

Climatic design of vernacular housing in different provinces of China

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Abstract

For 2000 years, the inter-connexion between the specific structure of the Chinese eastern climates and the cultural background have produced remarkable vernacular housing types, both well adapted to the local conditions, and reflecting consistent values and knowledge. Stemming from a similar archetypal form, each house plan is translated through the specificity of the climate and resources of its site. One can think that the value and the diversity of this housing stock is due to the combination of the specific structure of the Chinese eastern climates, which creates the contrast of cold-dry winters and hot-humid summers, with the structure of the *Ming t'ang*, which contains the opposition of the *yin* and the *yang*. These two strong factors imprint a substantial cultural and conceptual unity upon all these housing types. Moreover, on the one hand, the geographical variations and, on the other hand, the local building materials generate a large diversity of housing types, of building techniques and of climatic devices which can be observed all around the country. These lessons could be valuable design guidelines from the past for the future.

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1. Climatic introduction

Between the Siberian anticyclone winter influence and the Pacific Ocean monsoon influence, all the Chinese eastern provinces experience considerable seasonal variations, with the double distortion of each one following the latitude from the north to the south.

At the small scale, the local conditions are further diversified according to the topography, the altitude and the sea distance, influencing the temperatures and the precipitation, the whole remaining within the major contest between the two main seasonal influences.

This opposition affects the living space in particular and its influence is structural; protection from the winter conditions must be provided against the cold northwest wind to form a shelter, while aperture disposition is dominated by the summer humid southeast wind so as to provide the necessary ventilation.

These two needs can be satisfied by a structure oriented to the southeast or the south and closed northwest or

north, and moreover the sun seasonal solar needs can also be satisfied with a welcome maximum winter sun radiation and an easy summer sun shading on the southeastern or southern façades.

By accepting these, it can be seen that the Chinese climate strongly influences the structure of Chinese housing.

The analyses of several Chinese climates (Fig. 1) reveal the persistence of the winter/summer opposition, but with important nuances such as

- diminution of the rainfall with the altitude of the northern provinces: at latitude near 37°, one observes 629 mm at the low altitude of 35 m and 180 km far from the sea (Bei Suzha, Hebei) and only 462 mm at the higher altitude of 817 m and 440 km far from the sea (Chi Qiao, Shanxi);
- reduction rainfall with the altitude of the southern province on Jiangxi: at a latitude of 29°, one observes 1468 mm at the low altitude of 46 m and 560 km far from the sea (Nan Chang), and 1811 mm at the higher altitude of 600 m and 320 km far from the sea (Xiao Qi);
- generally, from the north to the south one observes higher yearly rainfalls and higher yearly average

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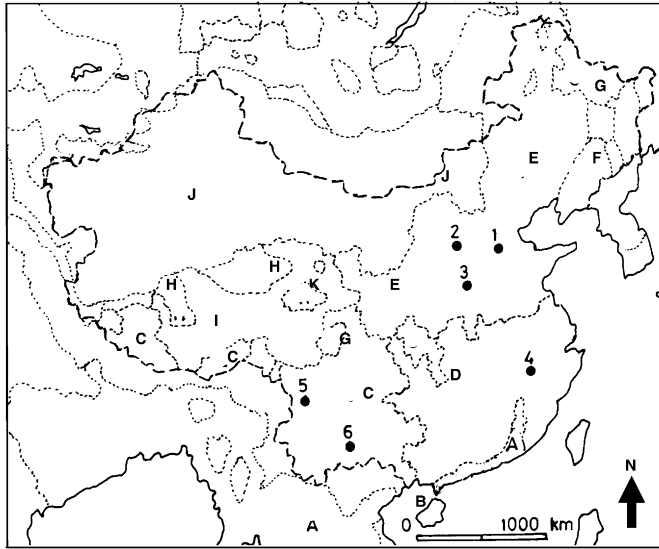


