Application Building Information Modeling (BIM) for Renovation Project

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Abstract

Building Information Modeling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of Projects. This study work is intended to understand the links between BIM and energy analysis tool for renovation project. To achieve this goal; to reduce the energy use and carbon emissions from buildings, there is a need to efficiently renovate the existing building facilities to improve energy performance. Building Information Modeling (BIM) assists architectural assess different alternatives at the renovation stage of a building life so that effective energy strategies are attained within the building constraints. However, for the retrofitting work, there is a need for a proper and systematic methodology to monitor the behaviour of buildings and to make critical decisions to ensure that the energy criteria of the design are really met in practice. This study introduces a conceptual BIM-based model that can improve the energy and meet the requirements for high rise residential buildings.

Keywords: Building Information Modeling, Energy Analysis, Renovation and Revit Architecture

I. INTRODUCTION

Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

The construction industry is facing new challenges for renovation projects considering energy management. The society demands new infrastructure, reduction in the consumption of energy and resources, and implementation of sustainable construction due to current concerns about sustainability and environmental impacts of the Construction industry. While Building Information Modeling (BIM) is not a new concept within the Architecture, Engineering, and Construction (AEC) industries, their integrated potential is just beginning to be realized. A lot of research has been conducted to further enhance the capabilities of BIM in design and construction. However, there has been very little research done so far on the impact that BIM can have on renovation construction practices. This research is intended to identify the potential capabilities of BIM software in relation to renovation construction practices. Recognizing that most of the attention to date has focused on new commercial and public buildings, it is important to increase our focus on untapped opportunities for existing buildings and homes. Revisiting our existing buildings and making them cleaner, safer, and more efficient is one of our advantageous opportunities to cut global emissions and conserve natural resources; create jobs and save taxpayer.

II. PROBLEM STATEMENT & OBJECTIVE

There has been very little research done so far on the impact that BIM can have on renovation construction practices and particularly to untapped opportunities for the development of existing buildings and homes; to make them cleaner, safer, and more efficient and have opportunities to cut global emissions and conserve natural resources; create jobs and save taxpayer. To achieve this we need to obtain objective i.e. to develop the alternatives for renovation so as to reduce the current energy consumption of the project.

III. SCOPE

A project is limited to the case study of "Shivalee Resident" and all the relevant data will be collect from "Patel Consultant Vapi". Used of Architecture Revit 2015 tool to develop 3D model and energy analysis.

IV. METHODOLOGY

Since the purpose method is to reduce the energy consumption of the building by using BIM tool. This will be implemented through the following four phase.

1) Phase I: First Energy analysis will be generated for the existing structure by using the Revit Architecture software. All the relevant data are collected for the stakeholders of the project.
2) Phase II: After that strategy will be develop and data will be collected regarding the alternatives to do renovation work. The data are collect from the expert and as per that strategy are been made for the renovation work.
3) Phase III: Again energy analysis will be done for the renovated structure to examine the impact of alternative solutions for renovation project as compared to the existing structure.
4) Phase IV: Comparing both the analysis report. If it is not exceptable again the work has to be done from Phase II.

V. ALTERNATIVE FOR ENERGY CONSERVATION

Energy conservation refers to reducing energy consumption through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Even though energy conservation reduces energy services, it can result in increased environmental quality, national security, personal financial security and higher savings. It is at the top of the sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion. To gain insight into the practical application of utilizing BIM to implement energy saving practices into an existing renovation, an actual existing building was chosen to serve as a case study. A cursory review of possible energy analysis achieved was also performed to show connection between BIM technology and energy analysis. To reduce the energy Autodesk Revit Architecture software is use and changes are made in the plan and also to generate the energy analysis report. For this energy analysis report of existing building was carried out the after changes are made again energy analysis report is generate with new facilities.

