

The Comparison of Building Performance of Green and Conventional Building using Revit & Autodesk Insight

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Abstract - Building demand energy in their life cycle right from its construction phase to demolition phase. High energy consumptions may lead to serious environmental impacts like increase in the rate of global warming. Therefore, it is important to study the energy consumption of building at the conceptual stage. One of the recent methods to evaluate energy consumption of buildings is Energy analysis using Building Information Modelling (BIM) tools -Autodesk Insight, BIM is an intelligent 3D model-based process that gives Engineers the insight tools to more efficient plan, design, construct, and manage buildings and infrastructure. BIM assist designers assess different design alternatives at the conceptual stage of a building life so that effective energy strategies are attained within the building constraints. To conduct a comparative study of building performance of conventional and adoption Laurie green building,(it is an adoption from Laurie Baker construction methods) integrating BIM based energy analysis in predicting the energy consumption of a . For this purpose, the Autodesk Revit Software and Autodesk Insight which is a cloud based energy analysis program is used.

Key Words: Building Information Modeling, Conventional Building, Green Building, Performance Analysis, Revit, Autodesk Insight.

1. INTRODUCTION

Green buildings are considered as environment favorable constructions. The expenses of constructing a green Building is less than the conventional building and the operation and upkeep expenses are less and have Excellent environmental advantages. Green Building is similar to an ordinary building only with same functional usage but the differences are there in the design concepts adopted and construction techniques used to preserve the surroundings and nature. Sustainable development is viewed as development with low environmental impact, and high economic and social gains. Professional architects and engineers are more concerned about the sustainability and energy performance of proposed buildings. Analyzing the Energy consumption of buildings at the conceptual design

stage is very helpful for Designers when selecting the design alternative that leads to a more energy efficient facility.

1.1 Building Information Modeling (BIM)

presently one of the prominent trends in the architecture, engineering and construction sector. The objective of the study is to evaluate a Laurie Baker model Green residential building analysis using Autodesk Revit. In Revit a full building model can be used to create an energy analytical model. Building performance analysis carried out in this research emphasizes on the savings in cost and environmental friendly impacts as a result of choices and methods adopted to lower the energy demand and CO2 emissions. The social impact is also necessary and essential for achieving the sustainability criteria, but however is difficult to evaluate using BIM software. The results are compared with that a conventional building of similar design but with no Green features.

1.2 Laurie Baker Adaptation

Sample In Kerala during 1970s architect Laurie Baker revolutionized the concept of architecture through his affordable and green constructions. Laurie Baker represented a unique tradition of architecture that blended man and nature. He emphasized local materials and traditional concepts in constructing dwellings, demonstrating a strong commitment to mass, affordable housing. The objectives are to develop a Revit model of a residential building at Muvattupuzha, Kerala, India and converting into a Laurie Baker model green building, perform Building Performance analysis of and green building using Autodesk revit and Autodesk Insight and to conduct a comparative study of building performance of conventional and green building. Building Performance analysis carried out in this project emphasizes on the savings in cost and environmental friendly impacts as a result of choices and methods adopted to lower the energy demand and CO2 emissions.

1.3 Autodesk Revit Architecture

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1.4 Autodesk Revit Architecture

Green features Autodesk Insight is a cloud based Energy Analysis Program which helps to improve energy and environmental performance throughout the building life cycle by letting us integrate Energy analysis, lighting analysis and solar analysis for a holistic approach to building performance design. This tool is only available to subscribers of Autodesk software and students for a period of 3 years.

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2.METHODOLOGY

2.1 Conventional building

First identifying and visiting the Conventional Building selected for the study. The building chosen for the research is Residential Building at Kaloorkkadu, Muvattupuzha, Eranakulam. The required drawings and other information are collected. Total plinth area is 1510 sq. ft.

2.2 Planning of Green Building

The client approached us to rebuild their conventional building as a green, (sustainable) building with more space. At the site there is a tree behind the conventional building. we have planned an open-to-sky circular court, without cutting down the tree, completing the

inner wall of the house in a pattern of staggered brick. It is an adoption from Architect Laurie Baker construction. Here the green building is circular. It is one of the Baker's more successful circular houses. Straight wall constructions with curved walls-an innovative way to enclose a larger volume at the lower material cost. The wall construction by Rat trap bond and the roof is filler slab. The plan orients outwards in a semicircle consists of Family room, two bed room, kitchen, dining and pooja with a plinth area of 2086 sq.ft. Providing solar panel and rain water harvesting.

