Replacement of steel reinforcement by bamboo and partial replacement of aggregate by coconut shell

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ABSTRACT

Bamboo and coconut shell are not rare and very much costly. Steel has traditionally been utilised as a concrete reinforcing material. However, due to cost and availability, the use of alternative acceptable materials as reinforcement has become a serious problem. Despite the fact that bamboo has been utilised as a building material, particularly in underdeveloped countries, its application as a concrete reinforcement is still limited due to several uncertainties. Bamboo may be used to replace steel in concrete reinforcement since it is a natural, inexpensive, and easily accessible material. Concrete is the most often utilised building material. Aggregates account for the majority of all concrete materials; therefore, obtaining structurally low weight concrete from trash is a difficulty. Coconut shells, a natural waste product, can be used to replace these natural aggregates. To verify its viability, compression tests on a cube and a split tensile test on a cylinder were carried out. Steel bars are used to strengthen concrete to compensate for its low stress bearing capacity.

Keywords:- *Bamboo, coconut shell, cement, aggregate, compression*

1.Introduction

The Clemson Agricultural College has conducted considerable research on the use of bamboo as a reinforcement in Portland cement concrete. Bamboo has been utilised as a construction material by human civilization for a very long time, but its application as reinforcement has received little attention since the Clemson research. In 1964, the US Army Engineer Waterways Experiment Station investigated the viability of employing bamboo as a reinforcing material in precast concrete components. The ultimate load bearing capability of the precast concrete components with bamboo reinforcing was estimated using ultimate strength design methodologies that were adjusted to take into consideration the features of the bamboo reinforcement. In the study that was done, this paper was used as a reference. As a result, the members of this group submit their ways in this report for improved strength and more applicable methods with the least amount of sacrifice in strength.

2. DISCUSSION

2.1 Bamboo

Common bamboo, Bambusa vulgaris, is an open-clump bamboo species. It is native to Indochina and the southern Chinese province of Yunnan, although it has been widely farmed and has been naturalized in a number of areas. It is one of the biggest and most immediately identifiable bamboo species. Bamboos are perennials that grow quickly, with some species reaching up to 30 cm (1 foot) every day. Culms are woody ringed stems that develop in branching clusters from a thick rhizome. They are hollow between the rings (nodes) and grow in woody ringed stems that are hollow between the rings (nodes) (underground stem). Bamboo culms can grow to be 10 to 15 cm (4 to 6 inches) tall in the smallest species to more than 40 meters (130 feet) tall in the tallest. While immature culms' narrow leaves grow directly from the stem rings, larger culms frequently generate horizontal leaf-bearing branches.

2.1.1 Why bamboo substitute is used?

According to studies, certain species of bamboo have the same ultimate tensile strength as mild steel at the yield point. The maximum tensile strength of bamboo has been shown to be equivalent to that of mild steel and ranges from 140 N/mm2 to 280 N/mm2. Bamboo is a useful material because of its high strength-to-weight ratio, ease workability, and availability. However, because to its low natural durability, bamboo must be chemically treated. Bamboo trusses, bamboo roofs, skeletons, bamboo walling/ceiling, bamboo doors & windows, bamboo flooring, scaffoldings, and so on may all be made out of it.

2.2 Coconut shell

The coconut tree (Cocos nucifera) is the only extant species of the genus Cocos, which belongs to the palm tree family (Arecaceae). The name "coconut" (or the archaic "cocoanut") can refer to the full coconut palm, the seed, or the fruit, which is a drupe, not a nut, according to the botanical definition. After the three indentations on the coconut shell that mimic facial features, the term originates from the old Portuguese word coco, which means "head" or "skull." Coconut palms are believed to be largely cross-pollinated, although some dwarf varieties are self-pollinating.

2.2.1 Why coconut shell substitute is used?

Due to large-scale consumption, abundant natural resource availability has become a fantasy for today's modern society. The uncontrollable rate of population increase exacerbates the problem of coarse aggregate availability for building. Consumption of aggregates expanded dramatically as a result of growing urbanization and industrialization. As a result, the researchers must come up with alternatives to coarse aggregate. As the population grows, so does the amount of industrial garbage, home waste, and other waste. In India, it has been discovered that coconut shell, as an agricultural waste, necessitates large dumping yards and is an environmental pollutant. If it can be used as a coarse aggregate, it should be a blessing to the civil engineering community rather than a hindrance.

3. Literature Review

[1] Building with bamboo has a long history in areas where the plant grows abundantly, such as South America, Africa, and, in notably, Southeast Asia. Bamboo is one of the most ancient building materials. For the past one and a half decades, the developing world, particularly India and China, has been a hive of construction activity. The building sector is one of the most polluting businesses in the world, despite the fact that it is not clearly apparent. Both concrete and steel production have a significant negative impact on the environment.

[2] The palm kernel shell and coconut shell, both of which belong to the palm shell family, were investigated. These are agricultural waste products that may be found in great numbers across the world's tropical climates. When

utilised to substitute typical coarse aggregate in concrete manufacturing, research has shown that coconut shell is better suited as a low strength, light weight aggregate.

[3] Researchers have discovered novel materials for structural uses in civil engineering in recent years. Scientists, engineers, and designers require knowledge and training in order to identify solutions to reduce building costs and develop effective plans. Bamboo is a fast-growing woody plant that belongs to the Poaceae family of grasses (Agarwal et al. 2014). Within three to four years, it reaches peak strength, and within five years, it reaches maturity. It has a reasonably high tensile strength, with certain species having tensile strengths that are comparable to mild steel. Because of these characteristics of bamboo, researchers have focused their efforts on using bamboo materials as concrete reinforcement. According to Rahman et al. (2011), using bamboo as a reinforced material.

[4] The studies were carried out on treated and untreated bamboo reinforced concrete beams with standard steel reinforcement. Stirrup's materials, which are Thermo Mechanically Treated rods and bamboo, are used to reinforce untreated bamboo reinforced timbers. Treated bamboo reinforced beams are built of stirrups made of Thermo Mechanically Treated rods and bamboo covered with epoxy (Concresive Master Index 1315) and fine sand for excellent bond strength. To explain its durability, flexural strength, and sustainability, comparative experimental values of conventional steel, untreated, and treated reinforced concrete beams are used. Describe its durability, flexural strength, and long-term viability.

4. CONCLUSIONS

The possibility of using bamboo and coconut shell as a reinforcement and aggregate replacement has been evaluated in this study through a series of experimental investigations on 18 columns, including 6 steel reinforced concrete columns with conventional concrete (Type A), 6 steel reinforced concrete columns with coconut shell concrete (Type B), and 6 bamboo reinforced concrete columns with coconut shell concrete (Type C) (Type C). Moisture test on bamboo, compression and tensile test on bamboo specimens to determine Young's Modulus are among the tests carried out as part of this study. After that, compression and split tensile tests for conventional concrete and coconut shell concrete were carried out, followed by an axial load test on columns.

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