

The effect of community housing environment optimisation on residents' cultural self-confidence under the guidance of socialist core values

Xiuli Zhang^{1,2,*}

¹ School of Marxism Studies, Henan Polytechnic University, Henan, 454003, China

² Henan Research Center of Chinese Characteristic Socialism Theoretical System (Henan Polytechnic University), Henan Polytechnic University, Jiaozuo, Henan, 454003, China

Corresponding authors: (e-mail: zhxiuli1234@126.com).

Abstract Thousands of years of history have allowed the Chinese building system to take the essence and remove the dregs, absorbing all kinds of excellent culture, and forming a distinctive philosophical and spiritual connotation and cultural style. On the basis of analysing the spiritual expansion of architectural philosophy and phenomenology, the article proposes a method of analysing the trend of the evolution of the spiritual connotation of buildings by combining the Sill coefficient and the standard deviation ellipse, and evaluating their cultural connotation by combining with the cultural symbols of the buildings' perceptions. The overall fluctuation of the Sill coefficient of buildings in various historical periods in the Northeast region is between 0.002 and 0.028, with small fluctuations, while the fluctuation of the Sill coefficient of the central region is between -0.014 and 0.027 in comparison. The mean value of the audience's rating of the perception of cultural symbols of buildings is 4.246 points. The cultural perception of buildings can effectively obtain the cultural connotations embedded in buildings, and combined with the trend of the evolution of spiritual connotations of buildings under different historical periods, we can understand the cultural nature of buildings and provide new development ideas for optimising modern architectural design.

Index Terms Sill coefficient, standard deviation ellipse, building, architectural design, architectural culture

1. Introduction

Architecture is not only the basic needs of human life, but also a carrier, carrying traces of society, history and culture. Whether in ancient or modern times, architecture plays an important role, not only as a place of human existence, but also as a symbol of culture and a witness of history [1]-[4]. The spiritual connotation and culture of different historical periods are different, from the pyramids of ancient Egypt to the Great Wall of China, buildings have shown unique historical and cultural values in both scale and structure [5]-[7]. With the development of human society and the progress of science and technology, modern architecture has shown different characteristics and cultural connotations. Modern architecture focuses on the combination of functionality, practicality and aesthetics, reflecting the values and aesthetic pursuits of modern society [8]-[11]. In addition, modern architecture in different regions also presents their own cultural connotations. For example, the Eiffel Tower in Paris symbolises the industrial progress and modern spirit of France, while the Statue of Liberty in New York embodies the spirit of freedom and human rights of the United States [12]-[14].

The historical and cultural connotation of architecture is closely connected with the development of human society. It is not only a place for human life and activities, but also a carrier of social history and cultural heritage [15], [16]. Through its unique style and design concept, architecture carries rich historical information and cultural significance, and shows the aesthetic pursuit and values of the society in different times. At the same time, architecture plays an important role in the functional demand, historical heritage, artistic value and environmental protection of the society [17]-[20].

This paper innovatively proposes a quantitative method to analyse the trend of the evolution of the spiritual connotation of buildings, which clarifies the distribution of the spiritual connotation of buildings through the Sill coefficient and combines with the standard deviation ellipse to understand the trend of the evolution of the spiritual connotation of buildings.

As a kind of physical language that materialises artistic thoughts, buildings can not only reflect spatial characteristics but also show time and cultural characteristics, and integrate different types of philosophical thoughts. Starting from the theoretical logic of architectural philosophy, the article analyses the constituent elements and cultural characteristics of buildings in the spirit of architectural phenomenology. Using the Sill coefficient method and standard deviation ellipse, it analyses the spatial and temporal evolution trend of the spiritual connotation of

buildings, explores the evolution of cultural symbols of buildings through the perception of cultural symbols of buildings, and designs an evaluation system of cultural perception of buildings to obtain the audience's perception of the culture of buildings. Through the spiritual connotation and cultural perception of buildings, it provides a reference direction for the innovation of modern building design and cultural expression, helps the modern architectural design to better meet the cultural needs of the audience, and cultivates the audience's cultural awareness of buildings.

II. Philosophical expressions and cultural connotations in buildings

Infused and rendered by national culture, Chinese ancient architecture presents a variety of charming and characteristic architectural styles, showing traces of the ancient people's integration of nature, transformation of nature and conquest of nature in their survival, with unique aesthetic value. From the ancient architecture, one can feel the spiritual pursuit and creation of the ancients, and see the unique cosmic and spatial and temporal views in their philosophical thinking. Ancient architecture in the development of cleverly reflecting the regional spatial environment and Taoist philosophical thinking, the clever combination of man and nature as an opportunity to show the Chinese philosophical thinking in the building.

II. A. Philosophical Foundations and Spiritual Expansion of Architecture

II. A. 1) Theoretical logic of architectural philosophy

Philosophical reflection on architecture (including cities), i.e. on macro- and micro-architecture, within the larger system of building science, is the study of philosophical issues in architectural, scientific systems [21]. The research objects and categories of architectural philosophy have three "basic parts", namely, epistemology - the view of nature, axiology - the view of history, methodology - the view of practice, and it also includes "four levels", that is, basic theory, technical science, engineering technology and various phenomena themselves. The evolution of the relationship between architecture and philosophy is shown in Figure 1, which contains three main distinct phases.

