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Design of Green Building

Aryan Thakur[1], Shubham Suryavanshi[2], Vishal Tigulwad[3], Arathy Menon[4]
[1](Civil Department, Viva Institute of Technology, India)
[2](Civil Department, Viva Institute of Technology, India)
[3](Civil Department, Viva Institute of Technology, India)
[4](Civil Department, Viva Institute of Technology, India)

Abstract : *The design focuses on optimizing energy efficiency, reducing water consumption, improving air quality, and using sustainable materials. It incorporates natural ventilation, solar shading, and daylighting to reduce non-renewable energy reliance. This aims at studying the different features of a Green Building and preparing a 2D model in AUTOCAD and 3D model in REVIT and load calculations on ETABS and energy, water usage on EDGE software as well as comparison between conventional and Green Building.*

Keywords – *AUTOCAD, EDGE Software, ETABS, Green building, REVIT, Sustainable materials.*

1. INTRODUCTION

The built environment significantly impacts the planet, contributing to resource depletion, greenhouse gas emissions, and habitat loss. Sustainable architecture is a vital response to these challenges. This project explores the design of green buildings, emphasizing sustainability, efficiency, and harmony with nature. Green building design prioritizes energy efficiency, water conservation, and sustainable materials, creating functional and environmentally responsible spaces.
Green building design prioritizes sustainability, energy efficiency, and minimal environmental impact. Materials like recycled steel and reclaimed wood reduce waste and energy consumption. Energy-efficient options like HVAC and low heat windows enhance thermal performance. Locally sourced, non-toxic materials minimize environmental harm and improve indoor air quality. Durability is crucial with materials like clay bricks and natural stone, requiring minimal maintenance. Water-efficient materials like astral pipes and rainwater harvesting systems help manage water. By integrating these materials, designers can create structures that align with ecological principles and enhance occupants' health and comfort.

2. LITERATURE REVIEW

2.1 Prutha Patel, Anant Patel, Use of sustainable green materials in construction of green buildings for sustainable development (2021) - Green buildings can significantly reduce ozone-damaging substances, water usage, and costs by almost half, while also reducing tenant satisfaction and loan fees. Green building plans can be more affordable and cost-effective by using sustainable methodologies and approaches. Key advantages include energy savings, increased worker efficiency, better indoor air quality, longer structure lifespan, and a smaller environmental footprint. Green premiums may increase with greenness, and comparing green buildings to conventional ones can lead to a 12-15% increase in total cost.

2.2 Mr. Santu Kar, Dr. Rajiv Ganguly, Modelling and comparison of green building with conventional building (2016) - Green buildings aim to minimize the impact of the built environment on human health and the natural environment. They incorporate environmental considerations into every stage of construction, focusing on design, construction, operation, and maintenance. Green buildings use light shelves, AAC blocks, sunpaths, and tropical skylights for ventilation and light. Despite higher construction costs, their life cycle costs are 33.7% and 50.6% less without and after solar panels. Energy analysis using REVIT helps compare both structures.

2.3 Yun-Tsui Chang, Shang-Hsien Hsieh, A REVIEW OF BUILDING INFORMATION MODELING RESEARCH FOR GREEN BUILDING DESIGN THROUGH BUILDING PERFORMANCE ANALYSIS (2020) – A high-performance building, as defined by the Energy Independence and Security Act, optimizes and integrates all major performance attributes of a building, including environmental sustainability, cost-benefit, occupant productivity, and operational considerations. Building Information Modeling (BIM) plays a crucial role in achieving this, enhancing design decisions and team interaction. Azhar and Brown (2009) conducted a study on the effectiveness of Building Information Modeling (BIM) in sustainability analyses. They identified energy, daylight/solar, and LEED analysis types, and Autodesk Green Building Studio, Ecotect, and IES Virtual Environment as the most popular software.

2.4 Farzad Jalaei, Ahmad Jrade, INTEGRATING BUILDING INFORMATION MODELING (BIM) AND ENERGY ANALYSIS TOOLS WITH GREEN BUILDING CERTIFICATION SYSTEM TO CONCEPTUALLY DESIGN SUSTAINABLE BUILDINGS (2014) – BIM significantly impacts design practice by enabling accurate assessment of proposed schemes and evaluating their sustainability and functional requirements. It addresses global challenges like sustainability and life cycle costs, integrating performance analysis from an early design phase. BIM systems facilitate collaboration and communication between project participants, enabling multidisciplinary information to be superimposed within a single model. Combining sustainable design strategies with BIM technology can change traditional practices and produce high-performance designs for proposed buildings. BIM models provide visualization, built-in intelligent objects, and data for building geometry and energy calculations.

2.5 Tian Han, Qiong Huang, Anxiao Zhang, Qi Zhang, Simulation-Based Decision Support Tools in the Early Design Stages of a Green Building (2018) – The paper analysed popular software and methods for early simulation in building performance. It categorizes software as: simulation plugins for popular CAD tools, geometry design tools. These tools are organized into plugins for popular design tools, such as SketchUp, Rhino, and Revit, and GUIs for mature simulation engines, such as Design Builder and N++. The paper also reviews different software studies and discusses the importance of decision-making in the early design stages. As well as the paper discusses plugins for design tools like SketchUp, Revit, and Rhino, which enable design and simulation functions, often paired with external simulation engines for specific tasks.

