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Research Article

New Technological Measures of Sustainable Buildings in Triple Bottom-Line Analysis

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At present, China is in a period of rapid urbanization, and the concept of green structure is getting more and more attention. Green structures can solve asset utilization and ecological problems brought about by rapid urbanization. Therefore, green structure has become the only way for the development of China's construction industry. This paper aims to study the feasibility analysis of new green building technology measures. The related concepts of green building, the analytic hierarchy process, and the meaning of life cycle cost are proposed. The main assessment bottom lines include engineering, environmental, social, and economic bottom lines. From the application examples of green building technology in the starting area of Guangzhou International Financial City, it can be seen that, based on the green building technology proposed in this paper, it is necessary to sort out specific technologies and practices suitable for the actual application of the project in a specific project. Then, the applicability and incremental cost of each technology can be analyzed, and finally, a green building technology system suitable for specific project applications is formed. The experimental results show that compared with residential buildings, the increase of public buildings is 338 million yuan, and the increase of nonassigned parts is about 9.84 million yuan.

1. Introduction

As cities continue to grow in size and overall populations, interest in energy and assets in urban communities continue to expand, and so does disease in urban communities. With people's in-depth thinking on urban issues, the concepts of "sustainability" and "green" have gradually become a consensus around the world. In the context of large-scale urbanization, the construction industry has entered an era of relatively rapid development. Large-scale building demolition makes large buildings occupy a lot of land resources, consume a lot of water resources, and have a great negative impact on urban air quality and microenvironment. The waste generated from the construction to the demolition process of the building will have a huge load on the ecological environment.

The optimization and integration of green building comprehensive evaluation system is an important research direction in the current green building field. The research on the evaluation system is conducive to the development of the evaluation and comparison of green buildings and helps to formulate evaluation standards for green buildings. It also contributes to the design, construction, operation, and management of green buildings. The concept of green building includes not only the quality of the indoor environment but also the impact of the building on the external environment. The innovation of this paper is to discuss the feasibility analysis of new green building technology measures, which has certain innovation and practicability, and is conducive to the sustainable development of economy and society.

2. Related Work

With the escalation of the logical inconsistency between monetary turn of events and ecological security, the basic and broad plan strategies for the customary development industry have been not able to meet the necessities of practical turn of events, green structure energy preservation, and natural assurance, which will definitely turn into the prerequisites of future structures. Accordingly, the improvement of the development business has turned into an examination area of interest. Shi and Song started from the green building theory, which combines the characteristics of life cycle cost and takes sustainable development as the guide. The green building cost is divided into five stages: decision making, design, construction and commissioning, operation and maintenance, and recovery [1]. Blanco et al. accepted that a manageable innovation for further developing energy effectiveness in structures is the utilization of metropolitan vegetation, and found that building indoor air temperature relies upon a few distinct boundaries. These boundaries are connected with the environment of the area, the actual structure, and its motivation [2]. Liu established a virtual building model using building information modeling (BIM) and used this model to analyze and simulate the annual energy consumption [3]. Gogoi expounded the characteristics of green buildings and tried to find out the factors that affect the satisfaction of occupants in purchasing or recommending green buildings [4]. However, the shortcoming of these studies is that they are too one-sided.

With the development of social economy, more and more scholars have conducted research on AHP. Jagtap and Bewoor introduced the application of analytic hierarchy process (AHP) in the identification of key equipment in thermal power plants [5]. Emmanuel proposed a higher education teaching evaluation method combining analytic hierarchy process (AHP) and data envelope analysis (DEA) [6]. Ahmed et al. proposed a goal-based AHP method. The method assigns pairwise comparison values based on field data collected from the Mumbai city road network (consisting of 28 road segments) [7]. For exact testing utilizing well-being administrations research instruments, Agapova et al. met a false ACR AC board of crisis division radiologists and nonradiologists. The general propriety of imaging studies to analyze thought a ruptured appendix was evaluated by multistandard choice examination [8]. However, the shortcoming of these studies is that the model is not scientific enough and needs to be further improved.

3. Relevant Methods for the Feasibility Deconstruction of New Green Building Technical Measures

3.1. Green Building Technology

3.1.1. Green Building Technology Development Process. As per the turn of events and activity of green structure innovation, the existence pattern of green structure innovation improvement is isolated into five phases and three periods [9]. The specific stages are shown in Figure 1.

In the generation stage, in the process of conception and gestation of green building technology, the main work includes the initial conception of technology and the generation of technology prototype. The second stage of green building technology development is the technical review stage. At this stage, a specific analysis is carried out to generate the technology of the stage, and a feasibility study report of the technology is formed. The technical design stage is the third stage of technical development, and the work in this stage includes preliminary design and construction drawing design. In the fourth stage of technical construction, green building technology is put into operation, and the main work includes technical preparation, technical construction, and technical completion acceptance. As the last stage of green building technology development, the use feedback stage often requires a longer feedback time and, at the same time, can best reflect the technical operation effect, also known as the posttechnical evaluation stage [10].

3.1.2. Material Selection and Construction of Green Buildings. Building materials are an integral part of buildings, and green building materials are the basis for green buildings. At present, one of the reasons why the concept of sustainable building development in China is not implemented in place is that building materials consume high resources and energy in the production process and use process, causing serious environmental pollution [11–13]. Trying to use environmentally friendly and pollution-free green building materials and vigorously building green buildings is one of the effective ways to save energy and protect the environment.

In recent years, green building materials used in buildings include ecological cement, green ecological concrete, green paint, green glass, and other green materials (as shown in Table 1).

The basic mineral composition and performance of ecological cement are similar to ordinary cement, but the quality is high and the cost is low. There are many types of green ecological concrete. Permeable concrete has water permeability and is mainly used for road and ground pavement, with great application potential. At present, 7%–15% of urban roads in China are covered by concrete. Sound-absorbing concrete can significantly reduce noise, mainly used in airports, highways, subways, and other places where constant noise is generated [14, 15]. Green HPC extends the life of buildings and is cost-effective. Green paint has the characteristics of strong adhesion, long service life, and harmless to people. It is a high-performance paint. Low-E glass is a kind of green glass, which can greatly reduce the dissipation and radiation of indoor heat to outdoor spaces [16].

