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The fortunate dimensions of Taiwanese traditional architecture

S-C Chiou, R Krishnamurti
Department of Architecture, Carnegie Mellon University, Pittsburgh, PA 15213, USA
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Abstract. Taiwanese traditional architecture has been classified as belonging to the Southern style of Chinese architecture. Owing to geographical and climatic conditions, and to its own history, Taiwanese architecture has diversified from mainstream Chinese architecture. This diversification has given rise to styles of buildings that were (and are) quite distinct from their Chinese origin. The authors begin with a comparison of Taiwanese and Chinese traditional architectures highlighting their differences. The authors go on to describe the different systems used for measuring key dimensions in Taiwanese traditional buildings, and the procedure for their determination.

Introduction

Taiwanese traditional architecture refers to a style of buildings constructed by the *Hàn*[1] people,[2] in the traditional style, on the island of Taiwan (Formosa) in the Republic of China. Generally these buildings were constructed before 1920.[3] We are interested in vernacular houses, though many of the issues we consider in this paper also apply to the other building types, for example, temples, public buildings, and so on. The vernacular style is characterized, in plan, by an enclosure courtyard; and as a whole, by wood construction.[4] It is interesting to note that much the same principles of traditional wood construction are still being followed in Taiwan with other building materials.

Taiwanese architecture is a branch of Chinese architecture,[5] though there are marked peculiarities. In one sense, these can be distinguished by a special construction and design system that has its origins in the immigrant roots of Taiwanese architecture. Nearly all traditional Chinese (and Taiwanese) buildings were bilaterally symmetric. The axis of symmetry was located along the central line of the main hall (*tīng* or *táng*), considered the sacred (or holiest) of family spaces. For this reason, all of the main spaces (rooms) in the building lie on the axis of symmetry; other secondary spaces were located to the left or right of this axis. One of the doctrines of Chinese philosophy is the doctrine of the mean (*zhōng-yōng*). The Chinese character *zhōng* means balance, center, middle, and symmetry. This doctrine of balance was not only a philosophy of life, but also a philosophy for architecture.

(1) The phonetic spellings for Chinese words in the paper are from *Learner's Chinese–English Dictionary* (8th edition) and correspond to the Pinyin system.

(2) The Chinese nation is made up of over fifty different nationalities such as the *Hàn*, *Mǎn*, *Méng* (Mongol), *Huí*, and *Zàng* (Tibetan). Chinese culture, with the *Hàn* culture at its core, was created and enriched by all the nationalities working in concert. Political unity and the manifold bonds among the nationalities constituted a favorable condition for the continuity of classical Chinese architecture. See Wong and Chung (1986).

(3) Japan pursued the movement of modernization in Taiwan in the 1920s.

(4) Traditional building materials also included bamboo, earth, stone, and brick. Of these, wood construction was the most prevalent.

(5) The late Chinese architectural historian, Professor Ssu-ch'eng Liang (1901–72), has characterized Chinese architecture compositionally as having three main parts: the raised platform, body, and roof (Liang, 1984).

The spaces in a building were arranged in a particular fashion. The axis of symmetry always bisected the main central hall. All of the other spaces were developed through this central hall. Starting with the *táng-wū* (also referred to as *tīng-táng*; in Taiwan, it is called *zhèng-shēn* or *cùo-shēn*) which includes the hall, two *xiāng-fáng*'s (in Taiwan, it is called *hù-lóng* or *shēn-shǒu*) were generated. An example of *zhèng-shēn* is shown in figure 1. The two *xiāng-fáng*'s were the basic elements of the *hé-yuàn*, the enclosure-courtyard. The *hé-yuàn* was basic to most Chinese (and Taiwanese) traditional architecture; the spaces bordering the enclosure had openings facing the courtyard. The number of spaces in a *táng-wū* ranged from one through nine, and never exceeded eleven; typically, it was seven; nine and eleven were reserved for the imperial palace. Each space in a typical *táng-wū* had a unique name: *míng* (light), *cì* (secondary), *shāo* (tip or end), and *jìn* (finished). See figure 2. This concept is universal to Chinese architecture though the terminology was not, for instance, artisans in Taiwan did not use this terminology.

The ancestors of most present-day Taiwanese came to the island between a hundred and three hundred years ago, mainly, from the provinces of Fukien (*Fú-jiàn*) and Kwangtung (*Guǎng-dōng*), two provinces in the southeastern part of mainland China. See figure 3. The immigrants to this 'new world' formed neighborhoods fashioned according to the mores of their own hometown (on the mainland).

Figure 1. *Zhèng-shēn* (*táng-wū*) and *hù-lóng* (*xiāng-fáng*): *Huáng* family residence, *Shēn-kēng*, Taipei (after Lin, 1990, page 24).

jīn (finished)	*shāo* (tip or end)	*cì* (secondary)	*míng* (light)	*cì* (secondary)	*shāo* (tip or end)	*jīn* finished

Figure 2. Terminology for a typical *táng-wū* (*zhèng-shēn*).

They preserved their religion, customs, languages, and architectural styles in their new neighborhood. Initially, there were three main ethnic immigrant groups in Taiwan.(6) Prior to 1895, when after Japanese occupation Taiwan was made a colony of Japan, these groups had engaged in intergroup rivalry and conflict.(7)

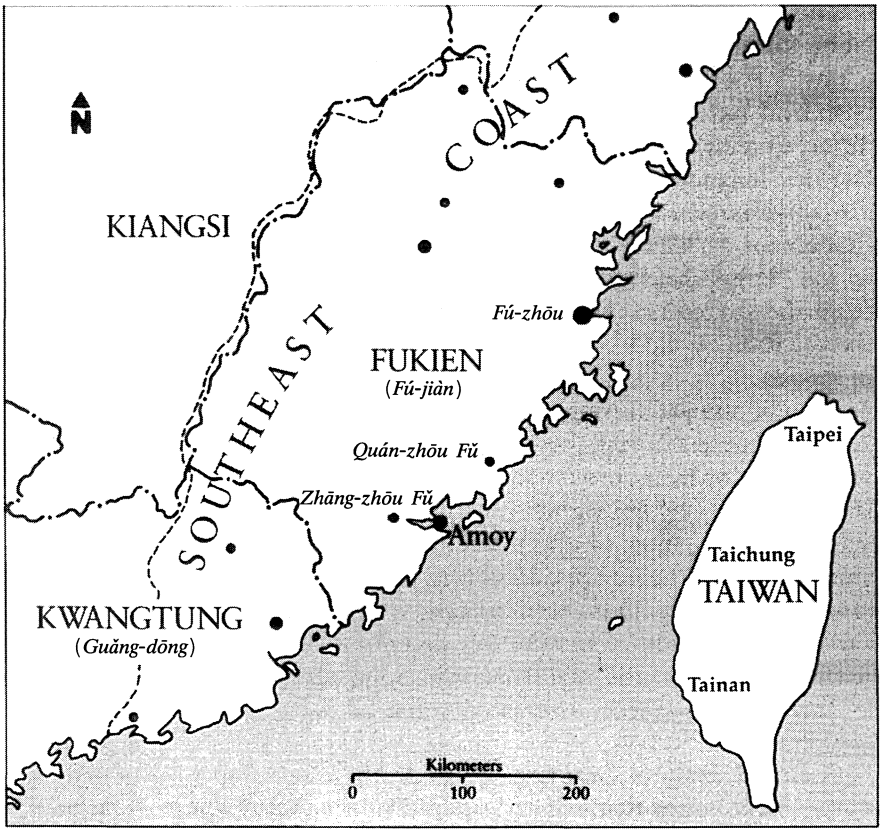


Figure 3. Southeast coast of China and Taiwan, about 1800 (after Sangren, 1987, page 27).

