

# The Application of BIM Technology in Architectural Lighting Design

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**Abstract:** With the continuous development of science technology, Building Information Modeling (BIM) technology has slowly garnered wider attention from designers and architecture professionals. BIM, the 3D model-based process that allows for efficient planning, designing, constructing and managing buildings and infrastructure, could potentially revolutionize the building architectural discipline. This paper analyses the significance of the application of BIM technology in architectural lighting design, as well as the application points and the trends.

**Keywords:** *BIM technology; architectural lighting design; point; trend*

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## 0 Introduction

The lack of resources, sustainability goals and global trends encourage architects and designers to incorporate resource management values into their discipline. Over the past few years, the Building Information Modeling (BIM) technology has sparked increasing attention from designers and architectural professionals due to its many benefits and resource savings capabilities. BIM refers to the modelling of building information using digital technology, which can effectively integrate geometric, physical and function information in a construction project, effectively completing both visual information management and simulation analysis. Development of 3D modeling began in the 1970s, pioneered by the

early computer-aided design (CAD) systems in some industries. While other industries slowly developed their own 3D modeling software that catered specifically to their industry, the construction sector was confined to the conventional 2D design.

In the early 2000s, BIM modeling was introduced to support building design for architects and engineers. Subsequent improvements were made and more features were added to the BIM software in the following years, and soon BIM has become one of the most ubiquitous tools in construction industry. BIM can also be an effective professional multi-disciplinary collaborative design tool for generating architectural designs. The tool also contains editing and medication functions that support data of maintenance and deconstruction processes.

## 1 Significance of application of BIM technology in architectural lighting design

The application of BIM technology in architectural lighting design could enhance the operational stability of the work, while also increasing the value of design content and quality. BIM technology can efficiently construct a complete building model and enable modifications to be made in any form, angle, structure or mode. The editing process can be projected instantly into the design thus providing a time-efficient tool for designers and architects<sup>[1]</sup>. Secondly, users could also improve the report list of a project by running a comprehensive evaluation of new designs in combination with previous designs, ensure that the measurement and statistics can be completed based on the information stored in CAD file, and store

the grid information in an Excel spreadsheet table. Lastly, BIM also enables effective implementation of integrated design structure. This way, BIM technology can help users to effectively link various phases of the construction project, thus fundamentally consolidate the operational process of the model design [2]. See table 1 for the traditional rendering making methods:

**Table 1 Traditional rendering methodology**

	Software	Output	Disadvantages
1	3D modeling software	3DMAX model	Illumination calculation software fails to apply appropriate illumination parameter after modeling.
2	Photoshop	Improved day-view renderings	Photoshop color selection

3DMAX design is a project of Autodesk that is used mostly for animation and rendering. Photoshop, on the other hand, is commonly used for photo editing and colour modification purposes. However, most conventional software could not integrate material information automatically, which presents a major drawback for creating radiance input file. Compared to conventional software, BIM technology can simulate high quality illumination through the integration of straight calculation of lighting, surface material of the building, and other lighting parameters. A user can radically enhance the physical calculation of the parameters by simply following the illumination specification, glare requirement and other criteria in the design.

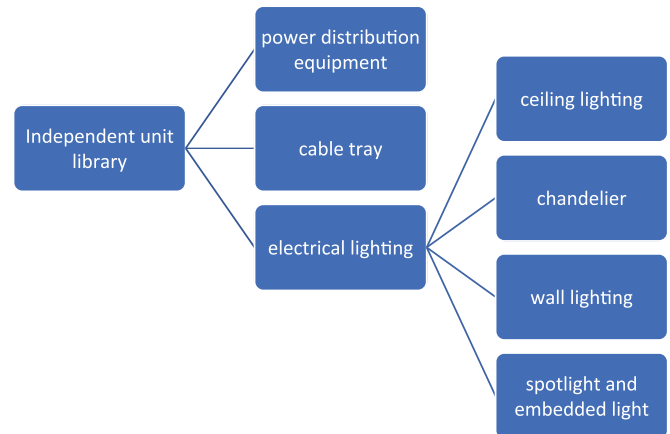
## 2 The application of BIM technology in lighting design

In designing lighting features for an architecture, it is imperative to consider the interaction between different lighting parameters in the design: radiance, surface material, position of windows, reflectance of radiance materials, specularly and roughness values, and geometrical information. This way, BIM could process the information to provide quality output to help designers determine the most efficient and appropriate type of lighting for a specific corner or location in a building design.

### 2.1 Template creation

When applying BIM technology in lighting design, it is imperative to integrate the rigorous analysis and output from the software with construction professionals to ensure quality outcome [3]. It may be helpful to establish a standard operating procedure on the file management processes, particularly on the naming

scheme, to provide accountability and references for future work. A rigorous file management process could help professionals to better understand the scope of the entire project and allows for efficient referencing [4]. A simple grouping scheme is shown in Figure 1.



**Figure 1 A simple grouping scheme can ensure efficient file management and referencing**

### 2.2 Template design

One of the most commonly used design template is the AGi32. It is an energy-analysis program native to the BIM tool that provides 3-dimensional lighting design and rendering capabilities. One of the advantages of the AGi32 is its ability to effectively handle 2D graphic format interface for integration into the template. The AGi32 tool can help designers to include the calculation of energy reflected by walls, door-windows structure to produce reliable results for indoor and outdoor lighting designs [5].

