

# Construction and Application of Cultural Gene Library of Ancestral Hall in Canton Region

Yanling ZHANG, Xu LUO\*, Xiaohe XU, Kaman MAK, Dandan RUAN

**Abstract:** Ancestral halls in Canton region are an important part of culture and architectural art in Canton region. Currently, research mostly analyzes from the perspective of clan culture and architectural crafts, and rarely explores architectural characteristics and inheritance from the perspective of cultural gene and constructs the gene map of architectural culture. Taking the theory of cultural gene as the starting point, this paper extensively studies the cultural background and inheritance process of cultural genes of ancestral halls in Canton region through literature research and field research. Based on the thinking method of gene reverse transcription in biology and the cultural three-level hierarchy, the main cultural factors were extracted and classified to establish the cultural gene library, gene hierarchical diagram and gene maps of Cantonese ancestral halls. The Analytic Hierarchy Process method (AHP) was used to screen and rank the cultural factors analyzing their importance in all levels in the cultural gene hierarchical diagram. To summarize, this paper discussed the development and evolution of cultural factors of Cantonese ancestral halls and their contemporary inheritance requires more attention on the innovative translation design of core cultural factors with higher importance, based on the principle of authentic and integral preservation of original, providing new perspective and decision-making references for the inheritance of ancestral halls in Canton region.

**Keywords:** ancestral hall; Canton region; cultural gene

## 1 INTRODUCTION

Since the publication of the United Nations Convention for the Protection of the World Cultural and Natural Heritage in 1972, the awareness about urban heritage preservation has been significantly raised [1] and the inheritance, protection and utilization of cultural heritage is regarded as the important source to enhance the national cultural confidence and history confidence.

In the Pearl River Delta region of Canton region, the patriarchal clan system has a profound and well-developed history, which is an important part of the traditional Chinese culture. And ancestral halls, which are at the center part of traditional village space and life, are one of the most typical carriers of Cantonese culture, fully reflecting the history and development of clan culture and condensing the essence of Cantonese culture and architectural art. According to the reports of the Third National Cultural Relics Census of Guangdong Province in 2010, there is a total amount of about 7,500 ancestral halls in Guangdong Province and about 5,200 ancestral halls are located in Canton region, accounting for 69% of the totally registered number in the province [2]. However, in the process of urbanization and modernization in China in the past 40 years, a large number of ancestral halls are facing a serious crisis of cultural inheritance because of the lack of scientific guidance, limited knowledge etc. which is specifically demonstrated as the problems of non-occupation, unoccupied hollowing out, inconsistent with traditional forms and lack of distinctiveness [3]. Thus, the study of its architectural culture is of great significance to inherit Chinese traditional culture and supplement related researches.

Currently, many in-depth researches on ancestral halls in the Canton region have been conducted by scholars from a different field, achieving numerous accomplishments in varying perspectives, such as the clan cultural, and traditions of traditional villages [4, 5], the special feature and evolution of ancestral halls [6, 7], the decorative arts of ancestral halls [8, 9] and so on. Nevertheless, research from the perspective of architectural-cultural genesis is relatively rare. To expand the research perspectives on ancestral halls in the Canton region, this paper studies the

inheritance of traditional architecture through the cross application of cultural gene theory and traditional architecture theory. Specifically, the cultural three-level hierarchy theory was introduced in this paper to establish the cultural gene map of ancestral halls, as well as capture and rank the cultural gene factors by their importance. And finally, the development, evolution and contemporary inheritance of cultural factors were analyzed based on their architectural characteristics, providing new perspectives and strategies for the preservation and exploration of Cantonese ancestral halls in the new era.

## 2 CULTURAL MEME THEORY

### 2.1 "Meme" and Cultural Gene Theory

In bio-genetics, "gene" refers to the basic unit of an organism's genetic evolution. The concept of "cultural genes" was first proposed by biologist Richard Dawkins in the 70s of the 20th century. In book "The Selfish Gene", he explored the similarities between cultural transmission and genetic transmission and argued that cultural transmission is also a form of "evolution." He drew an analogy between the basic units in culture and the genes in biology and named them "Meme" [10]. In 1988, the Oxford English Dictionary included the term Meme, meaning "the basic unit of culture, transmitted in a non-genetic way, especially in the form of imitation".

In China, the study of cultural gene theory mainly focuses and extends on a specific problem in traditional culture. Liu Changlin, one of the earliest scholars in China conducting cultural gene research, defined cultural gene as "the underlying psychological structure and way of thinking that has had a profound impact on the culture and history of a nation"[11]. Since cultural genes are different from biological genes, it is difficult to use them as a direct scientific experiment. Therefore, the current research mostly starts from the perspectives of history and logical analysis, and introduces quantitative statistical methods for analysis [12].

### 2.2 Cultural Gene Characteristics

In biology, genes refer to pieces of DNA that carry genetic information. Chromosomes are carriers of genetic

information. Proteins are important components of the body, and DNA can control its synthesis through transcription and translation. In the field of architecture, architectural culture factors are analogized to genes, architectural culture genes are analogies to DNA, architectural culture plays the role of carriers of genetic information, and the constituting architectural elements are analogous to gene-expressed proteins. Similar to the laws of heredity and variation in biology, cultural genes will be selectively copied in the process of adapting to external conditions, and reach a relatively stable cultural inheritance state over time, which is manifested as cultural continuity. At the same time, in the process of replication, cultural genes will be also affected by different natural and cultural environments, especially the impact of outside cultural genes, which may lead to gene mutations.

Besides, according to the one gene-one enzyme hypotheses in genetics, the catalytic action of the enzyme, which is also determined by the corresponding gene, has indirectly control of the genetic character of organisms, resulting in what is not exactly one-to-one correspondence between gene and genetic characters [14]. And cultural gene is also affected by the catalytic action of enzyme, which refers to its specific cultural fields, so that it has national character, social character and regional character nature. In this context, the fitness of cultural gene and its origin environment is the basis of stable inheritance. As a result, the genetic recombination between foreign cultural genes and traditional cultural genes and the mutation of traditional genes cannot be inherited stably in its original environment, leading to the unsteady character to a certain extent.

### 2.3 Cultural Three-Level Hierarchy Theory and Cultural Gene Classification

There are many ways to classify culture, among which Malinowski proposed the theory of the three structures of culture, including the artifact layer, the organizational layer, and the conceptual layer [14]. In the context of Chinese culture study, culture has been widely discussed from the perspective of dichotomy with material and spirit, three-level theory, four-level theory and etc. [15]. These theories provide different perspectives and research directions for in-depth exploration of cultural phenomena. Among them, the cultural three-level hierarchy theory proposed by historian Pang Pu in 1986 has been widely used in the cultural gene extraction of Chinese traditional crafts, [16], and the analysis of traditional Chinese architectural culture [15]. This theory combined the Chinese cultural context with the theories of foreign scholars, and proposed a three-level theory of cultural structure, namely the surface layer, the middle layer, and the inner layer. These three levels correspond to the external material culture, the social culture reflecting the characteristics of the national region, and the spiritual culture at the level of consciousness [17]. Therefore, in this paper, the architectural culture genes have also been classified and constructed according to these three levels. The surface layer covers the visible material and cultural characteristics of architecture, the middle layer includes social and cultural characteristics such as production and lifestyle and national culture, and the inner layer covers the spiritual level of cultural core.

