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# An Investigation of Pervious Concrete Using Bamboo Reinforcement under the Effect of Tensile Force

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**ABSTRACT:** Bamboo is one of the oldest building materials used by mankind. Bamboo is used for construction purpose. It has good strength and durability. Productions of 1 tonnes of bamboo consumes 1 tonnes of CO<sub>2</sub> from the atmosphere in comparison to steel which emits enormous amount of CO<sub>2</sub>. This project work discusses the performance of pervious concrete with and without reinforcement of bamboo. The aim of project is to explore the use of bamboo as reinforcement in pervious concrete. Strength and permeability of bamboo reinforced pervious concrete mainly depends on aggregate size and proportions of material and bamboo. Size of aggregate are 6mm, 8mm & 10mm and water/cement ratio of 0.30 is taken for preparation of pervious concrete. Admixture is also employed to decrease the water/cement to 0.26. A total of 14 beam and 3 slab are casted by different proportion of aggregate and kept in curing for 14 days and 28 days. Permeability and flexural strength test performed on the specimen.

**KEYWORDS:** Tensile Strength, Flexural Strength, Permeability, Reliability, Reinforced concrete

## I. INTRODUCTION

Pervious concrete is a special type of concrete made only of cement and coarse aggregate, devoid of fine aggregate [7]. Pervious concrete has high porosity with void ratio ranges from 20 to 30%. Density of pervious concrete is about 75% of normal concrete. Pervious concrete has interconnected voids which in turns helps to drain off the water rapidly.

Apart from this bamboo is a sustainable green building materials used in various construction work. It has tensile strength similar to steel due to which it is used as a reinforcement materials. Bamboo has good durability. Conducted study on pervious concrete by using pebbles as a coarse aggregate. Properties such as compressive strength, split tensile strength, permeability, porosity and dry density was performed on six cylinder and six prism specimen. It was found that pervious concrete made with pebbles as coarse aggregate results in superior permeability. Showed cast wise comparison on of steel reinforcement with bamboo reinforcement. Or with steel and bamboo reinforcement which indicates that bamboo reinforcement is 3times cheaper than steel. Discusses various combination of pervious concrete with different aggregate size and water content.

Water/cement ratio 0.3 and mix of 50% aggregate gave void ratio of 35.12%. Increase of density of pervious results in increase in compressive strength presented the reinforcement of bamboo strip in normal concrete size of bamboo strip was 300mm length and 12mm wide beam was made by reinforcing steel and bamboo and found that BRCC is 54% less strength than RCC beam. Presented the shear strength behaviour of bamboo fibre reinforced sole. Species of bamboo was tulda having size 20X30mm was reinforced in sole shows that shear strength of sole can be increased by introduction of bamboo. Bamboo reinforced concrete slab panel was tested for concentrated load at mid span, result showed that first crack observed at 15.65KN at mid span peak load was 16.20KN. Species of bamboo was dendro calmus strictus of 15mm wide.

## II. METHODOLOGY

### Mix Proportion

Concrete mix design has been prepared according to ACI522 R-10. For the preparation of a beam using aggregates of 6mm, 8mm, 10mm and 12.5mm the water cement ratio is of 0.3 and using admixture 0.26. cement used of grade 53 and the type was ordinary Portland cement. The specimen of beam produced with the mix proportion is of size 700X150x150mm (IS 516-1959) and the maximum quantity of cement used about 6kg and each size aggregates was about 26kg in a beam. The admixture has been used was carboxylate superplasticizer.

Mix proportion of pervious concrete.

### Mix Proportion Of Pervious Concrete

| Sr No | Components           | Density     |
|-------|----------------------|-------------|
| 01    | Cement OPC           | 270 - 415   |
| 02    | Aggregate            | 1190 - 1480 |
| 03    | Water / Cement Ratio | 0.27 - 0.34 |
| 04    | Fine Course          | 0 - 1:1     |

### B. Test Specimen/ Experimental Evaluations

#### 1. Cube

For the preparation of pervious concrete mix cube of size 150X150X150mm (IS 516 & 1959) has been adopted from IS 522 R-2010 study of pervious concrete.

