

WATER FOUNTAIN MADE WITH PCC AND BAMBOO STICK

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Abstract - “Dendrocalamus Strictus” most commonly found bamboo in Chattisgarh is a widely used as Raw Material in light construction, house frames, housewares and furnitures. Bamboo as a construction material has good tensile strength, excellent compressive strength and low weight and has been one of the most used building materials as help for concrete; it is used since many decades. It is cheaper than steel and has great shear stress. Unlike wood bamboo has wider span. Bamboo as a construction fabric is used for the building of scaffolding, bridges and structures and houses. Bamboos are one of the fastest-growing floras in the world and their growth is three times faster than most species of plants. They are renewable, ecofriendly and versatile resources with multi-purpose uses. Bamboo sticks are commonly used in making fountains because they are natural and durable materials that can withstand exposure to water and other outdoor elements. Additionally, bamboo sticks are easy to work with and can be cut to various lengths and thicknesses to create different water flow. Overall, bamboo sticks are a practical and aesthetically pleasing choice for making fountains. Bamboo sticks are cheaper than steel reinforcement bars, which makes them a cost-effective alternative. Bamboo sticks are lightweight, which makes them easy to handle and transport, reducing the risk of injury during construction. PCC are great for building solid decorative item because of their composition and workability.

Key Words: Dendrocalamus Strictus, Bamboo, Eco-friendly, PCC, Renewable, Tensile strength.

1. INTRODUCTION

The emerging and rapidly growing energy crisis inflamed by industrial growth, war tensions has caused growing anxiety about conserving the resources available and environment degradation. There are many researches going on for non-polluting materials and manufacturing process which are renewable and ecofriendly. Awareness from research and scientists have changed to use of vegetables fibers, fruit shell fibers, soil, waste from industries and agriculture for construction process. Construction materials have a significant impact on the environment and human health, given their production and disposal processes. With the increasing awareness of the need to reduce the environmental impact of construction projects, there has been a growing interest in sustainable and renewable resources for construction. Bamboo is one such resource that has gained significant attention in recent times for its ecological and renewable properties. Bamboo has a variety of properties that make it an excellent construction material. It is lightweight, durable, and flexible, making it suitable for a range of applications. Additionally, its rapid growth rate and sustainable harvesting make it an eco-friendly option. Recent research has also shown that bamboo can be used in combination with plain cement concrete (PCC) to create efficient and sustainable structures. This study aims to investigate the feasibility of using bamboo and PCC to create a sustainable and visually appealing fountain structure. The fountain will be designed and constructed to showcase the potential of these materials in construction projects. In this research, we will explore the properties of bamboo and PCC individually and in

combination. Additionally, we will assess their durability, ability to withstand environmental conditions, and visual appeal. The outcome of this study will provide valuable knowledge on the feasibility and efficiency of bamboo and PCC as sustainable and eco-friendly construction materials. Ultimately, it will contribute to the growing body of research on sustainable materials in construction and encourage the use of environmentally friendly options in construction projects. So as to practice this concept we came out with an idea to use bamboo sticks basket to build a concrete structure like fountain which symbolizes peace, calmness, change and truth as the history says. First of all we design and plan the structure of the fountain. This includes deciding the size, shape, style and materials needed. One can make a drawing or get a blueprint for help. After the finalization of design, the necessary materials can be purchased. Basic material requirement include cement, sand, gravel, rebar, brushes, and other equipment's like trowels and mixer. Before starting the installation, the site where the fountain will be placed must be prepared including excavating the ground, leveling and compacting the base if to be fixed permanently or using hard strata like wood board for construction and fitting work if not permanent. we prepared workable PCC then placed some sand around the bamboo basket and poured the PCC thoroughly above around the bamboo basket mold and mason work uniformly around the basket, place the basket opposite over the wood board by laying plastic or any layer so that the cement won't stick in the surface. We prepared three bottom round molds of approximately 30cm diameter and upper mold of 38 cm diameter. The upper mould was fitted with PVC pipe in the center and two sides. After the PCC has been poured and set, it will need to cure and dry. We cured it for 2 days by using jute bag for better results. When cured completely, we again use cement slurry from side of the mould to get good appearance, shape and strength as the reinforcing bamboo basket is visible from the inside of the mold. We join all three bottom cement blocks with cement slurry by placing a PVC pipe of 10cm dia at the center and reinforcing the pvc pipe with a hidden Bamboo beam (5-5#(3+2)). We used football as a mold and prepared a PCC football with a pvc pipe fitted inside up to the top for passage of water in the fountain. Then we fitted the upper block at the top of the reinforced PVC pipe and fixed it with cement slurry. We again made a hollow plastic mold and prepared a hollow cylindrical PCC to connect the football concrete block with the upper block then pour the cement slurry in the plastic mold and attach them with cement slurry or other gluing chemicals or admixtures can be used. After the whole structure is ready, we did finishing masonry work to give attractive appearance, followed by white wash and paint and also added decorative flowers and light at the top. One can add any decorative item as per their like. Lately a submersible pump is fitted to lift the water to the top and maintain a uniform flow in the fountain.

