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Research on Performance Evaluation of Green Building Materials Based on Deep Learning Model

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Abstract:

The research purpose of this article is to improve the greenness of building materials. In this paper, a comprehensive evaluation and optimization model of green building materials energy saving is constructed by comprehensively using BIM full life cycle technology and Bayesian deep learning model network structure. The model achieves the effect of accurately evaluating the green performance of buildings. We use the BIM model to extract relevant data for quantitative indicator analysis. At the same time, we use the Bayesian network to conduct a comprehensive and comprehensive evaluation of the environmental performance of green building materials. The results show that the evaluation method has certain practicability and scientific, which lays a working foundation for the evaluation of BIM application value in green building materials and the research on application value promotion strategy.

Keywords*:Deep Learning; Green Building Materials; Material Performance Evaluation; Full Life Cycle Technology.*

I. INTRODUCTION

Facing the increasingly severe problems of energy shortage and environmental pollution, taking the road of green and sustainable development has become the focus of attention of various countries. In this context, green building materials have gradually become a new trend in the sustainable development of global buildings in the 21st century. As a multi-dimensional model information integration technology, BIM is the digital bearing and visual expression of the physical and functional characteristics of construction projects, and is an important support for the informatization of the construction industry [1]. The application of BIM to green building materials can effectively realize the information management and sharing and utilization of the whole life cycle of construction projects. One of the important roles of BIM application is to support the analysis and inspection of environmental performance, energy consumption and other aspects of construction projects. and simulation, which can provide a basis for scheme optimization and scientific decision-making in the whole process of construction projects, making green building materials more green and environmentally friendly.

Whether at home or abroad, when researching building energy consumption, it focuses on building energy consumption prediction and building energy consumption optimization. In the research on building energy consumption forecasting, some scholars have used the STIRPAT model to build a model of factors affecting urban building energy consumption, and used the least squares method and ridge regression analysis to calculate and analyze the model [2]. Some scholars have explored a model for building energy consumption prediction and building energy conservation analysis based on multiple linear regression with building type and area as parameters. Some scholars first screened out the key design parameters through single factor sensitivity analysis, and then carried out simulation calculation through orthogonal experimental design and multiple linear regression. Some scholars regularly update building models with online building operation data through dynamic artificial neural networks with nonlinear autoregressive exogenous structures. Some scholars have proposed a method to optimize the maximum likelihood model for predicting heating and cooling loads, and can search the possible parameter space. In the energy consumption optimization research, some scholars use the energy consumption simulation software DeST-c to simulate the relationship between the thermal performance of the building envelope and the building energy consumption under three different climate zones, and use the whole life cycle cost evaluation method to carry out evaluate. Some scholars use the energy consumption simulation software DeST-h to calculate the influence of the envelope structure parameters on the heating energy consumption in winter, and obtain the optimization scheme through orthogonal experiments. Some scholars take the sum of heating and lighting energy loads as the objective function, establish a functional relationship with the goal of minimizing energy consumption, and use genetic algorithm to optimize the solution. Some scholars use simulation technology to simulate building energy consumption, put forward the design principle of near-zero energy consumption building scheme, and use single-objective optimization method to optimize building energy consumption parameters. Some scholars focus on developing solutions with optimal development costs to meet NZEB standards. The result is 50% to 75% lower thermal energy requirements than current German building standards.

In this paper, scholars at home and abroad have conducted extensive discussions on the application of BIM in building environmental performance, energy consumption analysis, etc. Some scholars have found through research that the application of BIM in green building materials mainly focuses on building energy models, carbon emission analysis and assessment, indoor and outdoor environmental quality, light pollution, etc. Some scholars in Hao have studied the data transfer method between BIM and building energy models, and proposed a BIM-based building energy model evaluation method to develop energy-efficient building designs. Some scholars have proposed an automated model that combines BIM, LCA, energy analysis and lighting simulation tools with a green building material certification system, and develops plug-ins on the BIM tool to measure the environmental impact and the physical and chemical energy of building components [3]. Some scholars use the BIM-based green building material design method to simulate and analyze the optimal design of the building's solar radiation, natural light, natural ventilation and noise in advance. Some scholars have analyzed the energy consumption status of existing green building materials in combination with actual projects, and used BIM to optimize project management. In the research on the environmental performance evaluation of green building materials using BIM, some scholars use the literature reading method to screen and integrate the environmental performance evaluation indicators of green building materials, and establish the core index system for environmental performance evaluation of green building materials. The software objectively scores the building's environmental performance indicators. Some scholars have analyzed the development points of green building materials and BIM, and on this basis, they have deeply discussed how to effectively use BIM to promote the development of green building materials. Under this background, this paper takes green building materials as the research object, and combines BIM whole life technology and Bayesian network structure to establish a scientific and objective comprehensive evaluation and optimization model of green building materials, aiming to promote the development of green building materials in China.

