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SUSTAINABLE MATERIALS AND THEIR IMPACT ON PROJECT COST

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Abstract

The construction industry is rapidly expanding due to increasing infrastructure development and urbanization. However, conventional construction materials significantly contribute to environmental degradation and increase structural dead load and project cost. Sustainable construction materials provide an efficient alternative by improving structural performance, reducing lifecycle cost, and minimizing environmental impact.

This report presents a detailed study on the implementation of sustainable materials such as foam concrete, fly ash blocks, and recycled aggregates in residential building construction. Special emphasis is given to foam concrete floor filling as a replacement for conventional brick bat filling. The study evaluates execution methodology, density testing, structural load comparison, cost comparison, advantages, limitations, and site observations.

The results indicate that foam concrete significantly reduces dead load, improves construction speed, enhances thermal insulation, and reduces overall project cost.

Keywords: Sustainable materials, Foam concrete, Lightweight construction, Cost reduction, Residential buildings

1. INTRODUCTION

Construction materials play a major role in determining the strength, durability, and cost efficiency of residential building projects. Traditional materials such as brick bat filling increase structural load and require more execution time. Sustainable construction materials provide an alternative solution by reducing environmental impact and improving construction efficiency.

Foam concrete is one of the most effective lightweight materials used for floor filling applications. It reduces dead load on slabs, improves leveling accuracy, and enhances construction speed.

This report focuses on the practical implementation of foam concrete and other sustainable materials in residential construction and evaluates their effect on project cost and performance.

2. OBJECTIVES OF THE STUDY

The objectives of this study are:

- To study sustainable materials used in residential construction
- To analyze foam concrete floor filling methodology
- To compare brick bat filling with foam concrete

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• To evaluate density testing procedure of foam concrete
• To study structural load reduction using lightweight materials
• To analyze project cost savings using sustainable materials

3. SCOPE OF THE STUDY

This study focuses on the application of foam concrete floor filling in residential apartment construction. The report evaluates execution procedure, density testing results, structural load comparison, and cost comparison between conventional brick bat filling and foam concrete filling.

The study also includes the use of fly ash blocks and recycled aggregates as sustainable alternatives in construction.

4. NEED FOR SUSTAINABLE MATERIALS IN CONSTRUCTION

Sustainable materials are required in modern construction due to the following reasons:

• Reduction of structural dead load
• Reduction of environmental pollution
• Conservation of natural resources
• Faster construction speed
• Reduction of lifecycle maintenance cost

Foam concrete is widely adopted in high-rise residential buildings because of its lightweight properties and ease of execution.

5. MATERIALS USED IN THE PROJECT

5.1 Foam Concrete

Foam concrete is a lightweight cement-based material produced by mixing cement slurry with stable foam. It is widely used for floor filling in residential buildings.

Advantages:

• Lightweight material
• Reduces slab load
• Provides uniform leveling
• Improvised thermal insulation
• Faster execution compared to brick bat filling

Typical density range:

800 kg/m³ – 1200 kg/m³

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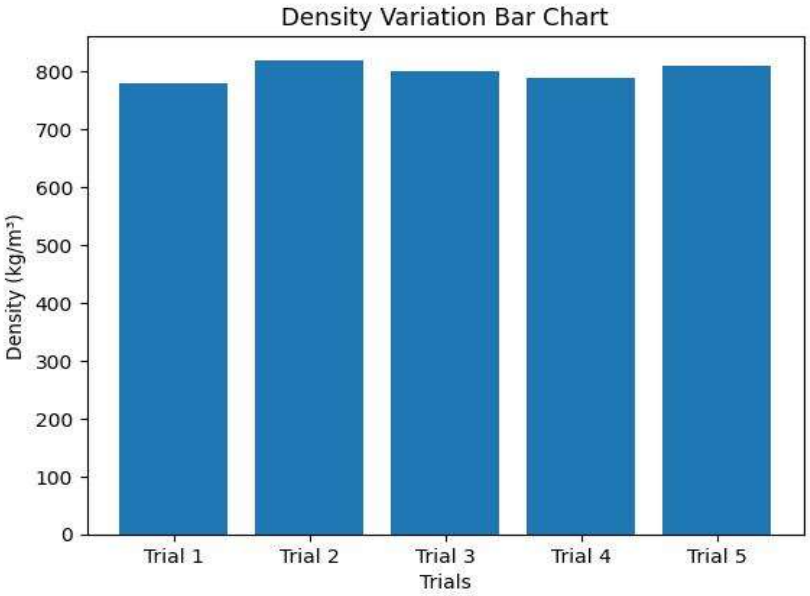

