UNDER THE BACKGROUND OF GREEN ARCHITECTURE, THE AESTHETIC ELEMENTS OF HENAN'S TRADITIONAL ANCIENT ARCHITECTURE AND MODERN ARCHITECTURE BASED ON BIM TECHNOLOGY

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ABSTRACT

With the introduction of the "double carbon" target in China, green building has gradually become a trend in the development of China's construction industry. The combination of traditional architecture and modern architecture based on the concept of green architecture has become a new pursuit for architects. Based on this, this study integrates the aesthetic elements of traditional ancient architecture in Henan with modern architecture in the context of green building design. This paper first introduces the basic theory of the green building evaluation system and compares and analyzes the green building evaluation system at home and abroad. Secondly, the feasibility of using BIM technology in green buildings is demonstrated in terms of usage cost, and the application of BIM technology in green building evaluation is introduced with the modernization design of an ancient building in Henan. Finally, we calculated and analyzed the key indicators of the energy performance of a building in Henan. According to the results, the studied case building has a 13% reduction in the system-integrated part-load performance coefficient and a 6.6% reduction in the integrated heat gain coefficient of the envelope structure.

KEYWORDS

Green building; evaluation system; BIM; traditional elements; modern architecture

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1. INTRODUCTION

China has a long history of architectural culture, and different local architectural forms have their characteristics and are integrated with local human characteristics. These buildings are the crystallization of the wisdom of ancient Chinese working people, with perfect structural forms, unique architectural styles, and ingenious and varied design techniques [1-3]. Modern architecture is widely used because of its social needs and represents the course of social development. Modern architecture needs the connotation and heritage of traditional architecture, and traditional architecture needs the comfort and practicality of modern architecture [4-6], which are complementary to each other. Therefore, it is very necessary to study how to combine the two together in a reasonable way. In addition, many traditional ancient architectural aesthetic elements can be applied in urban construction. We should combine the development needs of modern cities, and between traditional and modern architecture, we should find a common point between the two, and design architecture that is both new and historical [7-9].

In today's increasingly severe energy and environmental problems, the country insists on the concept of green development. The concept of "green development + ecological priority" has become a major direction to lead China's economic development, in which the concept of "green development" has become a fundamental guideline and direction [10-12]. As a pillar industry of the national economy, the construction industry has a huge negative impact on resources and the environment [13,14]. Therefore, it is very necessary to develop green buildings to provide healthy, comfortable, and efficient living space and living environment for human beings and to realize the harmonious coexistence between human beings and nature. It is also a fundamental way to effectively improve China's living environment, reduce building energy consumption, solve energy problems and achieve sustainable development of the construction industry [15-17]. Xu et al [18] detailed the design criteria for green buildings based on a parent-child theme park design case. They analyzed the design of this park from two major aspects: general layout planning and architectural design and discussed how the architectural design influenced the achievement of green building goals. The results show that following their design approach to architectural design can effectively reduce building energy consumption and achieve green goals. In addition, this case provides a reference for other projects. Umaroullar et al [19] conducted a comparative study of green building certification systems (GBCS) in developed and developing countries in the context of energy policy developments. They developed a matrix to numerically assess the GBCS of

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different countries. The results showed that the GBCS of different countries have similar characteristics to their regional development levels in terms of sustainable development. Anggraeni et al. [20] applied the green building concept to the design of a university laboratory complex, focusing on energy efficiency, water use, and air quality from the planning stage to the building maintenance stage. According to the results of the acceptance of the completed integrated laboratory, it can be found that this green building plan has high land utilization, energy efficiency and building environmental management level, thus saving some costs. Xing et al [21] concluded that vigorous development of the green building industry (GBI) is one of the effective ways to achieve a green economy and energy saving and emission reduction. Based on this, they analyzed the promotion strategy of China's green building industry from the perspective of social network theory by developing an evolutionary game model. Through this model, they examined the interactions between technology, knowledge sharing, and firm behavior in innovation networks and found that the cost of collaborative innovation is the key to determining the evolutionary steady state. In addition, government financial support as well as grants are crucial for the development of green building construction.

