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Retraction

Retracted: On the Application of BIM Technology and Neural Network Algorithm in the Study of Energy-Saving Optimization of the Envelope Structure of Assembled Buildings in the Western Sichuan Plain

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] H. Li, X. Li, Y. Jiang, and C. Wei, "On the Application of BIM Technology and Neural Network Algorithm in the Study of Energy-Saving Optimization of the Envelope Structure of Assembled Buildings in the Western Sichuan Plain," *Journal of Sensors*, vol. 2022, Article ID 1653838, 12 pages, 2022.

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Research Article

On the Application of BIM Technology and Neural Network Algorithm in the Study of Energy-Saving Optimization of the Envelope Structure of Assembled Buildings in the Western Sichuan Plain

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With the rapid development of the economy, carbon neutral and carbon peak are on the agenda in China, and the reform of intelligent construction and assembly building is in full swing in the Chinese construction industry. In order to further explore and study the relationship between the textural structural issues of the envelope structure and the overall energy consumption situation of the house, and further bridge the gap between the actual energy-saving design scheme and the actual application scheme, therefore, this paper takes a certain place as a research object to study the phenomenon of design assembly energy saving, based on dozens of assembly building enterprises researched, selected samples of envelope components studied, selected BIM technology for premodeling optimization, used neural network algorithm for analysis of influencing factors, and studied the application in the study of energy-saving optimization of assembly building envelope in the western Sichuan plain area, and used OpenStudio was used to build a model to simulate the heating and air conditioning load of the assembled building numerically and to fit the quantitative relationship between the variable factors and the building energy consumption. On this basis, the relationship between multifactor and single-factor variables is identified and evaluated using relevant variables means.

1. Introduction

With the rapid development of the economy, carbon neutrality and carbon peaking are on the agenda in China, and the reform of intelligent construction, green building, and assembled building is in full swing in China's construction industry. During the development of China's modernization, the construction industry has been the focus of attention because it is related to the safety of people's lives and properties [1]. With the introduction of modern energy conservation and sustainable development concepts, the construction of assembled buildings will take the dominant position. The assembled building has the advantages of improving construction efficiency, saving construction cost, energy saving, environmental protection, and noise reduction. The introduction of building science and technology has accelerated the industrialization of the construction industry into assembled buildings [2]. Therefore, the development of the construction industry must be considered and supported. Building information modeling (BIM) is a technical abbreviation for building information modeling, a simulation based on three-dimensional digital technology [3]. Specifically, in digital terms, it can clearly show the condition of the building before its construction, so that problems can be reduced.

Therefore, the application of technology in the construction process can lead to unprecedented developments in the construction industry, especially for the optimization of the energy efficiency of the envelope of assembled buildings, where BIM technology can be used to save time and costs with its premodeling capabilities for optimization studies [4].

The core of assembled buildings is "integration", and the building management information system (IMSMA) technology is an "integration" tool for the whole life cycle of prefabricated design, manufacturing, construction, renovation, and construction management [5]. BIM technology provides powerful technical support for prefabricated structure construction planning, and 3D BIM models can solve the problem of frequent structural collisions in 2D design, which greatly reduces "errors, leaks and collisions" in the project and improves work efficiency [6]. Construction information management technology enables standardized planning, performance planning, precast accounting, piping optimization, and foundation testing to be performed in the planning stage [7]. Design, collision detection, and design module modeling can be performed at a deeper stage. BIM-based modular construction process for construction planning of prefabricated structures. Combining traditional shop design with in-depth structural design enables a more standardized process. Modularity is a series of standard design modules consisting of standard functional modules [8]. Modular design uses a system of standard construction modules to improve production efficiency, reduce the cost of parts in the manufacturing process, simplify the assembly of parts, adjust the type of relevant construction materials and parts, and achieve assembly integration. When creating a library of modules, they are aggregated into structural models, such as "structural blocks," which provide a basis for visualizing decisions [9].

Artificial neural networks do not have to determine in advance the mathematical equations associated with the input and output cards, simply because you need to train your brain system to learn further mathematical rules [10]. When you input the rules expected by the value of the input function, you end up with the simplest mathematical result that is close to the value of the input function. Artificial neural network system is one of the intelligent information computing and processing systems, and one of its main core functions is training algorithms. In this paper, we analyze and discuss the influencing factors through the neural network construction algorithm system.

This paper first summarizes the overall climate characteristics, and then systematically summarizes the climate for the plains in the western Sichuan region, and determines the energy consumption factors based on the summarized results. After that, the parameters of the maintenance structure of the assembled building are limited in scope, and OpenStudio software is used to simulate the energy consumption values at a later stage, so as to determine the method of the simulation and the evaluation index of the benefits, to derive the relationship between the energy consumption of the facade of the assembled building and the building, and to draw an energy consumption diagram.

2. Research Background

The main applications of BIM technology in engineering are, as Zhuji reviewed, the advantages of the application of general contractor construction organization and management technology and construction organization technology [11]. It is hoped that general contractors will seize the opportunity of applying new technologies in construction organization, actively participate in the development and implementation, improve the level of enterprise project management and market competitiveness, and drive the transition of enterprise management to a new stage. According to Zhang, building information simulation technology, as a 3D visualization and simulation technology, can establish an ideal information sharing platform based on the entire design information and effectively improve the overall level of project management [12]. Construction information technology has become one of the most important aspects of home construction. The application of construction information modeling in general contractor project management is studied in detail in the hope that it can provide some help to China's construction project management. Joseph J described the eight stages of BIM marketing plan and argued that owners and developers are changing their perceptions of BIM services [13]. Specifically, when the construction business is still in its infancy, a client or prospect may submit a proposal containing a vague definition of the scope of the construction work. Currently, both the client and the prospect have specialized knowledge and experience in the actual projects of the construction business, but he proposes a marketing development program based on the technology of the construction business to help increase the marketing revenue of the construction business. To ensure the construction cycle, installation quality, and economic efficiency of subway stations, Lee proposed the introduction of building information modeling (BIM) to address subway station construction safety issues. The application methods and effectiveness of BIM are studied from the perspective of integrated pipeline modeling and four-dimensional modeling, and it should be noted that the project cycle can be reduced by 15%, but it is assumed that the effectiveness of BIM needs further study. Mark believes that modern BIM can be used to develop models. It covers technical information, particularly the design, construction, and operational cycles of many projects, and argues that this can lead to shorter construction times, cost savings, and quality. Therefore, the advantages of the application are particularly obvious [14].