II. CONSTRUCTION OF THE ENVIRONMENTAL PERFORMANCE EVALUATION INDEX SYSTEM OF GREEN BUILDING MATERIALS

Through sorting and induction, the environmental performance evaluation index of green building materials is composed of several interrelated and interacting elements. These elements determine that the index system has a certain level of hierarchy due to their characteristics. Therefore, the environmental performance evaluation index system of green building materials is used. It is divided into four parts: resource consumption, energy utilization, ecological environment, and indoor environment.

2.1. Resource consumption indicators

The consumption of building resources is closely related to the surrounding environment: hospitals, supermarkets, schools and other public facilities can bring convenience to users; heating in winter and air conditioning in summer can reduce the discomfort caused by the climate environment to the human body [4]. Compared with the huge consumption of resources in the construction and operation stages of buildings under traditional construction methods, green building materials incorporate the concept of ecological energy saving in the design stage, recycling building materials, and making full use of underground space. The consumption will be less than that of traditional buildings.

2.2. Energy utilization indicators

Compared with traditional buildings, the advantage of green building materials is to minimize the use of non-renewable energy on the premise of ensuring people's normal life, so as to reduce the damage to the environment. For example, solar energy can be converted into electricity through special equipment; rainwater can be collected and processed to replace part of tap water; in addition, the design of green building materials will also consider the use of natural light as much as possible to meet indoor lighting needs.

2.3. Eco-environmental indicators

A good ecological environment can bring users a happy mood. Therefore, the ecological environment analysis should run through the whole life cycle of green building materials, the impact of the construction stage on the surrounding ecological environment, the green vegetation coverage rate during construction, and the classification, collection and treatment of garbage during the construction and use stages are all in the life of green building materials. Note during the period.

2.4. Indoor environment indicators

Green building materials can reduce the consumption of resources in the whole life cycle, and the design also needs to bring maximum comfort to users in the indoor environment. Therefore, the indoor acoustic environment, natural lighting and thermal environment are all essential inspection indicators.

III. BIM-BASED EVALUATION AND OPTIMIZATION MODEL FOR GREEN BUILDING MATERIALS

According to the evaluation requirements and the performance of green building materials, the Ecotect software in BIM is used to simulate, and combined with the expert experience method, the specific parameters of each indicator are quantified, and the corresponding grade is determined, and each indicator is judged according to three grades of excellent, average and poor. As a digital processing algorithm, the Bayesian algorithm can quickly and efficiently complete the parameterization of the evaluation results. The Bayesian parameterization evaluation process is mainly based on network structure learning and parameter learning [5]. Therefore, the energy-saving evaluation of green building materials based on BIM and Bayesian technology mainly includes four steps, namely, scoring function construction, optimal network structure determination, parameter learning and evaluation value determination. The principle of the scoring function is the minimum description, that is, the one that is compressed the most under the given assumption is the optimal one. If a certain algorithm is used to save the real number set D, it is convenient to save and edit the real number. The sum of the algorithm and the edited real number is the total length. The detailed calculation model is shown in formulas (1) and (2).

$$MDL\left(B\middle|D\right)=\frac{log\ N}{2}\left|B\right|-LL\left(B\middle|D\right) \tag{1}$$

$$LL\left(B\middle|D\right)=\Sigma_{i=1}^{n}log\ p\left(X_j\right)=\Sigma_{i=1}^{n}\Sigma_{X_j\in val\left(X_j\right)}P_D\left(X_j\middle|\pi_i\right)log\left(\theta_{X_j}\middle|\pi_i\right) \tag{2}$$

The scoring function is the basis for constructing the optimal network structure, and the search algorithm determines the optimal network structure based on this. Search algorithms have many forms, of which the most widely used is the greedy search algorithm. The data set required for network structure learning is a priori data, and the corresponding processing process is described later. Assuming that the initial edge is represented by e, the set of edge elements is represented by E, and there is $e \in E$ at the same time, select from the set of edge elements E, find the optimal e, add e to the scoring function, and observe and record its change value, which is represented by $\Delta(e)$. On the basis of determining the initial network structure, select the best edge element e, so that $\Delta(e) f \Delta(e)'$ is established and satisfies $\forall e' \in E$, including $\Delta(e) f 0$, this process will continue until all unqualified e are deleted from the edge element set. The parameter learning needs to use the maximum likelihood estimation method. In the parameter learning process, it is assumed that the subset of the node value set is represented by D, and the subsets are independent of each other. It can be seen from the maximum likelihood estimation principle that the joint probability density of D can be obtained. A network structure with the largest value range is established on the above, and this network structure is represented by S, and the involved calculation model is shown in formula (3).

