

Construction Materials for Sustainable Environment in Residential Building

Harshpreet Singh¹, Prashant Patil²

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ABSTRACT

This research examines sustainable materials used in residential construction to mitigate environmental impacts and enhance long-term sustainability. The construction sector has a profound effect on global resource depletion and environmental degradation, particularly through the use of traditional materials like cement and bricks. As concerns about climate change and resource scarcity intensify, there is an increasing need to shift toward sustainable building materials. This study evaluates various eco-friendly alternatives such as recycled aggregates, low-carbon cement, and renewable resources like bamboo, as well as innovative construction practices that utilize these materials. The life cycle impact of these materials—from extraction to disposal—is assessed to understand their environmental footprint. The study also explores the financial and social implications of adopting sustainable materials, focusing on their cost-effectiveness, energy efficiency, and potential for reducing greenhouse gas emissions. Additionally, the research highlights the growing importance of energy-efficient building designs, which improve thermal performance and indoor air quality. Findings show that, although the initial costs of sustainable materials are higher, they offer long-term economic, environmental, and health benefits. The paper concludes by advocating for policy changes and increased awareness to promote the widespread adoption of green building materials, ensuring a more sustainable future in residential construction.

Keywords: Sustainable materials, cost analysis, Construction Techniques

Introduction

The construction industry plays a significant role in shaping the built environment, yet it is also one of the largest consumers of natural resources and contributors to environmental degradation [1]. As the global population continues to grow and urbanization accelerates, the demand for residential buildings is expected to rise, further intensifying the pressure on the environment [2]. This situation necessitates a shift towards more sustainable construction practices that minimize resource consumption, reduce waste, and mitigate the environmental impacts associated with building materials [3]. The concept of sustainable construction materials has gained prominence as a key strategy in addressing these challenges, particularly in the context of residential buildings, which represent a substantial portion of global construction activities [4].

Sustainable construction materials are those that have a lower environmental impact throughout their lifecycle, from extraction and processing to use, maintenance, and eventual disposal [5]. These materials are often characterized by their ability to reduce energy consumption, greenhouse gas emissions, and waste generation, while also promoting the conservation of natural resources and enhancing the overall sustainability of the built environment [6]. The adoption of such materials is critical in the pursuit of a sustainable construction industry, as it can significantly contribute to the reduction of the environmental footprint of residential buildings [7].

One of the primary drivers behind the push for sustainable construction materials is the growing recognition of the construction sector's contribution to climate change [8]. The production and use of traditional construction materials, such as cement, steel, and bricks, are associated with significant

carbon emissions. For instance, cement production alone accounts for approximately 8% of global CO₂ emissions [9]. As the demand for housing continues to grow, so too does the need to find alternative materials that can deliver similar performance characteristics while having a reduced environmental impact [10]. This has led to increased interest in materials such as recycled aggregates, low-carbon cement, natural fibers, and bio-based materials, all of which offer promising pathways to more sustainable construction practices [11].

In addition to mitigating environmental impacts, sustainable construction materials also offer several other benefits that are particularly relevant to residential buildings [12]. For example, the use of materials with superior thermal properties can improve energy efficiency, leading to reduced heating and cooling costs for homeowners. Similarly, the incorporation of materials with lower toxicity levels can enhance indoor air quality, contributing to healthier living environments [13]. Moreover, sustainable materials often promote the use of locally sourced resources, which can reduce transportation-related emissions and support local economies [14].

Despite the clear benefits, the widespread adoption of sustainable construction materials in residential buildings faces several challenges [15]. These include the higher initial costs associated with some sustainable materials, the lack of awareness and knowledge among construction professionals and consumers, and the need for regulatory frameworks that incentivize their use [16]. Overcoming these barriers requires concerted efforts from various stakeholders, including policymakers, industry leaders, and researchers, to promote the development, dissemination, and implementation of sustainable construction practices [17].

1.1 Environmentally Sustainable Building

“An construction is environmentally sustainable if it requires a smaller amount of water, improves its energy efficiency, conserves natural resources, produces less waste, and offers better spaces for those living there than a traditional structure[18].

Simply put, Sustainable Building is the development and running of a building that is mindful of the environment. And for numerous valid factors, Ecological Building has grown more widespread [19]. The idea of encouraging sustainable and Ecological Construction concepts has assumed a prominent position in the real estate sector due to the current paradigm shift [20]. Several Sustainable Building innovations are being created to pave the path and simplify the method for overtime procedures for environmentally friendly and environmentally friendly buildings as various stakeholders look for opportunities to get more involved in supporting these ideas [21]. But what exactly is Green Building technology? Let's comprehend it [21].

Sustainability Structures are planned, built, and managed to promote the well-being and health of their people inside, as well as a vibrant neighbourhood and the natural world [22].

