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Comparison of solar energy analysis and thermal comfort of ordinary and green buildings using LEED evaluation system (Case study: a 14-storey building in the north of Tehran)

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Introduction

The construction industry is one of the main components of the economy of any society around the world, but it has significant and negligible effects on the environment, the economy, and society. The construction industry is one of the largest consumers of energy, raw materials, and water; It is also one of the most polluting industries.

During construction, the construction industry uses billions of raw materials, or about 40% of the world's raw materials such as stone, pebbles, sand, and 25% of the world's raw wood, each year. It is worth noting that this industry accounts for about 40% of energy consumption and 16% of world water consumption. Statistics and current trends show that carbon dioxide emissions from buildings 2035 will reach 42.4 million tons worldwide 2035. Today, the construction industry and construction, in general, are looking to adopt green building strategies and policies to alleviate some of the sustainable concerns such as carbon dioxide emissions and fossil fuel-based energies that cause global warming.

Green buildings are constructed using building information modeling (BIM) technology. The LEED rating system is one of the rating systems in the United States that has been used to score construction projects in this study. In this study, two ordinary and green residential construction projects located in the north of Tehran have been studied using the LEED evaluation and scoring system. It is worth mentioning that in this research, thermal comfort and energy analysis of the two types of buildings have been studied and compared, and finally, they have been scored using the LEED scoring system.

The purpose of this study is to help decision-makers in the concept stage of the project to obtain the necessary information about the degree of sustainability of the building to be implemented so that they can make the right decisions, better choices, and alternatives to achieve a sustainable design.

Methodology

How to work in this study is that the project is designed in a BIM environment in Revit software that all the required data was entered as input to the software and applied to the project. Then, using the Insight 360 plugin, which is the energy analysis engine of Revit software, energy analysis was performed on both models and the analysis results

were extracted. A database of elements, components, and materials used within Revit BIM was created.

Two types of buildings have been used in the period of operation of the life cycle of a building by the BIM method. Also, through its integration with a sustainable design, the possibility of energy analysis and sustainability during the operation of the life cycle of buildings are examined and evaluated. Two models are proposed, one based on the design process of green buildings and the other model that lacks green elements in terms of studying ecological and environmental impacts through the analysis of sustainability components, and potential valid points are listed.

This research focuses on the conceptual design phase of the project. With the help of BIM technology, two types of buildings in the northern part of Tehran, one of which is a building compatible with an environment-friendly with the characteristics and criteria of a green (sustainable) building and the other building without sustainable design as a new architectural structure. Both structures are designed and implemented in a specific geographical climate and the same climatic conditions and are in the operation stage. They are compared, analyzed, and finally, the evaluation of the two models is done through the LEED evaluation system.

In this study, BIM technology, energy analysis software, and LEED evaluation system were combined in the conceptual design phase to determine how successful the construction project under design can be in achieving sustainable architecture and green building and the benefits that can be gained from the system. How much is the LEED rating and how much credit can it get from the LEED.

Results and Discussion

Using a combined model obtained from LEED and BIM, the designed project was evaluated. This model is such that according to the latest version of the LEED system, in the Excel software environment, LEED headings and items that are included in each chapter along with the number of points that can be obtained from each section or what sections are required to be implemented as Tables were prepared. Scoring was done manually and according to the booklet, the instructions of each section of the topics, if provided in the designed project, gained its own score. By entering the score of each section, the total score was obtained and it was determined what credit both types of buildings gained from the LEED evaluation system.

One of the most practical indicators for examining air temperature conditions in terms of comfort is the Oleg bioclimatic table. In Oleg, the temperature range is between 21 and 28 degrees Celsius. The output results of the native Tcic software were used to analyze the bioclimatic diagram of Oleg using 5-year statistical data. The results obtained from the Oleg chart showed that the residents of both buildings are in their comfort zone in summer in July, August, September at night, and October during the day. In other words, residents feel comfortable in the shade when the airspeed is imperceptible, i.e., less than one meter per second. About the green building under study, by creating a canopy and console in the southern part of the building and creating a green space on the balcony of the floors in the northern part of the building, air cooling has been done naturally, but in a normal building due to urban planning criteria for a passage width of

fewer than 12 meters The balcony was not possible.

In a comparative analysis of the energy of the two types of buildings, it was observed that the parts of the facade that move towards the green color are the parts that receive more light and, consequently, receive more energy.

Conclusion

Evaluating and analyzing the results of Olgi and energy diagrams in both buildings, it was shown that in the green building, by creating depressions in the perimeter of the building and designing the canopies, it was determined that in hot seasons, these surfaces refract from sunlight by breaking. Prevents maximum solar energy inside the building, which leads to energy savings by reducing the use of heating and cooling devices. In a typical building without a canopy on the facade of the building with high-temperature windows for the period of one year can be annoying for residents, so that for indoor air conditioning may need to use the high capacity of these refrigeration devices.

Finally, it was shown how credited each building was to the LEED system. According to the obtained results, during the optimal design process, it was observed that most of the points obtained from LEED are related to the energy and atmosphere sector. The total number of points obtained from the LEED system for the green building was a total of 42 points and for the normal building was 17 points, at the end of which the green building (Viva Yucc) was able to obtain the US Green Building certification.

