
Unraveling fēng-shuǐ

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Abstract. This paper comes in three parts. First, relevant principles of *fēng-shuǐ* are enunciated and examined. Second, these principles are applied to procedures to compute two parameters of predesign behaviour in Chinese traditional architectural practice: the fortunate orientation for a building site and an auspicious date for the start of its construction. Third, an interactive computer implementation is described that incorporates these procedures.

1 Introduction

“In many ways, fēng-shuǐ [*fēng-shuǐ*]⁽¹⁾ was an advantage to the Chinese people, as when, for example, it advised planting trees and bamboos as windbreak, and emphasised the value of flowing water adjacent to a house site. In other ways it developed into a grossly superstitious system. But all through, it embodied, I believe, a marked aesthetic component, which accounts for the great beauty of the siting of so many farms, houses and villages throughout China.”

Joseph Needham (1956, page 361)

The Chinese have long been accustomed to take into account the cosmic aspect of nature; for instance, cities and important buildings represented ideal images. It was natural to choose a site that looked towards the sun—namely, the south or southeast—as these directions were considered to be the best orientations both practically and spiritually. The ancient cities of Xian, Beijing, and Nanjing are good examples where the city roads ran (mostly) along north–south and east–west directions, and where the main entrances of buildings and courtyards (usually) faced south.

China, for the most part, has a prevailing southeasterly wind, cold in the winter and warm in the summer. By orienting buildings towards the south or southeast, the Chinese could take advantage of the wind and sunshine to plan for courtyards with a pleasant microclimate. This basic idea of orientation developed into a special branch of Chinese philosophy called *fēng-shuǐ* (or geomancy).

This paper—motivated by rituals of Chinese traditional architectural practice that also constitute predesign behaviour and provide specific parameters for vernacular design and construction—is in three parts. First, in sections 2, 3, and 4 the relevant principles of *fēng-shuǐ* and the Chinese calendar system are examined. Second, in section 5 these principles are applied to procedures to compute the fortunate orientation for a building site and an auspicious date for the start of its construction. Last, in section 6 an interactive computer implementation, which incorporates these procedures, is described.

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

2. *Fēng-shuǐ*

Fēng-shuǐ is the art of adapting buildings, rooms, and furniture so as to achieve a maximum of harmony with nature, particularly its local environment and climatic conditions. The origin of *fēng-shuǐ* dates back to the *Hàn* dynasty (202 BC–AD 220). It was first applied by *Guō, Pù*⁽²⁾ (276–324), a scholar of the *Jìn* dynasty (265–420), to the design of graves (circa AD 300). *Wáng, Jí* (circa 11th century), another scholar of the *Sòng* dynasty (960–1279), first applied its principles to house design. *Fēng-shuǐ* was almost universally considered, applied in all localities and to different building types. It is still in use today.

氣乘風則散，界水則止。古人聚之使不散，行之使有止，故謂之風水。

“Qi [*qì*] (breath), if it rides the wind, would be scattered, but it would stop at water. Ancient people would concentrate Qi [*qì*], so this was called wind and water, or Feng Shui [*fēng-shuǐ*].”

The Burial Book (Zàng-shū)⁽³⁾

translated by Lawrence Liu (1989, page 29)

Literally, *fēng* is invisible wind and a medium of *qì*, the universal spiritual [life] breath, and *shuǐ* is visible water which together serves to protect *qì*. The Chinese believed that each place on earth has special topographical features (natural and artificial) that indicate (and sometimes modify) the *qì*. According to *fēng-shuǐ*, the geographical features are shaped by ‘*yīn*’ and ‘*yáng*’ breaths.⁽⁴⁾ The place where the breath accumulates is considered the ideal location for building a *yáng* house (a living person’s home) or a *yīn* house (a grave). To keep this living breath, the form of the *yīn* or *yáng* house must be able to ‘store the wind’; otherwise, the breath would be blown away. This concept determines not only the axis and location of a building, but also principles of form: symmetry, front and back, symmetrically located secondary buildings, and so on. In short, *fēng-shuǐ* is based on the notion that people ought to live and work in harmonious surroundings—the aforementioned *Wáng, Jí* wrote,

“... a grave, a wide river in front, a high cliff behind, with enclosing hills to the right and left, would all constitute a First Class Feng Shui [*fēng-shuǐ*] position” (Liu, 1989, page 29).

⁽²⁾ All Chinese persons mentioned in this paper (in their transliterated Chinese form) are indicated first by their surname, and then by their given name separated by a comma.

⁽³⁾ Authorship is credited to *Guō, Pù*, of the 4th century, although some researchers doubt the authenticity of this (Han, 1983, pages 130–131; Needham, 1956, page 360). However, it is almost certain that this book was finished by the time of the Northern and Southern Dynasties (*Nán-Běi* Dynasties, circa AD 386–589). *The Burial Book (Zàng-shū)* is believed to be the first to describe the fundamental theories of Chinese geomancy (see Han, 1983, pages 130–131).

⁽⁴⁾ In the *Yi-jīng* (Canon of Changes) or Chinese philosophy, *yīn* and *yáng* are guiding concepts and are the two opposing yet balancing principles in nature; the former meaning feminine, negative, and death, the latter masculine, positive, and living. The Chinese distinguish(ed) between the two forms of construction—*yīn* buildings, dwellings of darkness (referring to such edifices as monuments, mausoleums, tombs, and funeral homes, which are erected for the dead) and *yáng* buildings, dwellings of light (referring to a habitat for the living)—and linking the two together in a single system. There is a strong relationship between *yīn*, *yáng*, and *fēng-shuǐ*. According to Freedman (1979, page 318), “It is very important to grasp the idea that in the Chinese view a building is not simply something that sits upon the ground to serve as a convenient site for human activity. It is an intervention in the universe; and that universe is composed of the physical environment and men and the relationships among men. Men are bonded to the physical environment, working good or ill upon it and being done good or ill to by it. ... Modifications in the landscape reverberate. So that, in principle, every act of construction disturbs a complex balance of forces within a system made up of nature and society, and it must be made to produce a new balance of forces lest evil follow. Chinese are frightened by the act of building—and they are wary, too, of the tricks that carpenters and masons can play on them”.

Joseph Needham (1956) has referred to *fēng-shuǐ* as a pseudo-science. The main tenets of *fēng-shuǐ* combine the *Yì-jīng* (Canon of Changes), and five natural elements (*wǔ-xíng*)—metal, wood, water, fire, and earth. Two main schools of *fēng-shuǐ* have been developed: the earthly forms and cosmology.

2.1 Earthly forms (*Jiāng-xī* school)

The school of earthly forms in *fēng-shuǐ*—also known as the *Jiāng-xī* school—focused on the landscape. It was developed in the 9th century by *Yáng, Yún-sōng*; *Zēng, Wén-chuán*; *Lài, Wén-jùn*; *Liào, Yǔ*; and *Xiè, Zī-yì* in *Jiāng-xī*, a province in the southern part of China. This school of thought took into account the environment surrounding a site and basic needs of daily life such as water. For instance, four aspects were considered in determining the orientation and/or location of a site—*lóng* (dragon), *xuè* (navel or lair; literally, the dragon's lair, or the origin of *qì*), *shā* (sand or plain), and *shuǐ* (water).

“A site should be surrounded on three sides by higher land, like the crook of the elbow in a curved arm, to provide protection from inclement weather or an enemy. The lie of the land should be gently sloping and, if possible, there should be a river or valley nearby to allow surface water to drain easily” (Liu, 1989, page 29).

Figure 1 illustrates an ideal site. Here *qì* specifies the topography termed *xíng-qì*.

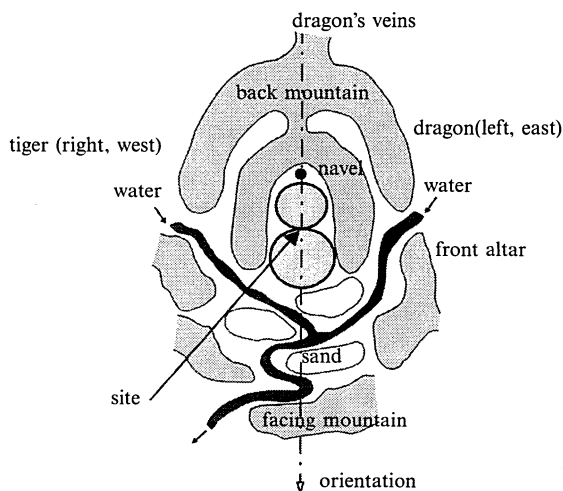


Figure 1. An ideal *fēng-shuǐ* site based on the school of earthly forms.

2.2 Cosmology (*Fú-jiàn* school)

Wáng, Jí is credited with establishing this particular school of *fēng-shuǐ*. It is also shown as the *Fú-jiàn* school of *fēng-shuǐ*, because it originated from the central area of *Fú-jiàn*, a province neighboring *Jiāng-xī*, in the southeastern part of China. Unlike the school of earthly forms which is a qualitative theory, the cosmology school is essentially computational. Geomancers of the cosmology school attempted to find rational methods to arrive at decisions that impinged on ordinary life. In the school of cosmology, *qì* is the cosmic breath, *xīng-qì* or *tiān-qì*. In order to determine *qì* it seems, as it were, that the geomancer attempted to ascertain a cosmic order.

This form of geomancy was based on the eight-trigrams and the five-stars (which are described below) whereby one determined relationships of creation and destruction from which a variety of auspicious or inauspicious situations, measurements, events, etc can be determined.

2.2.1 The eight-trigrams

The eight-trigrams were derived from the *hé-tú* and *luò-shū*, which are illustrated in figure 2. These corresponded to numerical tables that correlated natural phenomena. The origins of *hé-tú* and *luò-shū* are still unknown, though in the *Xì-cí-xhuàn* (in Book II of the *Yì-jīng*)⁽⁵⁾ and *Hóng-fàn-piān* (a chapter in *Shàng-shū*)⁽⁶⁾, one finds references to a myth that describes how *hé-tú* and *luò-shū* came into being. At any rate, it is obvious that these numerical tables must have existed prior to these books (circa 1000 BC).

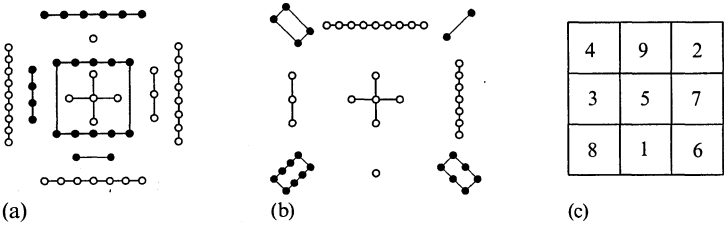


Figure 2. (a) *Hé-tú*, (b) *luò-shū*, and (c) magic square.