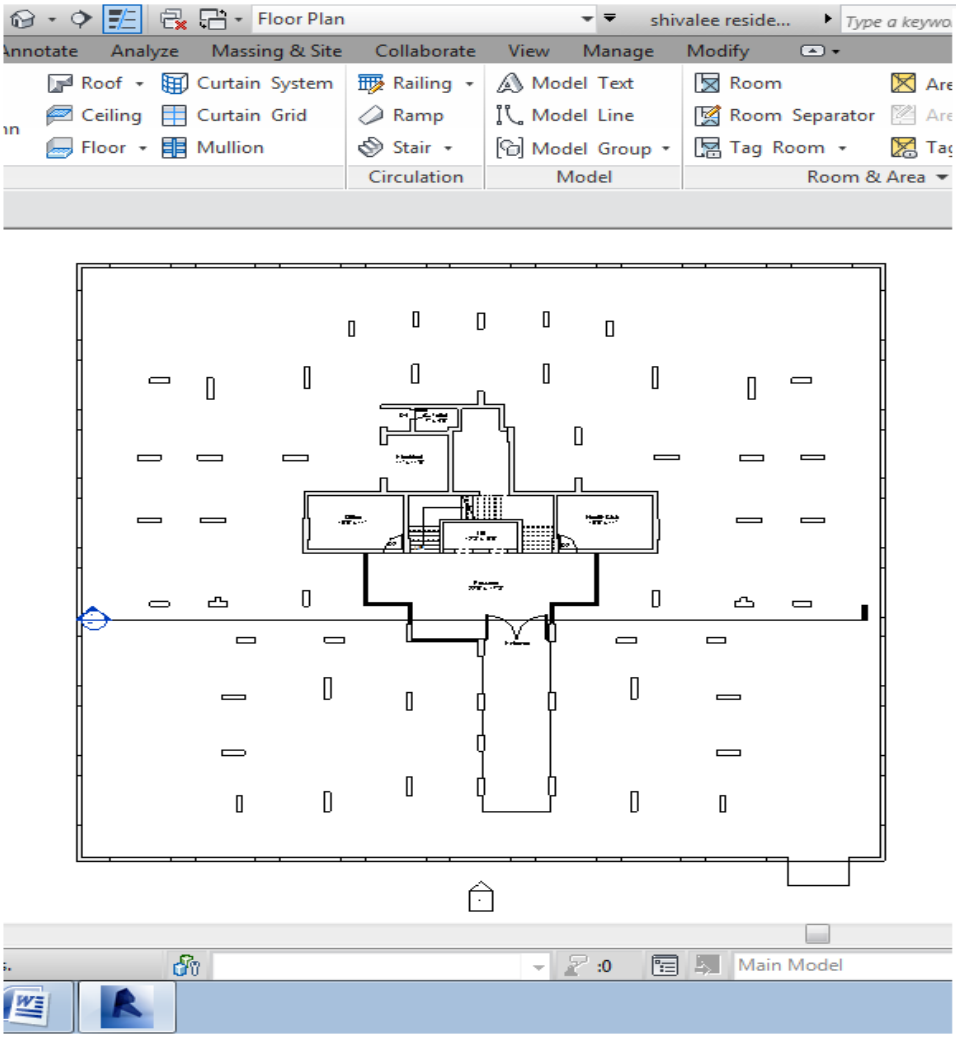


Fig. 1: Screenshot of Ground Floor Plan

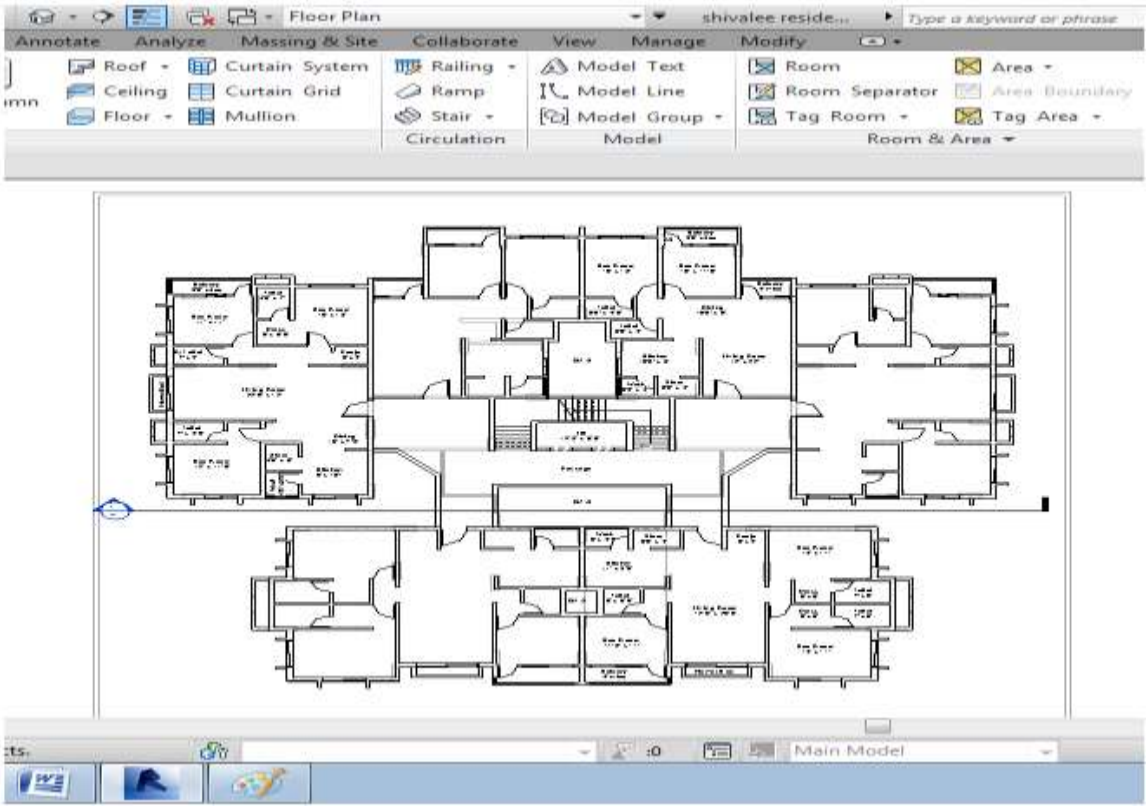