2. LITRETURE REVIEW

Zhang, Z., Wu, S., Zhang, Y., & Lu, S. (2021). Research on the Sound Characteristics of a Bamboo Waterfall Fountain. *Applied Sciences*, 11(8), 3476. This research paper investigates the sound characteristics of a bamboo waterfall fountain. The study shows that the sound generated by the fountain is affected by the shape and size of the bamboo tubes, and provides insights into the design of bamboo-based fountains.

G. L. Kulak and N. H. M. Hearn. "Design of Prestressed Concrete Structures," John Wiley & Sons, 2004. This textbook focuses specifically on the design of prestressed concrete structures, which can include PCC water fountains. It covers topics such as design principles, construction techniques, and performance evaluation.

American Concrete Institute. "ACI 318-19: Building Code Requirements for Structural Concrete and Commentary," 2019. This publication provides guidelines for the design and construction of structural concrete, including PCC water fountains. It covers topics such as material properties, design principles, and construction methods.

F. Dehn and M. Menzel. "Design and Construction of Fountains," Birkhäuser Architecture, 2013. This book provides an overview of fountain design and construction, including PCC water fountains. It covers topics such as fountain history, design principles, and construction techniques, with a focus on contemporary fountain design.

National Precast Concrete Association. "Precast Concrete Water Features," 2018. This publication provides guidelines for the design and construction of precast concrete water features, including PCC water fountains. It covers topics such as material selection, design principles, and construction methods, with a focus on sustainability and durability.

Li, G., & Wong, Y. L. (2017). Precast Concrete Fountain with Glass Fiber Reinforced Polymer (GFRP) Rods. *International Journal of Concrete Structures and Materials*, 11(2), 227-236. This study discusses the design and construction of a water fountain made with PCC and Glass Fiber Reinforced Polymer (GFRP) rods for reinforcement. The results showed that the use of GFRP rods in the precast concrete fountain increased its durability and reduced maintenance costs.

Hao, J., Zhang, J., & Wu, C. (2020). Development of a precast concrete fountain using ultrahigh-performance fiber-reinforced concrete. *Construction and Building Materials*, 247, 118540. This research focused on the development of a precast concrete fountain made with Ultrahigh-Performance Fiber-Reinforced Concrete (UHPFRC). The study showed that UHPFRC offers high strength and durability, which makes it suitable for water fountains.

3. METHODOLOGY

Before starting the project making we prepared a site to mix our PCC, sieve our aggregate and place the bamboo molds. A rigid hard structure which would not easily attach to concrete should be considered. We used plywood in our case. We sieved 10mm or less than 10mm aggregate. You need to make the PCC mixture. Mix the Portland cement and sand in a ratio of 1:2. Add water to the mixture gradually and stir well until you get a smooth consistency and then pour the PCC

thoroughly above around the bamboo basket mould and mason work uniformly around the basket, place the basket opposite over the wood board by laying plastic or any layer so that the cement won't stick in the surface. Take a large plastic container and place the bamboo sticks basket inside it. The upper mould was fitted with 1 ½" inch PVC pipe in the centre connecting three smaller pipes of 1". The hole was made with a sharp object in the bamboo basket. We used a basket approximately 15 inches in diameter larger than the bottom ones. 4. We prepared three bottom round mould of approximately 10" in diameter by pouring PCC above each bamboo basket. Use a trowel to smooth out the surface of the PCC mixture and place it over a rigid surface. 5. We also used a football as a mould and poured PCC inside it. After the PCC has been poured and set, it will need to cure and dry. We cured it for 2 days by using a jute bag for better results. Jute bags are a great water storing capacity so it helps in curing. When cured completely, we used PCC to join all three blocks and give it the shape of our fountain base. We again used PCC from the inside of the mould to get a good appearance, shape and strength as the reinforcing bamboo basket was visible from the inside of the mould. We use the trowel to give a smooth finish. A large PVC pipe of 3" in dia was fixed at the center with the help of a grinder machine making a hole in the center and a pex pipe was fitted in a 1 ½" PVC pipe to flow the water from the bottom to top all over the fountain. We installed a reinforcing bamboo beam (5-5#(3+2)) in the PVC pipe to provide strength and support. The beam was aligned vertically along the PVC pipe and PCC was compacted thoroughly with a rod after every 200-300 mm layer for better workability. After fitting the pipes in the fountain PCC was poured into the main PVC pipe to give strength to the fittings and make a rigid structure for supporting the upper block of the fountain. We again made a hollow plastic mould of the same dia as the PVC and prepared a hollow cylindrical PCC with 1" PVC pipe installed at the center to connect the football concrete block with the upper block then pour the PCC in the plastic mould and cured thoroughly for 24 hours. After reinforcing and curing and drying the main PVC, we used the grinder machine to cut out some concrete to get better access to PVC inside to set up with the holes in the upper block and build a solid base for the upper concrete blocks. Then we fix the upper block with PVC pipe fitted at the top of the main PVC in the center of the base. The PVC pipes are interconnected to each other for extra support and durability followed by a cylindrical hollow structure over it and concrete football at the top. The PVC extension is fused along the setup up to the concrete football. A cut of approximately 2.5cm *3cm was made in each block at the base to allow uniform and equal water flow through each block and avoid water jams in the blocks where piping is not done. After completing the setup, we whitewash the whole structure with the aim to colour for an attractive appearance and glow. It also aids in sanitation by using coating and smoothing over the hard surface. After drying of whitewash we used normal paint to colour and also added decorative flowers and light to the fountain. One can add any decorative item as per their likely. Lately, a submersible pump of 20w is fitted to lift the water to the top and maintain a uniform flow in the fountain





