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Solar integration and sustainable design in urban interiors

¹Monalisa KT, ²Shreya Mishra and ³Dr. Nischay N Gowda

¹Student, Department of Interior Design, JD School of Design, Bengaluru, Karnataka, India

²Assistant Professor, Department of Interior Design, JD School of Design, Bengaluru, Karnataka, India

³Head of Department, Department of Interior Design, JD School of Design, Bengaluru, Karnataka, India

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Corresponding Author: Monalisa KT

Abstract

This study explores strategies for integrating solar power and sustainable design practices in urban residential interiors to promote accessible, energy-efficient, and eco-friendly living spaces. Despite government subsidies encouraging solar adoption, uptake remains limited in urban areas due to high upfront costs, limited awareness, and behavioral hesitancy. By examining scalable solar solutions, passive solar design principles, and the use of energy-efficient materials, this research develops practical design guidelines aimed at enhancing the appeal and feasibility of solar-powered interiors for middle-income urban residents. The study employs a mixed-method approach, incorporating a literature review, case studies, and simulations to assess the cost-effectiveness and energy efficiency of solar-integrated interiors. Findings indicate that modular solar systems, combined with passive design techniques, significantly reduce energy demands, offering sustainable alternatives suited to urban residential environments. This research contributes to closing the gap between policy incentives and practical applications of solar technology, providing actionable solutions to advance green building practices in urban settings.

Keywords: Solar power, sustainable interiors, passive design, energy efficiency, green building

Introduction

With the growing demand for sustainable energy solutions, solar power has emerged as a pivotal renewable resource. Urban areas, characterized by high energy consumption, present significant opportunities for integrating solar technology to address environmental challenges and reduce dependency on conventional energy sources. The concept of green-certified buildings and energy-efficient interiors offers a pathway toward creating eco-friendly urban spaces that promote sustainability and economic viability. This research focuses on analysing electricity usage in moderately consuming urban buildings and studying green-certified structures to understand the potential of solar energy integration. By examining case studies and conducting surveys, the study aims to identify barriers, explore innovative design solutions, and propose practical strategies for urban solar energy adoption. The findings contribute to the broader discourse on sustainable development and provide actionable recommendations for architects, interior designers, and policymakers.

Need of the Project

Rapid urbanization has intensified energy demand, leading to environmental degradation and resource depletion. Solar energy offers a clean, renewable alternative, yet its implementation in urban settings remains underutilized. This research identifies the gaps and proposes strategies to enhance solar adoption through sustainable design practices.

Aim: To develop strategies for integrating solar energy into urban interiors to promote energy efficiency and sustainability.

Objectives

- Analyse existing energy consumption patterns in urban buildings.
- Explore the role of interior design in optimizing solar energy use.
- Identify barriers to solar adoption and propose actionable solutions.

Literature Review

Reference Research Papers

1. "Use of Renewable Energy in Buildings" by İzzet Yüksek and İlker Karadağ – Explores the adoption, challenges, and benefits of integrating renewable energy solutions in residential and commercial structures.
2. "Are LEED-Certified Buildings Energy-Efficient in Practice?" by Ali Amiri, Juudit Ottelin, and Jaana Sorvari – Examines the practical energy efficiency of LEED-certified buildings, addressing their performance and sustainability impact.

- Building Name: Avenue Supermarts Ltd.
- Location: Srigantha Bengaluru, Karnataka, India, 560091
- Rating System: LEED O+M: Interiors v4.1 (LEED v4.1)
- Certification Level: Gold
- Date of Last Certification: December 14, 2024

This certification underlines the building's commitment to sustainability, particularly in interior operations and maintenance, showcasing efforts to enhance energy efficiency, reduce environmental impact, and promote sustainable practices.

