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Research Article

Evaluation Of Visual Characteristics Of Decorative Landscape Of Traditional Residential Buildings: A Case Study Of Beijing Siheyuan

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ABSTRACT

Taking Beijing Siheyuan as an example, this study deeply discusses the visual characteristics of traditional residential building decoration landscape, and constructs a set of comprehensive evaluation index system. By using the methods of literature review, field investigation, analytic hierarchy process and computer aided design, the paper makes a comprehensive evaluation of the architectural structure, decorative art and color application of Siheyuan. Through detailed field investigation and expert interviews, the research puts forward multi-dimensional evaluation indexes for courtyard grouping, spatial scale, architectural appearance and detailed decoration. The results show that these evaluation indexes can effectively guide the protection and reuse of traditional residential buildings, and at the same time provide a scientific basis for the inheritance and development of traditional culture. This study not only improves the understanding of the visual characteristics of traditional residential buildings, but also provides a new perspective and method for the sustainable development of cities and the protection of cultural heritage.

Key words: traditional residential buildings, Siheyuan, visual characteristics evaluation, cultural heritage protection, comprehensive evaluation index system, analytic hierarchy process

1. Introduction

With the rapid advance of global urbanization, the protection of traditional architecture and cultural heritage has become a key issue of international concern. Traditional houses not only carry rich historical and cultural values, but also are important symbols of national and ethnic identity. In recent years, with the increasing emphasis on traditional culture, the evaluation of architectural decoration landscape and visual characteristics of traditional houses has gradually become a research hotspot in the field of architecture and cultural heritage protection. These architectural decorations not only reflect the accumulation of history, but also express the exquisite art and the depth of humanity (Zhang Ying, Zhang Yixin, Wang Xiaobin, 2022)[1]. However, due to the impact of modernization and urbanization, many traditional houses are facing the threat of disappearing and are in urgent need of effective protection and reasonable utilization strategies.

Although there has been some research progress in the evaluation of visual characteristics of decorative landscape of traditional residential buildings, these studies mostly focus on qualitative description and lack systematic and quantitative analysis methods (Fan Miyu and He Li, 2024)[2]. In addition, the evaluation standards and methods of traditional residential buildings in different regions and historical periods need to be further improved and unified (Li Zirui, 2024; Yuan Yue, 2023). Therefore, this study proposes to adopt a more systematic and scientific evaluation method to objectively evaluate the visual characteristics of traditional dwellings through quantitative analysis, and further[3-4] explore their cultural value and artistic charm.

Beijing Siheyuan, as one of the classic forms of Chinese traditional houses, has been widely studied and concerned for its unique architectural style and cultural connotation. This study will take Beijing Siheyuan as an example, through the comprehensive application of modern science and technology and multi-dimensional analysis method, in-depth study of its architectural structure, decorative art and color application, aiming to

reveal the unique visual features and deep cultural connotation of the decorative landscape of Beijing Siheyuan. The research results will provide theoretical basis and practical guidance for the protection, inheritance and reuse of traditional houses, while promoting cultural inheritance and innovation, and contributing to social harmony and sustainable development.

In order to achieve this purpose, this study adopts advanced technical means such as literature review, field investigation, systematic evaluation method and computer aided design. In particular, this study carried out a field investigation of the courtyard houses in the area of Bell and Drum Tower, and recorded their style and status quo in detail through surveying, mapping, photographing and video. In addition, this study also designed the interview content and consulted the experts and practitioners in the construction industry to obtain the evaluation indicators and their weights. In the aspect of data collection and analysis, AHP is used to sort out, analyze and calculate the data through questionnaire survey and software, and the weights of each index are obtained. These rigorous research methods and data collection means will help us to have a more comprehensive and in-depth understanding of the decorative landscape and cultural value of Beijing Siheyuan.

2. Analysis of visual features and features of decorative landscape of traditional residential buildings

The visual feature of decorative landscape of traditional residential buildings is an important part of traditional Chinese architectural culture, and its unique charm and style attract the attention of countless people. These characteristics are mainly reflected in the appearance, structure, color and decoration of buildings (Pan Hui and Su Wenshan, 2023)[5].

Take Beijing Siheyuan as an example, which is famous for its unique architectural decoration landscape and distinctive visual features (Huang Zhenwei, 2023) [6]. These features not only deeply reflect the profound heritage of Chinese culture, but also highlight the delicacy and harmony of traditional architectural aesthetics. The layout of Siheyuan is rigorous and orderly, and it is usually designed symmetrically along the central axis, fully demonstrating the important position of etiquette and the concept of class in traditional Chinese culture. The courtyard structure consists of multiple courtyards surrounded by courtyards, which not only protects the privacy of the occupants, but also ADAPTS well to the climate characteristics of Beijing. In terms of architectural elements, Siheyuan adopts a distinctive hard mountain or rest mountain roof, and is decorated with auspicious auspicious auspicious auspicious animals; Exquisite wood-grated Windows and delicately carved window cuts show the cultural taste of the host. And the red door, combined with a bronze door ring, reflects the traditional greeting etiquette. In addition, the decorative art of the courtyard is also unique. The brick and wood carvings are exquisite, and the painted and calligraphic works add a strong artistic atmosphere. In the choice of materials, Siheyuan tends to use durable natural materials, such as gray tile, black brick and wood. At the same time, its color collocation is low-key and harmonious. The clever use of red, black, gray and white colors creates a calm and elegant visual effect.