3.1.3. Theoretical Basis for Economic Analysis of Green Buildings

(1) The Principle of Correlation Analysis. Statistical analysis of correlation is one of the commonly used methods in economics. The calculation principle of the correlation coefficient is as follows: in the first place, the covariate of the two factors is determined, and afterward partitioned by the different scattering and standard deviation of the two factors to normalize to acquire a normalized score with a unit eliminated [17]. The calculation formula of the correlation coefficient is as follows:

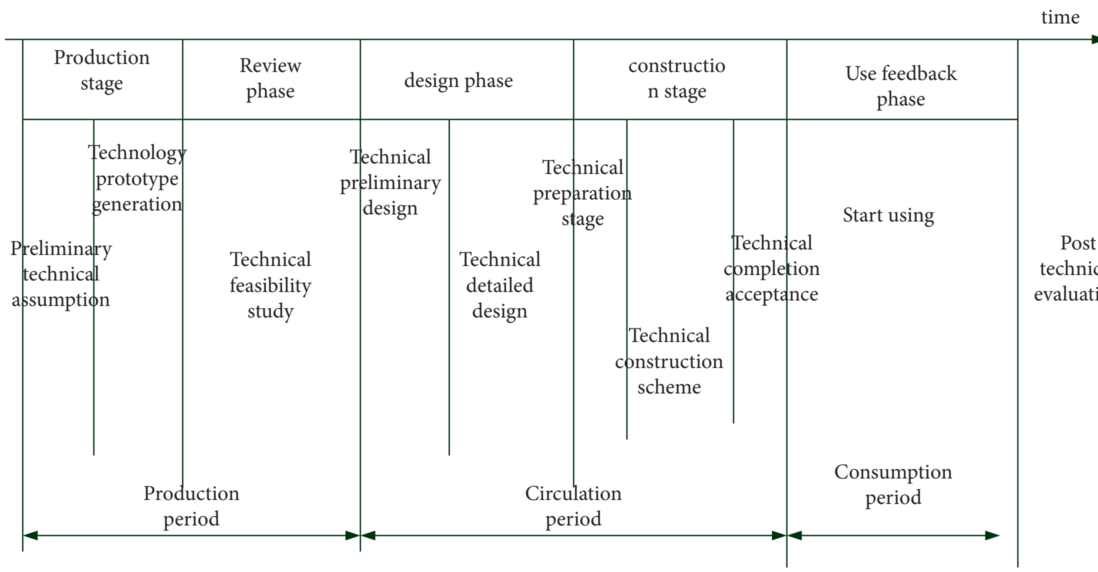

FIGURE 1: Development process of green building technology in the whole life cycle.

TABLE 1: Classification statistics of green building materials.

Serial number	First-class classification of green building materials	Secondary classification of green building materials
1	Green cement	
2	Green concrete	Permeable concrete; sound-absorbing concrete; radiation proof concrete; keywords green high-performance concrete; recycled concrete; plant compatible concrete
3	Green paint	Waterborne coatings; solvent-free coating; solvent-based coatings with high solid content; powder coating
4	Green glass	Hollow glass; vacuum glass; low radiation glass; smart glass
5	Other green materials	Thermal insulation materials; waterproof materials; green chemical building materials; other new products of green building materials

$$r = \frac{\operatorname{cov}(a,b)}{S_a S_b}, = \frac{\sum(A-\overline{A})(B-\overline{B})}{\sqrt{\sum(A-\overline{A})\sum(B-\overline{B})}}. \quad (1)$$

The correlation coefficient r is between −1 and 1. A positive value indicates a positive correlation between the variables, and a negative value indicates a negative correlation between the variables. The degree of correlation between variables is proportional to the absolute value of the r coefficient. A and B are the independent variable and dependent variable in the sample point, respectively. $\overline{X}, \overline{Y}$ are the mean of the independent variable and the mean of the dependent variable in the sample points, respectively. Since the correlation coefficient is a t-distribution, the test of the correlation coefficient is as follows:

(a) Make assumptions: $H0: R = 0$; $H1: R \neq 0$;

(b) Calculate the value of the statistic based on the data of the research sample:

$$T = \frac{p}{\sqrt{1-p^2/n-2}}, = \frac{p\sqrt{n-2}}{\sqrt{1-p^2}}. \quad (2)$$

Among them, n is the number of samples.

(c) Carry out inspection and judgment:

When the significance level is ∂, we check the T distribution table, the degree of freedom is n-2, and the corresponding critical value is $T_{\partial/2}(n-2)$. If there is $|T| > T_{\partial/2}(n-2)$, the null hypothesis should be rejected, which means that at the significance level of ∂, the two variables are significantly related. Otherwise, the null hypothesis should be accepted that at significance level ∂, the two variables are not correlated [18].

(2) The Principle of Linear Regression Analysis. The main purpose of regression analysis is to build a regression model with the help of independent variables; according to the

measured data, the parameters of each index in the model are solved. The reliability of the model is judged by the degree of fit between the predicted data and the measured data, so that the model can be used to predict the relative dependent variables.

Generalized mathematical model for multiple linear regression analysis. Let the predictable variable be B, which is affected by m variables $A_1, A_2, \ldots, A_m$ and unpredictable random factors, the general multiple linear regression model is expressed as follows:

$$B = \beta_0 + \beta_1 A_1 + \beta_2 A_2 + \cdots + \beta_m A_m + \varepsilon. \tag{3}$$

Among them, $\beta_1, \beta_2, \ldots, \beta_m$ is the regression coefficient.

For the existing n sets of sample data, it can be expressed as follows:

$$\begin{bmatrix} B_1 \\ B_2 \\ \cdots \\ B_n \end{bmatrix} = \begin{bmatrix} 1 & a_{11} & \ldots & a_{m1} \\ 1 & a_{12} & \ldots & a_{m2} \\ \cdots & \cdots & \cdots & \cdots \\ 1 & a_{1n} & \ldots & a_{mn} \end{bmatrix} \cdot \begin{bmatrix} \beta_0 \\ \beta_1 \\ \cdots \\ \beta_m \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \cdots \\ \varepsilon_n \end{bmatrix}. \tag{4}$$

This matrix can be rewritten as $B = A \cdot \beta + \varepsilon$. The least square method is used to calculate the value of the model regression coefficient β. First, the sum of squares of errors (SSE) must be minimized so that the minimum sum of squares of errors can be obtained through the partial differentiation of formula (5) to β.

$$\mathrm{SSE} = (B - X\beta)' \cdot (B - A\beta). \tag{5}$$

Among them, ε' is the transpose matrix of ε. The normal formula to obtain the least squares theory is $(A'A)\beta = AB$.

