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ENERGY ANALYSIS OF SMITHA MEMORIAL CANCER, THODUPUZHA CENTER USING BIM TECHNOLOGY

Irin Ann Isac[1], George M Roy[2], Ittoop R Ancheril[3], Rohith Jerry[4]

[1]Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,
[2]Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,
[3]Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,
[4]Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,

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Abstract -*Construction industry has the quality of having each product unique and transient. With the current growth of technology other industries have changed and improved their process but the construction industry is still labor intensive and follows the same conventional process of creating drawings by architects or designers and building is erected by contractors. 2D CAD (Two Dimensional Computer Aided Drawing) possesses views like plan, section and elevation, in which modification in one particular view demands manual modification in all other views. This process is hectic and error prone. The application process represents each object as a building component like walls, beam and column. Building model gets automatically updated in each view with modification in any one of the views which saves time and is less error prone. BIM establishes a transparent information technique to all the stakeholders of each element of building from design to demolition.*

Key Words: energy analysis, BIM, solar analysis

1. INTRODUCTION

The aim of this paper is to present an application of 6D building information modelling (6D BIM) on a real hospital. The building taken for the case study is Dr Advani's Smita Memorial Cancer Hospital & Research Centre which is currently constructing a 350 Bedded, 3 lac sq. ft. of Multispecialty Hospital in Kerala which is due to launch in November 2021. The Hospital has been designed and constructed after a thorough market study of some of the best hospitals in India and Abroad. The location of the Hospital is Thodupuzha which is one of the most developing places in Kerala. The paper is intended to be set as a guideline to the building owners to prepare 6D BIM building. It also helps to provide an insight into the various dynamic energy solutions.

2. OBJECTIVE

The main objective of this project is to create an architecture BIM model of the SMITHA MEMORIAL HOSPITAL AND RESEARCH CENTER, Thodupuzha, and create an energy efficiency analysis to determine the positioning and direction of the solar panels to attain maximum efficiency in order to reduce the energy expenditure of the building and hence contribute a small part to this social cause. The direction and intensity of sunlight, rainfall and wind will be estimated using the weather forecast. This could be analyzed to search out the type of material to be used on certain points of the building to confirm maximum energy efficiency. Materials to be added to confirm the smallest amount of external energy to be to the building is estimated. Generally the foremost comfortable human temperature for a building is 75 Fahrenheit. Materials will be chosen from the library in Revit and added to the model to achieve a temperature near the ideal temperature. After the analysis the extra energy requirements of a building for ventilation, temperature control etc. is discovered.

3. ENERGY ANALYSIS

This method is used from the pre-planning stage to the design process to execution and during the running and maintenance of the building throughout the expected life of the building. This method in addition to giving us information on how energy can be saved at certain stages of construction and maintenance. It also gives a much more detailed information on what the alternatives can be used for and how it will affect the energy use of the structure in the long run. Energy Analysis although not directly creates profit, but by using this method and by obtaining the relevant information on the alternative materials & techniques for construction that can be used by the builder can make a better informed choice on how it can be done, which in turn helps in reducing the loss that could occur during the construction phase and maximize the profitability of the building during its design life time. Hence the Energy Analysis method is not just a tool which is used for optimizing the wastage of energy by reducing its loss in active and passive ways but also as a tool to increase the revenue that a structure can generate during its life period.

4. METHODOLOGY

The plan and elevation CAD drawings are imported to REVIT and an architecture BIM model of the SMITHA MEMORIAL HOSPITAL AND RESEARCH CENTER, Thodupuzha is built.

The material constituents of the building are already predetermined, energy estimates and additional optimizations are suggested. After the energy analysis is carried out, the additional energy requirements of a building for ventilation, temperature control etc. is found out accordingly. BIM enables energy analysis of a building to be performed before it is actually constructed and makes the building energy efficient

Application Softwares which include INSIGHT are used to carry out these processes to make the building more energy efficient.

4.1. Model creation

Initially a 3D model was created of the hospital. Further the structural model of the building was created, which included beams, columns and slabs that formed the skeleton of the structure on which all other elements is to be added, this is the most fundamental part of structure and where large quantities of cement, aggregate and water for the formation of concrete and steel for casting in beams, columns and slabs will be used, thus these are the elements which will absorb and emit the major amounts of heat during construction, these are the passive elements that contribute to the energy use of the structure during its life, and so are designed with the properties these materials should possess in mind.

Next step is the creation of the architectural model of the structure, this included elements such as windows, doors, flooring, and staircases among other elements. These form both the passive and active elements of the structure as the type of doors, windows and flooring materials used along with their individual properties and when used as a collective can help to reduce a sizable amount of energy, which would have been lost otherwise due to poor material choices

4.2. Material selection

One of the most important choices during the construction of a building is the choice of materials. This becomes ever more important when the structure is put under the Energy Analysis Method, as the thermal and other such energy dependent properties of materials have a prominent role in determining the amount of energy the building can gain or lose due to the materials that are chosen

The materials used were selected from the library of BIM which included information on rate of absorption and emission of heat, the behavior of molecules, thermal conductivity, density, its porosity and permeability amongst other properties which all combined provide highly detailed information on how the building will perform in the long run and during changes in different weather conditions and working that the structure will be exposed to during the course of its life.

