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Development of Concrete Block using Bagasse Ash

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***Abstract* -** The rapid expansion of the construction industry has significantly increased the demand for sustainable and eco-friendly building materials. Simultaneously, the disposal of agricultural waste such as bagasse ash, a by-product of sugarcane processing, has emerged as a major environmental concern. This study investigates the potential use of bagasse ash as a partial replacement for cement in the production of concrete blocks, aiming to reduce environmental impact while maintaining adequate structural performance. Bagasse ash exhibits pozzolanic properties, which enable it to react with calcium hydroxide and enhance the strength and durability of concrete when used in appropriate proportions.

In this research, concrete mixes were prepared by replacing cement with bagasse ash in varying percentages, typically ranging from 5% to 25%. The prepared blocks were then evaluated for key physical and mechanical properties, including compressive strength, density, water absorption, and durability. The results demonstrated that at optimal replacement levels, bagasse ash improves certain properties of concrete, particularly compressive strength, due to the pozzolanic reaction. Additionally, it contributes to reduced material costs and lowers carbon emissions associated with cement production.

Overall, the use of bagasse ash in concrete blocks presents a practical and sustainable solution for waste utilization while promoting environmentally responsible construction practices.

I. INTRODUCTION

The construction industry plays a vital role in the economic development of any country. However, it is also one of the largest consumers of natural resources and a significant contributor to environmental degradation. The demand for conventional construction materials such as cement, sand, and aggregates has increased rapidly due to urbanization, industrialization, and population growth. Among these materials, cement is the most widely used binding material in concrete production. Despite its extensive use, the manufacturing of cement is highly energy-intensive and results in the emission of large quantities of carbon dioxide (CO_2), a major greenhouse gas responsible for global warming and climate change.[1] In recent years, there has been a growing concern about the environmental impact associated with cement production and the depletion of natural resources. This has led researchers and engineers to explore alternative materials that can partially replace cement without compromising the strength and durability of concrete. One of the most promising approaches is the utilization of industrial and agricultural waste materials as supplementary cementitious materials. These materials not only help in reducing the environmental burden but also promote sustainable development in the construction sector.

MATERIALS

Materials

- Cement (OPC)
- Bagasse Ash
- Fine Aggregate (Sand)
- Coarse Aggregate
- Water
- Mould

Methodology

The use of bagasse ash, a by-product of the sugar industry, in concrete block production presents an eco-friendly and sustainable alternative to conventional materials. This project focuses on partially replacing cement with bagasse ash to improve waste utilization and reduce environmental impact. Initially, bagasse ash is collected, dried, and sieved to obtain uniform particle size. Concrete mixes are then prepared with varying percentages of bagasse ash as a cement substitute. Standard molds are used to cast concrete blocks, which are then cured for specified periods. The blocks are tested for compressive strength, water absorption, and durability. Finally, results are compared with conventional concrete blocks to evaluate performance and feasibility.

OPC 53 Grade cement conforming to IS 12269:2013 was used as the sole binder in the Normal mixes. The 53 Grade designation indicates a minimum 28-day compressive strength of 53 MPa when tested as standard mortar cubes per IS 4031. Key physical and chemical properties verified prior to use are presented in Table 3.1. The specific gravity of 3.15 and

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fineness (Blaine surface area ≥ 225 m²/kg) are consistent with standard OPC 53 Grade requirements. The initial setting time of 30 minutes minimum and final setting time of 600 minutes maximum were confirmed in compliance with IS 12269:2013

Material	Mass (kg)	Volume (m3)
Cement (OPC)	405	0.129
Fine Aggregate (Sand)	643	0.243
Coarse Aggregate	1120	0.415

Table 01-Normal Concrete Mix Proportion per m^3

Materials	Quantity (kg)		
	10%	15%	25%
cement	12.21	11.55	10.19
bagasse ash	1.36	2.04	3.40
water	5.70(Lit)	5.70(Lit)	5.70(Lit)
Fine Agg	21.54	21.54	21.54
Coarse Agg	37.52	37.52	37.52

Table 02- Concrete Cement Replace SCBA Mix Proportion

II. RESULTS AND DISCUSSION

The results obtained from the experimental study on concrete blocks incorporating sugarcane bagasse ash (SCBA) as a partial replacement of cement are presented and discussed in this section. The main objective of this study is to evaluate the influence of SCBA on the mechanical and durability properties of concrete blocks. Various tests such as compressive strength, water absorption, and density were conducted on both control and SCBA-modified concrete mixes. The performance of SCBA concrete blocks is compared with conventional concrete to identify the optimum replacement level. The discussion highlights the effect of SCBA's pozzolanic nature on improving the microstructure of concrete. It is observed that SCBA contributes to better particle packing and reduced pore spaces within the concrete matrix. However, excessive replacement of cement with SCBA may lead to a reduction in early-age strength. The results also indicate improvements in durability characteristics due to reduced permeability. The behavior of concrete blocks is analyzed with respect to different curing ages. Overall, this section explains how SCBA influences the overall performance of concrete blocks and supports The Normal OPC mix was designed for M30 characteristic compressive strength (fck = 30 MPa) in accordance with IS 10262:2019. The target mean compressive strength (f'ck) is calculated as 38.25 MPa. In this study, 10% of cement is replaced with bagasse ash by mass, while maintaining the total binder content constant. The modified binder consists of 90% OPC and 10% bagasse ash. The water–binder ratio is kept unchanged to achieve the target mean strength. This experimental study focuses on the partial replacement of Ordinary Portland Cement (OPC) with Sugarcane Bagasse Ash (SCBA) to evaluate its impact on the mechanical properties of normal strength concrete. Based on an initial M30 grade design (as per IS 10262:2019), the following methodology and material proportions were established for the casting of test specimens.