The study of energy-saving technologies for envelope structures has been carried out mainly by scholars in Beijing and other places for some energy-saving materials and energy-saving methods for relevant public buildings in the region, as well as for building structures, to explore the current status and energy-saving methods for buildings in different fields [15]. Xu Xiaoli studied and analyzed a residential building in Tianjin using CFD techniques, and by the analogy with MATLAB models, she designed an intelligent control system for indoor cold and blood heat sources [16]. Dean et al. studied the protection facilities of the cooling zone in summer and winter through computer simulation. Scholars Qiankun Wang et al. have further extended their research on the optimization of energy efficiency of building structures by using BIM technology, as well as algorithms such as neural networks and related data mining techniques for assembled building enclosures in Wuhan [17]. Foreign scholars have further explored the structural and energy-saving optimization of assembled buildings. The research was conducted on the basis of the network [18]. Liu summarized the development status of prefabricated components in China, presented the problems, and summarized the relationship between exterior wall (SI) structures and energy efficiency based on the analysis of various data. Current domestic and foreign scholars have not made an in-depth analysis of the problems related to energy consumption of assembled buildings, although they have done research and analysis on the envelope structure of assembled buildings, especially in the board of the domestic assembly design of the city, the research on the energy saving of such assembled buildings is in a backward state compared to foreign countries, especially the city design of the program is seriously derailed [19]. Domestic scholars always analyze energy consumption after qualitative research on architectural design solutions, which is not coherent and leads to many problems. The core of this thesis is to help architectural designers to reduce the interference of relevant factors in the selection of the best building solutions, thus providing the best energy-saving design solutions, and to help architects to have a deeper understanding of the selection of materials and their thicknesses for the maintenance structures of assembled buildings, so as to obtain the best energy-saving solutions with the highest economic efficiency [20].

3. Research Methods and Materials

3.1. BIM Technology

3.1.1. Concept. BIM technology is a product of information technology, so it uses multimedia for model modeling and building data to represent building components. But it is not just a modeling method, it is a new concept, and it is digital information modeling. It simplifies architectural innovation, building design, building models, and processes in prefabricated buildings.

3.1.2. Features. The application of BIM technology in architecture is characterized by high coordination, visibility, graphical design, and high simulation intensity as shown in Figure 1.

High degree of coordination: If this problem is difficult to solve, BIM technology can be used because it has high adaptability. Designers and designers can simulate the 3D construction site according to the actual situation of the construction site and seek solutions through the model.

Visibility: One of the main problems of architectural design is interior architecture. A construction model is a visual and spatial model that allows construction workers to clearly see every location, greatly reducing errors in complex and hidden locations. Compared to 2D graphics, designers can reduce tremendous intellectual labor and design time, and can also correct errors by searching the modeling framework, greatly increasing the usability of the designer.

Modeling: Modeling is the main construction method, but not only simulates the already built model, but also simulates the virtual construction process. The main simulation methods include solar simulation, full-spectrum image simulation, and heat transfer simulation. In addition, the actual simulation can be based on four-dimensional simulation technology (project development time or three-dimensional simulation), while the preparation of the proposal phase can greatly improve the success rate.

High simulation intensity: Architectural works are inseparable from the use of working drawings, but their preparation is different from 2D working drawings. Optimization of construction planning drawings, pipeline data, model sequences, and maintenance of structural shutters is discussed in detail on the basis of visual display of buildings through multifaceted analysis of the model.

3.2. Neural Network Algorithm. Neural network is essentially a model of nonlinear prediction; as his name suggests, it is an algorithm that imitates the human and animal-like nervous system for computation. It is based on imitating the human and animal brain neural network system to perform the computation and then to process the content of each module. Neural network algorithm is a derivative of data mining technology, which is one of the types of data mining technology that can be used for big data mining, such as analysis, classification, aggregation, and other data mining functions. Its advantages and disadvantages are very clear, the first advantage is that it is extremely resistant to interference, and the second is that it is capable of deep learning and better memory in a nonlinear situation and can handle more complex situations. At the same time, it has two disadvantages. First, its computation and processing results are low-dimensional and cannot be adapted to a high-dimensional environment, so it has a hard-to-interpret nature. The second is that whether it is supervised or unsupervised learning, it requires a long learning time and data collection using more traditional neural network methods.

3.2.1. Generalized Regression Neural Network. Generalized regression neural network generalized regression neural network (GRNN for short) is a four-layer forward propagation neural network; its network structure has fewer parameters and better nonlinear mapping ability; and of course, this kind of neural network its initial point is the input layer, the end is the output layer, and then after two intermediate layers are the pattern layer and the summation layer to get the output of this kind of neural network algorithm. The difference between this neural network and other neural network algorithms is that there is no supervised learning and unsupervised learning data input and training process. The training results are obtained by optimizing the relevant factors in the second layer. It does not have a specific computational process like other types of neural networks, but has a specific supervised and unsupervised learning data

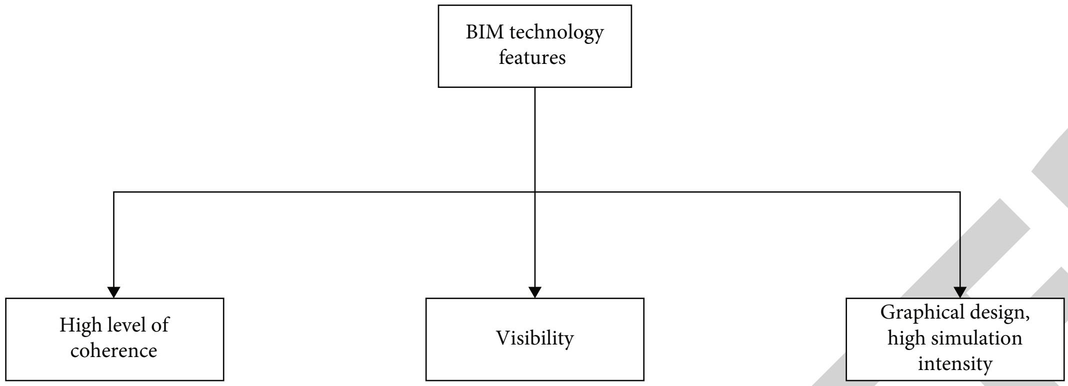

Figure 1: BIM technology characteristics.

processing process and training process. The computational process is not shown in detail here, and the specific computational process can be obtained by the radial basis neural network inference, which will not be done in this example. Although this kind of neural network combined with the generalized theory, it does not require supervised and unsupervised learning training, but its second layer, that is, its mode layer, is prone to the phenomenon of violation of statistical laws; Firstly, it is very easy to cause the phenomenon of underfitting and not easy to fit, and secondly, the relevant factors in his will appear random wandering phenomenon, so it is more troublesome as shown in Figure 2.