Therefore, the regression coefficient matrix can be obtained as follows:

$$\beta = (A'A)^{-1} AB. \tag{6}$$

Tests of regression mathematical models. After the model is established, it is also necessary to test the model and calculate the prediction error. Tests of regression mathematical models include the following: fit degree test, overall model significance test, regression coefficient significance test, collinearity diagnosis, and homogeneity of variance test [19]. In the fit test, the coefficient of determination R^2 represents the fit and explanatory power of the linear regression model established by the independent and dependent variables. The value of R^2 is between 0 and 1, and the closer to 1, the higher the degree of fit. The formula for calculating R^2 is as follows:

$$R^2 = \left(\frac{\sum (A - \overline{A})(B - \overline{B})}{\sqrt{\sum (A - \overline{A})^2} \sqrt{\sum (B - \overline{B})^2}} \right)^2. \tag{7}$$

The F test was used to determine whether the overall regression model was significant. The variance is decomposed to calculate the value of the F statistic. When the F value is larger, the significance level is higher. The formula for calculating F is as follows:

$$F = \frac{\sum (\widehat{B} - \overline{B})^2 / m}{\sum (B - \widehat{B})^2 / (n - m - 1)}. \tag{8}$$

Among them, SSR refers to the variance between the sample point and the average point; SSE refers to the variance of the distance from the sample point to the regression point. F obeys F $(m, n-m-1)$ distribution. When the significance level is ∂, if F is greater than $F_\partial (m, n-m-1)$, it indicates that the overall regression model is significant and can be used for prediction; otherwise, it is not significant.

The T test was used to judge whether the regression coefficient of the regression model was significant. The formula for calculating the T statistic is as follows:

$$T_u = \frac{\widehat{\beta}_u}{\widehat{\sigma} / \sqrt{\sum_{v=1}^{n} (A_{uv} - \overline{A}_u)^2}}. \tag{9}$$

Among them,

$$\widehat{\sigma} = \sqrt{\frac{\sum_{u=1}^{n} (B_u - \widehat{B}_u)^2}{n - m - 1}}. \tag{10}$$

The statistic T obeys the $T(n-m-1)$ distribution. When the significant level is ∂, if there is a T greater than $T_\partial (n-m-1)$, the regression coefficient reaches the significant level. Otherwise, it is not significant. In addition to the insignificant correlation between the independent variable and the dependent variable, there are other reasons for the insignificant regression coefficient. For example, the number of samples or variables is too small, and a certain independent variable and other independent variables have complex collinearity [20].

In order to avoid the correlation between independent variables being too high, affecting the stability and significance of the regression coefficient, and making the analysis results of the regression model difficult to interpret, a complex collinearity analysis should be carried out on the independent variables. We use tolerance or variance inflation factor (VIF) to assess the degree of collinearity of independent variables. Tolerance is calculated as follows:

$$\mathrm{Tolerance} = 1 - R_u^2. \tag{11}$$

Among them, R_u^2 is the square of the complex correlation coefficient between the ith independent variable and other independent variables.

Tolerance and VIF are reciprocals of each other. The value of tolerance is between 0 and 1. The closer to 0, the stronger the collinearity is; the closer to 1, the weaker the collinearity. Similarly, the larger the VIF, the higher the degree of collinearity between variables. When the VIF is greater than or equal to 10, it means that there is a serious multicollinearity between the variables.

Self-correlation analysis. After the model is established, the error between the regression value and the actual value should not only show a random normal distribution but also the errors generated between the variables should be independent of each other without self-correlation [21]. The DW statistic is used to determine whether the error terms are independent, and the calculation formula is as follows:

$$DW = \frac{\sum_{u=2}^{n} \left(\varepsilon_u - \varepsilon_{u-1}\right)^2}{\sum_{u=2}^{n} \varepsilon_u^2}. \tag{12}$$

The value of DW is between 0 and 4. When DW is 0, it means complete positive autocorrelation; when DW is between 0 and 2, it means that there is positive autocorrelation: when DW is 2, it means no autocorrelation. DW between 2 and 4 indicates that there is a negative autocorrelation; DW of 4 indicates a complete negative autocorrelation. Generally, when the DW value is between 1.5 and 2.5, it can be considered that there is no self-correlation phenomenon. The test of the significant relationship and correlation of the regression model is based on the assumption of the regression model. If the assumption of the model does not hold, the regression model cannot be used, so the regression hypothesis should be tested.

3.2. Hierarchical Deconstruction Process

3.2.1. The Concept of AHP. AHP is a hierarchical weighted decision analysis method proposed in the early 1970s. As analytic hierarchy process (AHP) can be seen from the name, this method is that when using AHP to analyze problems, it is necessary to first concretize and stratify the layers. Then, a hierarchical organization model is established [22–24]. Through the hierarchical model, the research question will be composed of several elements, which form a hierarchy according to the logical relationship, which can generally be divided into three categories: the highest layer, the middle layer, and the lowest layer. Analytic hierarchy process is divided into four steps, namely, the creation of the ladder hierarchical structure model, the establishment of each judgment matrix in each layer, the single-level sorting and the total sorting, and their respective consistency checks. The specific operation process can be seen in Figure 2 [25].

AHP is a systematic analysis method, and it is concise and practical. We effectively combine qualitative and quantitative methods, decompose complex problems, and make it easier to grasp and understand. At the same time, AHP requires less data and information, and focuses more on qualitative analysis and judgment than the general quantitative method, and finally realizes qualitative and quantitative optimization problem decision analysis.

3.2.2. The Basic Steps of AHP. The first premise of establishing a hierarchical model is to fully understand the problem that needs to be solved. On the basis of fully understanding the problem, it is necessary to grasp the scope and factors contained in the problem, and to understand the mutual relationship and subordination of these factors. Only after having a clear understanding of the above content can we classify the factors involved in the problem to be analyzed. We construct a hierarchical model diagram with interconnected elements as shown in Figure 3.

(1) The highest level (target level) represents the problem that needs to be solved; that is, the overall goal is to be achieved by the analytic hierarchy process.
(2) The middle layer (criteria layer) represents the intermediate link to achieve the overall goal, such as the criteria and indicators for measuring the overall goal.
(3) The bottom layer (the solution layer) represents various solutions and measures selected to solve the problem.

3.2.3. Weight Vector of the Judgment Matrix $A = (x_{uv})_{n\times n}$.
(1)
Calculate the product of all elements of each row of the matrix, that is:

$$y_u = \prod_{v=1}^{n} x_{uv}\,(u = 1, 2, \ldots, n). \tag{13}$$

(2) Find the nth root of y_u, that is:

$$W_u = \sqrt[n]{y_u}\,(u = 1, 2, \ldots, n). \tag{14}$$

(3) Normalize the vector 55, let:

$$Q = \frac{W_u}{\sum_{k=1}^{n} W_k}\,(u = 1, 2, \ldots, n). \tag{15}$$

Then $Q = (Q_1, Q_2, \ldots, Q_n)^T$ is the required weight vector, which indicates that for the overall target M, the weight of each criterion Z_u is $Q_1, Q_2, \ldots, Q_n$, and $Z_1, Z_2, \ldots, Z_n$ can be sorted in a hierarchical order with a value of Q_u.