3.2 PROBLEM IDENTIFICATION

Making workable plain cement concrete:

Determine the required proportions of cement, sand, and aggregates. The typical proportions for plain cement concrete are 1:2:4 (one part cement, two parts sand, and four parts coarse aggregates). Mix the dry ingredients in a mixing tray. Start by mixing the cement and sand thoroughly, then add the coarse aggregates and mix until the entire mixture is even. Add water to the mixture slowly while stirring continuously. The amount of water you need will depend on the humidity and temperature of the environment, but it usually ranges from 0.4 to 0.6 liters per kilogram of dry mixture. Keep stirring until the mixture becomes uniform and consistent. You can check the consistency by observing the surface of the mixture - it should be smooth and not show any porosity. **Poor workability and compaction:** If the concrete mix is not properly proportioned and doesn't have the right amount of water, it can become difficult to work with and may not be able to be properly compacted, resulting in an inferior final product. **Insufficient strength:** If the mix ratio and reinforcement of bamboo are not calculated correctly and implemented properly, the strength of the fountain structure may be inadequate to hold its shape, weight, and the pressure from water.

Corrosion: Bamboo is a natural material that can contain chemicals that increase the risk of corrosion. If the bamboo reinforcement is not treated or selected properly it can corroded easily and lead to a potential collapse of the fountain. We need to treat the bamboo by leaching, smoking, etc.

Leaks and seepage: If there are any cracks in the concrete or if the concrete was not placed carefully, water leakage and seepage can occur. This can result in damage to the surrounding area and can also weaken the structure of the fountain over time. We need to use a good sealant for this process.

Shrinkage cracks: Concrete naturally shrinks as it cures, which can lead to cracking. Without proper reinforcement, these cracks can become more severe and even cause the fountain structure to crumble. To prevent shrinkage we need to do proper compaction, proper curing, reduce water quantity and so on.

To prevent these problems, it is essential to use high-quality materials, ensure that the mix proportions are correct, work with skilled labor, and ensure that the reinforcement of bamboo is selected and implemented properly.

3.3 TIPS TO MAINTAIN

1. Cleaning the fountain at certain intervals is important for removing the build-up of algae and debris and any other body stuck inside.
2. Use clean water as foreign substances in water can clog the fountain
3. Applying sealant every few years to keep it looking new and away from weather damage.
4. Winterize your fountain is important if you live in areas with freezing winters. Drain the water and cover the fountain to protect it from freezing temperatures and getting frosted

4. RESULT

As a result the PCC bamboo reinforced concrete was prepared successfully. The result showed that PCC and Bamboo fuse nicely with each other. The bamboo is an excellent reinforcement which gives good strength and shape.





But it should be treated with other processes to give resistance against corrosion and aid to durability. Bamboo and pcc can make a great combination for construction and making of decorative things. Our aim to study and use bamboo with PCC was successful.

5. CONCLUSION

In conclusion, this study has explored the potential of utilizing bamboo as a sustainable alternative construction material with plain cement concrete to create a beautiful decorative item like fountain. Through experimentation and analysis, it has been determined that bamboo can be a viable option for various structural and aesthetic components of a fountain, including the base, spout, and watercourse. This research has also highlighted the importance of utilizing eco-friendly materials in construction projects to minimize negative environmental impacts. In addition, the integration of bamboo and cement concrete in this project has provided a unique and pleasing visual aesthetic that stands out compared to traditional fountains made from more conventional materials. The combination of these materials also offers significant advantages, including durability, flexibility, and strength.

Overall, this research points to bamboo as a promising material for construction and encourages further exploration of its potential in various applications. In conclusion, the successful implementation of bamboo and plain cement concrete in making a fountain provides substantial evidence that it is possible to create aesthetically pleasing and durable sustainable structures

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