3.2.2. Wavelet Neural Network. This paper focuses on data processing using a two-part algorithm for neural networks. These two types of algorithms are effective supervised learning and ineffective unsupervised learning, which are common in algorithms. In the latter part, the data are first analyzed by certain algorithms for clustering, so as to obtain the central part of the hidden neural network, and then, the results of this step are used to perform calculations to figure out the value of the width of the number. The wavelet neural network and the structure of which are shown in Figure 3.

3.2.3. Fuzzy Neural Network. This type of neural network (FNN for short) is, first of all, a deep combination of fuzzy theory and neural network algorithm. In the process of data mining and information processing by neural network algorithms, fuzzy theory is incorporated to improve the mapping and the relevance of mathematical relationships. The efficiency of supervised learning and unsupervised learning is better improved. The algorithmic formulas of such neural networks and the related structural diagrams are more commonly used and common and can be found in general textbooks. This kind of neural network is shown in the figure, and it goes through five levels in the process of training and supervised and unsupervised learning; at the beginning of the two levels, as the level increases, the range of calculations required will double, but as it enters the third level and enters the fourth level and enters the fifth level, the content of calculations will gradually decrease until it becomes one. Of course, when this type of graph is input, the first thing is to test the dimensionality at the node of the input layer and test the dimensionality. The specific value assumes that the dimension value is n and the node that needs to be input is n. Depending on the number of nodes required, it is passed all the way to the layer of the dimensionality function and the related layer of functions for further computation, as well as finally to the output layer. This type of fuzzy theory combined neural network has the same nature as the wavelet neural network and the neural network combined with generalized theory in that it uses the traditional gradient form of computation downward to calculate the centroid of the affiliation and the associated required width value and the final output value and the weights we need. This is shown in Figure 4.

3.3. Assembly Building. Prebuild is a suitable method for the discussion of the actual construction process. The basic principle of construction is that the components required for manufacturing prefabricated components must be assembled and used at the construction site in the workshop, and the prefabricated components must be assembled from the building. Assembled buildings are integrated assemblies that can be standardized in design and managed with information technology. Its unique design, short construction time, and cost savings are the links that enable the construction industry to grow. Building assembly attracted people in the early twentieth century, but the first assembled buildings were simple, large, and uniform. Subsequently, architects improved them, creating a variety of exterior structures, increasing the flexibility of the building, and providing a qualitative mastery of the completed building. In recent years, with the development of technology in all sectors of society, the construction industry will flourish with the support of technology.

3.4. Energy-Saving Design

3.4.1. Regional Climatic Characteristics of Cold Winters and Hot Summers. The relevant units in the current society are trying to achieve high efficiency and achieve energy saving as much as possible. The current building code "Thermal Design Code for Civil Buildings" (GB50176-93) divides China into five climatic regions. Since different external environments are bound to have different degrees of impact

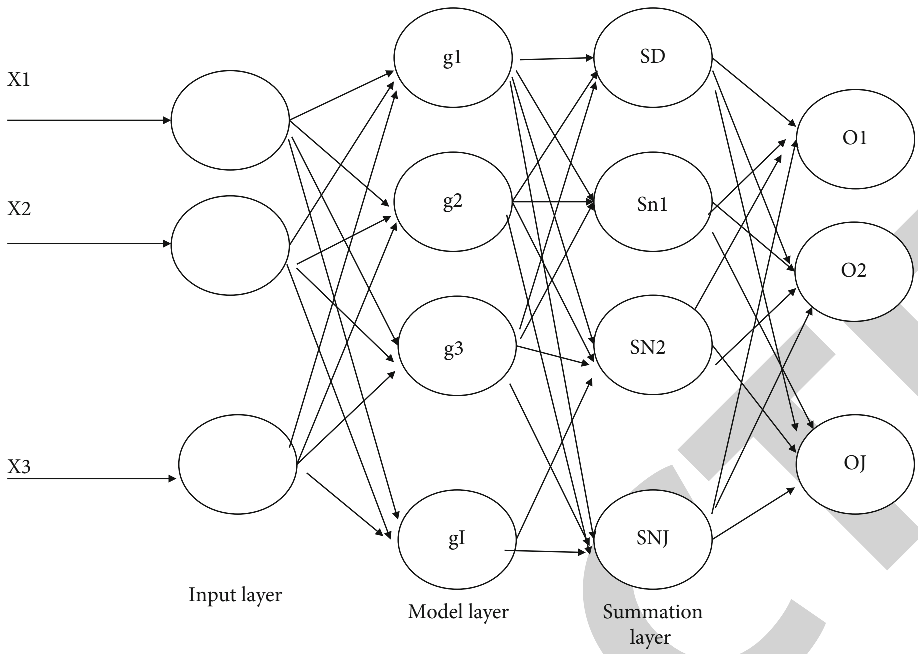

Figure 2: Generalized regression neural network structure diagram.