3.2.4. Consistency Test of Judgment Matrix. When the compared elements are ambiguous and complex, in general, the constructed judgment matrix cannot be completely guaranteed to be completely consistent. At this time, the largest eigenroot $\lambda_{\max}$ of the judgment matrix A will be greater than the order n of the matrix, and there are other eigenvalues that are not 0. If we make the largest eigenroot $\lambda_{\max}$ of the judgment matrix close to n and make other eigenvalues close to 0, we can make the judgment matrix have a satisfactory consistency. This further ensures that reasonable results are obtained. Then, in order to judge whether the consistency of a matrix meets the satisfactory requirements, it is necessary to carry out the consistency test.

First, we need to obtain $\lambda_{\max}$ (maximum eigenroot) of the judgment matrix A according to the following formula:

$$\lambda_{\max} = \sum_{u=1}^{n} \frac{(AQ)_u}{nQ_u}(u = 1, 2, \cdots, n). \tag{16}$$

Among them, AW is the product of the judgment matrix A and the eigenvector Q, and $(AQ)_u$ is the uth component of AQ.

Next, we calculate the consistency index (C.I.)

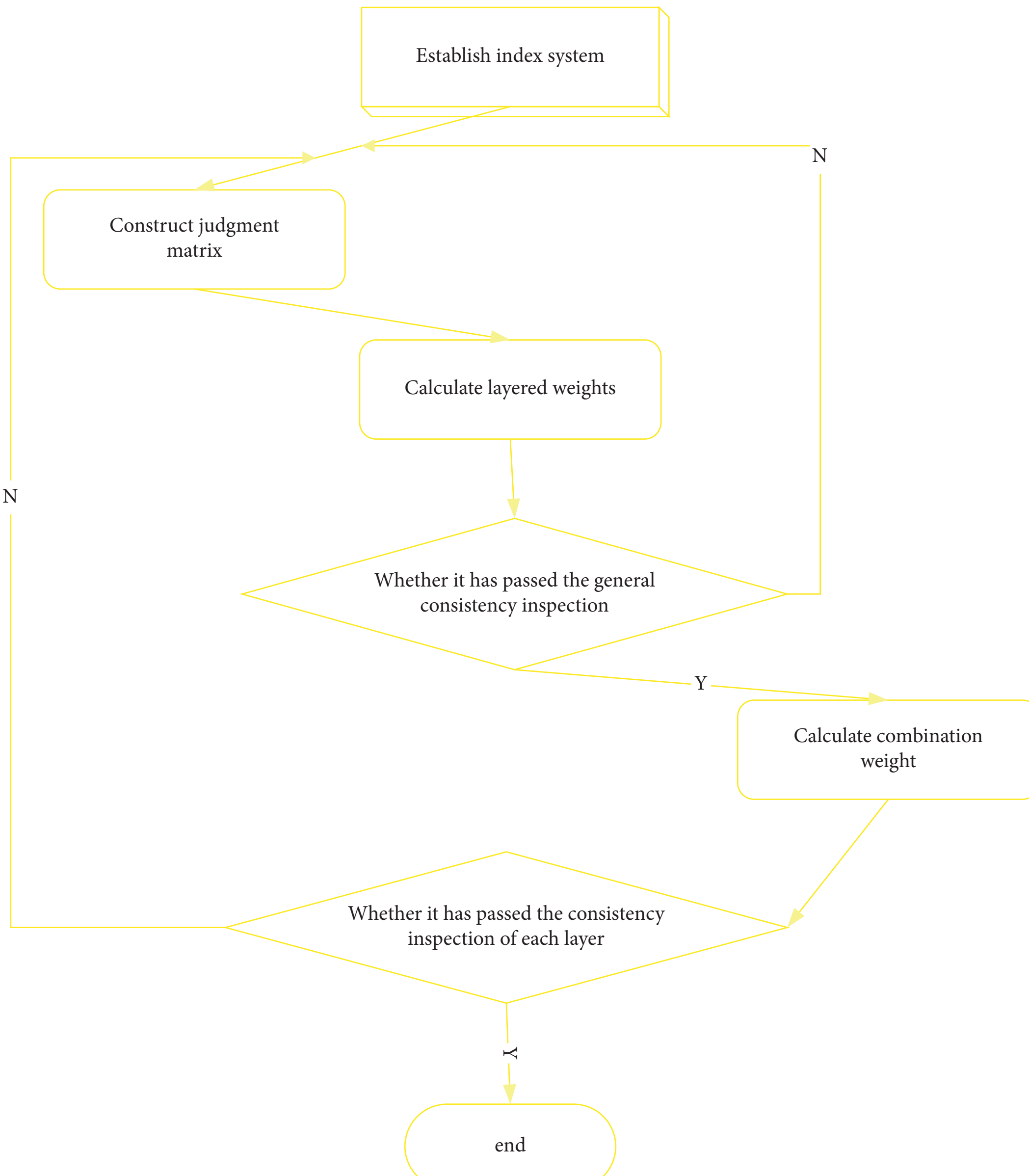

Figure 2: Step diagram of AHP.

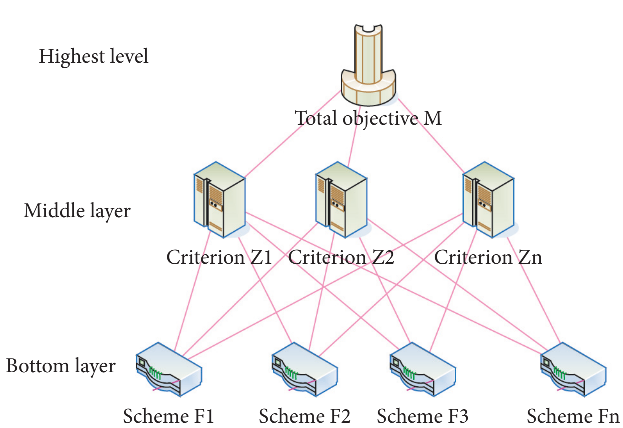

Figure 3: Analytic hierarchy structure model diagram.

$$\text{C.}I. = \frac{(\lambda_{\max} - n)}{(n-1)}. \quad (17)$$

Furthermore, C.R. is obtained by the following formula:

$$\text{C.}R. = \frac{\text{C.}I.}{\text{R.}I.}. \quad (18)$$

In the formula, C.R. is the consistency ratio, and R.I. is the average random consistency index.