Hé-tú is an arrangement of the numbers 1 through 10: 1 and 6 are to the north, 2 and 7 to the south, 3 and 8 to the east, 4 and 9 to the west, with 5 and 10 placed in the center.⁽⁷⁾ *Hé-tú* has been interpreted, at least, in the following three ways:

- (1) The numbers 1, 3, 5, 7, and 9 are *yáng*; 2, 4, 6, 8, and 10 are *yīn*.
- (2) There is a *yīn-yáng* pair for each side. The *yīn-yáng* pairs specify the rule from which all things can be generated.
- (3) The first five natural numbers, 1–5, known as *shēng-shù* (mother numbers) generate the next five natural numbers, 6–10, termed *chéng-shù* (son numbers). Mother and son numbers are respectively *yīn* and *yáng*. These are used to interpret the eight-trigrams.

Luò-shū is a three-by-three magic square filled with distinct numbers from 1 to 9 with equal row and column sums. The number 1 is in the middle of the bottom row. The *yīn* numbers 2, 4, 6, and 8 are at the four corners. The *yáng* numbers 3, 5, 7,

⁽⁵⁾ *Xì-cí* (Appended Judgments) has two parts which are the fifth and the sixth wing in Book II (The Material—one of appendices to the original text of *Yì-jīng*) of the *Yì-jīng* (Canon of Changes). They constitute a treatise that presents many difficulties and introduce the general issues of the Canon of Changes. *Sì-mǎ*, *Qian* (circa 145–86 BC), perhaps the greatest and most famous historian in China, sometimes referred to as the ‘father of history’, called them *Dà-zhuàn* which means ‘great commentary’ or ‘great treatise’ (see Wilhelm, 1977, pages 255–261, 280–355). *Zhū*, *Xī* (AD 1130–1200), the author of commentaries on most of the Chinese classics, and whose interpretations remained the generally accepted standard until the middle of the 17th century, stated (Wilhelm, 1977, page 258): “The appended judgments are the judgments originally made by King Wén [*Wén*] and the Duke of Chou [*Zhōu*] and appended by them to the hexagrams and their lines; they make up the present text of the book. The section before us is the commentary in which Confucius explains the appended judgments, at the same time giving a general introduction to the whole text of the complete work”.

⁽⁶⁾ The Classic of History (or The Book of Documents, *Shàng-shū*) is one of the Six Classics—the others are The Book of Songs (*Shī-jīng*), the Ritual (*Lǐ-jì*, a set of texts including the Records of Rites), The Classic of Music (*Yuè-jīng*, now lost), The Canon of Changes (*Yì-jīng*), and The Spring and Autumn Annals (*Chūn-qū*). The Classic of History records the history and social activities from the late primitive period (circa 3000–? BC), *Xià*, *Shāng*, to *Zhōu* dynasty (circa 1027?–256 BC). It is a collection of documents purportedly compiled by Confucius (circa 551–circa 479 BC) (see Shirokauer, 1991, pages 22–24). There are two scripts of this book: the Old Script and the New Script. The *Hóng-fàn-piān* is in the New Script of the Classic of History (*Jīn-wén Shàng-shū*) which was appended by the later Confucians.

⁽⁷⁾ Each direction is associated with one of the five natural elements, for instance, east is wood, west is metal, south is fire, north is water, and center is earth.

and 9 are located to the west, center, east, and north, respectively. The *luò-shū* implies that *yáng* lead *yīn*.

易有太極，是生兩儀，兩儀生四象，四象生八卦。
“Change [*yì*] has the universe [*tài-jí*] which produces two principles [*liǎng-yí*] which produce four-bigrams [*sì-xiàng*] which, in turn, produce the eight-trigrams [*bā-guà*”⁽⁸⁾ (translated from *Xì-cí-zhuàn*, *Yì-jīng*).

This concept of change is illustrated in figure 3. The resulting ordering on the eight-trigrams is referred to [*Fú-xī*]⁽⁹⁾ as *xiān-tiān bā-guà* (eight-trigrams in former heaven order”).

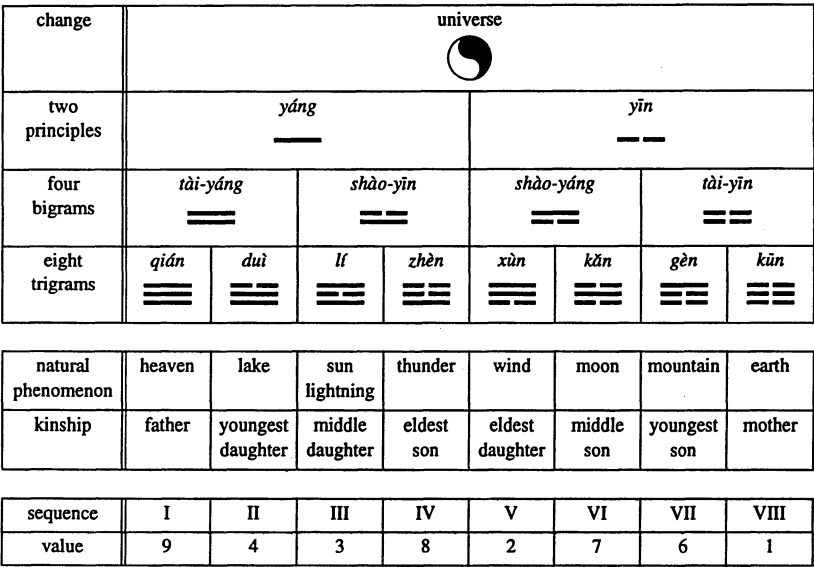


Figure 3. Change according to the *Yì-jīng*.

The eight-trigrams split into two groups according to the following numeric property: if the long bar is considered to represent 1 and the two short bars –1, then a trigram has a number associated with it which is obtained by multiplying the bars in the trigram. Thus, a trigram is either *yáng* (1) or *yīn* (–1). The eight-trigrams fall into two equicardinal groupings:

- yáng* group: *qián*, *zhèn*, *kǎn*, and *gèn*;
- yīn* group: *kūn*, *xùn*, *lí*, and *duì*.

The eight trigrams can be used to represent a number of different sorts of things such as natural phenomena, kin relationships, and so on. Figure 3 includes an interpretation of kinship within a family according to the *yīn/yáng* groupings.

Each trigram, taken in order of the generated sequence I to VIII, can be assigned, based on its *yīn/yáng* grouping and *hé-tú*, a distinct number, excluding 5 and 10, from either the mother or son numbers. The first generated trigram, *qián*, which is *yáng*, is given the largest son number 9 (which is also *yáng*). If we follow the sequence, in order,

⁽⁸⁾ Superimposing a *yáng* on the top of a *yáng* principle is called *tài-yáng* (great *yáng*); however, a *yīn* on the top of a *yáng* principle is called *shào-yīn* (little *yīn* or *yáng* with *yīn*) which is no longer *yáng*. The eight-trigrams produce sixty-four hexagrams which together with their associated commentaries constitute the core of the *Yì-jīng* (Canon of Changes).
⁽⁹⁾ *Fú-xī* was believed to have been the father of Chinese animal husbandry, marriage, calendar, and musical instruments. The construction of the eight-trigrams of the *Yì-jīng* is ascribed to him (Schirokauer, 1991).

we get the values: *duì* 4, *lǐ* 3, *zhèn* 8, *xùn* 2, *kǎn* 7, *gèn* 6, and *kūn* 1. If we place these values into the eight-trigrams in former heaven order, and add 5 to the center, we find that the resulting arrangement is exactly the same as *luò-shū*. In the eight-trigrams in former heaven order, the trigrams on the left—*qián*, *duì*, *lǐ*, and *zhèn*—are *yáng*; the others, naturally, are *yīn*.

In *fēng-shuǐ*, the sequence of the eight-trigrams that is employed is [*Wén-wáng*]⁽¹⁰⁾ *hòu-tiān bā-guà* ('eight-trigrams in later heaven order'). The later heaven order can be obtained by rearranging the former heaven order. It was believed that the symbols for *yīn* and *yáng* originally represented numbers. Ancient scholars have mentioned that *yáng* stood for 3 and *yīn* for 2.⁽¹¹⁾ The Canon of Changes treated *yáng* as 9 and *yīn* as 6. If we take the latter values, the sum of each trigram can be calculated: *qián* is 27, *duì* is 24, *lǐ* is 24, *zhèn* is 21, *xùn* is 24, *kǎn* is 21, *gèn* is 21, and *kūn* is 18. The total sum of the eight-trigrams is thus 180. Because *yīn* and *yáng* have to be balanced, 180 has to be sum-wise evenly distributed:

group 1: *qián* (27), *zhèn* (21), *kǎn* (21), *gèn* (21);

group 2: *duì* (24), *lǐ* (24), *xùn* (24), *kūn* (18).

Now there is only one way to divide the groups into two further subgroups while maintaining divisional balance. Figure 4 shows the subdivision of the groups each into two subgroups with sums of 48 and 42, respectively.

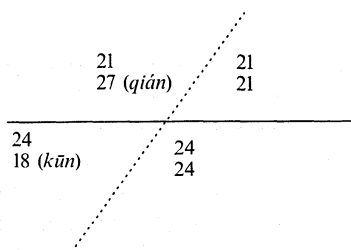


Figure 4. The numbers of eight-trigrams for later heaven order.

According to this numerical division, it is clear that *zhèn*, *kǎn*, and *gèn* are interchangeable within an ordering; so too are *duì*, *lǐ*, and *xùn*. However, the later heaven order is fixed in a particular fashion. There is a historical explanation for this. The later heaven order was developed in the Zhōu dynasty (1027?–256 BC). Zhōu originated from the northwestern part of China. Naturally, it was believed that the trigram with largest sum (27), *qián*, should be to the northwest. According to the history of the Zhōu dynasty, the first ancestor (or emperor) of zhōu gave his eldest son lands to the east. Thus, the trigram *zhèn* (eldest son) is to the east. The trigrams *kǎn* (middle son) and *lǐ* (middle daughter) have to be in opposite positions. Thus far, the positions of six trigrams have been decided. The two remaining trigrams, *xùn* and *duì*, are respectively positioned to the southeast and west. It is still a mystery as to why these are so located.

The ancient geomancers of the cosmology school also incorporated the *luò-shū* magic square into the later heaven order. According to the *hé-tú*, the number 1 is to the north. This combination of the later heaven order of the eight-trigrams, *luò-shū*,

⁽¹⁰⁾ *Wén* (circa 1150 BC) established the Zhōu dynasty (the Western Zhōu, 1027?–771 BC, and the Eastern Zhōu, 770–256 BC). This was after the Shāng dynasty (traditionally 1766–1122 BC, or circa 1600–1027 BC), and before the first empire (*Qín* dynasty, 221–207 BC).

⁽¹¹⁾ The earliest spatial representation for *yáng* was three short bars, not a long bar. It is interesting to note that the ancient Chinese used the first two primes, 2 and 3, to describe the essence of the universe.

and *hé-tú* provided the basis of the cosmology school. Figure 5 illustrates the two different orderings of the eight-trigrams. For the purpose of this paper, we note that the orientation of a house or site was based on the ‘twenty-four aspects’,⁽¹²⁾ which were derived from the above combination.

