iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** III **Month of publication:** March 2026

DOI: https://doi.org/10.22214/ijraset.2026.77851

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue III Mar 2026- Available at www.ijraset.com

Project on Corn Cob Ash Replaced Cement in Concrete by Acclerated Curing

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Abstract: ***The rapid growth of the construction industry has significantly increased the demand for cement, leading to higher carbon dioxide emissions and environmental degradation. Cement production is one of the major contributors to global CO_2 emissions, which creates the need for sustainable and eco-friendly alternatives. This project focuses on the partial replacement of cement with Corn Cob Ash (CCA) in concrete and the application of accelerated curing techniques to improve early strength development. Corn cob ash, an agricultural waste material obtained from burning corn cobs, possesses pozzolanic properties that make it suitable as a supplementary cementitious material in concrete production. Utilizing such agro-waste not only reduces environmental pollution but also promotes sustainable waste management practices.***

The main objective of this study is to evaluate the mechanical properties and performance of concrete when cement is partially replaced by varying percentages of corn cob ash under accelerated curing conditions. In this project, different mix proportions were prepared by replacing cement with CCA at different percentages such as 5%, 10%, 15%, and 20% by weight. The concrete specimens were subjected to accelerated curing methods such as hot water curing or steam curing to enhance the early strength gain. Compressive strength tests were conducted at different curing ages to analyse the strength development and compare it with conventional concrete. The results indicate that partial replacement of cement with corn cob ash up to an optimum percentage improves the compressive strength and durability characteristics of concrete. Accelerated curing significantly reduces the curing time while maintaining adequate strength, making it suitable for precast concrete elements and fast-track construction projects. However, higher replacement levels beyond the optimum percentage may lead to a reduction in strength due to the lower cementitious content. This project demonstrates that corn cob ash can be effectively used as a sustainable and economical alternative material in concrete production. The combination of CCA replacement and accelerated curing not only enhances early strength but also contributes to environmental sustainability by reducing cement consumption and agricultural waste disposal problems. Hence, the study supports the development of green concrete technology for sustainable construction practices.

I. INTRODUCTION.

Concrete is the most widely used construction material in the world. The key binding material in concrete is Ordinary Portland Cement (OPC) Ordinary Portland Cement. However, cement production contributes significantly to carbon dioxide emissions and environmental pollution. To reduce cement consumption and promote sustainable construction, agricultural waste materials such as Corn Cob Ash (CCA) are being used as partial replacement of cement.

Corn cob is an agricultural by-product obtained after removal of maize grains. When burnt under controlled conditions, it produces ash rich in silica content, which exhibits pozzolanic properties.

Accelerated curing techniques such as hot water curing and steam curing are used to achieve early strength gain in concrete.

This project focuses on:

1) Use of accelerated curing method
2) Study of compressive strength and durability

II. LITERATURE SURVEY

1) Several researchers have studied agricultural waste as cement replacement.
2) Research findings show:
3) Corn Cob Ash contains silica and alumina.
4) It behaves as a pozzolanic material.
5) Optimum replacement level is between 5% to 20%.

6) Strength decreases at higher replacement levels.
7) Accelerated curing increases early strength.
8) Studies indicate that CCA concrete can be used for non-load bearing and low-cost construction.

III. OBJECTIVES

1) To reduce cement usage by partially replacing it with Corn Cob Ash (CCA).
2) To utilize agricultural waste effectively in concrete production.
3) To prepare CCA by controlled burning process.
4) To replace cement with 5%, 10%, 15% and 20% CCA in concrete.
5) To apply accelerated curing for early strength gain.
6) To test compressive strength as per IS 516:1959.
7) To determine the optimum percentage of CCA replacement.
8) To promote eco-friendly and sustainable construction.

IV. METHODOLOGY

Collection of corn cob
↓
Burning to produce ash
↓
Grinding and sieving ash
↓
Mix design of concrete (M20 Grade)
↓
Replacement of cement with CCA
↓
Casting of cubes (150mm × 150mm × 150mm)
↓
Accelerated curing (hot water curing at 90°C)
↓
Compressive strength testing

V. EXPERIMENTAL WORK

A. *Materials Used*

1) *Cement – Ordinary Portland Cement*

2) *Fine Aggregate – River sand*

3) *Coarse Aggregate – 20mm size*

4) *Water – Potable water*
5) *Corn Cob Ash*

B. Preparation of Corn Cob Ash

1) Corn cobs collected from farms
2) Dried properly
3) Burnt in open furnace
4) Ash collected
5) Sieved through 90-micron sieve

C. Mix Proportion (M20 Grade)

Control Mix (0% CCA)
1 : 1.5 : 3
(Cement : Fine Aggregate : Coarse Aggregate)
CCA Replacement Levels:
5%
(Cement : Corn Cob Ash 5%, Fine Aggregate : Coarse Aggregate)
10%
(Cement : Corn Cob Ash 10%, Fine Aggregate : Coarse Aggregate)
15%
(Cement : Corn Cob Ash 15%, Fine Aggregate : Coarse Aggregate)
20%
(Cement : Corn Cob Ash 20%, Fine Aggregate : Coarse Aggregate)

D. Accelerated Curing

- Concrete cubes were placed in hot water at 90°C for 24 hours.
- Accelerated curing helps in early strength gain.