(6) The three groups are *Quán-zhōu*, *Zhāng-zhōu*, and *Kè-jiā*. *Quán-zhōu* and *Zhāng-zhōu* are also referred to as *Mǐn-nán* because they came from the southern part of Fukien. *Mǐn* is another name for Fukien; *nán* is south in Mandarin pronunciation. *Kè-jiā* has two special meanings. In Chinese, *Kè-jiā* refers to the region in the Western part of Fukien and the Northern part of Kwangtung. In Taiwanese, *Kè-jiā* also means guests. Because the (people of) *Mǐn-nán* migrated to Taiwan earlier than the (people of) *Kè-jiā*, the former referred to these latter 'new' immigrants as guests. Most *Kè-jiā* came from Kwangtung, though some of them came from the mountains of Fukien. In fact, in China, the people from this area are still called *Kè-jiā*.

(7) The groups clashed with each other for many reasons, for example, land, water, business, and so on. In the main, the *Mǐn-nán* fought the *Kè-jiā*; the *Quán-zhōu* fought the *Zhāng-zhōu*. On occasions, the *Mǐn-nán* and *Kè-jiā* grouped together against the aboriginal (the *Gāo-shāo-zú* who lived in the mountains except Yami, and the *Píng-pǔ-zú* who lived in the valleys). The chief reason for these intergroup conflicts appears to have been for social and economic advantages in their new world. In Taiwan, there is a saying that describes this early period of Taiwan history: "Three years makes a small rebellion, and five years makes a great rebellion." This observation is key to an understanding of the diversification of Taiwanese architecture.

People built homes; the wealthy engaged famous artisans[8] to build theirs so that they could pride themselves on a great house, and thereby become leaders in their neighborhoods.

Owing, chiefly, to geographical and climatic conditions and its own history, Taiwanese architecture diversified from mainstream Chinese architecture. Chinese architecture is typified by the Northern style whereas Taiwanese architecture belongs entirely to the Southern style.[9] The typical characteristic of the Northern style is that the edges of eaves are linear. Moreover, the roof in the Northern style is much heavier with the shade on the elevation deeper and darker. On the other hand, the Southern style is much lighter and the edges of eaves are typically curved. The two styles are illustrated in figures 4 and 5.

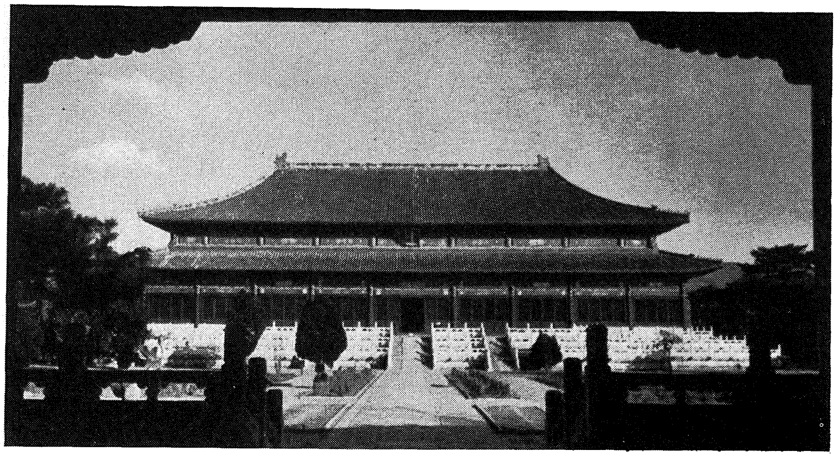


Figure 4. The Northern Style: *Léng-ēn Diàn*, Beijing (after Boyd, 1962, plate 95).

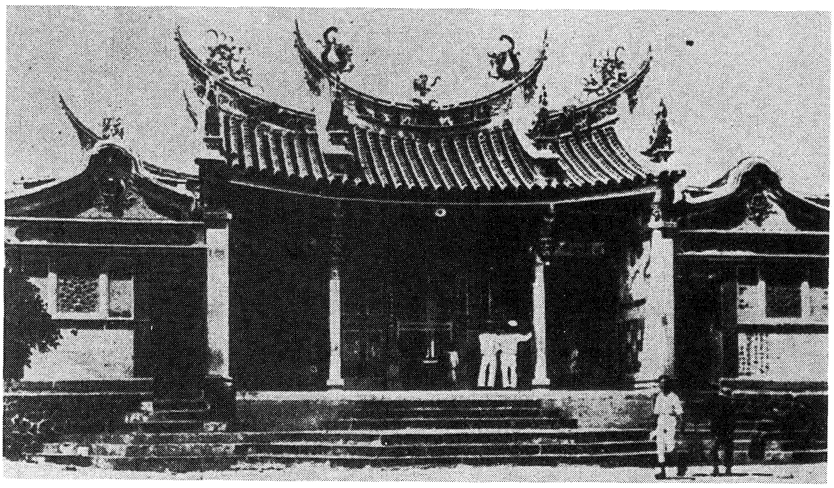


Figure 5. The Southern Style: *Tiān-hòu Gōng*, *Péng-hú*, Taiwan (after Li, 1980, page 74).

[8] Typically, highly skilled carpenters and masons generally from the same hometown as the owner.

[9] We use the words *táng-wū* or *xiāng-fáng* to refer to the main and secondary buildings in the Northern style Chinese architecture; in the Southern style or Taiwanese architecture, these buildings are referred to as *zhèng-shēn* or *hù-lóng*.