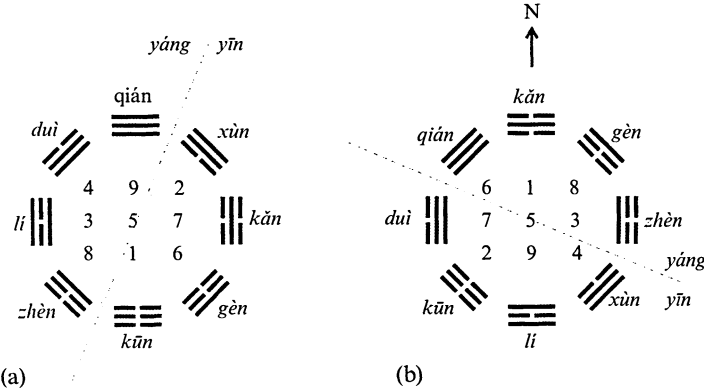


Figure 5. The heavenly orders of the eight-trigrams: (a) former heaven order, (b) later heaven order.

2.2.2 The five-stars

The five-stars (*wǔ-xīng*), the other basic element of the cosmology school, described types of mountain forms, and had names corresponding to the five natural elements (*wǔ-xíng*): metal, wood, water, fire, and earth. In fact, the terms ‘five-stars’ and ‘five-elements’ are equivalent (or synonymous). The five-elements⁽¹³⁾ were first referenced in the ancient Chinese book, The Classic of History [*Shàng-shū*, see footnote (6)]. In it are mentioned the five elements and their shapes—the five-stars. It was believed that each thing can be derived from the five elements, in a manner similar to the chemical processes we know today. Alternatively, everything belonged to the five-elements. It was, therefore, believed that to bring fortune or protect *qì* one had to follow rules of producing and destroying the five-elements as illustrated in figure 6. The five-elements are related to many other categories’ for example, see footnote (7).

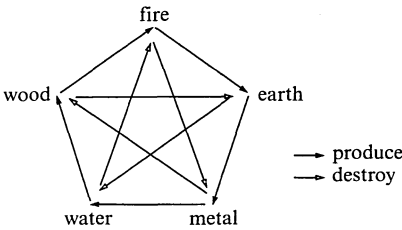


Figure 6. The relations among the five-elements.

⁽¹²⁾ The twenty-four aspects are related to the meteorological cycle of twenty-four fortnightly periods (see section 2). Aspect is defined in section 5.

⁽¹³⁾ The translation ‘five-elements’ is misleading for it implies inertia and passivity, instead of the dynamism and self-movement that is inherently part of the Chinese conception. As Schirokauer (1991, page 45) puts it: “Since the components of this concept recall the four elements of Greek philosophy, for a long time the Chinese term was translated as the ‘Five Elements’. This translation is misleading, for it implies inertia and passivity rather than the dynamism and self-movement inherent in the Chinese conception. Furthermore, the translation ‘Five Agents’, or ‘Five Phases’ more accurately reflects the Chinese view that the processes of nature occur in regular sequence”. Nonetheless, for this paper, we remain with the most popular translation, namely, ‘five-elements’.

By the late 19th and early 20th centuries, the two schools had merged. The term *fēng-shuǐ* now refers to the combined school of thought, and geomancers apply concepts from both. For further information and detail, the reader is referred to the original books on *fēng-shuǐ*, for example, *Fēng-shǔ Jiāng-yì* (Notebook of Chinese Geomancy, see Yo, 1986), *Dì-lǐ Mì-jué* (Secrets of Geomancy, see Luo, 1985), and *Bā-zhái Míng-jìng* (Book of Eight Buildings, see Gu, 1989), and recent research such as that by Chiou (1991), Feuchtwang (1974), Han (1983; 1987), Lip (1995), and Wang (1992). See also Zhang (1994) on the relationship between *fēng-shuǐ* and GIS applications.

3 The Chinese calendar

In Chinese traditional vernacular architecture, three important parameters of design—the orientation of a site, a propitious date for start of construction, and the basic measurements of the main central spaces—were derived from geomancy considerations and based on the Chinese calendar system.

“A calendar is only a method of combining days into periods suitable for civil life and religious or cultural observations. Some of its elements are based on those astronomical cycles which have obvious importance for man, such as the day, the month and the year; others are artificial, such as the week and the subdivisions of the day” (Needham, 1959, page 390).

Man has developed three basic calendars: the lunar calendar based on the phases of the moon; the solar calendar based on the apparent motion of the sun; and the lunisolar calendar. The ancient Chinese calendar was lunisolar (*yīn-yáng-lì*), and was based on the tropical year and lunar month. A tropical year measures 365.242199 days; the period of a lunar month—referred to as a *lunation*—is 29.5305879 days.

The ancient Chinese calendar was issued in the emperor’s official name and became part of the ritual paraphernalia that signified his dynasty’s right to rule. The imperial court was, therefore, the only proper place to apply astronomy. Officers of astronomy (that is, calendar makers) had two tasks: (1) to incorporate as many phenomena as possible in a correct calendar; and (2) to observe unpredictable phenomena and interpret their political meanings so as to warn the emperor that there was something amiss in his realm, so that he could take appropriate administrative measures (Ropp, 1990).

It has been estimated that at least 102 kinds of almanacs were known and used regularly in ancient China (*The New Encyclopedia Britannica* 1994, page 426). However, calendar makers would have been punished, even put to death, for mistakes made in their almanacs. The ancient Chinese calendar depended on the location of the capital, and the emperor’s decision on the starting day of a year or sexagesimal cycle.

After 1912, the Gregorian calendar⁽¹⁴⁾ was adopted as the official calendar, although the *nóng-mín-lì* (farmer’s or agricultural almanac) is also widely used. The farmer’s almanac combines ancient Chinese *yīn-yáng-lì* (the sexagesimal cycle), and general Chinese geomancy information into a single calendar (see Smith, 1992).

3.1 The sexagesimal cycle

The most ancient day-counting system in Chinese culture depended on the sexagesimal cyclical system. The *Shāng* Chinese counted days by combining the *celestial* or *heavenly stems* (*tiān-gān*) with ten elements, *jiǎ, yǐ, bǐng, dīng, wù, jǐ, gēng, xīn, rén, and guǐ*,

⁽¹⁴⁾ The Gregorian calendar is used throughout much of the world today. It can be traced back to the Roman republican calendar, which is thought to have been introduced by the Etruscan Tarquinius Priscus (616–579 BC), the fifth king of Rome. 1582 was the first year of the Gregorian calendar; 10 days were to be dropped from the calendar of 1582, the day after Wednesday, 4 October 1582 (Julian calendar) become Thursday, 15 October 1582 (Gregorian calendar).

and the *terrestrial* or *earthly branches* (*dì-zhī*) with twelve elements, *zǐ*, *chǒu*, *yín*, *mǎo*, *chén*, *sì*, *wǔ*, *wèi*, *shēn*, *yǒu*, *xū*, and *hài* into a system with a period of sixty elements. This day-counting system has been used for more than 3000 years. Probably around the year AD 2, during the *Hàn* dynasty, the sexagesimal cycle was adopted for counting years.

The sexagesimal cycle is shown in figure 7. For ease of presentation and explanation, we use the letters *A–J* to represent the celestial stems, and *a–l*, the terrestrial branches. As examples, the first element of the sexagesimal cycle, *jiǎ-zǐ*, is depicted as *A-a*; the next element, *yǐ-chǒu*, is symbolically *B-b*, and so on.

<i>jiǎ</i>	<i>yǐ</i>	<i>bǐng</i>	<i>dīng</i>	<i>wù</i>	<i>jǐ</i>	<i>gēng</i>	<i>xīn</i>	<i>rén</i>	<i>guǐ</i>
<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>

The celestial stems and their symbolic notation

<i>zǐ</i>	<i>chǒu</i>	<i>yín</i>	<i>mǎo</i>	<i>chén</i>	<i>sì</i>	<i>wǔ</i>	<i>wèi</i>	<i>shēn</i>	<i>yǒu</i>	<i>xū</i>	<i>hài</i>
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>

The terrestrial branches and their symbolic notation

<i>jiǎ-zǐ</i> (<i>A-a</i>)	<i>yǐ-chǒu</i> (<i>B-b</i>)	<i>bǐng-yín</i> (<i>C-c</i>)	<i>dīng-mǎo</i> (<i>D-d</i>)	<i>wù-chén</i> (<i>E-e</i>)	<i>jǐ-sì</i> (<i>F-f</i>)	<i>gēng-wǔ</i> (<i>G-g</i>)	<i>xīn-wèi</i> (<i>H-h</i>)	<i>rén-shēn</i> (<i>I-i</i>)	<i>guǐ-yǒu</i> (<i>J-j</i>)
<i>jiǎ-xū</i> (<i>A-k</i>)	<i>yǐ-hài</i> (<i>B-l</i>)	<i>bǐng-zǐ</i> (<i>C-a</i>)	<i>dīng-chǒu</i> (<i>D-b</i>)	<i>wù-yín</i> (<i>E-c</i>)	<i>jǐ-mǎo</i> (<i>F-d</i>)	<i>gēng-chén</i> (<i>G-e</i>)	<i>xīn-sì</i> (<i>H-f</i>)	<i>rén-wǔ</i> (<i>I-g</i>)	<i>guǐ-wèi</i> (<i>J-h</i>)
<i>jiǎ-shēn</i> (<i>A-i</i>)	<i>yǐ-yǒu</i> (<i>B-j</i>)	<i>bǐng-xū</i> (<i>C-k</i>)	<i>dīng-hài</i> (<i>D-l</i>)	<i>wù-zǐ</i> (<i>E-a</i>)	<i>jǐ-chǒu</i> (<i>F-b</i>)	<i>gēng-yín</i> (<i>G-c</i>)	<i>xīn-mǎo</i> (<i>H-d</i>)	<i>rén-chén</i> (<i>I-e</i>)	<i>guǐ-sì</i> (<i>J-f</i>)
<i>jiǎ-wǔ</i> (<i>A-g</i>)	<i>yǐ-wèi</i> (<i>B-h</i>)	<i>bǐng-shēn</i> (<i>C-i</i>)	<i>dīng-yǒu</i> (<i>D-j</i>)	<i>wù-xū</i> (<i>E-k</i>)	<i>jǐ-hài</i> (<i>F-l</i>)	<i>gēng-zǐ</i> (<i>G-a</i>)	<i>xīn-chǒu</i> (<i>H-b</i>)	<i>rén-yín</i> (<i>I-c</i>)	<i>guǐ-mǎo</i> (<i>J-d</i>)
<i>jiǎ-chén</i> (<i>A-e</i>)	<i>yǐ-sì</i> (<i>B-f</i>)	<i>bǐng-wǔ</i> (<i>C-g</i>)	<i>dīng-wèi</i> (<i>D-h</i>)	<i>wù-shēn</i> (<i>E-i</i>)	<i>jǐ-yǒu</i> (<i>F-j</i>)	<i>gēng-xū</i> (<i>G-k</i>)	<i>xīn-hài</i> (<i>H-l</i>)	<i>rén-zǐ</i> (<i>I-a</i>)	<i>guǐ-chǒu</i> (<i>J-b</i>)
<i>jiǎ-yín</i> (<i>A-c</i>)	<i>yǐ-mǎo</i> (<i>B-d</i>)	<i>bǐng-chén</i> (<i>C-e</i>)	<i>dīng-sì</i> (<i>D-f</i>)	<i>wù-wǔ</i> (<i>E-g</i>)	<i>jǐ-wèi</i> (<i>F-h</i>)	<i>gēng-shēn</i> (<i>G-i</i>)	<i>xīn-yǒu</i> (<i>H-j</i>)	<i>rén-xū</i> (<i>I-k</i>)	<i>guǐ-hài</i> (<i>J-l</i>)

Figure 7. The sexagesimal cycle.

