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# DIMENSIONAL HIERARCHIES IN TRADITIONAL CHINESE ARCHITECTURE FROM COSMIC ORDER TO HUMAN EXPERIENCE

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The dimensional system of traditional Chinese architecture is a complex integration of technical specifications and cultural concepts, profoundly reflecting the philosophical thoughts and institutional ethics of traditional Chinese society. This paper aims to systematically reveal the hierarchical dimensional control methods from overall planning to interior details and their inherent logic, constructing a "macro-meso-micro" analytical framework through interdisciplinary research methods of architectural history, archaeological discoveries, literature review, philosophy, and anthropology. At the overall planning level, traditional Chinese architecture adopts a modular grid system, whose dimensional settings are governed by the triple influences of ritual hierarchy, feng shui geomancy, and the "unity of man and nature" cosmology. In individual buildings, traditional Chinese architecture takes the "Cai Fen system" or "Dou Kou system" as the core modulus, achieving standardised production of components while realising artistic interpretation through the hierarchy of "Cai Fen" and the combination of "Chu Tiao" (bracket extensions). In interior spaces, dimensions are based on human activity needs, achieving the unity of functionality and artistic conception through means such as decreasing bay widths and height variations. This theoretical framework of three "dimensional levels" reveals the unique wisdom of ancient China in transforming abstract cosmological views into specific built environments, providing a historical reference for contemporary architectural design in terms of regional expression and inheritance of humanistic values.

**Keywords:** Traditional Chinese architecture, Scale control, Cai Fen system, Ritual system, Cosmology, Spatial Hierarchy, Modularisation.

## Introduction

Western architectural historiography has developed a multidimensional interpretive tradition regarding the proportional systems of classical orders. From Vitruvius' *Ten Books on Architecture*, which linked human proportions with cosmic order through modular theory, to Alberti's emphasis on the moral metaphors behind "number and beauty," and Le Corbusier's "Modulor" pursuing both mathematical precision and humanistic scale, their proportional systems have always intertwined aesthetic norms, philosophical speculation, and social symbolism. In contrast, traditional Chinese architecture has also developed a spatial control system centered on "scale hierarchy". Early Chinese architectural scholars such as Liang Sicheng and Liu Dunzhen provided preliminary interpretations, constructing a spatial cognitive framework for traditional Chinese architecture.

While its technical wisdom has gained academic recognition, its underlying logic and cultural implications still lack systematic international acknowledgement. This cognitive disparity manifests as asymmetry in academic discourse, such as Pevsner's judgment of Oriental architecture as "illogical decoration" in *An Outline of European Architecture*<sup>1</sup>, and reflects methodological limitations in cross-cultural research. This study originates from this imbalance in knowledge exchange. When the complex relationship between proportion and symbolism in Western architectural tradition has been fully explained, how can the unique wisdom in China's "scale hierarchy" system be integrated into the core dialogue of global architectural theory? This academic gap does not stem from opposing value judgments but calls for a more inclusive comparative perspective – by revealing different paths taken by the two traditions in addressing the fun-

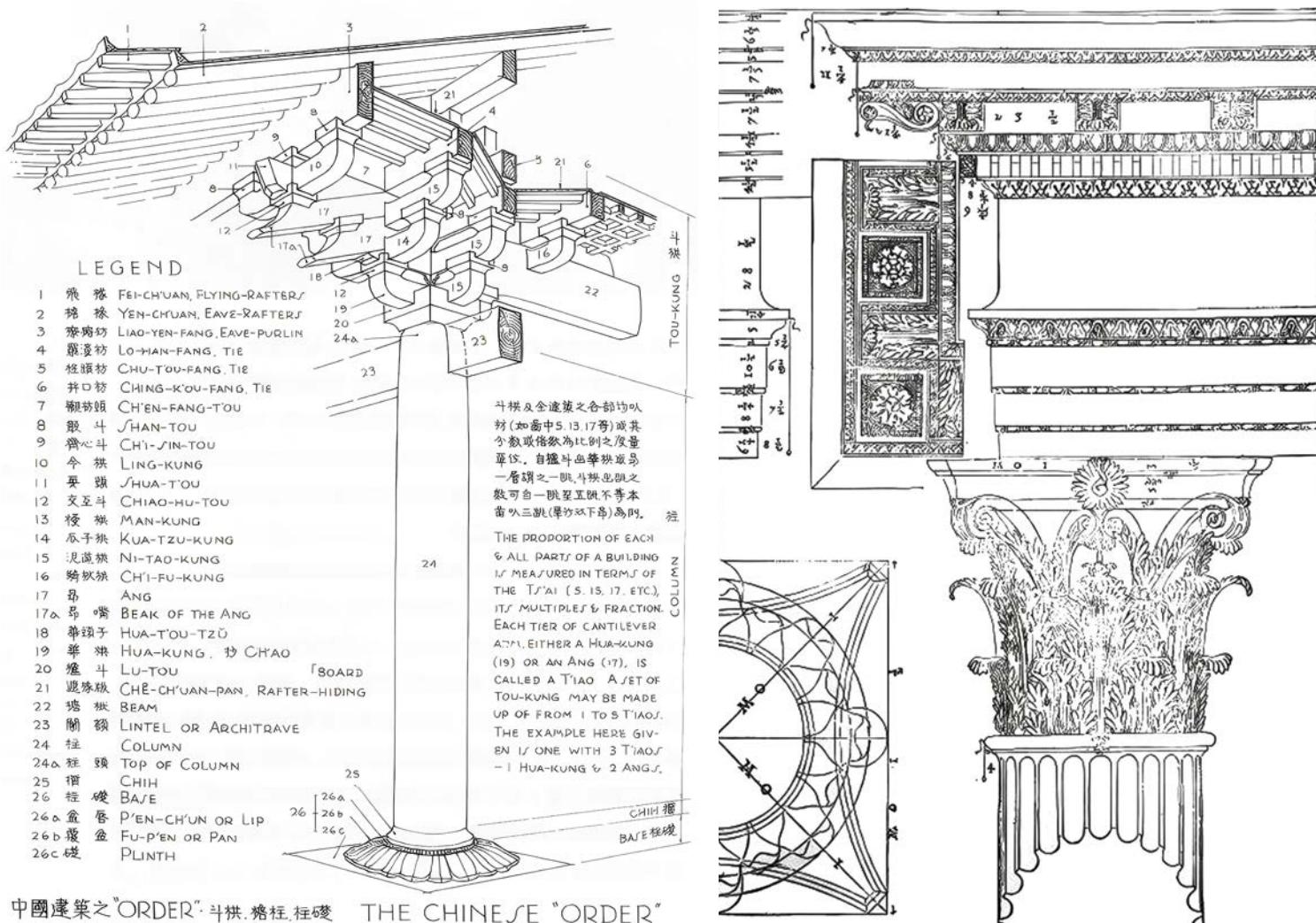
<sup>1</sup> Pevsner, *Outline of European Architecture*.

<sup>2</sup> Liang, *A Pictorial History of Chinese Architecture*.

<sup>3</sup> Steinhhardt, *Chinese Architecture*.

