

# STUDY ON THE PHILOSOPHY “HARMONY BETWEEN HUMAN BEINGS AND NATURE” AND ITS EFFECT ON SOLAR ARCHITECTURE DESIGN

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## 1. Introduction

"Harmony between human beings and nature" philosophy is the basic spirit of ancient Chinese culture and the essence of traditional Chinese architectural culture. "Harmony between human beings and nature" concept does not deny the difference between man and nature, but stressed the unity of man and nature (Chenxi Bai,2003). The relationship of man and nature is not hostile, but rather interdependent. The core idea of "Harmony between human beings and nature" is the coordination and adaptation of artificial environment and natural environment. Building should be an integral part of the natural environment and be harmony with nature. "Harmony between human beings and nature" not only embodies the ideal of ancient human life, but also form Chinese traditional architectural types. Based on different regions of climate and lifestyle, different types of traditional vernacular buildings were formed. With the development of modern technology and impact of foreign ideas, many traditional buildings are considered obsolete. Modern building tend to high-tech, but also brings high energy consumption. So, with the analysis of traditional houses types, this paper studies the energy consumption difference of traditional houses and modern high-tech buildings and the effect of "Harmony between human beings and nature" philosophy on a solar house design and construction process, propose that building design should be combined with natural environment and human adaptive thermal comfort.

## 2. Analysis of "Harmony between human beings and nature" philosophy

"Harmony between human beings and nature" was originated in the Zhou and matured by Zhang Zai, Cheng Yi in the Song Dynasty (Hui Hu,2009). Based on traditional Chinese confucian culture, "Harmony between human beings and nature " philosophy is reflected in various fields.

Yellow Emperor's Canon of Medicine which marked the development of Chinese medicine from experience medicine to the new stage of theoretical medicine, advocates "Harmony between human beings and nature ", specifically expressed in the theory of "correspondence between man and universe "( Jutai Bao, Jing Su, 2003). The idea of "correspondence between man and universe " consider that all things contain two aspects of yin and yang, only yin and yang blend of harmony, all the things are able to survive, similarly person's internal organs and other organs have seasonal changes in circadian rhythms. While view of nature and philosophy implied in the traditional Chinese feng shui theory both reflected " Harmony between human beings and nature ", asking people to "go with the flow". In the traditional architecture design, regardless of the Royal Palace or residence, settlement location, general layout, indoor and outdoor environmental design, building material, construction technology and other fields will be first considered to the integration of local climate and natural geographical environment (Qun Zhao, 2004). At the same time, a dynamic indoor

environment is created according to the lifestyle of local, and parameters variation of indoor environment coincide with variation of the human body biological rhythms. As shown in Fig.1 ,which implements and reflects " Harmony between human beings and nature " in architecture design.

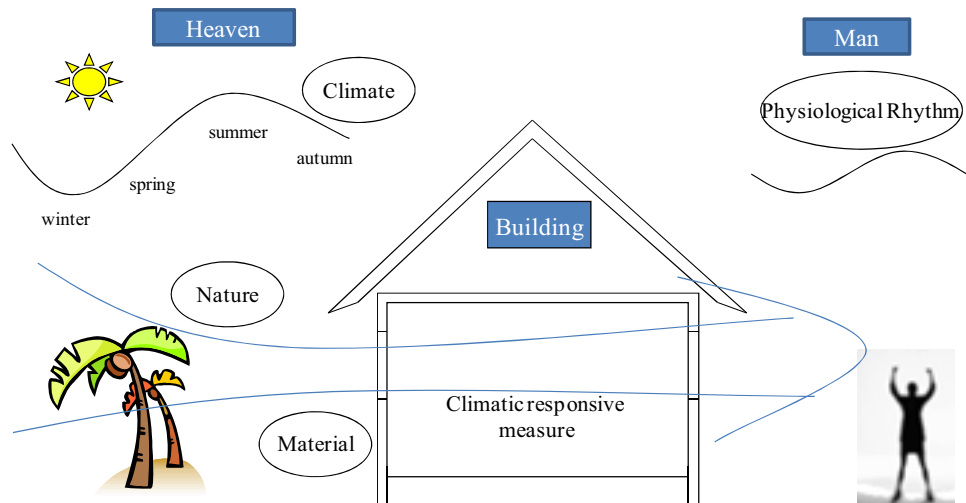


Fig.1: Embodiment of "Harmony between human beings and nature" philosophy in building design