Proportion has been used as cement aggregate ratio = 1:4

Water/cement = 0.3

Size of cube = 150X150X150mm

Quantity of aggregates = 18kg

Cement = 4.5kg

Water content = 1350ml

Kept in curing for 28 days for better bonding between cement and aggregate after drying period of 24 hrs. Three set of aggregate has been used of size 12.5mm, 10mm and 8mm.

#### 2. Beam

Preparation of beam specimen without using admixture and reinforcement. Mix proportion of beam has been prepared as size of beam 700X150X150mm (IS 516 & 1959)

Water/cement ratio = 0.30

Aggregates quantity = 26kg of each aggregate

Cement quantity = 6kg

Water = 1800ml

#### 3. Beam with Admixture and Bamboo reinforcement

##### A. Add mixture

Super plasticizer which has high range water reducer have been used as an additives for making high strength concrete and which have chemical compound that enhance the production of concrete with fifteen percent less water contain. Superplasticizer allow water reduction in water contain by 30% or more.

The conplast SP430G8 carboxylate superplasticizer was used as a water reducer for preparation of beam. Quantity of such plasticizer has been taken about 1% of cement used in the preparation of beam.



**Fig. Actual Work of Project**

#### **B. Bamboo**

Far of the bamboo species has been taken in the experiment procedure belong to family bambusoidea splits of bamboo have done by sharp knife decides of 600x20x10mm area of bamboo has taken which should not be more than 4% for the bamboo reinforcement.(IS-8242) Bamboo splits have tied securely before placing between the concrete mix for suitability. Treating for bamboo split in boric acid have been also done about 48hrs for enhancing the durability and sustainability properties of bamboo.(IS 401-2001)

Bamboo reinforced concrete construction follows same design mix proportion and construction technique which has used for steel reinforcement. Properties of bamboo was similar up to much extent as steel reinforcement. Bamboo is also a biodegradable and renewable which is energy efficient and of natural origin and environmentally sustainable.

#### **C. Cement**

Cement is the most important key to any construction industry and it is use for various purpose and also made in many composition for a wide variety of uses. Cement use in infrastructure industry are named after their commonly reported place of origin, such as Roman cement, or for their affinity to other material, such as Portland cement, which is resembled by the Portland stone. Used for building in Britain.

The selection of type of cement and brand is most important to obtain good quality of concrete. Ordinary Portland Cement grade 53 was used in work. Referring IS 12269 1987 all properties of cement were determined. The initial setting time of cement was 36min and final setting time was 600min

#### **D. Aggregates**

Aggregates is formed by combining several small stone into a whole mass loosely compacted together. These form 80% of the concrete mix and so their properties are crucial to the properties of concrete. Aggregate can be classified in two size groups that is fine aggregates and coarse aggregates.

Coarse aggregates was used to prepare samples like cube, beam and slab. One of the basic reason of choosing this stone was its availability in near by area. Aggregates of 12.5mm, 10mm, 8mm and 6mm crushed sand stone were used.

#### **E. Water**

Portable water was used for the experiments. Clean water was used for mixing and curing and free from injurious amount of oil, acid, salts, sugar and other organic materials. Portable water is used because it is considered satisfactory for mixing concrete. Sea water contains salt which is dangerous is not permitted for mixing and curing the pH value of the water should not be less than 6, also a mix design with excess amount of water can collapse the void space, making an almost impenetrable concrete surface.



**F. Bamboo**

Bamboo is a typical root and a very fast growing plant which can be used as a construction material. It has node and internodes and also property of bamboo varies. As per the researches it has been found that bamboo has ultimate tensile strength and yield point which is same as mild steel at such limits. Bamboo needs chemical treatment for their durability.

Accordingly near by one billion peoples in the world lives in bamboo houses. Their development of technologies is a counting quest for improvement in infrastructure of whole world. Bamboo is the most effective material in construction by the superior character of bamboo such as being physically powerful hard and low costing material. Bamboo is a very light in weight compare to steel. Bamboo is a renewable and versatile resource. Bamboo is giant grass generally grows in tropical and sub tropical region.