Sustainability Construction is, in practice, a whole-systems strategy for construction that involves:

- Designing for habitable societies.
- Utilizing the sun and location to the building's benefit to provide organic cooling, ventilation, and illumination;
- Planting with native, drought-resistant flora and water-efficient methods.
- Constructing solid, long-lasting structures.
- Minimizing and reusing building and demolition debris.

Constructing constructions, employing environmentally conscious methods, and utilizing resources effectively the building's complete lifecycle, including choosing a location, planning, development, and administration, upkeep, remodeling, and dismantling [23]. This method extends and enhances the traditional design considerations of finances, utility, resilience, and ease. A sustainability structure is called a 'high efficiency' or sustainable structure [17].

When applied, these measures help protect the planet for generations by saving biodiversity and preserving water and air quality. They benefit us today by enhancing our well-being and comfort and preserving air quality. In addition to reducing repairs and replacement costs, lowering utility bills and the cost of owning a house, and boosting property and reselling values, Sustainability Building strategies are financially beneficial for everyone.

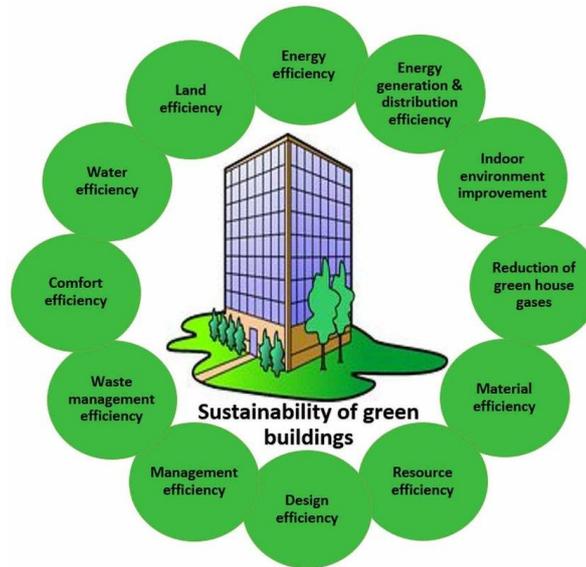


FIG 1. Sustainability of Sustainable Building [24]

A sustainable building results from a design philosophy that focuses on boosting the effectiveness of resource use (e.g., energy, water, and materials) while reducing impacts on human health and the environment throughout the building's lifecycle [24]. This is accomplished through more effective siting, planning, building, operation, maintenance, and removal [25]. Commonly, sustainable buildings are constructed and maintained to minimize the general effect of construction on people and the environment by effectively using electricity, water, and other resources, and other assets; safeguarding the health of tenants and enhancing worker efficiency; and decreasing waste, pollutants, and damage to the environment [26].

1.2 Sustainable materials reduce environmental impact

The construction industry has seen a significant shift towards sustainability, particularly in residential buildings where the choice of materials plays a critical role in reducing environmental impact [27]. Sustainable construction materials are those that minimize resource depletion, reduce carbon emissions, and promote energy efficiency, while still meeting the technical requirements for durability, strength, and functionality [28]. One of the primary ways sustainable materials reduce environmental impact is through the use of renewable and recycled resources. Materials like bamboo, which grows rapidly and has high tensile strength, are increasingly being used as an alternative to traditional wood [29]. Recycled steel, which can be reused multiple times without losing its properties, is another example of a sustainable material that reduces the need for new raw materials, thereby conserving natural resources and reducing the carbon footprint of construction projects [30].

Moreover, sustainable materials contribute to energy efficiency in residential buildings. Insulating materials such as sheep's wool, cellulose insulation (made from recycled paper), and rigid foam boards significantly reduce the energy required for heating and cooling [31]. These materials not only enhance the building's thermal performance but also lower energy consumption, which is a major contributor to greenhouse gas emissions [31].

The technical values of sustainable materials are equally important. For instance, materials like concrete with supplementary cementitious materials (SCMs) such as fly ash or slag cement improve the durability and longevity of structures while reducing the amount of Portland cement needed—a significant source of CO₂ emissions [32]. Similarly, low-VOC (volatile organic compounds) paints and finishes improve indoor air quality, ensuring a healthier living environment for residents. In summary, sustainable construction materials are pivotal in reducing the environmental impact of residential buildings [33]. By integrating renewable resources, recycled materials, and energy-efficient components, these materials contribute to the creation of eco-friendly homes that align with global sustainability goals, while also ensuring that the technical performance of the building is not compromised [34].

