Is There Aesthetic Beauty in Traditional Chinese Vernacular Architecture?

中國傳統民居建築之中有否蘊含美學原理？

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摘要

中國的傳統民居在實用之餘常給人一種含蓄的美感，但當問到它「美在何處」，則又難以具體作答。西方理論每以「比例」來衡量一建築物之美，本文亦嘗試用此種偏向科學的方法，分析傳統民居「建築」之中「比例」的運用。希望透過此研究，窺探傳統匠師之智慧，並展現民居之「內在美」。

文章主要分成兩個部分。由於比例不離尺寸，第一部分會首先列舉匠師所採用的尺度、模數等。從已有的基本資料，進一步檢視這些「手段」背後的原理和相互關係，及其對建築設計之影響，如促進模數制及構件的標準化等。（這裡主要是把中國學者所得譯成英文）

第二部分是個案研究，選取了位於香港荃灣的「三棟屋」。此屋屬於「三堂兩橫式」客家民宅，佈局細緻，法度嚴謹。透過「作品」，可印證前述「手段」之實際應用情況。經過研究，發現「三棟屋」之平面設計乃基於一六尺乘六尺之網陣，及巧妙地運用了「二比三」之比例。其實在香港一些其他的傳統民居之中，亦發覺有類似的「比例」上的考慮，這些都有待進一步的考察。

證據顯示中國傳統民居建築之中果然蘊含美學原理。但有別於西方的理論性取向，中國建築對「比例」的運用較偏於實際，如宋材分模數制便是一例。這對研究「中式」的民居美學有提示作用。再者，中國偉大的官方建築乃與民間建築一脈相承，是以深入了解民居對發展中國建築實有根本上的重要性。

Key words: Vernacular Chinese Architecture, aesthetics, proportion, scale, *Lu-Ban Jing*, (Lu Ban's Manual)

1 Introduction

"Is there aesthetic beauty in traditional Chinese vernacular architecture?" This is not the kind of question one would expect an answer from the common people because beauty in the house they live in is of no concern to them. However, not being aware of the fact whether beauty exists in their architecture or not, does not mean that the architecture itself has no beauty. If one looks at the manner in which the building blocks are arranged and the alignment of fenestrations, the way of building materials and structures are chosen, one would not help asking the same question. In this paper, we attempt to answer this question by examining the vernacular built-forms through our concept of aesthetics, i.e. scale and proportion. We hope to understand and reveal the wisdom of its builders - the anonymous craftsmen who were at the very roots of the great architectural achievements of China.[1]

To study architecture in terms of 'aesthetics' is a somewhat Western almost neo-scientific approach, in which we try to measure beauty by certain principles. The Renaissance thinker L.B. Alberti tried to define beauty as "that reasoned harmony of all the parts within a body, so that nothing may be added, taken away, or altered, but for the worse"(Alberti 1988). This clearly

refers to the principle of proportion, the ordered relation of numbers and measures. Despite its western flavour, proportional beauty exists as a universal, it can be observed in nature and in the manifestations of different cultures. In China, however, the notion of proportion was oriented towards pragmatism rather than theory, which may hint at an alternative approach in studying Chinese proportions. This point can best be illustrated by comparing two diagrams of the human body, one found in an old Chinese work on acupuncture (Lu 1980) and the other by the Renaissance artist A. Durer (Lawlor 1982) (Fig.1). Lu's diagrams on p122-127 depict a module system for determining the position of acu-points. It is a standard set of measurements which is reduced to 'relative inches' in accordance with the variation of size of a normal human body, which is taken as a standard. This is strikingly similar to the 'modular coordination of timber construction' (*caifen zhi*, 材分制) in the *Yingzao Fashi* (營造法式) Durer's drawing. It is however, drawn according to an anatomical canon.

Evidently, Chinese imperial architecture displays a rich knowledge of proportion as a design principle, though such knowledge was seldom explicitly discussed in the past. And if we take note of the continuity between the great and little traditions in China, it would be reasonable to assume that similar qualities might be found in her folk architecture.

In constrast to applied ornament which is visible to the eye, proportion is a hidden quality in buildings, and can only be revealed through analytical methods. Hence the paper begins with investigating the different scales and design modules (and any other building traditions) used by vernacular builders, which would have implications on the proportioning of their artefacts. Then we shall examine traditional Hakka dwellings (its detailed dimensions and underlying composition), to verify the possibility of proportion in the design. It is hoped that this study will serve to test the hypothesis that there is intrinsic proportional beauty behind vernacular Chinese built-form and compare this to the explicit geometrical aesthetics of western architecture (Lung 1991).

2 Vernacular Building Traditions

2.1 Construction scale

The basic foot-rule[2] used by Chinese craftsmen is called the 'construction scale' (*yingzao chi* 營造尺) or the 'carpenter's scale' (*mugong chi* 木工尺). The scale was developed into a form of a square-rule (*qu chi* 曲尺), like the one described in the *Lu Ban Jing* (*Lu Ban's Manual* 魯班經).[3] The shorter leg measures 1 *chi*, and the longer leg is usually determined by the principle of '**side-five-diagonal-seven**' (*fangwu xieqi* 方五斜七),[4] i.e. the side-to-diagonal ratio of a square, giving a length of **1.4** *chi* (7÷5=1.4 is a good approximation of $\sqrt{2}$=1.414...).[5] This clearly indicates the craftsmen's knowledge of the $\sqrt{2}$ proportion, and their preference for using integers (5:7) in their practice. The measure of the construction scale varies in different regions, where one *chi* ranges from 275 mm to 320 mm.[6]

Besides being used as a basic measuring and construction tool, the square-rule is also related to the fengshui practice of 'pressing-white' (*yabai fa* 壓白法) (Fig 2.1).[7] It associates different measurements with luck and other attributes, such as the five-elements. The *Lu Ban Jing* describes the 'inch-white method' (*cunbai fa* 寸白法) which controls the house dimensions in inch units (dimensions in inches ending with the digits '1', '6' and '8' being considered auspicious). In some practices the 'foot-white method' (*chibai fa* 尺白法) is also used (feet ending with digits '1', '2', '6', '8' and '9'), for example, in the Chaozhou region (陸元鼎1991 p.189-190). An interesting aspect is the preference for odd numbers for the vertical (heavenly) dimensions and even numbers for the horizontal (earthly) ones, according to the traditional *yin-yang* symbolism. Here it should be noted that even numbers are good for coordination of symmetrical plans because of their divisibility by two. Similarly number symbolism is readily found in sacred architecture such as, the pyramids and the Altar of Heaven (天壇) in Beijing. Yet, as pointed out by K. Ruitenbeek (1993, p61-62) such geomantic rituals have minimal architectural significance for vernacular built-forms because the dimensional adjustments are small and hardly discernible to the eye. Paradoxically, much effort was spent by the villagers themselves in constructing this 'imaginary' or 'psychological' architecture. However, this demonstrates that the craftsmen were in fact capable of handling intricate relationships in the dimensioning of a house, as was reflected in the actual physical layout of their buildings.