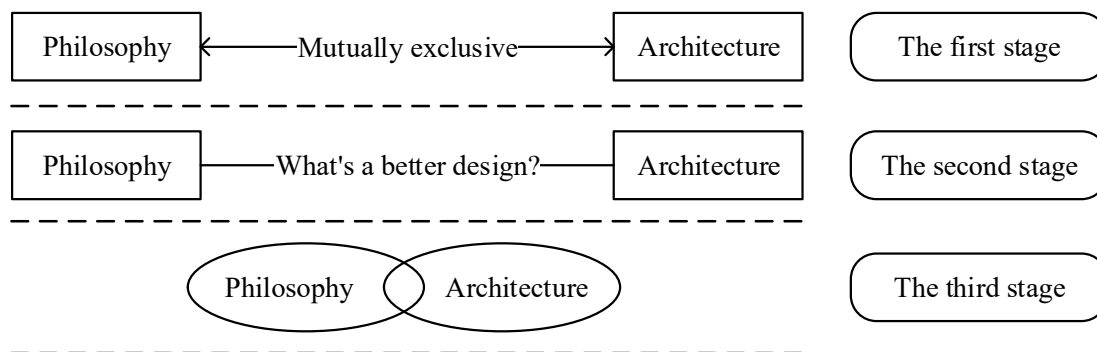


Figure 1: Evolution of architecture and philosophy

In the first stage, architecture and philosophy have little connection with each other, and in this stage philosophy is basically critical of architecture, attacking its shortcomings on the basis of philosophical aesthetics and ethics. In the second stage, under the influence of philosophy, architecture does not simply submit to the criticism of philosophy, nor does the engineer simply admit that he has developed from philosophy, but emphasises other alternative ways of relating to philosophy to feed back the influence of philosophy. In the third stage, philosophy and architecture practically realise a partial merger or overlap, and from the point of view of architectural perfection, design as an important practical aspect of architecture, failure is prone to and inherent in architecture, and constitutes a kind of tortuous learning process of technological progress.

II. A. 2) Spiritual Expansion of Architectural Phenomenology

What distinguishes phenomenology from other philosophical ideas or philosophical movements is the methods it uses. It focuses on observing the phenomena of things, thinking about and understanding the essence of things, emphasizing logical thinking, weakening the methods of psychology, etc. Based on Heidegger's philosophy of being (man reaches existence through dwelling), he expands the phenomenology of architecture and the spiritual connotation of its objects. The relationship between existential philosophy and the spiritual connotation of architecture is shown in Figure 2. The point of connection is that in order for people to settle down, they must have a connection with the environment, so that the meaningless environment can produce meaning, and architecture can help people complete the action of "settling". Therefore, in Heidegger's philosophy, the discussion of the

problem of human existence is expressed in the phenomenology of architecture as a discussion of how to construct buildings with "meaning" or "spirit of place".

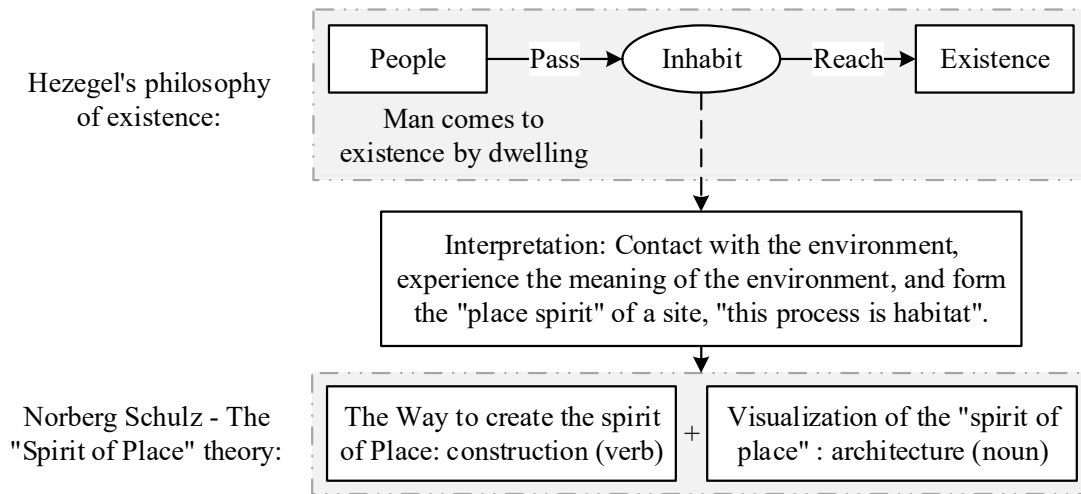


Figure 2: The relationship between philosophy and architecture

There are two main ways to expand phenomenology from the field of philosophy to the field of architecture, one is the discussion of the 'spirit of place' derived from Heidegger's existentialist philosophy, and the other is the discussion of spatial perception derived from Merleau-Ponty's phenomenology of perception. Relying on this theory to clarify the transformation of its spiritual connotation under architectural phenomenology can help explore the spiritual connotation of buildings.

II. B. Composition of building elements and cultural identity

II. B. 1) Building components

As a product of the accumulation of economic, cultural and social aspects in the process of urban development, the constituent elements of buildings are roughly divided into material elements and human elements [22]. Based on the performance of the spiritual connotation of buildings, this paper divides the constituent elements of buildings into natural elements and artificial elements. Among them, the natural elements are the development matrix of artificial elements, the natural and artificial elements as tangible elements are the material carrier of human elements, and the human elements as intangible elements are the spiritual connotations of the natural and artificial elements, which are complementary to each other. The constituent elements of a building are shown in Figure 3, with the natural elements mainly including mountains, rivers and lakes, the artificial elements mainly including buildings, structures and specific spatial places, and the human elements mainly including religious beliefs and cultures, historical cultures, trade and commerce cultures, toponymic cultures, historical events and folk customs.

