layer bamboo mesh is 47% more than that of single-layer conventional wire mesh panels with a 25mm x 25mm aperture, and about 2.5 times greater than that of single-layer conventional wire mesh. Panels reinforced with bamboo instead of the more common wire mesh are more cost-effective. Lightweight constructions may make use of these panels for walls, even if their flexural load bearing capability is lower than typical.

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