$$\frac{\partial LnP_w(D)}{\partial w_{ijk}} = \Sigma_{h=1}^{m} \frac{\partial P_w(D_h)}{\partial w_{ijk}} \times \frac{1}{P_w(D_h)} = \Sigma_{h=1}^{m} \frac{P_w\left(Z_i = (k,j) \middle| D_h\right)}{w_{ijk}} \tag{3}$$

In the above formula, $P_w(D)$ represents the joint probability density, and the joint probability density is the comprehensive value of the numerical set of each node; w_{ijk} represents the probability value k of the parent node of the i child node in the j state; $LnP_w(D)$ represents the $P_w(D)$ monotonically increasing function; The parent node is located in the value of k, j state $Z_i = (k,j)$ respectively; $P_w\left(Z_i = (k,j) \middle| D_h\right)$ represents D_h ((known evidence) and the joint probability distribution of each node in each state. The evaluation value calculation is a comprehensive process, and the joint probability of the terminal node is assumed to be in state 3. The rating result of the terminal node is excellent, the rating result in state 2 is average, and the evaluation result of state 1 is poor, in which $P(state_i)$ is used to represent the conditional probability value of the terminal node in each state, and the goal of using BIM and Bayesian network technology is to quantify The various evaluation indicators of green building materials can finally obtain the energy-saving evaluation effect of green building materials, and the corresponding calculation model is shown in (4).

$$G = 90 \times P(state_3) + 60 \times P(state_2) + 30 \times P(state_1) \tag{4}$$

It can be seen from the above formula that when G ≥ 60, the green energy-saving evaluation of a building is assumed to be excellent; if 30 ≤ G < 60, the green energy-saving evaluation of a building can be assumed to be average; when G < 30, the green energy evaluation of a building can be assumed. The energy-saving evaluation was judged to be of poor quality [6]. Therefore, through the above process, the comprehensive evaluation of energy saving of green building materials can be achieved, and the comprehensive evaluation can be used as the result of Bayesian forward inference, laying the foundation for the optimization of the performance of green building materials. Using the reasoning function of the Bayes algorithm, through forward reasoning, the relationship between the influencing factors of

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energy-saving evaluation can be found out, and the decision-making support for optimizing the energy-saving performance of green building materials can be provided. The forward inference process needs to change the probability of the influencing factor nodes. Under the condition that other probabilities are fixed, Bayes can obtain the energy-saving evaluation probability value through propagation, and compare the probability changes of each node to verify the validity of the network model and determine each node. The corresponding calculation formula is shown in (5).

$$P(T)=\Sigma_1\left(P\left(T=1\middle|P(X_1=X_1,X_2=X_2,...,X_n=X_n)\right)X\times P(X_1=X_1,X_2=X_2,...,X_n=X_n)X_i\right) \\ \in(state_1,state_2,state_3) \tag{5}$$

The number of root nodes is represented by n, the state value of each root node is represented by $state_1,state_2,state_3$, there are 3n arrangements; the forward propagation conditional probability table of Bayes network is represented by $|P(X_1=X_1,X_2=X_2,...,X_n=X_n)$; and the joint probability distribution of terminal nodes is which $P(X_1=X_1,X_2=X_2,...,X_n=X_n)$ is represented; the level probability value is represented by $P(T)$.

IV. PERFORMANCE EVALUATION AND ANALYSIS OF NEW RESIDENTIAL BUILDING MATERIALS

The construction upstream process of material production and processing and building construction is considered in the ecological analysis. Component renewal and replacement and final dismantling treatment process in the operation phase. Transportation, construction labor and mechanical issues, and cleaning included in each stage are not included. In the economic analysis, labor and mechanical costs for new construction and replacement are considered [7]. It is particularly pointed out that in this study, a building life cycle analysis based on building materials and a building life cycle analysis based on building components were carried out to compare the results of the two different algorithms and the possible reasons. The material loss rate during construction is not considered at the component level (Figure 1 cited in Environmental impacts of building materials and building services components for commercial buildings in Hong Kong).