However, the Chinese construction industry has been slow to promote information technology, and the upgrading of the industrial structure has been severely constrained. Since the 1940s, most reports from government and professional organizations have shown that the construction industry is characterized by fragmentation, lack of efficient communication between the various parties involved, lack of formal protocols and structural confusion in the construction process. The emergence of BIM (Building Information Modeling) has broken the traditional management and technology model of the construction industry and enabled information sharing. The software can improve project refinement management and engineering efficiency, while enabling the unification of the client's interests and the design function of the building [22-24]. It plays a very important role in early investment control as well as in the operation, integration and control of the entire construction project, enabling the joint development of the corresponding engineering information management, time, quality and cost management, and improving the technical level of the building. Green building, as a more popular construction method nowadays, has the characteristics of large amount of information, extensive sources, scattered storage, complex types and high energy consumption control requirements. And BIM, as a data interaction platform that can efficiently transfer information and improve data management, digitizes the information of relevant attributes in all phases of the building. At the same time, this technology also guarantees the inherent unity of information in the planning and design, construction and operation phases of computable buildings, which provides new ideas and opportunities for the development of green buildings. management and green technology [25,26]. Specifically, it is a seamless integration of the spatial and temporal dimensions. In the temporal dimension, the collection, organization, summarization and analysis of green building design information can be realized through the parametric model of BIM. For example, coordinated design and data centralization on a single data platform, and

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integration of cross-discipline and cross-phase design and management information into the BIM model. This also provides a mobile, automated and intelligent data platform for later post-project evaluation and even operation evaluation. In the spatial dimension, the BIM model can realize data sharing through a variety of software, giving strong data support and guarantee for performance simulation and evaluation of green buildings [27,28].

In addition, the integration of traditional architectural elements with modern architecture is a new development mode in the architectural industry [29]. Where traditional architecture is concentrated, there exists a large amount of historical information, which is the materialization of people's aesthetics of an era, and the connotation of the architecture can be grasped to a certain extent by studying to understand the spiritual qualities of a place. The organic combination of traditional architectural design concepts and modern architectural design can be reflected as a combination of spiritual essence, a process of abandonment and absorption, and an experience of interaction between traditional culture and modern life. At the same time, the working methods and design ideas that combine tradition and modernity are more worth exploring, and we hope to make urban architectural design not only improve the living environment and economic growth, but more importantly, inheritance, coordination, and development of humanistic spirit and other aspects [30,31]. Jia et al [32] appreciated the architectural design of the Yucheng Museum. The traditional Chinese architectural culture applied in the design process was analyzed from various aspects of the building, such as the planar shape of the museum, the patterns of the doors and windows, the carved objects inside the house, the roof shape, and the color palette of the whole building. They found that the Yucheng Museum well integrated traditional architectural elements within the building and promoted the development and transmission of traditional Chinese architectural culture. Vijulie et al [33] found that the traditional Romanian architectural style is gradually disappearing and the development of architectural styles in European countries and modern society has caused a great impact on traditional Romanian architecture. By means of a field survey of local people's and tourists' views on these issues, they found that older people have more conservative views, while younger people generally prefer foreign modern architecture. In response to this the authors argue that it is necessary to preserve the traditional architecture of Romania, and at the same time to keep up with the times, combining some features of modern architecture with traditional architectural elements.

To sum up, the combination of tradition and modernity in architecture is an eternal proposition. Since the modernist architectural style of Europe and America was introduced to China, many architects have done a lot of research on the application of traditional architectural elements in modern architecture. And in order to conform to the main theme of today's social development, it is also very necessary to apply green architecture and information technology to this research. In this paper, in the context of green architecture, the aesthetic elements of traditional ancient architecture in Henan are designed to be integrated with modern architecture. At the same time, BIM technology is used to make scientific decisions and management of the whole process application of this design to achieve the optimization of the value of the BIM application. Finally, this study tries to build a bridge between traditional and contemporary architectural creation, so that it can get out of the shadow of global convergence and realize the inheritance and promotion of traditional architectural culture.

2. THE BASIC THEORY OF GREEN BUILDING EVALUATION SYSTEM

Since the establishment of a green building evaluation system involves a wide range of specialties and a wide range of disciplines, it requires the full cooperation of experts from various neighborhoods to complete this important and complex task. Therefore, a series of index systems and clear regulations are needed to guide the practice of green building and to certify the greenness of buildings. A set of scientific and perfect green building evaluation system can effectively regulate the green building market and promote the healthy development of the green building market. It also helps to guide and regulate the practice of green building, which can effectively save resources, improve economic efficiency and reduce energy consumption, etc.