3.2 The meteorological cycle

In 1993 two American astronomers, Kevin D Pang (Jet Propulsion Laboratory) and John A Bangert (US Naval Observatory), proved and announced that the Chinese calendar synchronised to 5 March 1953 BC (see *Sky and Telescope* 1993). Evidence from the *Shāng* oracle bone inscriptions shows that, at least by the 14th century BC, the *Shāng* Chinese had established the solar year at 365.25 days and lunation at 29.53 days. Evidence also suggests that no later than the Spring and Autumn period (770 – 476 BC) of the Eastern *Zhōu* dynasty, the Chinese had developed the Metonic cycle—that is, 19 tropical years with a total of 235 lunations—about a century ahead of Meton’s first calculation, around 432 BC (see Needham, 1959; *The New Encyclopedia Britannica* 1994, page 425). During this cycle of 19 tropical years there were 7 intercalations of the months. By the 3rd century BC, the meteorological cycle (*èr-shí-sì jié-qì*: 24 fortnightly periods) had been established. The 24 periods of the meteorological cycle are shown in table 1.⁽¹⁵⁾ Each period corresponds to a 15° motion of the sun on

⁽¹⁵⁾ For the meanings of each point, the reader is referred to Bodde (1991); Bredon and Mitrophanow (1966); Needham (1959). Bodde views these 24 periods as some kind of of symmetric relation.

Table 1. The twenty-four periods of the meteorological cycle.

Period		Approximate starting date (in the solar calendar)
Beginning of Spring	<i>lì-chūn</i>	5 February
Rains	<i>yǔ-shuǐ</i>	20 February
Awakening of Creatures (from hibernation)	<i>jīng-zhí</i>	7 March
Spring Equinox	<i>chūn-fēn</i>	22 March
Clear and Bright	<i>qīng-míng</i>	6 April
Grain Rain	<i>gǔ-yǔ</i>	21 April
Beginning of Summer	<i>lì-xià</i>	6 May
Lesser Fullness (of Grain)	<i>xiǎo-mǎn</i>	22 May
Grain in Ear	<i>máng-zhōng</i>	7 June
Summer Solstice	<i>xià-zhì</i>	22 June
Lesser Heat	<i>xiǎo-shǔ</i>	8 July
Greater Heat	<i>dà-shǔ</i>	24 July
Beginning of Autumn	<i>lì-qū</i>	8 August
End of Heat	<i>chù-shǔ</i>	24 August
White Dews	<i>bái-lù</i>	8 September
Autumn Equinox	<i>qū-fēn</i>	24 September
Cold Dews	<i>hán-lù</i>	9 October
Descent of Hoar Frost	<i>shuāng-jiàng</i>	24 October
Beginning of Winter	<i>lì-dōng</i>	8 November
Lesser Snow	<i>xiǎo-xuě</i>	23 November
Greater Snow	<i>dà-xuě</i>	7 December
Winter Solstice	<i>dōng-zhì</i>	22 December
Lesser Cold	<i>xiǎo-hán</i>	6 January
Greater Cold	<i>dà-hán</i>	21 January

the ecliptic.⁽¹⁶⁾ It takes about 15.218 days for the sun to travel from one point to another, and 365.25 days to complete its journey in the cycle.

3.3 Resonance

In order to synchronise discrepancies between the tropical year and lunation, calendar makers, in all cultures, have attached importance to certain ‘resonance’—the Egyptian Sothic cycle, *octaëteris*, saros (eclipse cycle), the Metonic cycle, Callippic period, and the Julian period. In China, certain resonance periods have been introduced, for example, see Eberhard and Mueller (1936) on the *Sān-tǒng* calendar system.

Zhāng

A period of 19 tropical years which is almost equivalent to 235 lunations is called *zhāng*. The 235 lunations is taken to contain 110 hollow months of 29 days (*xiǎo-yuè*: short months) and 125 months of 30 days (*dà-yuè*: long months). This period totals 6940 days.

- A *zhāng* is the same as the Metonic cycle, which consists of 12 years of 12 lunations each and 7 years each of 13 lunations. The intercalated year is called a *complete year* or *full year*. In a complete year, the *intercalated month* has the same name as one of the other months though the number of days may differ. Which month was chosen to be intercalated was subject to the following constraints (Bredon and Mitrophanow, 1966):
- (a) Spring Equinox (*chūn-fēn*) was always in the second month.
 - (b) Summer Solstice (*xià-zhì*) was always in the fifth month.
 - (c) Autumn Equinox (*qū-fēn*) was in the eighth month.
 - (d) Winter Solstice (*dōng-zhì*) was in the eleventh month.

⁽¹⁶⁾ The plane of the Earth’s yearly journey around the sun.

(e) The first, eleventh and twelfth months were never intercalated.

In general, intercalations are in years 3, 6, 8, 11, 14, 16, and 19 of a period.⁽¹⁷⁾ Chinese New Year begins with the lunation during when the sun entered the zodiacal sign of Aquarius, between 20 January and 19 February in the Gregorian calendar.

Bù

A *bù* is 4 periods of *zhāng*, and is the same as the Callippic period. A *bù* consists of 940 lunations equalling 76 tropical years of 365.25 days each.

Huì

A *huì* equals 27 periods of *zhāng* (513 tropical years) and equals 47 lunar eclipse cycles (of about 135 lunations each).

“With the Han [*Hàn*] value for the length of the lunation, the smallest number of lunations which would give a round number of days was 81 (i.e. 2932 days), and when this was combined with the lunar eclipse cycle of 135 lunations, the former being multiplied by 5 and the latter by 3, both giving 405 lunations or 11960 days, the shortest period of whole days in which the eclipse cycle could be completed was found” (Needham, 1959, page 407).

Tǒng

Three *huì*’s (81 *zhāng*’s, 1539 tropical years) is a *tǒng*. Three *tǒng*’s (1686360 days) was found to be the smallest concordant period of 28106 sexagesimal day cycles, 57105 lunations, 4617 tropical years, and 423 eclipse cycles.

Jì, suì, or dà-zhōng

A *jì* is 20 times a *bù*, that is, 1520 tropical years, or 9253 sexagesimal day cycles, which corresponds to the period of Jupiter’s synodic revolution (Needham, 1959). Thus the sequences for sexagesimal day and month cycles repeat every 80 years.

Dà-bèi, yuán, or shǒu

A *dà-bèi, yuán, or shǒu* equals 3 *jì*’s.

Jì (grand period)

A *jì* (grand period) equals 7 *dà-bèi*’s, that is, 31920 tropical years. It was believed that after a *jì* had elapsed, “all things come to an end and return to their original state” (Needham, 1959, page 406). It is exactly equal to 4 Julian periods.⁽¹⁸⁾ Some interesting results include:

$$\begin{aligned} 1 \text{ } jì &= 7 \text{ } dà-bèi\text{'s} = 7 \times 3 \text{ } jì\text{'s} = 31\,920 \text{ tropical years} = 399 \times 80\text{-year periods} \\ &= 4 \text{ Julian periods} = 4 \times 28 \times 15 \text{ Metonic cycles} = 4 \times 19 \times 15 \text{ solar cycles} \\ &= 4 \times 28 \times 19 \text{ Indiction cycles.} \end{aligned}$$

Tài-jì-shàng-yuán (world-cycle or ‘great year cycle’)

During the *Hàn* dynasty it was thought that in exactly 138240 years all planets would repeat their motion. By combining this ‘cogwheel’ with the 4617-year period (3 *tǒng*’s), the whole ‘world cycle’ can be taken to be 23639040 years. The beginning of it was known as the ‘Supreme Ultimate Grand Origin’ (*tài-jì-shàng-yuán*) (Needham, 1959; Bodde, 1991).

⁽¹⁷⁾ Some exceptions may be found; for example, 1984 was a complete year, although it was year 5 in the period.

⁽¹⁸⁾ The Julian period (7980 tropical years) was introduced by French scholar Joseph Justus Scaliger (AD 1540–1609) and based on the Metonic cycle of 19 years, a ‘solar cycle’ (Victorinus sabbatical cycle) of 28 years, and the (Roman) Indiction cycle of 15 years. (Needham, 1959; *The New Encyclopedia Britannica* 1994, pages 419–420).

4 Eight-characters

Many Chinese believed the date and time of birth characterise a person's innate nature (*fú-yuán*, origin of fortune) by which their fate in life was decided. This date was, therefore, for that person, the provenance for the practice of Chinese geomancy.⁽¹⁹⁾

The Chinese refer to the date and time of birth as *eight-characters* (*bā-zì*). The time of birth is represented by the (lunisolar) year,⁽²⁰⁾ month, day, and the hour of birth. Each has a representation in the sexagesimal cycle. Each element of the sexagesimal cycle is a pair made up of a celestial stem and a terrestrial branch; therefore, each aspect of a date and time of birth is made up of two characters denoting the stem-branch pair. There are rules, of course, for interpreting the sexagesimal cycle to construct the description of a date and time of birth.

4.1 (Lunisolar) year

The first cycle began in 2637 BC⁽²¹⁾ (*Collier's Encyclopedia* 1988, page 141). For instance, 1984 was the start of a sexagesimal cycle, that is, the (lunisolar) year 1984 corresponded to the element *A-a*.

In practice, there are two distinct modes of specifying any particular (lunisolar) year. In the *exact* mode, a (lunisolar) year starts with the 'Beginning of Spring' (*lì-chūn*), the first period of the meteorological cycle, and ends at the start of the next 'Beginning of Spring'. In 1996 the 'Beginning of Spring' began on 4 February at 9:08 PM; in 1977 it will begin on 4 February at 3:04 AM. Thus, the (lunisolar) year of 1996, *C - a* (*bǐng-zǐ*), is between 4 February 1996, 9:08 PM and 4 February 1997, 3:03:59 AM.⁽²²⁾

In the *lunar* mode, a (lunisolar) year starts from the first day of the lunar year and ends on the eve of the last day of the year. These dates are determined by when the moon is in its 'new-moon' phase. Thus, the (lunisolar) year for 1996 started on 19 February 1996 and ended on 6 February 1997.

The ancient Chinese believed that the world would encounter great changes every 180 years, which they described as *shàng-yuán* (upper cycle) through *zhōng-yuán* (middle-cycle) onto *xià-yuán* (lower-cycle). In *fēng-shuǐ*, this 180-year period is called *sān-yuán* (three cycle). The current sexagesimal cycle (1984–2043) is in lower-cycle.

4.2 (Lunisolar) month

For each (lunisolar) month, its terrestrial branch is determined by its *order*. The terrestrial branch of the first month of a (lunisolar) year is *c* (*yín*), of the second month is *d* (*mǎo*), and so on. There are two ways of determining the order depending on the mode in which the year is specified.