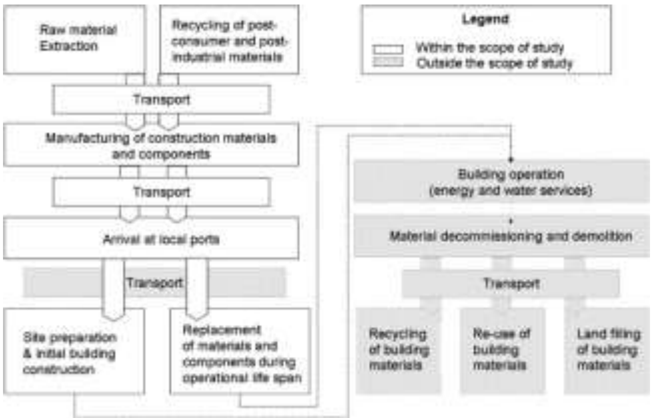

Fig.1 System Boundary Diagram

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The building structure is a shear wall structure, partly filled with concrete blocks. Insulation material: XPS extruded polystyrene board and FTC phase change insulation material. The main outer wall thickness is 200mm reinforced concrete and 200mm aerated concrete block. The energy supply is in the form of district gas boiler heating and district grid power supply (Figure 2 is the first floor plan of the Revit building, the picture is quoted in Detailing in Revit).

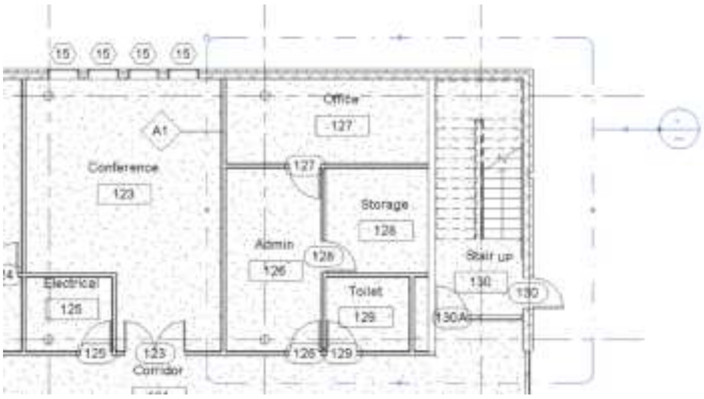

Fig. 2 The first floor plan of the Revit building

The basic data of this study include: 1) the area and volume information of building materials extracted and estimated from the BIM model, 2) the building construction drawings, 3) the energy consumption model of the building and operation stages, 4) the district heating system data, 5) according to the German The maintenance and replacement time of building components determined by the component life specification, 6) China's building materials density table specified in China's "Practice Manual for Cost Engineers", 7) LCI database Ecoinventv2.2 and BEPAS data.

4.1. Building material density

The material and component statistics in BIM are calculated according to physical dimensions, which are volume and area units, while the material calculation unit in Ecoinvent2.2 is usually the mass unit, and the material density is used to convert the volume to the mass unit. For cost analysis, since the "Basic Price of Construction/Decoration Project Budget" is basically represented by volume units, only part of the construction and materials are required for unit conversion.

4.2. Repair and Replacement

The service life of building components is the necessary data for life cycle assessment, which is generally based on long-term observation and statistics based on the experience value obtained from the service life of components. The actual building construction and structural service life depend to a large extent on the production quality, design quality, specific load-bearing load and maintenance of the building components. In general, the life span of a certain building component is a range of values. In building evaluation, the average value is often used to represent the life span of a building component.

4.3. Using energy consumption

The ground floor of Building A is a small shop, and the rest are living spaces. The building electricity is mainly divided into room electrical electricity, lighting, small power system, cooling and domestic hot water (in the DB simulation, the domestic hot water is generated by electricity), and the Gas heating (natural gas) is the heating method (Figure 3).