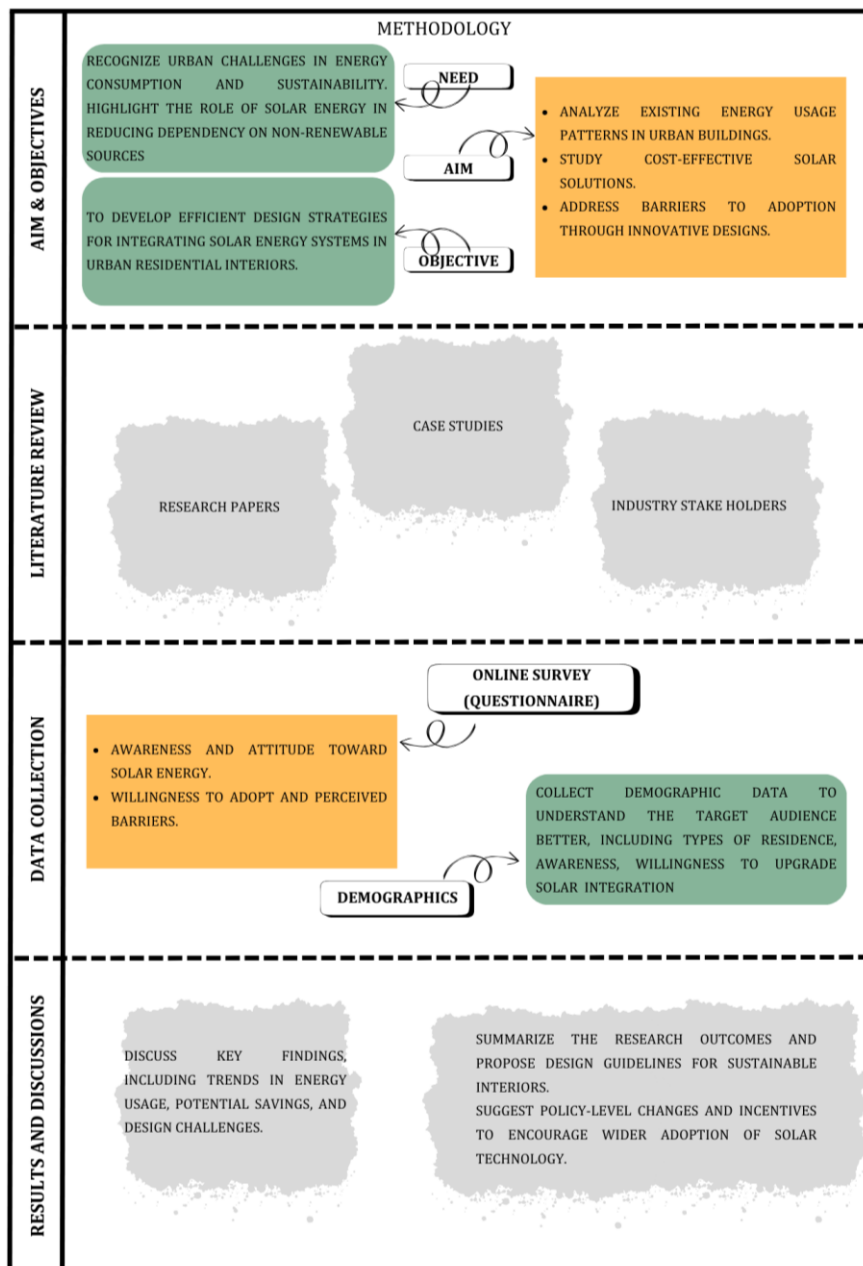
Online Case Studies

1. Suzlon One Earth, Pune – A LEED Platinum-certified building utilizing renewable energy sources.
2. Infosys Pocharam Campus, Hyderabad – An example of sustainable campus design achieving LEED Platinum certification.
3. Green Building Certification Details

Industry Stakeholders

Avenue Supermarts Ltd., Bengaluru: A green-certified building demonstrating sustainable operational practices.

Methodology



Results and Discussion
Demographics

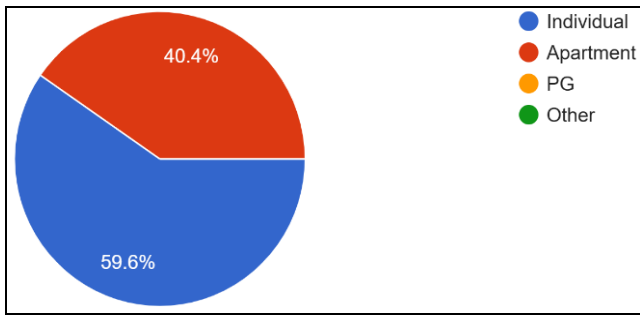


Fig 1: What type of building do you reside in?