3.3. Life Cycle Costs

3.3.1. Definition of Life Cycle Cost Analysis. Life cycle cost (LCC) was first proposed by the US Department of Defense, and this theory was applied to the procurement of military equipment. The U.S. Department of Defense originally

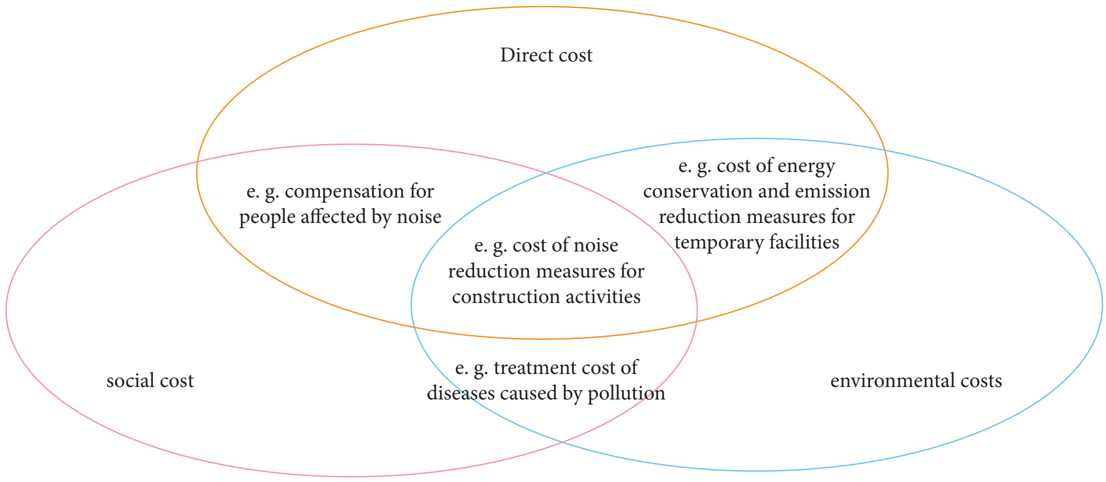

Figure 4: Schematic diagram of generalized life cycle cost.

defined LCC as the total cost to the government to set up and acquire the system and the life cycle of the system, which includes development, setup, use, logistical support, and decommissioning. Life cycle costs calculated earlier are static costs and do not take into account the time value of money. Its schematic figure is shown in Figure 4.

Life cycle cost refers to the sum of costs throughout the entire life process of a product. Generally speaking, it includes various costs from the research, design, production, use of the product to the research, design, production, use, maintenance, and the final disposal stage of the waste life process [26].

Based on different perspectives and classification methods, the life cycle cost of a product can be divided into different parts. Generally speaking, the life cycle cost of a product can be divided into external cost and internal cost. External cost refers to the synthesis of all environmental costs in the life cycle process, while internal cost refers to the cost of raw materials and basic engineering invested by the enterprise in the production process of the product.

3.3.2. Technical Framework of Life Cycle Cost Analysis. Unlike LCA, LCC currently does not have internationally accepted implementation methods and steps. Based on the comprehensive analysis of previous research results, this paper summarizes the implementation steps of LCC with reference to the technical framework of life cycle assessment, which is also based on the idea of life cycle. It can be summarized as the following steps, and the details are shown in Figure 5.

Step 1: the determination of the evaluation scope. Similar to a life cycle assessment, the first step in an LCC study is to define the scope of the study, which generally covers the entire life cycle of the product or process, but also depends on the actual situation. This step determines the scope of application of LCC and the size of the subsequent workload.

Step 2: Identify the costs of each stage. We divide the life cycle stages of the product according to the determined evaluation scope, track the energy flow and material flow of each stage, conduct inventory analysis, and obtain the cost list of different stages.

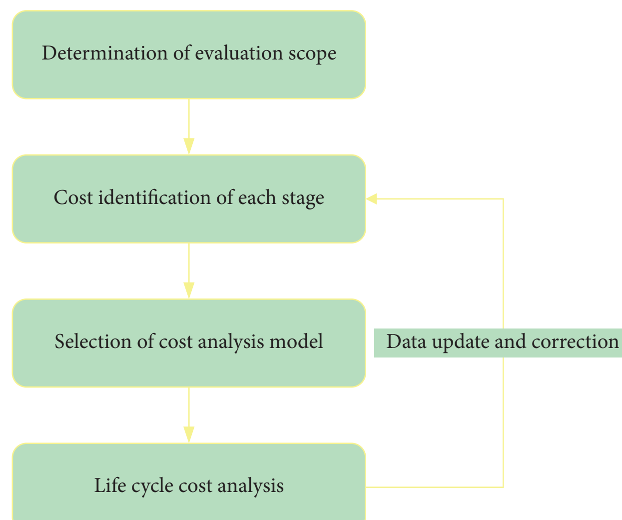

Figure 5: Life cycle cost analysis technology roadmap.

Step 3: the choice of cost analysis model. On the basis of the above steps, the possible costs of each stage are summarized, an appropriate cost analysis model is selected, and a reasonable cost structure is constructed so that each cost has a clear cost relationship.

Step 4: life cycle cost analysis. We choose an appropriate analysis method to analyze each element in the life cycle cost model. Commonly used analysis methods include linear regression, correlation analysis, and sensitivity analysis.

4. Experiment Deconstruction with Suitable Green Building Technology in the New Urban Area of Guangzhou

4.1. Deconstruction of the Status Quo of Green Building Development in China. Since the first application for the green building label in 2008, from the deployment of various central documents to the implementation of corresponding local laws, the management system related to green buildings has been gradually improved, which has laid a good social environment for the vigorous development of green buildings in China (Figure 6). As of December 31, 2014, a total of 2,538 green building project labels have been applied for and evaluated (including design labels and operation labels) nationwide, covering an area of 290 million square meters. Among them, there are 2,379 design and identification projects (with an area of 21.118 million square meters), accounting for 93.7% of the total number of applications. There were 159 operating identification projects (with an area of 19.547 million square meters), accounting for 6.3% of the total number of applications. Compared with 2008, the total number of applications for green building labels has increased by 109 times. It can be seen that the social consensus on the development of green buildings in China has gradually formed.

The projects applying for the green building evaluation label are mainly one-star and two-star levels, and three-star level is lower than the former two [27]. Taking the data from 2008 to 2014 as an example (as shown in Figure 6(a)), there are 966 one-star projects (126.328 million square meters), 1054 two-star projects (118.505 million square meters), and 518 three-star projects (45.868 million square meters).