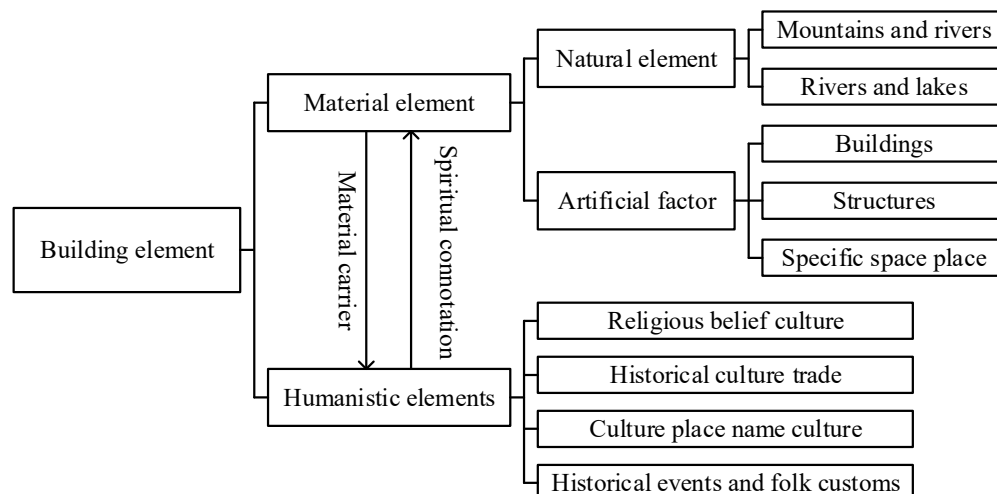


Figure 3: The composition of the building

As the ecological base of the building, the natural elements are the carriers of the ideology of mankind in the process of adapting to and transforming nature, reflecting the unique spiritual value of the building. Artificial elements, as the material space carriers of historical lineage, life production and customs in the built environment of the city, have condensed the needs of human beings in pursuing quality life in different historical periods. Human elements are the comprehensive embodiment of folk customs, life production, behavioural activities, religious beliefs and economic level, which is the essence of local characteristics. Through the extraction and identification of human elements, the cultural connotation of buildings can be explored.

II. B. 2) Cultural identity of the building

The cultural identity of a building is a whole with a specific structure formed by the interconnection and interaction between cultural elements and elements, and between elements and places. The cultural elements constituting the cultural relationship in a building include not only material entities, but also non-material forms such as ideology and consciousness, and there are a great number of types of cultural relationships formed. The constituent elements in the cultural vein of the building are arranged and evolved in an orderly manner according to a certain level, and the whole system has absolute openness and dynamic stability.

(1) The wholeness of architectural culture. The material form of cultural elements and spiritual form of cultural elements is a kind of mutual promotion, interdependence, objective relationship. Material culture is the basis for the formation and sublimation of spiritual culture, and the guidance and deepening of spiritual culture elements in order to create a corresponding rich and colourful material culture.

(2) The hierarchy of architectural culture. The hierarchy of the system reveals the vertical hierarchy of the system, the commonality at different levels, while the type of the system reveals the multiple states of the system and its commonality from the horizontal.

(3) The openness of architectural veins. Architectural culture exists in the time and space of the building, and constantly exchanges material, energy and information with the external environment, which has the characteristic of openness. The openness of architectural culture to the natural environment and social environment makes the internal and external factors linked, forming a dialectical relationship between internal and external factors.

III. Spatial and Temporal Evolution of Buildings and Perception of Cultural Symbols

Architecture is a kind of entity language that materialises artistic ideas, and is not limited to space alone, it will eventually pass with time, the space structure of the scales and the smooth flow of time are all embodied in the architectural entity. Under the rendering and influence of national culture, ancient buildings have formed an architectural system with Chinese characteristics and charms, witnessing the traces of overcoming nature, transforming nature and integrating nature in the social activities of people in ancient times, with unique spiritual connotations and cultural characteristics. Relying on the spatial evolution of buildings to express the spiritual changes, it fully demonstrates the national cultural confidence under different periods.

III. A. Spatial and temporal evolution of spiritual connotations of buildings

The main objective of analysing the spiritual connotation of buildings under the perspective of philosophical development is to explore the spatial and temporal evolution trend of buildings under different periods, focus on the shift of the centre of gravity of buildings, and then clarify the trend of the change of spiritual connotation under different periods. Thus, this paper introduces the Sill coefficient and standard deviation ellipse to study the trend of buildings in different periods, aiming to study the evolution of the spiritual connotation of buildings.

III. A. 1) Sill factor method

The Sill coefficient is an inequality coefficient that can be decomposed additively using information theory [23]. Its measurement model can be expressed as:

$$I(o) = \frac{1}{N} \sum_{i=1}^N \log \frac{\bar{Y}}{Y_i} \quad (1)$$

where N is the number of units, Y_i is the numerical level of the i rd unit, and $\bar{Y}$ is the average of Y_i . A larger Sill coefficient indicates a higher level of inequality.

One of the greatest advantages of using the Sill coefficient as a measure of inequality is that it allows for the decomposition of the overall variance into intra- and inter-regional variances, from which it is possible to calculate the extent to which the variance between regions and between units within regions contributes to the overall variance, thus providing a more targeted basis for decision-making. The Sill coefficient includes two Sill coefficient decomposition indicators (G and L), the difference between them lies in the difference in the weighting method.

According to the research needs of this paper on the spiritual connotation of buildings, the main use of the Sill L indicator for illustration.

If all units are divided into group G according to a certain method, the Sill coefficient $I_{(o)}$ can be decomposed as follows. Namely:

$$I_{(o)} = \sum_{g=1}^G P_g I_{(o)g} + \sum_{g=1}^G P_g \log \frac{P_g}{V_g} \quad (2)$$

where $I_{(o)g}$ represents the Sill coefficient calculated when group g is taken as a whole, V_g represents the share of the numerical level of group g in the total numerical level, and P_g represents the share of the population of group g in the total population. The left-hand side of the equation represents the overall variation, while the first term on the right-hand side of the equation represents the within-group variation, which can be used to measure the differences between units within a region, and the second term represents the between-group variation, which is used to reflect the differences between regions.