From the characteristics of Siheyuan, it can be seen that the visual features and features of the decorative landscape of traditional Chinese residential buildings are as follows:

(1) In appearance, traditional residential buildings often adopt the combination of wood structure and brick structure, forming unique architectural elements such as eaves, brackets and cornices, so that the whole building presents a curved and soft lines and a sense of heaviness.
(2) In terms of structure, traditional residential buildings often pay attention to the integration with the natural environment, using natural elements such as mountains, rocks, water and wood for decoration, so that the buildings complement the surrounding environment.
(3) In terms of color, traditional residential buildings often adopt simple and elegant color matching, such as red walls and black tiles, blue bricks and yellow tiles, which not only shows the solemn and elegant architecture, but also harmonizes with the natural environment.
(4) In terms of decoration, traditional residential buildings pay attention to details, often use carving, painting, brick carving and other techniques for decoration, so as to make the buildings more artistic and ornamental.

3. Evaluation index of visual characteristics of decorative landscape of traditional residential buildings

3.1 Compound cluster characteristic index

The evaluation of courtyard characteristics of traditional residential buildings involves multiple dimensions.

(1) The degree of enclosure, which not only shows the integrity and closure of the courtyard, but also concerns the sense of space, privacy and security. The evaluation includes the consideration of the integrity of the courtyard wall and the surrounding environment (Wu Jie, 2020)[7].
(2) Symmetry, which examines whether the building presents a central symmetry, and discusses how this symmetry can improve the overall visual effect and enhance the sense of stability and beauty (Liang Yizhe, 2017)[8].
(3) Plot ratio is a standard to measure the efficiency of courtyard space utilization. Reasonable plot ratio is crucial to land resource utilization and courtyard comfort level. In addition, the master-slave composition

reflects the proportional relationship between the main building and the secondary building, and a reasonable composition can highlight the hierarchy and cultural connotation of family functions (Bai Limin, Wei Yuzhi et al., 2023)[9]. The location of the house door is also an important evaluation index, which is not only related to the rationality of the entrance of the house, but also reflects the etiquette and hierarchy.

(4) Courtyard space satisfaction comprehensively considers space layout, function and aesthetics. A highly satisfactory courtyard space has a significant impact on improving living experience and building cultural value (Chen Kexin, Zhang Yuruixin, 2023)[10].

3.2 Spatial scale characteristic index

In the process of evaluating the decorative landscape of traditional residential buildings, the spatial scale characteristic index is crucial, which covers the building height, area, bay size, yard size, building story number and elevation proportion, etc., and comprehensively considers the spatial layout, functionality and visual effect of the building.

(1) Building height: building height appraises whether the height of the building is coordinated with the traditional residential buildings. Traditional residential buildings often pay attention to the coordination with the surrounding environment, so the rationality of building height not only reflects the stability and modesty of the building itself, but also can maintain the harmony and unity of the overall landscape of the surrounding environment.

(2) Building area: The building area takes into account the size of the floor area and space of the building. Traditional residential buildings often pay attention to spacious courtyards and reasonable spatial layout, so the size of the building area should match the scale of the courtyard, which can not only meet the needs of life functions, but also maintain the sense of openness and permeability of the courtyard.

(3) Bay size: Bay size evaluates the width of the building bay, reflecting the spatial layout and functionality of the building. Reasonable room size can provide a comfortable living environment for the occupants, but also to ensure the lighting and ventilation effect inside the building, enhance the practicality and comfort of the space.

(4) Courtyard size: The courtyard size evaluates the area and shape of the courtyard, as well as its impact on the living environment and visual effect. As the core space of traditional residential buildings, the size and shape of the courtyard directly affect the quality of life of the occupants and the overall beauty of the building, so it is necessary to design the size and layout of the courtyard reasonably according to the specific situation.

(5) The number of building floors: The number of building floors considers whether the number of building floors is in line with the characteristics of traditional residential buildings. Traditional residential buildings often pay attention to the sense of hierarchy and moderate height, so the design of building floors should conform to the proportion and proportional relationship of traditional buildings, which can not only meet the functional needs, but also maintain the overall harmony and beauty of the building.

(6) Elevation ratio: Elevation ratio evaluates the proportional relationship of the building's elevation and its impact on the visual effect of the building's appearance. Reasonable elevation ratio can enhance the three-dimensional sense and aesthetic feeling of the building, make it more visually attractive and artistic value, and thus improve the overall quality and image of the building (Zhang Lingdi, Du Yunxiang, 2022). [11]

3.3 Building appearance characteristic index

The appearance characteristics of traditional residential buildings are crucial to the shaping of the overall architectural image. Therefore, the index of architectural appearance characteristics has become an important basis for evaluating the decorative landscape of traditional residential buildings, including the following aspects:

(1) Evaluation of roof form and slope. Whether the shape and slope of the roof conform to the characteristics of traditional residential buildings, and its impact on the appearance of the building. The roof of traditional residential buildings often adopts slope roof, and its shape and slope often reflect the regional culture and climate characteristics, so reasonable roof shape and slope can enhance the architectural style characteristics and the overall beauty.

