EFFECT OF BAMBOO AS THE REINFORCEMENT IN M20 GRADE CONCRETE

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Abstract *Now a day's concrete are used as the basic material for the construction work. The concrete is good in compression but weak in the tensile strength. So the steel is used as reinforcement in cement concrete to achieve tensile strength. Problem encountered with the steel has high in cost, corrosion, etc., due to these reason bamboo is used as the reinforcement in cement concrete. The bamboo is used in both technical as well as the non-technical ways. Bamboo is the low cost, fastest growing, renewable natural resource. Bamboo is used to control the cost of construction and promote the use of natural products the study is required to be carried out. In this present study an experimental investigation has been conducted to study the workability, compressive strength and split tensile strength of concrete by using steel reinforcement and bamboo reinforcement. And comparison has made between steel reinforcement and bamboo reinforcement with plane concrete for 7 and 28 days curing for M 20 grade concrete.*

KEY WORDS: Bamboo reinforced concrete, Steel reinforced concrete, Compressive strength, Split tensile strength, Corrosion etc..,

1. Introduction

Steel prices have seen a significant increase in recent years. Developing nations have challenges in accessing steel due to its high cost, and the building sector is now experiencing significant restrictions on the use of steel. The manufacture of steel involves significant consumption of fossil fuels. However, research institutions have shown the potential for a substantial decrease in steel emissions in building projects. Meanwhile, it is crucial for underdeveloped nations to prioritize the construction of structures that are cost-effective and do not need advanced technology. Advanced technology and dependable building techniques. Some places are experiencing environmental degradation due to the fast growth and manufacturing of materials such as iron, steel, glass, cement, and aluminum, which rely on finite natural resources. This degradation includes contamination of the air and water. However, plants and fibers are renewable resources that may be reproduced on a yearly basis. Bamboo is a distinct collection of enormous grasses, with the culm emerging from subterranean rhizomes. It occurs spontaneously in many regions worldwide, however some species are intentionally cultivated. Bamboo woods are distributed across the tropical and subtropical regions, namely between latitudes of around 40° south. These places have average annual temperatures ranging from 20°C to 30°C. Bamboo species appropriate for use in water pipes may be found at elevations ranging from 20 to 3,000 meters.

The plant reaches full maturity between the ages of three and four years. Recently, researchers worldwide have started to investigate the use of inexpensive and energy-efficient alternative building materials. Out of the several options for such replacements, bamboo, known for its rapid growth, has significant economic potential. For centuries, bamboo has been used in the building of bridges and dwellings across Asia. Bamboo requires lower energy inputs for harvesting and transportation. Due to its inexpensive production costs in comparison to steel, bamboo is considered feasible even in nations and areas without modern manufacturing technologies and building skills.

Our laboratory performed a research to determine the practicality of using bamboo and non-steel materials as reinforcement in concrete structures. This research examines the impact of bamboo corrosion, the bond characteristics influenced by the surface state of bamboo reinforcement, and the

flexural behavior of bamboo reinforced concrete slabs under different curing conditions.

Bamboo Reinforced concrete

Bamboo reinforced concrete construction employs same design, mix proportions, and construction processes as those used for steel reinforced concrete. The steel reinforcement has been substituted with bamboo reinforcement. The properties of bamboo reinforcement, the mix percentage of concrete, and the design and construction techniques for bamboo reinforced concrete. Bamboo, a natural substance, has been extensively used for many applications. Primarily used as a material that can withstand heavy loads. It is used for constructing shelters from a previous era.

Bamboo is often used for scaffolding, formwork support structures, and several other applications in building construction. These are restricted to undertakings of medium to large scale. While bamboo has been known to exist for millennia, its use as a reinforcing material is a recent invention in the world of civil engineering building. This idea was derived from a research done at Clemson Agricultural College. Bamboo is both biodegradable and renewable. It is energy efficient due to its natural origin and ecologically friendly character. For generations, these features have compelled the building industry to use this.

The details on how bamboo is efficient in replacement for steel reinforcement in concrete

Objectives of the study

For this project the following objectives were made

1. To study the bamboo reinforcement in cement concrete.
2. To collect the required materials and calculate mix design for M20 grade of concrete and prepare the cubes and cylinders.
3. To check the workability, compressive strength, and split tensile strength of concrete by using steel reinforcement and bamboo reinforcement.
4. The comparison has made between the steel reinforcement and bamboo reinforcement.
5. The research intends to develop the appropriate and cheaper water proofing treatment for bamboo, to reduce its water absorption and increase the bond strength.
6. The research aims to develop experimental data on engineering properties of bamboo. Bamboo being natural material, available data showing wide variation in properties with age, species, location and country.