## 3 CONSTRUCTION OF CULTURAL GENE MAP OF ANCESTRAL HALLS IN THE CANTON REGION

### 3.1 Ancestral Halls in the Canton Region

"Canton" is a geographical category, which refers to the Pearl River Delta region centered on Guangzhou, and is also a social cultural category, which refers to the ethnic groups speaking Cantonese dialects in the Canton region. And ancestral hall includes traditional clan ancestral halls, ancestral halls, family temples and other types, as well as the Hezu ancestral hall named after the academy.

Originally, the ancestral hall was a place for royal clans to worship their ancestors. During the Song Dynasty, Zhu Xi constructed an elaborate clan system in the Family Rites, advocating the establishment of ancestral halls on the east side of the main back hall. With the change of regime and the southward migration of the population, after the Song Dynasty, the Pearl River Delta gradually became the economic center of Canton region, and clan villages began to form. In the early Ming Dynasty, the system of ancestral hall and ancestor worship was incorporated into the national canonical system, and the patriarchal clan system further developed. In the middle and late Ming Dynasty, the implementation of government decree, the prosperous commodity economy and the improvement of the patriarchal system promoted the peak period of the first ancestral hall construction, which promoted the consummation of the ancestral hall system. In the early Qing Dynasty, regime change and economic setback destroyed the original clan system. With the rapid development of commerce and the accumulation of wealth, the clan power in the Canton region continued to grow. Therefore, ancestral halls were widely built and matured in the middle of the Qing Dynasty. At the same time, the prevalence of "virtual clans" with "different clans with the same surname" also led to the emergence of many Hezu ancestral halls. In the late Qing Dynasty, the rapid development of national capitalism and the collapse of social order also caused the government to vigorously revive the traditional clan system, leading to the peak of the construction of ancestral halls once again. In the Republican period, traditional culture such as the concept of clan kinship was affected by foreign ideas, and the turbulent social background caused the construction of ancestral halls to decline. To summarize. At all stages, ancestral halls have shown unique characteristics of the times and evolved a certain architectural shape, developing a unique ancestral hall culture in the Canton region during the long process of development [18].

### 3.2 Construction of Cultural Gene Library

The construction of cultural Gene Library in this paper consists of three steps: the extraction of cultural materials, the construction of cultural gene hierarchical diagram and cultural gene map [16].

In this paper, the methodology of cultural material extraction is literature research, online research and field research. The cultural gene material resources of ancestral hall in Canton region, such as text, pictures, videos, audio recordings and other forms, are collected, extracted and analyzed as cultural factors. According to the cultural hierarchy theory, the first level of the cultural gene

hierarchical diagram is classified as surface, middle and inner layers, which are also the three genomes. Then, based on this foundation, the gene plexus contained in each level is screened out, that is, the second level of the cultural gene hierarchical diagram. The cultural factors screened in the cultural database are the third allies of the cultural gene hierarchical diagram, corresponding to the next level of each gene cluster. Finally, the genealogy tree method was used to construct the cultural gene genealogy of Canton region, and the extracted pictures and other cultural materials were assigned to the corresponding cultural gene genealogy categories, which jointly constituted the cultural gene map of ancestral halls in the Canton region.

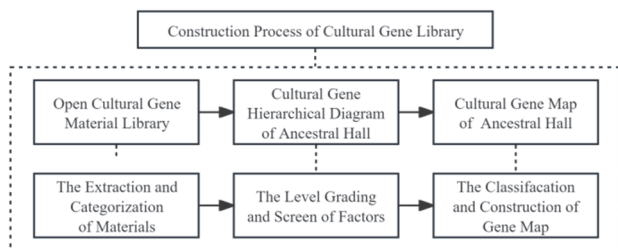


Figure 1 Cultural meme extraction procedure diagram

### 3.3 Extraction of Cultural Factors of Ancestral Halls in the Canton Region

This paper uses the thinking method of gene reverse transcription in biology to extract the cultural factors of ancestral halls in Canton. Architectural culture gene is the smallest unit of architectural culture inheritance, which has the functions of carrying genetic information, replicating genetic information, varying genetic information and so on. Analogizing with the DNA coding in biology, the architectural culture gene is regarded as the basic unit for analysis in this paper uses, to extract the cultural gene hierarchical diagram of ancestral halls in the Canton region. In biology, the four bases are encoded according to the principle of complementary pairing, which determines the characteristics of DNA, and RNA transmits genetic information to proteins that exhibit the characteristics of the organism. Similarly, the three levels of architectural culture, architectural culture genes and architectural culture factors in this paper can correspond to the three levels of protein, DNA, and RNA in the process of biological genetic transcription. Through the analysis of architectural culture, the architectural culture genes are extracted and the gene hierarchical diagram and cultural gene map of ancestral halls in Canton region are constructed.

#### 3.3.1 Surface Layer Factor Extraction

The extraction of flat space factor. In the Canton region, the layout of the ancestral hall adopts the rigorous method of central axis to meet the main function of sacrificial ceremony and show the power and financial strength of the clan. And the scale of the whole hall, the size of the individual architecture and decoration are also expanded by certain criterion [19]. At present, there are four types of plane combination widely used, of which one road three into three bays is the most common form. One way two into three bays is less used in large ancestral halls, whose

number is second only to the form of one way three into three bays. Three ways three into three bays are mostly used in large ancestral halls with complex functions, which can well highlight the cohesion and financial strength of the family. The three into five bays all the way is a common form of large ancestral halls with higher grades and large land occupation [18].

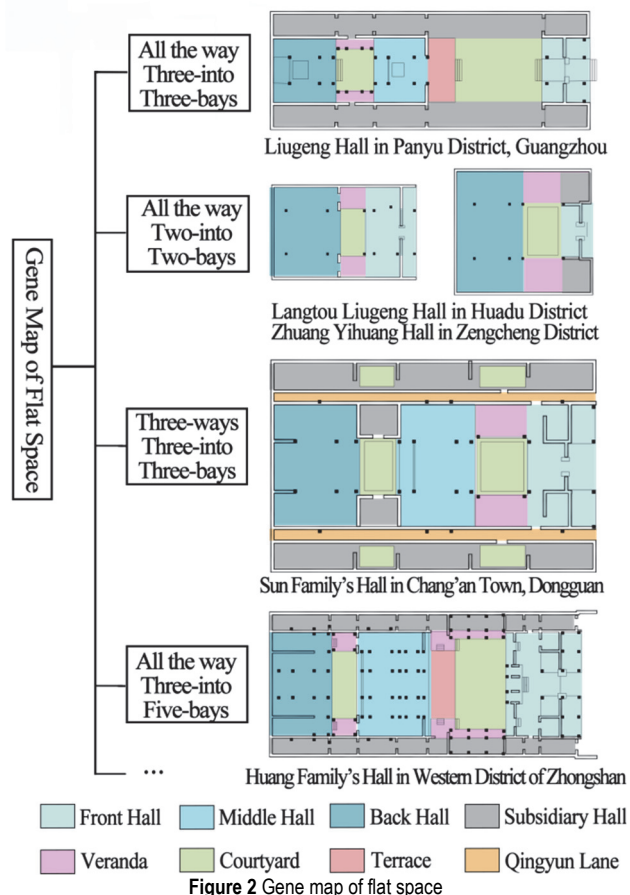


Figure 2 Gene map of flat space

The extraction of constituent element factor. For the constituent elements of the ancestral hall, most of them are strictly arranged along the central axis and the individual architectures and other outdoor elements are arranged in turn. The constituent elements, appearing on the liturgical axis, are commonly in the three-into sequence of "front hall - middle hall - back hall". As the beginning of the entire architectural sequence, front hall is the most important single architecture on its facade. Specifically, it is mostly common to use the higher-grade open hall type (which is also called mentang type or changying type) with shutai, an ancient ritual structure aside the front door. And the relatively closed form recessed-door type is the second most common, while the flush-door type is seldom used. As the main hall part of the ancestral hall, the middle hall is an important place that carries the functions of sacrificial ceremonies and clan discussions, with the highest grade of forms in the whole hall [18]. The facade of middle hall could also be classified by its openness whether with Pavilion or not. The back hall, locating at the end of the axis, is the seat for the memorial tablet for ancestors [4]. In addition, a variety of auxiliary constituent elements may also appear in the ancestral hall, such as the subsidiary halls located on both sides of the axis, the memorial archway in