<sup>4</sup> Chen, *Study on the Timberwork System of Ying-zao Fashi*.

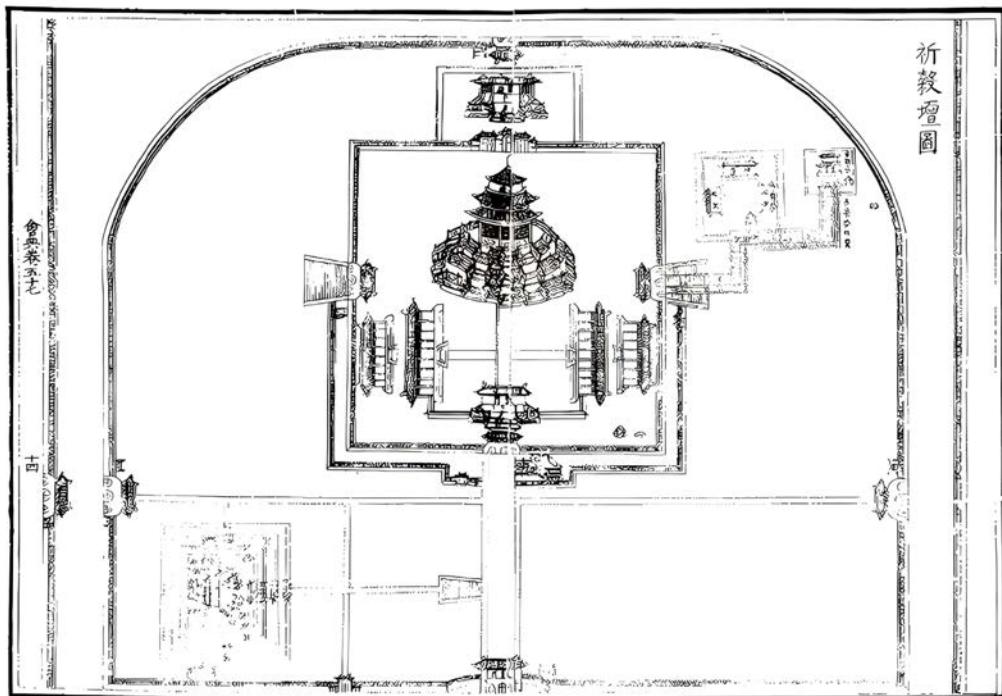
<sup>5</sup> Fu, *Research on Ancient Chinese Urban Planning, Architectural Complex Layout and Architectural Design Methods*.



1 | The "material-based approach" of ancient Chinese architecture versus the 'orders' of ancient Western architecture. (Liang, A Pictorial History of Chinese Architecture (1984), SDX Joint Publishing Company, Beijing 2023; Palladio, A., translated by Li, Zheng, *The Four Books of Architecture* (1570), China Architecture & Building Press, Beijing 2015).

damental question of "how to construct a meaningful world through scale," we may provide novel intellectual resources for contemporary architectural theory. Research on the scale of traditional Chinese architecture began in the 1930s. In *A Pictorial History of Chinese Architecture*, Liang Sicheng systematically introduced the structural system and formal evolution of ancient Chinese architecture in English for the first time<sup>2</sup>, enabling the *Cai*, *Qi*, *Fen* modular system of the *Cai-fen System* in the *Yingzao Fashi* (Treatise on Architectural Methods) to be analysed in parallel with Western classical orders and enter the international perspective. Although Western Sinologists such as Nancy Steinhardt have paid attention to the "imitating heaven and earth" characteristics of the *Mingtang* architecture<sup>3</sup>, they mostly attribute it to symbolism and neglect the scale translation mechanism at the technical level.

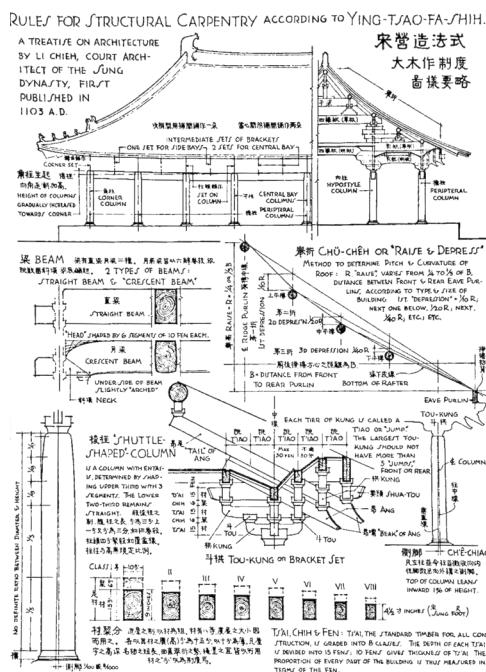
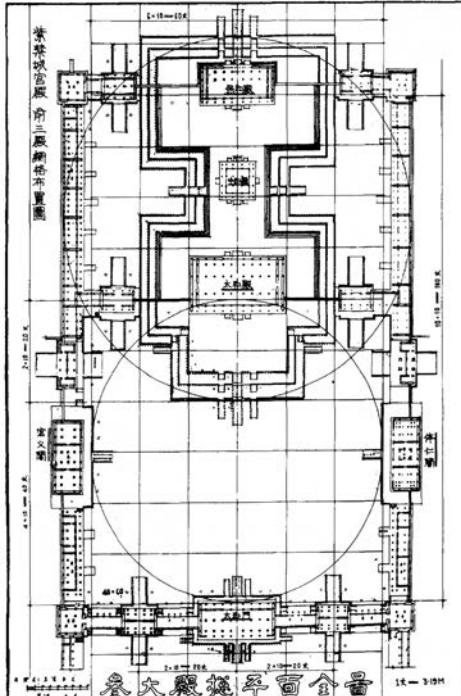
Domestic research presents a division between technical and cultural history. In *Studies on the Timberwork System of Yingzao Fashi*, Chen Mingda conducted a comprehensive mathematical analysis of the *Cai-fen System*, deconstructing the corresponding relationship between the eight grades of *Cai* and architectural hierarchies, and establishing the foundation for quantitative analysis of wooden architecture<sup>4</sup>. In *Research on Ancient Chinese Urban Planning, Architectural Complex Layout and Design Methods*, Fu Xinian revealed the dominant role of ritual numbers in architectural scales through the example of the "Nine Heavens" scale design of the Circular Mound Altar at the Temple of Heaven<sup>5</sup>. However, such studies mostly focus on a single scale level – either emphasizing textual research on the provisions of *Yingzao Fashi* or concentrating on macro-level planning of individual cases like the Forbidden City – lacking an integrated theoretical frame-



2 | *Ji Gu Tan Painting*. (Source: *Yisanga, The Great Qing Dynasty Code · Kangxi Reign, Chinese Classics and Culture*, 2017, 162).

3 | General Layout Plan of the First Three Halls of the Forbidden City. (Source: *Fu, Selected Papers on Architectural History by Fu Xinian, Baihua Literature and Art Publishing House, Tianjin 2009*).