Fig. 1. Climatic map of China and location of villages: (A) TROPICAL HUMID, with a long dry season; (B) TROPICAL HUMID with a short dry season; (C) TEMPERATE with dry winters and mild hot summers; (D) TEMPERATE without dry season; (E) DRY moderate and dry; (F) SUB-POLAR with dry winters and mild summers; (G) SUB-POLAR with dry winters and cool summers; (H) DRY, cold and very dry; (I) DRY, cold and dry; (J) DRY, moderate and very dry and (K) POLAR, very cold and dry. (1) Bei Suzha, (2) Chi Qiao, (3) Xia Futou, (4) Xiao Qi, (5) San Yuan and (6) Du Jia.

temperatures: 14.7 °C (Bei Suzha) and 10 °C (Chi Qiao), 17.2 °C (Nan Chang) and 16.7 °C (Xiao Qi);

- the same range can be observed in the Yunnan province further south: 912 mm with 17.9 °C at latitude 24° and 540 km from the sea (Du Jia), and 1357 mm with 13.6° at latitude 27° and 950 km from the sea.

2. Cultural background

If the entire Chinese vernacular housing stock is not only one housing type, “the four wings” buildings around a courtyard have at least a 2000-year history. This housing type can be seen all around the country, but the natural conditions and the way of life in the different regions have led to a large variety of plans and elevations. Thanks to their organization and their scale, these houses occupy an essential place in Chinese architecture; in every respect, the symmetry of the plan and the closed look from the outside are the main characteristics.

According to the Tao principles from Lao-tseu, the magic square which is the basis of the four-wing buildings relates to the *Ming t’ang* (Fig. 2) which is a Calendar House, where Space and Time are identified so as to produce an identification to the universe.

Four lines cut the basic square into nine squares where the central square remains the Time pivot and the four peripheral squares (buildings) to the cardinal orientations and the four seasons.

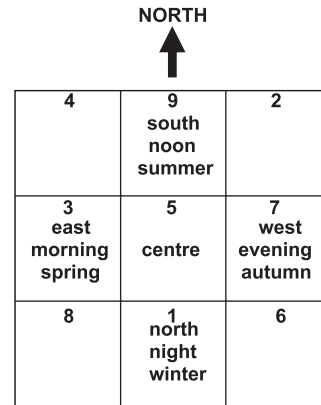


Fig. 2. The *Ming t’ang* structure, “the House of the Calendar”. The different areas of the square are associated to orientations, seasons and periods of the days. To each moment of the time exists a place in the space and specific environmental conditions.

The Chinese climates and their structure as described above find here a strong space identification, where the different buildings around the courtyard can create the microclimate suitable for each season, thanks to their different orientations with respect to the seasonal winds and solar radiation.

Starting from a theoretical concept, the principle reaches a very tangible result.

The magic square can be the foundation of different forms depending on the squares which can be built among the nine internal areas, as demonstrated by the different possibilities of plans.

3. Experiences in Chinese vernacular housing

Three opportunities have been useful to the author to appreciate the relations between the Chinese vernacular housing and the climatic conditions.

The first one dates back to the time of his architecture studies in 1969–70, with the book *La Pensée Chinoise* by Granet (1968), and *Chinese Architecture* from Boyd (1962); the main lesson was the Space–Time identification, but at that time local experience was lacking.

The second one was the 1999 UIA Congress in Beijing where he presented a paper *Climatic Guidelines for Building in China*; the main lesson was the great unity of eastern Chinese climates with their winter/summer contrast; however, this study was also completely theoretical, with only a short, but fundamental experience of urban Beijing during the congress.

The third one is the Sino-European project SUCCESS which was completed in the autumn of 2005. This is a real and thorough experience of six provinces in China after four local missions in seven villages (Fig. 1): *Bei Suzha* in Hebei, *Chi Qiao* in Shanxi, *Xia Futou* in Henan, *Jiang Jiazhai* in Shaanxi, *Xiao Qi* in Jiangxi, and *San Yuan* and *Du Jia* in Yunnan; the main lessons were the cultural unity and the diversity of the creative climatic design of the vernacular housing.

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