the middle of the front hall and middle hall for guidance, commemoration and memory, as well as the pavilions and terrace for worship and entertainment in front of the middle hall. "Way", also called "Jian", describes "the architecture sequence of single architectures in an ancestral temple distributed along a deep axis" [4]. The main way and the side ways are sometimes connected by Qingyun lane, which is a crucial constituent element in climate adjustment.

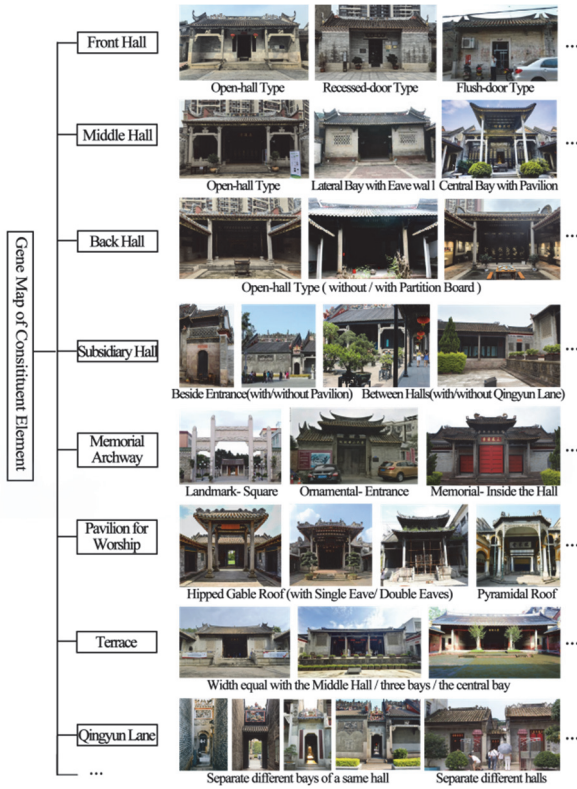


Figure 3 Gene map of constituent elements

The extraction of architecture material factor. A variety of different architecture materials are widely used in Cantonese ancestral hall, including common materials such as timber, stone and blue bricks, as well as materials such as oyster shells and sea moon with regional characteristics as the architecture wall. The choice of these materials considers the characteristics of adapting to the hot and humid weather of Cantonese and the targeted application. For example, dark bricks could better absorb sunlight radiation and have effectively cool effect. And the timber column with stone base is designed to adapt to the influence of humid climates. These architecture materials played an important role in the construction of the Cantonese ancestral hall and have proven their adaptability and reliability over a long period [4].

The extraction of architectural color factor. Traditional ancestral halls are more advocating a solemn and dignified overall atmosphere, and the architecture materials maintain their original colors, and the architectural colors are mainly white stone and blue bricks and gray tiles [19]. Compared with the traditional dwellings, the ancestral halls are more exquisite and gorgeous, with rich decorative colors on the basis of the traditional residential colors [20], while the indigo blue is the most widely used in decoration. During the Republican period, Western art and thought were introduced into China and the characteristic of Western

aesthetic and art were also presented in Cantonese ancestral hall. Located in Kaiping, the Fengcai Hall is a typical case which combined the traditional architecture with Western style in ancestral halls, with a western color scheme of yellow pillars and white walls, reflecting the distinctive characteristics of the times [18].

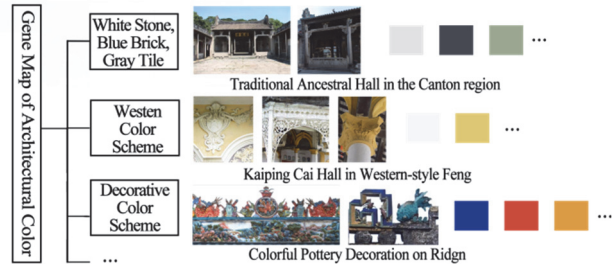


Figure 4 Gene map of Architectural color

The extraction of decorative craftsmanship factor. The decorative arts of the ancestral halls in the Canton region are an important part of their architectural art and it can be divided into brick carving, stone carving, wood carving, ash sculpture, pottery sculpture, color painting and etc. by making materials. Taking the Chen Clan Ancestral Hall as an example, built during the Guangxu period, it is one of the most exquisitely decorated ancestral halls in China with gorgeous carvings, sculptures and paintings, which is also regarded as the representative of the Cantonese decorative craftsmanship. From the perspective of decorative components, wood carvings are mainly used on beam frame, bracket arches, sparrow brace and etc.; brick carvings are on wall eaves, lintel, gable wall head etc; stone carvings are on column base, railings etc.; ash sculptures are mainly used on the roof ridge and gable eave board; pottery sculptures are common on the roof ridge while the color paintings are mainly used on the front door and wall surface [18].

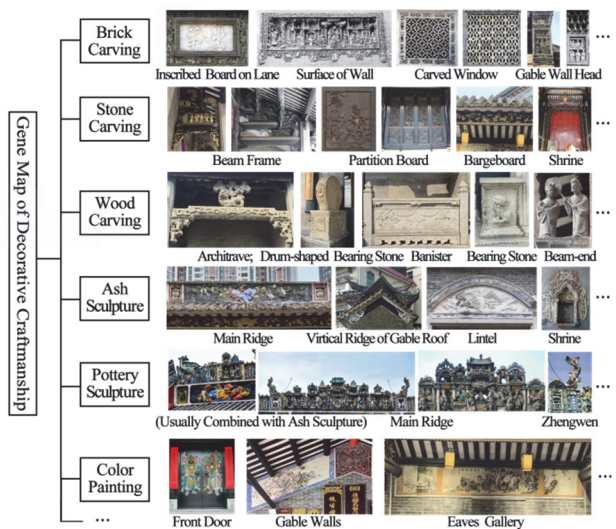


Figure 5 Gene map of decorative craftsmanship

The extraction of architecture component factor. The diverse decorations of the Cantonese ancestral hall are attached to several architecture components, the representative of which are including roof ridge, gable, door and caved window, as well as the column base, bearing stone, gable wall head and others. Among them, the roof has always been regarded as an important display part of architectural decoration, where ash sculpture and

pottery sculpture are commonly used to achieve exquisite and vivid effects. As for the forms of gable and roof ridge, there are two typical collocation modes, which are antique ridge match with the wok ear gable and the dragon boat-shaped ridge match with flush gable roof with flying ridge [21]. And the beam frame, which is mostly applied "Chaliang type" in Cantonese ancestral halls, that is, the structure whose end of the load-bearing beam is inserted into the column body (one side or both sides), and beam frame with camel-hump shaped support or short column and the antique type are commonly used [8].

