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Study Of Strength & Deflection Of Bamboo Fiber Reinforced Concrete Member Under Flexural Loading

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ABSTRACT: *The objective of this manuscript is to study the strength & deflection performance of bamboo reinforced concrete member under flexural loading. Bamboo is used as an alternative of steel as a reinforcing material to confirm its tensile strength and bond strength. This is an empirical study oriented, time consuming and rigorous attempt and the documentation involved previous case studies as reported in civil engineering journals of repute. The consequences are categorically tested and the authors advocate for the use of bamboo reinforced concrete member under flexural loading.*

I. INTRODUCTION

In this endeavor we intend to find some alternative material of steel as reinforcing bar. In earthquake hit areas presently an efficient technology is being incorporated [1]. From the past experience it is observed that the steel reinforcements were corrugated after few years if proper workmanship was not maintained [2]. Researches in the past have proved bamboo to be the fastest renewable natural building material and a worthy alternative to steel. However, the merits of bamboo have been continuously overlooked with the advent of "modernity" in building construction. In the present work we check the flexural strength and deflection performance of Bamboo Reinforced member to increase the strength of bamboo concrete by mixing jute fiber [3]. Here jute is used as fiber because Jute fibre is 100% bio-degradable and recyclable and thus environmentally friendly. Moreover, jute has low pesticide and fertilizer needs. It is the cheapest vegetable fibre procured from the skin of the plant's stem. Last but not least jute has high tensile strength, low extensibility, and ensures better breathability of fabrics. Therefore, jute is very suitable in concrete member as a tensile member. Section II is a compact analysis of the proposed architecture.

The authors here empirically studied the attributes of jute in the present context of flexural loading. The comparative study endured better results and also they are in good proximity to modern civil engineering standards.

II. CONCRETE MIX DESIGN

To start concrete mix design first consistency of cement is measured is 32% [6]. Sieve analysis of coarse aggregate and fine aggregate with the help of [5] is measured and max size of coarse aggregate is 20mm. The proportionate mixture is adhered in the following-

II.I STIPULATIONS FOR PROPORTIONING

Concrete mix is designed for M25 grade by using OPC 33 grade conforming to IS 8112. Minimum cement content is 300 kg/m^3 with maximum water-cement ratio of 0.05. The climate exposure condition is moderate. The slump test is conducted to measure workability of 40mm with using SILICA super-plasticizer.

TEST DATA FOR MATERIALS

Specification		Values
Cement used		OPC 33 grade conforming to IS 8112
Specific gravity of	Fine aggregate	2.74
	Coarse aggregate	
Water absorption	Fine aggregate	Nil
	Coarse aggregate	
Sieve analysis	Fine aggregate	Conforming zone IV from IS 383-1970 [4]
	Coarse aggregate	Max 20 mm sieve size
Super-plasticizer		1% of cement

TABLE: 1 test data for materials

II.II TARGET STRENGTH FOR MIX PROPORTIONING
f'_{ck} = target average compressive strength at 28 days,
f_{ck} = characteristic compressive strength at 28 days, and
(IS 10262 : 2009 Clause 3.2.1.2)
s = standard deviation.
From Table I, standard deviation, *s* =5 N/mm^2
Therefore, target strength =25 + (1.65 x 4) =31.25 N/mm^2 [8]

II.III SELECTION OF WATER-CEMENT RATIO
From Table 5 of IS 456 : 2000 , maximum water-cement ratio = 0.50 [9]

II.IV SELECTION OF WATER CONTENT
From Table 2, maximum water content =186 litres (for 25 to 50 mm slump range) for 20 mm aggregate. [9]

II.V CALCULATION OF CEMENT CONTENT
Water-cement ratio	= 0.50
Cement content	= (186/0.50) = 372 kg/m^3

(IS 456: 2000 Clauses 6.1.2, 8.2.4.1 and 9.1.2) [9]

From Table 5 of IS 456: 2000, minimum cement content for 'Moderate' exposure condition = 300 kg/m^3

372 /m^3 > 300 kg/m^3, hence, O.K.

II.VI MIX CALCULATIONS
From table-3 of IS 10262 : 2009 volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (zone IV) for W/C ratio of 0.50 [8]

Volume of coarse aggregate = 0.66
Volume of fine aggregate = (1-0.66) = 0.34

II.VII MIX CALCULATION
a) Volume of concrete = 1 m^3
b) Volume of cement = (372/3.15)X(1/1000) =0.118 m^3
c) Volume of water = (186/1)X(1/1000) = 0.186 m^3
d) Volume of all in aggregate = 1-(0.118+0.186) = 0.696 m^3
e) Mass of coarse aggregate = (0.696X0.66X2.74X1000) =1258 kg
f) Mass of fine aggregate = (0.696X0.34X2.74X1000)=648kg

III. RESULT & DISCUSSION

Cement	=372
Water	= 186
C.A	= 1258
F.A	= 648
W/C	= 0.50
Total	2464.5

Plasticizer = 0.039

C : F.A :C.A
372: 648: 1258
1: 1.7: 3.3

Fig 1: HAICO Compression Testing Machine of Capacity 2000KN

Now using 1: 1.7: 3.3 ratio of cement: fine aggregate: coarse aggregate a trial and error method is done.

