International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 08 | Aug - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Energy Analysis & Optimization of A Residential Structure

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Abstract - This project delves into the critical realm of energy analysis and optimization for residential buildings. With global energy demand surging and environmental concerns mounting, the need for efficient energy consumption is paramount. The study employs a multidisciplinary approach, combining architectural design, data-driven insights, and advanced technologies. Real-world data collection, including smart meter readings and sensors, forms the foundation for evaluating energy usage trends, peak demands, and seasonal fluctuations. Building Energy Modeling (BEM) software aids in simulating diverse scenarios, enabling accurate predictions of energy performance.

Key Words: Autodesk Revit, Autodesk Insight, (EUI) Energy Use Intensity. BIM (Building Information Modelling).

1. INTRODUCTION

Energy analysis involves the comprehensive examination of energy utilization, production, and distribution within various systems and contexts. It encompasses the study of energy sources, consumption patterns, efficiency levels, and associated environmental impacts. By looking at these factors, energy analysis helps us find ways to use energy more efficiently, reducing wastage, and promoting sustainable practices. This involves evaluating the efficiency of energy conversion processes, identifying and mitigating energy losses, considering the life cycle impacts of energy-related activities.

A. Autodesk Revit Architecture

Autodesk Revit Architecture is a powerful and popular Building Information Modelling (BIM) software created by Autodesk. It revolutionizes the way architectural design, planning, and construction are approached by offering an integrated platform that enables architects, designers, and building professionals to create, collaborate, and manage information-rich 3D models throughout the building lifecycle.

B. Autodesk Insight

Autodesk Insight is a powerful software tool designed to facilitate building performance analysis and optimization. It empowers architects, engineers, and designers to gain a clear understanding of energy use and make well-informed decisions about how to manage it effectively, environmental impacts, and occupant comfort throughout the plan and Stages of development for building projects.

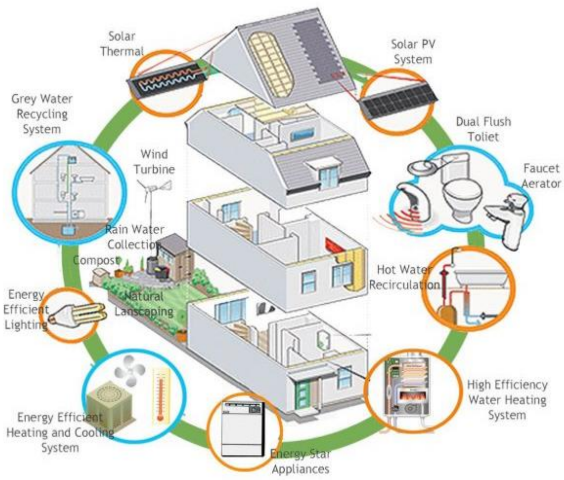


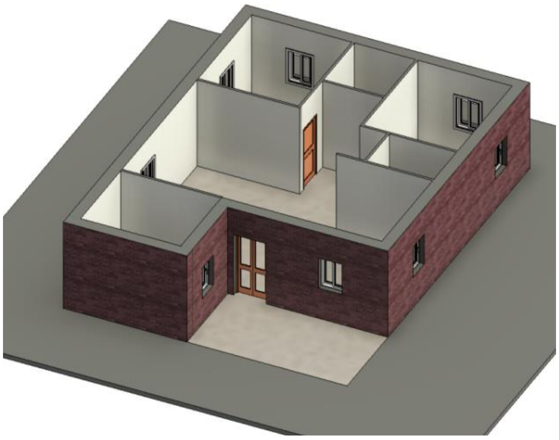
Fig -1: Components of Energy-Effective Structures

2. METHODOLOGY

Autodesk Insight and Revit are extensively employed for scrutinizing building energy dynamics. In the realm of energy analysis, a residential edifice nestled within the urban fabric of Hirandahalli, East Bengaluru, has been subject to meticulous examination. Positioned at 13.0504236221313 Latitude (13°03'01.5"N) and 77.7197036743164 Longitude (77°43'10.9"E), with an altitude soaring 877 meters up from sea level, this structure is rendered into a three-dimensional model via Revit software. Subsequent analysis is undertaken using Autodesk Insight, delving deep into its energy performance and environmental impact.

