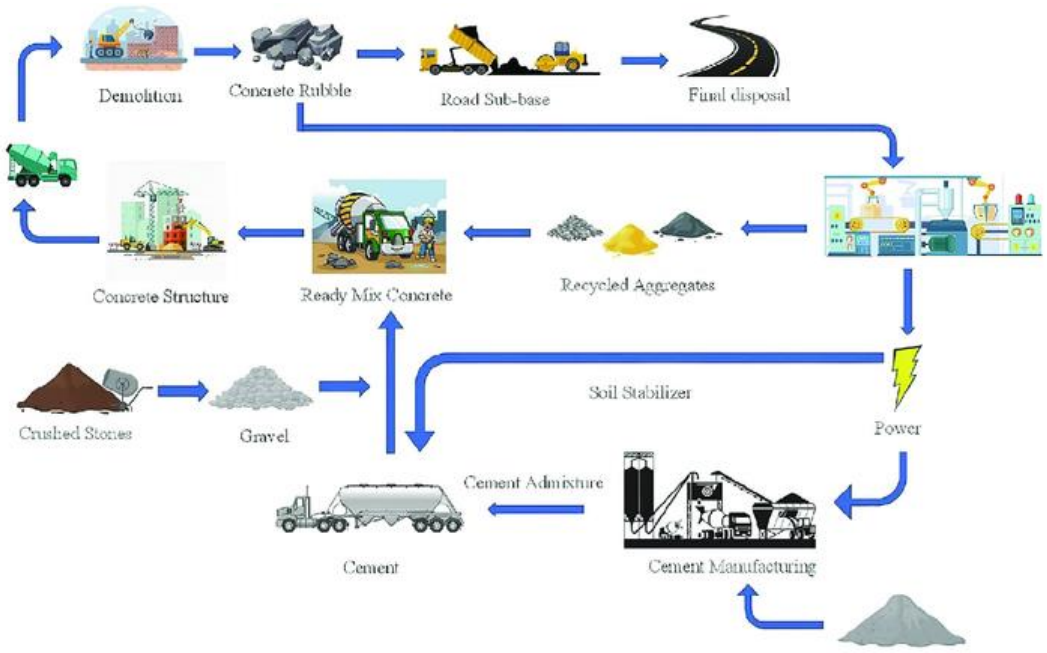
Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 03, March-2025

Improving the Strength of Concrete using Demolition Waste

Ummam Shitab, Anupam Kumar Gautam
Environmental engineering
Maharishi University of Information technology



Abstract:
This research explores the potential of using demolition waste as an alternative material for strengthening concrete. Concrete is one of the most widely used construction materials, but the environmental impact associated with its production and disposal is substantial. Demolition waste, which includes materials like crushed bricks, concrete, and tiles, can be repurposed to reduce the need for virgin aggregates and lower the carbon footprint of concrete production. The study evaluates various mixes, testing methods, and performance characteristics, ultimately aiming to develop an improved concrete formula with sustainable practices. The research concludes that using demolition waste in concrete mixes can enhance certain properties like compressive strength while promoting environmental benefits.

1. INTRODUCTION:

1.1 Background: Concrete is one of the most essential materials in the construction industry. It accounts for a significant portion of the global construction market. However, its production requires large amounts of natural resources and results in significant CO_2 emissions. The construction sector also generates a substantial amount of waste, particularly demolition waste. Globally, millions of tons of demolition waste are produced each year, yet much of it remains underutilised.

1.2 Problem Statement: While concrete is widely used, its production and disposal have substantial environmental impacts. The use of demolition waste as an aggregate alternative in concrete production has emerged as a potential solution to reduce both the environmental impact and the reliance on virgin materials.

1.3 Research Objective: The objective of this study is to investigate the use of demolition waste as a partial or complete substitute for natural aggregates in concrete production and assess its effects on the compressive strength and durability of the concrete.

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1.4 Research Scope: The research will focus on:

- Assessing the types of demolition waste that can be used in concrete.
- Conducting laboratory tests to compare the mechanical properties (compressive strength, tensile strength, etc.) of concrete with and without demolition waste.
- Reviewing the environmental implications of using demolition waste in concrete production.

2. LITERATURE REVIEW:

- 2.1 Concrete and Demolition Waste:
  - Overview of Concrete Composition: Cement, aggregates (fine and coarse), and water.
  - Types of Demolition Waste: Concrete debris, bricks, tiles, asphalt, and wood, which are often disposed of in landfills.
  - Previous Studies on Recycling in Concrete: Research by authors such as Mardani-Aghabaglou et al. (2015) and Ramos et al. (2019) has shown positive results when using crushed concrete and other waste materials in concrete, often improving sustainability without compromising strength.