2. Related Work

Vishnu Vijayan et.al Sustainable residential building construction is the primary focus of this project, which emphasizes affordable urban housing constructed from locally available materials. It investigates the possibility of building residential structures using environmentally friendly materials, specifically mud, to reduce energy use and impact on the environment compared to conventional concrete structures. Cost analysis and life cycle data are included in the project [35]. John Perez-Garcia et.al This paper provides a Life-Cycle Assessment (LCA) of alternative building materials, beginning with resource extraction and ending with building demolition. It is unique in the temporal distribution of environmental effects, from forest expansion to demolition. By quantifying energy, resource use, and emissions, the study evaluates the effects on the environment and identifies opportunities for future improvement. [36]. Shahriar Shams et.al (2012) The construction industry accounts for 40% of CO₂ emissions, and the energy consumption and CO₂ impact of construction materials vary. Emissions can be substantially reduced by selecting sustainable materials. A case study demonstrates that, in order to reduce environmental impact, glass and timber should be used more frequently than metals like steel and aluminum. [37]. Muhammad Mahboob et.al Every year, the demand for energy in developing nations rises, with construction consuming a lot of energy. Conservation is essential for lowering material costs and carbon emissions. Traditional materials have three times the embodied energy of energy-efficient wall structures, according to this study. Conventional materials also produce more CO₂ emissions [38]. Milena Medineckiene et.al (2010) The paper compares eco-friendly and conventional building materials to discuss construction's impact on the environment. It introduces a ranking system for building projects based on social, financial, and environmental factors. A wood-based blockhouse is found to be 6.6% better than a wood-frame building and 7.5% better than a brick house when the SAW-G method is used [39].

3. Research Methodology

This study employs SPSS software to analyze data from a sample size of 39, focusing on the challenges faced in promoting sustainable residential buildings in India. The methodology involves a comprehensive examination of prevalent myths and barriers impacting green architecture adoption. One major challenge is the misconception that constructing eco-friendly homes incurs higher costs compared to traditional buildings. Despite evidence suggesting that green homes are economically viable in the long term, this myth persists due to a lack of awareness among property investors. The study will use statistical analysis to evaluate how this myth affects investment decisions and the overall acceptance of sustainable building practices.

Another challenge is the insufficient awareness about available administrative support. Organizations such as the National Housing Bank (NHB) and Home Finance Companies (HFCs) like IIFL Home Loan are making efforts to promote green buildings by providing professional guidance and financial

incentives. The study will assess how these initiatives are perceived and their effectiveness in encouraging green construction. The general lack of awareness about the benefits of green buildings is a significant barrier. The study will explore the impact of educational campaigns, seminars, and media coverage on increasing public interest and understanding of sustainable living. SPSS will be used to analyze survey data on public awareness and its correlation with the adoption of green building practices.

3.1 Material Comparison

Table 1. Material Comparison

Criteria	Autoclave Aerated Concrete Block	Red Bricks
Cost	Usually higher than red bricks	Generally lower cost
Eco-friendliness	Environmentally friendly	Less environmentally friendly
Weight	Lightweight	Heavier
Straightness	Precise and uniform	May have variations in straightness
Insulation properties	Excellent thermal and sound insulation	Moderate insulation properties
Construction speed	Faster installation	Slower installation
Durability	Durable and resistant to pests	Less durable
Energy efficiency	Good energy efficiency	Lower energy efficiency

3.2 Fly Ash and Ordinary Portland Cement

Table 2. Fly Ash and Ordinary Portland Cement

Properties	Fly Ash	Ordinary Portland Cement (OPC)
Composition	Waste products from coal-fired power plants	The mixture of limestone, clay, and gypsum
Environmental Impact	Reduces carbon emissions and landfill waste	High carbon emissions during production
Strength	Generally lower strength compared to OPC	Higher strength and initial setting time
Durability	Enhances long-term durability of concrete	Provides good durability properties

4. Case Study

4.1 N B Bhalchandra Akashvan



Fig 2. 3rd Eye View of the Actual Site

The project, N B Bhalchandra Akashvan, is situated in Punawale, Pune, Maharashtra 411035. It features a proposed residential building with G+21 floors. The site spans 2.29 acres and includes one tower with 21 floors, housing a total of 317 units. The owner and developer of this project is Nandkumar Bhalchandra Bhondve, and the architectural design is by Samarth Chintamani Properties. The structural engineering is managed by JW Consultant, and the construction is carried out by the N B Bhondve Group. The cost per flat starts at 64 lakhs. This project is focused on sustainable building practices and is currently under construction, with possession expected by March 2030.