Guangzhou's green building work has been developed from point to face to ecological city construction, and a local green building policy, technology, and management system has been initially established. At present, Guangzhou is creating a green eco-city area, hoping to effectively control the quality of Guangzhou's development and become an advanced area of national green buildings. At the same time, in order to implement the new requirements put forward by the central government since the 18th National Congress of the Communist Party of China, the special green building work in Guangzhou urgently needs to start the research work on the implementation of the green technology system and form a green building technology application system that can guide the planning and design [28].

For the types of buildings applying for label certification, the 51% rate for residential buildings is slightly higher than 48% for public buildings and only 0.9% for industrial buildings. The participation of residential buildings and public buildings in green building evaluation already has a certain social cognition foundation, but the participation of industrial buildings in the evaluation of green building labels started late and developed slowly. Up to now, China has evaluated 28 green industrial building projects, including 3 three-star operation logos. The identification projects are distributed in 8 provinces and cities, 5 of which are coastal provinces. Guangdong and Jiangsu provinces, which are ranked high in terms of GDP, are particularly advanced in the number of applications for green industrial building labels. It can be seen that the local high economic level and the development level of civil green buildings also affect the degree of local industrial building development (Figure 7).

4.2. Four Bottom Lines of Deconstructing Architecture

4.2.1. nBL Evaluation Overview. This report uses the nBL assessment method. The nBL is a consistent structure that distinguishes and integrates significant elements into the strategy pursuing cycle and choice settling on process by guaranteeing that choices follow manageability standards. The report evaluates four bottom lines. The first bottom line is the engineering bottom line, which mainly includes fire resistance, seismic resistance, life, and main functions of the structure. The second bottom line is the environmental bottom line, which mainly includes environmental bottom line, mercury emissions, energy emissions, and recyclability. The third bottom line is the social bottom line, which mainly includes volume control, noise control, competition, community, and stress relief. The last bottom line is the economic bottom line, which mainly includes material cost, energy consumption rate, and saving of recyclable materials [29].

There are six stages from choosing markers, gathering significant information to changing information into ultimate conclusion values, which can be utilized to assess BAU and the first-level marks of options. To begin with, we pick a pointer. Second, gather logical information for tertiary markers. This information should be in a similar unit for additional correlation. Then, the information is standardized, weighted, and totaled. At long last, we analyze BAU and elective arrangements. These issues will be talked about exhaustively beneath.

4.2.2. Selection and Description of Indicators. In the first place, we pick a proper marker in view of the reason for the pointer, the spatial size of the undertaking, and the time span. The reason for these measurements is to think about the manageability of BAU and elective arrangements really. The spatial size of the task is situated at the University of Melbourne's Parkville grounds. The time span is from the material to the development handling stage. Based on these three factors, secondary and tertiary indicators were selected. A detailed description of each indicator is discussed in Figure 8.

4.2.3. Normalization, Weighting, and Aggregation. Subsequent to gathering BAU values and choices for each level-3 pointer, the information was standardized utilizing formula (19). Then, markers were emotionally weighted by the strength of significance utilizing the analytic hierarchy process (AHP) Saaty's pairwise rating scale. We standardize the segments by isolating the heaviness of every section by the complete load of every segment. After this, the amount of every segment ought to be one, and the last weight is the normal of each column. The measurements are then collected utilizing the added substance accumulation technique (formula (20)). The result of the standardized file and the weight is the collected measurement, which is the worth of each level 2 measurement. Therefore, the values of the level 3 indicators are aggregated into the values of the level 2 indicators. We repeat the same steps to aggregate the values of

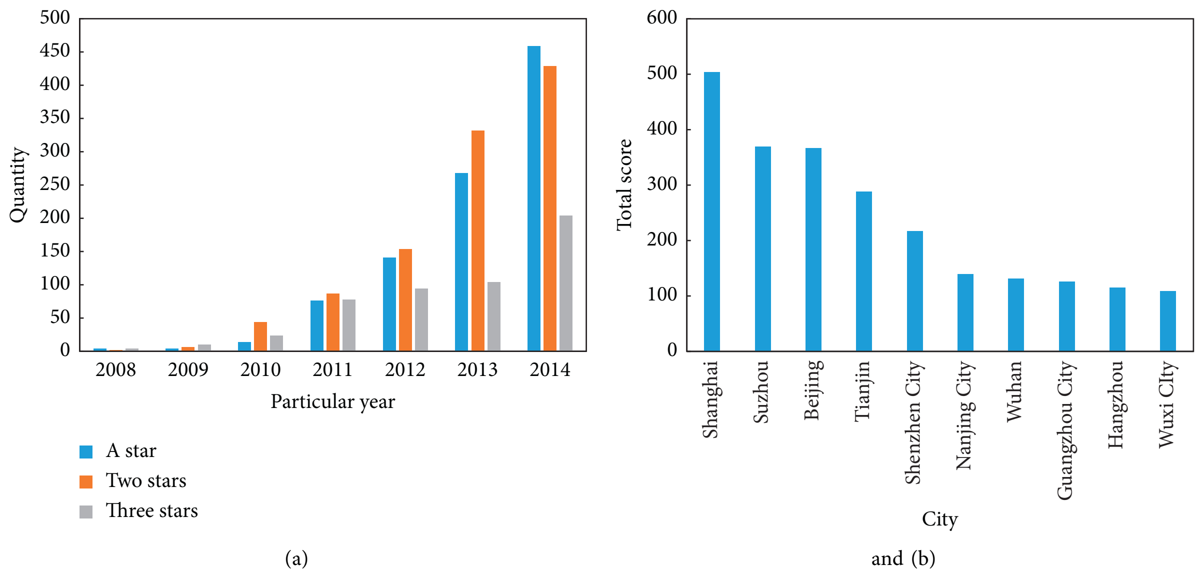

Figure 6: Status and ranking of green building development in China: (a) Status Quo of Green Building Development (2008–2014) and (b) ranking by the total score of urban green buildings in the "Green Building Map" website database.