Fig. 2: Screenshot of Typical Floor Plan

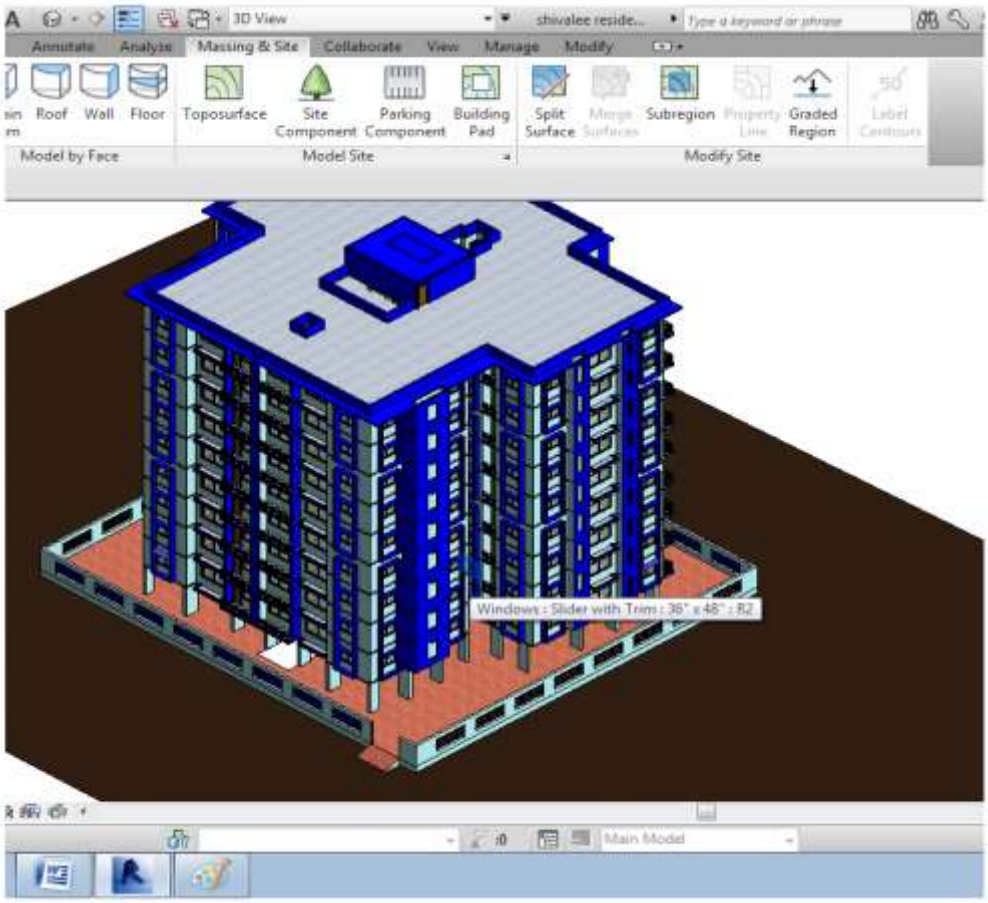
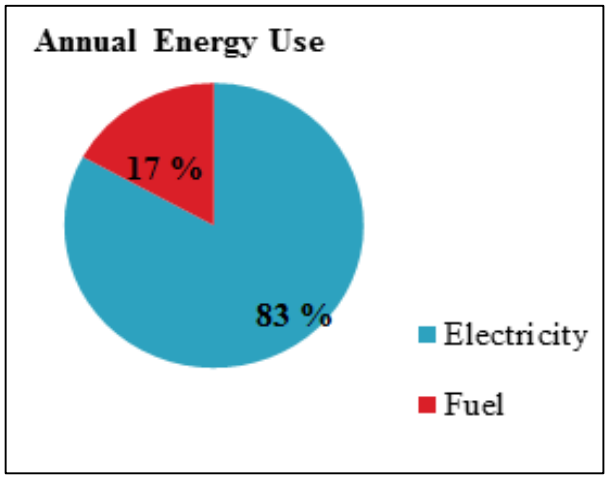