2.2 Lu Ban's scale

Another scale described in the *Lu Ban Jing* is the 'Lu Ban's scale' (*Lu Ban chi* 魯班尺) (Fig 2.2). The scale's 1'foot'corresponds to **1.44** *chi* on the carpenter's scale, and is divided into eight segments or 'inches', each being **0.18** *chi* (or **1.8** *cun*), thus it is also called the 'eight-characters scale' (*bazi chi* 八字尺). Good or bad luck is associated with the different segments, and in its application. Building dimensions should fall within the favourable segments. Its length of 1.44 *chi* is exactly the same as the longer leg of the square-rule (1 *chi* x 1.44 *chi*) as scaled from the illustration of *Lu Ban Yingzao Zhengshi* (Ruitenbeek 1993, p90-93) (魯班營造正式). This might suggest the birth of Lu Ban's scale from the construction scale plus the conception of $\sqrt{2}$ (Fig 2.4).[8] The use of 1.44 *chi* instead of 1.4 *chi* might be explained by the fact that it is divisible by eight and that the resulting 1.8 *cun* consists of the auspicious numbers 1 and 8. It is also noticed that this 1.8 *cun* is one tenth of *the zhanggan module* (see next section).

A pattern can be observed by extending Lu Ban's scale, implying design modules of 7.2 *cun* ($\sqrt{2}$÷2) and 14.4 *cun* ($\sqrt{2}$). A similar property of modularization exists in the previously described square-rule (when it is used as a scale for 'pressing-white') and could be best illustrated using its other version, the 'scale of flying-white' (*feibai chi* 飛白尺), mentioned in the encyclopaedia *Shilin Guangji* (事林廣記) (Ruitenbeek 1993, p90-93).[9] By extending this *feibai chi* now it becomes clear that actually the 1 and 6 segments generate a module of 5 *cun* (6-1=5). In addition,

the 1 and 8 segments give a difference of 7 *cun* (compared to 7.2 *cun*), and '1' and '11' give 10 *cun*, or 1 *chi* (full length of the scale). The sequence of 5, 7, 10 is formed, [10] which embodies the ratios 2:3, 5:7 ($\sqrt{2}$) and 7:10 ($\sqrt{2}$). Surprising overlapping of modules is also found when the two scales are placed side by side (Fig 2.4). Now the full proportional properties of the two common scales used by folk craftsmen are revealed. As we shall find later, the proportions of 2:3 and $\sqrt{2}$ are fundamental to the design of vernacular Chinese architecture.

In practice, the square-rule (with the method of 'pressing-white') was used to determine (or adjust, in a more correct sense) the final dimensions of a folk building. The dimensions of its openings (doors and windows) were cross-checked against Lu Ban's scale (as implied by its other name 'door scale' (*men chi* 門尺). Interspersed with the practice of *fengshui*, the two scales were popular with both the great and the little traditions, and found in much of the old literature, including the offical publication *gongcheng zuofa zeli* (工程造法則例). [11] It is most important to note that such scales and methods contribute to modular coordination and standardization of building elements in the design of buildings.

2.3 Zhanggan

In the two previously mentioned scales, the modules are derived from the basic metric system or purely geometrical properties. There is in fact, a third kind of scale, the *zhanggan* (literally a 'ten-feet-long yardstick' 丈竿), which is closely related to the construction aspect. This scale is not detailed in the *Lu Ban Jing*, but is mentioned by name (于榮編, 1:5b). Their use of this tool varied according to the different regions. In the imperial tradition of Beijing it was used to mark out all critical construction dimensions (which may not involve any module) (井慶升1985, p.9-11). In Fujian and Taiwan its name is *gaochi* ('drafting rule' 稿尺) (Ruitenbeek 1993, p64), and in Suzhou it is one *zhang* (equals ten *chi*), a long scale used simply for measurement (姚承祖1986, p.88).

Among the versions, the Chaozhou *zhanggan* is better documented and found to be more relevant to this study (陸元鼎1991, p.191-192). It is a large plank of wood measuring 18.6 *chi* (which keep in mind the auspicious numbers) (Fig 2.3). The 1.8 *chi* module actually equals the width of two 'rows of roof tiles' (*keng or wakeng* 瓦坑) of 0.9 *chi*, the latter being a common module in determining the widths of horizontal bays in a house. Two series of measurements are marked on the scale, which correspond to odd and even numbers of *keng* respectively. These measurements are found to be the major controlling dimensions in some dwellings (陸元鼎1991, p.192-196). The use of two *keng* as one module, ensures that the set of measurements in each series is consistently odd or even in the number of *keng*. (It is interesting to compare this with the Red and Blue series of Le Corbusier's 'Modular' system). In addition, the modular difference of 0.6 *chi* between the two series serves as another module for smaller dimensions such as level changes in platforms and steps. It is found that all measurements on the scale are even numbers, which correspond to the earth-mother symbolism in the method of 'pressing-white'. The application of the scale in construction is called *zhanggan fa* (丈竿法).

It is curious that the 1.8 *chi* segment (*dang* 檔) on the *zhanggan* is ten times the 1.8 *cun* module on the Lu Ban's scale (Fig 2.4). It is also well known that during construction, craftsmen drew building sections on the wall at the scale of 1:10. If not for mere coincidence, Lu Ban's scale could have been conceived as a scale rule at the outset! The fact that such usage was never noticed could be because it was lost for many generations, a typical fate of rationality (which would be transformed into superstition, for instance) in folk culture.

2.4 Other modules

Another module exists which is related to the human body: the *bu* (步, meaning footsteps) of 4.5 *chi*. It is used in the method called *yangcheng hebu fa* (陽埕合步法) to determine the plan dimensions of external spaces such as courtyards and lanes. This module is five times the *keng* module (5 x 0.9 chi), but the meaning of this 5:1 relationship between the two is unclear. Secondly, in traditional Japanese architecture, the module *inakama ken* measures 6 *shaku* (Japanese feet). Whether a 6 *chi* module was practiced in China still requires further investigation (see the following case study). [12]

3. Case Study[13] : Sam Tung Uk

3.1 Background

After examining the methods and principles of vernacular builders, we now turn to look at an actual example. The village **Sam Tung Uk** (or, *San Dong Wu* 三棟屋) in the Tsuen Wan district of Hong Kong was chosen as a case study for this purpose. The group of buildings were constructed during the Qing dynasty by a Hakka family, surnamed Chan (*Chen* 陳). The Chan clan migrated from the Fujian Province in China.

