International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 04, April-2019

CASE STUDY ON BAMBOO HOUSE

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Abstract- Bamboo is the material with low cost and CO_2 absorber. Bamboo is such a non -conventional material which can be use as replacement for concrete and steel in civil construction .The use of bamboo as construction material for house will give as affordable rates of houses. Use bamboo as alternative for concrete and steel leads to reduce down the CO_2 emission by tremendous amount. Different tests are performed on bamboo to check whether it will give satisfactory performance or not. The result shows that bamboo gives satisfactory tensile strength compare with steel and better compression than concrete. This paper discuss about a case study of house constructed using bamboo. Code of practice used for bamboo are IS 9096:2006 for preservation of bamboo, IS 6874:2008 for method of tests for bamboo, IS 15912:2012 for structural design using bamboo.

Keywords – bamboo, CO_2 emission, low cost seismic performance, codes of practice (IS 9096:2006, IS 6874:2008, IS 15912:2012).

I. INTRODUCTION

Bamboo is a type of grass having ancient history of making structures for living purposes over presently used conventional building material. Bamboo can grow at a faster rate i.e. reach its maturity within 3-4 years. As its growth rate is more it can be available in abundant quantity. A case study is performed on bamboo structure to look for its advantages and disadvantages as building material than steel and concrete.

II. STRUCTURAL DETAILS

A. Bamboo columns:

As column is the main component in the superstructure which transfers the load coming from above directly to the ground. A single bamboo cannot be used as vertical support. For making column, a bunch of bamboo is joined together as supportive member to the above structure. These bamboo are jointed together using nut and bolts by making holes at certain distance.

Fig.1 Column

Fig. 2 Joint in Column

B. Bamboo beams and trusses:

These are the horizontal member over the column which transfers the loads laterally. They also connects the columns with one another which is helpful to resist the lateral ground motion during earthquake and ensuring the safe position of the columns.

Fig. 3 King's Truss Made from Bamboo

C. Bamboo walls:

Bamboo walls are constructed by placing bamboo horizontally over one another splitted in half lengthwise. Over which plastering is done from the inside to give it interior designer works.

Fig. 4 Outside View of Bamboo

III. COST COMPARISON

Case study is conducted at bamboo house.
Location – At Gimavhane, Dapoli, Maharashtra
Plot size – 15*9 m
Bamboo species – *Dendrocalamus Stocksii*

The bamboo house on which the case study done consist of a living hall attached to the kitchen with a common toilet. There are three rooms constructed, two are at the ground floor and another one is constructed over the second bedroom.

The foundation is made from the laterite rock over which bamboo columns were constructed. A bamboo column is made of a six bamboo joined together as one member by a horizontal section at suitable distances using nut and bolts. Same is done for the beams but instead of using six bamboo as in columns only set of four bamboo were constructed. Walls are also made of bamboo over which plastering is done internally. For the roofing material G.I sheets are used with a overhang to cover the whole area.

TABLE I
Estimation for RCC Structure

sr. no	**Description of item**	**Quantity**	**Unit**	**Rate (Rs.)**	**Amount (Rs.)**
1	Excavation in foundation	88.83	m^3	146	12969.18
2	Soling	4.76	m^3	250	1190
3	pcc in foundation	12.69	m^3	4274	54237.06
4	Brickwork in CM (1:6)	47.56	m^3	4917	233852.52
5	DPC	10.18	m^3	274	2789.32
6	plinth filling (rubble soiling)	47.03	m^3	248	11663.44
7	flooring	117.58	m^2	799	93946.42
8	Dado	16.8	m^2	964	16195.2
9	Plastering	500.12	m^2	139	69516.68
10	Painting	500.12	m^2	127	63515.24
11	RCC Slab	3.03	m^3	7880	23876.4
12	RCC Column	2.65	m^3	7375	19543.75
13	RCC Beams	4.698	m^3	7542	35432.316
14	RCC Column footing	38.41	m^3	4981	191320.21
15	G.I Roof Sheet	254.8	m^2	280	71344
				total	**901391.736**
	contingency charges	901391.736*1/100		9013.91736	**910405.6534**
	water charges	910405.6534*1/100		**9104.056534**	**919509.7099**
	contractors profit	919509.7099*10/100		**91950.97099**	**1011460.681**
				total cost	**1011460.681**

Fig. 5: *case study site*

TABE II
Estimation for Bamboo Structure

sr. no	Description of item	Quantity	unit	Rate (Rs.)	Amount (Rs.)
1	Excavation in foundation	88.83	m^3	146	12969.18
2	soiling	4.76	m^3	250	1190
3	laterite rock	347	nos	35	12145
4	bamboo	3008.4	m	32	96268.8
5	nut & bolts	62	Kg	70	4340
6	plaster	338.25	m^2	139	47016.75
7	painting	338.25	m^2	127	42957.75
8	chicken mesh	20.25	m^2	1587	32136.75
9	chemical	109.4	lit	200	21880
10	G.I Roof Sheet	254.8	m^2	280	71344
				Total	342248.23
	contingency charges	3422.4823			345670.7123
	water charges	3456.707123			349127.4194
	contractors profit	34912.74194			384040.1614
		total cost			**384040.1614**

$$cost\ of\ bamboo\ house = \frac{384040.1614}{1011460.681} \times 100$$
$$= 37.96\ \%$$

Cost of RCC house = 100 -37.96 = 62.04 %

From the above estimation of building, cost of Rcc structure is 62 % of the house constructed using bamboo.

IV. CO_2 EMISSION

TABLE III
Carbon Emission in RCC structure:

	Rate of Co_2	Quantity	Co_2
1.Cement	866kg/ton	11500kg	10660.5kg
2.Steel	2.89 ton/ton	1802.36Kg	5208.36kg
3.Brick(including Bio-fill combustion)	195 g/kg	113652.02 kg (no. of bricks× volume × ρ of brick) (46155×0.19×0.09×0.09×1600)	22162.15 kg
		Total =	34879.67 kg of Co_2

TABLE IV
Carbon Emission for Bamboo Structure:

	Rate	Vol.	Co_2 Emission
Cement	927kg/ton	$1.4m^3$(Plaster)+$0.84m^3$(slab)=$2.24m^3$	2076.48kg

94% of Carbon emission is reduced.

V. CONCLUSION

[1] Bamboo is classified under as a grass but it is used as building material due to its light weight.
[2] Steel and concrete produces Co_2 but in case of bamboo situation is vice versa it absorbs Co_2 and releases amount of o_2 which is helpful to improve the atmospheric condition.
[3] It grows at faster rate due which it is available in maximum quantity and as a building material it does not required skilled labors to carry out the work.
[4] Its requires low initial cost than constructed using conventional building material. Due to its fibrous texture it can be easily bend and sustain heavy loads during seismic activity.
[5] The case study shows that the house constructed using RCC structure has almost 3 times more value than bamboo house.
[6] The total carbon emission done by RCC structure is 34879.67Kg of Co_2 while the bamboo house emits only 2076.48 Kg of Co_2. The bamboo house reduces the Co_2 emission by 94 % than the RCC structure.

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IS Codes –
i. IS 9096:2006 for preservation of bamboo.
ii. IS 6874:2008 for method of tests for bamboo.
iii. IS 15912:2012 for structural design using bamboo.