APPLICATION OF 6D BIM IN DESIGNING OF ENERGY EFFICIENT METRO RAIL STATION

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Abstract: In the modern changing world, infrastructure sector has also shown potential growth i.e., development of highway, metro rail projects etc. along with the others sectors. The purpose of this paper is for the process associated with the design and development of the metro rail station box and optimizing the energy consumption and carbon emissions by utilizing the Building information modelling and energy simulation. BIM has been widely used for enhance visualization, clash detection, time and cost management as well by various stakeholders along with the different phases of project life cycle but in the emerging era of sustainability the future infrastructure needs to be more energy efficient with minimum carbon footprint. By referring the various and available literature papers, some limitation can be spotted in the recent research work done in the area of energy consumption. Therefore by integrating BIM with other dimension like time, cost and energy simulation, an improved energy efficient metro station box and carbon emission reduction plan can be created which will help in building more sustainable and Eco friendly infrastructure in the recent future.

Index terms: Building Information Modeling; Energy Simulation; Project management; Metro Station Box; Sustainability

I. INTRODUCTION

BIM is a tool for developing and handling all the information on a project along with all the phases of project life cycle. Energy is a key topic in building design and use. To determine the amount of energy required to heat or cool a building many factors must be considered. Some basic factors include the materials used, quantities of materials, the size and configuration of space(s), and the building location. Buildings are analysed to determine their energy input requirements and then the systems that are designed to meet those requirements are analysed to determine their actual energy use. A majority of the information required for energy analysis is actually created during building design by architects, structural engineers, and others. If that information can be captured and shared with energy analysts, the work required in data collection and checking can be dramatically reduced and the overall time taken to perform the analysis can be shortened. This is the key interest of this 3D-computer-aided design (CAD)/building information modelling (BIM)-based energy simulation project, which aims at utilizing the information from early building design as input in the energy analysis process.

The architecture, engineering, and construction industry greatly needs new programs and methods of producing reliable energy simulations from BIM in an easily understood and prompt manner. Current methods and programs for running energy simulations are not very timely, difficult to understand, and lack high interoperability between the BIM software and energy simulation software. It is necessary to improve on these drawbacks as designers often decide on design configurations without the aid of energy modeling leading to the design and construction of non optimized buildings with respect to energy efficiency.

There is a vital need for improving the energy efficiency and carbon emission reduction of constantly increasing infrastructure with the help of BIM and energy simulation. Factors like orientations of the openings, size of opening, number of opening, building materials, etc can be taken into consideration for modification and improvement to achieve optimized energy demand and carbon emission. As energy consumed by the infrastructure buildings has very significant impact on the total energy consumption hence by minimising it by using BIM and energy simulation would prove to be an important role towards sustainability and environment.

6D BIM is modelled in handing over procedure and intended as a guide with all the necessary information which is given dynamically. It serves for organizing smooth functioning of the building and planning measures for maintenance work and renovations over the entire lifetime of the building. One of the most important benefits of 6D BIM is an easy access to the building element databases from which information about producer, type and model of equipment, service intervals, and technical specifications can be accessed at any time.

II. LITERATURE REVIEW

In this paper, the author (Park et al.) used Revit Architecture (a BIM tool), MS Access, and Visual Basic (VB) to implement the energy performance assessment EPAS through a data-based building information model,

instead of two-dimensional (2D) CAD to compare speed and accuracy. This study has limitations when used as a broader application, as the BIM-EPAS was based on the Korean EPI. "Building information modelling based energy performance assessment system "In this paper, the author used Revit Architecture (a BIM tool), MS Access, and Visual Basic (VB) to implement the energy performance assessment EPAS through a data-based building information model, instead of two-dimensional (2D) CAD to compare speed and accuracy.

(Hyunjoo Kim, 2013) says that current methods and programs for running energy simulations are not very timely, are difficult to understand, and lack high interoperability between BIM and energy simulation software. It is necessary to improve on these drawbacks as design decisions are often made without the aid of energy modelling leading to the design and construction of non-optimized buildings with respect to energy efficiency. The goal of this research project is to develop a new methodology to produce energy estimates from a BIM model expeditiously and to improve interoperability between the simulation engine and BIM software. This research also focuses on how the energy output from systems and components can be captured to facilitate energy costing. Energy use is a major requirement in building performance assessment systems, such as the Leadership in Energy and Environmental Design system developed by the 3D-CAD/BIM energy simulation development project intends to look closely at energy analysis requirements that can support energy analysis assessment and identify information exchange requirements. A case study was conducted to compare the simulation results from this new methodology with that of an existing commercial simulation program, Green Building Studio, and another energy simulation engine, Energy Plus. The comparison results from the case study were very similar to those produced from these two programs, with an average energy estimate variation of 1.87% and9.49%, respectively. By improving interoperability between the energy simulation engines and BIM authoring software, designers will be able to use energy modelling during early design development permitting them to create more energy efficient and sustainable buildings.