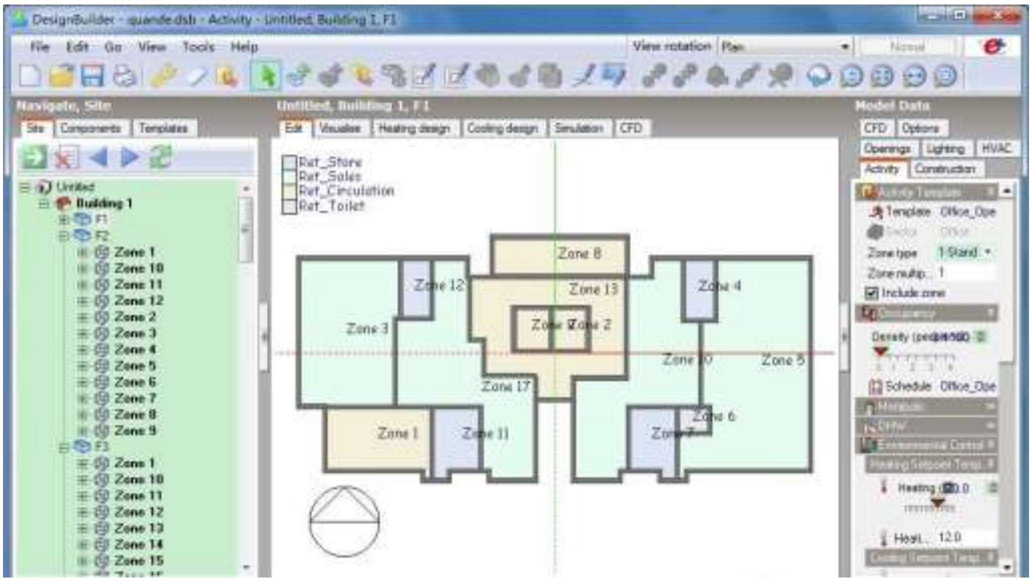

Fig.3 Basic layout of small shops on the ground floor of Residential Block A

TABLE 1 Energy supply breakdown and summary

		annual average	/year/m^2	50 years
Room electricity	kWh	285600.7	16.5	14280037
Illumination	kWh	314969.2	18.2	15748460
system	kWh	48828.54	2.8	2441427
Heating (gas heating)	kWh	913938.5	52.7	45696925
Refrigeration (electricity)	kWh	258705	14.9	12935251
Domestic hot water (electricity)	kWh	139565.6	8.1	6978278

4.4. List of building components based on BIM

According to the Revit modeling method, the high-rise residence is divided into reinforced concrete shear walls, other walls, floors and other building components (excluding beams and columns). 90% of the walls in the building are reinforced concrete walls, including staircases and elevator enclosures [8]. Insulation material: The exterior walls of some buildings on the ground are all 50mm thick extruded polystyrene panels (XPS), and the inner wall structure of the stairs is composed of 20mm thick FTC phase change insulation materials. Since this study is a simplified calculation, the beams and foundations of the building structure are not considered. The Revit building model can define and classify materials by component and location (Table 3).

TABLE 2 List of underground walls (drawn from Revit schedule)

member	Material	Quantity	Unit
Underground load bearing wall	RC	1359.2	m^3
exterior wall waterproofing	XPS extruded polystyrene board	5.9	m^3
Exterior non-load bearing wall	Shale brick blocks	149.0	m^3
underground wall	cement lime mortar	215.5	m^3

Two kinds of reinforced concrete in Ecoinventv2.2: ordinary concrete and foundation concrete, the density of ordinary concrete is 2380kg/ m^3, including 300kg cement, 1890kg crushed stone, and 190kg water, the base concrete is 2385kg/ m^3, including 325kg cement, 1880kg crushed stone and 180kg of water [9]. The Revit building model classifies the building system-component-construction layer according to the hierarchical relationship, and the quantitative list corresponding to the component-material can be obtained when the quantity of the component is exported from the schedule. The facade system mainly includes external doors and windows (including glass) and above-ground external walls (including thermal insulation layers) (Table 4-Table 6).

TABLE 3 List of Exterior Wall Materials

member	Material	Quantity	Unit
Exterior wall	RC	4196.7	m^3
	cement mortar	1573.2	m^3
	face brick	87.3	m^3
	latex paint	77.9	m^3
	Aerated block	2425.4	m^3
	FTC insulation materials	53.7	m^3
	Crack-resistant mortar meets alkali-resistant mesh	13.4	m^3
	Flexible putty primer	4.3	m^3
	Synthetic resin emulsion paint	4.3	m^3
	Adhesive for cement	114.2	m^3
	Insulation extruded board	571.1	m^3

TABLE 4 Door List

member	Material	Quantity	Unit
Door	Wood	64.61	m^3
	Plastic steel	6.47	m^3
	Low-E insulating glass	14.95	m^3
	Broken bridge aluminum alloy	3.62	m^3

TABLE 5 Window List

member	Material	Quantity	Unit
Window	Low-E insulating glass	50.0	m^3
	Broken bridge aluminum alloy	7.5	m^3

TABLE 6 Roof Checklist

member	Material	Quantity	Unit
Roof	Polymer modified asphalt felt	3.7	m^3
	Cement mortar (polypropylene)	9.3	m^3
	Extruded Polystyrene+	32.5	m^3
	RC	46.4	m^3

TABLE 7 Ceiling List

member	Material	Quantity	Unit
Ceiling	cement lime mortar	47.78	m^3
	metal-skeletal layer	151.65	m^3
	+Aluminum alloy material	40.44	m^3