The advantage of circular design is energy efficiency. With less exterior wall area, heating and cooling bills are lower. Cold winter winds flow smoothly around the house instead of leaking in and causing drafts. This circular design also withstands hurricane and tornado winds better. It is in situations such as these, where an old tree and an awkward slope are reconciled in a composite solution, that Baker's work achieves a sort of earthy on-site lyricism. The physical conditions of the site and their architectural resolution make the visitor aware not of their awkwardness but of the house's naturalness in accommodating them. Autocad plan of green building (Fig 1) is given .

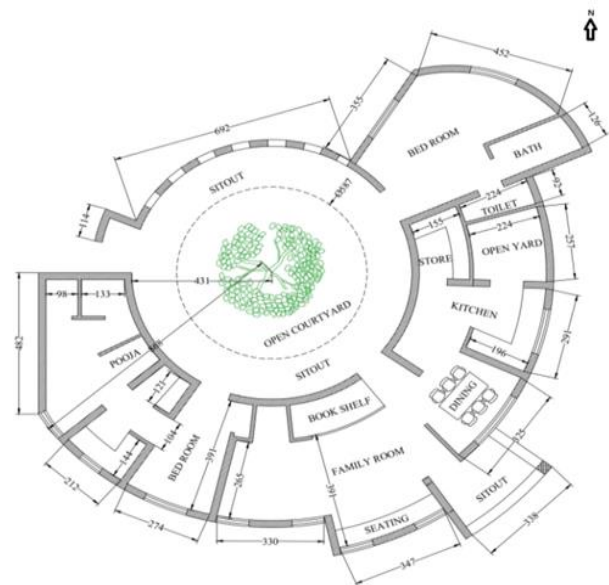


Fig -1: Plan of Green Building

2.3 Estimation

Calculated the estimation of conventional building and green building.

2.4 Software

The analysis proposed in the research mainly utilizes Software of Autodesk: Revit Architecture. For plan using Auto cad.

2.5 3D Model using Revit architecture

The 3D model (Fig 2) of the conventional building and green building (Fig 3) are developed in Autodesk Revit Architecture by creating a new Architectural template.



Fig -2: 3D Model of Conventional Building developed in Revit



Fig -3: 3d model of green building developed in Revit



Fig -4: 3D Model of Green Building developed in Revit top view

2.6 Energy Analysis using Revit Architecture

For the purpose of the Energy analysis of building with the help of Autodesk INSIGHT and Revit software, The three dimensional model of both the conventional and green

building is created using Revit Architecture and the model is further analyzed using Autodesk insight. The Energy simulation of a building involve the following steps;

- Collect the Drawings and information about the building to be studied.
- Create a 3D model using the Autodesk Revit software with the help of the drawings collected.
- Change the energy setting like building type, building operating schedule, type of HVAC system etc. as per your need.
- Locate your building using Internet Mapping Service inbuilt in Autodesk Revit.
- Automatically create a building energy model using the analyze panel in Revit software.
- Analyze and run results in the Autodesk Insight over the cloud.
- Estimate the energy use of the building.

Project location details in the location setting using either Internet mapping service or Default city list, also select the type of building, the use of building type in the Schedule section, if the project is actual ongoing project or just study for academic purpose and other details in the Energy setting and Advance Energy setting Option which is also available in the Analyze panel in Revit.

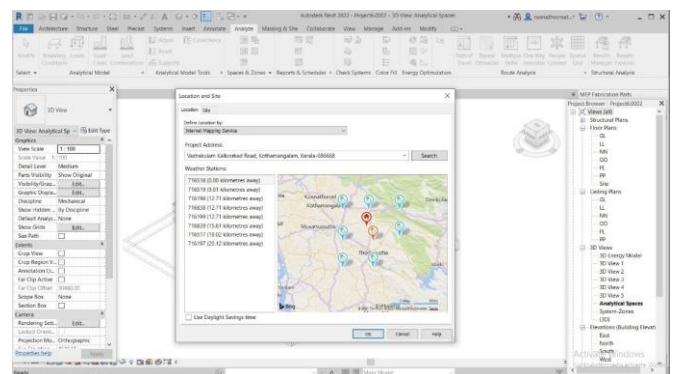


Fig -5: Selection location and site

The Project Location will help in determining the nearest Weather Station & weather details of the area of project, which helps in the analysis process. If the thermal properties of the building materials are to be considered, we can select that using the material thermal properties option available in Revit.