Stages associated in this work are,

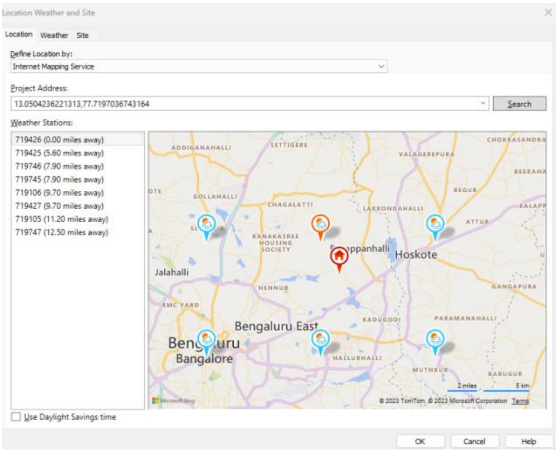
1. Collection of Drawings and Data : The drawing of the structure is concentrated on subsequent to gathering all the expected data about the given structure.
2. Creation of 3D Model : Utilizing the Autodesk Revit programming, An 3D model of the structure is developed using the drawings that have been collected.
3. Selection of Venture Area : Utilizing the Web Planning Administration, we've found the structure considered and Its geological condition is included in the product.
4. Energy Settings : Based on information about wall materials, rooftops, windows, and energy systems like air conditioning, plug load, productivity, working timetable, Changes have been made as needed.
5. Energy Model of the Structure Creation : Utilizing the examine board in Revit programming a structure energy model is made consequently.
6. Analyse and Run Energy Model : Understanding exhibits the potential presentation results in light of a scope of various plan situations executed. In the final step, we



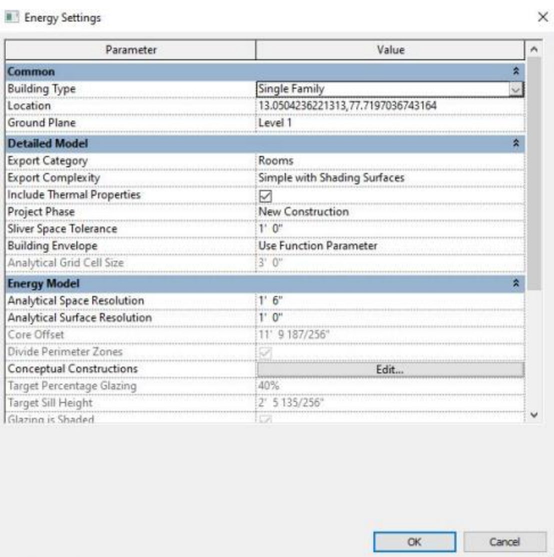
gauge the energy prerequisite and the expense of the structure in view of the data sources corrected in the Autodesk understanding programming.

Fig -2: Three Dimensional Model of the Structure

As we craft the three dimensional model, we carefully consider the warmth properties, selecting the most suitable material from the array of available options. Energy settings play a pivotal role in steering the trajectory of model creation, ensuring precise control over energy dynamics. These settings facilitate the seamless integration of material and thermal characteristics into the model, sparing us from undue complications. It's imperative not to tamper with energy settings at the beginning



stage of energy optimization, as certain characteristics are



inherently embedded within them for efficient model creation.

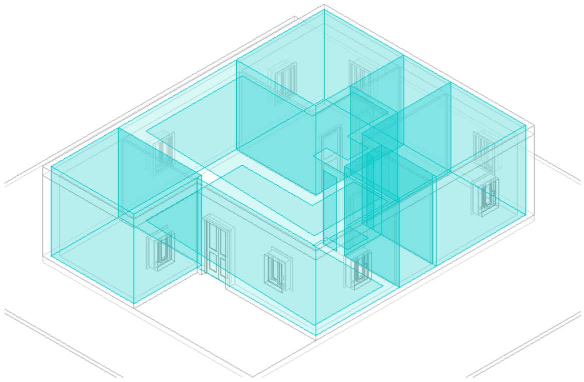


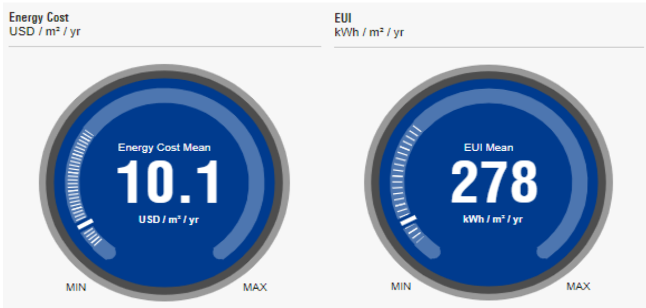
Fig -3: Discovering The Building Through IMS.