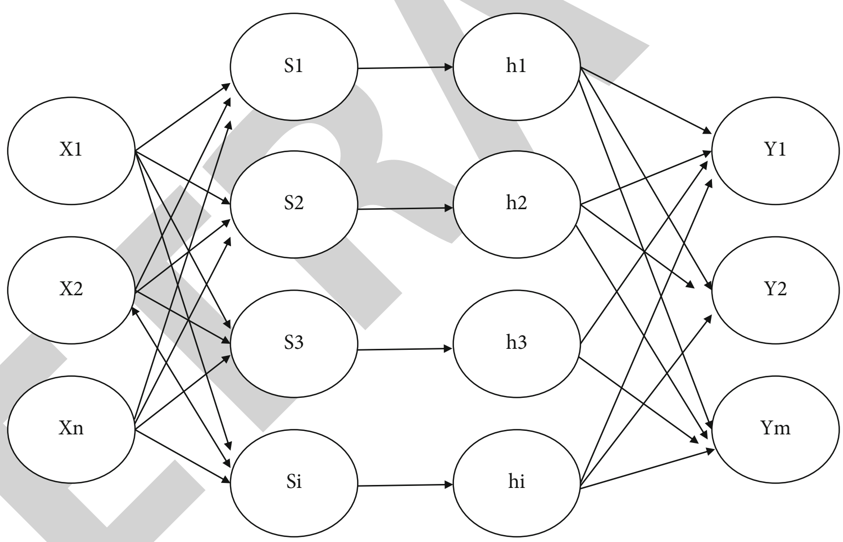

Figure 3: Wavelet neural network structure

on the energy consumption of assembled buildings, the external environment must be given priority consideration. It covers a wide area of Chengdu, Shanghai, and other major cities, and covers areas with different climatic characteristics and different climate characteristics. Since the thermal environment varies, the requirements for the construction and design of houses in different environments will be different, and thus, the laws of research will be different.

3.4.2. Overview of Energy-Saving Factors of Building Envelope Composition: Take the Western Sichuan Plain Area as an Example. In general terms regardless of the existence of the meaning are to stop all the external adverse factors caused by the cause of indoor problems. There are five parts: wall, door, door window, top, and bottom. It can be seen that the type of peripheral structure and the effectiveness of the thermal work are the entry points of the building energy-saving control, and the study of the peripheral structure is indispensable in order to achieve higher efficiency. The relevant calculation formulae are as follows.

(1) Average heat transfer coefficient of the envelope unit (considering the effect of thermal bridges)

$$K_m = K + \frac{\sum \psi_j l_j}{A}, \quad (1)$$

$$K = \frac{1}{R_0}, \quad (2)$$

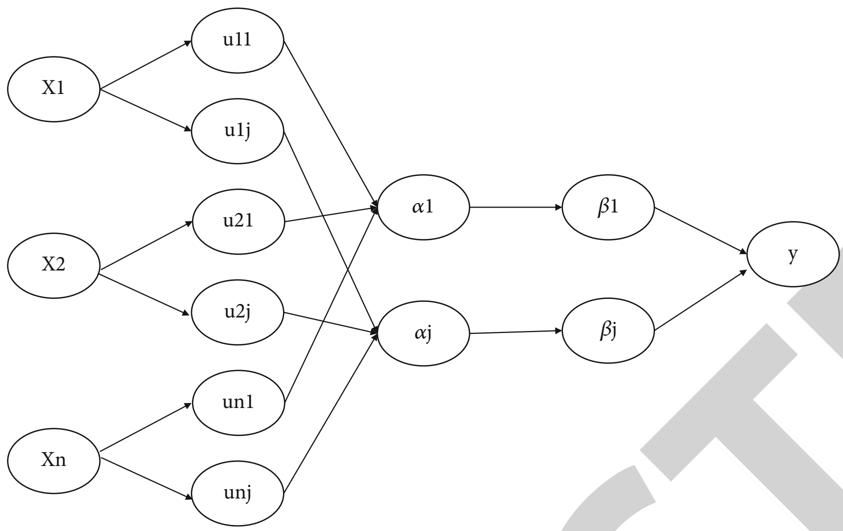

Figure 4: Fuzzy neural network.

where R_0 is the heat transfer resistance of the enclosure (m^2-K/W); K is the heat transfer coefficient of the flat wall of the enclosure; ψ_j [W/(m-K)] is the line heat transfer coefficient of the jth structural thermal bridge on the enclosure [W/(m-K)].

Heat transfer resistance of the flat wall of the enclosure structure:

$$R_0 = R_i + R + R_e, \quad (3)$$

where R is the thermal resistance of the material layer (㎡-K/W); R_i is thermal resistance of the inner surface (㎡-K/W), taken according to the specification; and R_e is the thermal resistance of the outer surface (㎡-K/W), taken according to the specification.

$$R = R_1 + R_2 + \cdots\cdots + R_n. \quad (4)$$

Flat wall thermal resistance of the envelope of multilayer construction materials:

The thermal resistance of single-layer materials:

$$R = \frac{\delta}{\lambda}, \quad (5)$$

where δ is the thickness of the material layer (m) and λ is the thermal conductivity of the material [W/(m-K)], according to the normative value.

(2) Multilayer construction materials of the envelope flat wall thermal inertia indicators:

$$D = D_1 + D_2 + \cdots\cdots + D_n. \quad (6)$$

Thermal inertia indicators of single-layer materials:

$$D = R \cdot S. \quad (7)$$

Thermal storage coefficient of the material:

$$S = \sqrt{\frac{2\pi\lambda c\rho}{3.6\mathrm{T}}}. \quad (8)$$

4. Results and Discussion

4.1. Research Methods and Tools. This paper is mainly to study the impact of different materials of the building envelope, mainly the exterior window insulation, on the energy saving of the building, and adopt OpenStudio software for different data to simulate the study, and the simulation will establish the simulation test for different materials with their corresponding values.

4.1.1. Primary and Secondary Variables. Since the experimental study mainly focuses on the envelope of the assembled building, and the outer wall of the assembled building has the largest contact range with the outside air and affects the energy consumption more strongly, its thermal performance is especially significant for energy consumption. In addition, the good or bad thermal performance is mainly related to many factors, so it cannot simply consider one aspect of the factors. The study for the insulation of the material thickness as the main variable, and the integration of China's often used four kinds of window materials and insulation materials as auxiliary variables.

4.1.2. Setup of the Simulation Process. Referring to the results of previous studies by foreign scholars, the base model here is always taken as a 15 × 4.8 × 3 m base model, and the first step is to use the software for simulation to work out the simulated values. In the second step, the graphs of the corresponding changes are edited according to the values. The data analysis software is used to make measurements, algorithm-related formulas, and program applications, and finally draw conclusions, and provide reference recommendations.

