The Analysis of Green Building System Based on BIM

LIAO Ji-xiang1*, JIANG Tang-ming1 and LIU Xing-ye2
1College of Engineering, Harbin University, Harbin 150086, China;
2College of Architectural engineering institute, University of Science & Technology of Heilongjiang, Harbin 150022, China;
59057071@qq.com

Abstract. The construction industry plays a decisive role in promoting social progress. With the rapid development of social economy, the construction industry is rising rapidly. The introduction of BIM technology into China, helps to reduce the consumption of building energy resource and advance building energy conservation. The comprehensive evaluation and analysis of building energy consumption is carried out through BIM technology. Revit software is used to simulate building construction and improve construction management. Quality and safety are the priority in the process of engineering construction projects while maintaining environment-friendly and sustainable development is next to this. This paper analyzes the BIM technology usage about Green Building in a systemic way, such as visual BIM model, design error correction, pipeline synthesis, construction coordination, virtual reality and operation management. BIM provides analysis and management for the sustainable development of green buildings, and has great potential in promoting the development and innovation of green buildings.

1. Introduction
With the social development in China has entered in a new stage, the construction industry is developing rapidly. The previous architectural design concepts and traditional construction drawing technology have been neither able to keep up with the current development trend nor meet the requirements of building energy conservation and environmental protection. However, BIM technology, with its advantage of environment friendliness and energy conservation, these issues that mentioned above can be resolved efficiently [1]. Building Information Modeling (BIM) technology can be applied in every link of architectural design, due to this, the optimization and sharing of green building information will be realized which also facilitate the effective communication and cooperation between designers.

BIM is a new term in the field of architecture in recent years. Actually, it is a kind of new technology that leads construction industry information technology to higher level, its comprehensive application. It will have immeasurable influence on the scientific and technological progress of the construction industry and greatly improve the integration degree of the construction project [2]. At the same time, it also brings huge benefits for the development of the construction industry, so that the quality and efficiency of the design and even the whole project can be significantly improved and the cost can be reduced. Building information model, based on 3d digital technology, integrates the engineering data model of various related information of the construction project, and is the detailed expression of the related information of the project [3]. Building information model is a direct application of digital technology in building engineering to solve the description problem of building...
engineering in software. Enables designers and engineers to respond correctly to various building information and provides a solid foundation for collaborative work. As shown in Figure 1, the building is drawn with Revit.

![Building drawn by Revit](image)

**Figure 1.** A building drawn by Revit

2. The significant application of BIM technology in green building

With the purpose of sustainable development, green building is able to make the resources with the optimally utilized, through plan designing and project construction so as to reduce environmental pollution. Green building can provide people with a comfortable and healthy living environment, make space more efficient and convenient, promote the harmonious development among man, nature and architecture.

2.1. Construction and budget of the green building

Green building is a systematic project with multiple manpower, multiple tasks and multiple financial resources. In the pre-construction preparation stage, a lot of manpower and financial resources can be consumed. During the construction process, unexpected situations can be encountered easily, which includes insufficient material budget, design drawings need to be modified. This will result in huge construction costs, protracted construction period. As a result, the sustainable development of green buildings will be impeded [4]. However, through BIM technology, these shortcomings can be greatly optimized, so that engineering changes can be realized in the initial stage of design. The save of project budget, the improvement of engineering programs feasibility, the reduce of construction conflicts and the controlled construction costs, all of these make the post-construction more convenient to manage and result in a maximized benefit.

2.2. The analysis of sound insulation control about indoor environment

In green building, BIM can be used to establish a 3D visual information model, in which all the information in construction can be realized. Specific to Windows, beams and columns, including the disassemble and installation of each floor slab. The indoor noise level of the room can be calculated by using the constructed BIM model statistics and the inner operation which can be used to determine the sound insulation performance of the main construction. By comparing with corresponding maximum and minimum requirement limits in the national standard "Civil Building Sound Insulation Design Specification", it is possible to determine whether there is noise interference in the room and adopt the corresponding solutions to meet the corresponding requirements and specifications.

2.3. In thermal performance of enclosure structure

In the pre-modeling design, 2D and 3D model can be built simultaneously in BIM. In building the model, the material thermal performance parameters of the exterior guard structure of the model can be given. These include the materials and insulation materials of roofing, walls and doors and
windows. Using the corresponding calculation function in BIM software, the output of the thermal engineering parameter value of the enclosure structure is compared with the national-related building energy-saving standard, so as to determine whether the thermal performance of the surrounding structure and the heating and air conditioning load of the designed building meet the energy-saving requirements. High thermal performance parameters of materials or good scheme design can help the thermal performance index of the surrounding structure and the annual calculation load of heating and air conditioning to achieve 10% better than the current national standard of energy conservation for buildings, so as to further achieve the relevant standards of green design evaluation in the “Green Building Evaluation Standard”.