4 | "Cai-fen system" (Source: *Li, J., annotated by Liang, S. C. Annotated Yingzao Fashi. China Architecture & Building Press, Beijing 1983*).



work that connects the "well-field grid" of overall planning, the "Cai-fen module" of individual buildings, and the "human scale" of interior furnishings. As Pan Guxi pointed out in *Chinese Architectural History*, existing research: «is like observing the same building under different focal lengths but failing to synthesize a complete three-dimensional image»<sup>6</sup>.

This dissertation focuses on three progressive research questions:

First, what specific scale control methods and technical tools have been developed in traditional Chinese architecture across the three levels of overall planning, individual design, and interior furnishings?

How are these levels articulated through craftsmen's practices?

Second, what cosmological views, social ethics, and bodily philosophies are embedded behind these methods? How do they collectively form the cultural genes of the scale system?

Third, what unique spatial aesthetic experience emerges when macrocosmic symbolism is translated into microcosmic spatial experience through meso-scale modular systems? The exploration of these questions will fill the structural gaps in existing research and promote a profound understanding of traditional Chinese architecture in international academic circles.

## Theoretical Framework and Methodology

Before delving into the hierarchical scales of traditional Chinese architecture, it is necessary to clarify a concept: the "scale" discussed in this paper does not simply refer to the proportional conversion relationship between architectural drawings and actual built structures (i.e., scale ratio), but rather denotes the totality of a complete system of dimensional measurement, proportional specifications, and control mechanisms employed in traditional Chinese architectural design.

This concept encompasses three interrelated dimensions: first, the actual measurement in the physical dimension (such as the *fen* in the *Cai-fen system* and the "construction *chi*" as units of measurement); second, the proportional relationships in the visual dimension (such as the weighing proportions between components and the spatial height-width ratio); third, the meaning-bearing in the cultural dimension (such as the expression of abstract concepts like ritual hierarchy and cosmic order through specific scales). This multi-dimensional concept of "scale" is the key to understanding traditional Chinese architecture from technical practice to cultural expression. This paper employs "hierarchy" and "modularisation" as core analytical lenses to construct a theoretical framework

for the scale system of traditional Chinese architecture, with the cultural concept of "architecture as a microcosmic epitome of the universe" serving as the theoretical foundation permeating the entire text.

The theoretical lens of "hierarchy" emphasises the systematic and hierarchical nature of scale control in traditional Chinese architecture, specifically manifested as a three-level control from macro to micro: at the overall planning level, spatial sequences are organised through scale frameworks such as "axis" and "*feng shui* pattern"; at the individual building level, standardisation of components and coordination of overall proportions are achieved through modular systems like the *Cai-fen system* or *Dou-kou system*; at the interior space level, a perceptible micro-scale experience is formed with "human scale" and "artistic conception creation" as the core. These three levels do not exist in isolation but form an interconnected holistic system through "top-down" regulatory constraints and "bottom-up" feedback adjustments.

The theoretical lens of "modularization" focuses on the technical wisdom and logical tools of scale control in ancient Chinese architecture, examining how core modular systems such as the "*Cai-fen system*" and "*Dou-kou system*" achieve design standardization, construction efficiency, and artistic unity. Unlike the proportion system centered on "orders" in Western classical architecture, the modularisation of ancient Chinese architecture emphasises more on adaptability – within the same modular system, adjustments to the grades of *Cai-fen* or *Dou-kou* can be made according to building hierarchy and functional requirements, ensuring both the stability of the system and the possibility of flexible adaptation.

The meta-theory permeating the above analysis is the cognition of "architecture as a microcosmic epitome of the universe" under the concept of "Unity of Man and Universe" in traditional Chinese culture. This concept holds that architecture is not only a carrier of physical space but also a concrete manifestation of cosmic order – by transforming cosmic concepts such as "Heaven is round and Earth is square", "Yin-Yang and Five Elements", and "Heavenly Stems and Earthly Branches" into specific scale data and proportional relationships, the built



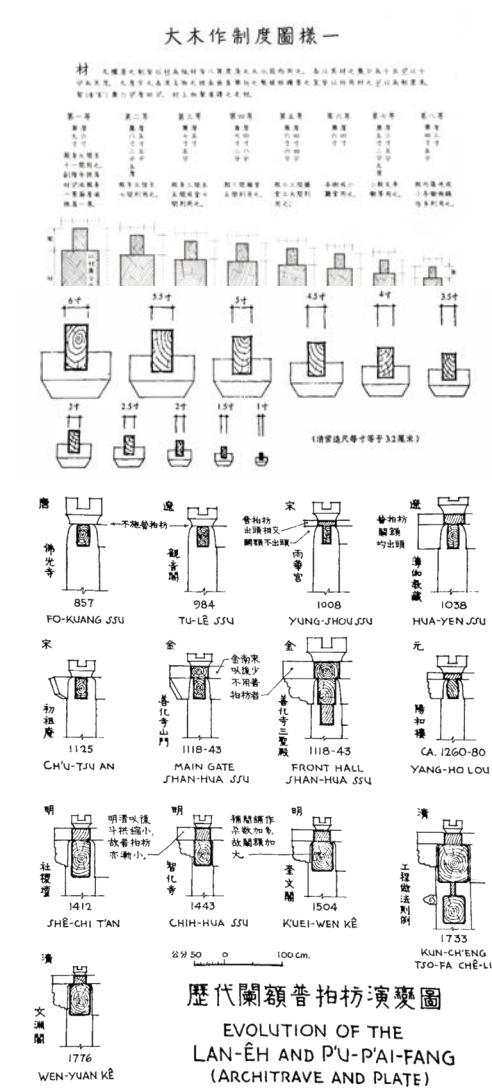
5 | Overview Photos of the Forbidden City.

environment becomes an intermediary connecting heaven and earth, and linking humans and deities. This unique wisdom of transforming abstract cosmological views into concrete scale imagery constitutes the deep cultural logic of the scale system in ancient Chinese architecture.