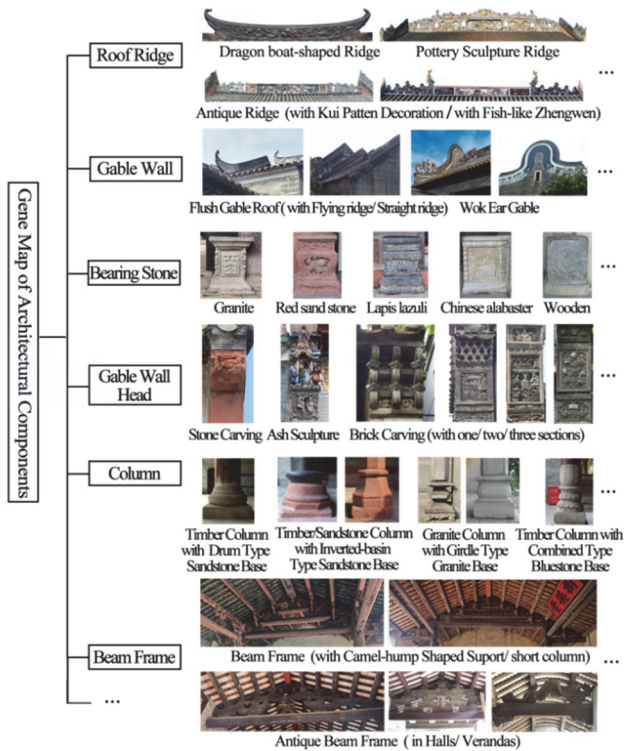


Figure 6 Gene map of architectural component

The extraction of decorative motif factor. Most of the decorative motifs have obvious symbolic meanings, which not only reflect the traditional idea of crushing victory, but also present a unique regional style of Cantonese [19]. There are mainly the following categories for the extraction of decorative motifs: dragon and variants motif, animal and plant motifs, figure motifs, literature motifs, geometric numeral motifs and western motifs.

### 3.3.2 Intermediate Layer Factor Extraction

The extraction of clan cultural factor. For the Cantonese ancestral hall, the development of the clan system is an important internal driving force for the formation of architectural culture. The most basic function of the ancestral hall is for sacrificial activities, which have obviously commemorative and spiritual values. And the sacrifice object are mainly the abstract or tangible spirits and material values belonging to the ancestors [4]. It is not only a place for sacrifice, but also an important place for clan management, establishing the internal order of the clan realizing harmony among the clan and safeguarding the interests of the family. In these ancestral halls, clan activities such as revising genealogy and discussing clan affairs are important means of family management, which

can enhance the sense of identity and belonging of clansmen. In addition, the Cantonese ancestral halls are also a venue for public events such as celebrations and gatherings, which not only strengthen the emotional bond between the clansmen, but also help to pass on the clan culture and history.

The extraction of folk culture factor. Many folk activities held in the ancestral hall are still preserved today, such as the Dragon Boat Festival, "having the ancestral hall meal" during festivals, the custom of wedding and funeral, the celebration of birth called "lantern wine" and the worship activities on winter solstice.

The extraction of production mode and lifestyle factor. Many residents in Canton region live as fishermen, and the typical life scenarios and characteristics of fishermen are also reflected in architectural culture, such as decorative motifs and architecture materials. At the same time, the construction of many Hezu ancestral halls is also related to the combined lifestyle of academies and the ancestral halls. And the Chen Clan Ancestral Hall in Guangzhou, which is known as the name Chen's academy, is a representative example of Hezu ancestral hall and its halls in main way are used for the ancestral hall while the auxiliary halls on both sides undertake the function of the school of their own students, separated by Qingyun Lanes. It is a typically regional characteristic of Lingnan architecture that applies the comb layout of the Cantonese village to the architecture with comprehensive functions [19].

### 3.3.3 Inner Layer Factor Extraction

The extraction of Cantonese spirit factor. Tang Xiaoxiang [22] made a rational analysis of the Cantonese architecture from the aesthetic viewpoint, and summarized the basic cultural spirit of Canton in the following four points: the first is the value orientation of being pragmatic and innovative, since the Cantonese have a social personality of profit-seeking and pragmatism, which are also reflected in the construction of architecture. Taking the design of the hybrid beam frame as an example, there is a combination of complex hump shaped bucket arches and simple beam frames, with short column, which is economic and aesthetic [18]. The second one is the social psychology of openness and accommodation, meaning that the Cantonese constantly learn and get ideological progress, rather than keeping conservative when faced with the impact of foreign culture. Thirdly, it is the intuitive and divergent and integrated way of thinking, which not only inherits the traditional thinking mode of Cantonese, but also has some characteristics of Western thinking. The fourth point is being fresh and lively, advocating the aesthetic ideal of nature, which is also the aesthetic style and spirit of the mainstream of Cantonese art.

The extraction of folk belief factor. The most basic function of the ancestral hall is to worship ancestors, which can be regarded as a continuation of ancestor worship in ancient times and a memorial service for ancestors with blood relations [4]. In the Cantonese ancestral hall, the motifs of fish, dragons and variants are very common, which is a reflection of the natural worship of snakes, fish, dragons and so on in ancient times and has obviously regional characteristics of Canton. Additionally, the feng shui theory in traditional Chinese culture is also an

important part of architectural culture, especially in the strict consideration of architecture layout and other aspects, such as the gable eave board of the wok ear wall, which is used for fire prevention and ventilation. It is often painted black, since water in the five elements is corresponding to black, meaning the suppression of southern fire evil and residential fire [18]. Besides, there are also many designs that show the desire to pray for good luck and wealth, which is the reflection of traditional "Yasheng" thoughts, such as official hat shaped wok ear wall, with a meaning of being champions.

### 3.3.4 Cultural Gene Map of Ancestral Halls in Canton Region

(1) Preliminary screening of cultural factors of ancestral halls in Canton region

Based on the preliminary extraction and classification of the above cultural factors of the ancestral hall of Cantonese, the results were preliminarily screened by questionnaire research to prepare for subsequent optimization of gene hierarchical diagram and quantitative analysis. The questionnaire was distributed online, and 40 valid questionnaires were finally collected for statistical description. The respondents of this survey are mainly young people with bachelor degree or above, 85% of the respondents have some or more understanding of ancestral halls in Canton region, of which 33.3% are men and 66.7% are women. From a professional point of view, 23 are architecture majors, 6 are non-architecture design majors, and 5 respondents are science and engineering and liberal arts majors, and the distribution of other majors is relatively balanced. The questionnaire uses the Likert nine-

level scale to score the importance of each cultural factor, and the scoring scales of 1, 3, 5, 7 and 9 are shown in Tab. 1, and the median values of adjacent scores are indicated by 2, 4, 6, and 8.

Table 1 Rating scale of the likert scale

Very unimportant	Unimportant	Neutrality	Significant	Very important
1	3	5	7	9

SPSS software was used to test the reliability of the questionnaire data. General studies believe that Cronbach's coefficient is greater than 0.7, which can be considered to be more consistent [23]. The reliability test of this questionnaire survey Cronbach's coefficient is 0.969, which is greater than 0.7. The survey results are credible and have good internal consistency, as shown in Tab. 2.