⁽¹⁹⁾ Fortune tellers—variants of the geomancer—would interpret a person's date and time of birth to foretell aspects of the person such as their fate, health, wealth, marriage, and so on. A typical example, still in practice, is 'matching' the date and time of birth of grooms with those of their prospective brides.

⁽²⁰⁾ To distinguish between date and time expressed in the Chinese calendar from that of the Gregorian calendar, we prepend the word 'lunisolar'.

⁽²¹⁾ It is not known why the first cycle began in 2637 BC. According to geomancers, the first cycle began on the first day of the Yellow Emperor (*Huáng-dì*, 2698 BC?), but this information is not reliable. *Huáng-dì* was the first of five emperors; he is credited with a long list of inventions, including the invention of government institutions. He appears in *The Classic of History* (*The Book of Documents*), a collection of documents purportedly compiled by Confucius (Schirokauer, 1991). However, the date 2637 BC (not 2698 BC) seems accurate, especially with respect to the material discussed in this paper.

⁽²²⁾ The times given here are based on Chinese standard time, though in practice the exact time is adjusted to the local time.

In the *exact* mode, a (lunisolar) month consists of two sequential fortnightly periods; respectively called the *divisional term* (*jié-qì*) and the *principal term* (*zhōng-qì*). For example, the first month begins at the start of ‘Beginning of Spring’ (*lì-chūn*), through the ‘Rains’ (*yǔ-shuǐ*), and ends before the ‘Awakening of Creatures [from hibernation]’ (*jīng-zhí*).

In the lunar mode, a (lunisolar) month starts from the first day of lunation and ends on the eve of the next lunation’s 1st, 29th, or 30th day. Therefore, the first lunation of a year is also the start of the first (lunisolar) month.

For any complete year, the intercalated month is divided into two based on the 15th day. The days before and including the 15th day belong to the previous month which has the same order as the intercalated month. The days after the 15th day belong to the order of the next month. Thus, the total number of months for any year is always counted as twelve.

The celestial stem for a (lunisolar) month is determined by the celestial stem of the (lunisolar) year and its order, according to the following rule: if the stem for the year is *A* (*jiǎ*) or *F* (*jǐ*), the stem for the month is counted from *C* (*bīng*) cyclically; if the stem is *B* or *G*, the count starts from *E*; if the stem is *C* or *H*, the count starts from *G*; if the stem is *D* or *I*, the count starts from *I*; or if the stem is *E* or *J*, the count starts from *A*. This rule which is divided into five groups for determining the starting stem for first (lunisolar) month is called *wú-hǔ-dùn-yuè* (‘five tigers escape from months’). Figure 8 illustrates the relationship between the celestial stem for a year and the sexagesimal cycle of each month.

month	branch	month based on meteorological cycle		celestial stem for year and sexagesimal cycles for the months				
		divisional term (<i>jié-qì</i>)	principal term (<i>zhōng-qì</i>)	<i>A / F</i>	<i>B / G</i>	<i>C / H</i>	<i>D / I</i>	<i>E / J</i>
		starts	passes through	<i>jiǎ / jǐ</i>	<i>yī / gēng</i>	<i>bīng / xīn</i>	<i>dīng / rén</i>	<i>wù / guī</i>
1	<i>c</i> <i>yín</i>	Beginning of Spring <i>lì-chūn</i>	The Rains <i>yǔ-shuǐ</i>	<i>C-c</i> <i>bīng-yín</i>	<i>E-c</i> <i>wù-yín</i>	<i>G-c</i> <i>gēng-yín</i>	<i>I-c</i> <i>rén-yín</i>	<i>A-c</i> <i>jiǎ-yín</i>
2	<i>d</i> <i>mǎo</i>	Awakening of Creatures [from hibernation] <i>jīng-zhí</i>	Spring Equinox <i>chūn-fēn</i>	<i>D-d</i> <i>dīng-mǎo</i>	<i>F-d</i> <i>jǐ-mǎo</i>	<i>H-d</i> <i>xīn-mǎo</i>	<i>J-d</i> <i>guī-mǎo</i>	<i>B-d</i> <i>yī-mǎo</i>
3	<i>e</i> <i>chén</i>	Clear and Bright <i>qīng-míng</i>	Grain Rain <i>gǔ-yǔ</i>	<i>E-e</i> <i>wù-chén</i>	<i>G-e</i> <i>gēng-chén</i>	<i>I-e</i> <i>rén-chén</i>	<i>A-e</i> <i>jiǎ-chén</i>	<i>C-e</i> <i>bīng-chén</i>
4	<i>f</i> <i>sì</i>	Beginning of Summer <i>lì-xiá</i>	Lesser Fullness [of Grain] <i>xiǎo-mǎn</i>	<i>F-f</i> <i>jǐ-sì</i>	<i>H-f</i> <i>xīn-sì</i>	<i>J-f</i> <i>guī-sì</i>	<i>B-f</i> <i>yī-sì</i>	<i>D-f</i> <i>dīng-sì</i>
5	<i>g</i> <i>wǔ</i>	Grain in Ear <i>máng-zhōng</i>	Summer Solstice <i>xiá-zhì</i>	<i>G-g</i> <i>gēng-wǔ</i>	<i>I-g</i> <i>rén-wǔ</i>	<i>A-g</i> <i>jiǎ-wǔ</i>	<i>C-g</i> <i>bīng-wǔ</i>	<i>E-g</i> <i>wù-wǔ</i>
6	<i>h</i> <i>wèi</i>	Lesser Heat <i>xiǎo-shǔ</i>	Greater Heat <i>dà-shǔ</i>	<i>H-h</i> <i>xīn-wèi</i>	<i>J-h</i> <i>guī-wèi</i>	<i>B-h</i> <i>yī-wèi</i>	<i>D-h</i> <i>dīng-wèi</i>	<i>F-h</i> <i>jǐ-wèi</i>
7	<i>i</i> <i>shēn</i>	Beginning of Autumn <i>lì-qū</i>	End of Heat <i>chù-shǔ</i>	<i>I-i</i> <i>rén-shēn</i>	<i>A-i</i> <i>jiǎ-shēn</i>	<i>C-i</i> <i>bīng-shēn</i>	<i>E-i</i> <i>wù-shēn</i>	<i>G-i</i> <i>gēng-shēn</i>
8	<i>j</i> <i>yóu</i>	White Dews <i>bái-lù</i>	Autumn Equinox <i>qiū-fēn</i>	<i>J-j</i> <i>guī-yóu</i>	<i>B-j</i> <i>yī-yóu</i>	<i>D-j</i> <i>dīng-yóu</i>	<i>F-j</i> <i>jǐ-yóu</i>	<i>H-j</i> <i>xīn-yóu</i>
9	<i>k</i> <i>xū</i>	Cold Dews <i>hán-lù</i>	Descent of Hoar Frost <i>shuāng-jiàng</i>	<i>A-k</i> <i>jiǎ-xū</i>	<i>C-k</i> <i>bīng-xū</i>	<i>E-k</i> <i>wù-xū</i>	<i>G-k</i> <i>gēng-xū</i>	<i>I-k</i> <i>rén-xū</i>
10	<i>l</i> <i>hài</i>	Beginning of Winter <i>lì-dōng</i>	Lesser Snow <i>xiǎo-xuě</i>	<i>B-l</i> <i>yī-hài</i>	<i>D-l</i> <i>dīng-hài</i>	<i>F-l</i> <i>jǐ-hài</i>	<i>H-l</i> <i>xīn-hài</i>	<i>J-l</i> <i>guī-hài</i>
11	<i>a</i> <i>zǐ</i>	Greater Snow <i>dà-xuě</i>	Winter Solstice <i>dōng-zhì</i>	<i>C-a</i> <i>bīng-zǐ</i>	<i>E-a</i> <i>wù-zǐ</i>	<i>G-a</i> <i>gēng-zǐ</i>	<i>I-a</i> <i>rén-zǐ</i>	<i>A-a</i> <i>jiǎ-zǐ</i>
12	<i>b</i> <i>chǒu</i>	Lesser Cold <i>xiǎo-hán</i>	Greater Cold <i>dà-hán</i>	<i>D-b</i> <i>dīng-chǒu</i>	<i>F-b</i> <i>jǐ-chǒu</i>	<i>H-b</i> <i>xīn-chǒu</i>	<i>J-b</i> <i>guī-chǒu</i>	<i>B-b</i> <i>yī-chǒu</i>

Figure 8. Five tigers escape from months: rule describing the relationship between the celestial stem of a year and sexagesimal cycles for the months.

4.3 (Lunisolar) day

The sexagesimal cycle for a (lunisolar) day is easily calculated. For example, the (lunisolar) day for 1 January 1996 was *D-j* (*dīng-yǒu*), and the cycle repeats every sixty days.

4.4 (Lunisolar) hour

Each day is divided into twelve periods (*shí-chén*) each of two hours. The periods correspond to the twelve terrestrial branches. The first period, from 11:00 PM to 0:59:59 AM, is denoted as *a* (*zǐ*). The celestial stem for the (lunisolar) hour depends on the celestial stem of the (lunisolar) day. The following rule, *wǔ-hǔ-dùn-rì* (‘five tigers escape from days’) determines the celestial stem: if the stem for the day is *A* (*jiǎ*) or *F* (*jǐ*), the stem for the hour is counted from *A* (*jiǎ*) cyclically; if the stem is *B* or *G*, the count starts from *C*; if the stem is *C* or *H*, the count starts from *E*; if the stem is *D* or *I*, the count starts from *G*; or if the stem is *E* or *J*, the count starts from *I*. This rule is illustrated in figure 9.