2.1. EVALUATION SYSTEM

2.1.1. U.S. LEED EVALUATION SYSTEM

The U.S. Green Building Council (USGBC) has developed the U.S. Green Building Rating System, LEED, and is promoting the development and improvement of LEED through education, advocacy, research, networks, committees and academic programs, etc. LEED is currently the most influential and authoritative green building rating standard in the world. The evaluation system mainly assesses buildings in terms of water use, building energy efficiency and atmosphere, and indoor air quality. The biggest advantage is its open and transparent evaluation process, as well as its strong flexibility.

The LEED rating system has six major products: LEED-NC (LEED for New Construction), LEED-EB (LEED for Existing Building), LEED-CI (LEED for Commercial Interior), LEED-CS (LEED for Core & Shell), LEED-H (LEED for Home), and LEED-ND (LEED for Neighborhood Development). LEED-NC and LEED-EB improve the measures of sustainable development for office buildings, and LEED-CI and LEED-CS constitute a model for integrating the inside and outside of commercial development.

The main evaluation elements of the LEED evaluation system are: site selection, water use efficiency, energy use efficiency and atmospheric protection, effective use of materials and resources, and indoor environmental quality. The evaluation points are divided into: evaluation prerequisites, score points, and innovation points, and the specific certification levels are.

1. Certified level, meeting at least 40% of the assessment points.
2. Silver level, meeting at least 50% of the assessment points.
3. Gold level, meeting at least 60% of the assessment points.
4. Platinum grade, at least 80% of the assessment points are met.

2.1.2. BRITISH BREEAM EVALUATION SYSTEM

BREEAM is the world's most successful green building rating system, assessing single buildings, mixed-use buildings, etc. BREEAM guides the practice of green building, directs market demand, reduces the burden on the environment and ensures the health of users.

The BREEAM system takes the global, local, indoor environment and management as the starting point, and the evaluation results are divided into four levels: pass, good, excellent and outstanding. The BREEAM system introduces a new concept "eco-points", which is an important concept for understanding the BREEAM system; the eco-points score is based on The score is based on the extent to which a part or the whole of an individual unit affects the environment as a whole.

2.1.3. CANADIAN GBTOOL EVALUATION SYSTEM

In 1996, Canada launched the Green Building Challenge (GBC), with the participation of the UK, France, and the US. Through the efforts of many countries, a green building evaluation system, GBTooL, was finally developed to reasonably evaluate the environmental performance of buildings, and the GBC developed an evaluation system through research to adapt to the uniqueness of different countries and regions. Experts in each country can adjust the criteria and weighting system appropriately according to the specificity of the region, so that the GBTooL evaluation criteria can be applied to each region and become an international standard.

The GBTooL evaluation index system basically covers all aspects of environmental performance evaluation of green buildings. The GBTooL environmental performance evaluation framework is divided into four standard levels: environmental performance issues, classification, criteria and sub-criteria. The GBTooL evaluation system has three functions: simple assessment, detailed assessment, and design guidance [34]. The evaluation levels are set in seven scales from -2 to 5. A score of -2 indicates that the building's performance does not meet the requirements. a score of 0 indicates the minimum required building performance, as defined by local standards. A score of 1-4 indicates intermediate different levels of building performance. a score of 5 indicates the best building performance. The building performance is expressed in the form of

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charts, including classification charts, group charts, comprehensive charts, etc. These charts can visually reflect the environmental performance of the buildings at each level and the areas that need further improvement.

2.1.4. JAPAN CASBEE EVALUATION SYSTEM

The Japan Sustainable Building Council has developed a local green building evaluation system, CASBEE, which emphasizes the evaluation of the emergency response function and service life of buildings and equipment, as well as the full utilization of existing buildings, due to Japan's special conditions such as scarce resources and frequent earthquakes. To accelerate the reform of the resource production model, developed countries have proposed the concepts of "4-fold factor" and "10-fold factor", which can be summarized as resource efficiency; in addition, the concept of eco-efficiency has been proposed. Based on the above concepts, CASBEE has proposed the concept of BEE for built environment efficiency.

$$BEE = \frac{Q}{L} = \frac{25 \times \left(S_Q - 1\right)}{25 \times \left(5 - S_{LR}\right)} \tag{1}$$

Where Q is the quality and performance of the built environment and L denotes the load of the external environment. S_q denotes the total score of the evaluation items in the category Q and S_{LR} denotes the total score of the evaluation items in the category L.