1.3 N B Bhalchandra Akashvan by NB Bhondve group

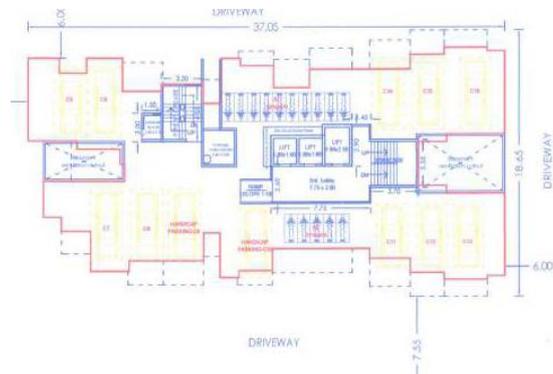
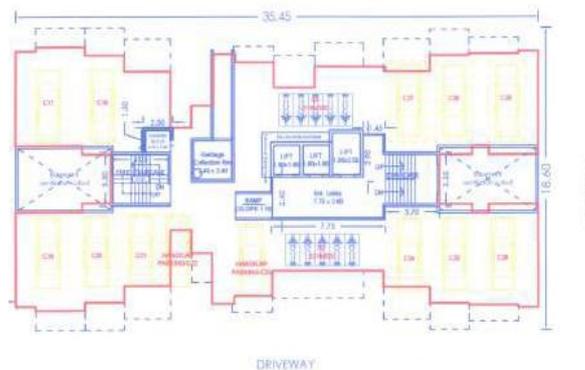


FIG 3. Building Plan



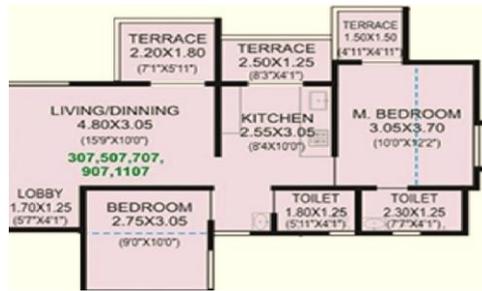


FIG 4. PLAN (2BHK)



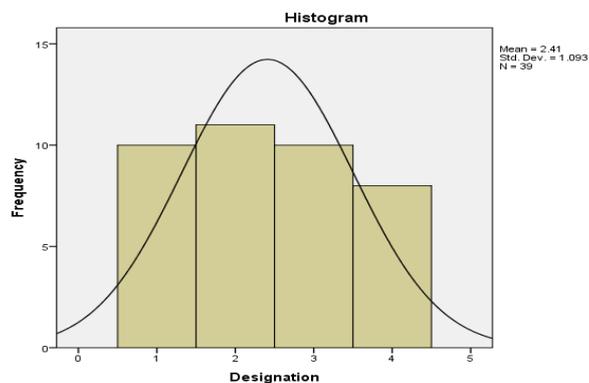
FIG 5. Foundation



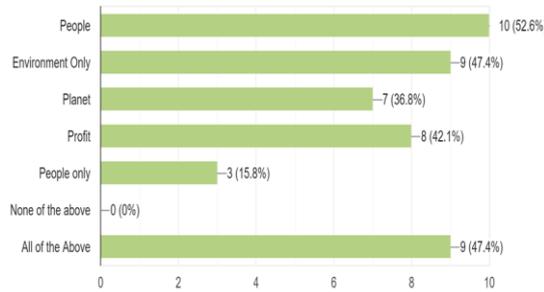
FIG 6. Column at Site

Bhalchandra Akashvan is a residential development in Punawale, Pune. The project is built by Samarth Chintamani Properties NB Bhondve Group. They provide 2BHK, 3BHK apartments with all necessities.

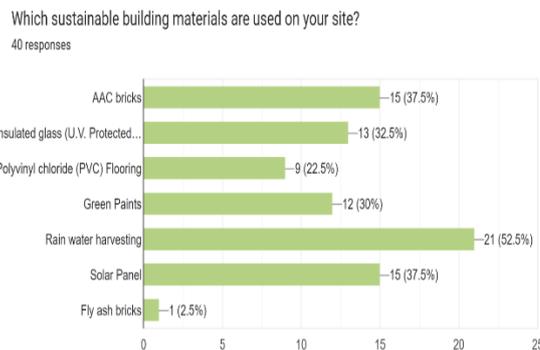
5. Results And Discussion



The distribution of roles among the 39 respondents is shown in the Above Graph. Contractors make up 28.2 percent of the workforce, followed by Owners and Project Managers, who each make up 25.6%. 20.5% of respondents fell into the "Any other" category. Project Managers and Owners are fairly evenly represented in this distribution, with Contractors having a slight advantage and fewer respondents belonging to other categories.



Above graph illustrates the key factors considered in sustainable buildings based on frequency and percentage. "Environment Only" is the most cited factor, with 28.2%, indicating a strong emphasis on environmental aspects. "People" and "Profit" each receive 15.4%, showing that social and economic factors are also important. "Planet" and "None of the above" each account for 10.3%, while "People only" and "All of the Above" are less frequent, at 7.7% and 12.8% respectively.



Sustainable Building Material AAC bricks at 37.5% as well as Fly ash bricks 2.5%. Polyvinyl Chloride 22.5% are used.