terrestrial branch	time period	celestial stem for day and sexagesimal cycles for hours				
		A / F <i>jiǎ / jǐ</i>	B / G <i>yī / gēng</i>	C / H <i>bīng / xīn</i>	D / I <i>dīng / rén</i>	E / J <i>wù / gù</i>
<i>a</i> <i>zǐ</i>	00:00 pm – 00:59:59 am	<i>A-a</i> <i>jiǎ-zǐ</i>	<i>C-a</i> <i>bīng-zǐ</i>	<i>E-a</i> <i>wù-zǐ</i>	<i>G-a</i> <i>gēng-zǐ</i>	<i>I-a</i> <i>rén-zǐ</i>
<i>b</i> <i>chǒu</i>	01:00 am – 02:59:59 am	<i>B-b</i> <i>yī-chǒu</i>	<i>D-b</i> <i>dīng-chǒu</i>	<i>F-b</i> <i>jǐ-chǒu</i>	<i>H-b</i> <i>xīn-chǒu</i>	<i>J-b</i> <i>gù-chǒu</i>
<i>c</i> <i>yín</i>	03:00 am – 04:59:59 am	<i>C-c</i> <i>bīng-yín</i>	<i>E-c</i> <i>wù-yín</i>	<i>G-c</i> <i>gēng-yín</i>	<i>I-c</i> <i>rén-yín</i>	<i>A-c</i> <i>jiǎ-yín</i>
<i>d</i> <i>mǎo</i>	05:00 am – 06:59:59 am	<i>D-d</i> <i>dīng-mǎo</i>	<i>F-d</i> <i>jǐ-mǎo</i>	<i>H-d</i> <i>xīn-mǎo</i>	<i>J-d</i> <i>gù-mǎo</i>	<i>B-d</i> <i>yī-mǎo</i>
<i>e</i> <i>chén</i>	07:00 am – 08:59:59 am	<i>E-e</i> <i>wù-chén</i>	<i>G-e</i> <i>gēng-chén</i>	<i>I-e</i> <i>rén-chén</i>	<i>A-e</i> <i>jiǎ-chén</i>	<i>C-e</i> <i>bīng-chén</i>
<i>f</i> <i>sì</i>	09:00 am – 10:59:59 am	<i>F-f</i> <i>jǐ-sì</i>	<i>H-f</i> <i>xīn-sì</i>	<i>J-f</i> <i>gù-sì</i>	<i>B-f</i> <i>yī-sì</i>	<i>D-f</i> <i>dīng-sì</i>
<i>g</i> <i>wǔ</i>	11:00 am – 12:59:59 pm	<i>G-g</i> <i>gēng-wǔ</i>	<i>I-g</i> <i>rén-wǔ</i>	<i>A-g</i> <i>jiǎ-wǔ</i>	<i>C-g</i> <i>bīng-wǔ</i>	<i>E-g</i> <i>wù-wǔ</i>
<i>h</i> <i>wèi</i>	01:00 pm – 02:59:59 pm	<i>H-h</i> <i>xīn-wèi</i>	<i>J-h</i> <i>gù-wèi</i>	<i>B-h</i> <i>yī-wèi</i>	<i>D-h</i> <i>dīng-wèi</i>	<i>F-h</i> <i>jǐ-wèi</i>
<i>i</i> <i>shēn</i>	03:00 pm – 04:59:59 pm	<i>I-i</i> <i>rén-shēn</i>	<i>A-i</i> <i>jiǎ-shēn</i>	<i>C-i</i> <i>bīng-shēn</i>	<i>E-i</i> <i>wù-shēn</i>	<i>G-i</i> <i>gēng-shēn</i>
<i>j</i> <i>yǒu</i>	05:00 pm – 06:59:59 pm	<i>J-j</i> <i>gù-yǒu</i>	<i>B-j</i> <i>yī-yǒu</i>	<i>D-j</i> <i>dīng-yǒu</i>	<i>F-j</i> <i>jǐ-yǒu</i>	<i>H-j</i> <i>xīn-yǒu</i>
<i>k</i> <i>xū</i>	07:00 pm – 08:59:59 pm	<i>A-k</i> <i>jiǎ-xū</i>	<i>C-k</i> <i>bīng-xū</i>	<i>E-k</i> <i>wù-xū</i>	<i>G-k</i> <i>gēng-xū</i>	<i>I-k</i> <i>rén-xū</i>
<i>l</i> <i>hài</i>	09:00 pm – 10:59:59 pm	<i>B-l</i> <i>yī-hài</i>	<i>D-l</i> <i>dīng-hài</i>	<i>F-l</i> <i>jǐ-hài</i>	<i>H-l</i> <i>xīn-hài</i>	<i>J-l</i> <i>gù-hài</i>
<i>a</i> <i>zǐ</i>	11:00 pm – 11:59:59 am	<i>C-a</i> <i>bīng-zǐ</i>	<i>E-a</i> <i>wù-zǐ</i>	<i>G-a</i> <i>gēng-zǐ</i>	<i>I-a</i> <i>rén-zǐ</i>	<i>A-a</i> <i>jiǎ-zǐ</i>

Figure 9. Five tigers escape from days: the rule that describes the relationship between the celestial stem of a day and the sexagesimal cycle for the hours.

5 Two applications

We consider two applications of *fēng-shuǐ* that constituted important rituals of Chinese traditional architectural practice: the determination of a fortunate orientation for a (building) site and an auspicious date for the start of its construction. Although many Chinese believe(d) that good choices for a building are harbingers of good fortune for themselves and their family, these rituals were not solely motivated by the desire

for a blessed house, they were also instituted to ensure the safety of workers during construction. Moreover, once construction was completed, there was a propitious date to thank the gods. Even today, among orthodox Chinese, the choices for a good site, its orientation, and construction date are still regarded as important.

There were other activities in both social and official life for which choosing a propitious date was considered important—for example, engaging in commerce, travelling, gathering fuel, digging, draining, building, laying foundation-stones, literary competitions, weddings, funerals, and so on. According to Bredon and Mitrophanow (1966), this reliance on propitious dates paints a picture of Chinese mentality, showing the blessings that people valued and the calamities they feared.

In addition to being rituals, choices for orientations and construction dates were parameters of predesign behaviour in Chinese traditional architectural practice; the orientation of a vernacular building typically determined its basic measurements (Chiou and Krishnamurti, 1995).

5.1 Auspicious orientation

There are a number of ways for determining an auspicious orientation for a new building. We consider one theory, from *fēng-shuǐ*, known as ‘eight-buildings’ (*bā-zhái*). The theory of eight-buildings, attributed to have been derived from the eight-trigrams and magic square, was a branch of the *Fú-jiàn* School, developed during the *Qīng* dynasty (1644–1911).

From the arrangement of the eight-trigrams, we can associate eight octants, each consisting of three *aspects*.⁽²³⁾ Each octant, associated with a number in the magic square, represents a *building* (*gōng* or *zhái*). The eight-buildings were divided into two categories: east and west. Buildings 1, 3, 4, and 9 belong to the east, and buildings 2, 3, 6, and 7 belong to the west. Usually, the category name is associated with a building, thus, ‘east building 1’.

The most important feature of the theory of eight-buildings is the determination, from the eight-characters, of the innate characteristics of a person (*fū-yuán*, innateness, origin of fortune). Based on this, an auspicious orientation can be suggested. We describe the process in four steps: (1) finding the three-cycle of a person’s year of birth; (2) finding the sexagesimal cycle of the person’s year of birth; (3) finding the person’s origin of fortune in the ‘eight-buildings’; and (4) suggesting an auspicious orientation. In the following formulae, we suppose the year to be denoted by y .⁽²⁴⁾

Step 1: the three-cycle of the year of birth

The following formula can be used for determining the three-cycle of the year of birth. Let r_1 be the index of the three-cycle. Then,

$$r_1 = \begin{cases} \lfloor ((y - 1 + 2367) \bmod 180) / 60 \rfloor & \text{if } y > 0; \\ \lfloor ((y + 2367) \bmod 180) / 60 \rfloor & \text{otherwise,} \end{cases} \quad (1)$$

where the truncated brackets indicate the largest integer not greater than the number within the brackets. The three-cycle is in upper, middle, or lower-cycle depending on whether r_1 equals 0, 1, or 2, respectively.

⁽²³⁾ Here, aspect is diametrically opposite to orientation. In *fēng-shuǐ*, a building or site is always the *subject*. That is, references to any direction such as left or right side is with respect to the building, and not the viewer. For the same reason, an aspect is the location, termed *zùo-shān* (sitting mountain) where the subject sits, and faces the orientation, termed *cháo-shān* (facing mountain).

⁽²⁴⁾ If y denotes a year before Christ it is negative; and positive otherwise.

Step 2: the index of the sexagesimal cycle of the year of birth

Let r_2 be the index of the sexagesimal cycle (1–60) for the year of birth.

$$r_2 = \begin{cases} (y - 1 + 2367) \bmod 60 + 1, & \text{if } y > 0, \\ (y + 2367) \bmod 60 + 1, & \text{otherwise.} \end{cases} \tag{2}$$

From the result, r_2 , we can easily obtain the indices of the celestial stem (1–10) and terrestrial branch (1–12) for the year y .

$$\text{celestial stem} = (r_2 - 1) \bmod 10 + 1, \tag{3}$$

$$\text{terrestrial branch} = (r_2 - 1) \bmod 12 + 1. \tag{4}$$

Step 3: the origin of fortune in the eight-buildings

The origin of fortune in the eight-buildings is the key to suggesting an auspicious orientation. It is represented as a trigram associated with a number from the magic square. The basic method for finding the origin of fortune is called *yě-mǎ-tiào-jiàn* ('wild horse jumping ravine'). In essence, it is a counting process from a certain point on a circle combining the terrestrial branches, magic square, and the eight-trigrams in later heaven order until the count equals the index, r_2 , for year y . Figure 10 shows the counting circle.

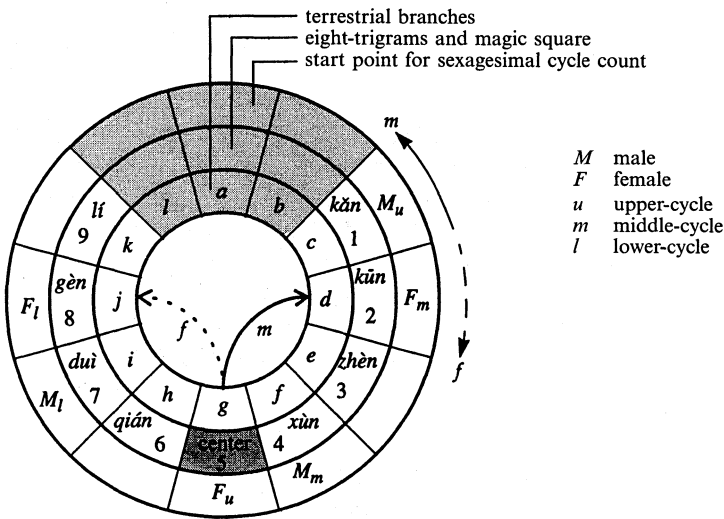


Figure 10. A counting circle for finding the origin of fortune.

The following are the rules for counting this index:

- (1) Always skip the terrestrial branches, l , a , and b .
- (2) For males count in a counterclockwise direction; for females, the count is clockwise.
- (3) For males, the start point for the count is c , f , or i , if the three-cycle index of the birth year, r_1 , is in upper, middle, or lower-cycle, respectively. Likewise, for females, the count starts at g , d , or j , respectively.
- (4) If the origin of fortune falls in the center, 5, for males, the position is taken to be *kūn* (2); and for females, *gèn* (8).

Equivalently, we can determine the origin of fortune, r_3 , by using the following formula.

$$r_3 = \begin{cases} (9 - r_2 + (1 + 3 \times r_1) + 1) \bmod 9, & \text{if male,} \\ (r_2 + (5 - 3 \times r_1) - 1) \bmod 9, & \text{if female.} \end{cases} \tag{5}$$

Step 4: auspicious orientation

Geomancers classified the *nine-stars*—the seven stars of the Great Bear constellation and two other smaller stars near Polaris—into eight ‘fortune classes’ which were assigned to the trigrams. Of these, I_1 : *shēng-qì* (vitality), is considered as the most fortunate. Three others in decreasing rank of good fortune are I_6 : *yán-nián* (longevity), I_2 : *tiān-yī* (heavenly doctor), and I_8 : *fú-wèi* (essence). The remaining are considered as unfortunate— I_3 : *huò-hài* (disaster), I_4 : *liù-shà* (six goblins), I_5 : *wǔ-guǐ* (five ghosts), and I_7 : *jué-mèng* (death). Figure 11 illustrates the eight fortune classes and their relationship to the nine-stars.