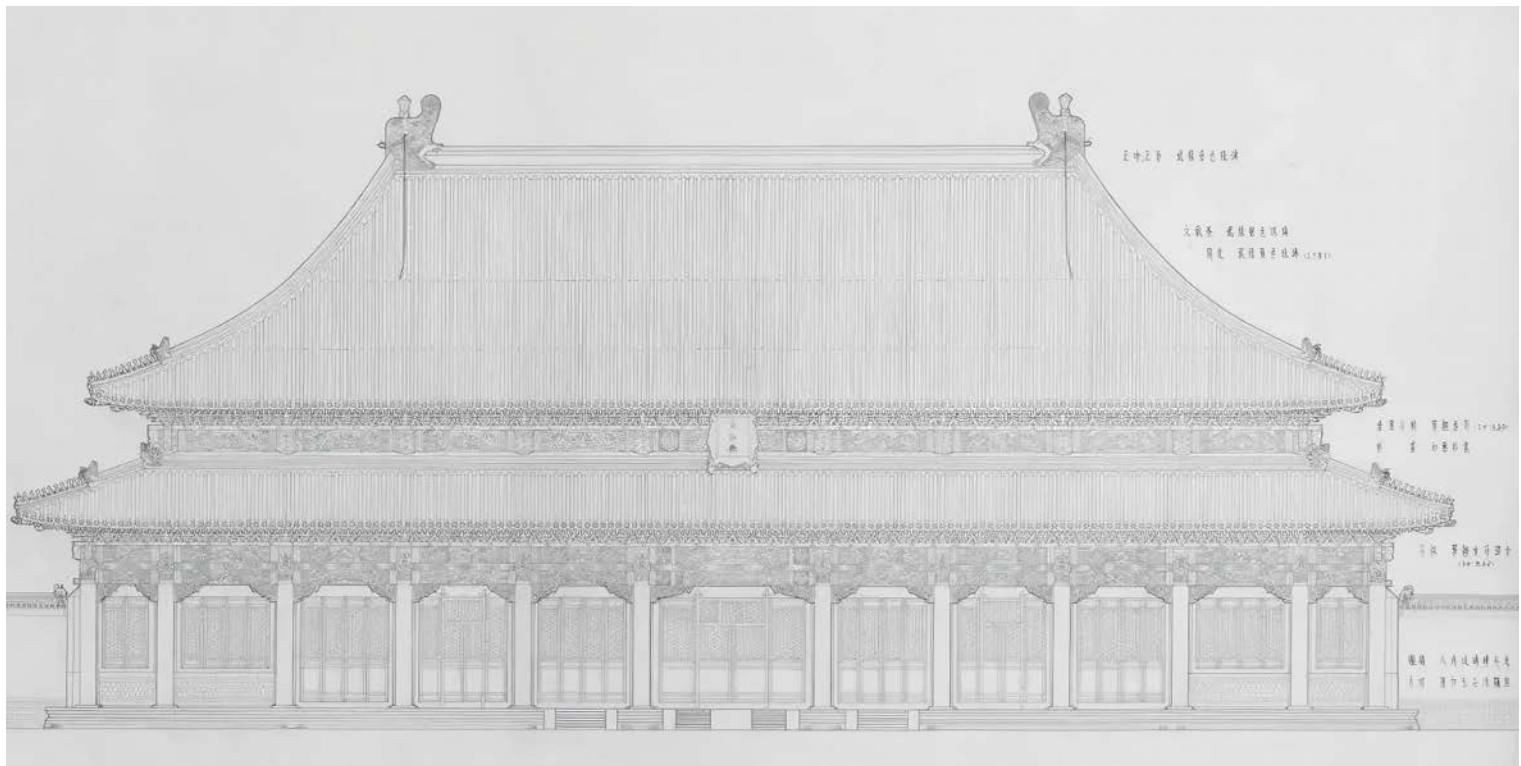
### Macro-Scale: Cosmic Order and Ritual Regulation in Overall Layout

The formation of macro-scale in traditional Chinese architecture is not merely a technical product, but the result of the interweaving influence of three factors: ritual system, cosmic symbolism, and "*feng shui* concepts", ultimately translating social ethical order and cosmic ideas into specific spatial scales. As the most externalised spatial expression of traditional Chinese architecture, the macro-scale is essentially a projection of the social order of "All under heaven is the king's land" and the cosmology of "Unity of Man and Universe" in the built environment.

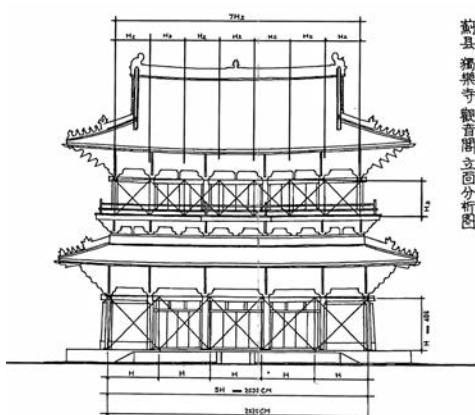
The traditional Chinese ritual system fundamentally determines the hierarchical norms of macro-scale control. The so-called *li* (ritual) refers to the religiously significant customs and ceremonies originating from clan society. After the emergence of feudal states, the originally customary *li* was reformed and perfected by the ruling class, becoming an embodiment of state will with legal nature and effect. This hierarchical differentiation is not only reflected in the



6 | "Dou-kou system" (Source: B. J. Ma, *Wooden Construction Technology of Ancient Chinese Architecture* (2nd Edition), Science Press, Beijing 2003).



7 | Facade of the Hall of Supreme Harmony. (Source: Shan, Liu, *Measured Drawings of Ancient Buildings on the Central Axis of Beijing*, The Palace Museum Press, Beijing 2017).



8 | Facade Analysis Diagram of Guanyin Pavilion, Dule Temple, Jixian, Tianjin. (Source: Fu, *Selected Papers on Architectural History* by Fu Xinian, Baihua Literature and Art Publishing House, Tianjin 2009).

height of the platform bases of individual buildings but also extends to the overall scale of architectural complexes. From a social perspective, through the hierarchical nesting of scales – from the imperial city to the palace city, and further to the halls – a hierarchical scaling of "state-palace-hall" is formed, strengthening the psychological identification of subjects toward imperial authority. The *Collected Statutes of the Ming Dynasty* stipulated the number of *jian* (spatial bays) for residences of officials of different ranks: "The front hall of dukes and marquises shall have seven or five *jian*; the main hall of first-rank and second-rank officials shall have five *jian* with nine purlins"<sup>7</sup>, while the main halls of the Forbidden City all have nine bays, symbolizing the highest dignity. As Liang Sicheng pointed out in *A Pictorial History of Chinese Architecture*: «The greatness of Chinese architecture lies in its expression of abstract political order through concrete scale language»<sup>8</sup>. Cosmic symbolism transforms abstract concepts of *Tianren Ganying* (Heaven-Man Interaction) into concrete scale language, using specific numbers as symbols of cosmic order to imbue architecture with special significance under particular scales. The ancient Chinese concept of "Heaven-Man Interaction" held that the order of human society should imitate the natural order of the universe, with architectural scale serving as the material manifestation of this imitation.

Geometric cosmic symbolism reaches its ultimate expression in the Temple of Heaven complex: the circular plan and square base of the Hall of Prayer for Good Harvests form a cosmic model of "Heaven is round and Earth is square", while its diameter of nine *zhang* (ancient Chinese units of length, 1 *zhang* is approximately equal to 3.03 m) and nine *chi* (ancient Chinese units of length, 1 *chi* is approximately equal to 33.33 cm) corresponds to the mythological imagery of "Nine Heavens". Directional symbolism is embodied in the axial layout of "facing south for reverence" – all major buildings of the Forbidden City are arranged along the north-south axis, with the main structures strictly oriented to face south. This directional choice not only meets lighting needs in the Northern Hemisphere but also originates from the philosophical concept in the *I Ching* that "the sage faces south to rule the world." Traditional *feng shui* concepts determine the density and height relationships of building groups. The key principle of "hiding wind and gathering *qi*" in *feng shui* theory is to regulate spatial energy flow through scale control. In courtyard organisation, the *qi port* theory in *feng shui* guides the length-width ratio of courtyards – for instance, the courtyards of the Six Eastern and Western Palaces in the Forbidden City mostly adopt a rectangular plan with a 3:2 ratio, which is believed to "gather *qi* without dispersion"<sup>9</sup>.