The relationship between human being and nature is one of the basic differences in Chinese and Western cultures. Chinese culture pays more attention to the harmony between man and nature, while the western culture emphasizes to conquer and overcome the nature (Zhuping Pan, 2004). Western who advocate theory of "upper hand" consider that human beings could survive in the hard struggle of overcoming nature. And the "Harmony between human beings and nature" holds that human being should change the nature, also should adapt to nature. The goal of human activities is not to rule the nature, but to adjust the nature to better meet the need of the human beings, at the same time, more attention should be paid to protect the nature and the environment. With the development of economy, and the degradation of environment, the western developed countries propose the climate responsive building in the architectural design, which gets the best environmental performance by integrating the climate responsive building elements and equipment into a system. Climate response and "Harmony between human beings and nature" have consistency, they are both combined and adapted to the local climate and other natural conditions. But such buildings pay more attention to the development of climate response components, such as advanced building envelope integrated, in order to promote technology further.

### 3. Embodiment of "Harmony between human beings and nature" in Chinese traditional houses

Traditional houses were formed in a particular period, a particular environment, combined with the local geography, climate, lifestyle and culture characteristics. Based on traditional Chinese Confucian culture, "Harmony between human beings and nature" is not only applied in Chinese philosophy, culture, arts fields, but also reflected in architectural concept and environment concept of the traditional houses. The attitude of harmony with nature was reflected during the construction of Chinese traditional houses. In

different climatic conditions, lifestyle and material and technical conditions, different residential buildings were built to adapt local natural environmental and different types of traditional houses were gradually formed. “Harmony between human beings and nature” in traditional houses is to embody building materials selection and climate responsive measures.

### 3.1 Building materials

The most significant features of traditional houses are local materials. Under the case of inconvenience of transportation in traditional societies, it’s impossible to spend a lot of manpower, material and financial resources from the distant place of origin to purchase large body and heavy building materials. This makes the nearest drawn from nature as a principle of traditional residential architecture. Table 1 shows the main building envelope materials of traditional houses located in different climatic regions (Xiufang Wang,2007). As from table1, most building materials of traditional houses are from local common resources, such as wood, adobe, artemisia and native plant artemisia, grass, etc.

**Tab. 1: Building materials of traditional houses**

Type	Construction	Wall	Roof	Floor	Window
Beijing courtyard	Timber Frame	Brick-stone + Soil	Wood +Reed mat	Grey brick	Removable window
Cave Dwelling	Brick-stone arch	Soil	Soil + Couch grass	Soil	Hemp fiber paper
Blockhouse	Timber Frame	Stone / Soil + Artemisia	Stone board+ Artemisia	Adobe brick	Deep concave funnel shape
Hathpace house	Soil Arch	Brick-stone + Soil	Adobe	Soil	Lattice window
Earth building	Soil Arch	Gravel + Rammed earth	Tile	Wood board	Little window
Balustrade house	Timber Frame	Artemisia /Wood	Couch grass / Clay Tile	Wood board	No window / Little window

Different materials have different energy due to the different consumption resources of growth and production. The energy coefficient reflect energy consumption of materials in the manufacturing in the process (Lawson Bill, Rudder David, 2000). Figure 2 shows energy coefficient contrast of several typical building materials. It can be seen that the energy coefficient of traditional building materials is relatively low, and the energy coefficient of modern building materials, such as reinforced concrete, is far greater than the traditional building materials,because of the complexity of manufacturing processes. It’s very direct and effective to analyze energy consumption of building materials by using the energy density. The energy density is to determine the materials energy of per unit area (Wang Renping, Cai Zhenyu, 2006). According to the energy coefficient and density of construction materials, the energy density of floor, roof ,and wall of buildings was analyzed, as shown in Figure 3.