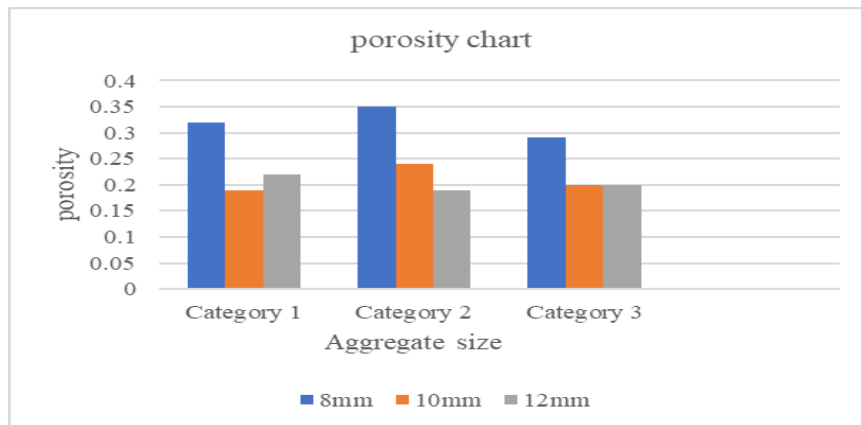
**G. Superplasticizer**

Superplasticizer are chemicals are used as admixture where well dispersed particles suspension are required. It is also know as high range water reducers. These polymer are used as dispersants to avoid particle aggregation.

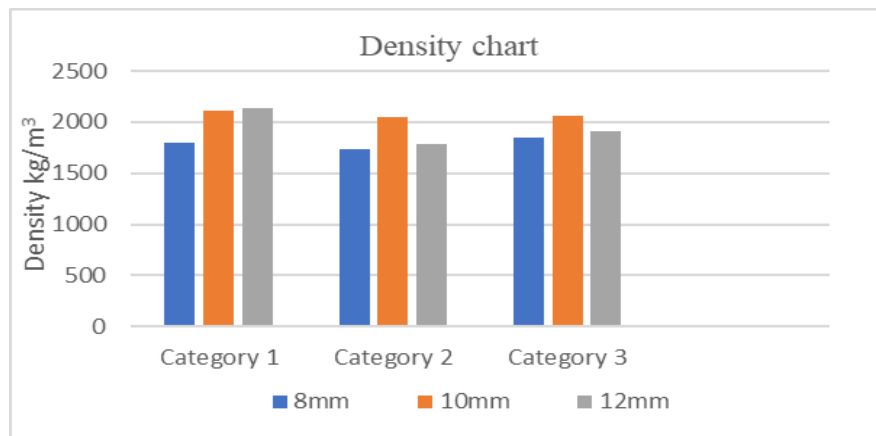
Polycarboxylate superplasticizers used as a high range water reducing admixture in high performance concrete, high strength concrete. The superplasticizer allow a water reduction up to 40% even with low dosage (0.2 0.3%)

**Features**

- 1) Increases in bonding between concrete and reinforcement steel.
- 2) Reduces cracking and shrinkage.
- 3) Enhances workability flow properties without any increase in water.
- 4) It produces extremely workable and flowing concrete without loss of strength.
- 5) It produces pumpable concrete where high strength concrete is needed.



Graph 1: Porosity Vs Aggregate Size



Graph 2: Density Chart

### III. CONCLUSION

Pervious concrete proves to be an excellent seeping passage for uncoated water on the surface. Using bamboo as a reinforcement rather than steel has been economical so far. Treatment of bamboo using chemical such as admixture and boric acid makes the structure long lasting for years. Overall strength of pervious concrete has been more better using bamboo as a reinforcement as compared to steel reinforcement. As pervious concrete has high porosity ratio which ranges from 20 to 30% and bamboo's properties are stronger which comparing to steel, thus the combination makes the structure more economical and durable.

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