The Hakka people are characterized by their modest living, clan unity, sense of defense and their emphasis on ancestral worship. All these concepts are reflected in the design of their houses. Sam Tung Uk is a local example of typical Hakka buildings, which can be classified as the type 'three-halls-two-flanks' (三堂兩橫). However, the plans of individual house units adopt Cantonese styles such as the 'three-bays-two-porches' (三間兩廊) and the 'ming-character-house' (明字屋) (陸，魏 1990, p.47, 48, 87). This shows the flexibility and richness in the layout of rural dwellings. Occupying an area of about 2000 m^2, the village gives us an impression of rigorous planning. The plan is strictly symmetrical, with the house units organized in an orderly fashion, and erected in two phases (around 1757 and 1786). The first phase consists of three rows of houses hence the name 'Sam Tung', (meaning 'three blocks' of building) which are integrated with a central spine of communal spaces and an ancestral hall. The second phase is an addition of three more rows of houses, two at the sides and one at the back, forming a protective 'wall'.

It would be interesting to investigate how the designs of the two phases are related (see Section 3.3). Two centuries old, the village had badly deteriorated, but in view of its distinguished architectural qualities it was restored and transformed into a folk museum in 1987.

3.2 Architectural analysis

3.2.1 Plan

When studying the plan dimensions of Sam Tung Uk, the first and key step is the conversion of the unit of measurement to that originally used by the builders. In this paper the scale of the Guangzhou region is assumed, in which 1 *chi* (Chinese foot) equals 283.3 millimetres (Fig 3.1). For simplicity, all plan dimensions are rounded to even numbers. It is observed that both the 'inch-white' and the 'foot-white' methods are applied. The dimensions, which are not 'white' in the foot unit, are adjusted by the inch. [14]

A closer examination of the plan reveals that the depths of the house units are constant, although variations are allowed in the horizontal bay widths. The typical depths for the first and second longitudinal bays (*jin* 進) are 11.4 *chi* and 18.6 *chi* respectively. It is exciting to find that, these two dimensions match exactly those of the *zhanggan*. This is not a conclusive evidence of the application of the *zhanggan* method, but might suggest something in common between the different building traditions, and more importantly, the possible use of modular coordination in design.

Every house unit has two or three transverse bays, which is the auspicious number of bays set out in Lu Ban's Manual. For the variable bay widths, they are probably governed by the relative importance of space, and the number of rows of roof tiles (*keng*) above. The difference in bay widths is sometimes very trivial, showing a painstaking adherence to the concept of ritual hierarchy. The numbers of *keng* are all odd for the houses in the three central rows. This may be explained by the attribution of the roof to the heaven, which is represented by odd numbers. However, even numbers of *keng* are found in the other rows (which were built later in the second phase), probably due to other *fengshui* considerations, or a concern in balancing the *yang* with the *yin*. On the other hand, roof tiles are known to be about 0.85 to 0.9 *chi* width. The widths actually measured are around 250 mm, thus by working backward the assumption on the *chi* unit (being equal to 283.3 mm) can be verified.

3.2.2 Section and elevation

In the study of the section and elevation the controlling vertical dimensions are the heights of the ridge purlins and the eave purlins (the height is measured from the floor level to the upper surface of the purlin). It is found that the longitudinal sections of the houses are typical (Fig 3.2d, e, f). The ridge purlin's height is almost equal to the typical depth of the main hall of a house (i.e. 18.6 *chi*), and the eave purlin's height about three fourths of this. It is discovered that the ridge-line is shifted forward from the center line of the house, giving an asymmetrical roof with different lengths of the sides. This is called the construction of '*yin-yang sides*' (陰陽邊)(Chung, s.4.5), again a *fengshui* consideration. A similar method is described in *Lu Ban's Manual*.

The buildings rise gently as they move from front to back. The last block (the ancestral hall), where the ancestral tablets are kept thus attain the highest level in the village. (It is interesting to observe that the last row of houses in phase two, though built further behind the ancestral hall, is kept from rising above it, reflecting a strict adherence to the Confucian's rite of kinship hierarchy). This is a typical treatment for Hakka dwellings, and suits the *fengshui* ideal of a house, being 'low in the front and high at the back'. This principle also functions well as drainage for the village. Moreover, the difference between successive floor levels is about 1.2 *chi*, which corresponds to two 'small' modules (0.6 *chi*) on the *zhanggan*. Standing near the ancestral tablet in the last hall, one can see a portion of the sky below the eave of the hall and above the ridge of the middle hall (Fig 3.2d). Although less sophisticated, this is the principle used in the Chaozhou method of 'passing-white' (過白) (陸元鼎 1991, p.197). This practice allows daylight into a hall, and symbolically enables the ancestors to communicate with heaven.

The characteristics of the elevation of Sam Tung Uk are simple and defensive (Fig 3.2a, b, c). It is said that no window existed originally on the external walls (龍炳頤 1992, p.25). The proportion of 2:3 can be seen even on its plain elevation. It will be seen later that the relationship of 'two to three' is of great importance in the whole design of the village (see Section 3.4).

3.2.3 Door dimensions and positions

Doors are given particular attention in *fengshui* practice, because functionally and symbolically they are the 'channels' where the house can communicate with the outside world. Auspicious dimensions and positions are chosen in order to bring good luck to the inhabitants. The door in the ancestral hall (Fig 3.3) measures for example, 3.6 *chi* by 7.8 *chi*. These dimensions conform to both the requirements of 'inch-white' (6 and 8 inches being auspicious) and to Lu Ban's scale (lying in the 'yi' 義 segment, which implies filial piety).

The requirements in positioning these doors are also set out in Lu Ban's Manual. A door should be placed at a distance from the eave dripping line after an odd multiples of steps (bu 步), each step being 4.5 *chi* (which is itself an odd multiple of the *keng*, i.e. 5 x 0.9 *chi*). An analysis of the plan shows that all the three doors lie at the "correct" positions (Fig 3.3). It is found that the *bu* module also governs the depth of the courtyards (3 *bu*) and the width of the lanes (1 *bu* and 2 *bu*).

3.3 Hypothesis: the generic plan

In analyzing the proportions of the plan, it was impossible to employ Western methodology, that is, by drawing arcs and diagonals, etc. What we had was a collection of slightly differing dimensions. After a long period of bewildermant we suddenly found that the existing plan could be 'completed' by mirroring the back row about the axis of symmetry of the side rows. In this way, a perfect square was obtained, which also gave rise to 11^0 regulating lines (Fig 3.4b). This was further supported by the possible position of the drying ground (*heping* 禾坪) which could be deduced from the edge of the basketball court on the site map (Fig 3.4a).