5.1 Detail Quantity Estimation of Sustainable Building

Table 3. Detail Quantity Estimation of Sustainable Building

SR.NO.	DESCRIPTION	QTY.(IN CUM)	FLY ASH CEMENT (IN BAG)	SAND(BRASS)	AGG.(BRASS)
I.	PCC (M10)	18	63	3	6
	1:4:8				
II.	FOOTING(M20)	122	996	18	37
	1:1.5:3 = 5-5				
III.	PLINTH BEAM	18	150	3	6

IV.	COLUMNS				
1	FOOTING TO PLINTH COLUMN	10	83	35	69
2	PLINTH TO FIRST COLUMN	17	192	2	5
3	FIRST TO SECOND COLUMN	11	91	3	3
4	SECOUND TO THIRD COLUMN	13	109	4	4
5	THIRD TO FOURTH COLUMN	13	104	4	4
6	FOURTH TO TERRACE COLUMN	12	98	4	4
7	TERRACE TO O.H.W.T	10	83	2	3
V.	BEAM				
1	FIRST FLOOR	18	150	3	6
2	SECOND FLOOR	16	131	2	5
3	THIRD FLOOR	14	114	2	4
4	FOURTH FLOOR	12	98	2	4
5	TERRACE FLOOR	10	82	2	3
6	O.H.W.T	9	75	2	3
VI.	SLAB				
1	FIRST FLOOR	51	420	8	16
2	SECOUND FLOOR	48.45	396	7	15
3	THIRD FLOOR	46.02	376	7	14
4	FOURTH FLOOR	43.72	357	7	13
5	TERRACE FLOOR	41.53	339	6	13

5.2 Detail Summary of Cost and Quantity Estimation of Materials

5.2.1 Cement

1. Sustainable Building Material

Concrete has excellent sustainability qualities, and the industry has made significant progress in reducing its CO2 emissions from cement manufacture. They are produced by implementing a carbon-negative manufacturing process and using renewable electricity It shows the Sustainable building material cement quantity of 4507, and one cement bag rate is ₹250 for that total cost of cement is ₹11,26,750

2. Cement

Table 4. Cement

Rate	250
Quantity	4507
Total Cost	₹ 11,26,750

3. Conventional building material

Table 5. Conventional building material

Rate	350
Quantity	4507
Total Cost	₹ 15,77,450

3. Sand

1. Sustainable building material

Sand, while technically a renewable resource, is not considered sustainable due to its extensive natural formation period, which spans millions of years. In the context of construction, sustainable building materials are preferred to mitigate environmental impact. For instance, the quantity of sand used in a project is measured in brass units, with a total of 126 brass required. Each brass of sand is priced at ₹3,500, leading to a total cost of ₹4,41,000. This highlights the significant financial and environmental costs associated with sand, emphasizing the need for more sustainable alternatives in construction practices.

Table 6. Sand

Rate	3500
Quantity	126 BRASS
Total Cost	₹ 4,41,000.00

2. Conventional building material

Table 7. Conventional Building Material

Rate	3008
Quantity	126 BRASS
Total Cost	₹ 4,41,000.00

5.3 Aggregate

1. Sustainable building material

Sustainable aggregates mean choosing the smarter option, extracting value from existing resources that would otherwise be wasted, while reducing the need to dig up more virgin rock. The more demand there is for products with recycled content, the more demand there is for recycling. It shows the Sustainable

building material aggregate quantity of 194 BRASS, and one aggregate bag rate is ₹4500 for that total cost of aggregate is ₹8,73,000.00

Table 8. Aggregate

Rate	4500
Quantity	237 BRASS
Total Cost	₹ 10,66,500

2. Conventional building material

Table 9. Cost of Electricity-Light-10 Years

Rate	4500
Quantity	237 BRASS
Total Cost	₹ 10,66,500

5.4 AAC Bricks

1. Sustainable Building Material

AAC blocks designed by the UAL Industries under the brand name KONARK are considered highly Sustainable as a building material. It shows the Sustainable building material AAC brick quantity of 125 M³, and one AAC brick bag rate is 3200 PER M³ for that total cost of AAC brick is 1600204.

Table 10. AAC Bricks

Rate	3200 Per M³
Quantity	125 M ³
Total Cost	₹ 4,00,000

2. Conventional Building Material

Table 11. Cost of Electricity-Light-10 Years

Rate	8 Rs Per Brick
Quantity	125 M ³
Total Number Of Bricks	125*500 = 62500 Bricks
Total Cost	₹ 5,00,000

AAC bricks are costing us 1,00,000 cheaper as our sustainable development material.