3. METHODOLOGY

3.1 Research and Literature Review

The preliminary research phase involves gathering existing data on design of green building. A thorough literature review identifies successful case studies, technologies, and design methodologies. And assess whether the proposed project is viable by analysing factors like materials, energy consumption, and water availability.

3.2 Layout and Passive Design

In a green building design, the layout should be optimized to make the most of natural resources such as sunlight and wind. This involves a 2D plan structure, strategic orientation of the building, placing larger windows on the north and south sides to allow maximum daylight penetration, reducing the need for artificial lighting. Passive solar heating can be achieved by designing spaces to capture and store sunlight during the day, while natural ventilation can be encouraged by aligning windows and openings to promote cross-ventilation, reducing the need for air conditioning.

3.3 Study on detailed information of materials & resources

In the design of a green building, the choice of materials and resources is critical for reducing environmental impact and improving sustainability. Sustainable materials should be prioritized, focusing on those with low embodied energy, minimal environmental impact during production, and the ability to be recycled or reused.

3.4 Selection of materials and resources.

Resource conservation is equally important. This involves selecting materials that are durable and have a long lifespan, minimizing the need for frequent replacements. Water-efficient systems, like low-flow fixtures and rain water harvesting, should be integrated into the building's resource management strategy. The use of non-toxic, low-VOC (volatile organic compound) paints, adhesives, and finishes helps ensure a healthier indoor environment for occupants, improving air quality.

- Certified Lumber
- Bamboo
- Natural Stone

- Plastic Lumber
- Steel Studs
- Perforated Metals
- Permeable Pavements
- Living Plants
- Solar cells
- Carpet Tiles
- High Performance Glass
- Geopolymer Concrete
- Lighting Fixtures
- Bio Bricks

3.5 Load calculation on ETABS.

ETABS is a structural analysis software that calculates various loads, including dead, live, wind, and seismic loads, for green building design. It defines the building's geometry, material properties, and load-bearing systems and allows load combinations based on local codes and standards. In green buildings, it considers material usage, structural efficiency, and sustainable materials. ETABS generates results to refine the design, ensuring safety and resource efficiency.

3.6 3D structure design on Revit.

Revit enables the creation of detailed 3D models with energy-efficient features like insulation, high-performance glazing, and passive design strategies. It simulates renewable energy systems and integrates rainwater harvesting systems. Revit's energy analysis tools assess building performance.

3.7 Water, Energy consumption calculation on EDGE Software.

EDGE is a specialized tool for green building design that helps calculate the water and energy savings through various sustainable strategies. The energy calculations focus on reducing the building’s energy consumption by evaluating factors such as HVAC systems, lighting, insulation, and window efficiency. EDGE helps assess water consumption and identifies opportunities for reducing water use, such as low-flow fixtures, rainwater harvesting systems, and efficient irrigation systems. The software allows you to set up scenarios, analyze the building’s performance, and make design adjustments to achieve optimal water and energy efficiency.

3.8 Comparison between green building and conventional building.

A comparison between green buildings and conventional buildings highlights significant differences in design, sustainability, and long-term performance. Green buildings prioritize environmental responsibility and resource efficiency from the outset. In contrast, conventional buildings are typically designed with lower upfront costs in mind, often without considering long-term sustainability. They rely heavily on artificial lighting, HVAC systems, and non- renewable energy sources, which leads to higher operational costs over the building’s lifecycle.

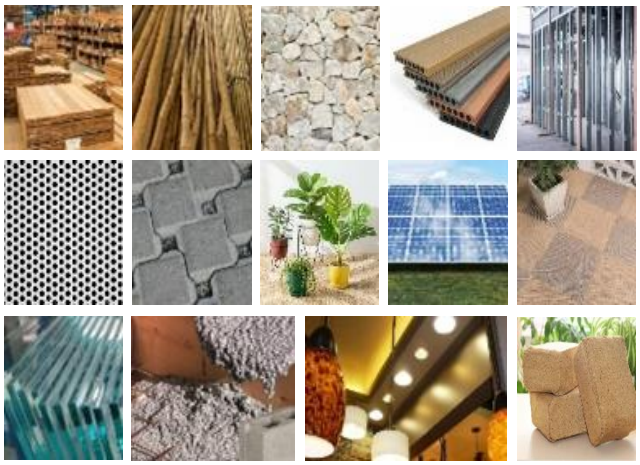

Fig. 2 AUTOCAD Plan

4. RESULT

The expected result would include comparison between conventional and green building with respect to materials, costing, energy consumption, water usage and indoor environmental quality.

5. CONCLUSION

Green building design focuses on sustainability and energy efficiency, utilizing sustainable materials, energy-efficient systems, and improving indoor air quality. The paper concludes, with the use of software's mentioned in paper and the design of structure will be carried out. And the load calculations will be done on ETABS as well as manual calculations, in the end there will be comparison of green building with conventional building.

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