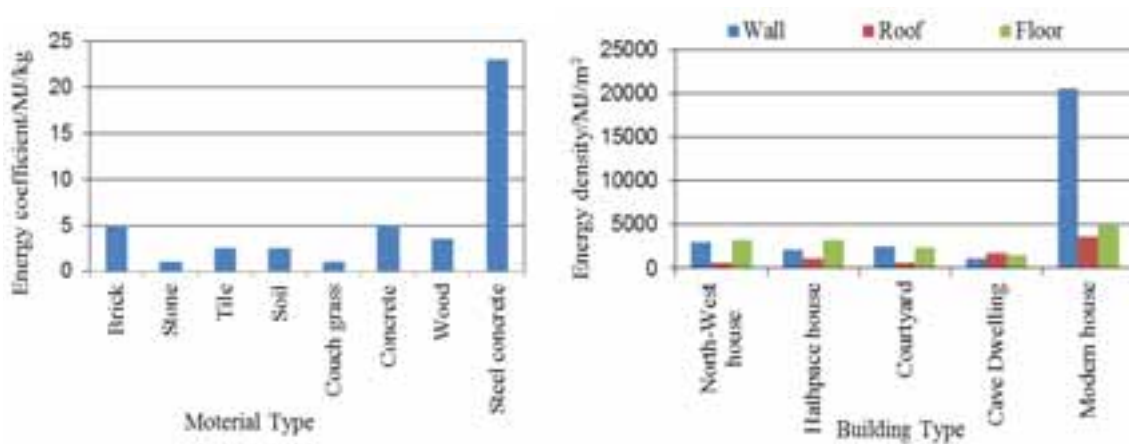


Fig.2: Comparison of the energy coefficient of building materials Fig.3: Comparison of the energy density of building types

As can be seen from Figure 3, due to the principle of local materials, building materials of traditional houses are mostly natural materials, or slightly processed materials. So the energy density of traditional houses is much smaller than the modern reinforced concrete buildings. It shows that the traditional houses constructed by natural ingredients are more energy efficient.

### 3.2 Building climate design

Combined with local climate, geography environment and other factors are considered in traditional houses design. From the construction site design, layout and spatial processing, etc, building design technology of traditional houses suited to local climate are achieved. Sunshine, temperature, humidity, wind speed, rainfall and other factors are considered in the location of residential buildings. Figure 4 shows the distribution and characteristics of typical Chinese traditional houses in different climatic regions (Jean Bouillot, 2008).