4.1.3. Neural Network. Neural network is essentially a nonlinear predictive model, as its name suggests, an algorithm that imitates the human and animal nervous system for computation. It is based on imitating the neural network system of human and animal brain, performing computations, and then processing the content of each module. Neural network algorithm is a derivative of data mining technology, which is one of the types of data mining technology that can be used for big data mining, such as analysis, classification, aggregation, and other data mining functions. Its advantages and disadvantages are very clear, the first advantage is that it is extremely resistant to interference, and the second is that it is capable of deep learning and better memory in a nonlinear situation, and can handle more complex situations. At the same time, it has two disadvantages: The first is that its computation and processing results are low-dimensional and cannot be adapted to high-dimensional environments, so it has a hard-to-interpret nature. The second is that both supervised and unsupervised learning require a long learning time, and data collection is done using the more traditional neural network approach.

Other kinds of algorithms require relevant mathematical mapping relations. The artificial neural network algorithm involved in this paper does not require a large number of mathematical mapping relations, so it does not need to input a large number of mathematical equations in the first place, because it needs to be able to learn some other basic mathematical rules systematically through training on the data in advance, so that it can output the required mathematical calculation results better and simulate the mathematical model better given certain function values and mathematical function values. As a complex discipline in computer science and mathematics and statistics, one of the main core functions of artificial neural network is training algorithms for mathematical calculations and information statistics.

The basic algorithm theory BP algorithm theory process mainly includes the process of linear propagation of the output signal deviation forward and backward and the process of linear propagation of the output signal error forward and backward and reverse which are two process calculation processes. That is, the signal error can be adjusted according to the two input directions from the actual input signal direction to the actual expected signal output, respectively, to calculate the signal output, from the direction of the real expected signal output and then to the real expected input direction of the two directions, respectively, to calculate the signal error to adjust the signal error weight range and error threshold. In the study of the propagation method after the forward superposition of the signal, the input node signal is mainly the node on the actual output of the signal after the inverse superposition through the role of the hidden layer, and the actual output node signal can be generated through the nonlinear transformation process. If we find that the actual signal output node position is not consistent with the actual input node expectation signal of the actual output node direction position, it will be easy to produce the process of backward feedback propagation method for signal error compensation. The principle of error input signal back propagation processing system is that the system will automatically back propagate its various output signals or error information values to each error input layer of the system through the hidden layer nodes layer by layer, and will sequentially transfer its output error signal values to the nodes on each layer corresponding to all other layers of the system error input signal elements, with the system in each layer of the system nodes obtained The output error input signal values obtained by the system at each layer node are used as the basis for its calculation to automatically adjust the weights among the error output signal elements of the system.

In this paper, in addition to the three neural networks introduced in Section 3, radial basis neural networks are also used. The last type is radial basis neural network (RBFNN for short). It is more convenient because it has only three layers, in addition to having supervised learning and unsupervised learning data processing like traditional neural networks. Secondly, it has a better statistical basis, it is a linear computation, and then, he can pass to the next layer after data processing by function. After three layers of computation, the output results are obtained. In the case of camera neural network, it outputs data mainly through two layers of algorithms, and the specific computation is supervised learning and unsupervised learning, respectively. In the place of supervised learning, he needs to perform clustering algorithm and analysis of some relevant data for clustering to figure out the required width value and the required neural network result.

4.2. Types of Factors Affecting the Energy Efficiency of Assembled Buildings

4.2.1. Types of Assembled Buildings. The Energy Conservation Design Standard for Residential Buildings in Hot Summer and Cold Winter Areas (JGJ134-2010) takes the perspective of energy conservation and classifies the building types of general residents in order to achieve the control of the whole building system as well as the coefficients. For example, 1 ~ 3-story residential buildings are basically villas, 4 ~ 11-story buildings are mainly slab-type structures, and domestic 12-story and above buildings are basically high-rise tower-type buildings.

4.2.2. Building Plan Form. For the energy consumption of the building, the energy consumption of the square plane traces is larger, while the energy consumption of the rectangle is relatively small. The regularity of the building plan determines the energy consumption of the whole house, and generally speaking, the more regular the pile of housing types such as ellipse or circle, the better the energy saving of the house, and the energy consumption will tend to a certain fixed value.

4.2.3. Building Window-to-Wall Ratio. Generally speaking, the area ratio of exterior windows is positively related to the seriousness of energy loss, and it is difficult to control energy loss when the area ratio of exterior windows is larger. Therefore, the study of window-to-wall ratio, especially the exterior windows, is the most important and cannot be ignored for the energy consumption of buildings. The development of buildings in China tends to pursue the neatness and openness of the whole roof, so the window-to-wall ratio is increasing, but in contrast, the energy-saving requirements have not been met, and the energy loss has gradually become a point that cannot be ignored. However, in general, it is desirable to increase the ratio of external window area for the comfort of the house.

4.2.4. Building Body Coefficient. According to the relevant building code system coefficient of presentation, in the building number of floors below three and below three, the coefficient of body shape cannot exceed 0.55; after the building between 11 and 4 floors, the body shape factor cannot exceed 0.40; for high-rise buildings above 12 stories, a building system number less than 0.35 is reasonable. The shape factor of the building depends on the size of the plane, the height, and the shape of the plane. The relevant factors are determined by the length and width of the building, so the focus should be on controlling the size and depth of the building in the design stage.

4.2.5. Building Maintenance Structure. As the main envelope of the building, windows, roof, walls, and floors, especially the external windows, the energy loss is basically in the external windows. The literature review on buildings has shown us that the energy loss is basically lost through the outer structure. In order to explore the energy-saving factors of buildings, the relationship between the thermal performance of the envelope and the way it is constructed and the energy consumption must be clear. The energy efficiency of a building is basically influenced by the material of the envelope structure. The heat and energy consumption of exterior windows and walls are at the highest level, so to improve the insulation performance of both will be of great help to the energy saving of the whole building. In China's cold winter and hot summer areas such as the assembly buildings in the Sichuan West Plain, the exterior walls again occupy a huge proportion of the entire exterior envelope, and in addition, the exterior envelope is also an important factor in energy loss.

4.3. Analysis

4.3.1. Parameter Setting. According to China's residential design code, the model adopts a $15 \times 4.8 \times 3$ m rectangular simulation model as the basis of the energy consumption simulation study in this paper and strictly restricts the data to the numerical values. The window-to-wall ratio is set to 0.3 to the north, 0.5 to the south, and 0.35 to the east-west.