III. A. 2) Standard deviation ellipse

Standard deviation ellipses are used to measure the direction, shape and mean centre of the spatial distribution of point elements. The long axis of the ellipse indicates the trend of the spatial distribution of the elements, the short axis indicates the ability to cover the elements, and the shorter the short axis, the stronger its centripetal force, and the longer the short axis, the weaker its centripetal force [24]. The difference between the long axis and the short axis and the ratio of the long axis is called the flatness, the larger the flatness, the more obvious the directional characteristics of the distribution of elements. Comparison of the size of the standard deviation ellipse area can be used to judge the degree of dispersion of the distribution of the elements, the smaller the area, means that the distribution of the elements is closer to the centre of gravity. In this paper, the standard deviation ellipse is used to judge the degree of spatial offset of the building, and the centre of the circle of the ellipse is calculated using the arithmetic mean centre, which is divided into a total of the following three steps. Specifically as follows:

First, calculate the variance of the standard deviation ellipse, then:

$$SDE_x = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{X})^2}{n}} \quad (3)$$

$$SDE_y = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{Y})^2}{n}} \quad (4)$$

Secondly, calculate the elliptical direction angle, then:

$$A = \left(\sum_{i=1}^n \tilde{x}_i^2 - \sum_{i=1}^n \tilde{y}_i^2 \right) \quad (5)$$

$$B = \sqrt{\left(\sum_{i=1}^n \tilde{x}_i^2 - \sum_{i=1}^n \tilde{y}_i^2 \right)^2 + 4 \left(\sum_{i=1}^n \tilde{x}_i \tilde{y}_i \right)^2} \quad (6)$$

$$C = 2 \sum_{i=1}^n \tilde{x}_i \tilde{y}_i \quad (7)$$

$$\tan \theta = \frac{A+B}{C} = \frac{\left(\sum_{i=1}^n \tilde{x}_i^2 - \sum_{i=1}^n \tilde{y}_i^2 \right) + \sqrt{\left(\sum_{i=1}^n \tilde{x}_i^2 - \sum_{i=1}^n \tilde{y}_i^2 \right)^2 + 4 \left(\sum_{i=1}^n \tilde{x}_i \tilde{y}_i \right)^2}}{2 \sum_{i=1}^n \tilde{x}_i \tilde{y}_i} \quad (8)$$

Thirdly, determine the standard deviation of the x-axis and y-axis, then:

$$\sigma_x = \sqrt{2} \sqrt{\frac{\sum_{i=1}^n (\tilde{x}_i \cos \theta - \tilde{y}_i \sin \theta)^2}{n}} \quad (9)$$

$$\sigma_y = \sqrt{2} \sqrt{\frac{\sum_{i=1}^n (\tilde{x}_i \sin \theta + \tilde{y}_i \cos \theta)^2}{n}} \quad (10)$$

In this paper, the spiritual connotation of a building is used as the weight of the standard deviation ellipse, and the evolution of the spatial distribution of the spiritual connotation of a building is judged by the trajectory of the centre of gravity of the standard deviation ellipse. Changes in the area of the ellipse can reveal the development trend of whether the spiritual connotation of a building is concentrated or expanded, the long and short semi-axes describe the direction of spreading of the main and secondary directions of the spiritual connotation of a building, and the ellipse azimuthal angle can reflect the changes in the main direction of the spiritual connotation of a building.

III. B. Evaluation of Perception of Cultural Symbols in Buildings

III. B. 1) Perception of cultural symbols in buildings

The cultural symbol of a building refers to the abstract feeling of the audience on the appearance of the building through the senses, which means that the audience has a certain cultural association with the building. The shape line, colour, texture and structure of a building are not only for the sake of aesthetics, but also for carrying design information. Modern people have more requirements for the building, need to meet the conditions beyond the practical function in order to attract the audience, can produce the cultural symbols that resonate with the audience has become an important part of the building design, through the cultural heritage can be constructed out of the building in the design of the new direction.

As the perception of cultural symbols is a subjective process, coupled with the differences in cultural background of each person, there is always a gap in communication. And the slightest change of cultural symbols in the building will have an impact on the perception of cultural symbols, and common understanding and common emotions exist to a certain extent. The process of perceiving cultural symbols is a process from encoding to decoding, in which designers process the cultural symbols and audiences interpret them according to their own cultural background and understanding ability. This process is close to the communication theory, i.e. message creation, carrier transmission, user acceptance and response generation. Therefore, in order to make the audience produce a clear cultural image, the designer needs to grasp the controllable part of the image production and choose the appropriate message as the carrier. And after the completion of the design to understand the degree of user acceptance, timely feedback, in order to facilitate the future design of the building.

III. B. 2) Evaluation of the perception of cultural symbols

After clarifying the perception of the building's cultural symbols, the evaluation of the building's cultural connotation is carried out on the basis of the audience's perception of the building's cultural symbols. Evaluation is a scientific and objective practical activity of judgement, and the results of evaluation are closely related to the evaluation indicators. In this regard, this paper establishes the evaluation system of building cultural symbols perception from three dimensions of building cultural symbols perception, experience sense, and access sense as shown in Table 1. The perception of cultural symbols includes macroscopic colony form, mesoscopic architectural features and microscopic architectural structure, the sense of experience includes emotional experience, historical experience, cultural experience and aesthetic experience, and the sense of acquisition includes the sense of achievement, the sense of pleasure and the sense of wonder.

Table 1: Cultural symbol perception evaluation

Dimension	explanation	Code
Cultural symbol perception	acroscopic settlement	C1
	Architectural characteristics	C2
	Microstructure structure	C3
Cultural experience	Emotional experience	C4
	Historical experience	C5
	Cultural experience	C6
	Aesthetic experience	C7
Cultural sense	Achievement of accomplishment	C8
	Achievement of pleasure	C9
	Achievement of hunting	C10

IV. Analysis of the Evolution of Spiritual Connotation and Cultural Perception of Buildings

The Chinese nation has a long history of 5,000 years, and the deep cultural soil and atmosphere have nurtured philosophical ideas and aesthetic concepts that are compatible with it. Traditional Chinese architecture has been deeply influenced by the development of philosophical thinking, forming a unique cultural system. Classical Chinese

architecture is based on the idea of human being, and requires that the proportion of the building's form, space combination, decorative techniques and structural functions are all centred around it. From a philosophical point of view, relying on the spiritual connotation of the building's spatial and temporal evolution and the perception of cultural connotations, to optimise the modern architectural design to provide a new direction of reference.

