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A Study on Replacement of Steel Dowel Bars by Bamboo Dowel Bars

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Abstract - The of steel demand is increasing at a rapid rate but the production of steel causes pollution. It's been found through research that bamboo can suitably replace steel in construction and other works. Bamboo is one of the oldest traditional construction materials used by mankind. Through research it has been found that some species of bamboo have ultimate tensile strength same as that of mild steel at yield point. Bamboo is a versatile material because of its high strength-to weight ratio, easy workability and availability. Bamboo needs to be chemically treated due to their low natural durability. In this study bamboo is used as a dowel bar in place of steel bar. different diameter of bamboo is using as dowel bar such as 20mm,25mm,30mm and 35mm in replaced with the steel dowel bar.

Keyword: Rigid Pavement, Dowel bar, Bamboo dowel bar, Aggregate, Cement, Sand.

1.Introduction

As per the world, India is counted one among the most important countries within the world and an outsized area of the country is under developing stage. The first need of the people living in rural areas is a shed to measure in. Due to low availability of conventional materials (like steel) in remote areas and also due to high costs, it becomes difficult to use this material in road construction, also the income of the people living in remote areas is not much and hike in prices of those materials is also a factor which affects their dream to live in good rigid pavement.

Concrete may be a widely used construction material for its various advantages like low cost, availability, fire resistance etc. But it can't be used alone everywhere due to its low tensile strength. So, generally steel is employed to strengthen the concrete. Though steel features a high tensile strength to enrich the low lastingness of concrete, use of steel should be limited since it's very costly and also such a lot energy consuming in manufacturing process. Thus, an appropriate substitute of this with a coffee cost, environmentally friendly and also a less energy consuming one, may be a global concern; especially for developing country. The bamboo Culm, or stem, has been made into an extended diversity of products ranging from domestic household products to industrial applications. samples of bamboo products are food containers, handicrafts, toys, furniture, flooring, pulp and paper, boats, charcoal, musical instruments and weapons. Bamboo is sort of common for bridges, scaffolding and housing, but it's usually used as a short lived exterior structural material. In many overly populated regions of the tropics, certain bamboos supply the one suitable material that's sufficiently cheap and plentiful to satisfy the extensive need for economical housing. It has been utilized in bicycles, windmills, scales etc. Its uses are broad and plentiful.

1.1 Research Aim

The objective of this study to gauge the utilization of Bamboo Dowel Bar in Rigid Pavement in the place of steel dowel bar.

2. Material and Method

2.1 Cement

According to the India standard classification, cement is used in the experiment. Cement is usually a material in the form of powder, which can usually be made in paste in addition to water and when mould or inserted, it will be installed in solid mass. The colour of the cement is mainly due to iron oxide. in the absence of impurities, the colour nor specific gravitational quality is tested. specific gravity is at least 2.90 Portland cement (pc) grades (UltraTech cement) were used for investigation. According to IS 1489: (Part - 1) 1991 Portland Pozzolana Cement (PPC) has been used, PPC concrete is thicker and more impermeable than OPC. The long-term strength of PPC is higher than that of OPC.

2.2 Water

Water fit for drinking is generally considered suitable for making concrete, water should be free of acid, oil, alkalis, vegetables or other organic disorders. soft water also produces weak concrete .in the solid mixture of water there are two functions, firstly, it reacts to chemically making cement paste with cement in which the ink set is placed in suspension until the cement paste is difficult .second ;it acts as a vehicle or lubricant in a fine set and a mix of cement. The normal tap water is used in conjunction with in experimental work with the density of 0.9908 and PH value of 7.3.

2.3 Natural Aggregate

Natural aggregate used in concrete conforms to IS 383. Natural aggregates are collected from the crusher plant where hard rock is crushed into various shapes which we collect from IS 20 mm sieve.

2.4 Fine Aggregate

There is a collection of mineral grains produced form the decomposition of the right consolidation /sand rocks. it is different form gravel only on the basis of grain or particle size, but it is different from women with biological content. organic substances are solved by the action of winds in the flow of sand or dry areas and separated; they are usually quite similar in size to grain. Sand is sold by cubic yards (0.76m3) or ton (0.91metric tons), but always sent weight. Depending on the structure and size of the grain, the weight can be 1,538 to 1,842 kg/m3. Construction sand has not been sent very far, and the quality of the sand used for this purpose various according to local supply.

2.5 Bamboo

Through a search it's been known that some species of bamboo have ultimate tensile strength an equivalent as of low-carbon steel at yield point. Experimentally it's been found that the ultimate lastingness of some species of bamboo is like that of low carbon steel and it varies from 140 N/mm2 4 - 280 N/mm2 Bamboo is an efficient material due to its high strength-to weight ratio, fine workability and availability. Bamboo must be chemically treated thanks to their low natural durability. It is often used as Bamboo trusses, Bamboo Roofs frame, Bamboo walling/ceiling, Bamboo Doors and Windows, Bamboo Flooring, Reed Boards, Scaffolding, etc.

3. Experimental program

We will discuss laboratory work. Which needs to be executed to obtain data and information related to the study. Experiments are conducted that need to be performed on physical properties. Here some tests have been done on them to see the property and behavior of the material which will help in the mix design of concrete. All tests conducted on sand, cement and aggregates are presented below:

3.1 Test on Aggregates

1. Specific Gravity and Water Absorption test
2. Sieve analysis test
3. Aggregate Crushing value test
4. Aggregate Impact Value test
5. Los Angeles abrasion test

3.2 Test on Fine Aggregate (Sand)

1. Gradation Of sand
2. Specific gravity and Water absorption test

4. Result and Discussion

This chapter discuss on a material test result and strength of concrete result. Number of tests conducted on material, green and harden properties to find the workability & harden properties of recycled concrete in concrete.