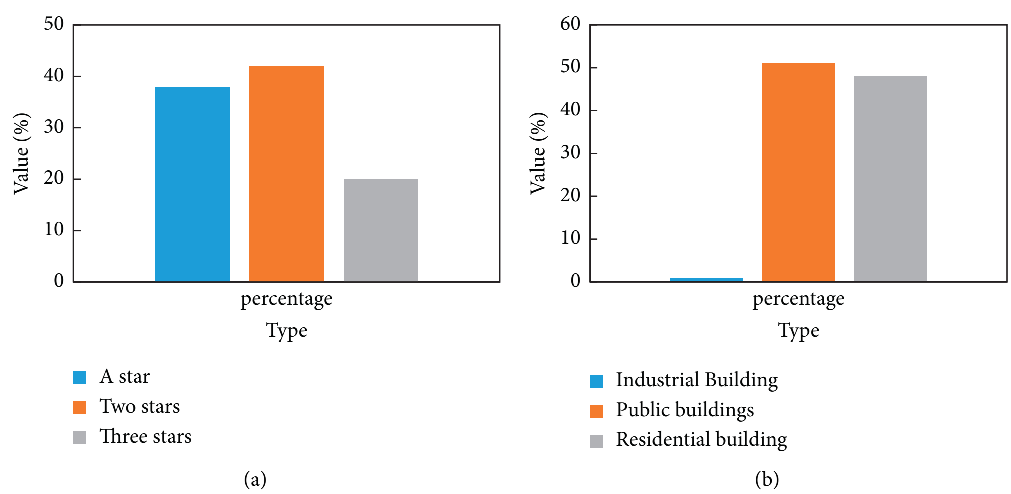

Figure 7: The distribution of stars and types of buildings with green building evaluation labels from 2008 to 2014: (a) star distribution of green building evaluation signs and (b) building type distribution of green building evaluation signs.

the level 2 metrics into the values of the level 1 metrics. First, level 2 indicators are subjectively measured according to the strength of their importance. We standardize the sections so every segment totals to one. Then, the result of the weight and the standardized record is the totaled incentive for each level 1 pointer.

$$\text{Normalized Index} = \frac{\text{Indicator value} - \text{worst value}}{\text{best value} - \text{worst value}}, \quad (19)$$

$$\text{Aggregated Indicator} = \sum (\text{Weight} * \text{Normalized Index}). \quad (20)$$

The loads of the four button lines (designing, financial, social, and natural) are emotional. The designing primary concern includes fire and seismic tremor opposition and the life span of the structure, with an accentuation on the wellbeing of the structure. Simply by guaranteeing the wellbeing of the structure and individuals inside will the remainder of the conversation be significant. Along these lines, indeed, designing is the main model. This report expects that proprietors have serious areas of strength for a natural manageability.

4.2.4. Weights and Results of Economic Indicators. Its weight distribution is shown in Table 2 and Figure 9.

4.2.5. Comprehensive Evaluation Results. The weights of the four button rows (engineering, economic, social, and

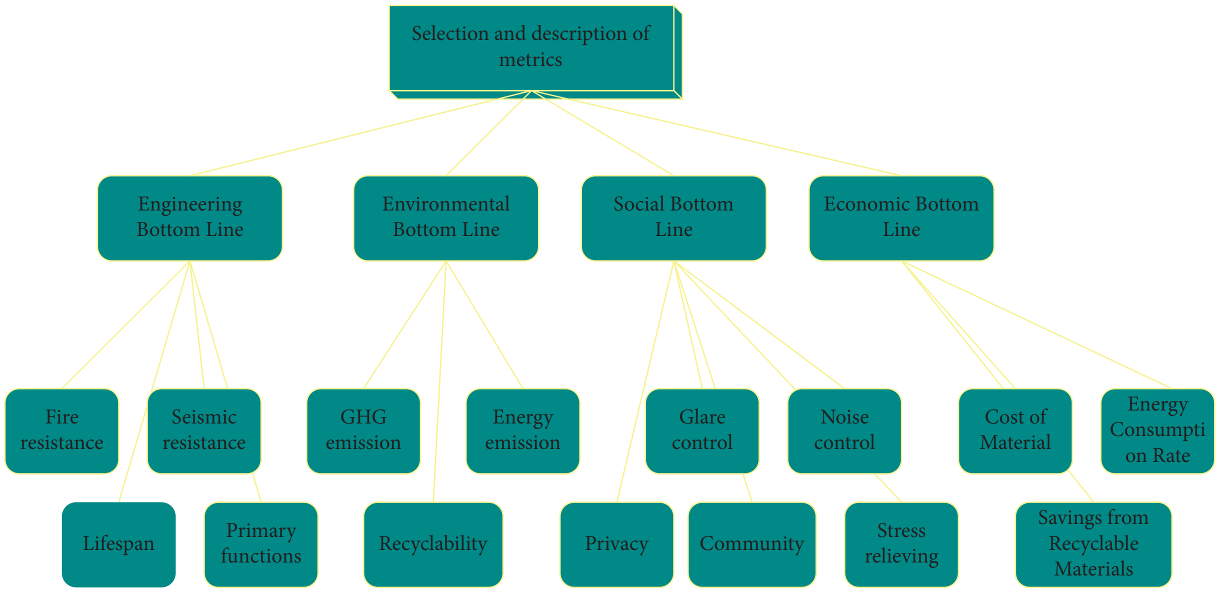

Figure 8: Metric selection and description.

Table 2: Weight distribution.

			Economic BL	
Level 1 aggregated	BAU		0.661	
	ALT		0.444	
		Life cycle costs		Benefits
Level 2 aggregated	BAU	0.791		0.400
	ALT	0.432		0.466
	Weights	0.667		0.333
		Cost of material	Energy consumption rate	Savings from recycling of external wall
Level 3 aggregated	BAU	0.787	0.800	0.400
	ALT	0.214	0.869	0.466
	Weights	0.667	0.333	1.000

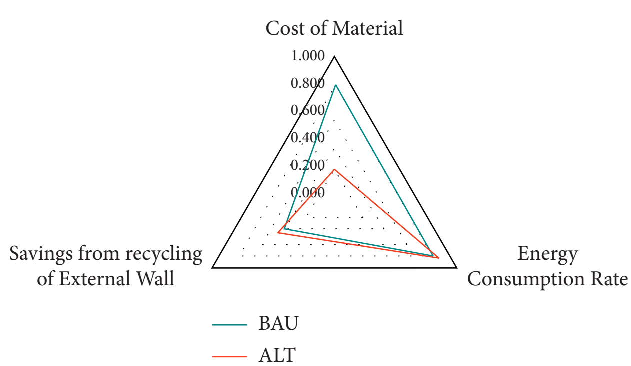

Figure 9: Economic indicator scores.

environmental) are subjective [30]. This report accepts that proprietors have major areas of strength for an ecological maintainability. Understudies of Architecture will concentrate on the design, materials, and soul of this structure. Sightseers can visit this famous structure and get a shallow impression of the college or the city. It has the obligation to communicate and direct certain social qualities—ecological assurance. Accordingly, the ecological properties have the most noteworthy weight. As per the authority site, the University of Melbourne is a public government assistance establishment that makes special commitments to society. Its monetary properties are not huge. Social and engineering

Table 3: Level 1 indicator scores.