TABLE 8 List of floor slabs

member	Material	Quantity	Unit
Ceiling	RC	1997.3	m^3
	C20 (fine stone) concrete	50.6	m^3
	sand cement mortar	189.6	m^3
	FTC insulation material	5.4	m^3
	granite	19.0	m^3
	No. 350 Petroleum Asphalt Linoleum	0.8	m^3
	Neoprene waterproof coating	0.005	m^3
	Polyurethane waterproof coating	0.13	m^3

4.5. Waste Management

After the end of the life of the building components and the end of the overall life cycle of the building, the building components and materials will be processed and disposed of in the next step, that is, the waste management at the end of the life cycle. Disposal route of construction products in Ecoinvent v2.2 1) Direct recycling 2) Sorting recycling 3) Final disposal (Figure 4 referenced at https://etoolglobal.com/faqs/what-boundaries-have-you-used-for-etool- lca/).

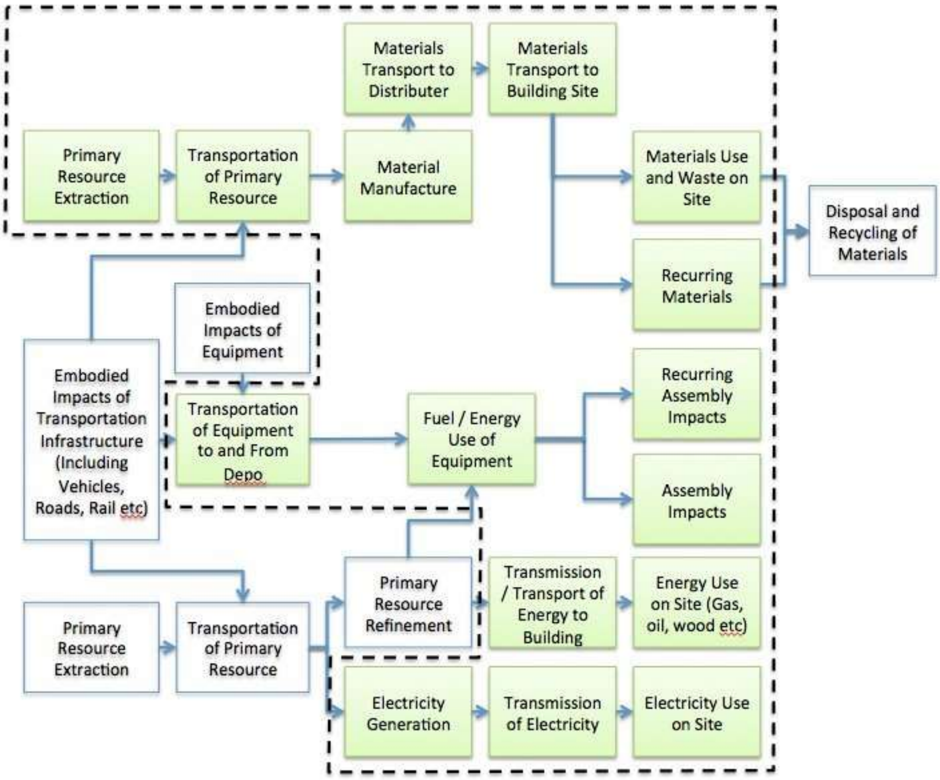

Fig.4 System boundaries for construction material disposal

V. RESULTS AND ANALYSIS

5.1. Primary energy consumption (non-renewable) use

Operational energy consumption accounts for 74% of the total life cycle energy consumption, physical and chemical energy consumption for new construction and maintenance and replacement accounts for 19%, and demolition and disposal energy consumption at the end of the life cycle accounts for 7%. Room electricity and lighting energy consumption account for nearly 75% of operating energy consumption, and natural gas heating consumes less non-renewable energy consumption, which is an ideal form of heating energy (Figure 5 is quoted in RENEWABLE ENERGY ALTERNATIVES–A GROWING OPPORTUNITY FOR ENGINEERING & TECHNOLOGY EDUCATION). In the physical and chemical energy consumption of new components, the main structural material of walls and floors is reinforced concrete [10]. Its energy content is relatively high, and the two account for 60% of the total physical and chemical energy consumption. The door and window components are processed through multiple processes, so the component energy content is relatively high, accounting for 53%. Since the life expectancy of the wall skirting finish is 10 years, the building components begin to be replaced in the 10th year, and then the components with different lifespans will be replaced in the 20th, 25th, 30th, and 40th years, of which the short-lived components have occurred several times. replacement. The curve changes between maintenance and replacement and the end of the life cycle. When the building is demolished in the 50th year, the primary non-renewable energy consumption at the end of the life cycle has increased significantly.