Chinese and Taiwanese architectures were both constructed around a *hé-yuàn*, an enclosure-courtyard. In the Chinese Northern style this courtyard is *sì-hé-yuàn* (figure 6), whereas in the Taiwanese Southern style it is *sān-hé-yuàn* (figure 7).[10]

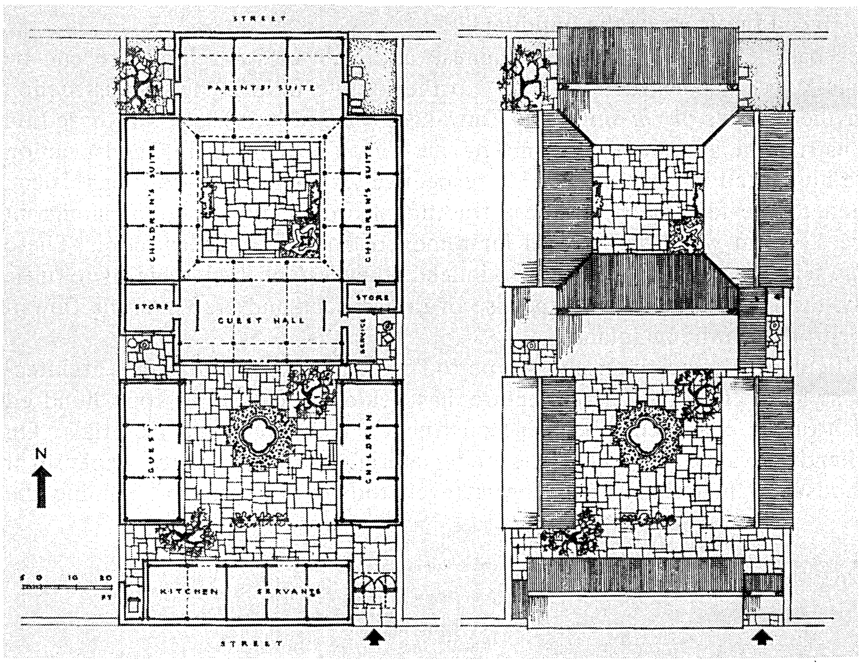


Figure 6. *Sì-hé-yuàn*: plan and roof plan of a typical Beijing house (after Boyd, 1962, pages 80–81).

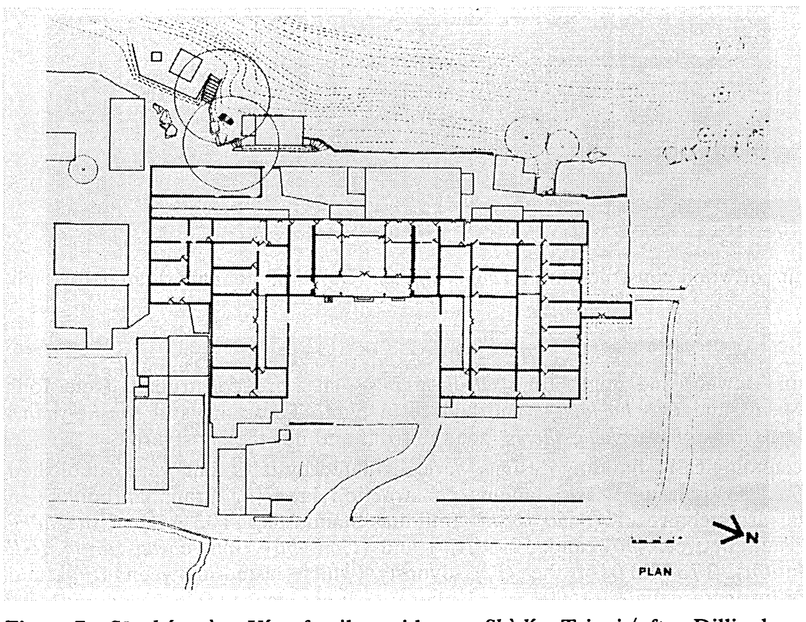


Figure 7. *Sān-hé-yuàn*: *Yáng* family residence, *Shì-lín*, Taipei (after Dillingham and Dillingham, 1985, page 31).

(10) *Sì* is four in English, and *sān* is three.

A *sì-hé-yuàn* comprises four units, two *táng-wū*'s and two *xiāng-fáng*'s, and in plan is a square form. Every (main) opening of a *sì-hé-yuàn* faces the courtyard. A *sān-hé-yuàn* comprises three units, a *zhèng-shēn* (*táng-wū*) and two *hù-lóng*'s (*xiāng-fáng*'s), and in plan is an inverted U-shape. The main openings of a *zhèng-shēn* always faced the front of the building.[11]

Another basic difference between Chinese and Taiwanese architecture can be found in the rules of construction. The Northern style follows rigid construction rules under the dictates of *zhì-shì*;[12] the Taiwanese (or Southern) style was based on a freer construction system not bound by *zhì-shì*. The contrasting construction systems are illustrated in figures 8 and 9, respectively. One explanation for this can be attributed to the fact that Taiwanese traditional architecture was an immigrant architecture. Taiwan was a new world far removed from the political core. There were no laws for immigrants to follow; indeed, they established their own rules. Importantly, the level of technical expertise of the artisans and craftsmen in Taiwan was inferior to that in the mainland.

It is difficult to define precisely the period for Taiwanese traditional architecture. The style of Taiwanese architecture has seldom changed in four hundred years. Much of the change has been in construction techniques and materials. On the other hand, advances in techniques and materials were not at the expense of older methods and materials; both coexist even today. One way of defining the

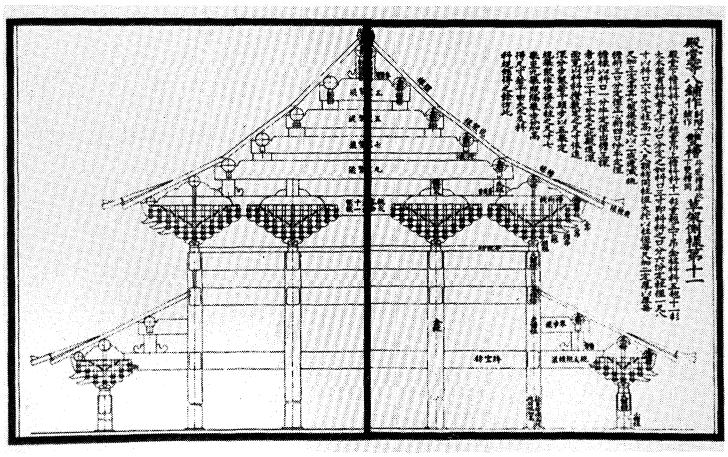


Figure 8. A diagram of wood construction in *Yíng-zào fǎ-shì* (Building Standards) (after Bussagli, 1989, page 83).

[11] Occasionally, in Taiwan, one might find *sān-hé-yuàn*'s that were constructed from four units, two *zhèng-shēn*'s and two *hù-lóng*'s, and square in plan. These are still *sān-hé-yuàn*'s because the main openings of the *zhèng-shēn*'s face the front and not the courtyard.