2.1.5. AUSTRALIAN NABERS EVALUATION SYSTEM

The Australian Department of Environment and Resources has developed a simple, comprehensive, and easy-to-use evaluation system, NABERS, based on the New South Wales evaluation system SEDA, concerning the BREEAM evaluation system, and taking into account the national conditions of Australia.

NABERS evaluates the environmental impacts of existing buildings during their operational life cycle, including greenhouse gas emissions, waste emissions, water use, energy use, and indoor environment. The NABERS evaluation method is to divide the sum of the star values obtained from each index by the sum of the star values obtained from the full score of each index, and the calculated percentage is the green performance evaluation result of the building.

2.1.6. CHINA'S GREEN BUILDING EVALUATION STANDARD

The first "Green Building Evaluation Standard" applicable to China's national conditions was promulgated in 2006. The standard covers the main technical contents

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including: land saving, energy saving, water saving, material saving, indoor environment, construction management, operation management, improvement, and innovation. Its outstanding advantage is that it is extremely flexible and can be specifically adjusted to the actual situation of weather, geographical location, and construction methods.

2.2. GREEN BUILDING EVALUATION SYSTEM USING BIM TECHNOLOGY

The application of BIM in the whole process of green building evaluation generates input costs of equipment, personnel, and technology costs. To further reflect the relevance and implementability of BIM application, this study provides a comprehensive analysis of the cost components generated by the application of BIM.

2.2.1. HARDWARE INPUT COST

BIM application mainly realizes its basic functions through the intelligent system, which generally includes the BIM platform, computer, and server, platform network switch, large screen TV wall, environmental monitoring system, etc. The calculation formula is as follows.

$$C_1 = C_{11} + C_{12} + C_{13} \quad (2)$$

Among them, C_1 indicates the hardware input cost of the BIM application, C_{11} is the cost of computers and servers, etc., C_{12} is the maintenance cost incurred to ensure the daily operation of the BIM platform, and C_{13} is the renewal cost of the hardware after a certain service life.

2.2.2. PERSONNEL INPUT COSTS

The input cost of personnel refers to the additional cost of BIM technicians' salary and the cost of training for project management personnel than the traditional project management mode. The specific calculation formula is as follows.

$$C_2 = C_{21} + C_{22} \quad (3)$$

Among them, C_2 is the new personnel input due to the application of BIM, C_{21} is the salary input of BIM technicians, and C_{22} is the training input of project management personnel.

2.2.3. SOFTWARE INPUT FEE

$$C_3 = C_{31} + C_{32} \quad (4)$$

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Among them, C_3 is the technical input of BIM-related system software, C_{31} is the acquisition cost of BIM system software, and C_{32} is the update cost of BIM system software.

In this section, we introduce in detail the green building evaluation systems that are widely used in various countries around the world and explain the corresponding evaluation methods, and we also apply BIM technology to them. In order to make the whole system more reasonable and further reflect the realistic meaning and implementability of BIM application, we make a theoretical analysis of the cost of the system. This section lays the theoretical foundation for the subsequent design of the integration of aesthetic elements of traditional ancient architecture and modern architecture in Henan.

3. RESULTS AND DISCUSSION

In the context of green building, this paper conducts a statistical analysis of the green energy-saving performance of a building in Henan, which fully integrates the aesthetic elements of traditional ancient architecture in Henan in the design phase. This section analyzes the energy-saving performance of this building in terms of the integrated heat gain coefficient of the envelope structure, the integrated part-load performance coefficient of the system, the renewable energy application ratio, and the maximum lighting power density, and establishes a new type of green building group energy-saving performance evaluation system.

3.1. COMPREHENSIVE HEAT GAIN COEFFICIENT OF THE ENCLOSURE STRUCTURE

As the case is located in Henan Province, the heating heat source comes from municipal hot water, and the main HVAC energy consumption of the building comes from cooling, so the air conditioning U evaluation is taken here. After calculating the temperature difference heat transfer and radiation heat transfer of each envelope structure such as the exterior walls, exterior windows, and non-transparent roof of the building, the calculation results are summarized in Table 1.