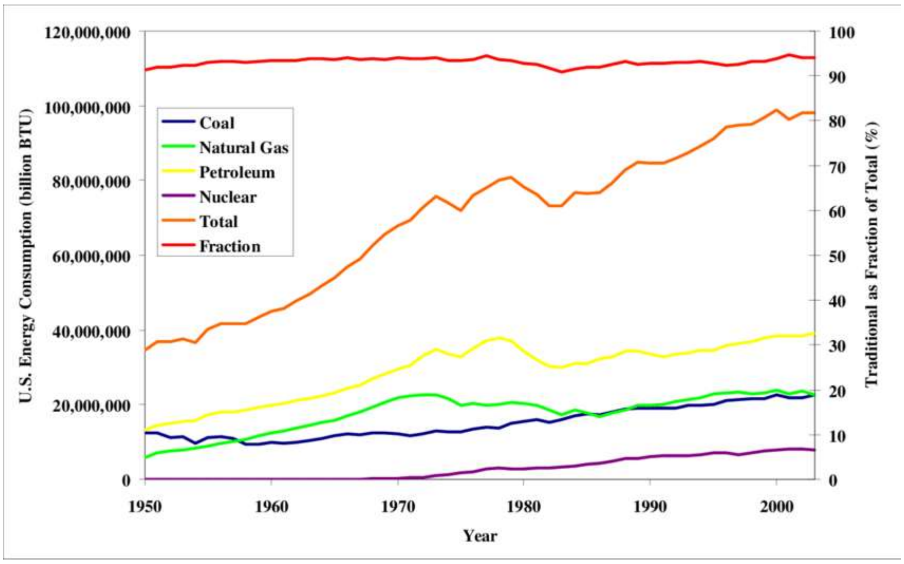

Fig. 5 Proportional allocation of each part of non-renewable energy consumption in one life cycle

5.2. Life Cycle Greenhouse Gas Emissions

Similar to the proportion of non-renewable energy consumption, operating energy consumption accounts for 77% of life cycle greenhouse gas emissions, new construction greenhouse gas emissions account for 11%, and maintenance and replacement stages and end-of-life stages each account for 6% (Figure 6 quoted in RENEWABLE ENERGY ALTERNATIVES –A GROWING OPPORTUNITY FOR ENGINEERING & TECHNOLOGY EDUCATION). In the energy consumption of operation, the greenhouse gas emissions of electricity used in lighting rooms still occupy a major position, the greenhouse gas effect of natural gas accounts for 30% of the total, and the greenhouse gas contribution of floors, walls, and doors and windows in the new construction stage accounts for the new physical and chemical greenhouse gases. 60% of the total [11]. Component removal treatment GHG emissions vary with component replacement and component end-of-life time. Component replacement and end-of-life greenhouse gas effects occurred in the 10th, 20th, 25th, 30th, and 40th years after the building was completed, and the most important repairs were updated in the 25th year, mainly interior wall finishes, floor finishes, Updates to the ceiling elements. The proportion of greenhouse gas emissions in the construction phase decreases year by year, and the proportion of greenhouse gas emissions in the operation phase remains basically unchanged after 25 years of construction.