Based on this 'discovery', and a more detailed examination of the plan, the hypothesis of a 'generic' planning square grid of 6 *chi* is put forward. (This is reminiscent of the 'auspicious' number '6', and it is of particular interest to also note that the Japanese *inaka-ma ken* is based on a module of 6 feet). H. Engel (1985 p.22) also noted the multi-divisibility of the number 6 by 2, 3, and 4. A generic plan is then drawn on this grid, which conveniently resembles the actual plan (Fig 3.4c).

If this hypothesis is correct, we can deduce that the process of making plans was as follows:

1. laying out the generic plan, but keeping in mind a planning grid of 6 feet;
2. adjustment of bay widths according to spatial hierarchy;
3. fine tuning these measurements according to the roof tile module and/or other modules;
4. final determination of dimensions according to the method of 'pressing-white'.

Also, it is very likely that the two phases of Sam Tung Uk were conceived together.

3.4 The 'Chinese proportion' of 'two to three'

'The intrinsic geometry underlying all material things is the basis for geomantic architecture,....' (Pennick 1979, p9) The proportion of 'two to three' is a favourite in Chinese architecture. This is an old tradition in philosophy and practice, evident in literature such as the *Yi Jing* (易經), the *Tao De Jing* (道德經) and the *Kaogong Ji* (考工記) (陸元鼎1991, p.195).

Symbolically, 'two' is the first even, and 'three' the first odd. One is *yin* and one is *yang*. Functionally, a beam with a 2:3 section is efficient. Aesthetically, a 2:3 rectangle is pleasing. And it is practical or makes sound sense to use integers in construction. All these demonstrate the beauty in the simple ratio of 'two to three'.

In Sam Tung Uk, the play of 'two to three' is found everywhere (Fig 3.5a, b, c). The architectural styles follow this principle: there are 3-halls-and-2-flanks (三堂兩橫), 3-bays-and-2-porches (三間兩廊). In every large house unit there are 3 transverse bays and 2 longitudinal bays (三間，二進). And the generic proportions in the previously described generic plan are also 2:3. Here we see another link between the great and the little traditions.

Curiously, in addition to the proportion 2:3, approximate proportions of the $\sqrt{2}$ (square root of two) and ø (golden section) are also noticed in the plan (Fig 3.5d). Traditional Chinese architecture does employ the ratio $\sqrt{2}$, but never use ø, consciously. (Actually the Chinese exhibit no knowledge of ø in their early mathematical history: it is a 'western' proportion). This phenomenon might be explained by the 'transformations' of the 2:3 rectangle. The numerical values for the three ratios $\sqrt{2}$, 2/3, ø, are respectively 1.414..., 1.5, 1.618... . Thus when the longer side of the 2:3 rectangle is kept constant, a small addition or subtraction in the shorter side would yield rectangles with approximate proportions of $\sqrt{2}$ or ø. Another interesting fact is that 2 and 3 are terms in the Fibonacci series (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...) which generates the ratio ø. (Another coincidence is that the numbers in the approximate value of ø, 1.618, are all auspicious).

Besides Sam Tung Uk, there are other local examples of traditional dwellings which display the same careful consideration of design proportion. One of them is another Hakka dwelling, Pun Uk in Yuen Long, in which the proportion $\sqrt{2}$ prevails. Detailed studies of all these buildings are much needed in order to obtain a fuller picture of the principles of proportion in vernacular Chinese architecture.

4. Conclusion

In this paper, we have examined both the methodological tools and the end products of vernacular builders. Though obscured by pragmatism and superstition, it can be seen that Chinese vernacular architecture does in fact possess beauty. The beauty of vernacular architecture stems from the wisdom of day to day life, sound common sense, and a continuous perfecting of the traditional architectural forms over many generations. It is a kind of beauty without words: simple and natural. Here we can see the very ideals common to Chinese people, namely harmony (between nature and people) and humanism (or secularism); both of which underlines the Chinese concept of beauty. We took an analytical approach in studying vernacular Chinese architecture (emphasizing the practical aspects of building), which proved to be fruitful.

We should remain aware, however, that the division between imperial and vernacular architecture is artificial. The built-forms of the great and the little traditions were, at least for the Han race, homogeneous. The palace looks like an elaborate house, the house a simplified palace. Both were guided by the same philosophies, both bound by similar, deliberate rules or codes. The relationship between the monumental and the vernacular is thus one of transition, not opposition. But due to a more earth-bound nature, the vernacular side shows more flexibility and liveliness, as evidenced from the multifarious transformation and adaptation of the house forms in different geographic and climatic situations. The importance of the vernacular traditions in Chinese architecture lies in the fact that the former was a nutrient contributing to the growth of the latter.

In addition to their functions, folk-crafts usually display rich attributed meanings. *Yin-yang* duality and numerology (symbolism of numbers), the two dominant concepts in Chinese philosophy and cosmology (Fig 4) (Berglund 1990), are found to be perfectly manifested even in the design of ordinary folk dwellings. These meanings are shared by everybody in a traditional community. Perhaps this is something we miss today in a multivalent society chasing after our 'modern' life. Finally, we notice that vernacular heritage is a vulnerable one, one which could pass away easily together with the generations that once cradled it, especially in a world of rapid modernization. So if one can see the meanings and inherited values; and if one can believe in the lessons of history; it is a logical act to secure this heritage and learn from it.

[1] 李允鈺, pp.58. In China, the craftsmen of imperial buildings were actually artisans. Their basic skills and techniques in ordinary buildings were developed into high imperial standards.

[2] Chinese measurements work on a decimal system: one *zhang* (丈) equals ten *chi* (Chinese foot 尺) , one *chi* ten *cun* (Chinese inch 寸), one *cun* ten *fen* (分).

[3] It is a rare documentation of the folk building traditions. The inclusion of the *qu chi* and *Lu Ban chi* in the manual shows that the two scales are well-known to the folk craftsmen.

[4] 程建軍, p.259. The length of the longer leg may be up to 2 *chi* in some regions, i.e. in the ratio of 1:2.

[5] 丁伯齡, p.127. Here two different sizes of the square-rule used in Beijing are cited: 5 *cun* x 7 *cun*, and 7 *cun* x 10 *cun*, nevertheless, both conform to the ration of $\sqrt{2}$

[6] 程建軍, p.259. But since the foot-rules were handed down from master to apprentice, the value would be fairly constant within a region. In this paper the value for Guangzhou (1*chi*=283.3mm) is employed in the case study.

[7] Here the word 'white' means the 'white stars' or lucky stars (*baixing* 白星). This is a kind of fengshui practice in determining the final dimensions of the house, and is explicitly stated in the *Lu Ban Jing*.

[8] ibid., p.80. The Japanese version of Lu Ban's scale (called *sashigane*) is described as a real $\sqrt{2}$ scale having a direct practical use. It is divided into ten inches and is used to determine the maximum size of timber which may be cut from a log (Ruitenbeek 1993, p80).