4.1 Test on Aggregate

4.1.1 Sieve Analysis test (IS 2386(Part I) - 1963)

Sieve Analysis of Natural Aggregate 20mm

Total Weight: 5000 g

Table 4.1: - Sieve Analysis for Natural Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
40	0	0	0	100
20	95	95	1.89	98.16
10	4879.5	4977.5	99.76	0.27
4.75	2.51	4980.0	98.80	0.25

Sieve Analysis of Natural Aggregate 10mm

Total Weight: 5000 g

Table 4.2: - Sieve Analysis for Natural Aggregate

IS Sieve	Weight (g)	Cumulative Retained Weight (g)	Cumulative Retained %	Cumulative % passing
12.5	0	0	0	100
10	673	63	13.46	86.54
4.75	4291	4964	99.28	0.72
2.36	9.50	493.50	99.47	0.53

4.1.2 Important properties of Aggregates are below:

Table 4.4: - Test result of Aggregates

Test Name	Natural Aggregate	Reference
Specific Gravity	2.70	IS 2386(Part III) - 1963
Water Absorption	0.962	IS 2386(Part III) - 1963
Aggregate Crushing value	14.67	IS 2386 (Part IV) - 1963
Aggregate Impact Value	11.37	IS 2386 (Part IV) - 1963
Los Angeles abrasion	15.45	IS 2386 (Part IV) - 1963

4.2 Test on Sand

Specific gravity and water absorption test (IS 2386(Part I) - 1963)

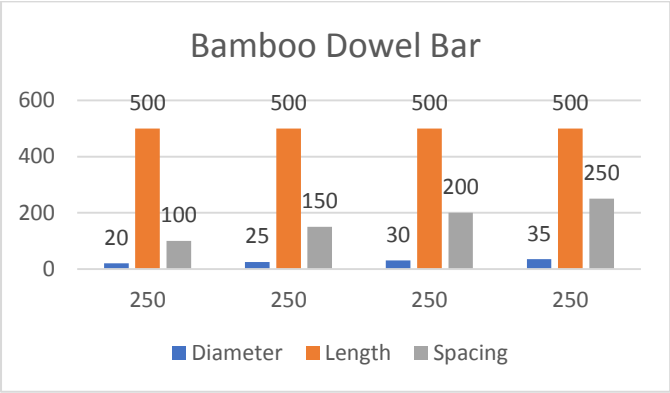
Table 4.5: - Specific gravity and water absorption test

S. No.	Determination No.	Test I
1.	Wt. of SSD sample, W1	528.5
2.	Pycnometer + water + sample, W2	1900.71
3.	Pycnometer + water, W3	1573
4.	Wt. of oven dry sample in air, W4	520.64
5.	Bulk specific gravity SDD=$\frac{W4}{(W2-W3)}$	2.593
6.	Apparent specific gravity = $\frac{W4}{W4-(W2-W3)}$	2.699
7.	Water absorption = $\frac{100x\,(W1-W4)}{W4}$	1.51
Average	Water absorption	2.69
Average	Specific gravity	1.51

4.3 Design of bamboo dowel bar

Table 4.6: - Design of bamboo dowel bar

Slab thickness,mm	Bamboo Dowel Bar Detail		
	Diameter,mm	Length,mm	Spacing,mm
250	20	500	100
250	25	500	150
250	30	500	200
250	35	500	250

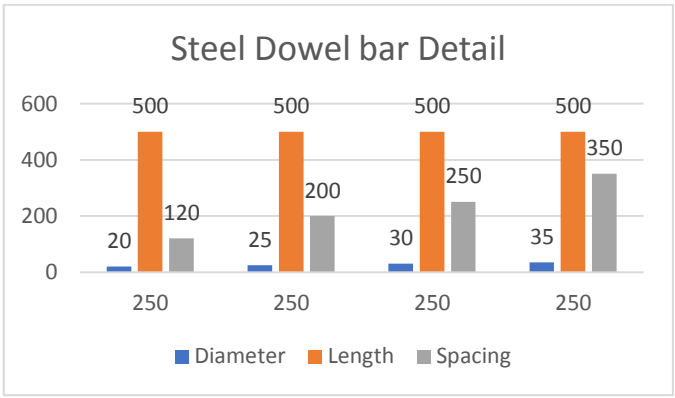


Graph 4.1: - Design of Bamboo Dowel Bar

4.4 Design of Steel Dowel bar

Table 4.7: - Design of Steel dowel bar

Slab thickness,mm	Bamboo Dowel Bar Detail		
	Diameter,mm	Length,mm	Spacing,mm
250	20	500	100
250	25	500	150
250	30	500	200
250	35	500	250



Graph 4.2: - Design of Steel Dowel Bar

5. CONCLUSIONS

1. In this work bamboo reinforcement technique instead of traditional steel reinforcement as dowel bar.
2. The main objective of the work is to reduce the cost of construction by replacing steel. Use of bamboo in the place of steel is good idea for low cost road.
3. The property of bamboo is the reason for which it was selected as the material for with dowel bar in rigid pavement.
4. When we replace a 20mm steel dowel bar to 20mm bamboo dowel bar so its spacing was a changed at 12mm to 10mm respectively.
5. For 1 km rigid pavement cost saving is about 89.84%.

5.1 Future Recommendation

1. In above result we suggest that bamboo bars are used in low volume traffic road because it is cost effective and easily available in markets nearby us.
2. Bamboo is a versatile material because of its high strength to weight ratio, easy workability and availability.
3. The analysis of the replacement of steel with bamboo as reinforcement shows that reinforcement with bamboo is quite cheaper than that of steel reinforcement.

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