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Experimental InvestigationOnConcrete Using Bamboo As A Partial Replacement For Coarse Aggregate

Chandan CS[1],Vanithashree CL[2] ,Rekha BG[3] , Manojkumar R[4] ,Prayag Gowda[5]
Asst. professor and student, Dept. of Civil engineering,CIT Gubbi.Tumkur, Karnataka, India.

Abstract :
Utilization of concrete in almost every civil engineering applications have continued to place high demand on constituent concrete materials. Concrete is an extensively used construction material for its various advantages such as low cost, availability, fire resistance etc. But it cannot be used alone everywhere because of its low tensile strength. So, generally steel is used to reinforce the concrete. But considering high cost of steel, bamboo is one of the suitable replacements of reinforcing bar in concrete for low-cost constructions. Bamboo is natural, cheap, widely available and most importantly strong in both tension and compression. To see the effect of bamboo fibre on compressive and tensile strength, bamboo Concrete cubes have been tested. On comparing the results with plain concrete cubes, strength becomes double in 28 days testing. It has been found that there is remarkably increase in the tensile strength and Compressive strength of bamboo Concrete cubes. First of all cubes and cylinders are casted with traditional methods and later same casted by replacing coarse aggregates with 5%, 10% and 15% bamboo fibres. The behaviour of specimens has to be studied and compared with conventional specimens.

Keywords: *Bamboo Fibre, Aggregate Replacement,Tensile Test, Workability, Compressive Strength, Low-Cost Construction.*

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I. INTRODUCTION

Utilization of concrete is increasing at a very high rate due to infrastructural development activities in the world. Concrete is one of the world's most widely used construction material. In addition, Concrete is the second most consumed substance in the world after water. Approximately ten billion tons of concrete is produced every year. Annual production represents one ton for every individual on the planet There are some negative impacts of more production of concrete like continuous extensive extraction of aggregate from natural resources will lead to its depletion and ecological imbalance. So many researchers are in search of replacing coarse aggregate to make the concrete economical and to extend sustainable development. The role of sugarcane bagasse, wood waste, plastic waste, fabric waste, polyethylene, rubber tires, vegetable fibres, paper and pulp industry waste, rice husk ash, natural fibre waste, peanut shell, waste glass, broken bricks are some cases of replacing aggregates in concrete. Therefore, there is a need to explore and to find out suitable replacement

material to substitute the natural stone. Bamboo has the fibrous content so it has the tensile strength. Bamboo are being naturally available in nature and since its shells are non- biodegradable; they can be used readily in concrete, which may fulfil almost all the qualities of the original form of concrete. More than 50% of the bamboo species occur in Eastern India- Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and West Bengal. In this type of concrete, the coarse aggregate is replaced with different percentages bamboo Pieces.

II. MATERIALS AND METHODOLOGY

1 Cement:

Physical and chemical for characteristics of cement play a vital role in developing strength and controlling rheology of fresh concrete. Fineness affects water requirements for consistency. When looking for cement to be used in High Performance Concrete one should choose cements containing as little C3A as possible because the lower amount of C3A, the easier to control the rheology and lesser the problems of cement-super plasticizer compatibility. Finally, from strength point of view, this cement should be finally ground and contain a fair amount of C3S.

- Setting time (initial setting and final setting time)
- Specific gravity of cement
- Fineness of cement

2 Fine aggregate:

Both river sand and crushed stones may be used. Coarser sand may be preferred as finer sand increases the water demand of concrete and very fine sand may not be essential in High Performance Concrete as it usually has larger content of fine particles in the form of cement and mineral admixtures such as fly ash, etc. The sand particles should also pack to give minimum void ratio as the test results show that higher void content leads to requirement of more mixing water. manufacturing sand (m sand) with fraction passing through the 4.75 mm sieve and retained on 300µm sieve is used and tested. And tested as per IS2386

3 Coarse aggregate:

The coarse aggregate is the strongest and least porous component of concrete. Coarse aggregate in cement concrete contributes to the heterogeneity of the cement concrete and there is weak interface between cement matrix and aggregate surface in cement concrete. This results in lower strength of cement concrete by restricting the maximum size of aggregate and also by making the transition zone stronger. By usage of mineral admixtures, the cement concrete becomes more homogeneous and there is marked enhancement in the strength properties as well as durability characteristics of concrete. The strength of High-Performance Concrete may be controlled by the strength of the coarse aggregate, which is not normally the case with the conventional cement concrete. Hence, the selection of coarse aggregate would be an important step in High Performance Concrete design mix. crushed stone angular shaped of coarse aggregate with fraction passing through the 12.5mm sieve and retained on 4.75mm is used.

4 Bamboo:

Bamboo usually found in south Asia, east Asia and south Pacific Ocean, to some extent in central and south America, China and India. Bamboo, as species of plant in the grass family possessing good strength and flexibility and can be used as building material. Bamboo is one of the traditional construction materials which has been used even now in rural areas. Bamboo can replace wood and steel in many applications like roof covering, footbridge reinforcement, scaffolding and bamboo houses.

Bamboo, as species of plant in the grass family possessing good strength and flexibility and can be used as building material. Bamboo fibres with size of varying length from 2 to 3 cm, breadth from 1 to 2 cm, and thickness of 1 to 1.5 cm is also used as replacement of coarse aggregate at the replacement precent of 5%,10% and 15%. The physical properties of all these materials were tested as per IS 383- 1970.Bamboo fibres can also be used as a filler material inconcrete in road construction or other ground works such as paver block construction, waist slab and other water retaining structures. Bamboo pieces may also be used with some effectiveness as a partial replacement of inorganic aggregates in concrete applications to decrease the dead weight of structures.