E. Compressive Strength Test

Test conducted using Compression Testing Machine (CTM).

VI. RESULTS AND DISCUSSION

Compressive Strength Results

Replacement %	7-Day Strength (MPa)	28-Day Strength (MPa)
0%	20.5	28.0
5%	21.2	29.5
10%	22.0	30.2
15%	18.5	25.0

A. Observations

1) Strength increased up to 10% replacement
2) Strength decreased at 15% replacement
3) 10% CCA showed optimum performance
4) Accelerated curing improved early strength

B. Advantages

1) Eco-friendly
2) Cost-effective
3) waste utilization
4) Reduced CO_2 emission

C. Disadvantages

1) Requires controlled burning
2) Strength reduces beyond optimum replacement

D. Applications

1) Non-load bearing walls
2) Rural housing
3) Pavement blocks

VII. CONCLUSION

1) Corn Cob Ash can replace cement up to 10%
2) 10% replacement gave maximum strength
3) Accelerated curing improved early strength
4) Sustainable and economical construction material

A. Future Scope

1) Study durability properties
2) Study flexural strength
3) Use in high-strength concrete
4) Large-scale field implementation

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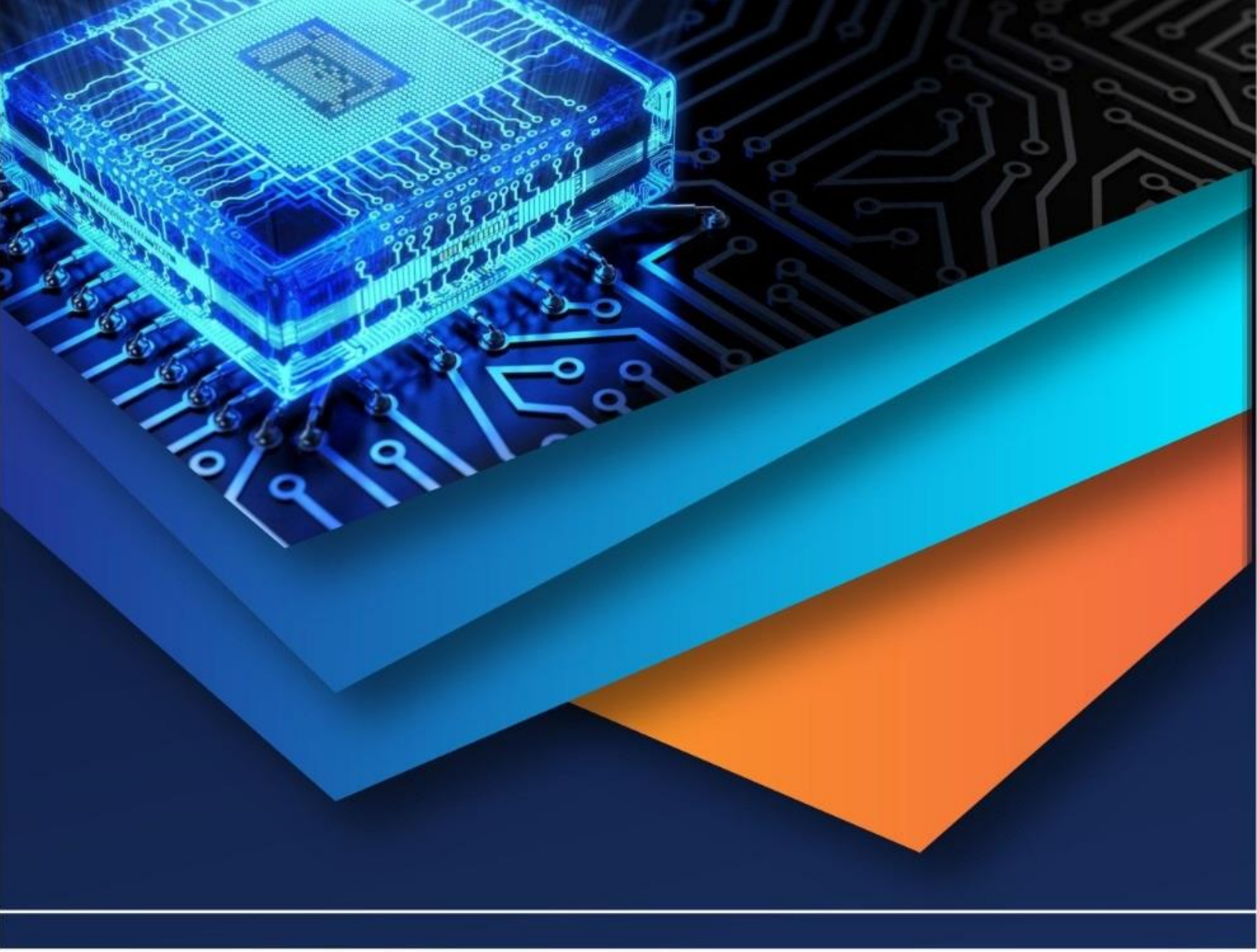

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