Table 12. Proposed 25-year cash flow for a solar panel

Year	Unit Cost (€)	Units Generated	Money Saved (€)
1	13.43	12,960	1,74,053
2	14.1	12,630	1,78,187
3	14.81	12,560	1,85,973

4	15.55	12,485	1,94,100
5	16.32	12,390	2,02,583
6	17.14	12,335	2,11,435
7	18	12,261	2,20,675
8	18.9	12,186	2,30,388
9	19.84	12,113	2,40,384
10	20.83	12,045	2,50,885
11	21.87	11,988	2,61,888
12	22.97	11,886	2,73,295
13	24.12	11,809	2,85,078
14	25.32	11,756	2,97,703
15	26.59	11,705	3,10,741
16	27.92	11,637	3,23,491
17	29.31	11,540	3,38,462
18	30.78	11,407	3,53,932
19	32.32	11,340	3,68,690
20	33.94	11,274	3,84,802
21	35.63	11,231	4,01,613
22	37.41	11,203	4,19,168
23	39.28	11,179	4,37,486
24	41.25	11,063	4,56,604
25	43.31	11,003	4,76,558
Total Savings after 25 years			74,78,330

This table lists the savings made over 25 years, with increasing unit costs and varying units generated each year, leading to a total savings amount of €74,78,330 after 25 years.

5.5 Solar Panel

Table 13. Cost of 10kw Solar Panel System for Our Project

Cost of 10kW solar PV system with 8kw of Panels	₹4,78,600 Including GST
Net metering agreement and load extension	Free
Free maintenance period <small>(one visit every alternate month or whenever you call for attending the fault. Material cost to be paid by the customer if required)</small>	36 Months
<small>Loan for solar plant is also available from nationalized banks with low interest rates and monthly EMI less than electricity bill.</small>	

5.6 Sustainable Building Material

Table 14. Solar Panel

Rate	₹ 4,78,600
Quantity	-
Total Cost	₹ 4,78,600

1. Conventional Building Material

Table 15. Cost of Electricity-Light-10 Years

Rate	NA
Quantity	NA
Total Cost	NA

5.7 Sustainable Building Material

Table 16. Rain Water Harvesting

Rate	₹ 70,000
Quantity	1
Total Cost	70000

1. Conventional Building Material

Table 17. Cost of Electricity-Light-10 Years

Rate	Na
Quantity	Na
Total Cost	Na

5.8 Total Cost Estimation of Materials for Sustainable Building

Table 18. Total Cost Estimation of Materials for Sustainable Building

Sr. No	Sustainable Building				Conventional Building			
	Quantity	Sustainable Building Material	Rate	Cost	Quantity	Conventional Building Material	Rate	Cost
1	4507 Bags	Fly Ash Cement Criteria 15 (4)	₹ 250	₹ 11,26,750	4507 Bags	Cement	350	₹ 15,77,450
2	126 Brass	Sand	₹ 3500	₹ 4,41,000.0	91 Brass	Sand	3500	₹ 4,41,000.0
3	237 Brass	Aggregate	₹ 4500	₹ 10,66,500	237 Brass	Aggregate	4500	₹ 10,66,500
4	Na	Water	Na	Na	Na	Water	Na	Na
5	1000 Ltr	Admixture Criteria 4,14,17 (5)	150 / Lit	₹ 150000	Na	Na	Na	Na
6	125 M ³	Aac Bricks Criteria 15(6)	₹ 3200 / M ³	₹ 4,00,000	125 M ³	Red Bricks	₹ 8	500000
7	Solar Panel	Solar Panel Criteria 18,19,14(10)	Lum -Sum	₹ 4,78,600	Na	Na	Na	Na
8	Rain Water Harvesting	R.W.H Criteria 11,21(7)		₹ 70,000	Na	Na	Na	Na
Total	₹ 37,32,850				₹ 35,84,950			

1. Overall Cost of Material

Table 19. Overall Cost of Material

Overall Cost Of Material	
Conventional Building	Green Building
4033000	6320000

The total cost of materials for conventional and green buildings. The cost of materials for a conventional building is 4,033,000 yen, whereas the cost for a green building is significantly higher, at 6,320,000 yen. This suggests that green buildings, which frequently use environmentally friendly and sustainable materials, cost more materials than traditional construction methods. Green building investments may contribute to long-term environmental and energy savings, despite the higher initial costs. This is a trade-off between the initial costs and the benefits in the long run.

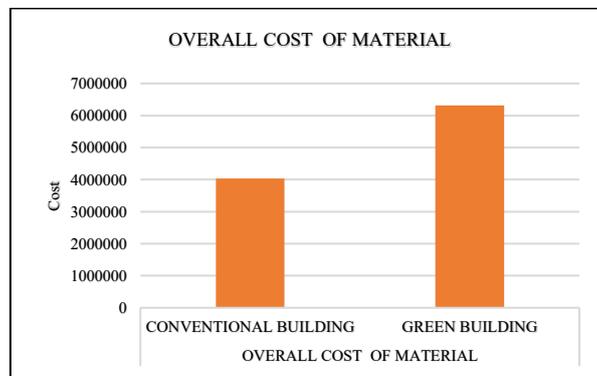


FIG 7. Overall Cost of Material

The Green Building's higher cost reflects the use of advanced, sustainable materials and technologies aimed at reducing environmental impact and improving energy efficiency.