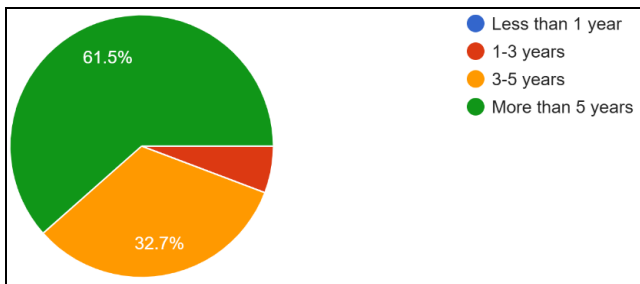


Fig 2: Since how long have you lived in this building

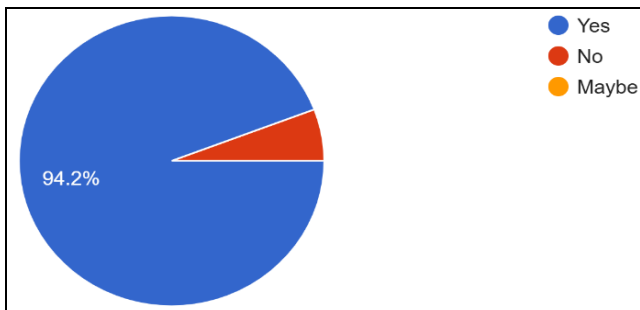


Fig 3: Is your building equipped with a rainwater harvesting system?

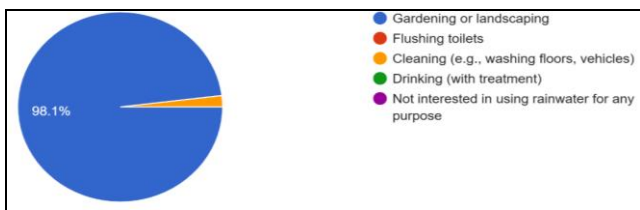


Fig 4: Which of the following uses would you prioritize for harvested rainwater in your building?

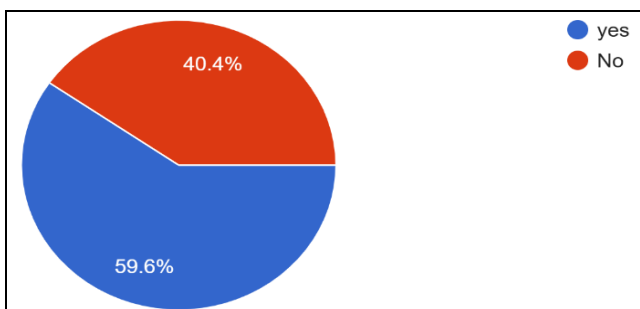


Fig 5: Are there any solar panels put on your building to heat the water or create electricity

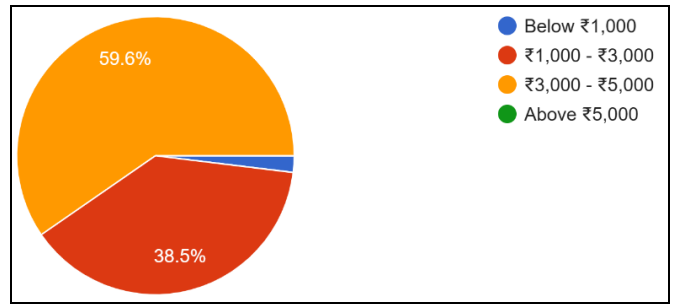


Fig 6: What is the approximate monthly electricity bill for your residence?

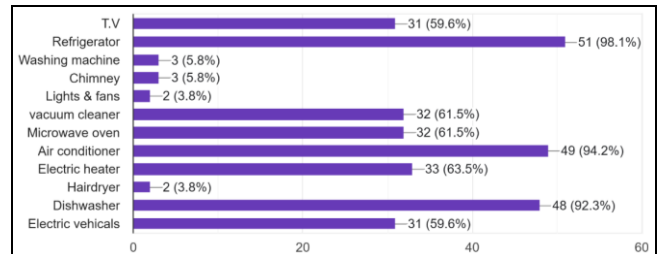


Fig 7: Which electrical appliances do you think utilize the most electricity in your home?

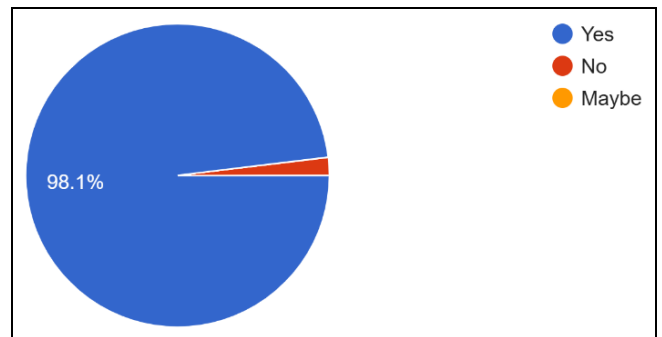


Fig 8: Is your building equipped with energy-efficient lighting, like Led bulbs?