IV. A. Trends in the evolution of the spiritual content of buildings

IV. A. 1) Evolution of the degree of equilibrium in buildings

The Chinese civilisation has a long history, and based on reference to existing relevant studies, the historical evolution of buildings is divided into seven periods, i.e. pre-Tang Dynasty, Tang, Song, Yuan, Ming, Qing and modern times, which are denoted by T1~T7 respectively. The historical data of the buildings were obtained from the data related to the local county records of China in the past dynasties, and China was divided into four different regions, i.e., the four regions of the east, the west, the centre and the north-east. Using the calculation method of Sill coefficient given in the previous section, the Sill coefficients of the buildings in each historical period are obtained as shown in Fig. 4.

In terms of time scale, the overall Sill coefficient for the modern period is the largest at 0.0069, i.e., the distribution of buildings in the modern period is the most uneven. In the pre-Tang period, the Sill coefficient reaches a minimum of -0.009, i.e. the distribution of buildings in this period is less varied. After the Tang period, with the cumulative increase in the number of buildings, the Sill coefficient shows an increasing trend, which also indicates that after the Tang period, the imbalance in the distribution of buildings in various regions of China is a strengthening trend. From the regional scale, the fluctuation of the Sill coefficient in the Northeast region is relatively small in all periods, and the fluctuation of the Sill coefficient tends to flatten out after the Song period, with the overall fluctuation range between 0.002 and 0.028. The fluctuation of the Sill coefficient in the central region is more obvious (-0.014~0.027), and the central region, due to the higher number of new buildings in each period and the higher cumulative total number of buildings, the difference with the rest of the region has been expanding, and the more obvious the characteristics of the distribution of the distribution of the cluster, which reflects the overall distribution of buildings with prominent characteristics of the imbalance. The unevenness expresses that the spiritual connotations of buildings in different regions vary greatly, and also confirms that buildings are the products of the materialisation of different national spirits, providing a reliable carrier for the dissemination of different national spirits.

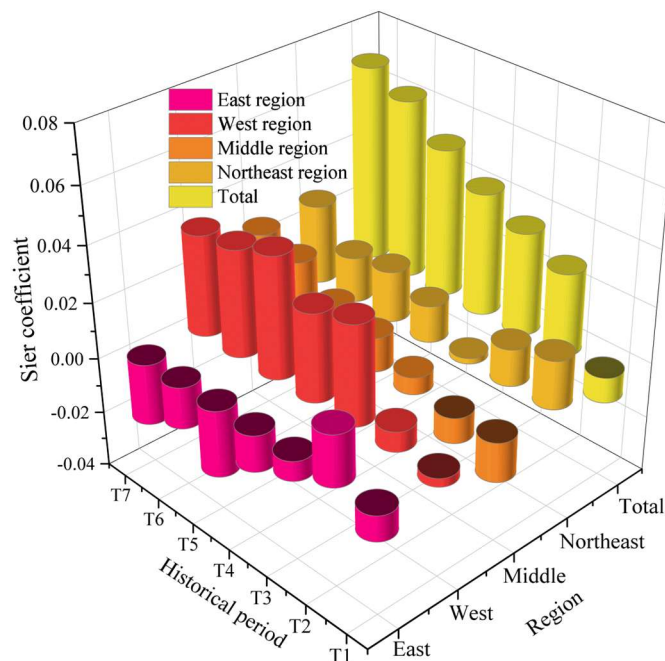


Figure 4: The Sier coefficient of buildings in various historical periods

IV. A. 2) Evolution of spiritual connotations of buildings

In this part, the standard deviation ellipse and the trajectory of the centre of gravity of the spiritual connotation of Chinese buildings under different periods are plotted using ArcGIS software, and the distance and direction of the centre of gravity of the spiritual connotation of the buildings are shown in Table 2.

The centre of gravity of spiritual connotations of Chinese buildings in different historical periods varies between 115.42°E~115.87°E and 34.24°N~34.59°N, and is always located in Henan Province. The centre of gravity of spiritual connotations of Chinese buildings maintains the trend of moving to the south, and its position moves from (115.42° E,34.27° N) to (115.87° E,34.46° N) at the beginning of the period, and the total displacement of the centre of gravity is 26.37 km, with an average speed of 3.77 km/a, which is relatively slow. The trajectory of the migration of the centre of gravity of the spiritual connotation of Chinese buildings can be divided into three periods, as follows:

Before the Tang Dynasty and the Tang period, during which the centre of gravity of the spiritual connotation of Chinese buildings moved in the south-east direction, the distance moved during this period was the shortest, with a total distance of 4.27km, and the slowest moving speed, with an average moving speed of 2.14km/a. The centre of gravity of the spiritual connotation of Chinese buildings in the Song Dynasty and the Ming Dynasty moved in the south-west direction, with the total distance moved increasing to 22.43km, and the average migrating speed to From the Qing Dynasty to modern times, the centre of gravity of spiritual connotations of Chinese buildings moved to the south-east direction, with a maximum migration distance of 21.57 km and an average migration speed of 10.79 km/a. The centre of gravity of spiritual connotations of Chinese buildings showed a 'southward' direction, indicating that the spiritual connotations of buildings in the southern region are stronger than those in the northern region. The centre of gravity of spiritual connotation of buildings in China shows a 'southward' direction, indicating that the spiritual connotation of buildings in the southern region is stronger than that in the northern region.