According to the results in Table 1, the difference between the air conditioning U-value of the case building and the air conditioning U-value of the corresponding reference building is calculated to be 6.6%. According to this difference, it is divided into 10 grades, from 1% to 10%, with 1 to 10 points respectively, so the case gets 6 points. The advantages of using this score classification method are as follows.

1. The score grade is carefully divided. The national standard GB/T 50378-2014 is divided into two grades for the evaluation of the thermal performance of the envelope structure, such as the heat transfer coefficient K is 5% lower than the standard required value of 5 points, is reduced by 10% is 10 points. The comprehensive heat gain coefficient U of the enclosure structure is divided

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from 1% to 10% of the overall performance of the enclosure structure, which can more accurately reflect the performance of the enclosure structure.

2. From the perspective of comprehensive performance, it can accurately evaluate all kinds of situations. For example, in a similar case, the building envelope, except for the non-transparent roof, meets the requirement of 5% improvement in thermal performance, only the non-transparent roof does not meet the requirement, and even if the non-transparent roof accounts for a very small proportion of the total envelope, the article does not score. The integrated heat gain coefficient U of the envelope structure, considering the envelope structure as a whole and calculating its single flat overall heat gain value, has a more accurate evaluation for the case that the performance of part of the envelope structure is not improved.

Table 1. Summary of calculation results

	Case building air conditioning	Refer to building air conditioning	Case building heating	Refer to building heating
External wall temperature difference heat transfer	1979	2120.5	-15058.4	-16134
Exterior window temperature difference heat transfer	5148	5169.5	-37545.3	-39333.1
Non-transparent roof temperature difference heat transfer	621	552	-4725	-4200
Radiant heat from external windows	15756.8	17332.5	11568.5	12725.4
Total	23504.8	25174.5	-45760.1	-46941.8
U(W/㎡)	12.8	13.7	-24.9	-25.6
Relative Difference	6.60%		3 %	

3.2. SYSTEM-INTEGRATED PART-LOAD PERFORMANCE FACTOR

Henan is located in the central region of China, and the heating heat source comes from municipal hot water, and cooling is mainly through HVAC. Therefore, the hourly weighting coefficient of the air conditioning period is taken here for evaluation. Henan generally enters summer with air conditioning from mid-May to September. The legal time for heating is from November 15 to March 31 of the following year. Therefore, the air-conditioning season is divided from May 15 to September 15. The hour-by-hour energy consumption of the building is calculated to calculate the time factor W/X/Y/Z, and the results are shown in Figure 1 below. The positive value is the heating energy consumption and the negative value is the air conditioning and cooling energy consumption. The values of W/X/Y/Z were determined by counting the number of

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hours in the zones of 100%~75%, 75%~50%, 50%~25%, and 25%~0 during the air conditioning period, respectively, and the results are shown in Table 2 below.

Based on the data in Table 2, the total SIPLV consumption of the building is 100.7, and the total air conditioning consumption of the reference building is 116.9. By making a difference between the SIPLV value of the case building and the SIPLV value of the reference building, the reduction is calculated to be 13%. According to this difference, it is divided into 15 classes, from 1% to 15%, and scored 1 to 15 points respectively. 13 points are scored in this case, which is converted to 8.7 points proportionally. This evaluation index has the following advantages.

1. The score grade is carefully divided. In the national standard GB/T 50378-2014, the evaluation of the HVAC system is divided into three levels according to the reduction of energy consumption D e. 5% ≤ D e <10% scores 3 points, 10% ≤ D e <15% scores 7 points, and D e ≥15% scores 10 points. The partial comprehensive performance factor SIPLV, which divides the overall HVAC energy consumption level from 1% to 15%, can more accurately reflect the HVAC system performance.

2. From the perspective of comprehensive functionalization, it can evaluate the system's performance more accurately. Specifically divided into three points ① chilled water / hot water temperature difference * flow rate to calculate the cooling and heating calculation results are more accurate. ② Electricity consumption is expanded to the HVAC system to better measure the overall energy consumption of the system. ③ The efficiency of the HVAC system calculated with time weighting coefficients is more scientific.