2. Cost of Cement Rs.

Table 20. Cost of Cement Rs

Cost of Cement Rs.	
Conventional Building	Green Building
1559950	1114151

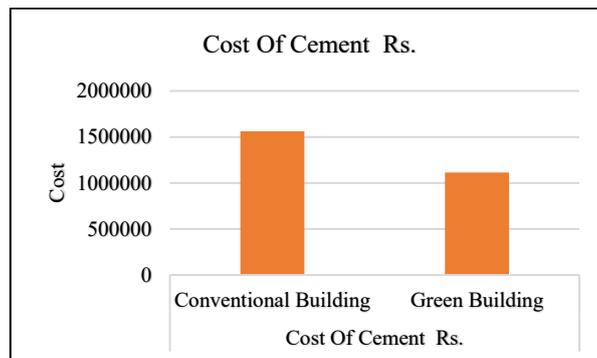


FIG 8. Cost of Cement Rs.

The costs of cement for conventional and green buildings are compared. The price of green building cement is Rs. 1,559,950, while the price of conventional building cement is Rs. 1,114,151. This suggests that green buildings have lower cement costs than conventional buildings, suggesting that green building practices could save money. In green building projects, the use of alternative materials or more effective construction techniques may account for the decrease in cement costs.

3. Cost of Sand Rs.

Table 21. Cost of Sand Rs.

Cost of Sand Rs.	
Conventional Building	Green Building
273782	273782

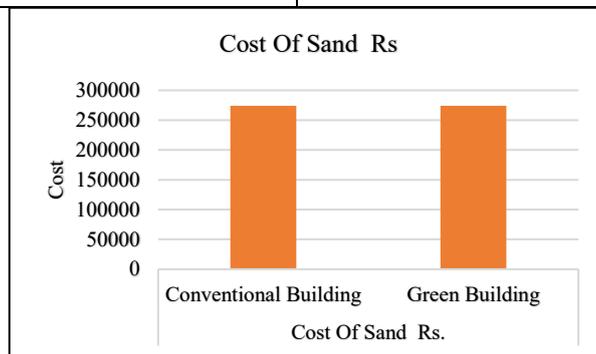


FIG 9. Cost of Sand

4. Cost of Aggregate Rs.

Table 22. Cost of Aggregate Rs.

Cost of Aggregate Rs.	
Conventional Building	Green Building
240000	252786

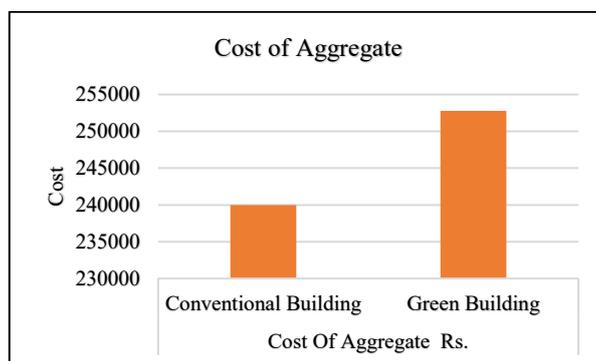


FIG 10. Cost of Aggregate

The price of aggregates for various kinds of buildings. The price difference between green buildings and conventional buildings is Rs. 252,786. This indicates that green building aggregates cost Rs more than conventional building aggregates. 12,786. The potential increase in the use of sustainable or higher-

quality materials, which typically command a higher price tag than more conventional options, is reflected in the higher cost of green buildings.

5. Cost of Admixture Rs.

Table 23. Cost of Admixture Rs

Cost of Admixture Rs.	
Conventional Building	Green Building
1559950	1114151

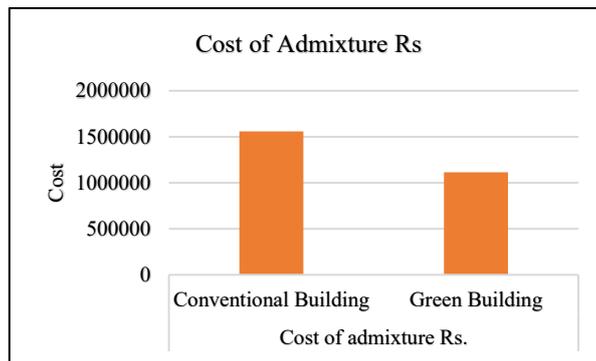


FIG 11. Cost of Admixture

The price of admixtures for conventional and green buildings. Green buildings cost Rs. 1,114,151, while conventional buildings cost Rs. 1,559,000. This suggests that green building practices have a significantly lower admixture cost, indicating potential savings and efficiency gains over conventional building methods.