### 2.3 Simulation analysis

The advancement in building architectural landscape has produced multi-faceted designs today, including many 3-dimensional designs. In order to properly illuminate these edifices, it is useful to incorporate the BIM technology into the design work. To accomplish this, designers import relevant structural or building information into the Ecotect software. The software will do a systematic analysis on the design to provide a brief outlook on the design structure and lighting effects [6]. This is important to help designers to edit and modify their designs if necessary.

It should be noted that in simulating lighting under natural condition, designers will have to adjust the corresponding points in the natural daylighting model and determine the various lighting parameters. For instance, the adjustment angle of the blinds and windows could be a critical link that could help

increase or reduce the actual light intensity factors in the building. Other factors such as comprehensive analysis of brightness, illuminance uniformity and glare values should also be considered especially for artificial lighting purposes. The visualization tool in the BIM system can help designers to accomplish this.

## 2.4 Green lighting system

The recent trend in lighting design in building follows the green revolution—a movement to reduce the energy consumption of artificial lightings in buildings and homes. Designers and architects can accomplish green lighting design by exploiting the features of BIM technology in their work [7]. The DIALux 4.10, a software developed by DIAL, is another tool that can help with planning, calculation and visualisation of indoor and outdoor lighting. The software is also compatible with the BIM technology.

## 3 The trend of the application of BIM technology in architectural lighting design

Despite the advantages of BIM technology, there exists disadvantages in the tool that could be further enhanced.

Table 2 lists some of the issues with BIM technology

	Issue	Solution
1	High hardware requirement. For CAD users, the difference between Revit software speed and painting can be significant	Popularize Revit, improve the technical aspect of the software and management.
2	Scattering data, limited user from electrical and electronic professional background	Improve the design and processing of parent library, conduct the analysis using the IES light distribution curve file.

By comparing the advantages and disadvantages of BIM technology, it is obvious that the future of BIM technology is aimed at further improving and perfecting the tool to better enable architectural professionals in their daily work [8].

BIM is modelled to fulfil required functionalities in a design. If building information is insufficient for a certain feature, data capture or survey techniques are applied. There are currently more than nine distinctive techniques that can be used for data capturing in BIM, which can be classified into two broad terms under non-contact techniques and contact techniques. Each of these techniques, however, contain certain drawbacks that could potentially compromise the overall quality of the output. Designers and researchers often combine some techniques and try to overcome the disadvantages of individual technique.

Besides, the Revit software function should be enhanced and new tools should be incorporated into the software bundle to ensure smooth software processing and compatibility with third-party applications. This can fundamentally improve the practical value of the application and the overall quality of the design work.

In addition, it is also recommended to improve the interface processing optimization of the BIM system to become compatible with other building analysis software like CAD system software. This can further strengthen the advantage possessed by the BIM software while providing a more complete platform of operation for users [9].

As for the lighting features in BIM technology, it is important to integrate the management and control specifications of the lighting design pattern. This allows for a complete BIM information processing flow and follow-up supervision mode.

## 4 Summary

In summary, the application of BIM technology in the field of architectural lighting design can effectively increase the value of technical operation and maintenance structure, optimize the operation of lighting system design, and allows for creative and innovative lighting designs. The aim of the industry should therefore be pointing towards creating a reliable platform that consolidates technical foundation of architectural design to allow for the optimization of project creation, and thus promote a win-win situation between the society and personal financial gain.

## References

- [1] Yang Yanting. The application of BIM technology in the field of architectural lighting [J]. Construction Engineering Technology and Design, 2018 (6):337.
- [2] Dong Hui. Application of BIM Technology in Architectural Lighting [J]. China Standardization, 2017 (12): 112-113.
- [3] Yao Siyuan. Application of BIM Technology in Operation and Maintenance Management of Office Building Lighting System [J]. Files, 2016, 6 (12):563.
- [4] Wang Zhongcheng, Wang Lei, Zhang Qiao et al. Application of Electromechanical Integrated Pipeline Arrangement of Metro Station Based on BIM Technology [J]. Information Technology of Civil Engineering, 2016, 8 (3):66-73.
- [5] Feng Siyuan. Discussion on the Application of BIM in Energy Saving of Highway Tunnel Lighting [J]. Fujian Quality Management, 2018 (11): 118-119.
- [6] Zhang Yongxin, Zhang Fengwei. Application Standards

- and Prospects of BIM Technology in Electrical Design of Buildings [J]. China Standardization, 2017(14).
- [7] Li Wei. Application of Indoor BIM Lighting Technology in Office Space Based on Green Building [J]. Residential and Real Estate, 2017 (30): 95.
- [8] Wang Mudan, Zhu Yuyang, Wu Yuanmin. Design of Energy Consumption Analysis and Monitoring System for Public Buildings Based on BIM Technology [J]. Civil Engineering and Information Technology, 2017 (01): 79-84.
- [9] Zhao Xin. Research on Electromechanical Installation Calculation of Rail Transit Engineering Based on BIM [J]. Value Engineering, 2018, v.37; No.502.