The final form of the perimeter wall structure and the selection of materials in this study were analyzed and set in accordance with the relevant standard regulations and the survey data, and the sandwich composite panels of reinforced concrete were selected. The sandwich precast exterior wall structure was decorated from the outside to the inside. The external decorative layer is mainly crushed concrete: The internal leaf wall panel is set at 200 mm, and the lime mortar is set at 15 mm as the thermal analysis sample of this external wall. XPS, EPS, PU, and phenolic are used as insulation materials.

4.3.2. Research and Analysis of Heating and Air Conditioning. In the study of the thermal performance of the external wall, the thickness of the insulation layer grows from 20 mm to 100 mm with a growth rate of 5 mm; the thickness of the insulation layer is set as the main variable; and XPS, EPS, PU, and phenolic as insulation materials are set as auxiliary variables.

(1) The use of neural networks and the use of OpenStudio software to explore the XPS as the insulation material when the base model for different windows in the use of different insulation thickness of the exterior wall heating and air conditioning load exploration, the data are as follows: the study selected four windows for the thickness of impractical insulation material for heating and load exploration, the data can be seen when the XPS insulation material thickness is greater, and the building year-round heating and air conditioning and load are decreasing trend, proving that the higher the thickness of the building's insulation, the smaller the load, more energy efficient and environmentally friendly, as shown in Figure 5

(2) Exploring the simulation of energy consumption when EPS is used for exterior wall insulation, the thickness of the insulation layer grows from 20 mm to 100 mm in sequence, resulting in a simulation test analysis of energy consumption of exterior walls with different window types see combinations. The thickness of the insulation layer was increased from 20 mm to 100 mm in sequence, so as to simulate and test the analysis of the energy consumption of the facade for different window types. The data analyzed are as follows: Four types of windows were selected for this study to explore the energy consumption of the facade. It can be seen from the data that when the thickness of the insulation material is larger, the energy consumption of the building's heating and air conditioning facade throughout the year is on a downward trend, proving that the higher the thickness of the building's EPS insulation layer, the smaller the energy consumption of the facade, the more energy-efficient and environmentally friendly it is, as shown in Figure 6

(3) When the insulation material of the building's exterior wall using phenolic/PU, the thickness of the insulation layer is set to 20 mm to 100 mm; exploring the energy consumption of various buildings under different windows simulation test analysis and exploring the material of the exterior wall insulation layer using phenolic/PU, the thickness of the insulation layer is set to 20-100 mm still, after exploring the building under different window types of the exterior wall energy simulation test analysis as shown in Figure 7

4.3.3. Simulation Study of the Total Load of Annual Energy Consumption Heating and Air Conditioning. Numerical simulation of the total load of heating and air conditioning of the base model under different heat transfer coefficients with different types of insulation materials are taken for the exterior

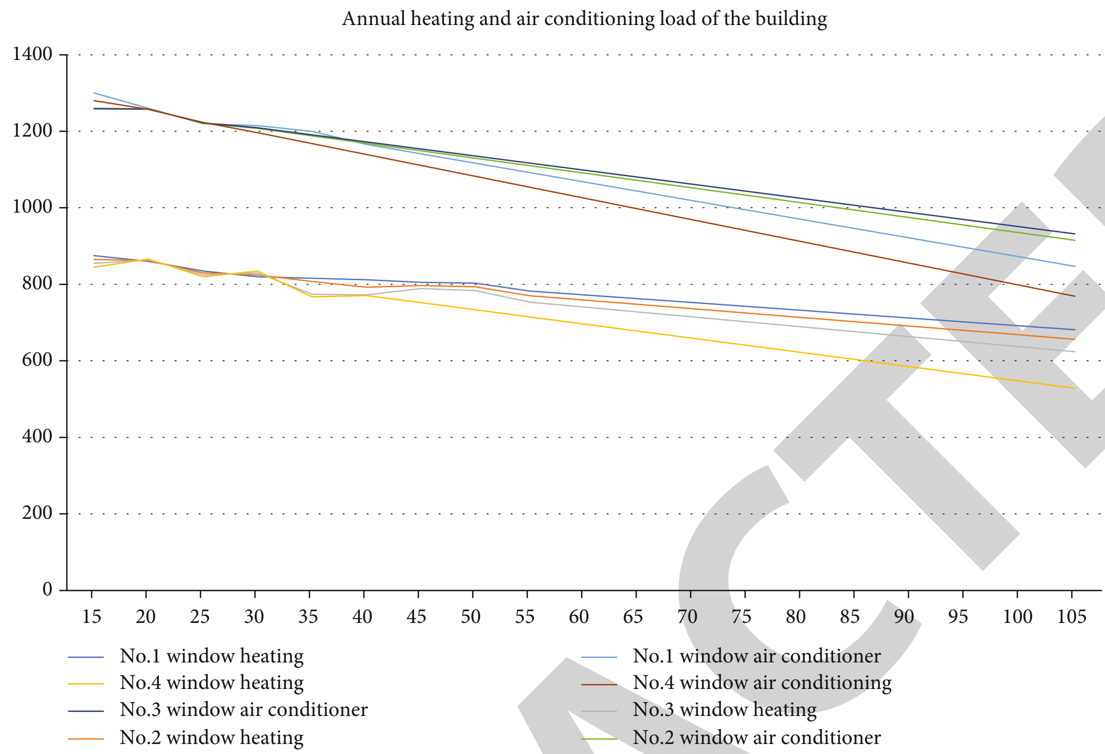

Figure 5: Building year-round heating and air conditioning load volume, XPS.