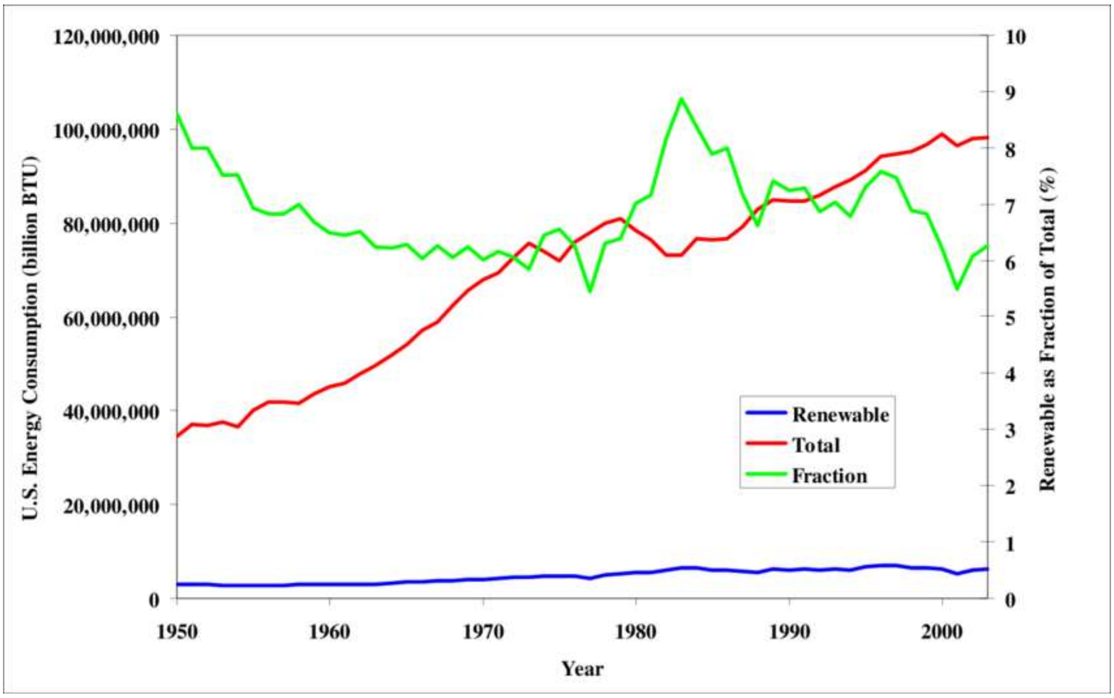

Fig.6 Proportion distribution of life cycle GHG emissions by component

VI. DISCUSSION OF RESULTS

6.1. Carbon Emission Analysis at Different Stages

From the perspective of the life cycle of prefabricated components, this project is analyzed. The production stage of total carbon emissions of prefabricated components in this project is the key stage of prefabricated components emission reduction. The production process is analyzed in detail, and it is found that the carbon emissions in the production stage mainly come from the use of building materials. of carbon emissions, concrete and steel are the main sources of carbon emissions. Therefore, in the actual production process, the waste of concrete and steel bars should be reduced. As the main material of concrete, cement can be considered to use a superplasticizer to reduce the amount of cement in the production process of concrete, and at the same time, it can improve the strength of prefabricated components. source to reduce carbon emissions as much as possible. As an indispensable material in the construction process, steel should improve the utilization rate of materials and use it rationally to reduce waste. Aluminum materials are used as embedded parts, and the amount of use is small. However, due to the large carbon emission factor of aluminum products, carbon emissions are generated to a certain extent. While reducing the waste of aluminum materials, it can be considered to use a carbon emission factor with a higher carbon emission factor. Small alternative materials are used as embedded parts, which can greatly reduce the generation of carbon emissions. The transportation stage is mainly related to the amount of component engineering and the length of the transportation distance. Consider choosing a component factory near the project for transportation to reduce carbon emissions.

6.2. Carbon Emission Analysis of Components

Analyzing the carbon emission of each component per cubic meter, the carbon emission of the prefabricated shear wall is the largest in the production stage, followed by the superimposed beam, which is mainly due to the large consumption of steel bars, resulting in more carbon emissions. The main consumables such as steel bars of the inner wall are smaller than other components, so the carbon emission is the smallest; the carbon emission per cubic meter in the transportation stage is related to the weight of the component, and the carbon emission per cubic meter in the construction and installation stage is related to the complexity of the component installation. Relatedly, the higher the complexity, the more energy is consumed mechanically during installation, and the greater the carbon footprint it produces. As a whole, the carbon emission of each component is directly related to its engineering volume. In the project, the carbon emission of the composite beam components is the smallest, mainly because the engineering volume of the composite beam is the smallest, so the components used in the project with the largest proportion are an important part of carbon emissions.

6.3. Carbon emission comparison with traditional construction methods

In the case of selecting similar building areas at the same stage, we use prefabricated components and traditional cast-in-place carbon emissions for comparative analysis. The carbon emission in the materialization stage of the traditional construction method is 0.114t/m^2, and the prefabricated component part of the prefabricated building is 0.056t/m^2, that is, the use of prefabricated components can reduce the carbon emission of the building. Comparative analysis and improvement of the prefabrication rate of the building Conducive to promoting the development of low-carbon buildings.It can be found that the proportion of carbon emissions of traditional cast-in-place buildings in the production and transportation stages is higher than that of prefabricated buildings, mainly because the rough management of the cast-in-place method leads to large material consumption and waste, which increases the generation of carbon emissions. The transportation phase of prefabricated buildings accounts for an increased proportion of carbon emissions compared to traditional cast-in-place.

VII. CONCLUSION

The energy-saving evaluation index system of green building materials is obtained by comprehensively using the literature method, expert experience method and questionnaire method. On the basis of combining BIM technology and Bayes network structure, a comprehensive evaluation and optimization model of green building energy-saving is constructed. The energy-saving performance of the building can be comprehensively scored, and the corresponding rating results can be obtained according to the scores.

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