Fig -4: Energy Setting in Revit

Fig -5: Energy Analysis Model

3. RESULTS

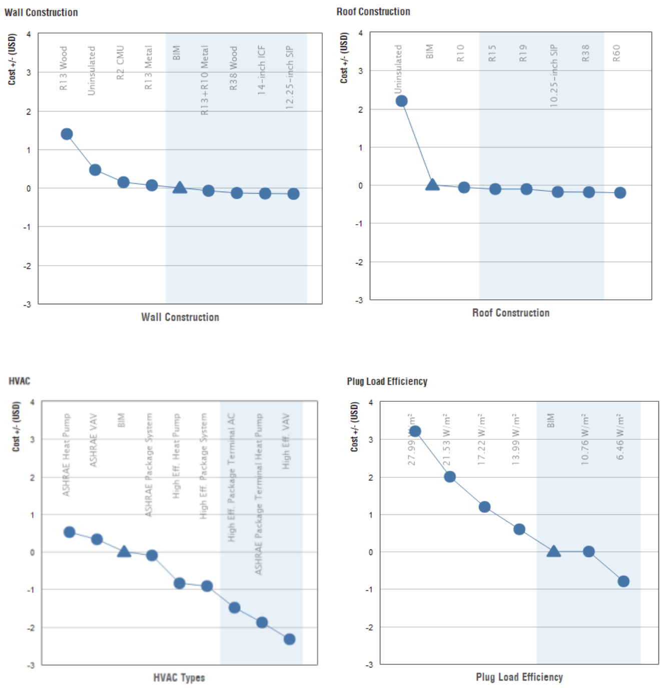
The quantification of energy usage is encapsulated through Energy Utilization Index (EUI), measured in kilowatt-hours per square meter per annum. EUI delineates the relationship

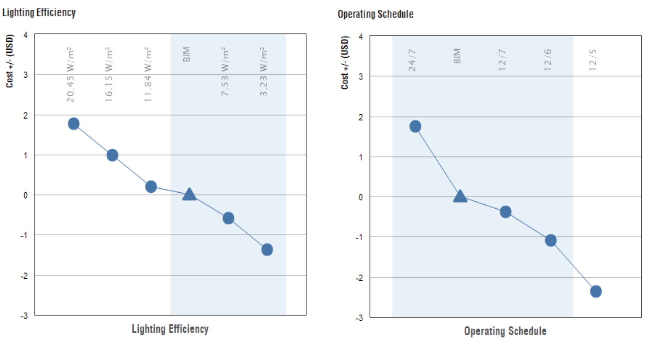


between the aggregate energy expended by a structure within a year and its encompassing floor area.

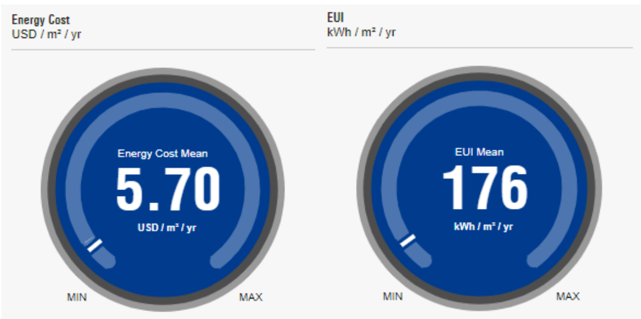
Fig -6: Benchmark Comparison Before Energy Optimization

The graphical representations below illustrate the changes in





Orientation, Annual Energy Usage, Window Wall Ratio, Window Glass, Wall Construction, Window Shades, Roof Construction, Infiltration, Lighting Efficiency, Day lighting



and Occupancy Control, HVAC, Operating Schedule, PV Panel Efficiency, Plug Load Efficiency, PV Surface Coverage, PV Payback Limit.

Fig -7: Benchmark Comparison after Energy Optimization

3. CONCLUSIONS

1. Consequently, an energy-efficient design approach will bolster advancements in sustainable architecture by enhancing energy consumption patterns.
2. Designing energy-efficient buildings entails comprehending results from energy simulation to help the stakeholder in finalizing the design that uses optimum energy and promotes sustainability.
3. Up to 60% Energy consumption & 50% cost reduction can be possible by energy analysis and optimization using Insight in the early design phase. More than 20% of energy saving can be done in the current building by optimizing the following factors i.e. Infiltration (Insulation), Lighting Efficiency, Day lighting & Occupancy Controls, PV - Panel Efficiency and payback period.

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