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Bamboo as a building material

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ABSTRACT

Bamboo was one of the cheapest raw materials that was in ancient and are being used nowadays in different sectors of Civil Engineering, i.e. the construction of structures like houses and even bridges. This paper presents an overview of mobile bridges constructed using bamboo, the types and characteristics of bamboo used for the construction of the mobile, tests to be done considerations to take before construction of the bridge, and the advantages of mobile Bridges. Also includes moisture content and the structure of the bamboo to be used.

Bamboo is a very adaptable plant. In various, it's utilized for buildings, furniture, textiles, and even as food. It is also environmentally friendly grass swirly. Bamboo is being increasingly invested as an environmentally friendly and economical option for constructing bridges, especially in rural areas and developing regions where conventional building resources may be limited or costly. Bamboo is lightweight compared to conventional bridge materials like steel or concrete, which simplifies transportation, assembly, and installation on-site. This Can lead to cost savings and reduce environmental impact during construction. Bamboo bridges possess remarkable resilience against wind, seismic activity, and traffic loads due to the innate flexibility of bamboos, enabling it to absorbs dynamic forces and vibrations. Moreover, this flexibility plays a crucial role in maximizing the risk of structural damage and reducing long-term maintenance. Certain varieties of bamboo, like Gundars bamboo, exhibit remarkable strength characteristics that rival these of wood and even certain types of steel. with appropriate engineering and treatment, bamboo has the ability to endure substantial weights and withstand various environmental conditions, rendering it viable op on for constructing bridges. Bamboo, a swirly renewable resource, exhibits rapid growth and regenerates efficiently after being harvested. The utilization of bamboo in the construction of bridges fosters sustainability by diminishing the dependence on non-renewable materials and mitigating the environmental consequences.

1. INTRODUCTION

Bamboo is a good material for many kinds of construction and has been valued for its strength, flexibility, and abundance throughout history. Its application in construction hasn't changed over me. Bamboo is a common material choice for environmentally friendly building projects all around the world. Bamboo can be used to create pedestrian bridges. A Pedestrian bridge is specifically constructed to cater for pedestrians and cyclists. These structures are typically Longer and steadier than footbridges, enabling them to handle higher volumes of traffic and cover greater distances. They come in different variety of designs and materials, frequently blending uniformly with aesthetics to inflate urban landscapes, Bamboo pedestrian bridges are commonly found in parks, nature reserves, and eco-tourism sites.

Bamboo bridges possess remarkable resilience against wind, seismic activity, and traffic loads due to the innate flexibility of bamboos, enabling it to absorbs dynamic forces and vibration. Moreover, this flexibility plays a crucial role in maximizing the risk of structural damage and reducing long-term maintenance. Bamboo had been utilized in the construction of a wide array of bridges, encompassing both uncomplicated footbridges and intricate structures. we decided to produce an innovative idea by creating a bridge that can be assembled and disassembled, and that bridge is known as the mobile bridge. Bamboo is a strong and flexible material that has been used for various construction purposes for centuries. In some regions, it's used as reinforcement material replacing steel due to its availability, tensile and compressive strength. For making the mobile bridge we are going to use bamboo as the major construction material because of its tensile strength, flexibility, durability, versatility, and compressive strength, other materials will be used too for the construction of the mobile bridge in rural areas and communities.

The mobile bridge will fulfill its intended purpose effectively for crossing rivers and lakes. it should be noted that the mobile bridge is a temporary structure whose uses are seasoned particularly in the rainy seasons. The usefulness of a bamboo mobile bridge would also depend on factors such as its design, size, load-bearing capacity, and the specific needs of the community.

Literature review.

A study found in the construction industry states that bamboo envelope performs better than a conventional brick & reinforced cement building and owing to the cost-efficient and green construction, it can be one of the major replacements of steel for concrete reinforcement. Bamboo has greater compressive strength than brick, concrete, and wood and shows the property of tensile strength that contests steel.