[9] The *feibai chi* is basically the same as the *quchi*, which is 1 *chi* long and divided into ten inches, but without the added long log.

[10] See footnote 4.

[11] 程建軍, p.263. In this construction manual of the Qing dynasty, 124 sets of favourable door dimensions which agree with both the 'door scale' and the method of 'pressing white' are specified.

[12] 姚承祖, p.19. A supporting fact is the existence of a '6-feet yardstick' (*liuchigan* 六尺杆)

[13] For other case studies, see Lung 1991, p.74 and Ng Chak Kin's unpublished report on the study of Pun Uk.(Pan Uk)

[14] This principle is also commonly applied to dwelpulings in Chaozhou. 陸元鼎, p.190.

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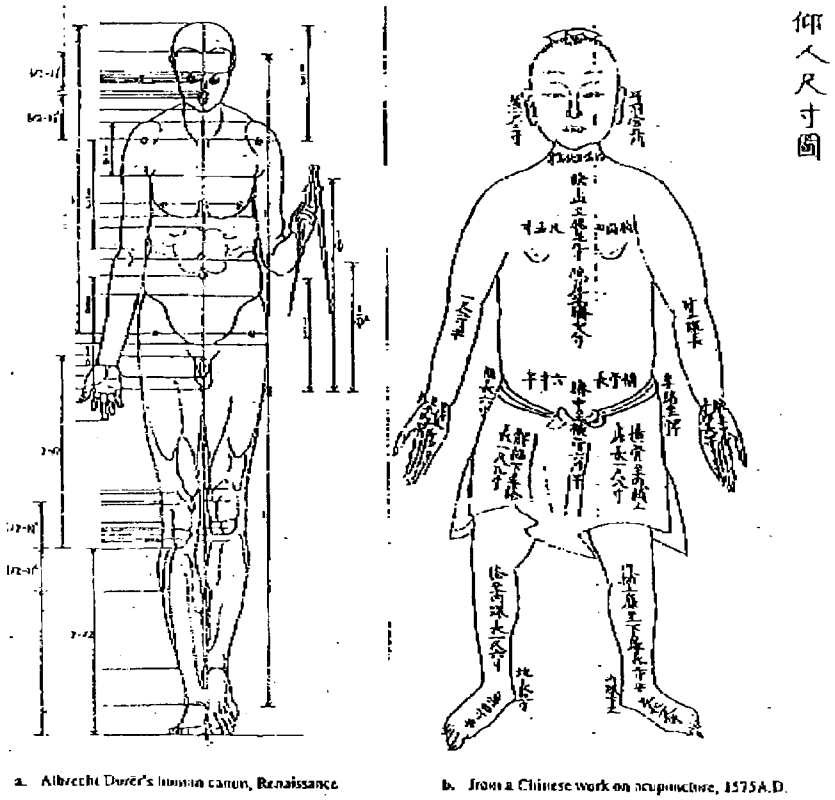

a. Albrecht Dürer's human canon, Renaissance　　b. From a Chinese work on acupuncture, 1575A.D.