Table 2 Reliability test

Cronbach's Alpha	The number of items
0.969	49

The factor importance score extracted from the questionnaire was calculated and sorted by the mean, and each of the 49 evaluation elements was arranged in descending order of the mean as shown in Tab. 3. The higher the average score, the respondent's recognition of it is higher, and the importance of the factor in the cultural gene hierarchical diagram is higher; so the cultural factor with an average score of less than 6.5 was eliminated in this paper, and other factors were screened comprehensively.

Table 3 Ranking of cultural factors

Sort	Sub-criterion layer B	Mean score	Sort	Factor layer C	Mean score
1	Constituent element	7.23	14	Timber	6.90
2	Architectural color	7.21	15	Middle hall	6.87
3	Decorative craftsmanship	7.08	16	Oyster shell	6.87
4	Cantonese spirit	6.97	17	Beam frame	6.86
5	Flat space	6.92	18	The ideal of being official	6.82
6	Folk spirit	6.87	19	Confucianism	6.82
7	Folk culture	6.74	20	Qingyun lane	6.77
8	Architectural component	6.59	21	Gable wall head	6.77
9	Value concept	6.45	22	Figure motifs	6.77
10	Clan system	6.42	23	Literature motifs	6.77
11	Architectural material	6.39	24	Empirically intuitive, divergent and integrated	6.77
12	Lifestyle	6.72	25	Memorial archway	6.74
13	Decorative motif	6.13	26	Column	6.72
Sort	Sub-criterion layer B	Mean score	Sort	Factor layer C	Mean score
1	Practical, pragmatic and profit-seeking	7.62	27	Back hall	6.69
2	Open and accommodating	7.46	28	Subsidiary hall	6.59
3	Gable wall	7.44	29	Bearing stone	6.53
4	Dragon and variant motifs	7.28	30	Terrace	6.51
5	Traditional patriarchal clan thought	7.28	31	Pavilion for worship	6.50
6	Roof ridge	7.23	32	Baogu stone	6.46
7	Blue brick	7.18	33	Arch	6.39
8	Plant motifs	7.13	34	Geometric numeral motifs	6.38
9	Animal motifs	7.10	35	Western motifs	5.87
10	Fresh, lively and advocating nature	7.05	36	Screen wall	5.85
11	Front hall	7.00	37	Ceremonial gate	5.57
12	Traditional value concept	6.97	38	Rebar and concrete	5.18
13	Stone	6.95			

(2) Construction of cultural gene map in Canton region  
The cultural factors screened by the questionnaire were used to construct the genealogy tree, and the cultural

genetic genealogy map of the ancestral hall in Canton region was obtained. Among them, the reference layer (primary genome) level is divided into three dimensions

based on the three-level theory of culture, namely the surface layer, the middle layer, and the inner layer. The second level is the 9 gene plexus levels screened, and the third layer is 41 alleles, which together constitute the cultural gene hierarchical diagram in the Canton region (Fig. 7). The gene map corresponding to the surface layer

of the exome was reflected to the gene hierarchical diagram to obtain the corresponding gene map, including gene map of flat space, constituent element, architectural color, decorative craftsmanship and architectural component (Fig. 2 to Fig. 6).

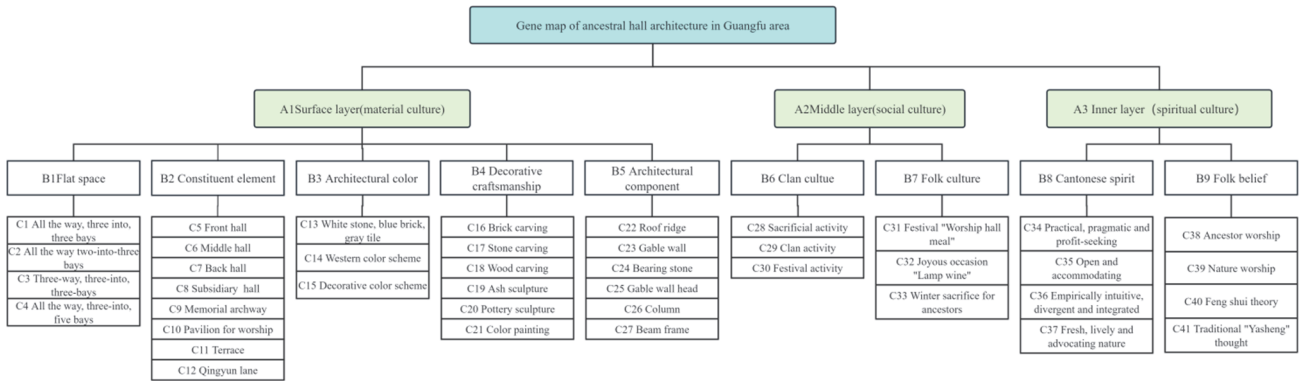


Figure 7 Genetic genealogy of ancestral halls in Canton region

4 EVALUATION OF THE CULTURAL FACTORS OF ANCESTRAL HALLS IN THE CANTON REGION

Based on constructing the cultural genealogy of ancestral halls in Canton region, the importance of cultural factors at each level in the genealogy tree was evaluated by AHP analytic hierarchy. According to Locken's ranking under a single criterion, each scale method has order-

preserving properties, so the 1-9 scale method is used [24]. In this study, the nine-level scale method was used to evaluate the AHP level of ancestral hall culture genes in Canton region, and the meaning of the scale values at all levels was shown in Tab. 4, and the questionnaire was analyzed by a nine-level scale.

Table 4 Scale method of levels 1-9

Scale	Meaning
1	Both elements are of equal importance to the previous element
2	Element <i>i</i> is slightly more important than element <i>j</i>
3	Element <i>i</i> is more important than element <i>j</i>
4	Element <i>i</i> is more important than element <i>j</i>
5	Element <i>i</i> is more important than element <i>j</i>
2, 4, 6, 8	Neighbor is represented in the adjacent scale value
The reciprocal of the scale above	Contrary to the above meaning (comparison of the importance of element <i>j</i> to element <i>i</i> )

In this survey, six experts in architecture were selected to evaluate the importance of the cultural factors of Cantonese ancestral halls in the same level, and constructed the weight judgment matrix of three levels of cultural genes of Cantonese ancestral halls ABC.

The AHP analytic hierarchy method was used to test the consistency of the weight judgment matrix composed

of various cultural factors. The *CR* value of the ratio ( $CR = CI/R$ ) is less than 0, indicating that the inconsistency of the matrix is within the acceptable range. Combining the data of the six questionnaires, the consistency index *CR* at all levels was less than 1, and it passed the consistency test, as shown in Tab. 5.

Table 5 Consistency test indicators of each factor

Index	A	B1	B2	B3	B4	B5	B6	B7	B8	B9
$\lambda_{max}$	3.05	5.34	4.18	8.73	3.05	6.41	6.35	3.03	3.03	4.13
RE	0.03	0.08	0.06	0.10	0.02	0.08	0.07	0.02	0.01	0.04
CR	0.05	0.08	0.07	0.07	0.05	0.07	0.06	0.03	0.03	0.05

The weights of factor C obtained by combining the weights of criterion layer A and sub-criterion layer B1- B9 are shown in Table 6. According to the ranking, the top ten factors are mostly clan culture, folk culture and Cantonese culture which are related to the worship and sacrifice of ancestors. The result indicates that the regional clan culture and the deep-seated Cantonese spirit occupy the most important position in the Cantonese ancestral hall culture, deserving further investigation and application in the protection and inheritance process of ancestral hall culture.