- 2.2 Advantages and Challenges of Using Demolition Waste:
  - Advantages:
    - Reduces landfill waste.
    - Minimises the extraction of virgin aggregates, reducing the ecological impact.
    - Can potentially improve certain mechanical properties.
  - Challenges:
    - Variability in the quality of demolition waste.
    - Possible contamination with impurities that may affect concrete performance.
    - Difficulty in standardising demolition waste for widespread use.

- 2.3 Strength and Durability of Concrete with Demolition Waste:
  - Concrete properties, such as compressive strength, tensile strength, and modulus of elasticity, are vital to structural performance.
  - Effect of Demolition Waste on Strength: While some studies report a decrease in compressive strength, others suggest that by optimising mix ratios, certain types of demolition waste can enhance strength or provide comparable results to natural aggregates.

3. MATERIALS AND METHODS:

- 3.1 Materials Used:
  - Cement: Ordinary Portland Cement (OPC).
  - Aggregates: Natural aggregates (sand and gravel) and demolition waste aggregates (crushed concrete, tiles, bricks).
  - Water: Potable water.
- 3.2 Demolition Waste Preparation:

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- Collection and Selection: Demolition waste is sourced from construction sites and processed (crushing, sieving, and washing).
- Characterisation: Analysis of the physical properties (size distribution, shape, moisture content) of the demolition waste.

- 3.3 Concrete Mix Design:
- Control mix without demolition waste.
- Experimental mixes with varying proportions of demolition waste as a replacement for natural aggregates (e.g., 10%, 20%, 30%).
- Other additives or chemical admixtures may be considered for better performance.

- 3.4 Testing Methods:
- Compressive Strength Test: Using standard moulds, concrete specimens are cured for 28 days and subjected to compression testing.
- Tensile Strength and Flexural Strength Tests: To evaluate the overall performance of the concrete.
- Durability Tests: Freeze-thaw cycles, water absorption, and chemical resistance.
- Microstructural Analysis: SEM (Scanning Electron Microscopy) may be used to investigate the bond between cement paste and aggregate.

4. RESULTS AND DISCUSSION:

- 4.1 Compressive Strength Results: Present the findings of compressive strength for each mix, including control and those with varying demolition waste proportions. Discuss trends such as:
- If there is an increase or decrease in strength.
- The effect of different types of demolition waste (bricks, concrete, tiles) on strength.
- Compare with relevant studies and benchmarks.
- 4.2 Durability and Other Properties: Discuss the results of tensile strength, flexural strength, and any observed improvements or concerns in the durability of concrete with demolition waste.
- 4.3 Microstructural Analysis: Discuss how the microstructure of concrete changes with the inclusion of demolition waste. Use SEM images to show the bond between cement paste and recycled aggregates.
- 4.4 Environmental Impact: Calculate the carbon footprint of using demolition waste versus natural aggregates in concrete production. Highlight the potential reduction in CO_2 emissions and the sustainable advantages.

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5. CONCLUSION:

- 5.1 Summary of Findings:
  - Conclude whether the use of demolition waste improves or reduces concrete strength.
  - Highlight any significant differences in properties like durability, workability, and sustainability.

- 5.2 Recommendations for Future Research:
  - Investigate the potential use of other types of demolition waste.
  - Further studies on the long-term durability of concrete with recycled aggregates.
  - Examination of cost-effectiveness and scalability for the construction industry.

- 5.3 Implications for the Construction Industry:
  - Discuss how widespread adoption of this method could impact construction practices.
  - Explore potential policy changes for encouraging the use of demolition waste.

REFERENCES:

- Include studies and academic articles that have contributed to the development of your research. For instance:
  - Mardani-Aghabaglou et al. (2015). "Utilisation of recycled aggregate in concrete: A review."
  - Ramos et al. (2019). "Recycling construction and demolition waste for sustainable concrete production."
  - Other relevant studies, standards, and books on concrete technology and waste management.

APPENDICES :

- Tables of experimental data.
- Diagrams or charts comparing strength and durability.
- Detailed material specifications.

This outline provides a comprehensive structure for your research paper. You can expand each section, adding experimental data, detailed analysis, and relevant discussions. Would you like help expanding specific sections or data analysis?