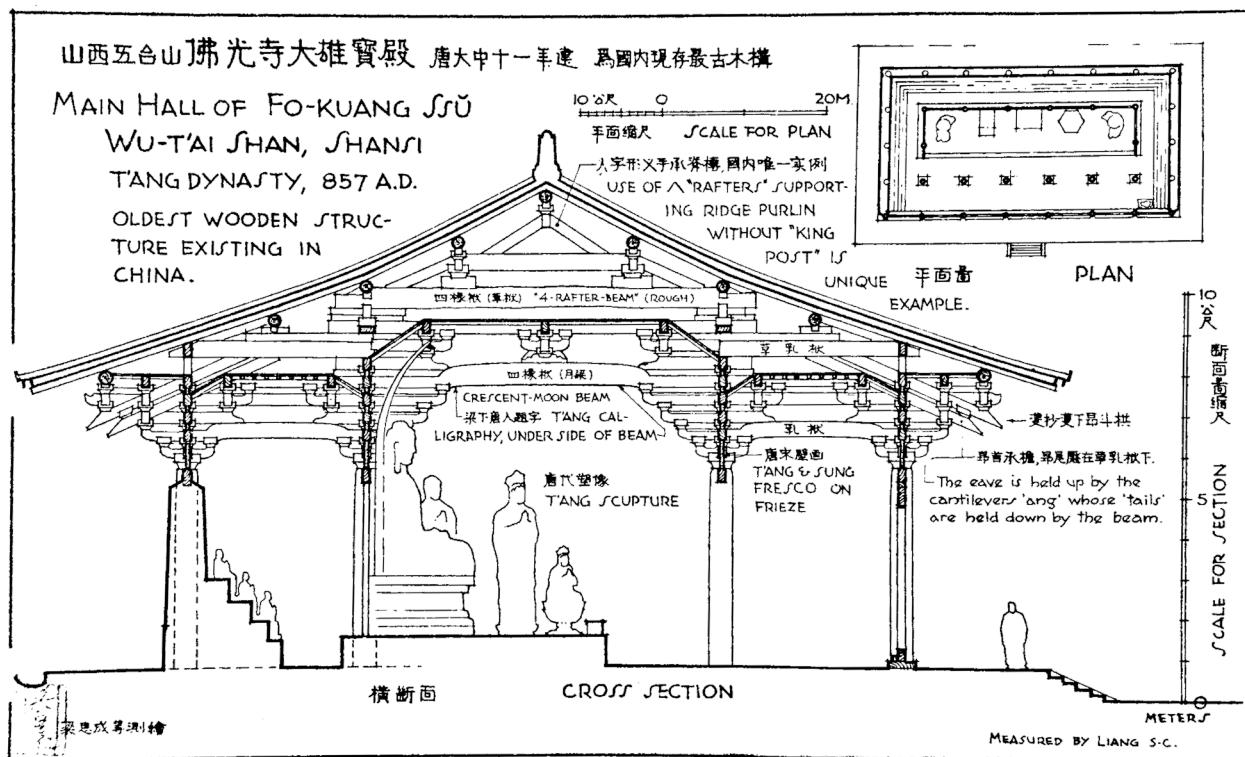
<sup>6</sup> Pan, *History of Chinese Architecture*.

<sup>7</sup> Yuan, *Collected Studies on the Collation of Da Ming Hui Dian*.

<sup>8</sup> Liang, *A Pictorial History of Chinese Architecture*, cit.

<sup>9</sup> VV. AA. *A History of Ancient Chinese Architectural Technology*.

<sup>10</sup> Fu, *Research on Ancient Chinese Urban Planning*, cit.



From a modern scientific perspective, this regulates and guides air flow through aspect ratios, adjusts the microclimate of buildings, and enhances thermal comfort in architecture.

The ritual system, cosmic symbolism, and feng shui concepts interact collectively, with the ritual system playing a dominant role. It maintains the feudal ethics of imperial supremacy through explicit spatial order, forming the theoretical foundation for the macro-scale of traditional Chinese architecture.

At the implementation level, macro-scale control in traditional architecture is established upon a modular grid system centered on the units of *zhang* and *chi*. This system is not merely a measurement tool but a crucial technology that transforms abstract spatial order into concrete construction rules. The *zhang-chi grid system* constitutes the fundamental spatial grid in architectural construction – using 1 *zhang* as the basic modular unit to form an equidistant square grid on the site, after which the positioning of building groups, courtyard dimensions, and axial spacing all strictly follow the coordinate relationships of this grid's nodes<sup>10</sup>. This requirement for order stability necessitates a high degree of standardization and replicability in macro-scale control. Notably, this grid system exhibits significant adaptability and flexibility, maintaining macro-level order unity while providing possibilities

for local functional variations, thereby demonstrating the wisdom of ancient Chinese planning techniques.

As a paradigmatic imperial palace of the Ming and Qing dynasties, the Forbidden City completely preserves the grand practice of macro-scale planning. Measured data reveals that its overall layout employs an expanded modular grid of 9 *zhang* × 9 *zhang*: the central axis stretches 96 grid units from the Meridian Gate to the Gate of Spiritual Valor, with an east-west width of 52 grid units, forming a 96 × 52 rectangular pattern that confirms the Dominant role of the ritual order of "the Son of Heaven dwelling in the center" over architectural scales<sup>11</sup>. Major palaces such as the Hall of Supreme Harmony, Hall of Central Harmony, and Hall of Preserving Harmony are all situated at grid intersections, with their face widths and depths strictly corresponding to multiples of the grid unit. Courtyard spaces similarly adhere to grid control – the square in front of the Hall of Supreme Harmony spans approximately 200 m east-west and 130 m north-south to present a 3:2 rectangular proportional relationship<sup>12</sup>. This grid system not only controls building positions but also enhances the rhythmic quality of axial sequences through multiple relationships of courtyard dimensions.

In the overall planning of the Forbidden City, the layout of the Six Eastern and Western Palaces corresponds to

9 | Main Hall of Fo-Kuang Ssu, (Source: Li, J., annotated by Liang, S. C. Annotated Yingzao Fashi. China Architecture & Building Press, Beijing 1983).

<sup>11</sup> Ibid.

<sup>12</sup> Yu, The Palace of the Forbidden City.



10 | Ancient Chinese painting about interior decoration.

11 | Ancient Chinese painting about furniture.

the Twenty-Eight Lunar Mansions, with building spacing and orientation determined by celestial movement patterns, transforming the palace complex into a "Heavenly Palace on Earth"<sup>13</sup>. This "cosmic mirroring" construction logic converts astronomical calendars into architectural modules, embodying the design philosophy of "observing celestial phenomena above and emulating earthly patterns below".