Fig. 1　The human bidy as seen from Western and Eastern points of view

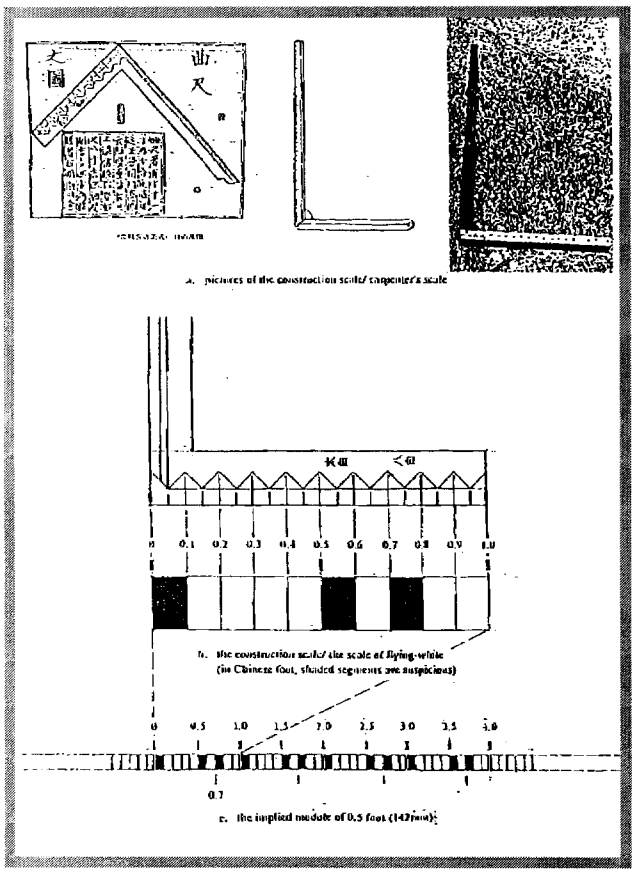

Fig. 2.1 The method of pressing white

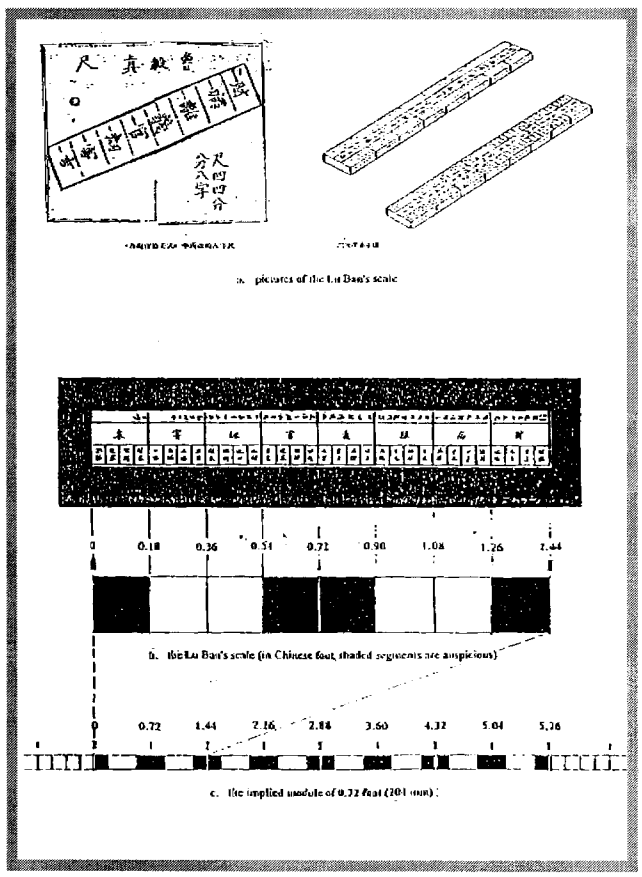

Fig. 2.2 The Lu Ban's scale method

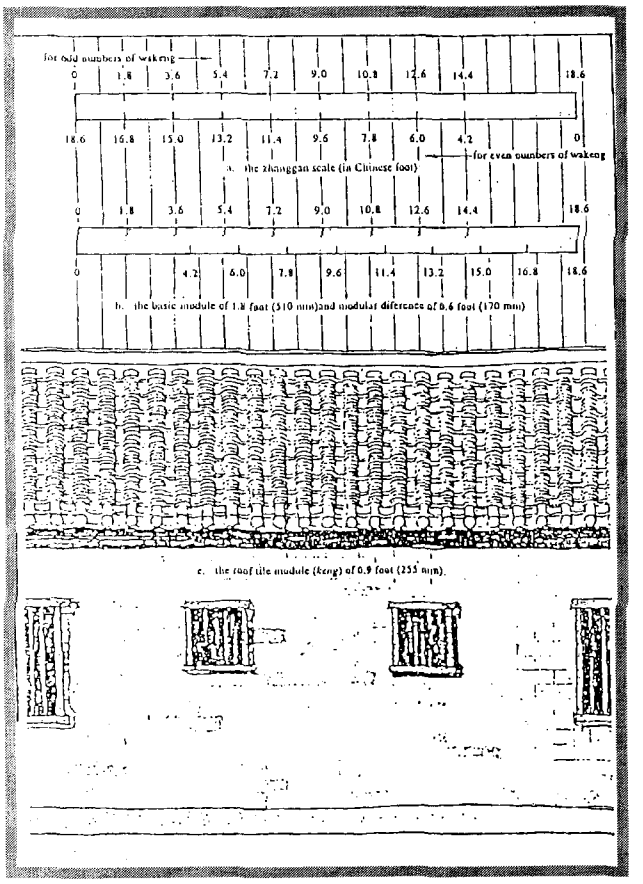

Fig. 2.3 The zhanggan

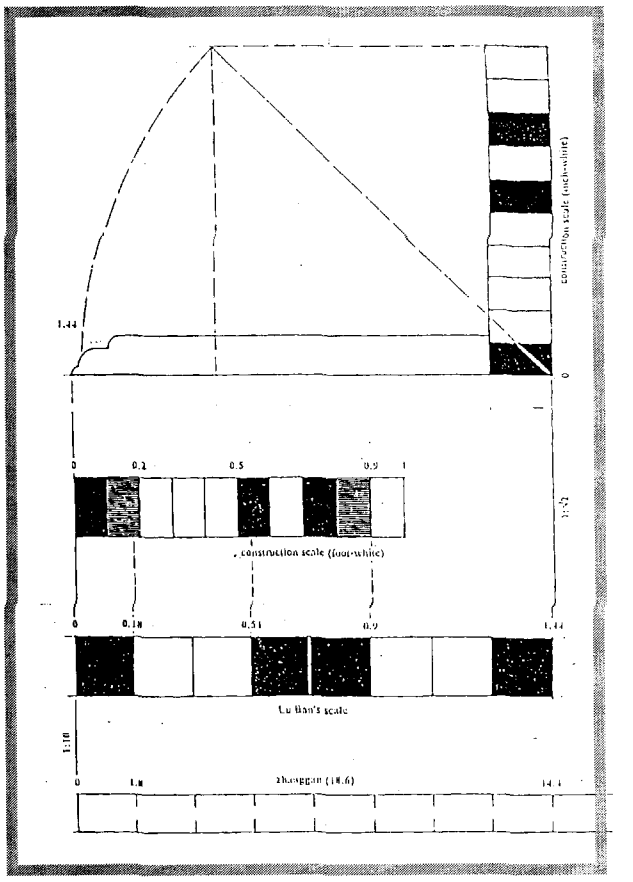

Fig. 2.4 relationships between the three scales

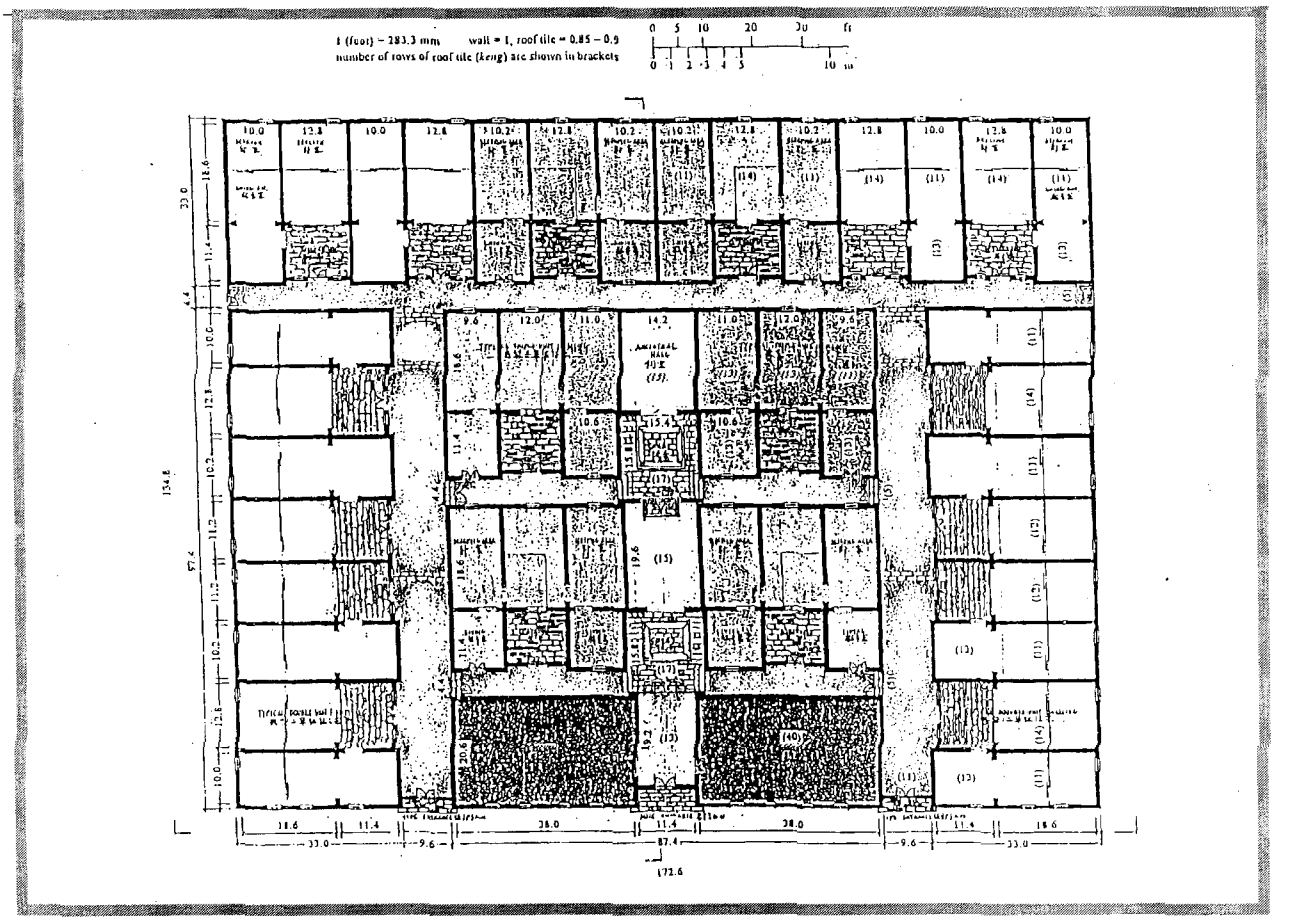

Fig. 3.1 Analysis: plan dimensions (in Chinese foot)