Table 2: The center of gravity moves distance and direction

	Center of gravity coordinates	Moving distance (km)	Moving direction	Time shift distance (km)	Moving speed (km/a)
T1	115.42° E,34.27° N	-	-	-	-
T2	115.78° E,34.38° N	4.27	East by south	4.27	2.14
T3	115.84° E,34.24° N	5.65	West by south	-	-
T4	115.65° E,34.41° N	7.14	West by south	-	-
T5	115.72° E,34.59° N	9.64	West by south	14.43	4.81
T6	115.81° E,34.51° N	13.64	East by south	-	-
T7	115.87° E,34.46° N	17.93	East by south	21.57	10.79

In order to further illustrate the evolution trend of the spiritual connotation of buildings under different periods, the standard deviation ellipse of the spiritual connotation of buildings is drawn using ArcGIS software as shown in Figure 5. In terms of spatial distribution, the standard deviation ellipse of the spiritual connotation of Chinese buildings under different historical periods is located in the central-eastern region of China, and the ellipse area shows a dynamic trend of shrinking, firstly from 5,274,200km² before the Tang Dynasty to 4,913,400km² during the Tang Dynasty, and then to 5,015,800km² during the Yuan Dynasty, and then to 4,623,700km² during the modern period, indicating that the spiritual connotation of Chinese buildings has evolved in the modern period. 4,623,700km², indicating that the spiritual connotations of Chinese buildings show a converging trend in East China, South China and Central China and South North China. From the direction of spatial distribution, the azimuth of the standard deviation ellipse of China's economic resilience shows an inverted V-shape, first increasing from 48.54° before the Tang Dynasty to 50.26° during the Yuan Dynasty, and then decreasing to 48.71° in the modern period, with an overall change of less than 1.72°, indicating that the spiritual connotation of Chinese buildings is in the form of a 'Northeast-Southwest'. The overall change is within 1.72°, showing that the spiritual connotation of Chinese buildings is mainly distributed in the direction of 'northeast-southwest'. In terms of distribution pattern, the long semi-axis shows a trend of continuous shrinkage, from 1,405.89 km before the Tang Dynasty to 1,372.63 km in modern times, while the short semi-axis undergoes a process of shrinkage, then slight rebound and then fluctuating shrinkage, but the overall shrinkage tendency remains unchanged, which indicates that spiritual connotations of Chinese buildings are further clustered in space. The spiritual connotations of different buildings show the characteristics of different regions, which provides reliable data support for understanding the evolution trend of the spiritual connotations of buildings.

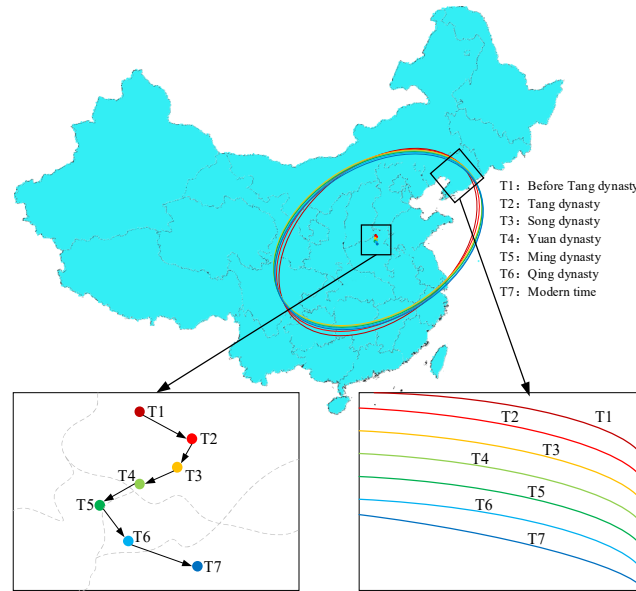


Figure 5: The standard deviation ellipse of the spirit of the building

IV. B. Evaluation of the perception of cultural symbols in buildings

IV. B. 1) Evolution of cultural symbols in buildings

The development of buildings in different periods vividly records and reflects the changes of human beings' exploration of nature, understanding of their relationship with the world, production and way of life, and fully reflects the trend of cultural evolution of human beings in different periods. Exploring the evolution of cultural symbols of buildings in different periods helps to cultivate the audience's cultural self-confidence, help them better trace their own cultural origins, and fully stimulate the audience's cultural awareness. Relying on the theory of the whole life cycle development of buildings, this paper draws the trend of the evolution of cultural symbols of buildings in different periods as shown in Figure 6.

The evolution of cultural symbols of buildings in different historical periods has gone through five stages, namely, incubation, formation, development, maturity and evolution, and the cultural symbols shown in different stages are quite different. Before the Tang Dynasty, the cultural symbols of buildings mainly originated from the evolution of the view of nature, and the buildings in the incubation period were mainly influenced by the view of nature dominated by the early farming culture and theological thought, and the buildings condensed the survival wisdom of early human beings in transforming the nature, and at the same time, the elements of the buildings represented by the places of worship also embodied the theological thought of worshipping the nature. In the formative period of Tang and Song dynasties, the spiritual and cultural core of the buildings is to express the religious meaning through the buildings, and this design way of using symbols to shape the cultural spirit has also had a profound impact on the formation and evolution of the buildings. Relying on the buildings to express the cultural expression of different religions, it promotes the expression of deeper religious beliefs in the buildings. From the Yuan Dynasty to the Ming Dynasty, China's social trends have been intertwined and evolved, triggering the awakening and development of classical cultural consciousness in garden design, and thus ushering in a golden period of development for classical buildings, and stimulating the creativity of many architects in the era of cultural development as a representative of the times. From the Qing Dynasty to modern times, the formation and evolution of buildings have taken the design philosophy represented by culture as the core source, and fully combined with the environment in which the buildings are located to carry out adaptive evolution and innovation. By sorting out the cultural symbols of buildings, the specific evolution of Chinese culture can be explored in depth, and even in the midst of historical changes, traditional culture is always adhered to, and the innovative development of cultural symbols of buildings is inherited in retrospection and integration.