	Score of level metrics		
	BAU	ALT	Weight (%)
Social BL	0.504	0.751	42.31
Environmental BL	0.691	0.803	12.25
Economic BL	0.661	0.444	22.72
Engineering BL	0.736	0.666	22.72
Total	0.664	0.689	

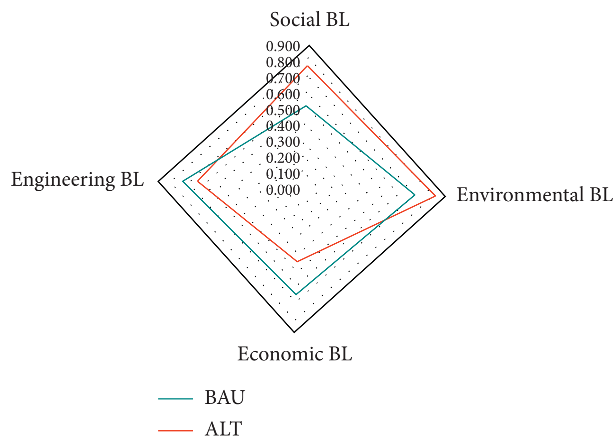

Figure 10: Level 1 indicator score.

Table 4: Green technologies used in typical green stormwater infrastructures.

Control measures	Green technology
Decentralized control measures at source	Tree pond, green roof, rainwater tank/bucket, sunken green space, rainwater garden, infiltration pavement, etc. (as shown in Figure 11(a))
Conveying measures	Grass planting ditch, ecological ditch, etc. (as shown in Figure 11(b))
Terminal centralized control measures	Landscape water body, rainwater pond, rainwater wetland, multifunctional regulation, and storage facilities (as shown in Figure 11(c))

(a) (b) (c)

Figure 11: Typical green stormwater infrastructure. (a) is the decentralized control measures at the source—concave green space; (b) is the transportation measure—shallow ditch with vegetation; (c) is the centralized control measure at the end—ecological pool.

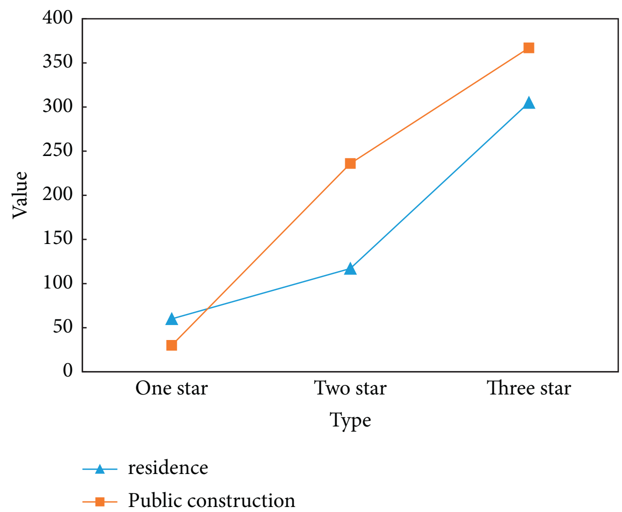

Figure 12: Schematic diagram of incremental costs of green buildings.

have no specific inclination, so they have a similar weight. That said, the environment matters, and the economy is the bottom line. Pairwise comparisons were performed based on Saaty's rating scale (Table 3, Figure 10).

4.3. Application Strategies of Water Saving and Water Resource Utilization Technology

4.3.1. Green Rainwater Infrastructure and Rainwater Utilization. Green stormwater infrastructure and rainwater utilization green stormwater infrastructure (GSI) mainly refer to a type of green infrastructure for urban stormwater control and utilization. Typical green rainwater infrastructures are divided into decentralized control measures at the source, transmission measures, and centralized control measures at the end, as shown in Table 4 (Figure11).

4.3.2. Promote High-Efficiency Water-Saving Sanitary Ware. We promote the use of water-saving appliances with higher water-efficiency grades, which can improve water-use efficiency at the source and reduce building water supply and sewage production. It can also reduce the scale of sewage treatment facilities and the energy consumed by sewage treatment, thereby achieving significant economic and environmental benefits. Since the technology is not limited by the nature of the building, the cost is low, and the incremental cost is low, it should be preferentially promoted in the new urban area of Guangzhou.

Nontraditional water sources mainly include reclaimed water, rainwater, and seawater. However, due to the abundant rainfall in Guangzhou, the use of river water as miscellaneous water also belongs to rainwater utilization in a broad sense. The rainy season in Guangzhou is from April to September every year, with an average monthly rainfall of 190 mm. The cooling water consumption period is basically the same as the peak rainfall period in Guangzhou. Due to the lower cost of rainwater treatment, it is more cost-effective.

4.4. Pre-Assessment of the Application of Green Building Technology in the Starting Area of Guangzhou International Financial City. According to the statistics of relevant institutions, the incremental cost of green building technology can generally be controlled at 2.7~9.3% of the overall construction cost. The incremental cost of a one-star green public building is only about 30 yuan/square meter, a two-star level is about 236 yuan/square meter, and a three-star level is about 367 yuan/square meter. From the perspective of the entire life cycle of buildings, vigorously promoting green buildings is an inevitable choice for building a low-carbon eco-city (Figure 12).

Compared with the national level, the investment cost of green building construction in the starting area of the Financial City has certain advantages. There are already supporting regional centralized resource utilization facilities such as overall development of underground space, municipal reclaimed water reuse system, regional centralized cooling, green transportation, and other supporting facilities in the starting area. *Requirements for the use of passive design techniques.* Therefore, the incremental cost of green buildings in the starting area of the Financial City can be estimated by the following amounts: according to the potential distribution map of green building grades in the starting area, the incremental cost of public buildings is 20 yuan per square meter for one-star green buildings, 100 yuan per square meter for two-star grades, and 200 yuan per square meter for three-star grades. Residential buildings are calculated based on the incremental cost of one-star green buildings of 10 yuan per square meter, and the total incremental cost of one-, two-, and three-star green buildings is about 348 million yuan. Among them, the increase in the transfer part is 338 million yuan, and the increase in the nontransfer part is about 9.84 million yuan.

5. Conclusions

The use of green structure innovation is a perplexing and orderly issue. This paper mostly concentrates on the advocacy and utilization of the innovation through the examination of the versatility of the innovation and plans the innovation application procedure. In order to further optimize and promote the application of green building technology in the new urban area of Guangzhou, future research on the application of green building technology needs to focus on the social aspects of technology promotion, which are management issues. It is also necessary to conduct more in-depth and comprehensive research on the existing problems, realization paths, and mechanism research of green building promotion in Guangzhou. These issues need to be deepened and improved in future research and study.

Data Availability

The data that support the findings of this study are available from the author upon reasonable request.

Conflicts of Interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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