

Development Of Sustainable Construction of Residential Buildings in Pcmc

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Abstract—This report reviews the development of sustainable construction practices for residential buildings in the Pimpri Chinchwad Municipal Corporation (PCMC) area, to reduce environmental impact while maintaining functional and economic feasibility. The paper reviews existing local construction methods and identifies key sustainability strategies, including energy-efficient building design, use of eco-friendly materials, water conservation measures, and on-site waste management. The methodology used in this report is the surveying of builders, contractors and engineers. The analysis suggests that the right selection of sustainable techniques with lower long term operational cost while improving indoor comfort for occupants. The paper concludes with recommendation for local builders, contractors and engineers to support implementation of sustainable residential construction in PCMC.

Index Terms—energy efficiency, green buildings, PCMC, residential buildings, sustainable construction, water management.

I. INTRODUCTION

India's cities are expanding rapidly, putting intense pressure on land, water, energy, and the broader environment, and the Pimpri-Chinchwad Municipal Corporation (PCMC) is a clear example of these challenges as fast population growth and rising housing demand increase material use, energy consumption, and greenhouse gas emissions. That's why making residential construction more sustainable is essential not only to conserve natural resources, but also to secure long-term economic benefits and improve living conditions for residents. This paper examines sustainable residential construction in PCMC by analyzing what motivates builders and developers to adopt greener practices, what strategies are currently applied, and what barriers they face. It

reviews local policies, material choices, energy-efficient solutions, and stakeholder experiences to suggest practical measures that can guide PCMC toward more environmentally responsible and livable urban growth.

PCMC has maintained impressive 48% green cover across its municipal area. Which demonstrates strong environmental planning. However, the remaining 52% area is of urban development, particularly residential construction, poses sustainability challenge.[1]

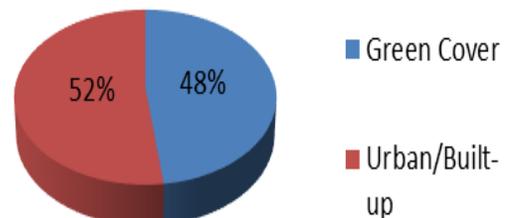


Fig.1: PCMC Land Use Distribution

II. PRINCIPLES OF SUSTAINABLE RESIDENTIAL CONSTRUCTION

1. **Resource Efficiency:** Maximizing material, energy, and water efficiency through the design, construction, and occupancy phases.
2. **Low-Impact Materials:** Prioritizing the use of renewable, recycled, or locally sourced materials to reduce embodied energy and carbon footprint.

3. Energy Management: Designing for reduced operational energy via passive ventilation, optimum orientation, and integration of renewable energy such as solar panels.
4. Water Management: Implementing rainwater harvesting, grey-water recycling, and plumbing fixtures that minimize consumption.
5. Waste Reduction: Minimizing construction and demolition waste, promoting material reuse, and enabling on-site or municipal recycling systems.
6. Healthy and Inclusive Environments: Enhancing indoor air quality, daylight access, and livable spaces; integrating green and accessible public areas.

1. Strong knowledge of solar energy systems and renewable energy: 92.9% (13 respondents).
2. Moderate knowledge of rainwater harvesting and water management: 71.4% (10 respondents).
3. Limited knowledge of green materials (fly ash bricks, recycled aggregates, green concrete): 42.9% (6 respondents).
4. Low familiarity with digital assessment tool (BIM, Life Cycle Assessment): 35.7% (5 respondent).

Barriers to Implementation

Respondents were asked to rank major obstacles to adopting sustainable residential construction included:

III. SURVEY METHODOLOGY

A survey was conducted via Google Forms among professionals including builders, contractors, and engineers actively engaged in residential construction projects within the Pimpri-Chinchwad Municipal Corporation (PCMC) area. The form consisted of 12 targeted questions designed to assess awareness, knowledge, current practices, and challenges related to sustainable construction. The survey also consists of recommendations on strategies to promote green building adoption. 14 professionals provided responses through online forms. The data collected were analyzed quantitatively for patterns in familiarity with use of sustainable materials and technologies, perceived obstacles such as cost and supply constraints, and receptiveness to policy incentives. This methodology ensures a practical realities and opportunities for sustainable residential construction in PCMC.

IV. SURVEY FINDINGS

Awareness and Knowledge of Green Building Practices

Among the 14 respondents surveyed, expressed awareness of green building or sustainable construction indicating a relatively high baseline knowledge among decision-makers. However, when queried on specific practices and materials, awareness varied significantly:

Table 1: Primary Barriers to Sustainable Construction: Survey Responses

Barrier	Frequency	Percentage
High upfront costs	14/14	100.00%
Limited local supply of green materials	12/14	85.14%
Lack of developer awareness	10/14	71.40%
Absence of regulatory enforcement	09/14	64.30%
Insufficient skilled workforce	08/14	57.10%

Current Implementation.