(2) Evaluation of door and window form. Whether the style and design of doors and Windows reflect the style of traditional residential buildings. The doors and Windows of traditional residential buildings often have unique shapes and decorations, such as carved window frames, antithetical lintels, etc. These characteristic doors and Windows can not only add beauty to the building, but also reflect the local culture and living customs (Shen Jianyu, 2023). [12].

(3) Architectural color considerations. Whether the color collocation of the building is coordinated with the traditional residential buildings, and the impact of color on the appearance of the building. The colors of traditional residential buildings often pay attention to the natural, simple and elegant tone, the color collocation should be in line with the local climate and environmental characteristics, can create a comfortable and pleasant living environment and visual enjoyment.

(4) Evaluation of material use. Whether the choice of building materials reflects the characteristics of traditional residential buildings. Traditional residential buildings often use natural materials such as wood, blue brick, etc. These materials not only have good durability and environmental protection, but also

enhance the traditional charm and cultural connotation of buildings (Zhang Baowei, Yang Tianyu, 2023). [13].

In general, appearance satisfaction refers to people's overall evaluation of architectural appearance, including aesthetics, coordination and characteristics. A satisfactory architectural appearance can attract people's attention, enhance the ornamental and recognizable degree of the building, and thus bring pleasant visual experience and cultural enjoyment to the occupants and tourists.

3.4 Architectural decoration and detailed feature index

(1) Evaluation of external facilities, whether the additional facilities outside the building, such as air conditioning units, pipelines, etc., affect the aesthetics of the building. In addition to affecting the overall beauty of the building, a reasonable design of external facilities should also consider its coordination with the architectural style and the integration of the environment, in order to maintain the overall coordination and beauty of the building (Zerenqu Zong, 2023))[14].

(2) Cultural considerations of architectural decoration, whether the architectural decoration elements reflect the traditional culture and regional characteristics. The decorative elements of traditional residential buildings are often integrated into the local traditional culture, customs and religious beliefs, which are reflected by carving, murals, sculptures and other forms, thus enriching the cultural connotation and artistic value of the buildings (Sun Guoliang, Chen Yumei, Li Chaofeng, 2022) [15].

(3) Decoration satisfaction refers to people's overall evaluation of architectural decoration, including aesthetics, culture and artistry. A satisfactory architectural decoration can not only enhance the ornamental value and comfort of the building, but also convey the cultural connotation and historical value behind the building, and bring pleasant visual and cultural experience to the occupants and viewers.

(4) Evaluation of paving practices: whether the materials and techniques of ground paving reflect the style and characteristics of traditional residential buildings (Feng Yuanyuan, 2018) [16]. The ground pavement of traditional residential buildings often adopts natural materials such as black brick and SLATE, and displays rich cultural implication and artistic value through brick carving, inlaying and other craft techniques. Therefore, the selection of pavement practices should take into account the overall style and environmental atmosphere of the building, so as to realize the organic connection with traditional buildings (Dai Jian, Lv Yutong, 2022) [17].

These indicators together constitute the evaluation system of the visual characteristics of the decorative landscape of traditional residential buildings, which can comprehensively and objectively evaluate the features and conservation and renewal effects of traditional residential buildings. Through the comprehensive evaluation of these indicators, it can better guide the protection, repair and renewal of traditional residential buildings, and realize the inheritance and development of traditional culture.

4. Research on evaluation standard system of traditional residential buildings

In order to protect and update the traditional residential buildings, it is necessary to establish a systematic style evaluation system to clarify the status quo of its style, the degree of fit with the tradition and the renewal effect. Aiming at traditional residential buildings, this system takes into account the influence of multiple factors such as courtyard group, spatial scale and architectural appearance, and combines the differences of different courtyards and the needs of protection and renewal to ensure universality (Wu Siyu, Zhang Danyu et al., 2022) [18]. Based on the characteristics of traditional residential buildings and existing studies, this study established a grading evaluation index system, adopted analytic hierarchy process and expert interviews to determine the index weights, and proposed weight grading and comprehensive scoring methods to evaluate the integrity and continuity of traditional residential architectural styles. 4.1 Construct the comprehensive evaluation index system of traditional style and features of Siheyuan

When selecting the evaluation indicators of traditional residential buildings, the principles of scientificity, applicability, systematization and operability should be followed (Chen Ying, Jin Guohong et al., 2021) [19]. architectural style. Applicability emphasizes that the indicators should be targeted at the characteristics of traditional houses. Systematicness requires the index to comprehensively cover elements such as layout, scale, appearance and details. Operational indicators need to be easy to judge, measure and assign values, so as to facilitate subsequent data processing. Following these guidelines, the traditional residential style can be more accurately evaluated and protected.