The author (Kamar Aljundi,2016) studied the main objective to examine the possibilities of thermal simulation with software tools incorporated into a BIM software to consider the effect of envelope thermal insulation and thermal mass on the thermal solace of a test cell. Evaluation of the effect of thermal insulation thickness, As displayed, expanding the thermal insulation thickness of 20 mm to 100 mm with high thermal mass in energy plus it is anticipated a decline of 100% in warming interest and an expansion in cooling request of 60%, while with Revit it is anticipated a little decline in warming interest of 5%and an expansion in cooling request of 35%. As referenced, all simulation models foresee higher warming requests for low thermal mass model than for high thermal mass and the cooling load is nearly the equivalent and free of the thermal mass of the test cell. In Energy Plus the adjustment in warming burdens for the 60 mm test cell with the high thermal mass contrasted and low thermal mass were 85%, 65% with the regular technique while with Revit there were no change, giving that Revit isn't evaluating accurately the impact of thermal inertia of construction. Contrasting those outcomes and the past ones for the low thermal mass test cell it is intriguing to take note of that the thermal model with high thermal mass in winter the cooling request is right around zero, because of the energy stockpiling in the thermal mass, which is additionally in charge of the decline in the heating demand of the test cell.

The author (Bourgeois et al.) uses methodology of data collection, examined that to reduced lighting use is shown to even increase primary energy expenditure for indoor climate control, trimming down initial primary energy savings in lighting alone. Depending on the proportion of buildings occupants that actively seek out day lighting, reduced lighting use through automated control may not always produce anticipated savings in primary energy for indoor climate control. The approach will be further implemented into the online Light switch Wizard interface to make fully integrated lighting simulations accessible to the design community at large. All of these simulation improvements and technology transfer activities will have the common goal of promoting an occupancy-centred approach to building design.

In this paper,(Gil et al.) the methodology adopted is data analysis and comparison of assessment of different energy saving methods to develop KEPIs. The sets of KEPIs and its methodology are required and it is basic necessary to complete decision support tool to optimize the energy use. Information model, instead of two-dimensional (2D) CAD to compare speed and accuracy. This study has limitations when used as a broader application, as the BIM-EPAS was based on the Korean EPI.

In this review of literature, it is conducted to identify and categorize key issues hampering the application of BIM to FM. In this paper (Dixit et al.) has also designed a questionnaire based on a literature review and surveyed FM professional sat two industry events. Additionally, the single most important issue stemming from the survey responses was the exclusion of FM professionals from project-delivery phases crucial to BIM creation.

Thermal aspect of the building operational energy is one of the key points to be investigated since it has the main proportion of operational energy consumption of the buildings. Green buildings often include measures to reduce energy consumption both the embodied energy required to extract, process, transport, and install building materials and the operational energy, i.e., the energy consumed during the in-use phase of a buildings life to provide necessary services, such as heating, cooling, and providing power for equipment. To reduce the thermal aspects of energy consumption in the operational stage, high-efficiency windows and insulation in walls, ceilings, and floors increase the efficiency of the building. Reducing the use of operational energy should be the main concern of architects who wish to design and build green

buildings. Analysis of the energy consumption of buildings is a difficult task, because it requires considering the detailed interactions between the building, the HVAC system, and the surroundings, as well as obtaining mathematical / physical models that are effective in characterizing each of those items.

The dynamic behavior of the weather conditions and building operation and the presence of multiple variables require the aid of computers in the design and operation of buildings that have improved performance from the standpoint of reduced energy consumption. The main purpose of the study was to identify several sustainable designs that can have positive effects on energy saving and to evaluate the annual lifecycle performance of a building in terms of its thermal aspect of energy consumption in the operational stage by using BIM, as well as by assessing the configurations of local, alternative materials to determine those that have the greatest impacts on building performance by reducing the annual usage of operational energy, thereby improving the energy efficiency of the building. The main purpose of this paper was to investigate the potential of BIM in assessing the effectiveness of different combinations of materials in various components of the building to decrease the annual operational energy consumption of the building. The paper also suggested some sustainable solutions that have been proven to be effective in reducing the energy consumption of the building. In fact, this study by (Shoubi, 2015) showed that considering traditional practices, as well as new technologies, can be an effective approach.

BIM Creation For BIM creation, a model is designed using a 3D-CAD program with the capability for if cXML export, such as ArchiCAD 14. The model is created with only the most basic of features: floors, walls, window(s), door(s), zone(s), and roofing. Although this might not seem like very much information, it is all required for running energy simulations. Interior walls should be added only if separating by thermal zones. Other simulation programs recommend the same procedure because increasing the interior complexity of the model adds time and potential issues without increasing simulation accuracy

CONCLUSION

After referring all the latest Literature/Research papers, the limitation of existing research papers is that the energy simulation and energy consumption are only done for the buildings and other infrastructure projects. The variable research gap is that no one has done the energy simulation, energy modelling for the Metro Station Box and it is very significant part of infrastructure. Existing energy demand and energy consumption required to be studied for the metro rail station box. Energy savings are basic requirements for intelligent control. As energy consumed by the infrastructure buildings has very significant impact on the total energy consumption hence by minimising it by using BIM and energy simulation would prove to be an important role towards sustainability and environment.

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