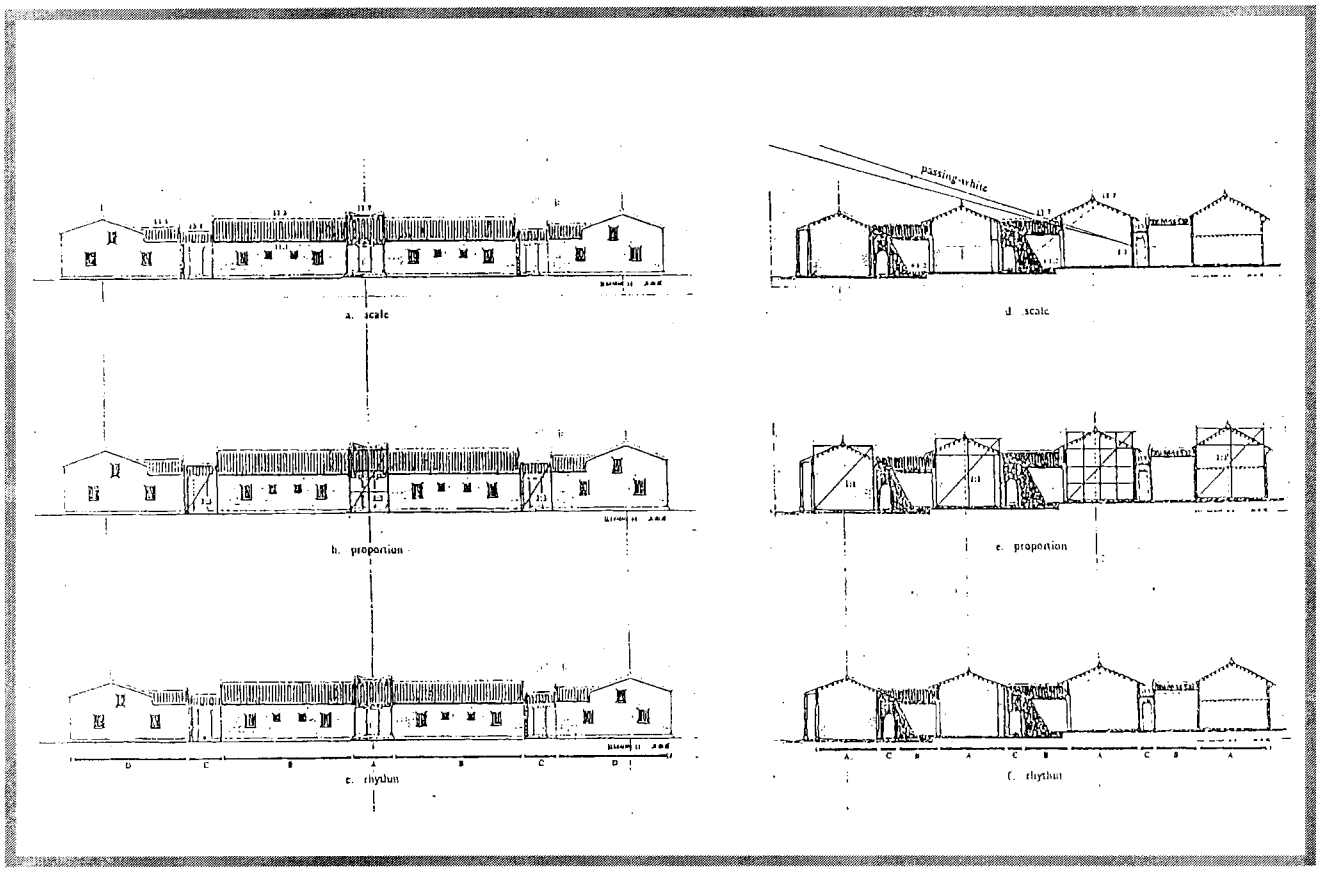

Fig. 3.2 Analysis: section and elevation

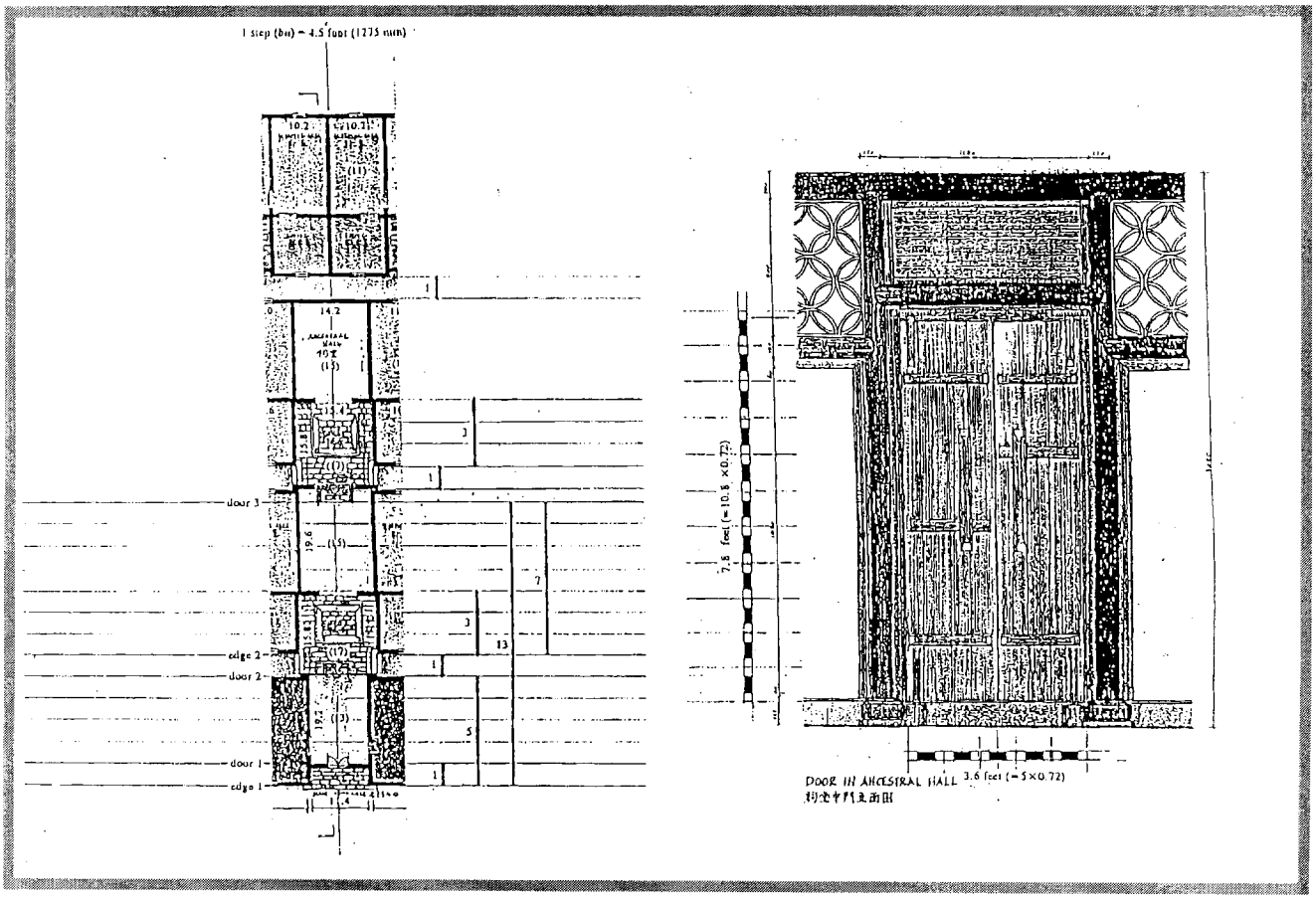

Fig. 3.3 Analysis: door positions and dimensions

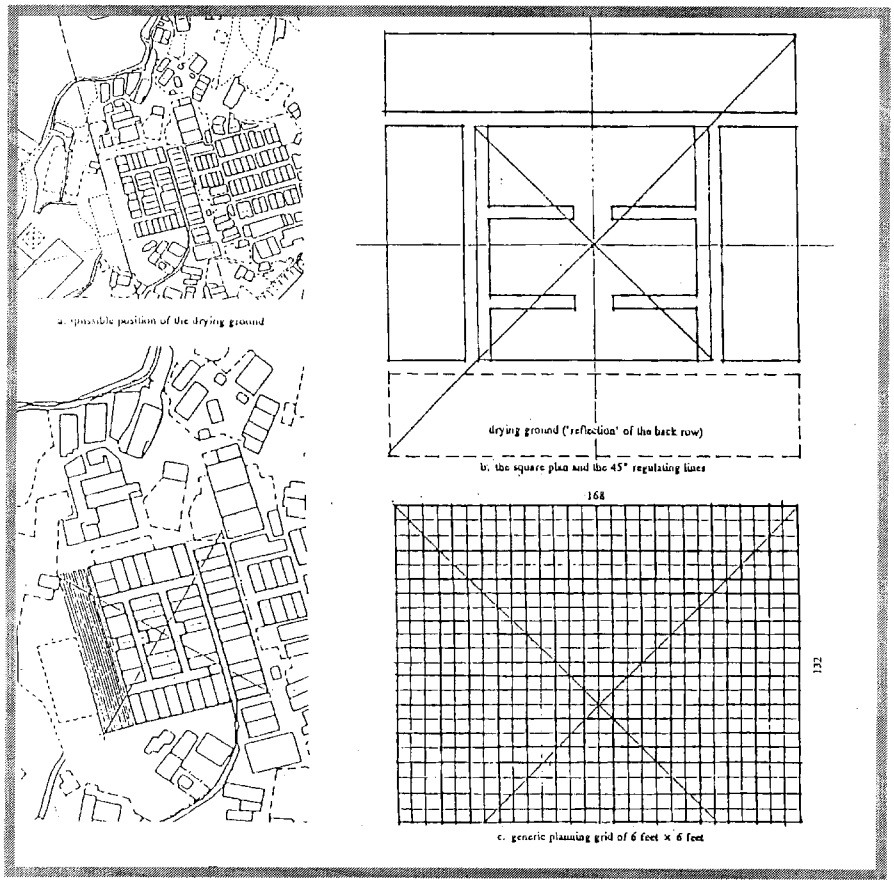

Fig. 3.4Hypothesis