[12] Socially and technologically, building designs were regulated by laws that were established by the various Chinese dynasties. Two famous construction laws (or 'grammar books') in Chinese traditional architecture, *Yíng-zào fǎ-shì* (Building Standards, 1103 AD) of the *Sòng* dynasty (which lasted between 960 and 1279 AD) and [*Gōng-bù*] *Gōng-chéng zùo-fǎ zé-lì* (Structural Regulations, 1734 AD) of the *Qīng* dynasty (which lasted between 1644 and 1911 AD), specify intricate details for the raised platform, body, eaves (*Dǔo-gǒng*), and roof of a building (Liang, 1984, pages 14–21). (*Gōng-bù* was the government department that administered engineering and construction projects, especially at the Imperial Palace.) Most Chinese traditionally based architecture was built according to the laws of the *Qīng* dynasty. *Zhì-shì* (or *fǎ-shì*, 'regulation style'), in general, refers to these two grammar books.

period for Taiwanese traditional architecture is by historic time periods. Prior to 1662, Taiwan was occupied in the south by Holland and in the north by Spain. Chinese culture formally dominated Taiwan after *Zhèng, Chéng-gōng*, a general of the *Míng* dynasty (1368-1644), fought the Dutch in 1662. That event was the start of the migration from Fukien. In 1683, the *Qīng* dynasty took over Taiwan and established Taiwan-*Fǔ*, governed from Fukien. In 1885, Taiwan became a province. In 1895, Japan defeated the *Qīng* dynasty and made Taiwan a colony. The decade of the 1910s witnessed the period of greatest change in Taiwanese traditional architecture with the urbanization of Taiwan. After 1945 modern architecture took over in Taiwan. Few buildings—apart from temples—have since been built in the traditional style.

Among the factors that shaped the design of the Taiwanese traditional dwelling were four key determinants which we have termed the *fortunate numbers*. The focus of the remainder of this paper is the procedure for the determination of the fortunate dimensions.

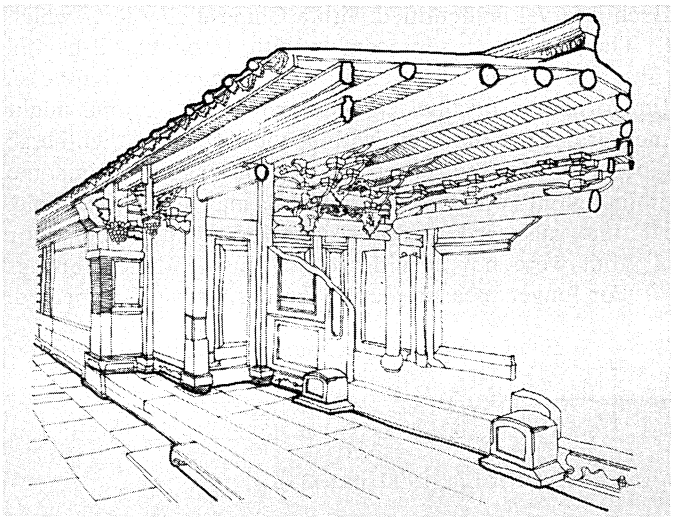


Figure 9. A construction diagram in Taiwanese traditional architecture (after Lin, 1990, page 60).

Rulers

It was important, in the design of traditional vernacular buildings, to employ 'good' dimensions (or measurements).[13] Equally important were the instruments or rulers that were used to measure off these dimensions. In Taiwanese traditional architecture, there were at least five kinds of rulers (or measuring systems) used in design and construction: the *Lu Ban* ruler and (the newer) opening and worship rulers, stride and step measures.

[13] The Chinese words for 'scale' and 'dimension' are the same, namely, *chǐ-cùn* or *chǐ-dù*. Physical dimensions employed in Taiwanese traditional architecture are sometimes referred to in the literature as scales. These are not scales in the sense that they correspond to measurements determined by a proportional system; but are instead simply absolute numbers that have particular associations with states of fortune. The choice of the ruler, and hence the particular association of a state of fortune for a given dimension, is determined by the design context where the dimension is required.

Lu Ban ruler

The *Lu Ban* ruler (*Lŭ-bān chĭ*) was the first general ruler for artisans. *Lu Ban* was said to be the first carpenter in China, and he invented the ruler that bears his name. A *Lu Ban* ruler has two units, nominally, 'feet' and 'inches'. Each *Lu Ban* foot is divided into 10 *Lu Ban* inches. In the metric system, a *Lu Ban* foot measures 29.69 cm. The *Lu Ban* ruler is also referred to as the Artisan's or Carpenter's ruler. The units or intervals of the other ruler systems employed in Taiwanese traditional architecture are all measured in *Lu Ban* units. For convenience we use the symbols $'$ and $''$ to denote *Lu Ban* feet and inches, respectively. For example, the measurement $1'4.4''$ represents a distance equal to 1 *Lu Ban* foot and 4.4 Lu Ban inches.

Opening ruler[14]

The opening ruler (*Mén-guāng chĭ*[15]) is used for measuring houses, especially openings and furniture. Figure 10 shows an opening ruler.[16] The basic scale for an opening ruler equals $1'4.4''$ in length, measuring a total of 42.76 cm, and is divided into eight equal intervals. Each interval is identified with a Chinese character which signifies a state of fortune. The characters represent 'wealth' (money), 'ill-health' (sickness), 'separation' (to live apart from one's family or community), 'rightness', 'officer', 'robbery', 'harm' (misfortune), and 'luck' (good fortune).[17] As one might expect, any dimensional measurements that fell within the 'wealth', 'rightness', 'officer', and 'luck' intervals bode well for the owner and his house; though, in some cases, dimensions that fall within 'rightness' and 'officer' intervals may not: for example, measurements within 'officer' intervals used as dimensions for the bedroom door were considered fortunate,[18] but were not considered so for the dimensions of the entrance to the house.[19] For longer measurements, the basic scale is repeated.

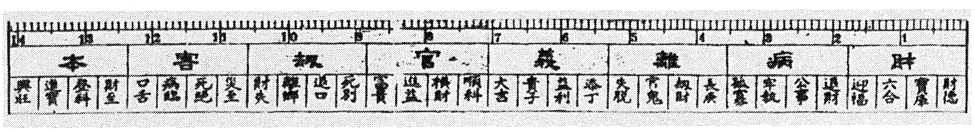


Figure 10. Opening ruler (*Mén-guāng chĭ*) (after Lin, 1990, page 34).

(14) Also known as the 'fortunate ruler for *yáng*'. In Chinese philosophy, *yīn* and *yáng* are the two opposing principles in nature; the former means feminine and negative, and the latter means masculine and positive. Thus, a 'building for *yáng*' is a habitat for the living. Monuments, mausoleums, tombs, and funeral homes are 'buildings for *yīn*' (or for the dead) and employ a different ruler system altogether.