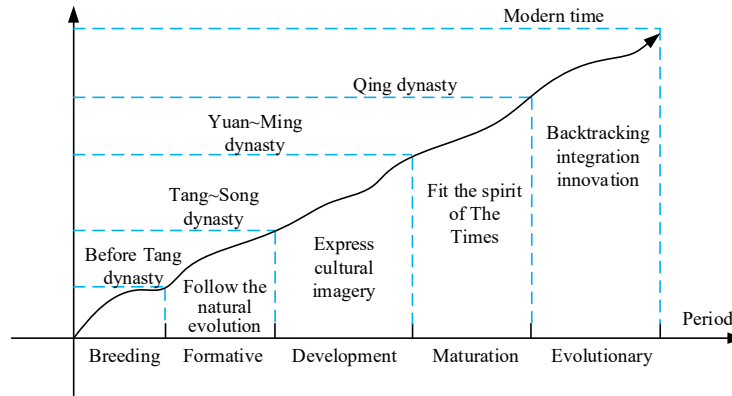


Figure 6: Evolution of building cultural symbols

IV. B. 2) Evaluation of cultural perception of buildings

Based on the evaluation scale of building culture perception established in the previous section, the corresponding questionnaire was designed and used to analyse the specifics of the audience's perception of building culture from a philosophical perspective. The questionnaire is quantified by a five-level Likert scale, and the scale degree changes range from 1 to 5 points, which means strongly disagree, disagree, general, agree, and strongly agree, respectively. The questionnaire was mainly distributed through the questionnaire star platform, a total of 1,000 questionnaires were distributed, 982 valid questionnaires were recovered, and the data obtained from the questionnaire were entered into the SPSS software for data statistics. Table 3 shows the results of the reliability test of the questionnaire. As can be seen from the table, the KMO value of each question item of the questionnaire is higher than 0.9, and the Bartlett's spherical test value of the overall scale is 2178.65, Sig is 0.007, which is less than 0.01 under the condition of 60 degrees of freedom and 1% level, and the assumption of sphericity is rejected, which indicates that the variables are correlated. The reliability and validity of the overall scale is good, which can provide reliable data support for analysing the audience's perception of cultural symbols of buildings, and can truly reflect the specific connotation of cultural symbols of buildings' perception.

Table 3: The reliability test results of the questionnaire

Item	KMO	Bartlett's spherical test		
		Approximate card	DF	Sig.
C1	0.916	1726.56	79	0.001
C2	0.923	2014.82	66	0.003
C3	0.909	2571.03	70	0.005
C4	0.935	1883.76	56	0.001
C5	0.961	2322.40	61	0.004
C6	0.918	2276.31	63	0.001
C7	0.909	2227.24	52	0.006
C8	0.956	2056.97	55	0.005
C9	0.903	2106.03	76	0.000
C10	0.917	2280.51	78	0.002
Total	0.925	2178.65	60	0.007

The acquired questionnaire data were entered into SPSS software for statistical analysis, and the analysis results of the evaluation of building culture perception were obtained as shown in Figure 7. Overall, the score of the audience's perception of the building's cultural symbols ranges from 3.873 to 4.558 points, with an overall mean of 4.246 points and a fluctuating range of standard deviation from 0.621 to 1.097. The range of scores of the audience's evaluation of the perception of cultural symbols in buildings is more consistent, and there is no large fluctuation. This indicates that the perception of cultural symbols of buildings is more obvious, and the audience can understand the trend of cultural change based on buildings, which supports the enhancement of the audience's cultural self-awareness and cultural self-confidence. In addition, the absolute value of the peak of the audience's cultural symbol perception of buildings is below 1.5, and the absolute value of the skewness is below 3, which indicates that the evaluation data of the audience's cultural symbol perception conforms to the normal distribution, and can fully reflect the accuracy of the audience's cultural perception of buildings. The audience can feel the historical precipitation and cultural changes from the buildings, which helps the audience to get a sense of achievement, pleasure and

curiosity, prompts the audience to become a specific carrier of the cultural communication of the buildings, and further enhances the ability to express the cultural self-confidence of the buildings under the philosophical perspective.

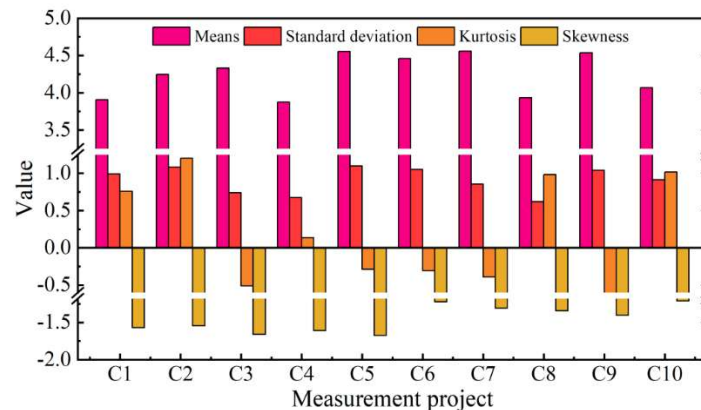


Figure 7: Cultural perception of building culture

V. Conclusion

Starting from the spiritual expansion of architectural philosophy, the article analyses the spatial and temporal evolution of the spiritual connotation of buildings through the Sill coefficient and the standard deviation ellipse, and carries out a perceptual evaluation of the cultural symbols of buildings. In the regional scale, the fluctuation of Sill coefficient of buildings in the Northeast region is relatively small in each period, and the fluctuation of Sill coefficient tends to flatten out after the Song period, with the overall fluctuation range between 0.002 and 0.028. Comparatively speaking, the fluctuation range of Sill coefficient in the central region is larger at -0.014~0.027, which reflects that the spiritual connotation of the buildings under different historical periods has a large difference, and the distribution of spiritual connotation of the buildings in different regions is not uniform. In addition, the overall rating of the audience's perception of the cultural symbols of the buildings is 4.246, indicating that the buildings can more directly spread the culture-related spirit, help the audience to cultivate cultural self-awareness and cultural awareness, and enhance the audience's cultural self-confidence. By analysing the evolution of spiritual connotation and cultural self-confidence of buildings in the philosophical perspective, it can provide cultural design guidance for the optimal design of modern buildings and help the development of cultural connotation of architectural design.