This study mainly evaluates the material elements of traditional residential buildings from the architectural level, combined with the evaluation of spatial satisfaction, and improves the application value. Starting from the four aspects of courtyard grouping, spatial scale, architectural appearance and details (Yuan M, LiZ, LiX, 2022)[20],as hown in Table 1, the following evaluation factors were selected:

A Courtyard cluster: enclosing degree, symmetry, plot ratio, master-slave composition, location of house door and satisfaction of courtyard space.

B Spatial scale: building height, area, bay size, yard size, number of building floors and elevation ratio.

C Building appearance: roof form, slope, door and window form, architectural color, material and appearance satisfaction.

D Details: external hanging facilities, architectural decoration culture, decoration satisfaction and paving practices.

Table 1 Evaluation index composition of traditional residential buildings style and characteristic

First-level index	Number	Secondary Indicators	Sources
Compound Group	C1	encirclement	Reference literature, this paper research proposed
B1	C2	Symmetry	Element map, design guidelines
	C3	Plot ratio	Existing research
	C4	Master-slave composition	Element drawing, design guidelines
	C5	Homestead door location	Element drawing, design guidelines
	C6	Courtyard space satisfaction	Reference literature, this paper research put forward
Spatial scale	C7	Building height	Elements layout, detailed planning, design guidelines
B2	C8	Built-up area	Design guidelines
	C9	Bay size	Element drawing, design guidelines
	C10	Yard size	Element drawings, design guidelines
	C11	Number of building floors	Design guidelines
	C12	Elevation scale	Element drawings, design guidelines
Architectural appearance	C13	Roof form	Elements drawing, technical guide drawing, design guide,
B3	C14	Roof pitch	Technical guidelines, design guidelines, existing studies
	C15	Door and window form	Element drawings, technical guidelines, design guidelines
	C16	Architectural colors	Technical guidelines drawing, design guidelines, existing research
Architectural appearance	Cl7	Materials	Elements drawing, technical guide drawing, design guide
B3	C18	Satisfaction with building appearance	Refer to the literature, this paper research put forward
Details	Cl9	Plugins	Technical guidelines Painting, design guidelines
B4	C20	Architectural decoration cultural	Refer to the guidance document, this paper research and put forward
	C2l	Architectural decoration satisfaction	Reference literature, this paper research put forward
	C22	Paving Practices	Element drawing, technical guide drawing, design guide

Clarify the importance and weight distribution of evaluation indicators of traditional residential buildings Analytic hierarchy Process (AHP) is a complex and systematic problem solving method combining qualitative and quantitative analysis, which is suitable for architectural and landscape evaluation. It consists of four steps: modeling, constructing judgment matrix, sequencing and consistency test (Che W, Cao Z, Shi Y, 2022) [21]. In this study, it is used to build index hierarchy and calculate weights. The usual nine-point method is used to compare two indicators at the same level. This study also adopts this method to collect expert opinions, build a judgment matrix, and calculate the weights with yaahp lo.3 software. After passing the consistency test, the final weights of indicators are obtained by geometric average method, as shown in Table 2:

Table 2 Comprehensive weights of evaluation indicators

First-level indicators	Secondary indicators				
Indicators	Weights	Base level indicators	Weights	High standard level indicators	Weights
Compound group	0.41	encirclement	0.13	Homestead door location	0.02
		Symmetry	0.06	/	/
		Plot ratio	0.05	/	/
		Master-slave structure	0.07	/	/
		Courtyard space satisfaction	0.08	/	/
Spatial scale	0.22	Building height	0.07	Floor area	0.02
		Bay size	0.04	Number of floors	0.02
		Yard size	0.04	Elevation scale	0.03
Building appearance	0.26	Roof form	0.09	Roof pitch	0.02
		Architectural colors	0.05	Materials	0.02
		Door and window form	0.04	/	/
		Satisfaction with building appearance	0.04	/	/
Details	0.11	Plugins	0.04	Architectural decoration culture	0.03
		/	/	Satisfaction degree of architectural decoration	0.02
		/	/	Paving practices	0.02

4.2 Quantitative evaluation and comprehensive score of the evaluation index of traditional residential building features

(1) Quantitative scoring mechanism of each evaluation index of traditional residential building style characteristics

This study mainly evaluates the material elements of Siheyuan residential buildings from the architectural level, and most of the selected indicators are objective indicators, that is, indicators that can be collected and calculated by means of description, judgment, measurement and other methods. Meanwhile, incorporating spatial satisfaction evaluation into the architectural evaluation system will help improve the application value of planning and evaluation. Therefore, combining with existing studies, subjective indicators will be added. Including courtyard space satisfaction, architectural appearance satisfaction and architectural decoration satisfaction (Taherkhani R, Hashempour N, Lotfi M, 2021) [22].

For objective indicators, the method of interval scoring is adopted, and the specific scoring standards are shown in Table 3. There are three levels for each indicator of basic level and high standard level. The scoring interval of the index should comprehensively consider the feature analysis of traditional residential buildings, design guidelines, evaluation research on existing building features and management and control factors of existing building features.