The Forbidden City exemplifies the most typical application of the numbers "nine" and "five": the Tiananmen Gate has nine bays in width and five bays in depth; the Hall of Supreme Harmony was originally constructed with nine bays in width and five in depth (currently eleven bays wide with five bays depth). This "nine-five" numerical combination directly echoes the imperial symbolism of "the ninth line of the QianGua (the first of the sixty-four hexagrams in the *I Ching*), flying dragon in the sky" from the *I Ching*. As a symbol of imperial authority, the overall planning scale of the Forbidden City far exceeds any princely mansion of the same period, fully embodying the hierarchical order of "the Son of Heaven's supreme dignity". The height of the artificial hill (Jingshan) north of the Forbidden City forms a specific proportion with the overall height of the palace complex – the viewing distance from the Hall of Supreme Harmony to the Wanchun Pavilion on Jingshan is approximately 1500

m, creating a specific vertical scale relationship that not only satisfies the feng shui requirement of "Xuanwu as backing mountain" but also forms a spatial momentum of "lower in front and higher behind".

Unlike Western classical architecture, ancient Chinese architecture emphasizes the metaphorical function of *Xiang* (symbolic imagery), transforming cosmic order into perceptible spatial experiences through *Quxiang Bilei* (drawing analogies from symbolic images). This act of encoding political order and cosmic concepts into a scale system constructs a stable and ordered worldview. Architectural scale becomes a symbolic carrier of cultural meaning, endowing traditional Chinese architecture with cultural depth beyond material functions and serving as a medium for interpreting traditional social structures and philosophical thought.

### Meso-Scale: Structural Modularity and Aesthetic Proportion in Single-Building Design

Traditional Chinese architecture has developed a technical system centered on modular control at the individual design level, whose profound ideology originates from the long-term accumulation of practical rational spirit of ancient craftsmen and wooden construction cultural philosophy. The essence of this system is to transform the abstract philosophy of "unity of  *and *Qi*" into specific construction principles, realize size control through the logic of "basic unit-multiple expansion", and ultimately achieve a high unity of technical rationality and artistic expression.*

The practical rational spirit manifests in transforming complex architectural creation into Computable mathematical model. As Li Jie, the Director of Imperial Architecture in the Northern Song Dynasty, emphasised in the preface to *Yingzao Fashi* (Treatise on Architectural Methods): «controlling labor and materials»<sup>14</sup>, indicating that the modular system originally originated from the need for labor and material control – reducing material waste through standardization and simplifying management through clear proportions. Chinese craftsmen deeply understood the mechanical properties of wood: the height-width ratio of *Cai* approximates the optimal bending resistance ratio for rectangular sections, while the subdivision of *Fenallows* com-

<sup>13</sup> Ibid.

<sup>14</sup> Li, *Annotated Yingzao Fashi*.

<sup>15</sup> Lin, *On Several Characteristics of Chinese Architecture*.

<sup>16</sup> Li, *Annotated Yingzao Fashi*, cit.

<sup>17</sup> Han, *Lectures on Chinese Architectural Culture*.

<sup>18</sup> Li, *Annotated Yingzao Fashi*, cit.

<sup>19</sup> Liang, *History of Chinese Architecture*.

ponent sizes to adapt to the grain characteristics of different wood species. As Lin Huiyin stated in *On Several Characteristics of Chinese Architecture*: «Chinese wooden structures never deliberately imitate the permanence of stone, but rather follow the nature of wood, achieving a unique 'temporary permanence」<sup>15</sup>. The dominant position of structural logic constitutes another core of this ideological system. In the modular system, visual proportions always subordinate to structural safety: beam height values satisfy bending strength requirements, bracket arm lengths depend on wood shear capacity, and column height-to-diameter ratios are controlled within 10:1 to prevent instability – enabling traditional Chinese wooden structures to stand for millennia on the earthquake-prone East Asian continent. Liang Sicheng commented in *Annotations on Yingzao Fashi*: «The greatest advantage of this system lies in transforming extremely complex architectural structures into definite proportional relationships, allowing builders to construct according to formulas even without being geniuses.»

The *Cai-fen System* summarised in the Song Dynasty's *Yingzao Fashi* established a modular system centered on *Cai* (timber module). Li Jie explicitly stated the design principle of "taking *Cai* as the ancestor" in *Yingzao Fashi*, regarding *Cai* as the basic modular unit for wooden structures. According to the *General Explanation* chapter of *Yingzao Fashi*: «All systems of house construction take *Cai* as the ancestor. There are eight grades of *Cai*, and they are used according to the size of the building». Here, *Cai* originally refers to the cross-section of standardised processed timber, with a fixed height-width ratio of 3:2, divided into eight grades (from the first grade *Cai* with 9 *cun* (ancient Chinese units of length, 1 *cun* is approximately equal to 3.333 cm) in height and 6 *cun* in width to the eighth grade with 4.5 *cun* in height and 3 *cun* in width). The specific grade is selected based on the building's rank and scale. *Fen* is the subdivided unit of *Cai*<sup>16</sup>. *Cai* has two types: full *Cai* and single *Cai*. Single *Cai* refers to the cross-section of brackets or beams in the dougong system, with 15 *Fen* in height and 10 *Fen* in width. Full *Cai* is 21 *Fen* in height and 10 *Fen* in width, with the difference between full *Cai* and single *Cai* being *Qi* (wedge). The eight grades of *Cai* have different dimensions and do



not form a decreasing sequence. Beams, columns, *Fang* (horizontal beams), *Ling* (purlins) in the building frame, and all components of dougong are measured by *Cai*, *Qi*, and *Fen*, which is exactly the meaning of "taking *Cai* as the ancestor". This system governs all component dimensions through multiple relationships: typically, beam heights are 1 or 2 *Cai*, all parts of dougong strictly follow fixed proportions, column diameters are usually 2 *Cai*, and column heights range from 30 to 40 *Cai* – fully embodying the design philosophy of "using *Cai* as the unit of measurement"<sup>17</sup>. The Song Dynasty also integrated the "Cai-fen System" with *Gongxian* (work hour quotas), laying the foundation for standardised production of components<sup>18</sup>.

The modular basis in the Qing Dynasty shifted from *Cai* to the width of the *doukou* (depression in the wooden component) of the dougong brackets, forming a more simplified "Dou - kou System". The "Engineering Regulations" stipulates: «All

calculations for the rise and fall, length, height, and width of *douke* (the term for *dougong* in the Qing Dynasty) are based on the width of the *doukou* where the horizontal arm is installed on the front face». This establishes the opening width of the base bucket (*doukou*) as the basic unit, divided into eleven grades (from 0.5 *cun* to 6 *cun*)<sup>19</sup>. Compared with the Song Dynasty system, the Qing Dynasty *Doukou System* exhibits stronger practicality, with all major wooden component dimensions being integer multiples of the *doukou* unit.

Taking the Hall of Supreme Harmony in the Forbidden City as an example, it adopts the first-grade *doukou* (6 *cun* in width). The diameter of the eaves columns is 3.5 *chi* (equivalent to 5.83 *doukou*, approximately a simplified value of 6 *doukou*), and the depth is 63 *chi* (equivalent to 10.5 *zhang*), exactly 105 times the width of the *doukou*, reflecting the penetration of the modular system into macro-scale.

