DEVELOPMENT OF ECO-EFFICIENT SUSTAINABLE CONCRETE BLOCKS USING SUGARCANE BAGGASE AND BAMBOO

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Introduction:

The construction industry is one of the largest contributors to environmental degradation due to its heavy dependence on cement, natural aggregates, and energy-intensive processes. Rapid urbanization and infrastructure growth have significantly increased the demand for conventional construction materials, leading to excessive consumption of non-renewable resources and higher carbon emissions. At the same time, large quantities of agricultural waste, such as sugarcane bagasse and bamboo, are generated and often disposed of through burning or landfilling, causing pollution and environmental imbalance.

In this context, the present project focuses on developing eco-friendly and sustainable concrete blocks by utilizing sugarcane bagasse and bamboo as alternative materials. This approach addresses two major challenges simultaneously: waste management and sustainable construction. Sugarcane bagasse, when processed into ash, exhibits pozzolanic properties that enhance concrete strength, while bamboo improves tensile strength, ductility, and crack resistance.

The integration of these agro-waste materials into concrete not only reduces the dependence on traditional raw materials but also lowers the carbon footprint associated with cement production. Moreover, it promotes the concept of a circular economy by converting waste into valuable construction resources.

This project is highly relevant in today's global efforts toward climate change mitigation and green construction practices. It contributes to the development of durable, and environmentally responsible building materials suitable for non-load bearing applications. Ultimately, the study supports sustainable development by combining innovation, resource efficiency, and environmental conservation in the field of civil engineering.

Objectives:

1. To utilize sugarcane bagasse and bamboo as key raw materials for making sustainable construction blocks.

2. To develop an optimal mix design for the blocks to achieve desirable properties such as compressive strength and water resistance.
3. To conduct laboratory tests to evaluate the mechanical performance of the developed blocks.
4. To increase durability & resistance.
5. To make the blocks cost-effective
6. To promote circular economy by converting agro-industrial waste into value-added construction materials

Methodology:

The methodology of this study follows a systematic and experimental approach to develop eco-friendly concrete blocks using sugarcane bagasse and bamboo as sustainable materials. The process began with the collection of raw materials, including cement, fine aggregate, coarse aggregate, water, sugarcane bagasse, and bamboo. Proper preparation of these materials was carried out to ensure consistency and reliability in results. The sugarcane bagasse was first sun-dried and then oven-dried to remove moisture, followed by grinding and sieving to obtain uniform particle size. Bamboo was processed by cutting it into small, suitable lengths to act as natural reinforcement in the concrete mix.

A mix design was then prepared based on standard IS guidelines to determine the appropriate proportions of cement, water, aggregates, and waste materials. Different trial mixes were developed by partially replacing conventional materials with varying percentages of sugarcane bagasse, while maintaining a constant proportion of bamboo. The materials were batched by weight and thoroughly mixed to achieve a homogeneous and workable concrete mix.

The prepared concrete was cast into standard moulds to form cube specimens and block samples. The moulds were properly cleaned and oiled before casting to ensure easy removal. Concrete was placed in layers and compacted using tamping rods to eliminate air voids and achieve proper density. After casting, the specimens were left undisturbed for 24 hours for initial setting.

Following demoulding, the specimens were subjected to curing in water for 7 and 28 days to ensure proper hydration and strength development. After the curing period, various laboratory tests were conducted to evaluate the performance of the developed concrete. These tests included compressive strength testing to assess load-bearing capacity, slump test to determine workability, and water absorption test to evaluate durability characteristics.

The results obtained from these tests were analyzed and compared with conventional concrete to determine the effectiveness of using sugarcane bagasse and bamboo. Graphs and charts were used as visual aids to represent variations in strength and workability with different mix proportions. This systematic methodology ensures accurate evaluation of eco-friendly concrete blocks and highlights their potential for sustainable construction applications.