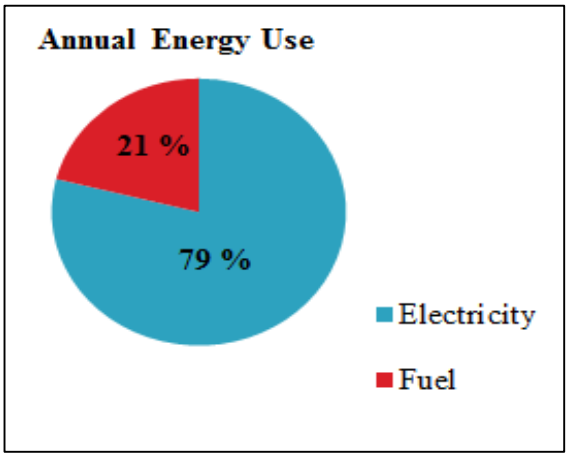
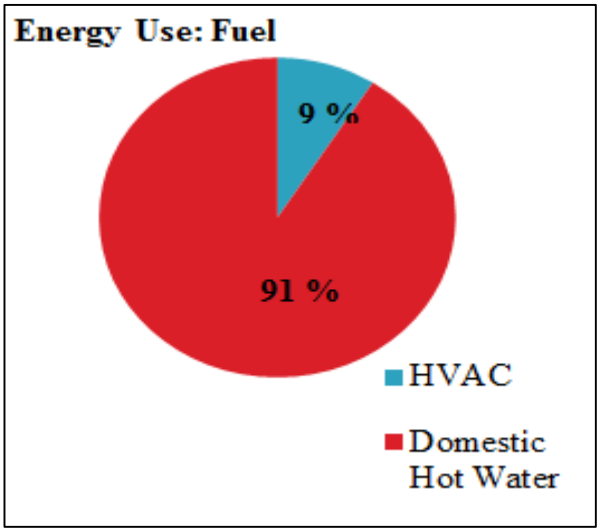
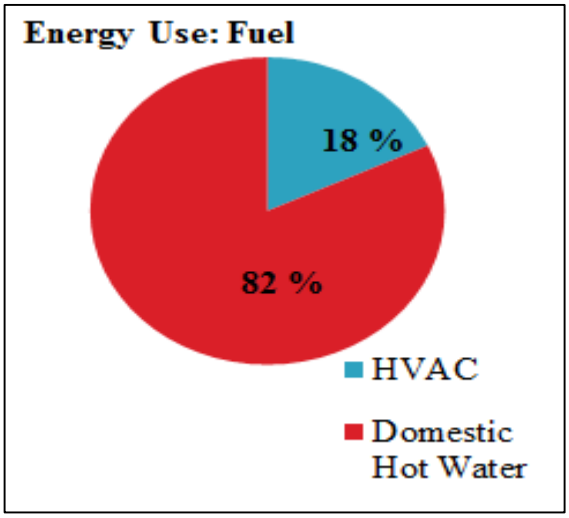