5.2 Fly Ash Blocks

Fly ash blocks are eco-friendly building materials manufactured using industrial waste from thermal power plants.

Advantages:

- Reduces cement consumption
- High compressive strength
- Smooth surface finish
- Reduced plaster thickness requirement

(Figure 5.2: Fly Ash Block Application)

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5.3 Recycled Aggregates

Recycled aggregates are obtained from demolition waste and reused in construction activities.

Advantages:

- Reduces landfill waste
- Saves natural resources
- Reduces transportation cost

(Table 5.3: Recycled Aggregate Comparison Table)

Sieve Size	Fine Aggregate (% passing)	
	Natural Aggregate	Recycled Aggregate
4.75 mm	95.6	98
2.36 mm	81.6	52.8
1.18 mm	71.6	38.6
600 micron	58.4	25.2
300 micron	38.8	11.2
150 micron	8.4	6.4
< 150 micron	-	-

3. RESULTS & DISCUSSION

6. METHODOLOGY

The methodology adopted for this study includes site observation and comparison between conventional materials and sustainable materials.

Step 1: Identification of conventional material

Step 2: Selection of sustainable alternative

Step 3: Study of execution procedure

Step 4: Density testing

Step 5: Structural load comparison

Step 6: Cost comparison

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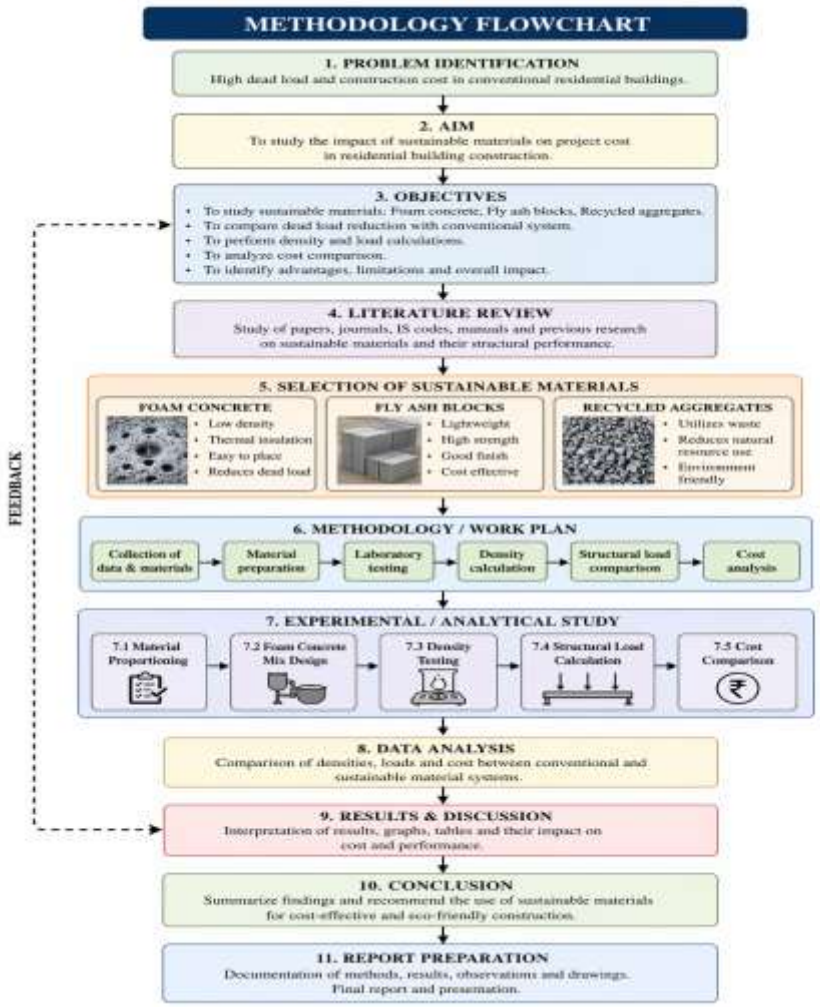