Table 3 Scoring range of evaluation index

Aspects	Indicators	Base Level			High Standard		
		0 points	Fifty cents	100 points	0 points	50 points	100 points
Courtyard Group	Enclosing	Open	"⊔" type	"Mouth" type	/	/	/
	Symmetry	Asymmetry	/	Center axis symmetry	/	/	/
	Plot ratio	> 0.7	(0.6, 0.7]	W0.6	/	/	/
	From constitution	Clutter None chapter	No obvious etc Level Division	Scattered high and low Be organized	/	/	/

① Yard building height score: It is necessary to score each building in the hospital first. If the height of the building is consistent with the historical original state, that is, the same as the data of the house or the surveying and mapping data is 100 points. If the historical data is lacking or affected by the change and the building height is 4 to 7.5 meters, it is 50 points. If the building height is greater than 7.5 meters, it is 0 points. S_1 And so on to get the height score of all the building monomer in the hospital. S_2, S_a, , , S_n Then sum up the scores of each building unit and divide by the number of buildings to get the height score of the courtyard, that is $S_{高} = \frac{S_1 + S_2 + \cdots + S_n}{n}$

② Courtyard building area score: if the total area is consistent with the historical original state, that is, consistent with the data of the house or surveying and mapping data is 100 points, if the plot ratio is within 0.7, the appropriate area is increased to 50 points, and if the area is not increased or decreased by unfounded private reconstruction, it is 0 points.

③ The score of the space size: For the most basic plane unit of the building monomer, it is necessary to score each building monomer in the hospital according to the index and select the building type. If the width and depth between the buildings meet the grade requirements, the interval is 100 points, and if the data is greater than the interval is 0 points, it is recorded as, and so on to get the width score of all the buildings in the hospital and the depth score of all the buildings in the hospital.

$S_{宽1}$、$S_{深1}$ $S_{宽2}$, $S_{宽3}$, , $S_{宽n}$ $S_{深2}$, $S_{深3}$, , $S_{深n}$ Then the width score and depth score of each building monomer are summed and divided by the number of buildings to obtain the width score and depth score.

$S_{宽}$ $S_{深}$ Finally, the average sum of the interval width scores and depth scores gives the interval size scores, i.e $S_{开间} = \frac{S_{宽1} + S_{宽2} + \cdots + S_{宽n} + S_{深1},\ S_{深2}, \cdots,\ S_{深n}}{2n}$.

④ Courtyard size score: It needs to be judged according to the type of courtyard. If the width and depth of the courtyard meet the requirements of the type, the interval is 100 points. If the interval data is greater than 0 points, it is recorded as the courtyard surface width score and the courtyard depth score, and then the sum average to get the courtyard size score, that is $S_{院宽}$ $S_{院深}$ $S_{院} = \frac{S_{院宽} + S_{院深}}{2}$

⑤ Score of building layers: According to the index, each building in the hospital should be scored first. If the number of building layers is 100 points, if the number of floors is 50 points, if the number of floors is greater than 2 floors is 0 points, then the number of floors of the building is recorded as, and so on to get the number of floors of all building monomers. S_1 S_2, S_3, , S_n Then sum the scores of each building monomer and divide

by the number of buildings to get the score of the number of floors of the courtyard building, that is $S_{层}=\frac{S_1+S_2+\cdots+S_n}{n}$

⑥ Roof form score: it is necessary to score each building monomer in the courtyard first. If the roof form of the building is a slope roof, 100 points, if the roof form is a flat roof, 50 points, if there are other roof forms, 0 points, then the roof form score of the building is recorded as, and so on to get the roof form score of all building monomers. s_1 s_2, s_3, , s_n Then sum up the scores of each building monomer and divide by the number of buildings to get the score of the courtyard roof form, that is $S_{顶}=\frac{S_1+S_2+\cdots+S_n}{n}$.

⑦ Roof slope score: It is necessary to score each building in the hospital first. If the roof slope of the building is less than or equal to 0.65:1, 100 points; if the roof slope is between 0.65:1 and 0.75:1, 50 points; if the roof slope is greater than 0.75:1, 0 points; at this time, the roof slope of the building is recorded as S1. And so on to get the roof slope score of all building monomers. s_2, s_3, , s_n Then sum the scores of each building unit and divide by the number of buildings to get the score of the roof slope of the courtyard, i.e $S_{坡}=\frac{S_1+S_2+\cdots+S_n}{n}$

⑧ Score of door and window form: It is necessary to score each building in the hospital first, if the building door and window form conforms to the traditional system of 100 points, if the modern simple form or the use of double Windows (traditional wooden screen Windows on the outside, thermal insulation Windows on the inside), antique wood frame insulating glass, antique wood wrapped aluminum or antique aluminum alloy Windows are 50 points, If there is a revolving door, sliding door, floor-to-ceiling window and other styles do not match or modern practices of the doors and Windows for 0 points, at this time the building doors and Windows form score is recorded as S1, and so on to get all building monomer doors and Windows form score. S_2, s_3, , s_n Then sum the scores of each building monomer and divide by the number of buildings to get the scores of courtyard doors and Windows form $S_{门窗}=\frac{S_1+S_2+\cdots+S_n}{n}$