The fundamental design maintains a total binder content of 405 kg/m³ with a strictly controlled water-to-binder (w/b) ratio of 0.42. In this specific experimental variation, 25% of cement is replaced with Bagasse Ash, resulting in a reduced cement content of 303.75 kg/m³, while 101.25 kg/m³ of Bagasse Ash is introduced as a supplementary cementitious material. By maintaining the water content at 170 kg/m³, the chemical balance for hydration and pozzolanic reaction is preserved. The skeletal structure of the mix is supported by 643 kg/m³ of fine aggregate and 1120 kg/m³ of coarse aggregate. The results demonstrate that variation in material composition leads to measurable changes in properties, and comparison with the control mix provides a clear understanding of these variations.

Compressive Strength (Cement 90% + Bagasse ash 10%)

Days	Cube 1 Load (MPa)	Cube 2 Load (MPa)	Cube 3 Load (MPa)	Strength (MPa)
7	18.5	19.2	19.6	19.1
14	24.8	25.6	26.0	25.5
28	29.0	30.2	30.8	30.0

Table 03- Compressive strength 7 ,14 and 28 days 10% bagasse ash

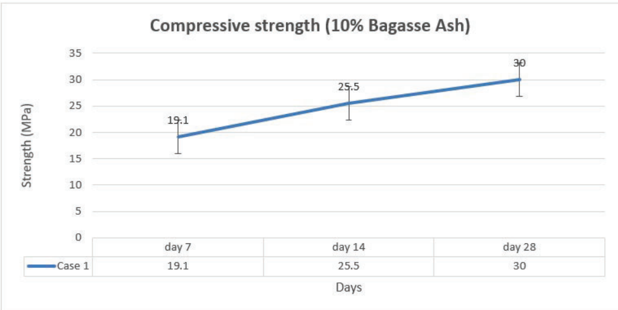

Figure 01- Compressive strength (10% Bagasse Ash)

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The compressive strength of concrete with 10% bagasse ash shows a consistent increase with curing time, starting at 19.1 MPa at 7 days, rising to 25.5 MPa at 14 days, and reaching 30.0 MPa at 28 days. This indicates that the addition of bagasse ash contributes positively to strength development, likely due to its pozzolanic reaction enhancing the concrete matrix over time. The gradual strength gain reflects effective hydration and improved bonding, while the minimal variation among the three cubes suggests good uniformity in mixing and casting. Overall, the results show satisfactory performance and slightly improved strength compared to conventional concrete.

Compressive Strength (Cement 85% + Bagasse ash 15%)

Days	Cube 1 Load (MPa)	Cube 2 Load (MPa)	Cube 3 Load (MPa)	Strength (MPa)
7	17.2	17.8	18.3	17.8
14	23.5	24.2	24.8	24.2
28	28.0	29.1	29.6	28.9

Table 04- Compressive strength 7 ,14 and 28 days 15% bagasse ash

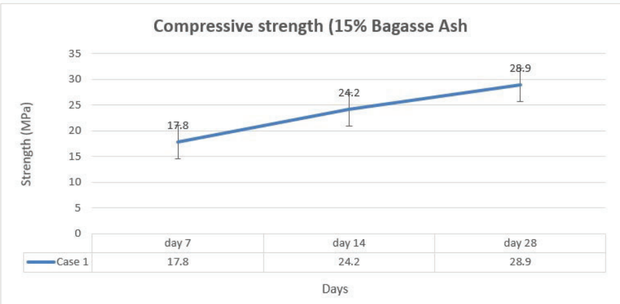

Figure 02- Compressive strength (15% Bagasse Ash)

The compressive strength of the concrete shows a steady increase with curing time, rising from an average of 17.8 MPa at 7 days to 24.2 MPa at 14 days and reaching 28.9 MPa at 28 days. This gradual improvement indicates proper hydration of cement and good curing conditions, leading to stronger bonding within the concrete matrix. The relatively small variation among the three cube results at each age suggests uniform mixing, casting, and testing. Overall, the results demonstrate normal strength development and satisfactory performance of the concrete mix.