Literature review

T. Gutu and colleagues published a paper in 2013. The research aims to investigate the mechanical strength features of bamboo in order to determine its potential as a sustainable material in the wood industries. Specifically, the study seeks to determine whether bamboo may serve as a complimentary material to wood in furniture production and building activities. The findings indicate that the strength characteristics of bamboo surpass those of the majority of both soft and hard woods. The investigation also revealed the presence of many kinds of solid bamboo in Zimbabwe. The study found that both solid and hollow bamboo may be equally used for furniture goods and building operations.

Kavitha s1 and T felix kala2, among others, in June 2016. Fibers are often used to enhance the resistance to cracking and reinforce the strength of concrete. Typically, a combination of different fibers is added to the concrete mixture in order to provide the necessary level of strength and resistance. Bamboo, characterized by its affordability, rapid growth, and wide distribution, is anticipated to make a substantial contribution to earthquake-resistant building and seismic retrofit technologies in developing nations.

It was observed that the workability of fresh concrete decreases as the fiber content increases. Additionally, the workability decreases with an increase in the aspect ratio and the addition of bamboo fibers at a volume of 1.0% leads to a significant improvement in both early and long term compressive strength and split tensile strength of the concrete.

Materials and methodology

OPC 53 grade cement

Ordinary Portland cement (OPC) of 53 Grade (UltraTech cement) from a single lot was used throughout the course of the investigation. It was fresh and without any lumps. The physical properties of the cement are determined from various tests conforming to Indian Standard IS: 8112:l1989 are listed in table below Cement is carefully stored to prevent deterioration in its properties due to contact with moisture.

OPC 53 grade cement

Coarse aggregates

The coarser the aggregate, the more economical the mix. Larger pieces offer less surface area of the particles than an equivalent volume of small pieces. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements. Using aggregates larger than the maximum size of coarse aggregates permitted can result in interlock and form arches or obstructions within a concrete form.

Coarse aggregates

Fine aggregates

Those particles passing the 9.5 mm (3/8 in.) Sieve, almost entirely passing the 4.75 mm (No. 4)sieve, and predominantly retained on the 75 µm (No. 200) sieve are called fine aggregate. For Those particles passing the 9.5 mm (3/8 in.) Sieve, almost entirely passing the 4.75 mm (No. 4) increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

Fine aggregates

Steel

Steel is an alloy of iron and carbon, and sometimes other elements. because of its high tensile strength and low cost, it is a major component used in buildings, infrastructure, tools, ships, auto mobiles, machines, appliances, and weapons.

Steel bars

Bamboo

Bamboo can be utilized as a building material as for scaffolding, bridges and houses. bamboo like true wood, is a natural composite material with a high strength –to-weight ratio useful for structures. Bamboo has a higher compressive strength than wood, brick or concrete and a tensile strength that rivals steel. bamboos are some of the fastest growing plants in the world, due to a unique rhizome dependent system. certain species of bamboo can grow 35inches/890mmwithin a 24hours period, at a rate of0.00003km/h (a growth of approximately 1 millimeter(or 0.02inches)every 2minutes).

Bamboo

Mix design used

Concrete Mix proportions for Trial Number 1

1. Cement = 438.13 kg/m3 Water = 197.16 kg/m3
2. Fine aggregates = 741.771 kg/m3
3. Coarse aggregate = 1123.08 kg/m3
4. Water-cement ratio = 0.45

Final trial mix for M20 grade concrete is 1:1.69:2.56 at w/c of 0.4

Tests to be conducted on concrete

1. Workability of concrete
2. Density of concrete
3. Compressive strength of concrete
4. Split tensile strength of concrete

Type of Reinforcement

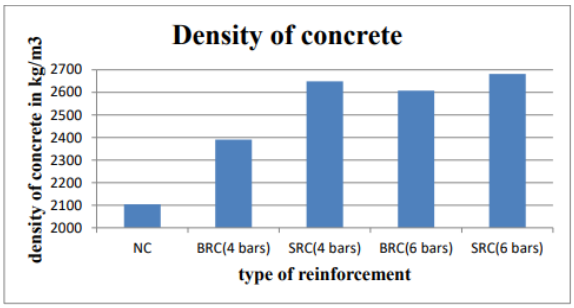
1. Normal Concrete
2. BRC(4 bars)
3. SRC(4 bars)
4. BRC(6 bars)
5. SRC(6 bars)