The Qing Dynasty *Doukou System* further simplified tenon-mortise specifications, forming the industry standard of "determining tenon length by doukou and mortise depth by *fen*".

Modular scaling endows traditional Chinese architecture with three core characteristics: standardised prefabrication, structural rationality, and flexible adaptation. These attributes have been fully verified in numerous classical architectural works.

Structural rationality manifests in the clear proportional relationships between components, enabling the architectural grandeur to transcend absolute dimensions. The Guanyin Pavilion of Dule Temple in Jixian County, standing at 23 meters tall, features nine layers of cantilevered brackets that not only achieve uniform load transfer but also form an elegant silhouette with "far-reaching lower eaves and tapering upper eaves", demonstrating the unity of structural logic and visual aesthetics<sup>20</sup>. This proportional system ensures that buildings maintain structural stability and visual harmony across different scales.

Flexible adaptation manifests as the dialectical unity of unified principles and flexible applications, most notably reflected in adaptations for buildings of different ranks and functions – within the same architectural complex, main buildings use first-grade *Cai* while auxiliary buildings use third-grade *Cai*, distinguishing ritual hierarchy through differences in *Cai* grades<sup>21</sup>. This flexibility enables the modular system to adapt to various architectural needs while maintaining internal logical consistency.

Although these two systems belong to different eras, they collectively shaped the technical aesthetics of wooden architecture. From the Song Dynasty's *Cai-fen System* to the Qing Dynasty's *Dou-kou System*, traditional Chinese architectural modular systems demonstrated strong vitality and adaptability. The standardisation and rationalisation ideas they embody still hold significant enlightenment value even today. This integration of rationality and sensibility, technology and culture, constitutes the core wisdom of Chinese wooden architecture.

### Micro-Scale: Humanistic Adaptation and Ambiance Creation in Interior Space

The micro-scale control of traditional Chinese architecture is essentially an ideological journey from "measuring heaven and earth" to "settling the human heart". The *zhang-chi* system, which exists as a module in macro planning, forms a precise coupling with human scale when entering interior spaces – behind this transformation lies the implementation of the "unity of man and nature" philosophy from abstract concept to perceivable daily experience. When Laozi's thought that «Thirty spokes share one hub; it is the emptiness inside that makes the wheel useful»<sup>22</sup> meets architecture, it transforms into the careful management of "void": the "nothingness" enclosed by walls and column grids is precisely the "being" that carries life situations.

The Ming Dynasty work *Chang Wu Zhi* emphasised the aesthetic orientation that «Elegance of a room does not depend on size; fragrance of flowers does not rely on quantity»<sup>23</sup>, pushing this philosophy to its extreme. The restraint on excessive scale and respect for human perception endow traditional Chinese interior design with astonishingly modern qualities. As Lin Huiyin stated in *Miscellaneous Notes on Suburban Architecture*: «The fundamental spirit of Chinese architecture is peace and contentment, best embodied in interior spaces that perfectly align with human proportions»<sup>24</sup>. This spirit runs through history – from the refinement of miniature spaces promoted by Song Dynasty literati's "study culture" to the stylistic language which is "slim, vigorous and neat" of Ming Dynasty furniture – all exemplify a spatial philosophy of being exquisite without being cramped.

The transformation mechanism from thought to practice builds a bridge between philosophical concepts and construction techniques. Traditional craftsmen disassemble abstract philosophy into operable technical paradigms, realizing the translation from abstraction to concreteness through the "measurement" system, forming a complete chain of "philosophical thought, human scale, construction module, spatial experience". The *Xiaomu Zuo* system in the Northern Song Dynasty's "Yingzao Fashi" clearly records:

«For a door 1 chi and 1 cun wide, its height should be 5 chi and 5 cun»<sup>25</sup>, a ratio that exactly matches the golden section between shoulder width and height of the human body – based on the average shoulder width of an adult male (1 chi and 1 cun), the door height is determined at a 5:1 ratio, which not only meets the functional needs of passage but also creates a visually stable feeling. The *Luban Jing* (Luban Classic) further extended this precision to daily life, stipulating «a table should be 2 chi and 8 cun high and 3 chi and 6 cun wide»<sup>26</sup>, corresponding to the elbow height and forearm length of an adult in a sitting position, ensuring that the elbows hang naturally and the forearms are flat when writing or dining.

Craftsmen converted these human scales into construction modules through the *Cai Fen System*. The *Yingzao Fashi* stipulates: «There are eight grades of *Cai*, and the size of the building determines its usage»<sup>27</sup>. Taking *Cai* as the basic unit (the first-grade *Cai* is 9 cun wide and 6 cun thick), which is further divided into *Fen* (1 *Cai* = 15 *Fen*). A door height of 5 chi and 5 cun is converted to 33 *Fen*, and a door width of 1 chi and 1 cun is 6.6 *Fen*, forming a fixed ratio of 5:1. This modular conversion mechanism not only retains the essential core of human scale but also improves construction efficiency through decimal conversion. Standardised scales are not rigid shackles but the foundation of spatial flexibility. The basic combination of "one table, one chair, one couch" formed in the Song Dynasty contains sophisticated ergonomic considerations: the square table has a side length of 3 *chi*, ensuring that four people can sit opposite each other without their knees touching; the backrest chair's *Danao* (top rail) is 2 *chi* and 5 *cun* high from the seat surface, perfectly fitting the natural curvature of the human spine; the "four-sided bed" is 6 *chi* long and 4 *chi* wide, allowing adult men to lie down without their feet hanging in the air and with arms fully extended.

The *Yingzao Fashi* defines the basic indoor unit "*Jian*" as the void "between four columns"<sup>28</sup>, providing flexible configuration possibilities for components such as partition fans and screens. The three-bay space of the *Zhilian Laowu* in Suzhou's Lingering Garden achieves a dramatic transformation of scale through the exquisite design of partition doors – when fully opened, indoor and



outdoor spaces merge into one; when closed, the "grid-patterned" heart forms a translucent visual barrier that maintains light transmission while defining functional zones, perfectly expressing the plasticity of *Jian*. The principles of "distant borrowing, adjacent borrowing, upward borrowing, and downward borrowing" summarised in Ji Cheng's *Yuan Ye* (The Craft of Gardens) expand spatial perception through visual proportion resetting<sup>29</sup>. The mere three-square-meter fan-shaped interior of the *Yushui Tongzuo Xuan* in Humble Administrator's Garden uses a three-foot-diameter circular hole window as a picture frame to incorporate the *Li Ting* and *Xuexiang Yunwei Ting* which located hundreds of meters away into view, creating a sense of depth in the composition. This is precisely an ultimate expression of the principle of "distant borrowing". From the rigorous regulations of the *Yingzao Fashi* to the artistic conception creation of literati gardens, the micro-scale control of traditional Chinese architecture demonstrates unique transformative wisdom – it translates abstract philosophy into tangible spatial strategies and articulates the eternal proposition of "people-oriented" through precise scale language. This is not merely architectural craftsmanship but a civilization's profound insight into the essence of life.