Options like conceptual types of the individual building elements can be changed in the conceptual types option in Advanced energy settings. Some of the values are default set in the software.

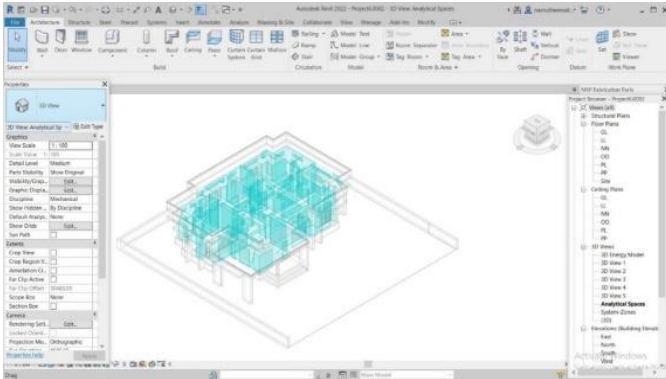


Fig -6: Energy model

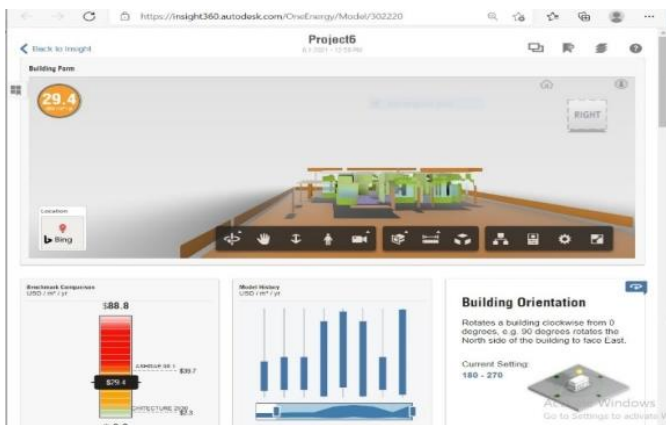


Fig -7: Interface of insight

The energy consumption of the building will be calculated as Energy Use intensity (EUI) in kWh/m² per year based on the energy setting of the project. EUI is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building. The analysis report will have many Design options like Operating schedule, window to wall ratio, HVAC systems, building orientation, lighting efficiency to alter and control the energy consumption of the building. The analysis report not only provide us with the Energy use intensity of the project but also the energy cost of the project per square meter per year.

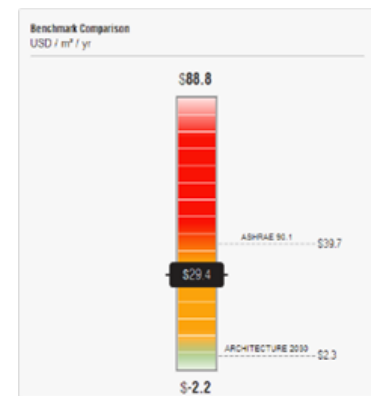
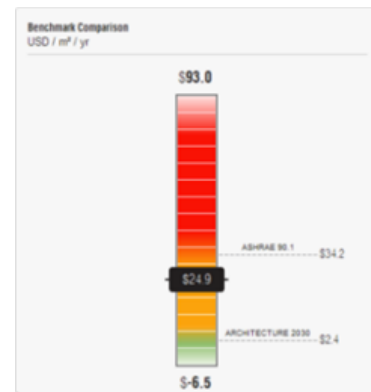


Fig -8: Benchmark comparison green and conventional building

The Insight 360 program provides the net annual energy use intensity and its corresponding yearly cost per unit EUI. It further attributes the energy use intensity to the main parameters that can affect it significantly. Insight 360 provides energy use values for the BIM model and other options provided by the program. Additionally, for reference in all further-mentioned comparative data, the BIM model EUI is to be taken as zero as it is considered as the baseline. The factors used by Insight 360 are as follows:

