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Comparative Studies of Certified and Non-Certified Green Residential Buildings in India

Aishwarya A. Sonawale[1], Rahul D. Shinde[2], Sushma R. Awad[3]
[1]M.E. Student, [2]Professor, [3]Professor , Department of Civil Engineering, RMD Sinhgad School of Engineering, Pune, Maharashtra, India

Abstract: ***The increasing urgency of sustainable urban development has amplified interest in green building certification systems such as IGBC, GRIHA, and SVA-GRIHA. This review paper provides a comprehensive comparative analysis of certified and non-certified residential green buildings, with a special focus on the Indian context. Drawing from a wide range of national and international studies, the paper evaluates key performance parameters including climate responsiveness, water efficiency, economic sustainability, post-construction performance, and policy evolution. Findings consistently reveal that certified buildings outperform conventional structures in terms of energy and water conservation, indoor environmental quality, occupant satisfaction, and long-term cost-effectiveness. Despite higher initial investments, certified green buildings offer significant environmental and economic returns over their lifecycle. The review emphasizes the critical role of policy support, public awareness, and stakeholder collaboration in driving the adoption of green certification frameworks. Overall, the paper underscores the transformative potential of green buildings in achieving sustainable urban growth and climate resilience.***

Keywords: Green Building Certification, Sustainable Construction, IGBC, Climate Resilience, Water Efficiency, Economic Sustainability, Comparative Study

I. INTRODUCTION

With rapid urbanization and rising environmental concerns, sustainable construction has become a critical priority, particularly in developing countries like India. Green building certification systems such as IGBC, GRIHA, and SVA-GRIHA have emerged as vital tools to promote environmentally responsible and resource-efficient construction practices. These certifications aim to minimize the environmental impact of buildings while enhancing energy and water efficiency, indoor air quality, and occupant well-being. This review paper aims to provide a comparative analysis of certified and non-certified residential green buildings within the Indian context, drawing insights from a range of national and international studies. By examining key parameters such as climate responsiveness, water efficiency, economic sustainability, post-construction performance, and the evolution of policy frameworks, the study explores the tangible benefits of green certification. The paper also emphasizes the importance of policy support, public awareness, and collaboration among stakeholders in accelerating the adoption of green building practices, ultimately contributing to sustainable urban development and climate resilience.

II. LITERATURE REVIEW

Several studies have explored the performance differences between certified and non-certified green buildings. Almeida et al. (2023) demonstrated that certified buildings better respond to climate change through passive design, renewable energy use, and sustainable materials. Similarly, Vijayan et al. (2020) highlighted environmental benefits such as reduced carbon emissions and improved insulation in green structures.

In the area of water efficiency, Agrawal et al. (2020) and Dagwal et al. (2016) showed that IGBC-based strategies like rainwater harvesting and dual plumbing significantly reduce water consumption. Tarde and Binayake (2022) confirmed that even partial IGBC implementation enhances overall resource efficiency.

Economic sustainability was addressed by Weerasinghe and Ramachandra (2018), who found that green buildings, though costlier initially, lead to long-term savings. Gujarathi and Gokhale (2018) echoed this through a Pune-based study showing lifecycle cost benefits.

Post-construction performance studies by Hople (2017) and Srinidhi et al. (2020) revealed that certified buildings offer better air quality, space utilization, and occupant satisfaction.

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Finally, Manna and Banerjee (2019) reviewed the green building movement in India, stressing policy needs, while Tsai's (2022) Taiwan-focused study emphasized material policies relevant to indoor air quality—offering insights applicable to the Indian context as well.

III. COMPARATIVE PERFORMANCE OF GREEN VS. NON-GREEN BUILDINGS

1) Climate Responsiveness and Environmental Impact

Laura Almeida, Keivan Bamdad, and Mohammad Reza Razavi (2023) presented a robust comparative case study that examined how certified and non-certified buildings respond to climate change. The study revealed that certified buildings utilize passive design strategies, renewable energy sources, and sustainable materials more effectively, leading to reduced greenhouse gas emissions and enhanced climate adaptability.

Vishnu Vijayan et al. (2020) supported these findings by showcasing the performance of sustainable residential constructions. Their research highlighted benefits such as reduced carbon footprints, superior insulation, and enhanced indoor environmental quality in green-certified structures.

2) Water Efficiency and Resource Management

Sanket Agrawal, Sunil Pimplikar, and Sarvesh Javdekar (2020) performed a detailed water audit of a high-rise building in Pune. Their study demonstrated that IGBC-aligned strategies—such as rainwater harvesting, dual plumbing, and water-efficient fixtures—resulted in considerable savings in water consumption, promoting sustainable urban water management.

Shubhra Dagwal et al. (2016) reinforced these insights by applying IGBC's Green Existing Building O&M guidelines, confirming that regular audits and efficiency measures can drastically reduce water wastage in residential structures.

Gauri Tarde and R.A. Binayake (2022) explored the practical applicability of IGBC certification, affirming that even partial implementation of the rating system in existing buildings leads to measurable improvements in resource efficiency and sustainability metrics.

3) Economic Sustainability and Lifecycle Cost Benefits

Achini Shanika Weerasinghe and Thanuja Ramachandra (2018) focused on economic sustainability, finding that green buildings, although costlier upfront (by around 8-15%), offered significant long-term operational savings and higher property valuations.