(Figure 6.1: Methodology Flowchart)

7. EXECUTION PROCEDURE OF FOAM CONCRETE FLOOR FILLING

Step 1: Surface cleaning

Step 2: Level marking

Step 3: Foam concrete batching

Step 4: Pumping operation

Step 5: Level finishing

Step 6: Curing process

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(Figure 7.1: Foam Concrete Pumping Activity)

(Figure 7.2: Level Finishing Activity)

8. DENSITY TESTING PROCEDURE

Density testing ensures lightweight performance of foam concrete.

Procedure:

- Collect fresh foam concrete sample
- Fill measuring container
- Record weight
- Calculate density

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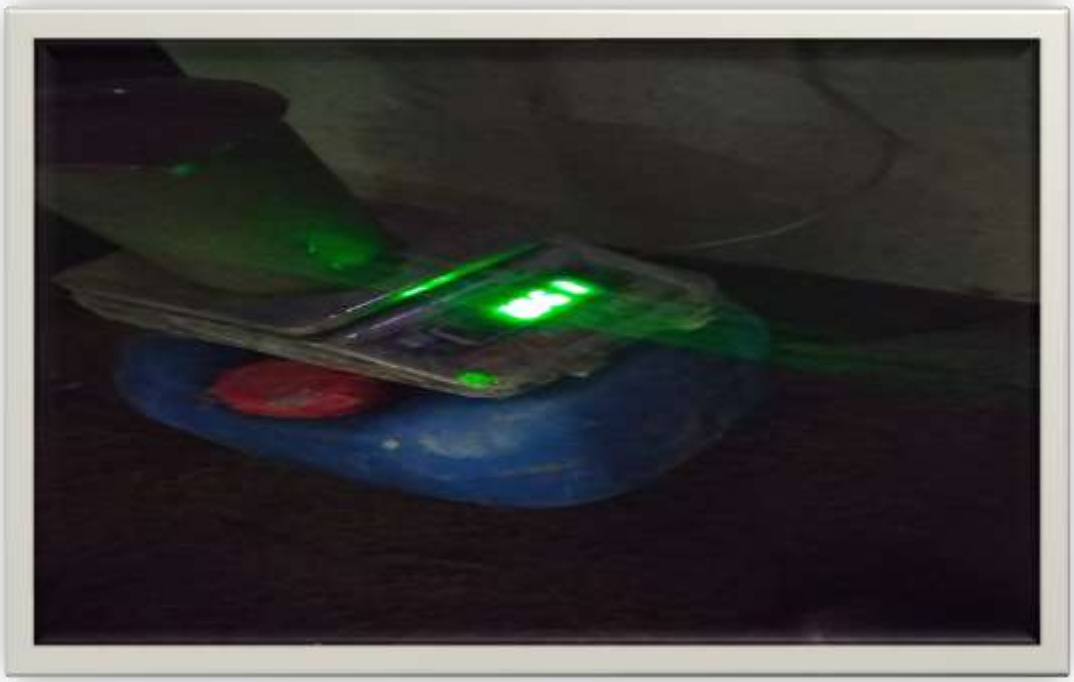

9. STRUCTURAL LOAD COMPARISON

Comparison between brick bat filling and foam concrete indicates significant reduction in structural load.