Nine Stars	<i>Tān-Láng</i>	<i>Jù-Mén</i>	<i>Lù-Cún</i>	<i>Wén-Qǔ</i>	<i>Lián-Zhēn</i>	<i>Wǔ-Qǔ</i>	<i>Pò-Jūn</i>	<i>Zǎo-Fǔ</i>	<i>Yòu-Bì</i>
Five Elements	wood	earth	earth	water	fire	metal	metal	water	earth

Categories	<i>shēng-qì</i>	<i>tiān-yī</i>	<i>huò-hài</i>	<i>liù-shà</i>	<i>wǔ-guǐ</i>	<i>yán-nián</i>	<i>jué-mèng</i>	<i>fú-wèi</i>
Fortunate	good ₁	good ₃	bad	bad	bad	good ₂	bad	good ₄
Symbol	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8

Figure 11. The eight fortune classes and the nine-stars.

For different origins of fortune, the arrangement of the fortune classes changes. Figure 12 shows the different arrangements based on distinct origins of fortune. The fortune classes indicating good fortune are highlighted. It is interesting to note for all origins of fortune with its aspect in an ‘east building’—that is, with $r_3 = 1, 3, 4$, and 9—the aspects north, east, southeast, and south are considered to be fortunate. Likewise, for origins of fortune with its aspect in a ‘west building’—that is, with $r_3 = 2, 6, 7$, and 8—the aspects northeast, southwest, west, and northwest are fortunate.

Each origin of fortune contains three aspects. These are known as the *twenty-four aspects*, and are shown in figure 13 (see over). The twenty-four aspects are identified by the celestial stems ($A-D, G-J$), terrestrial branches ($a-l$), and four trigrams: *qián*, *kūn*, *xùn*, and *gèn*. In Chinese traditional architecture, the fortunate dimensions of a building are calculated from the aspect of the building (Chiou and Krishnamurti, 1995).

trigram origin of fortune (& r_3)		N	NE	E	SE	S	SW	W	NW
		<i>kǎn</i>	<i>gèn</i>	<i>zhèn</i>	<i>xùn</i>	<i>lí</i>	<i>kūn</i>	<i>duì</i>	<i>qián</i>
<i>kǎn</i>	east 1	I_8	I_5	I_2	I_1	I_6	I_7	I_3	I_4
<i>gèn</i>	west 8	I_5	I_8	I_4	I_7	I_3	I_1	I_6	I_2
<i>zhèn</i>	east 3	I_2	I_4	I_8	I_6	I_1	I_3	I_7	I_5
<i>xùn</i>	east 4	I_1	I_7	I_6	I_8	I_2	I_5	I_4	I_3
<i>lí</i>	east 9	I_6	I_3	I_1	I_2	I_8	I_4	I_5	I_7
<i>kūn</i>	west 2	I_7	I_1	I_3	I_5	I_4	I_8	I_2	I_6
<i>duì</i>	west 7	I_3	I_6	I_7	I_4	I_5	I_2	I_8	I_1
<i>qián</i>	west 6	I_4	I_2	I_5	I_3	I_7	I_6	I_1	I_8

Figure 12. The distinct origins of fortune and the arrangements of the eight fortune classes.

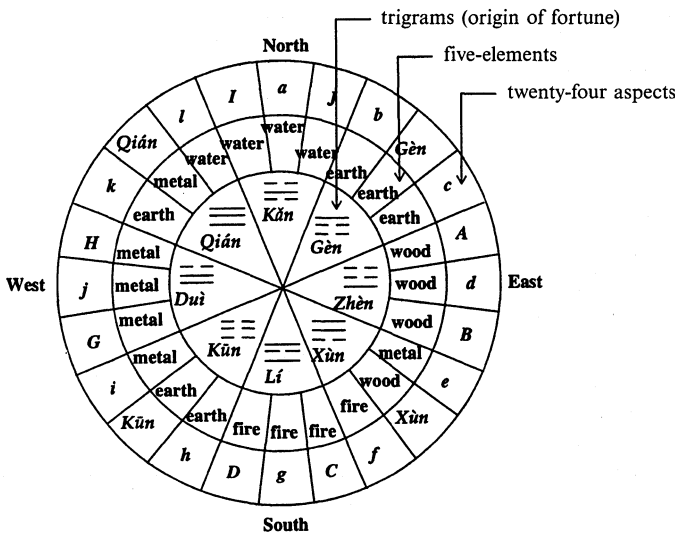


Figure 13. Twenty-four aspects and innateness positions.

5.2 Propitious construction date

The Chinese refer to a fortunate day as ‘propitious date on the ecliptic’, and believe that special events that took place on such days would bring good fortune to one’s family. This expression implies, at least, that the propitious date is based on the lunar calendar. We discuss two different methods in *fēng-shuǐ* for determining a propitious construction date: one based on a person’s month of birth, the other based on the aspect of the site (building).

5.2.1 Propitious date from a person’s month of birth

This method, taken from the *Yáng-zhái Shí-shū* (Ten Books of Buildings for *Yáng*), is based on the concept of the ‘five gods of innateness’—*qīng-lóng* (azure dragon), *míng-xǐ* (happiness), *cāng-kù* (warehouse), *dào-zéi* (robbery), and *bái-hǔ* (white tiger). Each god controls two celestial stems: dragon controls celestial stems *A* and *B*; happiness, *C* and *D*; warehouse, *E* and *F*; robbery, *G* and *H*; and tiger controls *I* and *J*.

The process is relatively simple and straightforward. There are six steps: (1) selecting the intended year for starting construction; (2) finding the terrestrial branch of the owner’s month of birth; (3) finding the positions of the five gods; (4) finding the possible month for construction; (5) checking whether the possible month is fortunate; (6) finding the fortunate day for construction.

Step 1: intended year for starting construction

The owner usually decided when to start a new construction. The intended year (for starting construction) would then be converted to the sexagesimal cycle.

Step 2: the terrestrial branch of owner’s month of birth

This is obtained by converting the owner’s month of birth by using equations (2) and (4).

Step 3: the position of the five gods

In *fēng-shuǐ*, the position (terrestrial branch) of the five gods of innateness bears a relationship to the terrestrial branch of the owner’s month of birth. This position, as indicated in figure 14, is obtained by shifting through 5 places from the terrestrial branch.

terrestrial branch of the month of birth	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>
position of the five gods	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>

Figure 14. Position of the ‘five gods’ of innateness.

Step 4: the possible month for construction

The terrestrial branch, in the sexagesimal cycle, for the possible month for starting construction in the intended year has to be identical to the position of the five gods.

Step 5: check if the possible month is fortunate

To check whether the possible month is fortunate or not depends on beliefs (associated with the five gods). For instance, dragon, happiness, and warehouse were considered gods of fortune, the other two not. It was, therefore, believed that a month was fortunate for construction if its celestial stem in the sexagesimal cycle was controlled by one of the three gods of fortune. That is, if the celestial stem was *A*, *B*, *C*, *D*, *E*, or *F*.

If the possible month is not considered fortunate, the geomancer may suggest that the owner postpone construction until a fortunate month can be found by repeating steps 1 – 5.

Step 6: fortunate day for construction

In the *Ten Books of Buildings for Yáng*, the following (lunisolar) days were considered suitable and fortunate for construction: *A-a* (1), *B-b* (2), *D-d* (4), *E-e* (5), *G-g* (7), *H-h* (8), *F-d* (16), *H-f* (18), *A-i* (21), *D-j* (34), *F-l* (36), *H-b* (38), *C-g* (43), *D-h* (44), *I-a* (49), *J-b* (50), *A-c* (51), *B-d* (52), *F-h* (56), *G-i* (57).⁽²⁵⁾ These twenty days were fixed. There were, of course, other details given in the book about unfortunate days and about determining fortunate days for other types of construction event, but a description of these details is not within the scope of this paper.

5.2.2 Propitious construction date based on aspect

The *Zhái-jīng* (Canon of Buildings) lists, for each month, the aspects that are consonant with the breath of life (*shēng-qì*) and breath of death (*sǐ-qì*) and those that conflict with breath of earth (*chōng tǔ-qì*). It was believed that construction could only start in those months for which an aspect of *shēng-qì* coincided with the given aspect. In figure 15 the various aspects for each month are summarised. Figure 16 (see over) depicts the fortunate months for starting construction for each aspect.

lunar month	1	2	3	4	5	6	7	8	9	10	11	12
<i>shēng-qì</i>	<i>a, J</i>	<i>b, gèn</i>	<i>c, A</i>	<i>d, B</i>	<i>e, xùn</i>	<i>f, C</i>	<i>g, d</i>	<i>h, kūn</i>	<i>i, G</i>	<i>j, H</i>	<i>k, qián</i>	<i>l, I</i>
<i>sǐ-qì</i>	<i>g, d</i>	<i>h, kūn</i>	<i>i, G</i>	<i>j, H</i>	<i>k, qián</i>	<i>l, I</i>	<i>a, J</i>	<i>b, gèn</i>	<i>c, A</i>	<i>d, B</i>	<i>e, xùn</i>	<i>f, C</i>
<i>chōng tǔ-qì</i>	<i>d, h</i>	<i>kūn</i>	<i>l, I</i>	<i>H, k</i>	<i>qián</i>	<i>c, A</i>	<i>J, b</i>	<i>gèn</i>	<i>f, C</i>	<i>B, e</i>	<i>xùn</i>	<i>i, G</i>

Figure 15. The aspects controlled by the different breath of *qì* for each month.

6 Lu-Ban: a computer implementation

We implemented a graphical interface, Lu-Ban⁽²⁶⁾, to determine auspicious orientations, construction dates, and fortunate dimensions. The program is written in C and TCL/Tk, an X-window based tool-kit. The entry port for Lu-Ban is shown in figure 17.

⁽²⁵⁾ The numbers in the parentheses are indices to the sexagesimal cycle.
⁽²⁶⁾ *Lǚ-bān* was accredited to be the ‘first’ carpenter in China. He invented the measuring system that bears his name. All ruler systems used in Chinese traditional architecture express measurements in ‘Lǚ-bān’ units.