- i. Building Orientation
- ii. Window-Wall Ratio
- iii. Window Shading
- iv. Window Glazing Material used
- v. Wall Construction
- vi. Roof Construction
- vii. Daylighting and Occupancy Controls
- viii. Air Infiltration
- ix. Lighting and Plug Load Efficiency
- x. HVAC Systems
- xi. Operating Schedule
- xii. PV Analysis

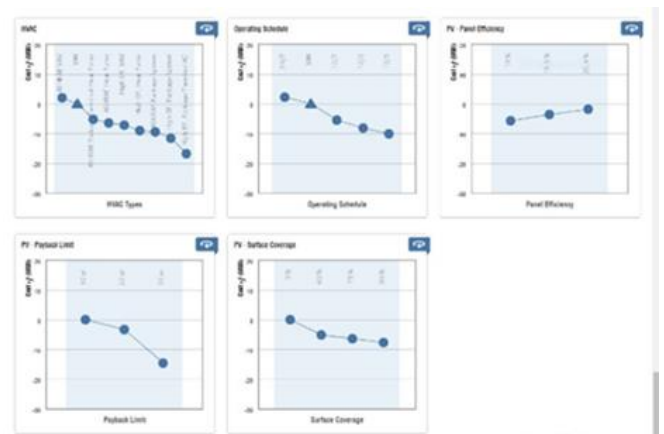


Fig - 11: Graph showing the energy cost of factors

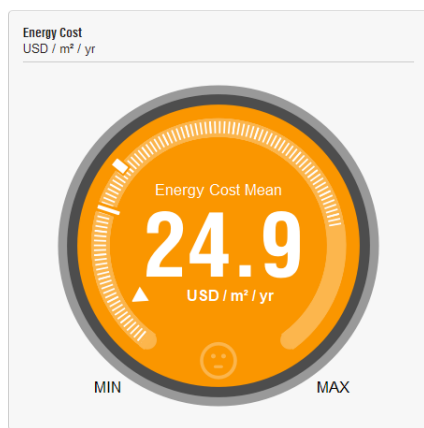


Fig -9: Range of Energy Use Intensity and Energy cost of green and conventional building

3. CONCLUSIONS

- The Building Information Modelling softwares like Autodesk Revit architecture and Autodesk Insight is found to be very effective for in developing and creating energy efficient buildings.
- From the Building Performance Analyses there is about 15% Energy Cost savings for the conventional building compared to the Green Building.
- Therefore, it is apparently clear from the study that constructing a Green Building is always beneficial to the nature and the environment. Also, with the help of this sustainable design application, various aspects of sustainability can be explored by the option of generating design alternatives.
- The total cost of conventional building (1510 sq.) is 42lakh and the total cost for green building (2086 sq.) is 30 lakh. So compared to the conventional building green building is found to be economical.
- The adoption of Laurie Baker construction resulted sustainable Architecture, maximized space, ventilation, light and aesthetic sensibility.

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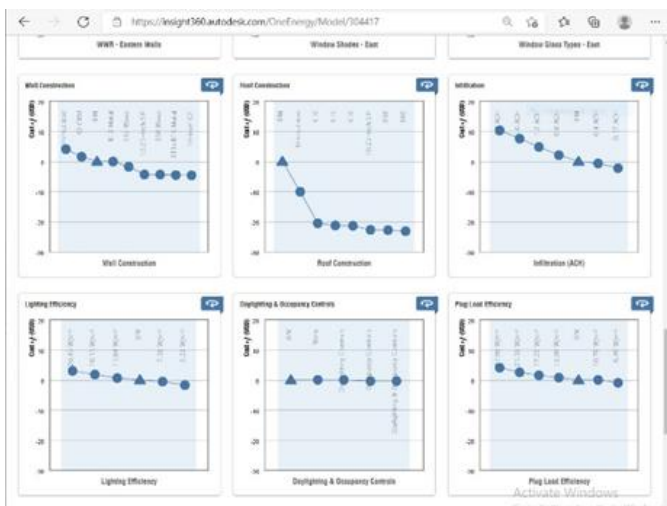


Fig - 10: Graph showing the energy cost of factors in Autodesk Insight

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