Keyword: Green building, sustainable building, building information modeling, sustainable development, LEED system

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References

Persian Refrences:

- Abdi, K., & Daneshmand Shirazi, M. (2017). Impact of green buildings on the environment (in Persian). *Report of Fars Province Building Engineering Organization*.
- Abdolabbas, F. (2021). Analysis of indicators to achieve a sustainable city of Dezful with emphasis on reducing greenhouse gases (in Persian). Scientific Journal of Iranian Urbanism, 226–237.
- Ardestani, M., Khagani, & Shoaei. (2015). Green roof as a factor for sustainable development and reducing energy consumption in the building (in Persian). International Congress on Sustainability in Contemporary Architecture and Urban Planning in the Middle East. https://civilica.com/doc/505621.
- Khorrami, M., Moaveni, S., & Mashkooh Razavi, H. (2012). The necessity of implementing a green building in Iran and comparing it with ordinary buildings today (in Persian). *National Conference on Iranian-Islamic Architecture and Urban Planning*. https://civilica.com/doc/202040.

Latin Refrences:

- Abergel, T., Dulac, J., Hamilton, I., Jordan, M., & Pradeep, A. (2019). Global status report for buildings and construction—towards a zero-emissions, efficient and resilient

buildings and construction sector. *International Energy Agency, Global Alliance for Buildings and Construction, UN Environment Programme*.

- Becerik-Gerber, B., & Rice, S. (2010). The perceived value of building information modeling in the US building industry. *Journal of Information Technology in Construction (ITcon), 15*(15), 185–201.
- Castro-Lacouture, D., Sefair, J. A., Flórez, L., & Medaglia, A. L. (2009). Optimization model for the selection of materials using a LEED-based green building rating system in Colombia. *Building and Environment*, *44*(6), 1162–1170. https://doi.org/https://doi.org/10.1016/j.buildenv.2008.08.009
- Chel, A., & Kaushik, G. (2018). Renewable energy technologies for sustainable development of energy efficient building. *Alexandria Engineering Journal*, *57*(2), 655–669. https://doi.org/https://doi.org/10.1016/j.aej.2017.02.027
- Construction, M.-H. (2013). World green building trends: Business benefits driving new and retrofit market opportunities in over 60 countries. *Bedford Massachusetts: Smart Market Report*.
- Eastman, C. M., Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*. John Wiley & Sons.
- Hui, I. D. S. C. M. (2019). New opportunities of using building information modelling (BIM) for green buildings. *The 15th Asia Pacific Conference on the Built Environment: 5R Technology for Building Environment*, 18–19.
- Krygiel, E., & Nies, B. (2008). *Green BIM: successful sustainable design with building information modeling*. John Wiley & Sons.
- Kulp, S. A., & Strauss, B. H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, *10*(1), 4844. https://doi.org/10.1038/s41467-019-12808-z
- Li, X., Xu, J., & Zhang, Q. (2017). Research on Construction Schedule Management Based on BIM Technology. *Procedia Engineering*, *174*, 657–667. https://doi.org/https://doi.org/10.1016/j.proeng.2017.01.214
- Liao, L., Teo, E. A. L., & Chang, R. (2019). Reducing Critical Hindrances to Building Information Modeling Implementation: The Case of the Singapore Construction Industry. *Applied Sciences*, *9*(18). https://doi.org/10.3390/app9183833
- Moakher, P. E., & Pimplikar, S. S. (2012). *Building information modeling (BIM) and sustainability–using design technology in energy efficient modeling*.
- Motawa, I., & Carter, K. (2013). Sustainable BIM-based Evaluation of Buildings. *Procedia - Social and Behavioral Sciences*, *74*, 419–428. https://doi.org/https://doi.org/10.1016/j.sbspro.2013.03.015
- Oyedepo, S. O., Anifowose, E. G., Obembe, E. O., & Khanmohamadi, S. (2021). 6 - Energy-saving strategies on university campus buildings: Covenant University as case study. In D. Borge-Diez & E. Rosales-Asensio (Eds.), *Energy Services Fundamentals and Financing* (pp. 131–154). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-820592-1.00006-3
- Ozturk, G. B. (2020). Interoperability in building information modeling for AECO/FM industry. *Automation in Construction*, *113*, 103122. https://doi.org/https://doi.org/10.1016/j.autcon.2020.103122
- Roodman, D. M., Lenssen, N. K., & Peterson, J. A. (1995). *A building revolution: how ecology and health concerns are transforming construction*. Worldwatch Institute

Washington, DC.

- Schlueter, A., & Thesseling, F. (2009). Building information model based energy/exergy performance assessment in early design stages. *Automation in Construction*, *18*(2), 153–163. https://doi.org/https://doi.org/10.1016/j.autcon.2008.07.003
- Solla, M., Ismail, L. H., & Yunus, R. (2016). Investigation on the potential of integrating BIM into green building assessment tools. *ARPN Journal of Engineering and Applied Sciences*, *11*(4), 2412–2418.
- United Nations. (2019). *The Sustainable Development Goals Report 2019*. UN. https://doi.org/10.18356/55eb9109-en
- Welle, B., Haymaker, J., & Rogers, Z. (2011). ThermalOpt: A methodology for BIM-based passive thermal multidisciplinary design optimization. *Center for Integrated Facility Engineering Technical Report*, *200*.
- Wong, K., & Fan, Q. (2013). Building information modelling (BIM) for sustainable building design. *Facilities*, *31*(3/4), 138–157. https://doi.org/10.1108/02632771311299412

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