Compressive Strength (Cement 75% + Bagasse ash 25%)

Days	Cube 1 Load (MPa)	Cube 2 Load (MPa)	Cube 3 Load (MPa)	Strength (MPa)
7	14.8	15.5	16.0	15.4
14	20.5	21.3	22.0	21.3
28	25.8	26.7	27.4	26.6

Table 05- Compressive strength 7 ,14 and 28 days 25% bagasse ash

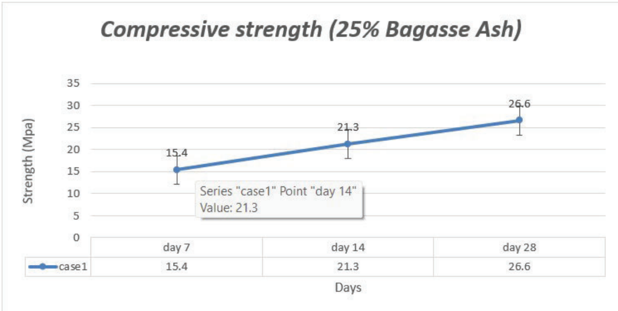

Figure 03- Compressive strength (25% Bagasse Ash)

The compressive strength of concrete with 25% bagasse ash increases with curing time, from 15.4 MPa at 7 days to 21.3 MPa at 14 days and 26.6 MPa at 28 days. Although strength development follows the normal trend, the values are lower compared to mixes with lower or no bagasse ash content, indicating that higher replacement may reduce early and ultimate strength. This is likely due to slower pozzolanic activity and reduced cement content at higher replacement levels. However, the consistent gain in strength and low variation among cubes suggest proper mixing and curing, with overall acceptable but comparatively reduced performance.

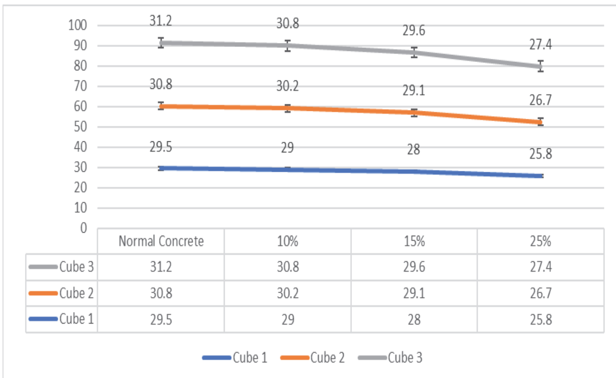

Figure 04- Compressive strength (Normal Concrete, 10%, 15%, & 25% Bagasse Ash)

III. CONCLUSION

At 10% SCBA replacement, compressive strength was nearly equal to conventional concrete. The 28-day strength reached about 30 MPa, showing minimal impact on performance This indicates SCBA's effective pozzolanic action and improved microstructure.

With 15% SCBA, a slight reduction in strength was observed. Although strength gain followed a normal trend, 28-day strength was marginally lower

At 25% SCBA replacement, a significant strength reduction occurred at all ages The concrete failed to achieve the required M30 strength at 28 days.

Overall, 10% SCBA is the optimum replacement level for maintaining strength. SCBA enhances sustainability and durability when used in proper proportions. The results show that normal concrete achieves the highest compressive strength, while increasing replacement levels (10%, 15%, 25%) consistently reduce strength. All three cubes follow a similar declining trend, confirming uniform behavior.Specific gravity values decrease from 2.25 in M0 to 2.09 in modified mixes, indicating a reduction in density due to the inclusion of fly ash and cow dung. Mixes such as M2 (2.12) and M6 (2.09) show lower values, while M7 maintains a value of 2.24, indicating a balanced composition.

Even at 10% replacement, the strength reduction is minimal, but beyond 15% the drop becomes more significant. At 25%, the strength falls noticeably below the target for M30 concrete (30 MPa). Therefore, partial replacement up to about 10–15% can be considered acceptable, but higher percentages adversely affect compressive strength and are not recommended for structural applications. maintaining measurable performance within the tested parameters.

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REFERENCES

1] A. Adesina, "Recent advances in the concrete industry to reduce its carbon dioxide emissions," Environ. Chall., vol. 1, p. 100004, Dec. 2020, doi: 10.1016/j.envc.2020.100004.

[2] A. Bahurudeen, K. S. Vaisakh, and M. Santhanam, "AVAILABILITY OF SUGARCANE BAGASSE ASH AND POTENTIAL FOR USE AS A SUPPLEMENTARY CEMENTITIOUS MATERIAL IN CONCRETE".

[3] M. A. Khan et al., "Optimizing concrete sustainability with bagasse ash and stone dust and its impact on mechanical properties and durability," Sci. Rep., vol. 15, no. 1, p. 1385, Jan. 2025, doi: 10.1038/s41598-025-85363-x.

[4] S. Sankeeth et al., "Optimizing mechanical properties of concrete using sugarcane bagasse ash," Results Eng., vol. 27, p. 105968, Sep. 2025, doi: 10.1016/j.rineng.2025.105968.

[5] N. Sa-nguanduan and K. Amornfa, "Sustainable Interlocking Blocks Containing Sugarcane Bagasse Ash: Structural Integrity, Cost Efficiency, and Environmental Benefits," Civ. Eng. J., vol. 11, no. 5, pp. 2150–2169, May 2025, doi: 10.28991/CEJ-2025-011-05-024.