4.3. Processing

After the Structural and Architectural Models of the building is created and the required type of materials selected and added to the structure the said file is then setup for generating the render which is to be uploaded into the Cloud service provided by BIM under the account the user is working with and within 24 hours the account the user used for generating and sending the model will receive an email with the details the energy analysis process, with various graphs detailing the thermal loads on the building comparing it with the loads from references of similar sizes and it also details how thermal loads are affecting each face of the building by its geographical location and the type of architectural elements used such as windows and open spaces on the energy efficiency of the building.

5. ENERGY ANALYSIS RESULTS

The model we created was uploaded to the AUTODESK INSIGHT software for the analysis process, the results generated from analysis are described here. The average annual utility cost required for the building under study is significantly lower with a value of $23.4 USD/m2/yr than the ASHRAE value of $29.9 USD/m2/yr for a building of its size. But this is not the lowest the building can achieve, as the building can reduce energy by $5 USD/m2/yr which is a reduction of almost 20% per year basis, and down to as low as $17.2 USD/m2/yr, which is highly significant because of the vast area the building possess and life the building is designed to operate. Similarly, the values can be expressed in terms of the energy use intensity (EUI). The energy use intensity value required for the building under study is significantly lower with a value of 309 kWh / m^2 / yr than the ASHRAE value of 401 kWh / m^2 / yr for a building of its size. This reduction in energy consumption can be done by various methods in the selection and use of materials and also in the design of the building, a whole host of alternative design choices and material choices are provided for reducing the energy consumption of the building. This is largely dependent on the orientation of the building, this is evident from the data generated, because the sides that receive the most sunlight during summer months and rain during the monsoon months have the lowest energy efficient and the materials used at these places are to be replaced with higher energy efficient ones as these will be most important in improving energy efficiency.

Fig -1: Energy Analysis Data

6. SOLAR PANELING

The amount of power that can be produced using solar energy and the amount of energy photovoltaic panels can generate can be determined. For this the geo-tagging of the model is performed as this will determine how much solar energy is received during the course of a year at that particular location. After this the type of analysis to be performed is decided and then the surfaces on which solar panels are proposed to be placed are chosen and then analyzed. The analysis provides the amount of energy saving the placing of panels will provide and the expected time it needs for recovering the costs of placement and this model can be used for energy analysis and whose result will provide information on how the placement of photovoltaic panels will help the increase of efficient use of energy for te=he model during its lifetime.

6.1. SOLAR PANELING- ANALYSIS RESULTS

From the data it is understood that placement of solar panels can only be performed on the roof of the building as any other location such as on the walls is neither highly energy efficient nor will it suit the architecture of the building, and it will also need an excessive capital expenditure which does not have comparative return in the long term and is advised against. The panels are to be fixed on the roof of the building which receives the highest amount of light from the sun and is recommended to be placed here, the amount of energy that can be generated from placing the panels on the roof is 1484kWhr/m2 per year which can produce large gains in the long term and is thus recommended.

7. GREEN BUILDING CERTIFICATION

The vision of the Indian Green Building Council (IGBC) council is, "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025"

The IGBC states, in its code about the rating system addresses the following aspects:

- Indoor Environmental Quality
- Sanitation & Hygiene
- Water Conservation
- Energy Efficiency
- Building Materials and Resources
- Site Selection & Planning

The conducting of energy analysis of the building creates an opportunity to certify the building as a green building by certifying agencies and is becoming a matter of prestige to builders. For classifying a particular building as green building the builder has to meet the criteria laid out by the IGBC and this must be kept in mind from the designing phase till the demolition of the building.

8. CONCLUSIONS

As a relatively new software for energy analysis, this journal explores the benefits of using a cloud based system over a traditional in-house process. It also focuses on the various steps performed from design and planning stage to creating work schedules, design and loading of structures to effective placement of solar panels.

Performance of energy analysis through creation of a 3D model has given a deeper insight into the how the design of the building can be changed and also how material are to be chosen in the planning and procurement stage can be altered to make the efficiency of the building better and in the life of the building reduce the operating cost.

The analysis of solar panel placement on the building helped in understanding the most effective orientation solar panels must be kept, in regards to the geographic location and the prevailing climatic conditions of the area are also understood, so as to achieve maximum efficiency and increase the self-sufficiency of the building and thus reducing cost of external power.

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BIOGRAPHIES

Miss Irin- Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,

Mr. George M Roy- Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,

Mr. Rohith Jerry- Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,

Mr. Ittoop R Ancheril- Graduate in Civil Engineering from Viswajyothi College of Engineering and Technology,