(15) It is also known as *Mén-gōng chĭ* or *Wén-gōng chĭ*. Literally, *mén-gōng* is translated as 'god of doors'; it implies the ruler was given by the god of doors to bring good fortune. We prefer the term *mén-guāng chĭ* which means to 'make light'. It should be noted that to allow light through doors is to honour one's ancestors or family. In fact, *mén-guāng* and *mén-gōng* have almost the same Taiwanese (Hokkien) pronunciation. [The ancient Chinese (*Hàn* language) pronunciation is preserved much more in Taiwanese than in Mandarin.]

(16) This ruler has to be read from right to left because the right-most character signifies 'wealth', which is the first character on the scale. See footnote (17).

(17) The eight characters are *cái*, *bìng*, *lí*, *yì*, *guān*, *jié*, *hài*, and *běn*. Most of these characters translate into words that need no further explanation. The Chinese word *guān* translates to officer; but, it embraces bureaucrats, civil servants, military officers, and, in general, individuals who had influence and were empowered to govern. In feudal times, people aspired to become 'officers'.

(18) In this case, it implies that the artisan wishes that a boy, who will rise to be an official of the government, will be born in this house.

(19) If entrances were designed according to 'officer' units, it implied that accusations would be brought forward against members of the household.

The opening ruler is still in use today for dimensioning doors, windows, tables, etc. Architects still use the fortunate ruler to decide upon dimensions for modern Taiwanese buildings.

Worship ruler [20]

The worship ruler (*Dīng-lán chǐ*[21]) was used for tombs and buildings associated with the dead. Figure 11 illustrates a worship ruler.[22] Though this ruler was not used for dimensioning houses, certain parts of the house might be designed according to the interval scales of a worship ruler, for instance, the table of worship. The basic scale of the worship ruler measures 1′2.8″ in length totalling 38.01 cm. The scale is divided into ten equal intervals, each associated with a Chinese character, namely, ‘wealth’, ‘loss’, ‘prosperity’, ‘death’, ‘officer’, ‘rightness’, ‘suffering’, ‘vigor’, ‘harm’, and birth’.[23] It is evident that dimensions selected in ‘wealth’, ‘prosperity’, ‘officer’, ‘rightness’, ‘vigor’, and ‘birth’ intervals were considered fortunate. As with the opening ruler, larger dimensions are obtained by additive repetitions of the basic scale.

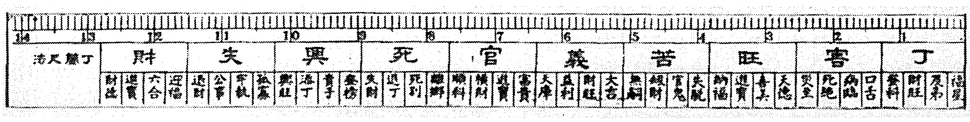


Figure 11. Worship ruler (*Dīng-lán chǐ*) (after Lin, 1990, page 34).

Stride measure

Stride measures (*bù-fǎ*) were used in determining larger scales in a house, for example, the open space (courtyard) and semi-open space (porch). Stride measures are based on the length of a stride, which equals 4′5″ (or 1.336 m). Generally, dimensions measured in odd numbers of strides—namely, 1, 3, 5, 7, and 11—were considered good. Another reason for the popularity of odd stride measures is that odd is *yáng*. In fact, each stride measure has a distinct meaning in Chinese geomancy.[24]

Step measure

Step measures (*tà-fǎ*) were used for determining heights of platforms.[25] The step measure is based on the concept of stairs. A step measure equals 3.5″ (or 10.4 cm). Six steps form a cycle, and each step has its own meaning. The first step signifies

[20] Also referred to as the ‘fortunate ruler for *yīn*’. See footnote (14).
[21] *Dīng-lán chǐ* is said to bear the name of *Dīng, Lán* who was a famous dutiful son in the*Hàn* dynasty (206 BC-220 AD). His story, *kē-mù-shì-qīn*, is described in ‘the twenty-four stories of Chinese dutifulness’, *èr-shí-sì-xiào*. It is one of worship. *Dīng, Lán* lost his parents when he was little. He made statues of his parents and worshipped them as though they were alive. He protected this memory even at the cost of his own marriage. To use this ruler is to invoke the memory of *Dīng, Lán* and the strength of his worship.
[22] The left-most is the first character, ‘richness’.
[23] The ten characters are *cái*, *shī*, *xìng*, *sǐ*, *guān*, *yì*, *kǔ*, *wàng*, *hài*, and *dīng*. See footnote (17).
[24] Chinese geomancy (*fēng-shuǐ*) is a form of Chinese philosophy in which it is believed that each place on earth has special topographical features (natural and artificial) that indicate (or modify) the universal spiritual (life) breath (*qì*). *Fēng* is the invisible wind and a medium of *qì*. *Shuǐ* is the visible water and a defense to protect *qǐ*. *Fēng-shuǐ* originated in the *Hàn* dynasty (202 BC-220 AD). It was first employed by *Guō, Pú* to the design of graves (circa 300 AD) and later by *Wáng, Jí* in the *Sòng* dynasty (960-1279 AD) to house design.
[25] This is not universally true of all Taiwanese traditional buildings. Some artisans used the concept of *yīn* and *yáng* to determine the height of platform, that is, measures in an odd number of steps were considered good for a house (or ‘building for *yáng*’).

heaven (*tiān*), the second earth (*dì*), the third human beings (*rén*), the fourth wealth (*fù*), the fifth honour (*gùi*), and the sixth poverty (*pín*). It is obvious that poverty (*pín*) is not considered fortunate.

Each of these different rulers was employed for specific purposes. The ruler systems not only helped in determining fortunate dimensions for a building, but also provided an effective way of keeping designs modular. Furthermore, dimensional scales related to material sizes. Rulers thus provided a means of constraining house plans, and at the same time, lent support to the artisans, as a guideline for good designs.

The fortunate dimensions

It was (and still is) believed that properly determined orientations, heights, widths, and depths brought good fortune. Ascertaining the orientation of the building was the responsibility of a geomancer;(26) the rest were tasks for the artisans.(27)

It turns out, in Taiwanese traditional architecture, that almost all measurements are directly related to the three basic dimensions of the central space. These numbers are referred to as the *fortunate dimensions*.

The orientation of a building is the direction of the main building in the enclosure-courtyard (*hé-yuàn*). The remaining dimensions are the height, width, and depth of the building. The *height* of a building is the distance between the lower part of the main beam in the central space (or room) to the ground; the *width* is the distance between the two partition supports in the central space, and the *depth* is the interior distance from the front entrance to the rear wall in the central space. The dimensions were all measured in *Lu Ban* units. The design and ornamentation of a building depended on its fortunate dimensions. Once the fortunate numbers were decided, these became the measures by which all other dimensions and measurements of the building were calculated. Moreover, from the fortunate numbers, one could estimate the amount of material required for construction.