Anshul Gujarathi and Vasudha Gokhale (2018) conducted a Pune-centric study that emphasized how green buildings exhibit higher cost-efficiency over time due to reduced utility bills, optimized building operations, and favorable financing opportunities.

4) Post-Construction Performance and Occupant Well-being

Mahesh Hople (2017) analyzed the post-construction performance of sustainable residential buildings. The research indicated improved occupant satisfaction, better indoor air quality, and overall enhanced living conditions in green-certified residences.

Srinidhi S.V., Mr. Syed Tufael, and Dr. S.K. Sekar (2020) offered a cost and performance comparison between a non-rated and an SVA-GRIHA-certified building. Their findings demonstrated better space utilization, material optimization, and efficient energy systems in the rated building, validating the economic and environmental returns of certification.

5) Evolution and Policy Landscape of Green Buildings

Dibas Manna and Sulagno Banerjee (2019) provided a panoramic view of the green building movement in India. Their review discussed the evolution of national standards, the influence of global protocols, and the need for greater policy enforcement and stakeholder education.

Wen-Tien Tsai added an international perspective by analyzing Green Building Material (GBM) policies in Taiwan, particularly regarding indoor air quality. Though Taiwan-specific, the study underlined the importance of material selection and regulatory frameworks, themes equally relevant in the Indian context

IV. CONCLUSION

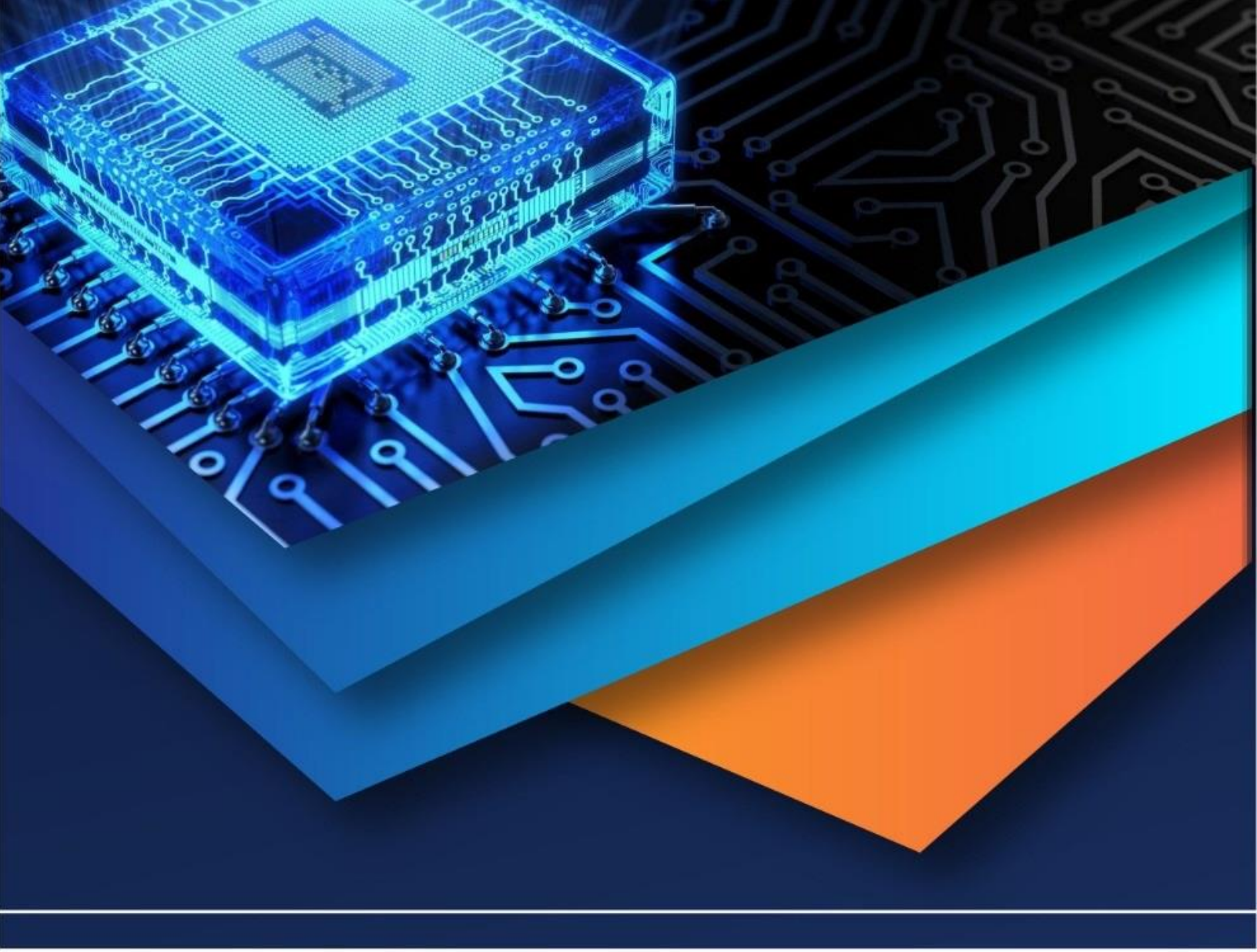
The reviewed studies collectively highlight that green-certified residential buildings offer measurable benefits across environmental, social, and economic dimensions. Whether through reduced emissions, improved water efficiency, or enhanced occupant satisfaction, the value proposition of certified buildings is clear.

The research advocates for stronger integration of green certifications into mainstream construction, enhanced policy backing, and ongoing performance monitoring to ensure long-term sustainability.

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