Introductory to the brief literature review it has to be recalled that the material "bamboo" shows an extreme diversity in growth and mechanical properties. Hence there is no unique "compressive strength" of bamboo like there is no such strength for timbers. As stated above the combined efforts of science and industry have managed in North America and Europe to classify structural timbers in a wood species overarching approach by assignments to strength classes. In Europe, this is followed up by a consistent sampling, testing, evaluation, and strength class assignment procedure

outlined introduction. In the case of bamboo such an approach is missing and most published results refer exclusively to individual species and rarely contain comparisons with species of other genera. Literature addresses in a very confined manner bamboo grown in Southeast Asia, especially Indonesia, China, and India, and in South / Middle America. Finally, it has to be stated that the lack of an international bamboo test standard up to the year 2019, now ISO 22157 [7], was detrimental as very different tests and evaluation procedures, being hardly or not at all comparable, have been used in the past. One of the first substantial contributions on bamboo strength and s stiffness was published by Atrops in 1969 [8]. The investigations comprised bending, shear, and compression of bamboo native to Trinidad, however, unfortunately, no genus or species was reported. In the following, regarding [8] and further literature, only aspects dealing with compressive properties parallel to the culm and (internode) fiber axis is discussed. The culm segments tested in [8] had very closely matching mean values of outer diameters D and wall thicknesses □□ of 77 mm and 7 mm, respectively. All specimens had an aspect ra o □□/□□ = 4. Three geometry types a - c were investigated having no node (a), a node close to each loaded end grain face (b), and a node at mid-length (c). Moisture content was 18% and density was ρ18= 730 kg/m³. The moisture content of 18% is below fiber saturation which in the case of bamboo is around 22%, so much lower as in the case of wood where a range of 2832% applies. The compressive strengths of all test series agreed very well. Series a and b showed closely matching average values of 40.5 N/mm² whereas series c gave a somewhat (7%) increased strength of 43.3 N/mm². The reason for the higher value in series c was attribute by Atrops to the radial reinforcement of the mid-length located node diaphragm. Complementary to shape strength also the clear wall strength was measured at specimens with dimensions (wall thickness x width x length) of 7 mm x 16 mm x 25 mm resulting in a 1.5 times higher mean strength of 62.1 N/mm². Janssen (1981) presents an overview of the literature known compressive strength tests with respective specimen dimensions and highlights a vast strength spread in the range of 35 N/mm² up to 85 N/mm² whereby uncertain es on moisture contents exist [9]. Own investigations by Janssen on bamboo species Bambusa Blumeana from the Philippines were performed with specimens cut from three culms with diameters of 70 – 90 mm and culm wall thicknesses of 5 – 9 mm. The specimen lengths were 50 mm, 100 mm, and 200 mm. The results obtained for specimens with and without nodes for a moisture content of 12% varied from minimally 61 N/mm² to maximally 104 N/mm². The mean compressive strength fc,0, mean,12 evolved as 81 N/mm². Specimens cut from the top of the culm showed on average 15% higher compressive strength values (□ □̄= 85 N/mm²) than specimens taken from the culm base (□ □̄= 74 N/mm²). The effect of nodes was found to be insignificant. Concluding this brief introduction into compression specimen sizes and results spreads the research of Ghavani [10] is regarded. The reason for that reference choice is that the investigations are related somehow to bamboo species and the origin of the reported G. Angus folia tests. In [10] seven different bamboo species belonging to three different genera, Bambusa, Dendrocalamus, and Guadua, all natives of South and Middle America, were investigated

2. MOBILE BRIDGE

A mobile bridge refers to a short-term type of bridge used in emergencies for passage by vehicles and pedestrians.

INSPECTIONS BEFORE CONSTRUCTION OF THE MOBILE BRIDGE

1. Structural Stability: The bridge should be stable structurally to bear the anticipated load as well as resist weather conditions and natural calamities such as floods.
2. Mobility: The bridge should be easy to erect strip down and carry to different locations. This may involve folding procedures.