Results and analysis

Workability of concrete

Grade Of Concrete	Slump in mm	Compaction Factor
M20	25	0.93

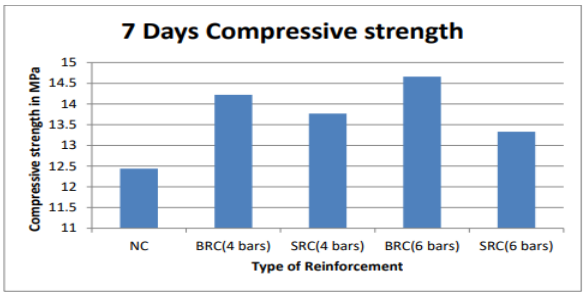
Density of concrete



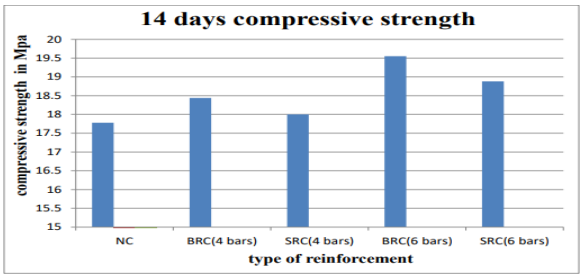
Density of concrete

Compressive strength of concrete

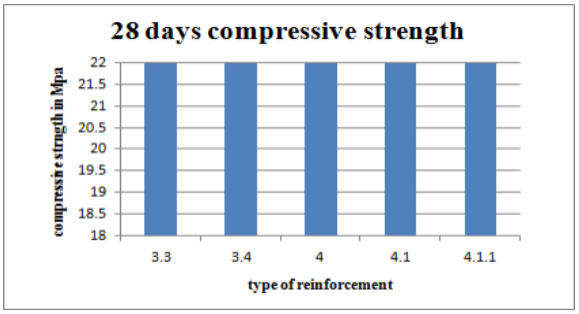
7days compressive strength of concrete



14days compressive strength of concrete

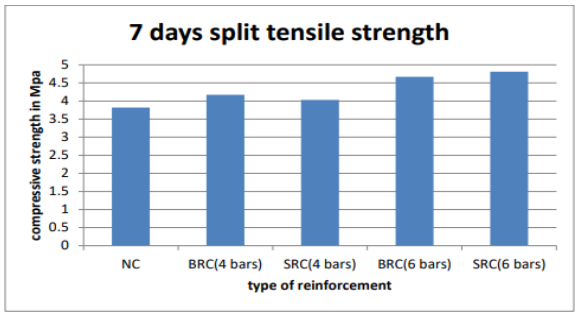


28days compressive strength of concrete

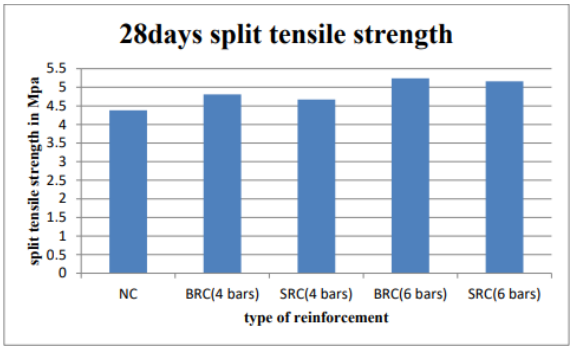


Split tensile strength of concrete

7 days split tensile strength of concrete



28 days split tensile strength of concrete



Conclusions

From the above experimental study the following conclusions are made:

1. The behaviour of bamboo is almost same as the plain steel bar. However, the bond strength with bamboo was higher than the one with plain steel bar.
2. In this project we have opted advanced bamboo reinforcement technique instead of steel reinforcement. This is good idea for low cost economical structure.
3. Bamboo reinforcement technique is used for both main and distribution reinforcement as it was same earlier done for steel reinforcement.
4. The maximum value of 7days and 14days compressive strength was observed for 6 bars of bamboo reinforced concrete .and The maximum value of 28days compressive strength was observed for 6 bars of steel reinforced concrete. And the minimum strength was observed for normal concrete(without reinforcement).
5. The maximum value of 7days split tensile strength was observed for 6 bars of steel reinforced concrete .and The maximum value of 28days split tesile strength was observed for 6 bars of steel reinforced concrete. And the minimum strength was observed for normal concrete (without reinforcement).
6. It is clear from results that this bamboo reinforcement technique is absolutely cheaper then steel reinforcement technique especially for single story structure.

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