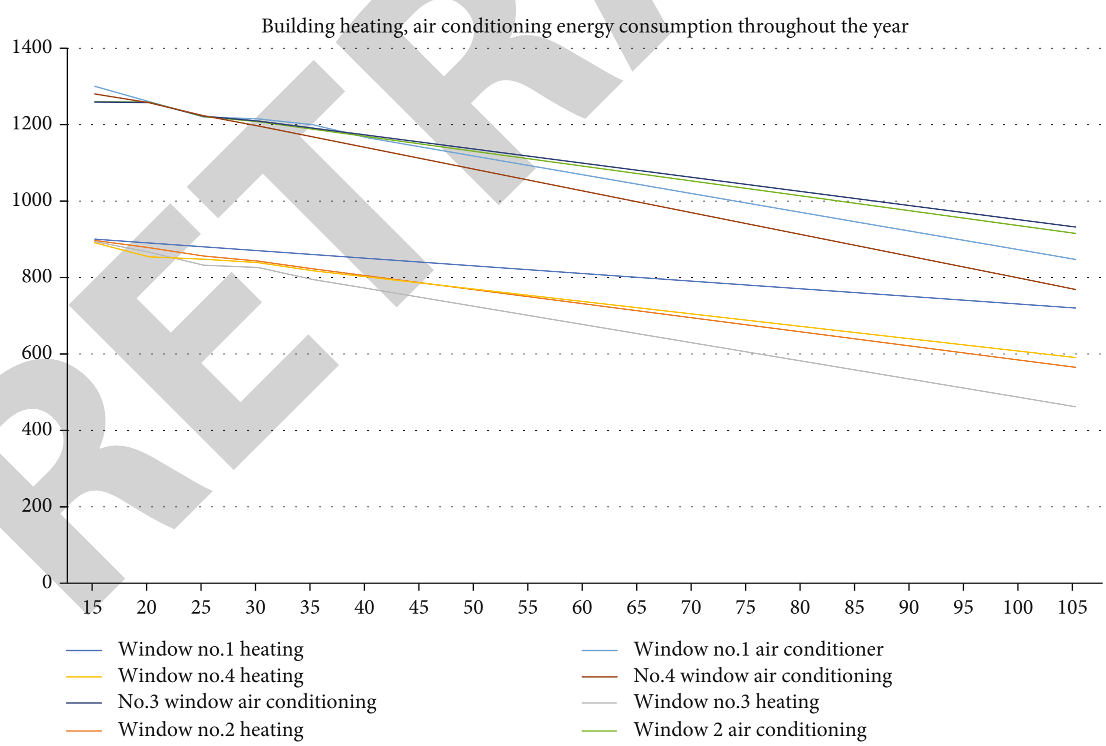

Figure 6: Building year-round heating, air conditioning energy consumption, EPS.

wall as an example of window number one. The insulation thickness takes the value range 20~100 mm, the market material supply, so take 5 mm as the difference. Window No. 1 (6+9A +6) is selected to establish the model of exterior wall insulation material such as XPS, EPS, and phenolic/PU for the annual energy consumption simulation, as shown in Figure 8.

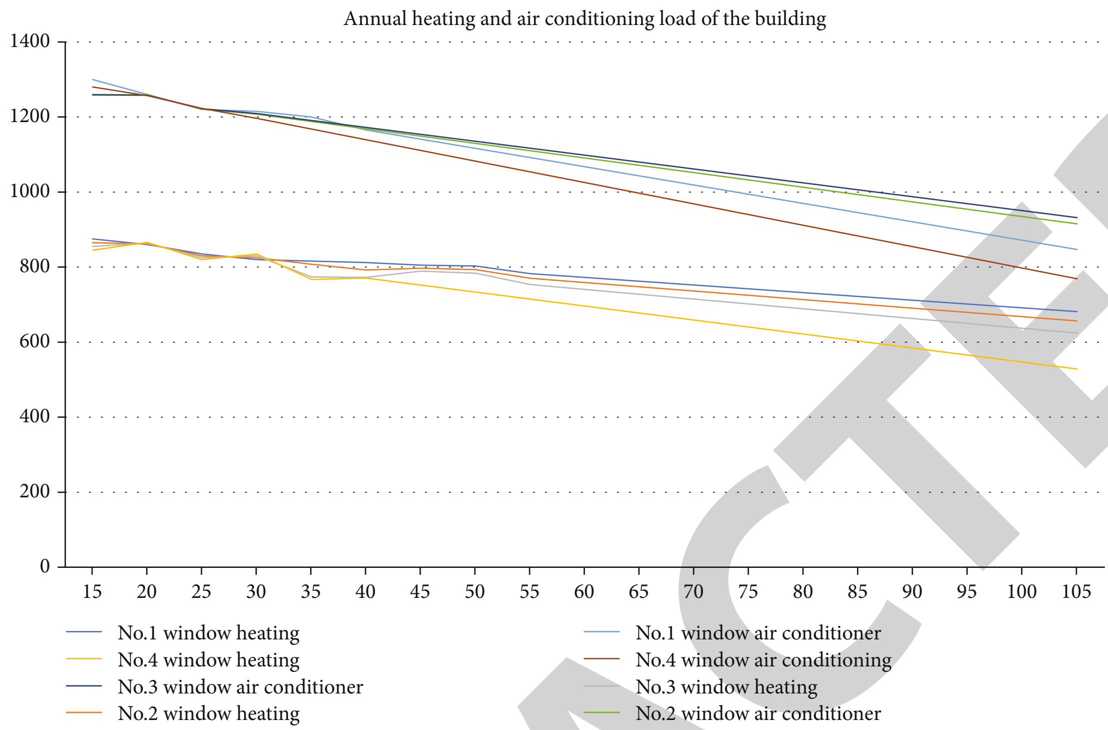

Figure 7: Building year-round heating and air conditioning energy consumption, phenolic/PU.