3. Environmental Considerations: The mobile bridge has a specific environment where it will work i.e. Rural areas that experience high rainfall and more floods almost every year. The rural areas of west Bengal, Andra Pradesh, Nagpur.
4. Usefulness: The mobile bridge will fulfill its intended purpose effectively for crossing rivers and lakes. it should be noted that the mobile bridge is a temporary structure whose uses are seasoned particularly in the rainy seasons.

TYPE OF BAMBOO USED FOR MOBILE BRIDGE

For the construction of mobile bridges, we have the Dendrocalamus …. Also known as male bamboo or solid bamboo which is one of the strongest and most durable bamboo. It's also native to South Asia and India.

CHARACTERISTICS OF DENDROCALAMUS BAMBOO

Bamboo has characteristics that include;
1. Strength- Dendrocalamus bamboo possesses remarkable strength despite its seemingly delicate appearance, enabling it to compete with steel in certain which makes its final extensive application in diverse construction projects.
2. Flexibility – Solid bamboo flexibility enables it to resist bending and breaking when undergoing pressure, making it a suitable option.
3. Durability - male bamboo is surprisingly durable, and its longevity depends on factors such as species. In this case, male bamboo is one of the most durable bamboo ever if not the most durable species on earth because of its durability it qualifies for the construction of the bridge and it can last for up to 10 years without defects.

MOISTURE CONTENT OF BAMBOO

The moisture content of male bamboo (Dendrocalumus) can vary depending on factors such as climate, season, and harvesting methods. The average freshly harvested bamboo contains a moisture content of 50% to 70% or even more. In order to be fit for construction, the bamboo has to be dried properly to eliminate large volumes of moisture contents to approximately 10% to 15%

LIFE SPAN OF BAMBOO: With proper care and management including regular maintenance, male bamboo can potentially live for over 20 years or more. Male bamboo is known for its longevity and can live for several decades under favorable conditions.

FUNCTIONALITY OF THE BAMBOO MOBILE BRIDGE

A bamboo mobile bridge serves various functions depending on the context and need, but in this project, it gives the important function of serving as a pedestrian bridge effectively for crossing rivers and lakes which is a temporary structure in remote areas that lack permanent infrastructures and it's manlily seasoned particularly for use in rainy seasons

DIAGRAM

ADVANTAGES OF BAMBOO

The various advantages of bamboo are mentioned below:

1. Light, strong and versatile
2. Environment-friendly

3. Affordable

4. Self-renewing resource

5. Fast-growing grass – 30cm to 1m in a day

6. Extremely strong natural fiber at par with standard hardwoods. The strongest part is its node.

7. It has a great capacity for stock absorption, thus making it useful in earthquake-prone areas

8. Highly productive.

Disadvantages of bamboo.

The major disadvantages of bamboo are as follows:

1. Lack of design guidance and codes.

2. Requires preservation.

3. Durability–bamboo is subjected to attack by fungi, and insects; for this reason, untreated bamboo structures are viewed as temporary with an expected life of not more than 5 years.

Discussion

Bamboo may be a natural resource with immense possibilities as an artifact in the housing industry. Its structural attributes like seismic resistance, high tensile and compressive strength, etc. models it distinct. Bamboo is being slowly recognized as a renewable, fast-growing & economic staple that may replace contemporary materials if treated carefully. It encourages economic expansion and also conserves natural wood resources to guard our ecological environment by providing a replacement.

CONCLUSION

Bamboo is a cheap and easy-to-get raw material for construction. Its tensile strength and compressive strength make it a perfect choice for quick and cheap construction work like the construction of the mobile bridge. Bamboo possesses a significant amount of strength and does not succumb to rusting which makes it an easy substitute in some incidents.

In conclusion, Bamboo has many advantages which include durability and a long-life span of up to 20 or more years. It is also cheap to get and transport. Bamboo is also light in weight thereby making it the main raw material for the construction of the mobile bridge. Bamboo also possesses some aesthetic beauty and is also visually appealing and can be integrated and used along with cement concrete and even metals.

Engineers can also use it for many other constructions works such as flooring, roofing, etc. Because of these qualities of bamboo, we recommend Engineers to also use it for construction.

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