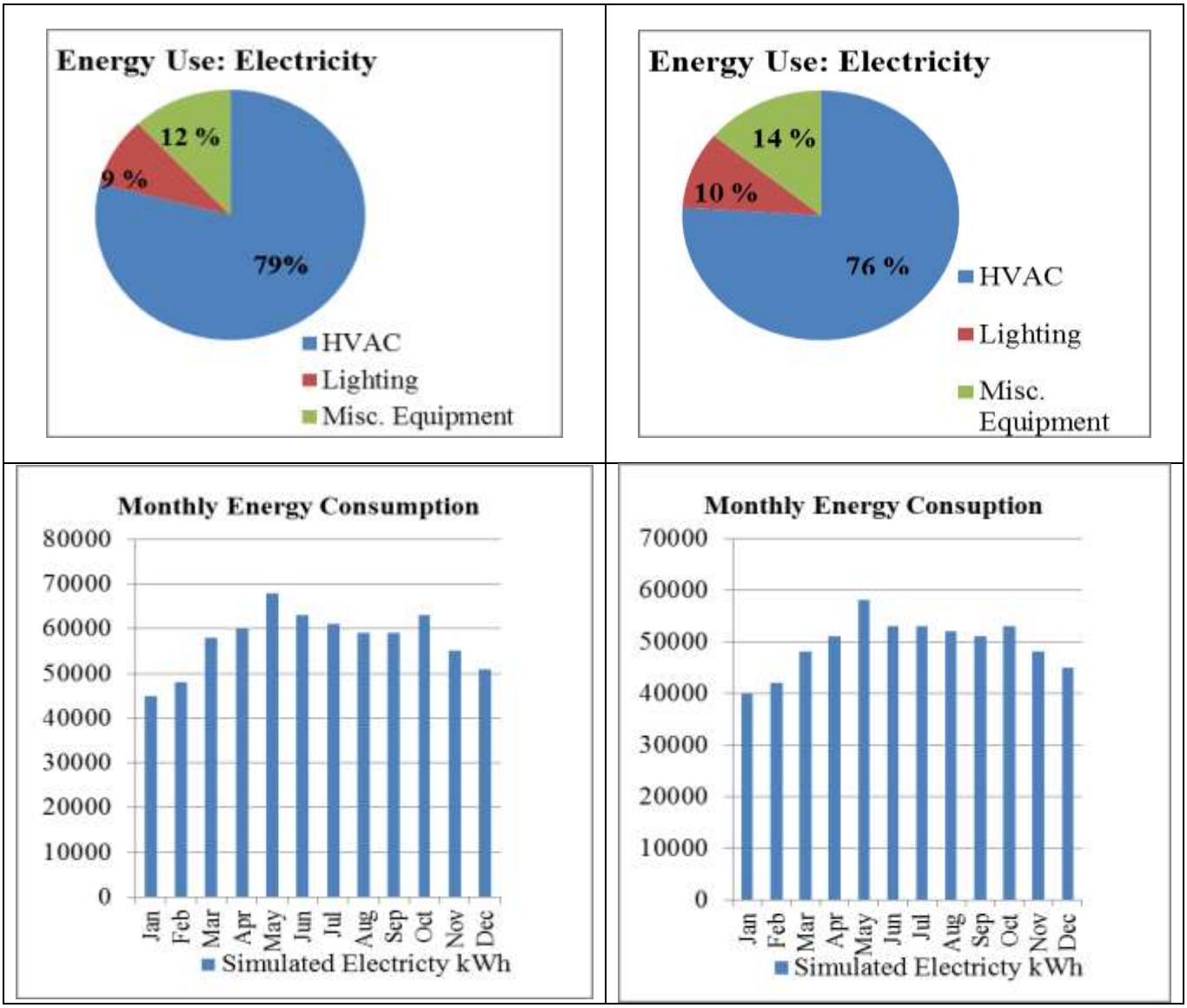
Fig. 3: Screenshot of 3D Elevation

Table – 1
Change in the facilities of the building.

	At present		*After Renovation*
	Door	*Window*	*Sliding Window*
For Flat 1 & 4			
Window in Living room	-	*2.28m x 1.22m*	*2.28 m x 2.10 m*
Window in Bedroom balcony	*0.76m x 2.10m*	*0.88m x 1.22m*	*3.05 m x 2.10 m*
Window in kitchen	*0.76m x 2.10m*	-	*1.22 m x 2.10 m*
For Flat 2 & 3			
Window in Dining	*0.76m x 2.10m*	*1.22m x 1.22m*	*1.83 m x 2.10 m*
Window in Bedroom balcony	*0.76m x 2.10m*	*1.52m x 1.22m*	*2.44 m x 2.10 m*
Window in kitchen	*0.76m x 2.10m*	-	*1.22 m x 2.10 m*
For Flat 5 & 6			
Window in Living room	-	*2.60m x 1.22m*	*2.59 m x 2.10 m*
Window in Bedroom balcony	*0.76m x 2.10m*	*2.13m x 1.22m*	*3.05 m x 2.10 m*
Window in kitchen	*0.76m x 2.10m*	-	*1.52 m x 2.10 m*

Table – 2
Difference between energy analyses report of existing and renovated facilities.