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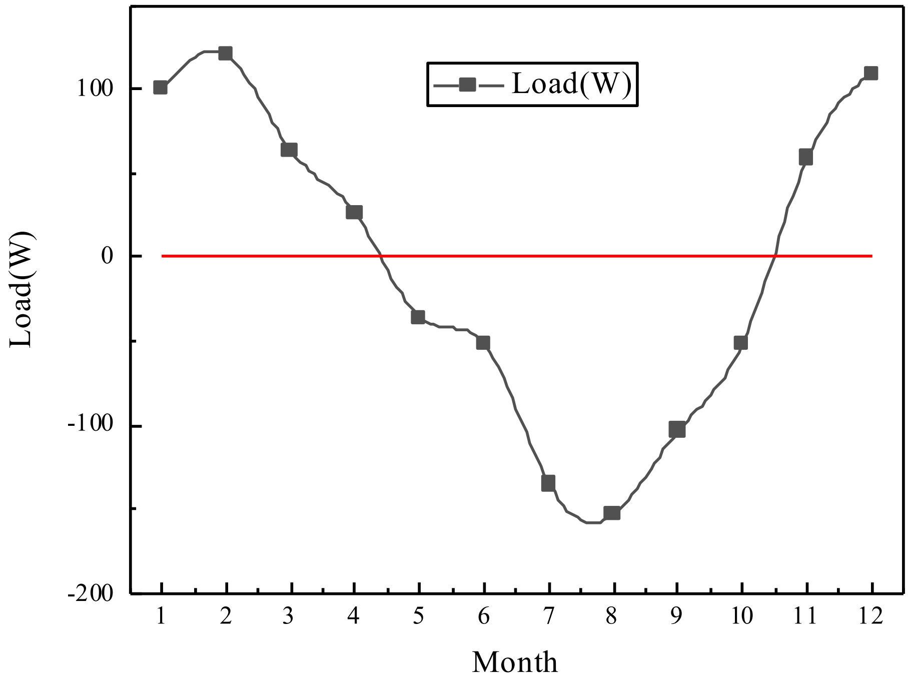

Figure 1. Yearly hourly air conditioning load

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Table 2. Summary results of hours

	Load ratio	Number of hours	Weighting factor
W	100%~75%	45	0.03
X	75%~50%	229	0.15
Y	50%~25%	690	0.45
Z	25%~0	586	0.38

3.3. RENEWABLE ENERGY APPLICATION RATIO

The solar hot water system is installed on the top floor of this case building, which provides about 2200 tons of hot water throughout the year, accounting for about 40% of the domestic hot water. The amount of 60°/50° hot water produced in winter and summer is about 533 tons/1182 tons respectively, which is converted into about 6220KWH/13793kWh. According to the calculation of the equivalent electricity method index X, the overall energy consumption of the building is first calculated in DEST, which is converted into equivalent electricity by applying the formula. By setting the relevant parameters in DEST, the overall electricity consumption of each system for the whole year can be obtained and converted into equivalent electricity value output results as shown in Figure 2.

For this case, its renewable energy equivalent electricity ratio X is 1.08%, and it can score 4 points according to the rating. The advantage of this evaluation system is that all renewable energy and building energy consumption can be integrated into equivalent electricity, and the unified unit of measurement facilitates accurate evaluation of renewable energy utilization level. The traditional evaluation scheme scores solar energy, geothermal energy, and other energy forms and sources separately, and does not unify the energy metric, but only scores heat and cold, electricity and hot water separately. There will be a situation where due to the different forms of the system, the difficulty of obtaining the score is different, resulting in less accurate evaluation. The method of equivalent electricity is used to unify the non-conventional energy and building energy consumption into equivalent electricity, and the score is made according to the proportion of equivalent electricity provided by non-conventional energy. This effectively avoids the above problems and can evaluate the level of building renewable energy use more directly, objectively, and accurately.