Funding

This paper is a philosophy and social science planning project in Henan Province: Research on the centennial construction and experience enlightenment of the cultural confidence of the Communist Party of China (No.: 2022BDJ007).

Research and Practice Project on Higher Education Teaching Reform in Henan Province: Research and Practice on the "Emergency+" Innovative Talent Training System for Provincial and Ministerial Joint Construction (No. 2024SJGLX0009).

References

- [1] Zhong, F. . (2020). Creative transformation and innovative development of lingnan traditional architectural culture-taking the architecture reconstruction design of liwan district in guangzhou as an example. *Journal of Physics: Conference Series*, 1649(1), 012014 (8pp).
- [2] Hu, Y. W. . (2018). An extension of the ecological environment and the context of regional architectural culture with human life behavior mode. *Basic & clinical pharmacology & toxicology*.(S7), 123.
- [3] Xiong, Y. , & Peng, F. . (2014). A Gene-Genetics-Based Study on the Inheritance Law of Traditional Architectural Culture. *International Conference on Civil Engineering, Architecture and Building Materials*.
- [4] Wang, L. , Gan, Y. J. , Li, Z. , & Qiu, J. H. . (2014). Architectural culture of guangdong merchant hall in pingle. *Applied Mechanics and Materials*, 584-586.
- [5] Enlil, Z. M. , & Dincer, Y. E. & I. . (2011). Cultural triangle and beyond: a spatial analysis of cultural industries in istanbul. *Planning Practice & Research*, 26(2), 167-183.
- [6] MERLINO, & Rogers, K. . (2014). [re]evaluating significance: the environmental and cultural value in older and historic buildings. *Public Historian*.
- [7] Loli, A. , Bertolin, C. , & Kleiven, T. . (2019). Refurbishment of historic buildings at a district scale: enhancement of cultural value and emissions reduction potential. *IOP Conference Series Earth and Environmental Science*, 352, 012023.
- [8] Masaki, Kawabata, Kunihiro, Matsumoto, Masanori, & Sawaki. (2017). Conservation of historic buildings in designated areas of important cultural landscapes. *Proceedings of The City Planning Institute of Japan, Kansai Branch*, 15, 53-56.

- [9] Nia, H. A. , & Rahbarianyazd, R. . (2020). Aesthetics of modern architecture: a semiological survey on the aesthetic contribution of modern architecture. *Civil Engineering and Architecture*, 8(2), 66-76.
- [10] Liu, C. , Lin, M. , & Li, Q. . (2021). A brief study on the aesthetics of modern financial architecture in hankou. *IOP Conference Series: Earth and Environmental Science*, 787(1), 012187 (9pp).
- [11] Yu, Q. , Li, X. H. , & Du, J. M. . (2014). Research on the modern architecture design using aesthetic culture. *Applied Mechanics & Materials*, 584-586, 128-131.
- [12] Merwood-Salisbury, J. . (2019). Modern architecture and luxury: aesthetics and the evolution of the modern subject. *Arts*, 8(3).
- [13] Anna Gumińska. (2018). Human Factors in the Correlation with Aesthetics and Pro-ecological Technology in Modern Architecture. *International Conference on Applied Human Factors & Ergonomics*. Springer, Cham.
- [14] Sabra, Z. , & Moaz, I. M. A. A. . (2021). Aesthetics of transformation in the artistic architecture in the light of anamorphosis. *International Journal of Multidisciplinary Studies in Art and Technology*.
- [15] Walker, S. . (2020). Architecture and the body, science and culture. *Architectural history*(63-), 63.
- [16] Chung, & Jai-Young. (2014). [senior column] history of architecture, culture and human, glove. *Review of Architecture & Building Science*.
- [17] Chen, Y. N. . (2014). Historical and Cultural Connotation of the Architectural Wood Carving Ornament in the Ancestral Temple of Chen Family -With "Feast in Bronze Sparrow Terrace Held by Cao Cao" and "Jiantu Conference" as Examples. *International Conference on Material Science and Environmental Engineering*.
- [18] Chen, B. , Xu, S. J. , Xie, Y. , & Yang, Y. P. . (2021). Exploration of the cultural symbols connotation of dong drum-tower in chinese tower building. *International Journal of Electrical Engineering Education*, 002072092098355.
- [19] Onescu, I. , Onescu, E. , & Mosoarca, M. . (2019). The impact of the cultural value on the seismic vulnerability of a historical building. *IOP Conference Series: Materials Science and Engineering*, 603, 042031-.
- [20] Smejkal, K. . (2019). The artistic value of the architectural work from the architectural psychology point of view. *Architecture. Construction. Education*.
- [21] Ahmet Hadrovic. (2023). Professor Ahmet Hadrovic's Philosophy of Architecture. *South East European Journal of Architecture and Design*(1),1-26.
- [22] Dada A D & Alibaba H Z. (2023). Comparison analysis between the components of vernacular and modern architectures for sustainable housing in Niger State. *IOP Conference Series: Earth and Environmental Science*(1).
- [23] Xinbao Tian & Xiaomin Liu. (2024). Are spatial imbalances in industrial structural change widening the common wealth gap?. *Heliyon*(14),e34417-e34417.
- [24] Tie Wang,Wei Wang,Mei Li,Ming Hsiang Chen & Jingrong Sun. (2024). Examining the spatial dependency between shared accommodations and points of interest. *Journal of Hospitality and Tourism Management*347-359.