Weight reduction achieved:

40% – 60%

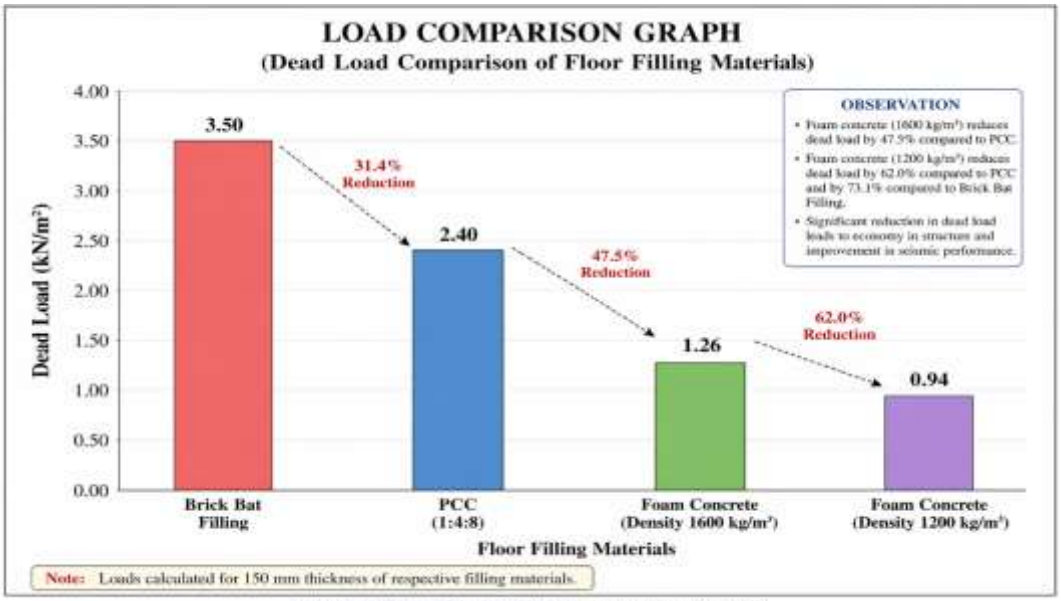

Fig. 10.1 Dead Load Comparison of Floor Filling Materials

(Figure 9.1: Load Comparison Graph – Insert Chart)

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10. COST COMPARISON ANALYSIS

Foam concrete provides long-term cost savings due to reduced execution time and reduced structural member sizes.

Cost savings achieved through:

- Reduced material usage
- Reduced labour requirement
- Faster execution
- Reduced maintenance cost

(Table 10.1: Cost Comparison Table)

Sl. No	Parameter	Brick Bat Filling	Foam Concrete Filling
1	Material Cost	Moderate	Slightly higher per m^3
2	Labour Requirement	High (manual placing required)	Low (pump-based placing)
3	Execution Time	Slow	Fast
4	Dead Load on Structure	High (≈ 1800 kg/m^3)	Low (≈ 800–1200 kg/m^3)
5	Structural Member Size	Larger beam & slab sections required	Reduced beam & slab sizes possible
6	Transportation Cost	Higher (bulk material handling)	Lower (lightweight material)
7	Levelling Accuracy	Moderate	High (self-leveling nature)
8	Crack Formation	Possible	Very minimal
9	Thermal Insulation	Low	High
10	Maintenance Cost	Higher over time	Lower
11	Construction Speed	Slower	Faster
12	Overall Lifecycle Cost	Higher	Economical

11. SITE OBSERVATIONS

During site inspection the following observations were recorded:

- Uniform level achieved using foam concrete
- Faster execution compared to conventional method
- Reduced cracking issues
- Improved surface finishing quality

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(Figure 11.1: Finished Foam Concrete Surface)

12. ADVANTAGES OF FOAM CONCRETE

• Lightweight material
• Improves thermal insulation
• Reduces structural load
• Faster construction
• Cost effective solution

13. LIMITATIONS OF FOAM CONCRETE

• Requires trained manpower
• Requires foam generator equipment
• Proper supervision required during execution

14. RESULTS AND DISCUSSION

Based on density testing results and site observations, foam concrete performed efficiently in floor filling applications. Structural load reduction improves building safety and durability.

Cost comparison confirms that sustainable materials reduce overall project cost compared to conventional materials.

15. CONCLUSION

Foam concrete is an effective sustainable alternative to brick bat filling in residential construction. It significantly reduces structural load, improves execution speed, and reduces overall project cost.

Adoption of sustainable construction materials improves both environmental performance and construction efficiency.

16. REFERENCES

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