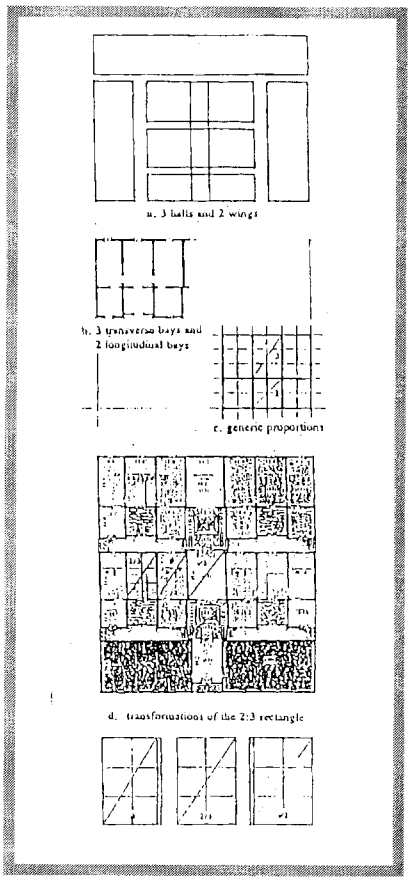

Fig. 3.5The play of "two to three"

太极图合河图

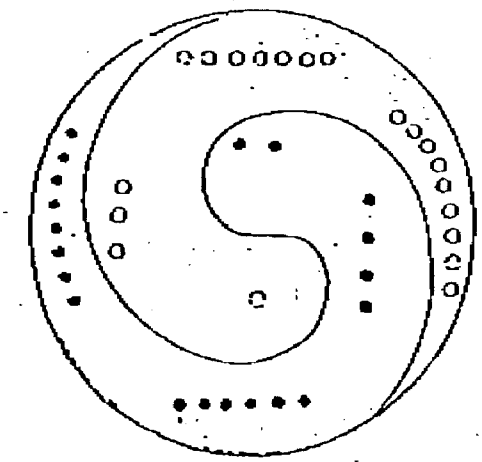

Fig. 4 The combined River Diagram (Taijitu) and Diagram of Supreme Ultimate (Hetu)

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