A fortunate measure has two parts: a fortunate *Lu Ban* foot measure and a fortunate *Lu Ban* inch measure. In many instances, only the fortunate inch measures were calculated. We can describe the process for obtaining the fortunate

(26) The geomancer, a person proficient in the art and practice of *fēng-shuǐ*, played a much more vital and influential role than merely determining the orientation of the building. The geomancer was involved in virtually every stage of design and construction, ranging from site selection and orientation, to ground breaking (*dòng-tǔ*) through to working on the main frames and main beam to eventually thanking the ground (*xiè-tǔ*), serving both as a prominent player and in a consultative capacity.

The main tenents of *fēng-shuǐ* combine the *Yì-jīng* (Canon of Changes) and five natural elements (*wǔ-xíng*), namely, metal, wood, water, fire, and earth. Some refer to *fēng-shuǐ* as a mystery theory, others believe that it reflects Chinese viewpoints on the environment. Needham (1991) in his book, *Science and Civilisation in China*, called *fēng-shuǐ* a pseudoscience. Recent research suggests that there is a correlation between principles of geomancy and environmental theories of modern architecture. In fact, the geomancer did not exclude the site in his various calculations pertaining to the house. For further information, the reader is referred to the original books on *fēng-shuǐ*, for example, *Fēng-shuǐ Jiǎng-yì* (Notebook of Chinese Geomancy; Fo, 1986), *Lǔ-bān Jīng* (Carpenter's Bible; Wu, 1986), *Lǔ-bān Cùn-bái Bù* (Carpenter's Handbook; Lu, 1985), [*Zhèng-bǎn*] *Yù-xiá-jì Quán-shū* (Handbook of Schedules, 1985), and *Dì-lǐ Mì-jué* (Secrets of Geomancy, Luo, 1985). See also footnote (24).

(27) In this respect, a good artisan was not only skillful at construction but was also capable of design. Most artisans learned their trade from their fathers or through apprenticeship to other artisans. Thus, design methods were handed down through oral instruction; many of the design concepts were related to *fēng-shuǐ* and taboos. The ability to calculate fortunate dimensions distinguished artisans from others, who, at best, were simply skilled workers or laborers.

numbers in the following four steps: (1) constraining the height of the building; (2) determining the attributes of the building; (3) estimating fortunate numbers for the height, width, and depth; and (4) deciding upon an actual height, width, and depth. The four steps are illustrated by the flowchart in figure 12.

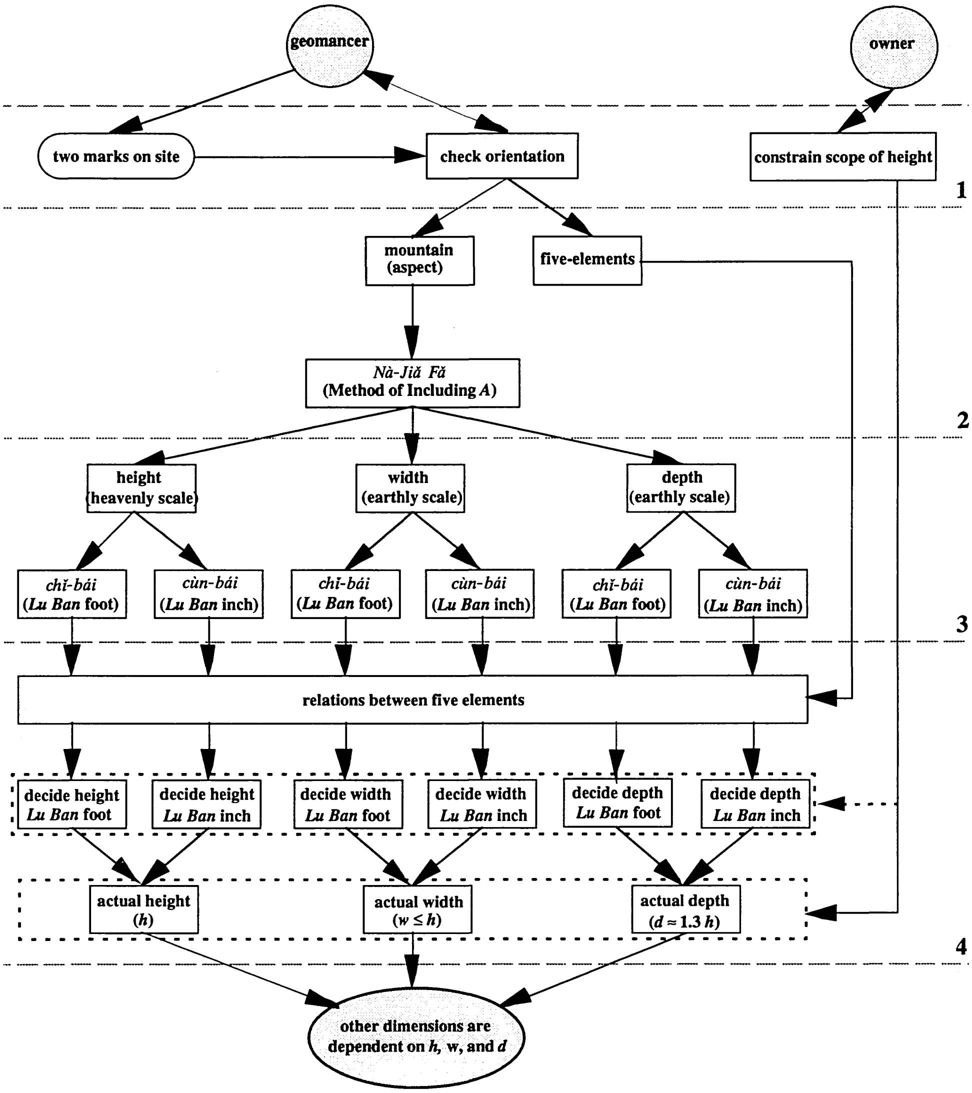


Figure 12. The flowchart for determining the fortunate dimensions of a building.

Step 1: Constraining the height of the building

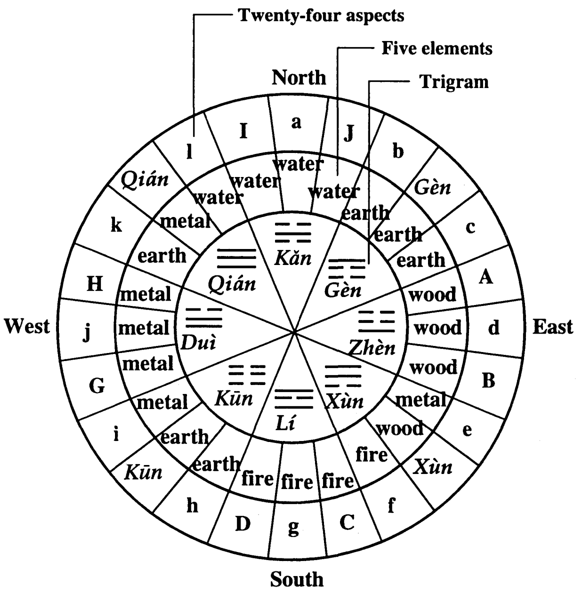
Once an orientation for the new building had been decided upon, the geomancer would mark the site at two places. One marked the location of the *key brick* (*hé-zhuān*),[28] and the other the front of the building. These two marks defined the orientation for the building. From the owner's brief, the artisans would have known

[28] The *key brick* signified the 'center' of the building. Many Chinese believed that the location of the center of the building was the source of good fortune and had been protected by the Gods. The altar or 'table of worship' was often placed directly above. So too was the location of the main beam (on which is drawn an eight-trigrams) in the central room.

the dimensional scale of the building. This information and orientation would have sufficed to determine a range on the height of the building.[29] In general, the width did not exceed the height;[30] the depth of the building was approximately 30% longer than the height. With a given orientation and range on heights, the artisans would use the eight-trigrams (*bā-guà*) to find the attributes of the building.