⑨ Architectural color score: Each building in the hospital should be scored first. If the color of the building is in line with the color tone of gray, blue, red, green, black and wood and the main color is gray and cyan, 100 points will be scored; if a large area of black, white, gold, silver and bright colors such as orange and purple are used, 0 points will be scored. Then the color score of the building is recorded as, s_1 And so on to get the color score of all building monomers. s_2, s_3, , s_n Then sum the scores of each building unit and divide by the number of buildings to get the architectural color score of the courtyard, i.e $S_{色}=\frac{S_1+S_2+\cdots+S_n}{n}$

⑩ Building material score: mainly evaluate the roof, structure, walls, doors and Windows and ground of the building five aspects. Each building in the hospital is carefully scored. If the material meets the traditional characteristics (wood, brick, tile, etc.), it will get 100 points; If modern materials (steel, plastic steel, etc.) are used but their appearance is similar to traditional ones, 50 points will be scored; If reflective materials (mirror glass, etc.) are used that destroy the traditional look, 0 points will be awarded. At this time, the building material sub-score is calculated as, material score, and so on to obtain the material score of all building monomer.

$S_{屋面1}$、$S_{结构1}$、$S_{墙体1}$、$S_{门窗1}$、$S_{地面1}$ $S_{材1}=\frac{S_{屋面1}+S_{结构1}+S_{墙体1}+S_{门窗1}+S_{地面1}}{5}$ $S_{材2}$, $S_{材3}$,…, $S_{材n}$ Then sum up the scores of each building unit and divide by the number of buildings to get the material score, that is $S_{材}=\frac{\sum_n^{i=1}S_{屋面}+\sum_n^{i=1}S_{结构}+\sum_n^{i=1}S_{墙体}+\sum_n^{i=1}S_{门窗}+\sum_n^{i=1}S_{地面}}{5n}$

11 For the score of external facilities, if household facilities, public facilities, awning and other external facilities are hidden by reserved space, it is 100 points, if it is blocked by traditional system components or landscape, it is 50 points, if it is exposed to 0 points.

(2) Comprehensive scoring method

Construct a two-level evaluation system for traditional features, with 80 points for basic level, 20 points for high standard level, and 100 points in total. If the score of the basic level is insufficient, the improvement of the high standard level will have limited improvement on the overall style and can be ignored. For example, when the basic level score is low, it is difficult for traditional materials and decorations to improve the style fit. Therefore, we only consider the impact of a high standard grade when the basic grade score is ≥40.

The comprehensive score is calculated, the scores of each index are set as, and the score set is constructed, where i=1 and 2 respectively represent the scores of the JTH index of level i for the basic level and the high standard level; s_{ij} $S=\{s_{i1},s_{i2},\ldots s_{in}\}\ (i=1,2,j=1,2,\ldots,n)$ s_{ij}Weight is, build a weight set, where is the weight of the JTH indicator of level i, the total score of the indicators of basic level and high standard level is and respectively, and the comprehensive score is

$s. w_{ij}\ W = \{w_{i1}, w_{i2}, \ldots w_{in}\}\ (i = 1, 2, j = 1, 2, \ldots, n)\ w_{ij}\ S_1\ S_2$

The index score of basic level is: when <40, the comprehensive score is s=s1; when S1≥40, the index score of high standard level can be included in the comprehensive score. $S_1 = \sum_{j=1}^{n} s_{1j} w_{1j}\ S_1\ S_2 = \sum_{j=1}^{n} s_{2j} w_{2j}\ S = S_1 + S_2$

This evaluation system adopts the way of grading and scoring to conduct quantitative evaluation of multiple indicators of the traditional style of Siheyuan, which highlights three significant advantages:

a. The system comprehensively and accurately evaluates the degree of fit between Siheyuan residences and traditional styles from four dimensions of courtyard layout, space size, building appearance and detailed features.
b. The secondary index of the system is cleverly divided into two levels: basic requirements and high tandards, which enables the refined evaluation of Siheyuan with different protection and renovation needs, so as to ensure that the evaluation can truly reflect the traditional characteristics of the courtyard style.
c. The evaluation results can show the specific scores of courtyard style in all aspects in detail, help us to accurately identify key indicators, and provide solid data support and reference basis for formulating reasonable and effective renewal plans.