Among the certified projects, the most commonly adopted features were:

Table 2: Current Adoption Rates of Sustainable Practices

Practice	Projects Using	Adoption Rate
Solar Rooftop Systems	11/14	78.6%
Rainwater Harvesting	9/14	64.3%
Waste Segregation / Composting	8/14	57.1%
High-Efficiency Fixtures	7/14	50.0%
Green Materials (Fly Ash, Etc.)	3/14	21.4%

Recommendations from Practitioners

When asked about recommendations to accelerate sustainable construction, respondents provided valuable insights that highlight several key strategies and approaches. These insights can be extended as follows:

1. 64.3% (9 respondents) practitioners recommended speeding up environmental clearances and green building certifications can help finish projects quicker and lower consultancy costs.
2. 78.6% (11 respondents) expressed giving better tax rebates, lowering development charges, and offering cheap loans can help cover higher initial expenses.
3. PCMC should help create partnerships to boost local production and distribution of certified green building materials.
4. While 57.1% (8 respondents) suggested holding regular workshop of contractors and builders about green building methods, materials and benefits will encourage more use.
5. Making sure current green building rules are followed strictly and checking projects often help to keep competition fair and prevent rule violations.

V. POLICY AND CERTIFICATION FRAMEWORKS

PCMC has updated its rules to promote sustainable construction, like they use the GRIHA rating system for new buildings.[2] If any building gets this certification, PCMC gives benefits like lower development fees, quicker approvals, and a discount on property taxes [3]. In 2025, PCMC launched the Green Society Initiative to encourage societies to follow eco-friendly practices, with yearly awards given to the best-performing society.[4] Along with GRIHA, PCMC also recognizes well-known green building certifications and IGBC and LEED. In fact, PCMC has earned the highest IGBC Platinum rating for its public infrastructure projects.[5] To reduce waste, the city has set up a special plant that recycles

construction and demolition debris by turning it into reusable materials.[6]

VI. WATER AND WASTE MANAGEMENT TECHNOLOGIES

Recent implementations in PCMC residential projects demonstrate:

1. Rooftop Rainwater Harvesting: Simple systems collecting runoff to underground tanks, providing 4-6 months of water self-sufficiency during monsoon [7].
2. Greywater Recycling: Treated wastewater for toilet flushing and landscape irrigation, typical reduction of municipal water demand by 20-30%.
3. On-site Waste Segregation and Composting: Vermicomposting and mechanical composting reducing landfill waste, with processed compost suitable for landscaping [8].

VII. GREEN MATERIALS AND TECHNOLOGIES IN PCMC

Sustainable Building Materials

The availability and adoption of green materials in PCMC has expanded, including:

1. Green Cement: Produced using fly ash and blast furnace slag, reducing clinker requirement and associated CO emissions by 30-40% compared to ordinary Portland cement [9].
2. Recycled Aggregates: Sourced from construction and demolition waste streams, reducing landfill burden and natural resource extraction. Various wastes like demolition debris, returned concrete, and coal residues are processed into recycled and replaces natural stone.[12]
3. Fly Ash Bricks: Industrial waste-based bricks offering reduced firing energy and improved thermal properties.[10]

Non-toxic Finishes: Low-VOC (volatile organic compound) paints and coatings promoting better indoor air quality for residents.[11]



Fig.2: Typical Recycled Aggregates [12] Table 3: Sustainable Green Materials

Materials	Key Benefit
Green Cement	30-40% CO2 reduction vs. Portland
Recycled Aggregates	Reduces landfill, saves resources
Fly Ash Bricks	Lower energy, better thermal properties
Non-toxic Finishes	Better indoor air quality (Low-VOC)

VIII. BARRIERS TO RESIDENTIAL SUSTAINABLE CONSTRUCTION

Systematic studies, literature review, and the current survey of 14 practitioners identify the following primary obstacles:

Awareness and Training Gap: Many contractors and builders in PCMC are not fully aware of the benefits and importance of sustainable construction practices. This lack of awareness can lead to a reluctance to adopt green building techniques.

Cost Considerations: Sustainable construction benefits the environment and yields long-term financial savings through reduced operational costs. However, high upfront costs remain the primary barrier.

Maintenance and Operational Challenges: There are significant challenges associated with the maintenance

and operation of sustainable residential construction in PCMC. By addressing these issues through investment in education, infrastructure, and regulatory support, PCMC can pave the way for a more sustainable urban future.

Strategies for Mainstreaming Sustainability

1. **Capacity Building:** Regular professional development programs for architects, engineers, and developers about green building principles and tools.
2. **Financial Mechanisms:** To offset initial expenditures, increase tax refunds, preferential loans, and concessional premiums.
3. **Promoting Digital Design Tools:** Encourage adoption of Building Information Modeling for design optimization and life cycle assessment for environmental analysis.

IX. RECOMMENDATIONS

Based on survey input from 14 practitioners and analysis of current PCMC initiatives, the following recommendations are proposed:

1. Set minimum requirements for green benchmarks
2. Institute Knowledge-Sharing and Capacity Building Programs: 57.1% of respondents requested this support
3. Strengthen Municipal Enforcement.

X. CONCLUSION

Sustainable residential construction in PCMC is well-supported by municipal policy, GRIHA/IGBC certifications, reduced fees, and the Green Society Initiatives. At the same time, many projects still struggle with issues like higher upfront costs, low awareness and inconsistent on ground implementation [Table 1]. Strengthening local supply chains for eco-friendly materials and technologies, and actively supporting housing societies that adopt green practices, will also make it easier and more attractive to build sustainably. Adoption varies with stronger use of solar rooftops and rainwater harvesting compared to green materials [Table.2]. Survey insights from professionals highlight training needs and support for financial incentives, workshops, and enforcement. Strengthening green supply chains and policy implementation will accelerate progress. If PCMC can combine strong policy with genuine community participation and market incentives that reward long term savings and environmental benefits, the city can gradually reshape its residential sector into one that is not only resource efficient and climate responsive, but also healthier and more affordable for its citizens.

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