As for the surface layer, as the core elements in the

whole architecture, the main sequence of "front hall - middle hall - back hall", memorial archway and Qingyun lane weigh higher. Besides, the commonly used factors in architectural color, decorative craftsmanship and architectural component layers also have high weigh, especially roof ridge, gable wall and relative decorative factors like ash sculpture, which have the best visual attraction. Therefore, the innovation and revitalization of ancestral hall culture should focus on the restoration and reconstruction of these factors, pursuing the full utilization on its contemporary conservation and translation.

**Table 6** Ranking of cultural gene importance of ancestral halls in Canton region

Criterion layer A		Sub-criterion layer B		Factor layer C	Weight	Sort
A1 Surface layer (Material culture)	30.9%	B1 Flat space	15.0%	C1 All the way, three-into, three bays	5.77%	6
				C2 All the way, two-into, three bays	2.51%	15
				C3 Three ways, three-into, three bays	5.40%	7a
				C4 All the ways, three-into, five bays	1.35%	19
		B2 Constituent element	6.6%	C5 Front hall	1.81%	18
				C6 Middle hall	1.20%	22
				C7 Back hall	0.63%	29
				C8 Subsidiary hall	0.19%	40
				C9 Memorial archway	0.95%	23
				C10 Pavilion for worship	0.37%	33
				C11 Terrace	0.20%	38
				C12 Qingyun lane	1.30%	20
		B3 Architectural color	2.9%	C13 White stone, blue brick, gray tile	1.93%	17
				C14 Western color scheme	0.28%	35
				C15 Decorative color scheme	0.67%	27
B4 Decorative craftsmanship	3.0%	C16 Brick carving	0.45%	32		
		C17 Stone carving	0.29%	34		
		C18 Wood carving	0.65%	28		
		C19 Ash sculpture	0.93%	25		
		C20 Pottery sculpture	0.46%	31		
		C21 Color painting	0.26%	37		
B5 Architectural component	3.3%	C22 Roof ridge	0.94%	24		
		C23 Gable wall	1.22%	21		
		C24 Bearing stone	0.11%	41		
		C25 Gable wall head	0.20%	39		
		C26 Column	0.27%	36		
		C27 Beam frame	0.58%	30		
A2 Middle layer(Social culture)	25.4%	B6 Clan culture	10.4%	C28 Sacrificial activity	3.58%	9
				C29 Clan activity	3.37%	11
		B7 Folk culture	14.9%	C30 Festival activity	3.49%	10
				C31 Festival "Worship hall meal"	6.19%	4
A3 Inner layer (Spiritual culture)	43.6%	B8 Cantonese spirit	35.0%	C32 Joyous occasion "Lamp wine"	2.63%	14
				C33 Winter sacrifice for ancestors	6.13%	5
				C34 Practical, pragmatic and profit-seeking	13.49%	1
				C35 Open and accommodating	9.77%	2
		B9 Folk belief	8.6%	C36 Empirically intuitive, divergent and integrated	4.39%	8
				C37 Fresh, lively and advocating nature	7.37%	3
				C38 Ancestor worship	2.73%	13
				C39 Nature worship	2.12%	16
				C40 Feng shui theory	2.90%	12
				C41 Traditional "Yasheng" thought	0.88%	26

## 5 THE DEVELOPMENT LAW OF ANCESTRAL HALL CHARACTERISTICS BASED ON CULTURAL GENE THEORY

### 5.1 Internalization and Genetic Expression of Cultural Genes in Canton Ancestral Halls

The internalization and externalization of architectural culture genes is a process of dynamic balance between the three aspects of environment, culture, and architecture, so that unique cultural genes are screened, mutated, and inherited from generation to generation, and present a relatively stable pattern in a certain period [25].

During the Song and Yuan Dynasties, the clan system and the development of the economy of the Cantonese led to the development of ancestral halls in Canton region, which was also the continuation of people's ancestor worship complex in ancient times. It also became the basis for the internalization of cultural genes of the Cantonese ancestral halls and one of the most important components of the cultural genes of Cantonese ancestral halls. During Ming Dynasty, the ancestral hall gradually began mature, and formed the main spacial model of "all the way three into three bays", as well as the "front hall-middle hall-back hall" on the central axis, and the provisions of the structure materials were also consistent with the criterion of traditional official architecture. At the same time, with the

rapid development of national capitalism and commerce, the concept of pursuing wealth and the demand of architecture clans and flaunting family strength led to the emergence of high-standard, large-scale ancestral halls. During the Ming and Qing dynasties, in spite of social turmoil and slow development, the shape and decoration of the ancestral hall were steadily inherited and the construction at that time was relatively hasty due to social background such as economic constraints. In the late Qing Dynasty, the construction peak was reached again. The revival of Confucianism, the revival of clans, and the development of local ethnic capital enterprises all further improved the social, cultural, and spiritual cultural foundation of the ancestral hall's cultural genes. Besides, the external architectural elements, forms, and construction skills gradually matured and stylized. Adhering to the idea of pragmatism and open integration, it also presents the characteristics of technical integration and comprehensive use in decorative arts. Overall, the cultural genes of the Cantonese ancestral hall reached a relatively stable stylized stage in the late Qing Dynasty.

### 5.2 Acculturation and Genetic Expression of Cultural Genes in Cantonese Ancestral Halls

In biological gene inheritance, the genes that control



different traits in chromosomes may get genetic variation caused by the impact of environment, producing chromosomes that are different from the ontology, such as genetic recombination or mutation. There is also gene variation in the development and evolution of architectural culture genes, which is also the essential reason of the generation of new culture, resulting in the expressed proteins, that is, the elements that make up the buildings that show new characteristics of architecture [26]. In the process of the development of the Cantonese ancestral hall, the exchange and acculturation with foreign cultures of different origins is the recombination of genes.

During the Republican period, the unstable social and the abolition of the imperial examination system weakened the clan power. At the same time, the ideology and culture from the West had a dramatic impact on traditional patriarchal system in China, resulting in the decline of ancestral hall construction. The strong foreign cultural gene factors recombined with the relatively weak local cultural gene factors, and the acculturation of different cultural genes accomplished. Although the core of the social, cultural, spiritual and cultural factors represented by the ancestral hall remains unchanged, some obvious characteristics of those times were presented at the external material layer of culture genes. The fengcai hall in Kaiping is an example of a combination of Chinese and Western style, in which some classic Western-style motifs such as cherubs are widely used in the decoration. Additionally, it also used a large number of reinforced cement and arch structure. Roman column and western cast iron decoration replaced the traditional construction forms in ancestral hall. Besides, the plane or façade scale of the architecture also pursues the golden ratio in western design principles, presenting a characteristic of modern eclectic architecture in the overall architectural style [18]. This kind of "acceptance" in the process of cultural accommodation is also the embodiment of the Cantonese spirit, which allows the cultural genes better integrate and communicate with foreign cultural genes, enhance its ability to maintain its own internal cultural genes, and adapt to the changes of the times.