Trial 1: Compressive strength of concrete ($660/150^2$) KN/mm^2 =29.33 N/mm^2

Trial 2: Compressive strength of concrete ($660/150^2$) KN/mm^2 = 29.33 N/mm^2

Trial 3: Compressive strength of concrete ($666/150^2$) KN/mm^2 =29.6 N/mm^2
From above trial method an average compressive strength is obtained.

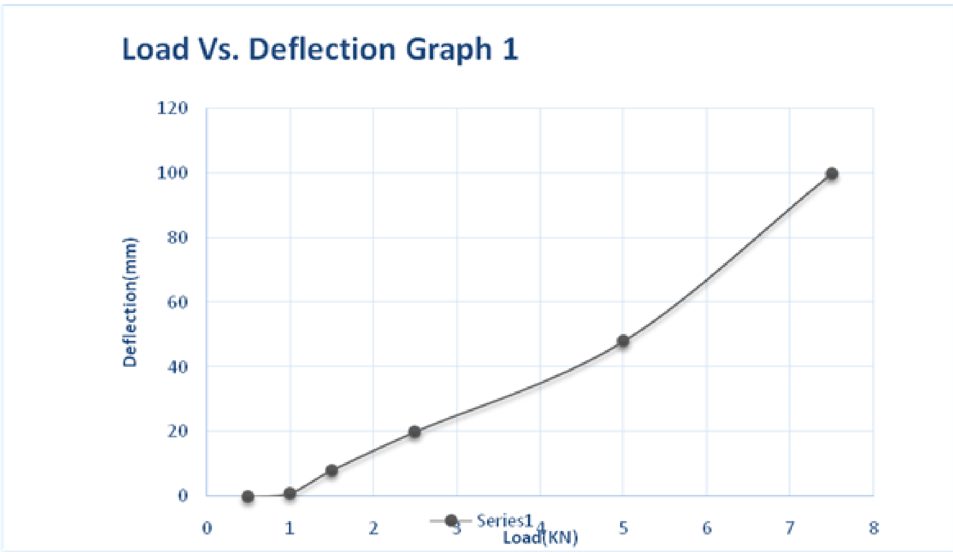
Average value is (29.33+ 29.33+29.6) /3 N/mm^2 =29.42 N/mm^2

Fig 2: Compressive Strength Cube

IV. FIGURES, GRAPHICAL REPRESENTATION AND TABLES

Applying load on the bamboo reinforced beam and the deflection is measured:

Applied load (KN)	Deflection (mm)
0.05	168-168=0
01	168-167=1
1.5	168-160=8
2.5	168-148=20
5.0	168-120=48
7.5	failed



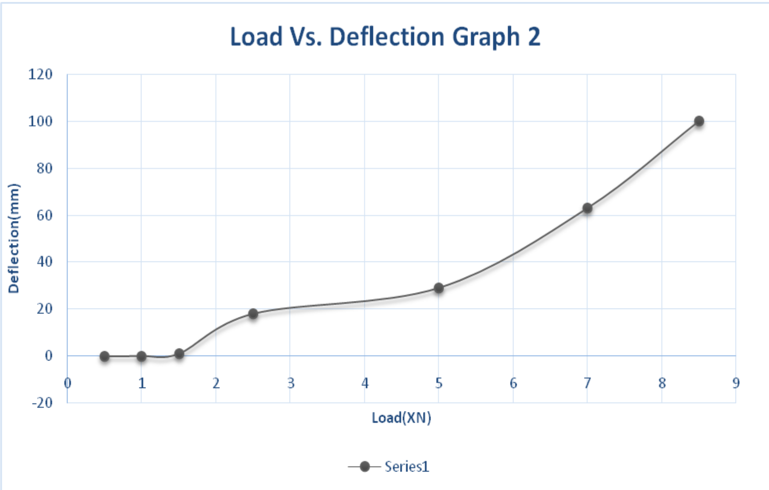
Graph: 1 Load vs. deflection graph for **bamboo reinforced beam** of dimension 100x100x500mm under two point loads at a distance of 200mm from the mid span of the beam in both side.

Fig 3: Failure Picture Of Bamboo Reinforced Beam After Appling Loading

Applying load on the bamboo fiber reinforced beam and the deflection is measured:

Applied Load (KN)	Deflection(mm)
0.5	168-168=0
1.0	168-168=0
1.5	168-167=1
2.5	168-150=18
5.0	168-139=29
7.0	168-105=63
8.5	failed

Load vs deflection graph is plotted from the above table.



Graph:2 Load vs. deflection graph for jute **fiber bamboo reinforced beam** of dimension 100x100x500mm under two point loads at a distance of 200mm from the mid span of the beam in both side.

Fig 4: Cracking of fiber bamboo reinforced beam after applying point load

V. CONCLUSION

When load is applied on the bamboo reinforced beam the beam failed in shear. Then after to increase the bond strength jute fiber is in induced in the concrete mix. It resulted in an excellent bonding. Radically the load carrying capacity increased by 1.0 KN. Thus it is a benevolent idea to resolve the shortcomings of steel.

Additionally, the cost of construction materials including steel is increasing continuously over the years and houses are becoming unaffordable for common man. Therefore in order to provide shelter to economically deprived persons of the society it is necessary to go either for alternate construction materials with conventional construction technique or to adopt conventional materials with alternate construction technique to reduce the cost of structure. It has been seen that bamboo jute fiber can be an alternative of steel. Thus the authors advocate for substantial use of jute in modern cost effective civil engineering.

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