Step 2: Finding the attributes of the building from the eight-trigrams

An eight-trigrams (*bā-guà*) is a simplified diagram of eight separate trigrams indicating the relationship between attributes and orientation. In actuality, an eight-trigrams is an arrangement of certain cabalistic signs consisting of various combinations of straight lines arranged in a circular or tabular form. It is created from the two primary forms (*liǎng-yí*), a continuous straight line called *yáng-yí* (symbol of the male principle) and a broken line called *yīn-yí* (symbol of the female principle). Each trigram in the table is associated with a direction: *qián* (south), *duì* (southeast), *lí* (east), *zhèn* (northeast), *xùn* (southwest), *kǎn* (west), *gèn* (northwest), and *kūn* (north)[31]. A representation of the eight-trigrams is given in figure 13.[32]



Celestial stems and terrestrial branches

Celestial Stems	code	Terrestrial branches	code
Jiǎ	A	Zǐ	a
Yǐ	B	Chǒu	b
Bǐng	C	Yín	c
Dīng	D	Mǎo	d
Wù	E	Chén	e
Jǐ	F	Sì	f
Geng	G	Wǔ	g
Xin	H	Wèi	h
Rén	I	Shēn	i
Guǐ	J	Yǒu	j
		Xū	k
		Hài	l

Figure 13. The twenty-four aspects of the different orientations of a building.

[29] The maximum length in which materials were available imposed an additional constraint on height. Another consideration for height was the social implication for the owner; the higher the building the more expensive to build and, hence, the more prestigious. In general, the height was approximately 10 – 15 *Lu Ban* feet for vernacular houses.

[30] Some artisans set the width to equal the height. This is because they did not want the posts (columns) to crash into another wall in the event of their falling. Other artisans did not impose such constraints.

[31] This layout is based on the *Yi-jīng* (Canon of Changes) and was known as 'eight-trigrams in former heaven order', *xiān-tiān bā-guà* (Feuchtwang, 1974; Lin, 1990; Williams, 1976).

[32] The eight-trigrams in figure 13 is based on a translation, from the original Chinese, of an artisan's notes into a convenient form for determining the fortunate dimensions (Chiou, 1990a, page 65). This layout of eight-trigrams, called 'eight-trigrams in later heaven order', *hòu-tiān bā-guà*, was based on the '*Luò-shū* magic square' which was a three by three square with distinct numbers one through nine in each cell. The column and row sums were equal. The number 1 was in the center cell of the bottom row (Feuchtwang, 1974; Lin, 1990).

The eight-trigrams is divided into twenty-four aspects comprising:
(a) the first and the last four elements of the 'celestial stems' (*tiān-gān*, heavenly stems) made up from eight of the following ten elements, *jiǎ*, *yǐ*, *bǐng*, *dīng*, (*wù*), (*jǐ*), *gēng*, *xīn*, *rén*, and *guǐ*;
(b) the 'terrestrial branches' (*dì-zhī*, earthly branches) with twelve elements, *zǐ*, *chǒu*, *yín*, *mǎo*, *chén*, *sì*, *wǔ*, *wèi*, *shēn*, *yǒu*, *xū*, and *hài*;
(c) four trigrams from the eight-trigram: *qián*, *kūn*, *xùn*, and *gèn*.
Each aspect is termed a *mountain* (*zuò-shān*).[33] Associated with each mountain is one of the five elements: metal (*jīn*), wood (*mù*), water (*shuǐ*), fire (*huǒ*), and earth (*tǔ*). The attributes of the selected element are used in the final step in deciding the actual height, width, and depth of the building. The information of the mountain is then transferred to a 'real' trigram for estimating fortunate numbers for the height and depth of the building. The method of transferring a mountain to a real trigram is what we term the *Method of Including A*[34] (or *Nà-Jiǎ Fǎ*). Every real trigram has one or more mountains (see table 1).[35]

Table 1. *Nà-Jiǎ Fǎ* (Method of Including *A*).

Trigram	The twenty-four mountains
Qián	*Jiǎ* (A)
Duì	*Dīng* (D), *Sì* (f), *Yǒu* (l), *Chǒu* (b)
Lí	*Rén* (I), *Yín* (c), *Wǔ* (g), *Xū* (j)
Zhèn	*Gēng* (G), *Hài* (k), *Mǎo* (d), *Wèi* (h)
Xùn	*Xīn* (H)
Kǎn	*Guǐ* (j), *Shēn* (i). *Zǐ* (a), *Chén* (e)
Gèn	*Bǐng* (C)
Kūn	*Yǐ* (B)

Step 3: Estimating fortunate numbers for the height, width, and depth of the building

The fortunate dimensions belong to one of two ('heavenly' or 'earthly') dimensions. The height is determined in 'heavenly' dimensions (*tiān-fù*); widths and depths are determined in 'earthly' dimensions (*dì-mǔ*). For each dimension, there are two groups of fortunate numbers. One group consists of measurements in *Lu Ban* feet, and the other are measurements in *Lu Ban* inches. Each of these fortunate numbers is determined according to different methods: *chǐ-bái* (or 'Instructions for Measuring in *Lu Ban* feet') and *cùn-bái* (or 'Instructions for Measuring in *Lu Ban* inches'). These methods are shown in tables 2 and 3, respectively. The *chǐ-bái* is an arithmetic table,[36] which includes nine stars[37] and the five elements. The *cùn-bái* is also an arithmetic table, but includes seven colors and the five elements.

[33] The concept of mountain comes from *fēng-shuǐ*. A possible meaning for the word 'mountain' or *zuò-shān* might be 'sitting on a location facing a certain direction'. Contrarily, *cháo-shān* is the faced location or direction, namely, orientation.

[34] For convenience, we refer to the mountain '*jiǎ*' by the letter '*A*'. *Jiǎ* is the first element of the celestial stems.

[35] Note that, in table 1, each mountain is associated with a letter. The coding scheme is identical to that in figure 13, where upper-case letters denote celestial stems and lower-case letters correspond to terrestrial branches.