Fig.Bamboo

Physical properties of bamboo

SL NO	**PARAMETERS**	**VALUES**
01	Specific gravity	0.575 to 0.655
02	Modulus of elasticity	61 to 160 N/mm2
03	Ultimate compressive stress	79.4 to 86.4 N/mm2

04	Safe working stress in compression.	10.5 N/mm2
05	Safe working stress in tension	16 to 35 N/mm2

Mix proportion :
The concrete mix is designed as per IS 10262 –2009. Thegrade of concrete which weadopted was M30with thewater cement ratio of 0.45. The mix proportions used forconcreteare1:1.9:2.26

Table-Mix Propotion

Cement	C.A	F.A	Water
437	635.3	1138	0.45

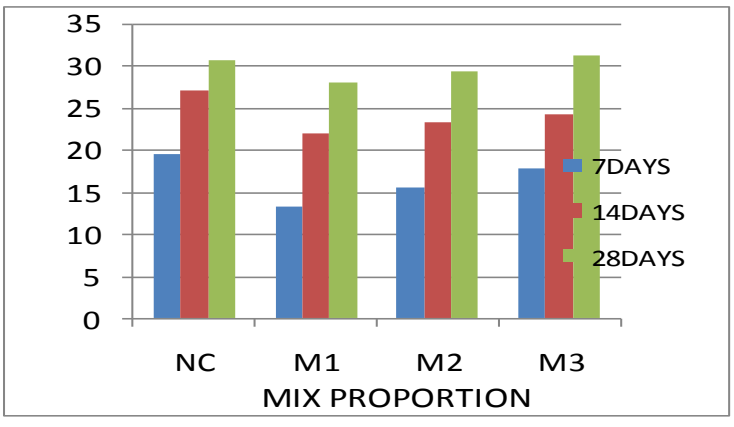
Test Specimen
Cubes of size 150mm X150mm X150 mm were preparedusing the standard moulds. The samples were casted usingthe three different percentages of bamboo (0%, 5%, 10%&15%). The samples were demoulded after 24hours from casting and kept in a water tank for 7, 14,and 21 days curing. A total of 42 specimens are casted For testing the properties such as compressive strength ana split tensile strength.

III. RESULTS

COMPRESSIVE STRENGTH
Compressivestrengthtestwereconductedon150mmsizeconcretecubesincompressivetestingmachineaccordancewiththespecificationsofBureauofIndianStandards. Compressive strength calculated by using formula
F=P/A
Where F= compressive strength in N/mm2
P= max.loadin N
A=c/s area in mm2

Proportion of replacement	Average 7days curing strength N/mm^2	Average 14days curing strength N/mm^2	Average 28days curing strength N/mm^2
NC	19.5	27	30.58
M1	13.32	21.89	27.92
M2	15.45	23.24	29.23
M3	17.8	24.2	31.2

Fig.Table-Compressive strength



SPLIT TENSILE STRENGTH TEST

Specimen of size 150mm diameters and 300mm length were tested. The test was conducted on the compressive testing machine. Cylinder specimen were placed under the compression testing machine in a horizontal direction perpendicular to the direction in which they were casted.

It is found by using equation

F=2P/IILd in N/mm2

Where,

P=Maximum load applied

d= measured depth of specimen

L=length of specimen

L=length of specimen

Proportion of replacement	Average 7days curing strength N/mm^2	Average 14days curing strength N/mm^2	Average 28days curing strength N/mm^2
NC	1.48	2.12	2.45
M1	1.05	1.61	2.8
M2	1.34	1.80	2.72
M3	1.04	1.93	2.96

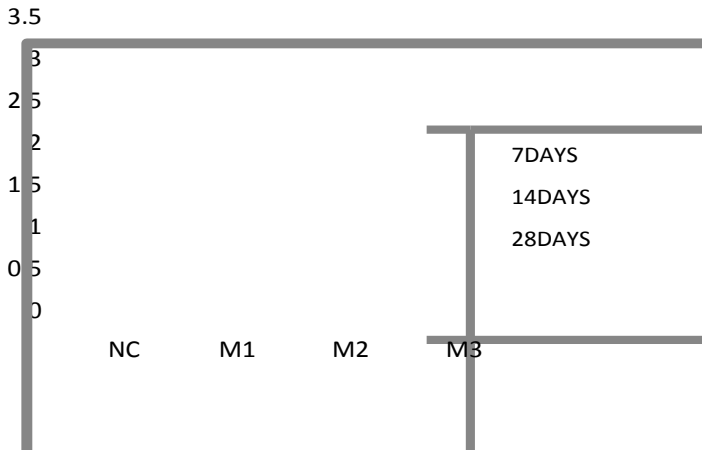


Fig.Table- Split Tensile Strength

III. CONCLUSION

To increase the speed of construction, enhance green construction environment we can use lightweight concrete. The possibility exists for the partial replacement of coarse aggregate with bamboo to produce lightweight concrete. Bamboo exhibits more resistance against crushing, impact and abrasion, compared to crushed granite aggregate. Bamboo can be grouped under lightweight aggregate. There is no need to treat the bamboo before use as an aggregate except for water absorption.

The main points of the study are:

- Light weight concrete can be produced by using bamboo as coarse aggregate.
- Increase in percentage of bamboo, decrease the densities of concrete.
- Bamboo with 15% partial replacement shows a higher strength than normal concrete.
- It is also reducing general construction cost and material cost

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