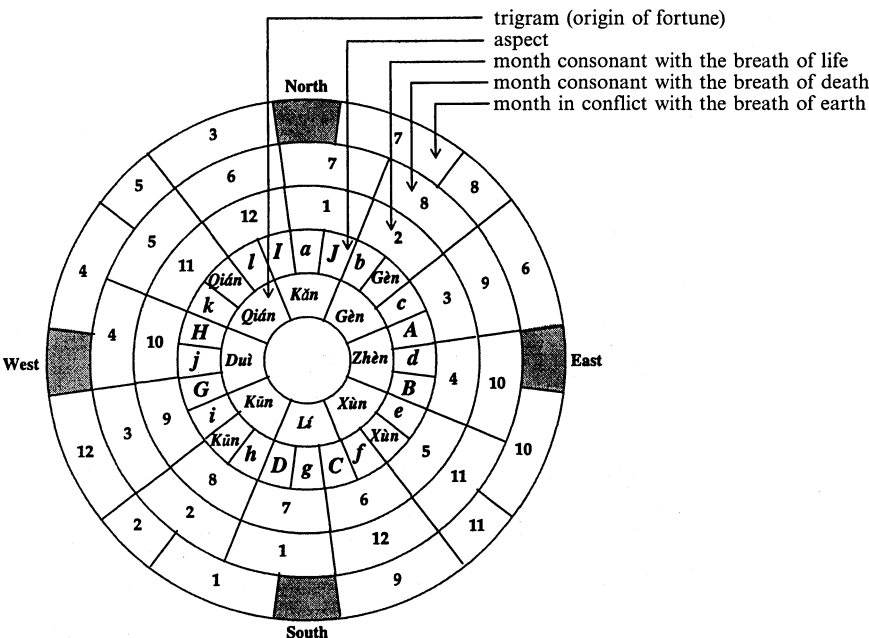


Figure 16. The fortunate months for starting construction for each aspect.

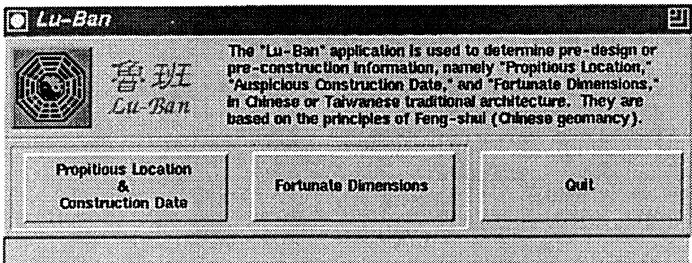


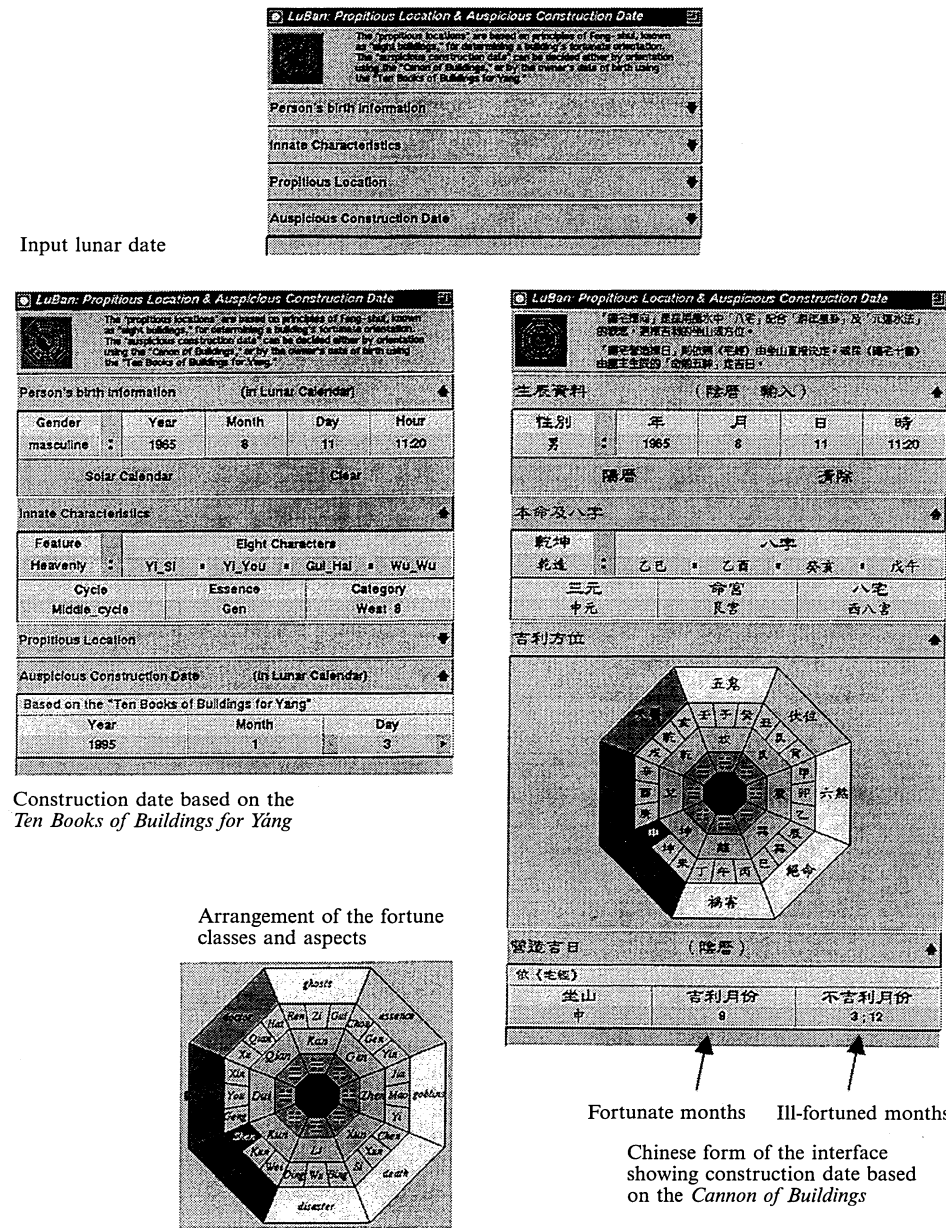
Figure 17. The entry port for Lu-Ban.

6.1 Auspicious orientation and construction date

The interface is shown in figure 18. The interface consists of four ‘folders’ each of which can be toggled to open or shut—the two bottom pictures illustrate the interface for the two different methods for selecting an auspicious construction date. The folders are arranged so that the information in any folder is constrained by the information inputted (and/or displayed) in the folder above. The interface was designed with a consistent display–interaction metaphor. Displayed information is centered in its field. An input field is triggered as such whenever the mouse moves over it; the field is then displayed as a right-justified entry box. The basic colours used in the design of the interface are traditional Chinese colours—shades of firebrick red⁽²⁷⁾, ochre, yellow, and white. The background is the colour of stone, the foreground dark brown almost black, and highlights in red. Headers for display fields are indicated by a lighter shade of the background.

⁽²⁷⁾ To the Chinese people, red signifies good or happy events whereas white indicates sad events such as deaths and funerals. We use paler shades of red to indicate fortunate situations that rank lower down the scale.

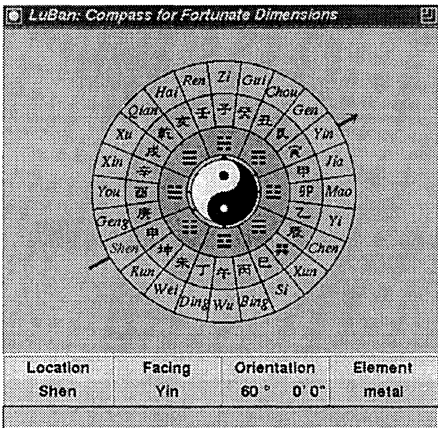
The first folder requires input of relevant information about a person—that is, gender and date and time of birth. Date information can be given using either the solar (Gregorian) or lunar (Chinese) calendar. The program automatically converts solar to lunisolar dates and vice versa. The conversion is driven by a mathematical table stored in a data file.⁽²⁸⁾ Our current implementation specifies this table for the years



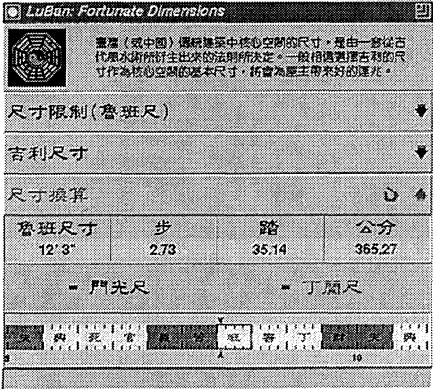
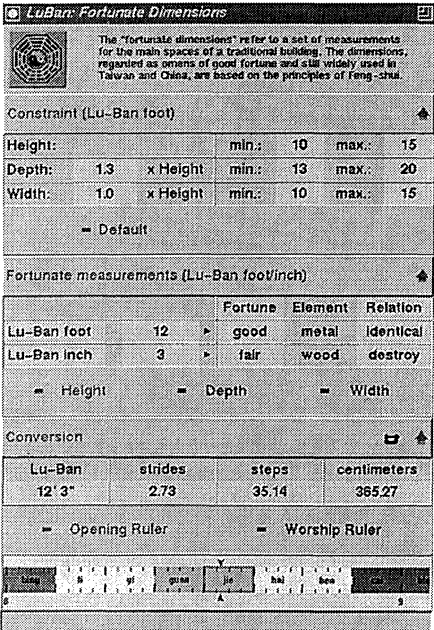
between 1877 and 2031. The lunisolar year is given by the lunar mode calculations based on the phases of the moon and is described in section 4.1. The information displayed in this folder can be toggled between solar and lunisolar dates. Conversion of either information form to the sexagesimal cycle system is automatic.

The second folder, which is display only, shows the eight-characters description of the date and time of birth, the index of the three-cycle, the person's origin of fortune, and the category of the eight-buildings corresponding to the person's year of birth.

The third folder displays the eight-buildings as well as the fortune classes with their associated aspects, which are coloured in shades of red. The information displayed depends on the person's origin of fortune. For different values, the arrangement of fortune classes changes. The user is free to set the aspect—that is, the orientation—for their intended building.



Compass for setting the orientation



The worship ruler (Chinese form)

Figure 19. The interface for the fortunate dimensions.

The last folder lets the user select the method for computing the auspicious construction date.

6.2 Fortunate dimensions

The interface for choosing fortunate dimensions is given in figure 19. The interface consists of two 'windows', one for a compass and the other for the fortunate dimensions. The compass can be moved to any orientation in any direction. The compass is linked to the previous interface in that any orientation set on the compass automatically sets the aspect for the building and vice versa. These values can be manually overridden by unlocking the connection. The compass can also be set through keyboard input by specifying its location, facing, or orientation.

The fortunate dimensions window consists of three folders. The first is for setting constraints—ranges for the fortunate height, depth, and width. The range for height is specified by minimum and maximum values. Ranges for depth and width can be set in two ways: either as a factor of the height, or by minimum and maximum values. Default ranges for the height, depth, and width are based on commonly found values for Taiwanese traditional vernacular houses.

The second folder displays possible fortunate dimensions—these values are automatically computed for the set ranges and selected orientation using the procedures described in Chiou and Krishnamurti (1995).

The third folder converts given dimensions into units used by other measurement systems: stride, step, centimeters, and the opening and worship rulers (see Chiou and Krishnamurti, 1995). This folder can be locked or unlocked. If locked, it converts and displays the selected fortunate dimension (height, depth, or width). If unlocked, the conversion corresponds to values that can be selected on the rulers. This is so that the user can find other fortunate measurements, such as door or window openings, that are not tied to the fortunate dimensions of the building. The opening and worship rulers are both illustrated in figure 19.

Lu-Ban is designed for user interaction in both English and Chinese. Toggling the eight-trigrams icon on the top-left-hand corner of the interface switches the display language. See illustrations in figures 18 and 19.

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