[36] In fact, it was handed down by oral instruction. We have transferred it to an arithmetic table to help us to understand how one can compute the fortunate numbers.

[37] The nine stars are the seven stars of the Polar constellation (Great Bear) and two other small stars near Polaris.

Table 2. *Chǐ-bái* (or Instructions for Measuring in *Lu Ban* feet).

	1	2	3	4	5	6	7	8	9
Nine Stars	*Tān-Láng* (α)	*Jù-Mén* (β)	*Lù-Cún* (γ)	*Wén-Qǔ* (δ)	*Lián Zhèn* (ε)	*Wǔ-Gǔ* (ζ)	*Pò-Jūn* (η)	*Zǔo-Fǔ* (θ)	*Yòu-Bì* (ι)
Five Elements	wood	earth	earth	water	fire	metal	metal	metal	water
Fortune	good	good	bad	bad	bad	good	bad	fair	fair
Heavenly Dimension	*Duì*	*Zhèn*	*Kūn*	*Kǎn*	*Xùn*	*Gèn*	*Lí*		*Qián*
Earthly Dimension		*Qián*	*Duì*	*Gèn*	*Lí*	*Kǎn*	*Kūn*	*Zhèn*	*Xûn*

Table 3. *Cùn-bái* (or Instructions for Measuring in *Lu Ban* inches).

	1	2	3	4	5	6	7	8	9
Seven Colors	white	black	dark	green	yellow	white	red	white	purple
Five Elements	water	earth	wood	wood	earth	metal	metal	earth	fire
Fortune	good	bad	bad	bad or fair	bad	good	bad	good	fair
Heavenly Dimension		*Kǎn*	*Kūn*	*Qián*	*Xùn*	*Gèn*	*Zhèn*	*Lí*	*Duì*
Earthly Dimension	*Qián*	*Lí*	*Zhèn*	*Duì*	*Kǎn*	*Kūn*	*Xùn*	*Gèn*	

Both methods are applied similarly, though the starting points for each may vary. For example, suppose the real trigram of the building is *zhèn*. From table 1, the possible aspects (mountains or *zuò-shān*'s) are *gēng* (G), *hài* (k), *mǎo* (d), and *wèi* (h). For each of these aspects we can estimate the orientation from figure 13. For example, for the aspect *gēng*, the orientation is east northeast by east (note: its mountain, *zuò-shān*, is west southwest by west). Its element group is metal. All of this information is used in step 4. The *Lu Ban* feet measurement for the height of the building would then be estimated starting from the second star;[38] the estimates for width and depth would start at the eighth star.[39] For the height, the fortunate measurements are 1, 5, (7), (8), 9, 10, 14, (16), (17), 18, ..., etc. These numbers are obtained by counting, from left to right, along the row corresponding to 'fortune', starting from the selected column in the 'heavenly dimension' row. The measurements within parentheses signify values that are associated with the fortunate value 'fair'. To obtain higher measurements, we wrap the last column onto the first and continue the count as above. In other words, the table is repeated in a periodic manner.

For the width and depth, a similar procedure to the one above is followed with the count starting instead from the selected column in the 'early dimension' row. In this case, the fortunate numbers are (1), (2), 3, 4, 8, (10), (11), 12, 13, 17, ..., etc.

Each measurement, so obtained, is associated with one of the five elements. The artisan would use, from step 1, the constrained range on the height of the building, from step 2, the attributes of the selected element, the groups of fortunate measurements, and the attributes of each corresponding associated element, to decide upon the actual height, width, and depth. This is described in the next and final step.

(38) From the row correspodnding to 'heavenly dimension' in table 2.

(39) From the row corresponding to 'earthly dimension' in table 2.

Step 4: Deciding the actual height, width, and depth

Once possible fortunate measurements in both *Lu Ban* feet and inches have been determined, the artisans would check whether these numbers fell within the allowable range for the height of the building. A further check would be to see whether the elements associated with these numbers 'fit' with the elements associated with the orientation of the building. For example, suppose the attribute of the orientation is denoted as A, and a possible fortunate number belongs to B. Both A and B must correspond to one of the five elements. For the number to be compatible with the orientation, one of the following conditions must hold.

(a) A is identical to B; or

(b) B produces A, or A destroys B.

Figure 14 describes the production–destruction relationship between the five elements. After checking all the possible fortunate numbers, an actual height was chosen that fell within its previously determined range. The width and depth are chosen from the possible fortunate numbers that satisfy the relationship between height and depth, and height and width also described earlier. The chosen height and depth act as a scale or guideline from which all other measurements pertaining to the building are determined.

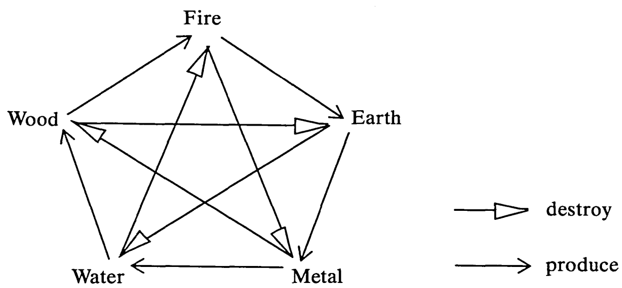


Figure 14. The relations among the five elements.

We can speculate on the reasons why such an involved procedure was devised in the first place. One may have been that the procedure formed part of the artisan's professional training. Another was that one could then distinguish between an artisan-designer and an artisan-worker by their ability to calculate fortunate dimensions.[(40)]

This procedure was not always used in its entirety for several reasons. Long enough timber was not always readily found; in this case, artisans would have settled on fortunate *Lu Ban* inch measurements. Cost of construction was another factor. Last, some believed that only temples, palaces for the gods, required fortunate measurements to be determined in both feet and inches.

[(40)] Any skill that elevated artisans socially would have been considered worthwhile. Socially, artisans were held in low esteem in Taiwan. Sometimes they had to compete with other artisan groups. It was a harsh social system in which an artisan group might not have been permitted to build for several years after failing a competition. On the other hand, an artisan group's social position could be elevated by winning competitions. In some circumstances artisan groups neither won nor lost. There are buildings in Taiwan extant that were built by two groups of artisans. One group usually built the left part of a building, the other the right part. There were a number of ways artisans tried to elevate their social position. One way was becoming adept at calculating the fortunate dimensions which required knowledge of *fēng-shuǐ*. Other ways included the use of 'magic' or 'sorcery' during the construction of a building through the use of charms (Knapp, 1989, pages 146–147; 1990, pages 65–67). By employing such procedures, artisans proceeded to make the design process mystical, thereby engendering further respect for their skills.

Of all the fortunate dimensions, the height of the building was considered to be the most important measurement. In cases where the procedure was not fully followed through, artisans set the width to equal the height and the depth to 1.3 times the height.

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