2.4. Water conservation and utilization of water resources
Only by improving the utilization rate of water resources can sustainable development be achieved. The BIM technology can be applied to the green architectural design, according to the “three-dimensional information model” Combined with the calculation formula of local rainstorm intensity and the intensity coefficient of local rainstorms, a relatively complete large database can be constructed. This model can also be used as an important proof of rainwater harvesting and calculation, according to different materials and different landscapes in the way of rainwater harvesting, the impact of runoff coefficient can be further confirmed and according to the area of green space, building and road, the collection of rainfall can be calculated while optimizing and adjusting the design plan in a timely manner [5].

BIM plays an important role in the construction budget of the building, the acoustic insulation control of the indoor environment, and the heat common energy of the envelope. Design out of the drawings can reflect the corresponding national standards. Figure 2 shows the application flow chart based on BIM green standard.

2.5. Virtual reality
BIM Technology can use screen to let engineering and technical personnel carry out virtual roaming, virtual design, simulation duration, process animation, virtual sales and other activities in the three-dimensional building space on the BIM platform. It combines the essence of the current architectural field and releases and shares it based on a shared platform.

2.6. Operation management
A large number of equipment and facilities information can be added to the components of BIM model, such as equipment model, equipment quantity, maintenance plan, warranty period, cost data, maintenance record, manufacturer information and equipment function, etc. Through updating the model and model information, the operator can accurately grasp the spatial location of the asset equipment, and based on the evaluation and analysis of the maintenance cost, give different maintenance schemes, so as to improve the efficiency of equipment maintenance, optimize the maintenance scheme, and reduce the overall maintenance cost.

2.7. Pipeline integration
By building BIM models of architecture, structure, mechatronics and other disciplines, designers can avoid collision conflicts among disciplines in the virtual three-dimensional environment, thus greatly improving the comprehensive design ability and work efficiency of pipelines. Find the most reasonable layout plan of the pipeline in the narrow space, try to improve the clearance height, and enable the owner to understand the design intention intuitively, so that the design can truly meet the needs of the owner, and facilitate the future operation and management.
3. Efficient integration and application of BIM and green building

3.1. The Creation of green building 3D model based on BIM
By applying BIM, green building engineering can be modeled and 3D model of green building engineering can be constantly improved, so as to guarantee the integrity of construction engineering and provide scientific guidance for actual construction operations. Three-dimensional information model is built according to the basis of the known two-dimensional model and the actual needs of the green building. For some complex and unclear division of labor projects, the axis of the 2D model can be directly transferred for 3D visualization, thus improving the integrity and accuracy of 3D modeling.

3.2. Optimization of green building performance based on BIM differentiation
At the beginning of green architectural design, an effective budget should be made for the sustainable development of the construction environment and energy. In the case of some complex model calculation and analysis, the use of traditional modeling and parameter settings will lead to a lot of errors. However, the emergence of BIM effectively solves this problem. Based on the information model established by BIM, the environmental and energy parameters of green buildings are calculated and analyzed accurately [6]. The construction situation can be simulated in advance, digital information can be provided for the problems encountered at the meeting, and solutions can be proposed in advance, so as to improve the rationality and integrity of the green building design scheme.

3.3. Risk control on construction site based on BIM
In the construction process of green building, it is very easy to appear some uncontrollable factors. In the past, the traditional practice is to find problems during the construction process and then put forward a rectification plan, but this will lead to one link changes, the other links change as well. If effective measures are not taken in a timely manner, it will bring great risks to construction.

However, the emergence of BIM has improved this disadvantage. By using BIM technology, problems in the early stages of construction can be identified and they can be resolved in an earlier...
time. BIM is the whole of building a green building model, no matter which link changes, the system will automatically recalculate and simulate other information, as shown in Figure 3, which greatly reduces the construction personnel to rebuild the model steps, so that the enterprise's profit spree is maximized.

![Figure 3. Risk control flow chart based on BIM](image)

4. Conclusion
In general, BIM technology has many advantages as it helps to better economize on energy, raw materials and water. It is one of the main directions of green building design in the future. It can effectively reduce energy consumption and environmental pollution for the construction industry, which has a profound impact and significance on the health and long-term development of the construction industry. As a result, relevant personnel should devote themselves to the in-depth study of BIM technology.

Funding
This project is supported by the research initiation fund for young doctors of Harbin University (HUDF2016208)

References
[1] David Bryde, Martí Broquetas and Jürgen Marc Volm. 2013 Intern. J.Proj. Manage. 31 971-980
[2] Volk R, Stengel J and Schultmann F 2014 Building Information Modeling (BIM) for existing buildings—Literature review and future needs Automation in construction 38 109-127
[3] Jung Y and Joo M 2011 Building information modelling (BIM) framework for practical implementation Automation in construction 20 126-133
[4] Abanda F H and Byers L 2016 An investigation of the impact of building orientation on energy consumption in a domestic building using emerging BIM (Building Information Modelling) Energy 97 517-527
[5] Azhar S 2011 Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry Leadership and management in engineering 11 241-252
[6] Woo J H 2006 BIM (building information modeling) and pedagogical challenges In Proceedings of the 43rd ASC national annual conference 12-14