5. Empirical test of the comprehensive evaluation index system of traditional residential architectural features

5.1 Investigation on the actual status of existing traditional residential buildings

(1) Case 1: No. 8, Caochang Hutong, Siheyuan, Beijing

No. 8 Caochang Hutong covers an area of 419.59 square meters, with a property area of 209.3 square meters and a plot ratio of 0.499. It adopts a courtyard layout with the entrance on the northeast side and the overall north-south symmetry. The courtyard, 18.14 meters wide and 24.79 meters deep, contains a courtyard. The buildings are all one story, and the north room has a self-modified mezzanine. The north room is higher than the two wing rooms in height and area, with a simple three-section facade design. The appearance of the building has been reformed independently. The east wing is newer, while the west wing and the north wing are older and damaged. In the detailed design, some facilities are exposed, the courtyard decoration is simple, the floor is messy, the use of concrete pavement bricks and tiles. (2) Case 2: Courtyard No. 6, Caochang Hutong, Siheyuan, Beijing

No.6 courtyard is 217.49m2 courtyard, no property certificate, plot ratio is 0.607, north, east and south three sides of the enclosure, the entrance is in the northwest side. The courtyard is square and symmetrical. The north and south rooms are of high grade. The building has one floor and 7m*6m courtyard. The appearance of the building adopts three-stage composition, and there is independent transformation. The north and south rooms are new and intact, while the east wing rooms are old and badly damaged. The details are simple, the wires are exposed, and the floor in the hospital is messy.

5.2 The overall evaluation and analysis of the architectural features and features of the existing traditional residential buildings

(1) Evaluation of traditional style and features of No. 8 Caochang Hutong

As shown in Table 4, in the subjective score of the courtyard, the average score of satisfaction with the courtyard space is as high as 85.50 points, indicating that the current situation of the courtyard space is relatively in line with the expectations of most respondents. This may be because the courtyard space with a width of about 10 meters and a depth of about 17 meters is enclosed on three sides, and the courtyard is square. Giving people the feeling of a gentle and open space. The average score of satisfaction with architectural appearance is only 29.77 points, which may be due to the different degrees of independent reconstruction of individual buildings, and the different facade colors, doors and Windows forms of each building in the unit, giving people a chaotic visual experience. Moreover, the construction time span of each individual building is large, ranging from 1949 to 2002, and the appearance maintenance is poor. The external wall skin peeling, damage and other phenomena.

Table 4 Subjective index scores of No. 8 Caochang Hutong

Score	0	50	100	Scores
Yard space satisfaction	1.53%	25.95%	72.52%	85.50
Building appearance satisfaction	48.09%	44.27%	7.63%	29.77
Satisfaction with architectural decor	42.75%	48.85%	8.40%	32.83

(2) Evaluation of traditional style and features of No. 6 Caochang Hutong

Compared with No. 8 Caochang Hutong, No. 6 Caochang Hutong has the highest average score of architectural decoration satisfaction, nearly 45 points (as shown in Table 5). This is due to the square mullion lattice design

of its north room doors and Windows, which adds features to the building. At the same time, its courtyard space satisfaction is also high, with an average score of more than 50, which is consistent with the rectangular courtyard layout of 7 meters wide and 6 meters deep, meeting the expectations of the respondents.

Table 5 Subjective index scores of No. 6 courtyard of Caochang Hutong

Score	0	50	100	Scores
Yard space satisfaction	9.92%	67.94%	22.14%	56.11
Satisfaction with building appearance	42.75%	48.09%	9.16%	33.21
Architectural decoration Satisfaction	22.90%	64.89%	12.21%	44.66

Vi. Discussion and reflection

This study takes Beijing Siheyuan as a case, through field investigation, expert interview and statistical analysis methods, in-depth analysis of the visual characteristics of traditional residential buildings, and establish the corresponding evaluation index system and scoring mechanism.

In the determination of evaluation indicators, this paper puts forward four categories of courtyard group characteristics, spatial scale characteristics, architectural appearance characteristics, architectural decoration and detail characteristics, as well as specific quantitative scoring mechanism, forming a complete evaluation system. Through field investigation and expert interview, the evaluation system is ensured to be scientific and objective. At the same time, the evaluation model is constructed by AHP, which realizes the in-depth quantitative evaluation of the visual characteristics of traditional residential buildings.

After a detailed analysis of the actual situation of Beijing Siheyuan, the validity and reliability of the evaluation index system and scoring mechanism are verified. For example, in the evaluation of No. 8 Caochang Hutong and No. 6 Caochang Hutong, many aspects were carefully scored, providing scientific support for the protection, inheritance and utilization of actual traditional residential buildings.

However, the study also faces some challenges and problems. The further improvement of evaluation criteria and methods requires interdisciplinary research and exploration; Technical means have not been fully applied, the future can explore the application of digital means in the traditional architectural evaluation; At the same time, the multidimensional analysis still lacks a comprehensive discussion on the relationship between traditional residential buildings and social and cultural background, which is an important direction for future research.

Vii. Conclusion

This study systematically discusses the evaluation of visual characteristics of the decorative landscape of traditional residential buildings, and constructs a set of comprehensive evaluation index system. Through the quantitative evaluation and comprehensive scoring of the characteristic indicators of courtyard group, spatial scale, building appearance and decorative details, the standard system of evaluation of traditional residential buildings is formed. On this basis, the existing traditional residential buildings were investigated and evaluated on the spot, their features and features were analyzed in depth, and the corresponding renewal strategies and practical exploration were put forward.

Through this study, we not only have a deeper understanding of the features and features of traditional residential buildings, but also provide scientific assessment tools and guidelines for their renewal and protection. On the basis of respecting historical and cultural traditions, the protection and renewal of traditional residential buildings should pay attention to the combination with contemporary society and people's lifestyle, so as to realize the organic integration of tradition and modernity, protect the unique charm of traditional architectural culture and promote the sustainable development of the city.