### 5.3 Contemporary Inheritance and Development of Cultural Genes in Cantonese Ancestral Halls

In recent years, the protection of the Cantonese Ancestral Hall has drawn more and more attention. After the 1980s, the restoration of the Cantonese ancestral hall began to be carried out in large quantities, and it was an important principle to "not change the original state of the cultural relics" in the process of protection and maintenance. With the change of functional orientation and demand, the translation design of ancestral hall is not a simple restoration and reconstruction of the original cultural genes, but a modern application and expression according to the actual situation on the basis of respecting original cultural genes. According to the importance of the cultural genes of the Cantonese ancestral hall, the clan culture and folk activities carried by the ancestral hall are the most important parts. Apart from the maintaining of historical style of the architecture, the protection and development of its traditional functions and activities like

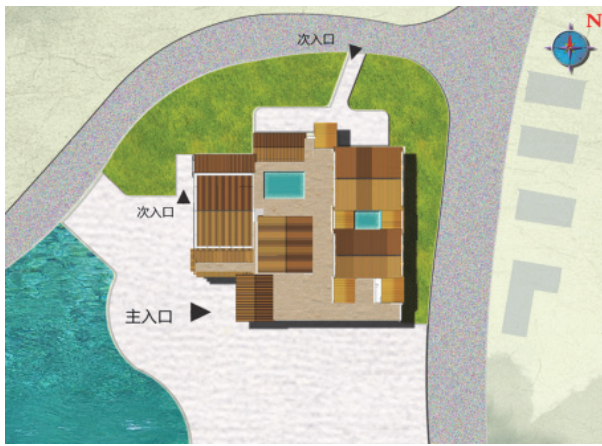
sacrifice and celebration also need to be taken into account, taking the activation design of Wenbing Lugong Ancestral Hall in Wenchong Village as an example. Located in Huangpu district of Guangzhou, Wenchong Village has a history of more than 800 years. There are 12 public ancestral halls retained in this ancient architecture group and Wenbing Lugong Ancestral Hall is one of them. And with the perspective of cultural genes, the activation design should figure out the present situation and identify the important factors in all three layers.

Firstly, the identification and translation design of factors in middle layer and inner layer need an overall perspective, comprehensively considering the application and specific positioning of each ancestral hall in the village. In this village, the Lu Clan's Great Ancestral Hall, which is constructed for the first ancestor Lu Taiquan of Lu family, is the main space for festive banquet and public activities in clan. Therefore, it is the core space bearing of activities in the clan culture and folk culture of social culture layer. Additionally, the other open ancestral halls, such as the Yanheng Lugong Ancestral Hall, are the important spatial carriers of folk culture, which are used to display traditional Cantonese culture like dancing-lion and lion-awakening and Cantonese embroidery, as well as hosting relative experiencing programs. Taking the needs of nearby residents and the principle of being practical into account, Wenbing Lugong Ancestral Hall and its surrounding architecture are re-positioned as an art training center, with the functions of history presentation and activities organization, which also fit with its traditional functions of missionary rites and the quiet architectural character.

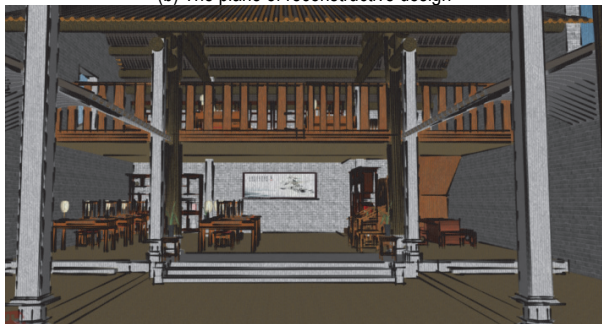
As for the surface layer of culture gene, the first consideration is the restoration of the basic spatial layout and architectural form. It is a common small ancestral hall with all the way three into three bays. With the original layout unchanged, the main hall is constructed in the form of mezzanines to supplement the use of space. At the same time, the original core elements, such as dragon boat-shaped ridge, Wok-ear gable, blue brick, grey tile, painted decoration and etc., are repaired to restore the original appearance. The construction applies the original materials and techniques and improves the lighting and ventilation conditions inside the architecture to meet the needs of modern functions. Two groups of courtyards are set up in the group for Chen exhibition and rest. The two forms of water courtyard and plant courtyard enrich the landscape, promote cooling and ventilation, and present an open and natural Lingnan style (Fig. 8).



(a) Wenbing Lugong Ancestral Hall



(b) The plane of reconstructive design



(b) The interior design rendering of reconstructive design

Figure 8 The renovation design of Wenbing Lugong Ancestral Hall

At present, there are also many other successful examples in the revitalization and utilization of ancestral halls. The protection and transformation of Liantang Ancient Village in Huangpu district of Guangzhou, was awarded as a "beautiful village" construction in Guangzhou, as well as one of the 14 city-level demonstration sites. It is a good reference for the activation and utilization of cultural relics and monuments (Fig. 9).



(a) Ancestral Hall Square



(b) Lotus pond and stone bridge



(c) "Shanshi Hall", the Middle Hall of Shisi Chen Gong Ancestral Hall



(d) Wok ear gable with gray sculpture decoration

Figure 9 Protection and transformation of Liantang Ancient Village

The ancestral hall is a flat space of three-way, three-into, three-bay with subsidiary halls on the left and right sides. The appearance shows typical material cultural genes including blue brick, gray tiles, wok ear gables, antique ridge with ash sculpture and so on. In terms of constituent elements, the traditional wok ear gable wall is combined with the hard gable roof and decorations including pottery sculpture and ash sculpture restored and retained, while the dwellings in village also apply flush gable roofs to unify the overall architectural style. In terms of architectural color, the main architecture, such as ancestral halls and houses, retains the classic white stone, blue brick and gray tile color scheme, and adds bright colors such as red to the auxiliary architecture for decoration and rendering. The success of these typical cases is that the cultural factors of the ancestral hall have been preserved to the greatest extent.

## 6 CONCLUSION

The heritage of ancestral hall in Canton region has rich values in regional history, social development and humanistic connotation. Since the previous studies rarely investigated ancestral halls in the perspective of culture gene theory, this paper studies the architectural culture of Cantonese ancestral hall and relative theory with the cross application of cultural gene theory and traditional architecture theory. With the methodology of literature research, online research, field research and quantitative analysis of data, the construction of cultural gene library and the importance analysis of culture gene factors were accomplished. Based on the cultural gene theory and the importance ranking of cultural gene factors, the inheritance process and contemporary application of cultural gene of

Cantonese ancestral hall were discussed, exploring a new perspective for the research of Cantonese ancestral halls.

Firstly, the inheritance process of cultural gene has the characteristic of continuity and instability. Like the inheritance of biological genes, the duplication and internalization of cultural genes make it continuously inheritance from generation to generation. And the original cultural gene may also be affected by foreign cultural gene, leading to genetic recombination and mutation. Since the stable inheritance of genes is closely related to the environment, the newly generated cultural genes may have an unstable inheritance in the original environment.

Secondly, based on the cultural three-level hierarchy theory, the architectural cultural genes were classified into three layers: surface layer, middle layer and inner layer, which are respectively corresponding to material culture, social culture and spirit culture. And the social culture and spirit culture are more important. This classification method can fully reflect the influence of culture on architecture in these three aspects, as well as the connection and diversity between different factors. After the construction of cultural gene hierarchical diagram and gene maps, the AHP hierarchical analysis method was used to rank the importance of the various cultural factors. Results indicate that local clan culture, Cantonese spirit, flat space and commonly used and visually attractive material factors are more important in the protection and application of Cantonese ancestral halls.