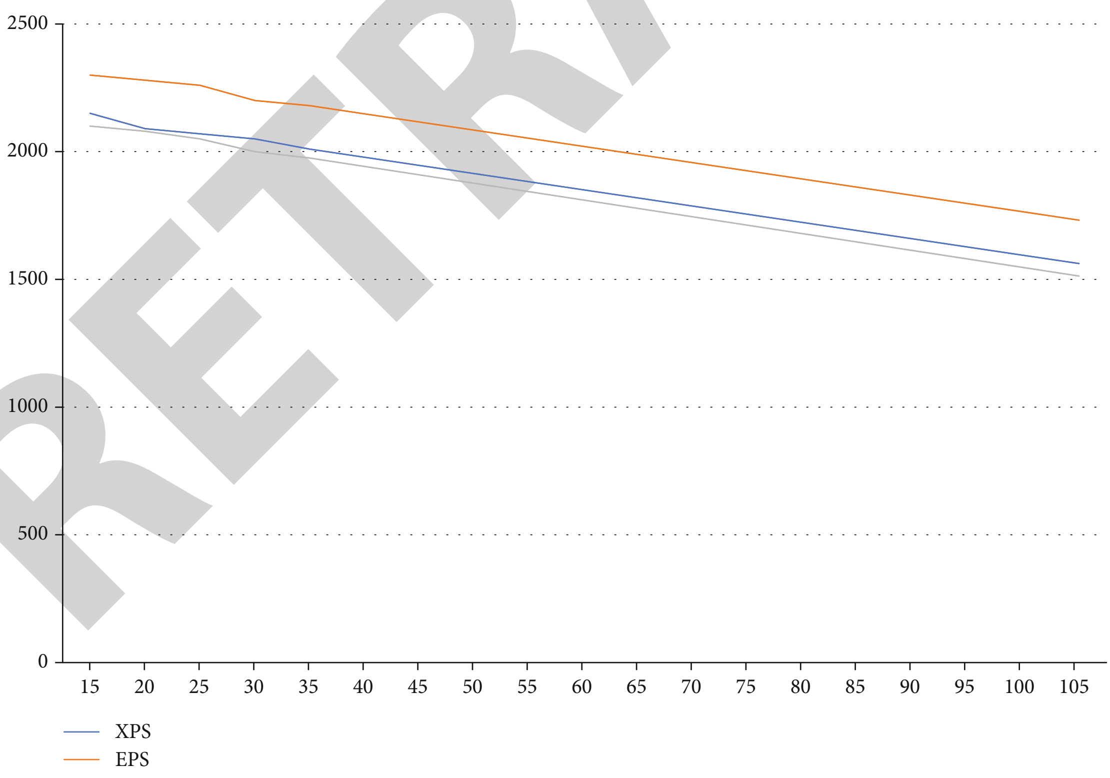

Figure 8: Relationship between insulation thickness and total heating and air conditioning load curve.

4.3.4. Multifaceted Analysis of Univariate Factors. With the external environment unchanged, SPSS software was used to conduct a multifaceted ANOVA on a single variable for the insulation thickness of the building's exterior walls and for different window types, so that the degree of influence of these two factors on the total air conditioning load could be distinguished.

4.4. Results. It can be concluded that the material coefficients K heat transfer coefficients of the building's exterior wall construction vary with different thicknesses of the insulation layer. As the material K values change, the building's energy consumption simulations behave similarly, and only the coefficients of heat storage and density have small differences, which lead to the same values of the experimentally simulated loads.

The simulation of heating and air conditioning loads using OpenStudio software is mainly applied to the base model of XPS-based insulation materials when different insulation thicknesses are taken in turn for the external walls. It is not difficult to find that, despite the increasing thickness of the insulation layer, the amount of load shows the opposite trend of reduction, most notably because the impact of different window types bucket air conditioning heating is small. Outdoor heat transfer capacity is determined by the thickness of the insulation layer, the thickness of the insulation layer from 20 mm began to grow to 100 mm in the process, the insulation layer is getting thicker and thicker, and the heat transfer capacity also decreases. It can be concluded that the thickness of the insulation layer and the heat transfer capacity show an inverse trend between the heating and air conditioning load is the same as the trend of change between the heating and air conditioning load, as the thickness of the insulation layer continues to increase, and the heating and air conditioning load are showing a continuous reduction but the rate of reduction in the shrinking trend. But all in all, compared to the decreasing trend of air conditioning, load heating energy consumption decreases and has a greater impact, while for heating load, the impact is smaller, and the cooling effect is stronger. Different window types have a smaller impact on the heating and air conditioning loads of the building, and the graphical trend is basically the same as XPS and EPS when phenolic/PU is used as the insulation material for the building exterior. It can be concluded that the air conditioning heating energy intensity of the assembled building in the west Sichuan plain area shows a decreasing energy intensity with the increase of the thickness of the insulation layer instead, and the decreasing trend is shrinking.

We take the no. 1 window as an example to study the numerical simulation of air conditioning load when heating the foundation formwork under different heat transfer coefficients, and it can be seen that as the thickness of insulation layer increases, the total energy consumption of the building shows a decreasing trend, and the magnitude is also shrinking. Different insulation materials show a positive correlation with the energy consumption as the heat transfer coefficient K increases in the same environment. From the figure, it can be seen that the three curves maintain the same trend of change, and finally conclude that whether the thickness of the insulation layer increases or not, and the change of energy consumption of the building under different insulation materials will not be much different.

From the equation, it can be concluded that R^2 is 0.999, 1, and 1.0001 and the p value of its F-test is 0 less than 0.005 which can be concluded that it is dominantly correlated and the fit of the simulation is better.

$$q_{\mathrm{XPS}} = 2533.207 - 23.699h + 0.258h^2 - 0.001h^3, \tag{9}$$

$$q_{\mathrm{EPS}} = 2566.490 - 19.818h + 0.186h^2 - 0.001h^3. \tag{10}$$

$$q_{\text{酚醛/PU}} = 2416.930 - 21.132h + 0.223h^2 - 0.001h^3 \tag{11}$$

The trends of the three curves of the fitted functional equation remain consistent in general.

5. Conclusion

This paper takes assembled buildings in the west Sichuan plain area as the research object, based on dozens of assembled building enterprises researched, selected samples of the studied envelope components, selected BIM technology for premodeling optimization, used neural network algorithm for the analysis of influencing factors, studied the application in the study of energy-saving optimization of the assembled building envelope in the west Sichuan plain area, and used OpenStudio to establish model to simulate the heating and air conditioning load of the assembled building numerically and fit the variable factors to quantify the building energy consumption. This paper first read the relevant literature to summarize the analysis methods of building energy consumption, researched and collected dozens of production schemes of assembled buildings, considered numerous complex influencing factors and various environmental situations, and finally decided to use OpenStudio as the analysis software, after which the corresponding data were derived and drawn according to the settings and restrictions of model parameters, considering different window types and insulation layer thickness materials. The relevant graphs were drawn. Afterwards, SPSS software was used to analyze the influence of various variables on the energy consumption of the building. The influence of covariates on building energy consumption and the quantitative relationship equations between variables and building energy consumption were summarized. Suggestions for optimization were made.

Data Availability

The dataset is available upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

Authors' Contributions

HuaDong Li and XuXiang Li made equal contributions to the manuscript. They worked together.

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