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References:

[1] Bai, L., Wei, Y., Shao, M., Zhang, D., & Rome. (2023). Analysis of cultural landscape characteristics and influencing factors of Northern Manchu traditional residential architecture: A case study of Ancient Town architecture in Wula Street, Jilin City. Architecture and Culture, 5, 173-175. DOI: 10.19875/ j.carolcarrollnki.jzywh.2023.05.055

[2] Che, W., Cao, Z., Shi, Y., et al. (2022). Renewal and upgrading of a courtyard building in the historic and cultural district of Beijing: Design concept of ‘multiple coexistence’ and a case study. Indoor and Built Environment, 31(2), 522-536.

[3] Chen, K., & Zhang, Y. (2023). Research on the cultural characteristics and renewal design of traditional architectural decoration in Suzhuang Village, Gaoping North, Southeast Shanxi. Chinese Architectural Decoration, 19, 125-127.
[4] Chen, Y., Jin, G., & Li, A. (2021). Renovation and upgrading of courtyard houses in Yuer Hutong: Design thinking based on the renewal of courtyard houses in Nanluoguxiang area. Beijing Planning and Construction, 5, 76-80.
[5] Dai, J., & LV, Y. (2022). Transformation of courtyard houses in historical and cultural districts of Beijing. Sichuan Building Materials, 48(01), 55-56.
[6] Fan, M., & He, L. (2024). Analysis on the Embodiment of Traditional Chinese Design Thought in Residential Buildings. Art Market, 2, 90-92.
[7] Feng, Y. (2018). Research on Indoor Adaptive Design of Beijing Siheyuan based on Modern lifestyle [Doctoral dissertation, Hebei University of Technology]. DOI: 10.27105/dcnki.Ghbgu.2018.000702
[8] Huang, Z. (2023). Comparison of courtyard space in traditional architecture: A case study of Beijing Siheyuan and Suzhou Folk Houses. Fujian Architecture, 9, 47-51.
[9] Li, Z. (2024). Architectural scenery adapted to local conditions—Inspired by the gem of Chinese traditional residential architecture—Construction techniques of stilted houses in Miao Village. Knowledge is Power, 2, 94. [10] Liang, Y. (2017). Analysis on the nature and protection measures of traditional residential houses in Beijing—Taking Siheyuan buildings in Beijing City as an example. Doors and Windows, 2, 251.
[11] Pan, H., Su, W., Wang, W., & Hu, C. (2023). Traditional local-style dwelling houses in Shandong: Main types and building characteristic analysis. Journal of Residential Science and Technology, 10, 30-34+63. DOI: 10.13626/j.carolcarrollnki.hs.2023.10.006
[12] Quzong, Z. (2023). Discussion on the protection and inheritance of Tibetan traditional architecture based on the rapid development of modernization. Tian Nan, 1, 67-69.
[13] Shen, J. (2023). Research on the Protection and Renovation Design of Traditional Architecture. Beauty and Times (City Edition), 12, 17-19.
[14] Sun, G., Chen, Y., & Li, C. (2022). Function and conservation of traditional architectural carving art in China: A case study of Huizhou architecture. Humanities World, 12, 44-50. DOI: 10.16737/j.carolcarrollnki.rwtx81281190.2022.12.007
[15] Taherkhani, R., Hashempour, N., & Lotfi, M. (2021). Sustainable-resilient urban revitalization framework: Residential buildings renovation in a historic district. Journal of Cleaner Production, 286, 124952.
[16] Wu, J. (2020). The conflict between traditional Chinese courtyards and modern residential buildings: A case study of Beijing Siheyuan. Art Appreciation, 6, 143-144.
[17] Wu, S., Zhang, D., Shen, J., Li, Z., Zhang, S., & Zheng, L. (2022). Commercial transformation of Beijing Siheyuan based on the background of architectural renewal: A case study of Diayuan. Urban Construction, 12(21), 101-104. DOI: 10.19892/j.carolcarrollnki.CSJZ.2022.21.21
[18] Yuan, M., Li, Z., Li, X., et al. (2022). How to promote the sustainable development of prefabricated residential buildings in China: A tripartite evolutionary game analysis. Journal of Cleaner Production, 349, 131423.
[19] Yuan, Y. (2023). Application and reference of traditional residential building design in modern green building design. Ju She, 33, 8-11+17.
[20] Zhang, B., & Yang, T. (2023). Perspective in the traditional buildings: Yangqiao ancient town protection and inheritance research. Journal of Shanghai Real Estate, 10, 15-18. DOI: 10.13997/j.carolcarrollnki.cn31-1188/f.2023.10.010
[21] Zhang, L., & Du, Y. (2022). Study on protection and renewal of traditional architecture in Shanxi under the theory of cultural gene. Famous Works, 25, 152-154.
[22] Zhang, Y., Zhang, Y., & Wang, X. (2022). Correlation analysis of traditional Siheyuan architecture and its architectural decoration elements. China Architectural Decoration, 24, 113-116.