Finally, the contemporary translation and application of cultural gene of the Cantonese ancestral hall need a comprehensive perspective to design and emphasise the exploration, protection and inheritance of the more important cultural factors. The preservation of material cultural factors requires ensuring their authenticity and integrity, while the inheritance of social cultural and spiritual cultural factors needs to design both traditional and innovative space and activities, aiming to inherit cultural memory, establish cultural identity and promote cultural spirit.

Despite constructing the cultural gene library, gene hierarchical diagram and gene maps of ancestral hall in Canton region, there are still cultural gene factors that were not considered in this paper. Therefore, further research is to excavate more cultural gene factors to supplement the gene library and gene maps, constructing a more comprehensive cultural gene system for ancestral hall in Canton regions.

## Acknowledgment

The work was supported by MOE Key Laboratory of Disaster Forecast and Control in Engineering, School of Mechanics and Construction Engineering, Jinan University, Guangzhou 510632, China. (2021) Joint Construction Plan for the Development of Philosophy and Social Sciences in Guangzhou during the 14th Five Year Plan period, Research on Classification Evaluation and Customized Activation Utilization of Traditional Villages, (No. 2021GZGJ208); (2023) Art Program of National Social Science Fund Project, Construction of Guangdong Overseas Chinese Cultural Gene Bank and Its Application in the Revitalization of Overseas Chinese Hometowns, (No. 23BH147).

## 7 REFERENCES

- [1] González Martínez, P. (2017). Built Heritage Conservation and Contemporary Urban Development: The Contribution of Architectural Practice to the Challenges of Modernisation. *Built Heritage*, 2017(1), 14-25. <https://doi.org/10.1186/bf03545666>
- [2] Mei, C., He, C., & Lai, W. (2023). The mode of art's involvement in local architectural heritage and the path of cultural revival : Take the ancestral temple in Guangfu as an example. *Architecture and Culture*, 8, 252-254. <https://doi.org/10.13942/j.cnki.hzjz.2023.12.026>
- [3] He, C. & Mei, C. (2021). Study on the Type and Mode of Ancestral Hall Space Transformation in Guangzhou in Urban Renewal: Taking the Ancestral Hall of Hunde Village as an Example. *Urban residence*, 10, 200-201. <https://doi.org/10.19875/j.cnki.jzywh.2023.08.083>
- [4] Feng, J. (2010). Research on the reclamation, settlement of ethnic groups and the evolution of clan ancestral halls in Guangzhou Prefecture in the Ming and Qing Dynasties. Doctoral dissertation, South China University of Technology.
- [5] Zhang, S. (2018). *Study on the spatial pattern of traditional villages in Canton region*. Doctoral dissertation, South China University of Technology.
- [6] Zhang, Y., Li, W., & Cai, X. (2023). A cultural geography study of the spatial art and cultural features of the interior of Lingnan ancestral halls in the Ming and Qing dynasties. *Journal of Asian Architecture and architecture Engineering*, 22(6), 3128-3140. <https://doi.org/10.1080/13467581.2023.2215846>
- [7] Yang, Y. (2013). *Research on the evolution of the shape of the ancestral hall of Cantonese*. Doctoral dissertation, South China University of Technology.
- [8] Liang, M. (2014). *Research on decoration of Cantonese ancestral hall*. Doctoral dissertation, South China University of Technology.
- [9] Chen, G. (2018). Regional study on the ash sculpture decoration of traditional buildings in Canton region. Doctoral dissertation, South China University of Technology.
- [10] Dawkins, R. (1976). *The Selfish Gene*. Oxford: Oxford University Press, 189-192.
- [11] Liu, C. (2008). *Systematic thinking in China: a cultural genetic perspective*. Beijing: China Social Sciences Press, 1-2.
- [12] Wu, Z. (2009). *Research on ancient urban space in Suzhou based on cultural gene perspective*. Doctoral dissertation, Nanjing: Nanjing University.
- [13] Wei, Q., Wang, Z., & Xu, Y. (2012). Recognition of Theoretical Foundation of "Regional Gene" Concept in Regional Building Construction System. *Huazhong Architecture*, 30(07), 8-11. <https://doi.org/10.13942/j.cnki.hzjz.2012.07.010>
- [14] Malinowski, B. (2002). *The Scientific Theory of Culture*. Beijing: Huaxia Publishing House.
- [15] Ge, Y. (2023). *Study on the spatial form of traditional villages in western Henan*. Doctoral dissertation, South China University of Technology.
- [16] Lu, L. (2023). *Research on the construction of Zhuangjin cultural gene map and its application in the design of cultural and creative products*. Doctoral dissertation, Guangxi Normal University.
- [17] Pang, P. (1986). Cultural Structure and Modern China. *Social Sciences in China*, 1986(5), 81-98.
- [18] Lai, Y. (2010). *Research on Cantonese Ancestral Hall in Pearl River Delta*. Doctoral dissertation, South China University of Technology.
- [19] Lu, Y. (1995). Guangzhou's Chen Clan Ancestral Hall and its architectural features of Cantonese. *Southern Architecture*, 1995(04), 29-34.
- [20] Lu, J. & Yan, P. (2020). Taking Guangfu Architecture as an

- example to discuss the characteristics of color art in traditional Chinese architecture. *Shanxi Architecture*, 46(20), 31-35.
- [21] Xu, Y. (2019). The Form and Evolution of Ancestral Halls in Canton Vernacular Settlements. *Huazhong Architecture*, 37(11), 129-133. <https://doi.org/10.13942/j.cnki.hzjz.2019.11.030>
- [22] Tang, X. (2003). *Research on architectural aesthetics of modern Cantonese*. Beijing: China Architecture and Engineering Press.
- [23] Hu, D. & Zhu, Z. (2020). Reliability and Validity Test of Questionnaire Based on SPSS and AMOS: A Case study of the relationship between Math anxiety, Math attitude and Math Effectiveness. *Educational Measurement and Evaluation*, 2020(11), 3-7. <https://doi.org/10.16518/j.cnki.emae.2020.11.001>
- [24] Luo, Z. & Yang, S. (2004). Comparison of scales in Analytic Hierarchy Process. *Systems Engineering-Theory & Practice*, 2004(9), 51-60.
- [25] Wang, Z. & Xu, X. (2022). Inheritance and enlightenment of Li traditional architectural culture in Hainan Island. *Small Town Construction*, 40(07), 112-119.
- [26] Song, X., Zhang, N., & Ma, C. (2023). Research on the Inheritance Mechanism and Demonstration of Traditional Rural Culture from the Perspective of Cultural Genes. *Architecture and culture*, 2023(12), 219-221. <https://doi.org/10.19875/j.cnki.jzywh.2023.12.067>

**Contact information:**

**Yanling ZHANG**

School of Mechanics and Construction Engineering,  
Jinan University,  
Guangzhou Guangdong, 510632, China

**Xu LUO**

(Corresponding author)  
School of Mechanics and Construction Engineering,  
Jinan University,  
Guangzhou Guangdong, 510632, China  
E-mail: tlouxu\_jnu@163.com

**Xiaohe XU**

School of Mechanics and Construction Engineering,  
Jinan University,  
Guangzhou Guangdong, 510632, China

**Kaman MAK**

School of Mechanics and Construction Engineering,  
Jinan University,  
Guangzhou Guangdong, 510632, China

**Dandan RUAN**

School of Mechanics and Construction Engineering,  
Jinan University,  
Guangzhou Guangdong, 510632, China