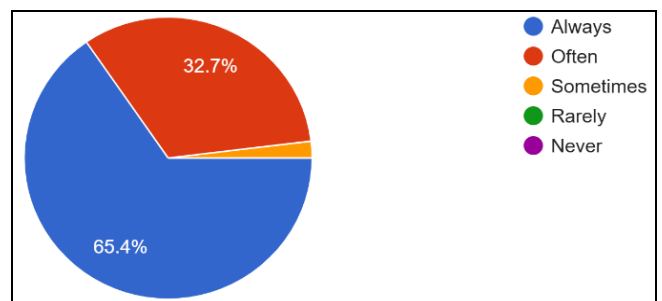


Fig 9: How often are energy-saving practices followed in building?

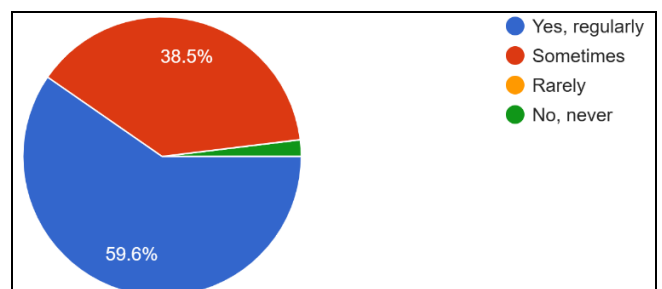


Fig 10: Do you track your monthly energy consumption?

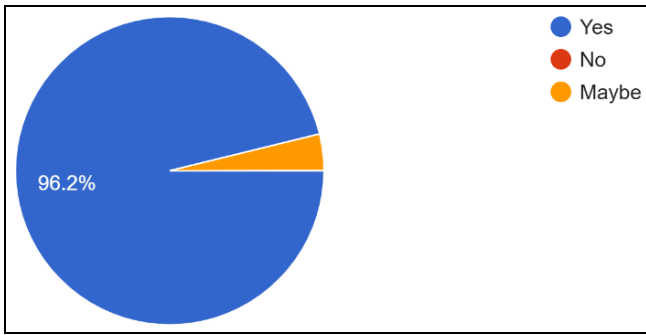


Fig 11: Do you find energy-efficient practices or appliances make a noticeable difference in your electricity bills

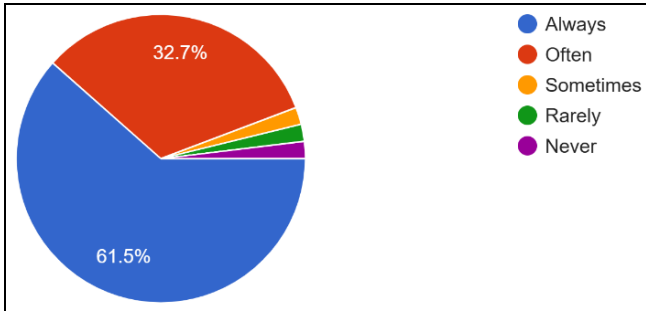


Fig 12: How often do you use natural lighting in your building?

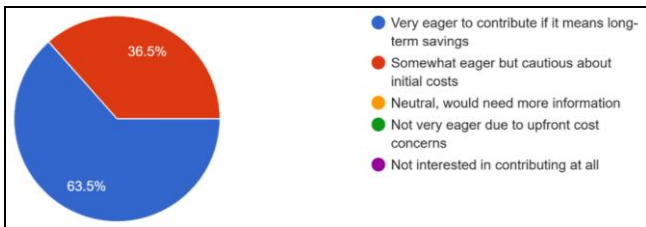


Fig 13: In the event if initial expenses resulted in cheaper long-term energy bills, how eager would you be to contribute?

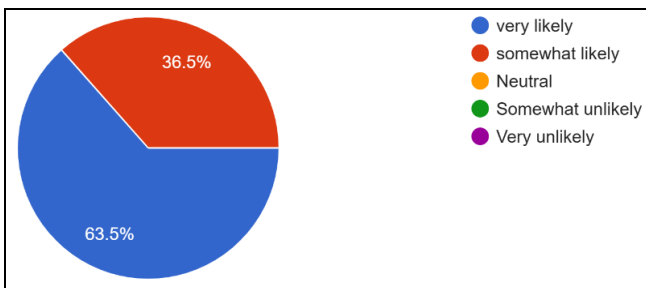


Fig 14: If a green building became available, how likely are you to think about living there?