### Synthesis: The Interplay of Hierarchical Scales and Its Cultural Logic

The scale control system of traditional Chinese architecture presents a high degree of internal unity, whose core lies

in the integrated application of the "modular" concept and *zhang-chi* measuring tools across the macro, meso, and micro levels.

At the macro planning level, *zhang-chi*-grid controls the orientation and spacing of building complexes. At the meso individual building level, the "*Cai-fen* system" or *Dou-kou* system achieves precise conversion from *zhang* to *fen* by unifying timber component dimensions as multiples of basic modules. At the micro interior level, the *zhang-chi* system returns to its practical essence through calibration with human scale. This coherence is not merely simple size superposition but rather a complete transformation from cosmic symbolism to human perception, achieved through dual constraints of mathematical logic and measuring tools.

The formation of the traditional Chinese architectural scale system is fundamentally driven by the combined action of four factors: social politics, philosophical cosmology, practical rationality, and literati aesthetics.

Social politics constitutes the primary constraint on scale control, as feudal imperial power required specific spatial order to establish and maintain the patriarchal ritual social order. This hierarchy was reinforced through the "central axis" in macro layout, transforming architectural scale into a spatial projection of the political order that "All under heaven is the king's land". China's unique philosophical cosmology – the "unity of man and nature" – is also embedded within the scale system. The practice of converting astronomical calendars into architectural

12 | Ancient Chinese painting about furniture.

**“ Multi-dimensional concept of 'scale' is the key to understanding traditional Chinese architecture from technical practice to cultural expression.**

<sup>20</sup> Wen, Zhang Wu Zhi (*Records of Superfluous Things*).

<sup>21</sup> Li, *Annotated Yingzao Fashi*, cit.

<sup>22</sup> Laozi, *Dao De Jing*.

<sup>23</sup> Wen, Zhang Wu Zhi (*Records of Superfluous Things*).

<sup>24</sup> Liang, Lin, *Miscellaneous Notes on Architecture in the Suburbs*.

<sup>25</sup> Li, *Annotated Yingzao Fashi*, cit.

<sup>26</sup> Wu, *Lu Ban Jing* (*Lu Ban's Classic*).

<sup>27</sup> Li, *Annotated Yingzao Fashi*, cit.

<sup>28</sup> Ibid.

<sup>29</sup> Ji, *Yuan Ye* (*The Craft of Gardens*).

scales was already institutionalised in the *Kaogongji*: «When craftsmen plan a state, it is nine li square with three gates on each side» – where *nine li* corresponds to the "Nine Provinces" and "three gates" symbolize the "Three Lights" (sun, moon, stars). By transforming abstract cosmological concepts into measurable architectural elements, a scale system of "symbolizing heaven through numbers" was formed. The essence of the modular system in architectural scales also embodies practical rationality. By converting dimensions of beams, columns, brackets, and other components into multiples of *Cai*, *Qi*, and *Fen*, standardised production and on-site assembly of components were achieved, enabling craftsmen to quickly calculate all component dimensions based on a single component's size – greatly improving construction efficiency and shortening construction cycles. Ancient literati aesthetics also uniquely shaped architectural scales by seeking profound artistic conception within geometric order. This mutable thinking elevates micro-scale from physical measurement to emotional experience, embodying that "unity of man and nature" is not merely a cosmological projection but a poetic expression of spiritual dwelling.

The four driving forces – social politics, philosophical cosmology, practical rationality, and literati aesthetics – do not exist in isolation. Instead, they intertwine through the three hierarchical scales, ultimately shaping the built environment embodying the "unity of man and nature."

## Conclusion

Through systematic investigation of the traditional Chinese architectural scale system, this study reveals its complete hierarchical system from macro to micro, from sacred to secular, and from institutional to artistic conception. This system transforms cosmology, social order, and humanistic experience into physical space, and is not an isolated technical specification.

At the macro scale level, the modular grid system exemplified by the Forbidden City constructs spatial coding through *zhang-chi* units, translating ritual requirements into measurable architectural language. The meso-scale modular system embodies the balance between technical rationality and artistic expression – by converting large

wooden components into multiples of basic modules, it achieves the unity of standardised prefabrication and artistic diversity. The micro scale reveals how "human body modules" shape spatial experience: through the variability of *jian*, furniture dimensions, and "view-borrowing" techniques, external cosmic order is transformed into internal life experience. The cultural logic permeating the three levels presents an isomorphic relationship of "cosmos-society-individual," constructing the cognitive framework that "architecture is a microcosmic epitome of the universe". This wisdom of transforming abstract concepts into concrete scales constitutes the most original characteristic of the traditional Chinese architectural system. Liang Sicheng pointed out in *A Pictorial History of Chinese Architecture* that "Chinese architecture has its own grammar"<sup>30</sup>, and the core of this "grammar" lies precisely in the transformation rules of scale across different levels.

The *scale hierarchy* analytical framework constructed in this study provides a new paradigm for understanding non-Western architectural systems. Western scholarship has long taken the classical order proportion system as a reference, while China's three-dimensional scale model of "modularity-symbolism-experience" demonstrates the diverse possibilities of architectural proportion theory, filling the gap in non-Western architectural proportion theory. Unlike Western "numerical ratio aesthetics", the scale logic of traditional Chinese architecture exhibits its characteristics of "relational aesthetics", strengthening ritual order through spatial narrative and providing an important case for comparative architectural history.

In today's era of industrialised construction, the traditional Chinese scale system can offer valuable ideological resources for infusing humanistic spirit and regional characteristics: in terms of modular application, the principle of "seeking variation within unity" in the *Cai-fen system* may provide ideas for resolving contradictions between industrialization and regionalism; in terms of spatial flexibility, the scale control of "changing views with each step" in *Jiangnan* gardens has direct reference significance for elastic space design in high-density cities; in terms of cultural identity, the method of transforming abstract values into per-

ceivable scales in traditional architecture provides ideas for carrying cultural memory.

The limitations of this study lie in its emphasis on official architecture cases, with insufficient attention to scale variations in local folk architecture. While it can explain the logic of official buildings such as the Forbidden City and Foguang Temple, it has not yet conducted in-depth exploration of the rules governing regional architectures like *Fujian Tulou* and *Shaanxi Yaodong* (cave dwellings), which may possess scale regulations different from the official system.

Future research can be expanded in two aspects: first, conducting comparative studies on local architectural scales, establishing an "official-folk" scale database, and analyzing differences in modular selection and proportion control across regions; second, applying digital technologies, using 3D laser scanning and parametric analysis tools to quantify the "empirical" proportions of traditional architecture, and establishing precise scale control models to provide new methodologies for traditional architectural research.

The essence of the traditional Chinese architectural scale system is a "living tradition", which is not only a crystallization of past wisdom but can also provide nourishment for future architecture through creative transformation. In today's era of intertwined globalization and regionalism, this wisdom of transforming cosmology, social order, and humanistic experience into spatial scales represents an important path for contemporary architecture to reclaim its cultural roots.

<sup>30</sup> Liang, *A Pictorial History of Chinese Architecture*.

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