6. Cost of Bricks Rs

Table 24. Cost of Bricks Rs

Cost of Bricks Rs.	
Conventional Building	Green Building
480000	1600204

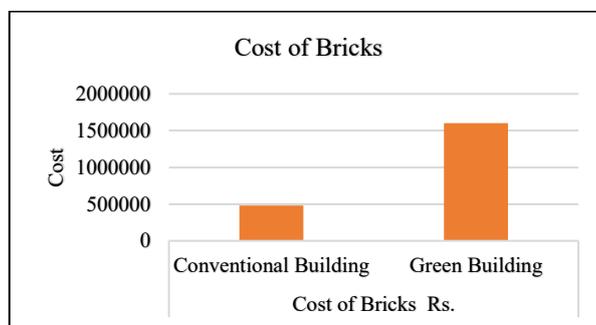


FIG 12. Cost of Bricks

The comparison of brick prices between traditional and eco-friendly building techniques. The price of bricks for conventional construction is 480,000 rupees, while the price for green construction rises

significantly to Rs. 1,600,204. This suggests that green building methods require significantly more bricks than conventional methods do, highlighting a possible trade-off between cost and sustainability in construction practices.

7. Cost of Tiles Rs

Table 25. Cost of Tiles Rs.

Cost Of Tiles Rs.	
Conventional Building	Green Building
1430000	2400000

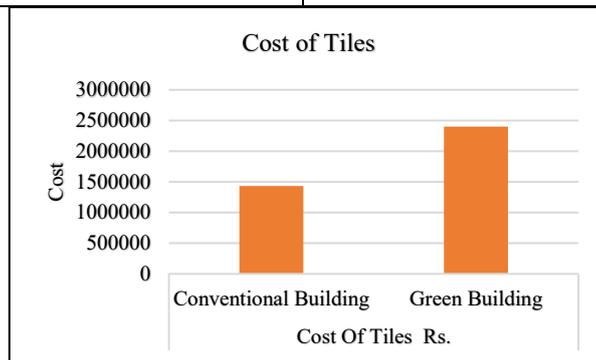


FIG 13. Cost of Tiles

The comparison of the costs of tiles in a conventional and green building. The cost of tiles for a conventional building is Rs. 1,430,000, while the cost of tiles for a green building is Rs. 2,400,000. This means that green building tiles cost a lot more because environmentally friendly or sustainable materials often require more money to buy. The use of cutting-edge materials or technologies to boost sustainability and productivity could be to blame for the higher costs associated with green buildings.

8. Cost of Electricity-Light-10 Years

Table 26. Cost of Electricity-Light-10 Years

Cost Of Electricity-Light-10 Years	
Conventional Building	Green Building
Fluorescent Bulb	Led Bulb
1170000	810000

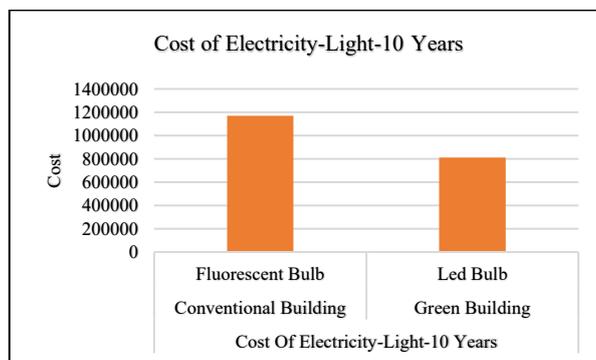


FIG 14. Cost of Electricity-Light 10 Year

A comparison is made between conventional and green buildings regarding the price of electricity for lighting over the course of ten years. The price is 1,170,000 yen for a conventional building with fluorescent lighting. On the other hand, a green building with LED lights costs 810,000 yen less. In terms of energy savings over a ten-year period, this significant reduction highlights the cost-effectiveness of LED bulbs and green building practices.

6. Conclusion

The research reveals that while sustainable materials for residential buildings often come with higher initial costs compared to conventional materials, they offer significant long-term environmental and economic benefits. Green buildings, utilizing materials such as fly ash cement, AAC bricks, and solar panels, not only contribute to reducing carbon emissions but also enhance energy efficiency, leading to lower operational costs over time. The study highlights the importance of considering the full lifecycle impact of materials—from production to disposal—in reducing the environmental footprint of buildings. Additionally, the social and health advantages of sustainable materials, including better indoor air quality and enhanced thermal performance, make them a compelling choice for residential construction. However, widespread adoption faces challenges such as higher upfront costs and lack of awareness among stakeholders. To overcome these barriers, the research suggests that policymakers, industry leaders, and researchers must collaborate to promote green building practices and provide incentives for adopting sustainable materials. Furthermore, public awareness campaigns can help shift perceptions about the affordability and feasibility of green buildings. The study concludes that embracing sustainable construction practices is essential for mitigating climate change, reducing resource depletion, and creating healthier living environments, ultimately contributing to a more sustainable built environment.

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