At present	*After renovation*
	
	



From this difference we can say that we have achieved reduction in the energy consumption of the building. We have reduced 14.03% of energy every year.

VI. CONCLUSION

The research findings contribute to the understanding of the current use of BIM in renovation construction practice and fill an existing gap in knowledge about the use of BIM for enhancing energy consumption. It presented a method to partly automate the procedures of implementing sustainable design for building projects at their renovation stage by integrating BIM and energy analysis. Development of an energy analysis system based on Autodesk Revit Architecture which makes use of the designed BIM model to automatically generate energy analysis report of structure. The use of these processes attributes will contribute to the reduction of existing building's energy and environmental footprint which, in turn, will ultimately lead towards a more sustainable future. Improving energy performance of our existing buildings is essential to a sustainable energy future and research is needed to make this happen. The energy consumption comparison has shown the following conclusions: 1) Dr. Fixit Heat-Shield as an insulation material for all walls was found as being the best alternative for the energy models. 2) Enlarging the windows and using Low-E glass decreases R-value and increases consumed energy.

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REFERENCES

[1] Anderson M. Lewis, Rodolfo Valdes-Vasquez, Caroline Clevenger, Tripp Shealy "BIM Energy Modeling: Case Study of a Teaching Module for Sustainable Design and Construction Courses" DOI: 10.1061/ (ASCE) EI.1943-5541.0000230. Case Study, 2014 American Society of Civil Engineers
[2] Andrew Fernans Tom, Sachin Paul "Project Monitoring and Control using Primavera" International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 3, March 2013
[3] Byungjoo Choi, Hyun-Soo Lee, Aff.M.ASCE, Moonseo Park, Yong K. Cho and Hyunsoo Kim "Framework for Work-Space Planning Using Four-Dimensional BIM in Construction Projects" J. Constr. Eng. Manage. 2014.140.
[4] Corey Cattano, Rodolfo Valdes-Vasquez, and Leidy Klotz "Barriers to the Delivery of Building Renovations for Improved Energy Performance: A Literature Review and Case Study" ASCE 2012.
[5] Darius Migilinskas, Vladimir Popov, Virgaudas Juocevicius, Leonas Ustinovichius "The Benefits, Obstacles and Problems of Practical Bim Implementation" 2013 The Authors. Published by Elsevier Ltd.
[6] Derrick Roorda, Mei Kuen Liu "Implementation of Building Information Modeling (BIM) on the Renovation of the Art Gallery of Alberta in Edmonton, Alberta" 18th Analysis and Computation Specialty Conference, 2008 ASCE.
[7] Douglas M. Brito and Emerson A. M. Ferreira "Strategies for representation and analyses of 4D modeling applied to construction project management" 2015 The Authors. Published by Elsevier B.V.
[8] Farzad Jalaei and Ahmad Jrade "Integrating BIM with Green Building Certification System, Energy Analysis and Cost Estimating Tools to Conceptually Design Sustainable Buildings" Construction Research Congress 2014 ©ASCE 2014.
[9] Ibrahim Motawa and Kate Carter "Sustainable BIM-based Evaluation of Buildings" 2013 The Authors. Published by Elsevier Ltd.
[10] Mohammad Kasirossafar, Abdollah Ardeshir and Reza Latifi Shahandashti "Developing the Sustainable Design with PtD Using 3D/4D BIM Tools" World Environmental and Water Resources Congress 2012: Crossing Boundaries ASCE 2012
[11] Patrick Bynum, Raja R. A. Issa, and Svetlana Olbina "Building Information Modeling in Support of Sustainable Design and Construction" Journal of Construction Engineering and Management ASCE / January 2013
[12] R. Hammond, N. O. Nawari, and B. Walters "BIM in Sustainable Design: Strategies for Retrofitting/Renovation" Computing In Civil and Building Engineering ASCE 2014
[13] Yong K. Cho, Sultan Alaskar, and Thaddaeus A. Bode "BIM-Integrated Sustainable Material and Renewable Energy" Construction Research Congress 2010