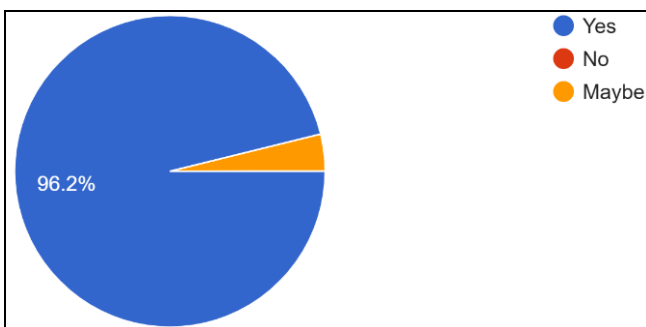


Fig 15: Would you support additional installations of renewable energy sources in your building?

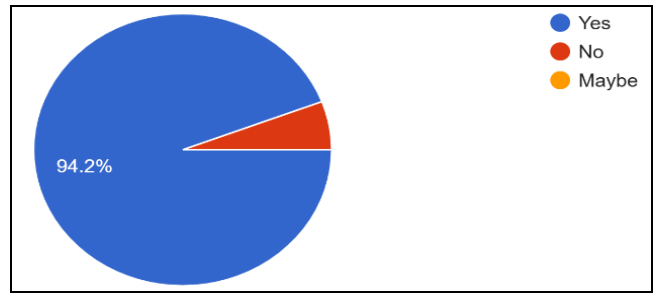


Fig 16: Are you familiar with government-sponsored programs?

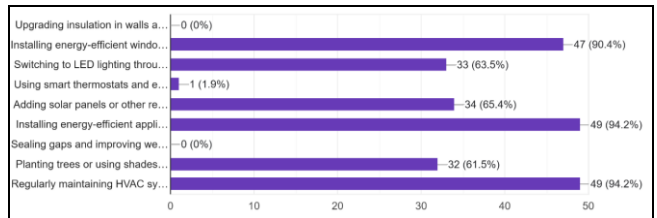


Fig 17: What additional measures do you think could improve the energy efficiency of your house?

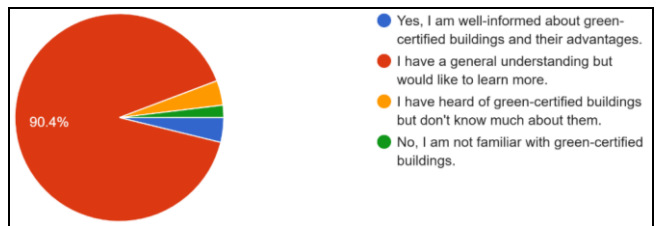


Fig 18: Are you familiar with green-certified buildings and their benefits?

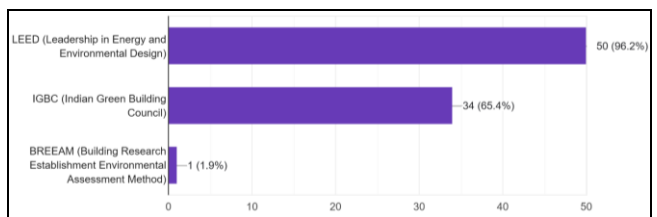


Fig 19: Which green building certification standards are you aware of?

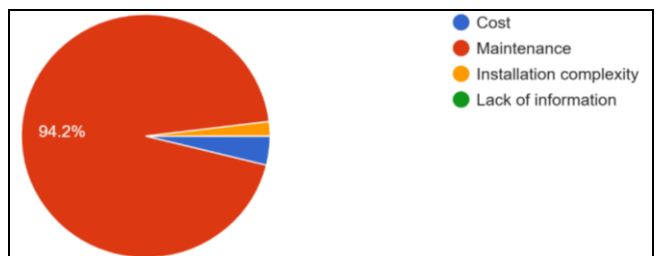


Fig 20: In your opinion, what are the biggest barriers to adopting solar energy in buildings?

The analysis reveals that most respondents reside in individual houses and have lived there for less than a year. While a majority are familiar with government programs like PM Surya Ghar and support renewable energy, concerns about cost are a significant barrier to adoption. Interestingly, despite a general understanding of green building principles, practical applications, like tracking energy consumption, is less common.

Survey Insights

- Awareness: 65% of respondents are unaware of green-certified buildings.
- Barriers: High initial costs (70%), Space Constraints (70%), and lack of reliable information (50%).

Recommendations

- **Policy Support:** Enhanced subsidies and tax incentives for solar installations.
- **Awareness Campaigns:** Educating urban residents about the benefits of solar energy.
- **Innovative Designs:** Developing cost-effective and aesthetic solar-integrated interiors.

Conclusion

Solar energy integration in urban interiors presents a promising solution to address energy demands and environmental challenges. This research underscores the importance of collaborative efforts among policymakers, architects, and residents to overcome barriers and promote sustainable living.

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