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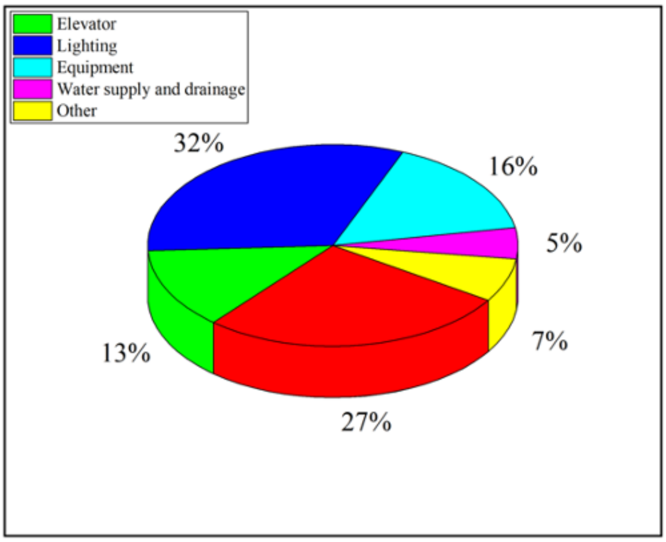

Figure 2. Calculation of annual electricity consumption of the case building

3.4. MAXIMUM LIGHTING POWER DENSITY

According to the relevant parameters of the case building, the hour-by-hour calculation of its model lighting power consumption, and the unit conversion are divided by the total area of the building to get the case building annual hour-by-hour lighting power density. As the current value of lighting power density of high-grade offices in the current national standard GB 50034-2013 is 15W/m2 and the target value is 13.5W/ m2, it is calculated that the reduction range is 10%, and according to this difference, it is divided into 10 grades. From 1% to 10%, the score is 1~10 points respectively. In this case, the L max of the building is 13.8W/ m2, and the reduction rate is 8%, and the building scores 8 points according to the calculation result. This evaluation index has the following advantages.

1. The score grade is carefully divided, to facilitate accurate evaluation. National standard GB/T 50378-2014 for lighting power density evaluation in accordance with the main functional area to meet all areas of the building to meet the 2 levels, the main functional area to meet the 4 points, and all areas to meet the 8 points. The maximum lighting power density L max, the overall lighting power density of the building is divided into 10 classes according to the proportion of the current value, which can more carefully and accurately reflect the level of lighting power density.

2. From the perspective of the overall lighting power of the building can measure the energy performance of the lighting system more accurately from two dimensions. I max is the maximum annual lighting power density value of the

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building as a whole, which includes not only the physical dimension of the whole building but also the time dimension of the annual time-by-time value, which can reflect the energy performance of the lighting system more truly and accurately.

In summary, this section proposes a novel green building evaluation system that incorporates BIM to score the performance of green buildings. Specifically, key indicators such as the integrated heat gain coefficient of the envelope structure, the integrated part-load performance coefficient of the system, the renewable energy application ratio, and the maximum lighting power density of a building in Henan were calculated.

4. CONCLUSION

In this paper, the performance of a green building in Henan is calculated and evaluated based on BIM technology in the context of green buildings. The building fully integrates the aesthetic elements of traditional ancient architecture in Henan in the design stage. According to the calculation and scoring results, the building has better energy-saving effects in key indexes such as integrated heat gain coefficient of envelope structure, integrated partial load performance coefficient of system, renewable energy application ratio, and maximum lighting power density. The specific results of the study are as follows.

1. In terms of the integrated heat gain coefficient of the envelope, the difference between the air-conditioning U-value of the case building and the air-conditioning U-value of the corresponding reference building is calculated and the reduction is 6.6%. According to the evaluation criteria proposed in this paper, the integrated heat gain coefficient of the building envelope is scored as 6.

2. In the system-integrated partial load performance factor, the total SIPLV power consumption of the building is 100.7 and the total air conditioning power consumption of the reference building is 116.9. By making the difference between the SIPLV value of the case building and the SIPLV value of the reference building, the reduction is calculated to be 13%. According to the evaluation criteria proposed in this paper, the system-integrated partial load performance factor of this building is scored as 13.

3. For the renewable energy application ratio of the building, after calculation, the renewable energy equivalent electricity ratio X is 1.08%. According to the evaluation criteria mentioned in this paper, the score can be 4 points.

4. The building's maximum lighting power density, according to the calculation results, its maximum lighting power density is 13.8W/m2, compared with the national standard of 15W/ m2, and its reduction rate is 10%. According to the

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evaluation criteria mentioned in this paper, the maximum lighting power density of the building scored 8 points.

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