Result and Conclusion:

In conclusion,

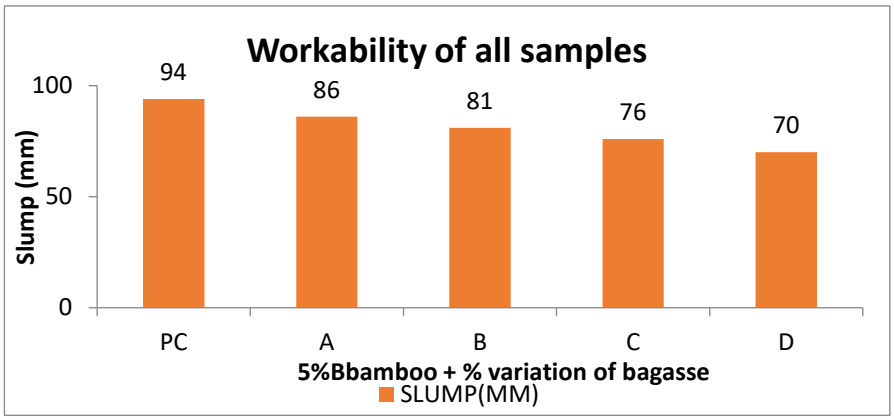

Figure 1: Variation of slump for all the samples

1. The variation in slump values for different concrete mixes.
2. It indicates the change in workability due to the addition of bamboo and sugarcane bagasse.
3. As the percentage of bagasse increases, the slump value decreases.
4. This reduction in slump indicates lower workability of the concrete mix.
5. The decrease occurs because bamboo fibers and bagasse particles absorb more water.
6. These materials also restrict the flow of concrete, making it less workable.

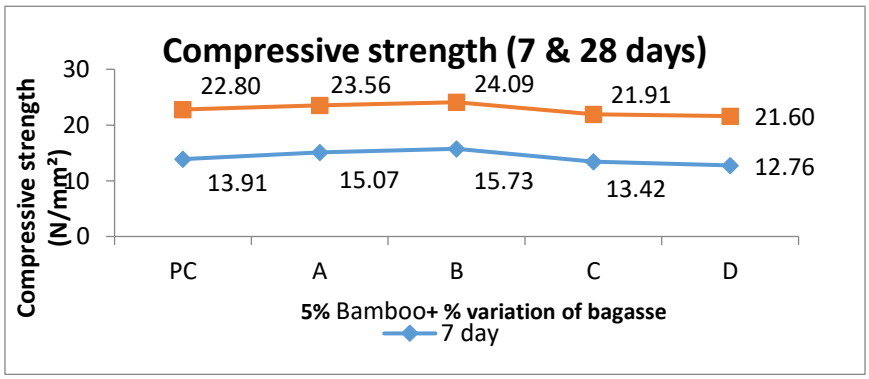

Figure 2: Compression strength of the samples at 7 days and 28 days

1. It highlights the strength variation for different mix proportions.
2. The mix containing 5% bamboo and 4–6% bagasse shows higher compressive strength.
3. This improvement is due to better bonding within the concrete matrix.
4. The pozzolanic reaction of bagasse contributes to increased strength.
5. Bamboo helps in improving crack resistance and load distribution.
6. However, strength decreases beyond the optimum level of bagasse content.
7. Excess bagasse reduces density and weakens the concrete structure.

References:

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Future Scope:

The future scope of this project includes:

1. Study long-term durability properties such as chemical resistance, weathering, and environmental exposure.
2. Investigate treatment methods for bamboo to improve strength, bonding, and moisture resistance.
3. Explore higher percentages and different combinations of sugarcane bagasse in concrete.
4. Incorporate other eco-friendly materials like fly ash, rice husk ash, and recycled aggregates.
5. Develop standard guidelines and codes for practical implementation in construction.
6. Improve workability and mix design techniques for better performance.
7. Promote use in rural and low-cost housing projects for sustainable development.