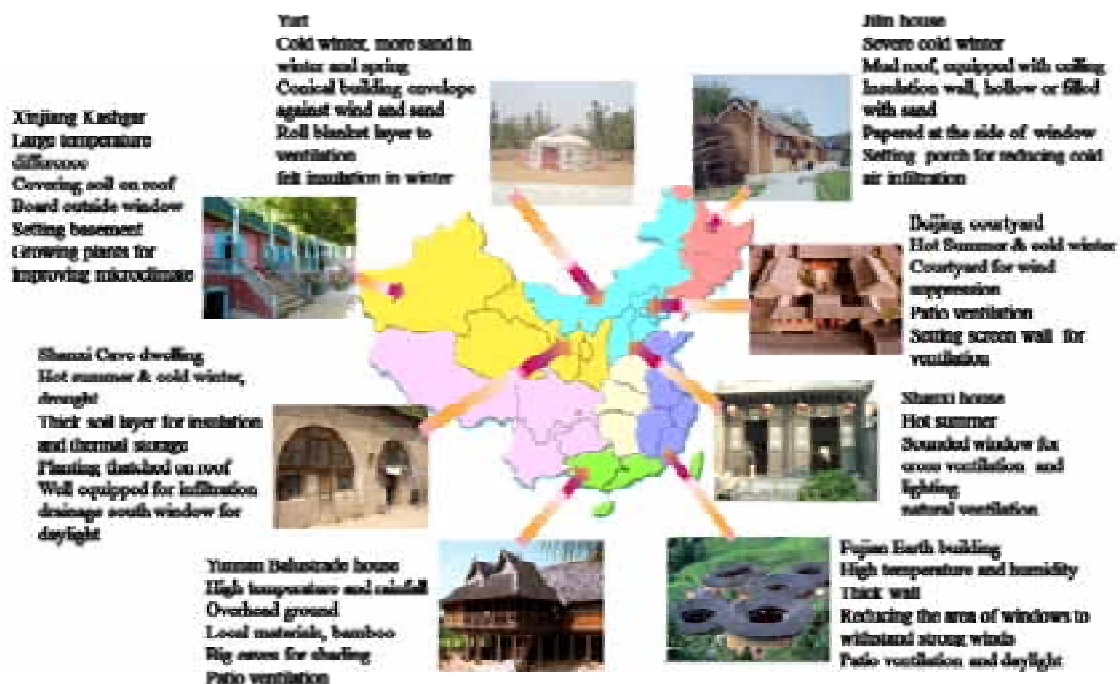


Fig.4: Chinese traditional houses of different climatic regions

Through research and analysis of model design of 10 typical traditional houses in five different climatic regions of China, application frequency of climate response measures of different climatic regions are summarized (Anh-Tuan Nguyen, 2011). As shown in Figure 5, under all weather conditions, considering the physical environment around buildings, building orientation and layout of all traditional houses are taken into account. Meanwhile, the abundant local natural materials, combined with heat or cold storage characteristics of materials are also used widely in weather measures; kang for heating or biomass for heating is also widely used in severe cold and cold regions. The application of natural ventilation is very common, while sunshade or courtyard is adopted to achieve summer cooling and daylight in southern region.

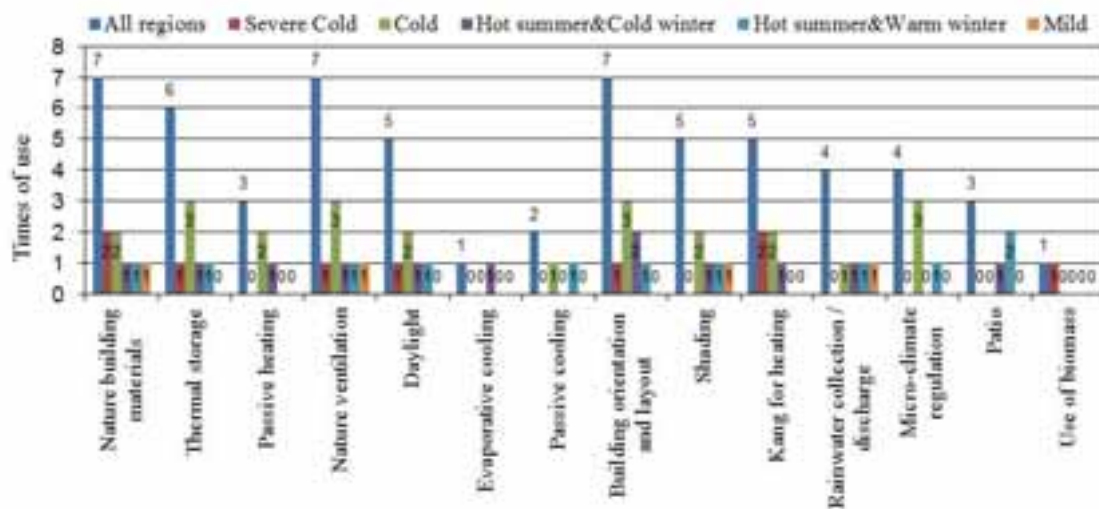


Fig.5: Frequency of use of different climatic responsive strategies

The traditional residence is a product of the society and nature. Along with the change of natural environment and social environment, a large number of traditional houses have been pulled down because they have not been repaired for many years, and traditional features also gradually disappear. By analysis the main cause is the contradiction between traditional building and urbanization. With the development of economy and urban real estate, many residences that survived thousands of years have been broken down. At the same time, changes of modern life and traditional life styles make traditional houses with simple style no longer popular. Therefore, the development direction of future architecture should be based on satisfying modern life, and uphold an attitude that live in harmony with nature, learn the ecological viewpoint reflected from the design and construction of traditional houses, make the buildings present a sustainable vitality.

#### 4. The design view of solar house for farmer

##### 4.1 Embodiment of “Harmony between human beings and nature” philosophy in building design

The theory “Harmony between human beings and nature” claim that man is an integral part of nature and the artificial environment should be harmony with natural environment. Combine with the Chinese traditional idea and climatic responsive design, one naturally adjust building was designed and developed by a common Chinese worker in cold area of China. Figure 6 shows the color solar house, which is located in Dalian. The

house has two bedrooms and a living room, basic information of building is shown in table 2.

During the design process of this building, the idea that conforming to nature and human beings is fully considered. Dalian is a coastal city in northeast China, which has cool summer and cold winter. Therefore, solving the heating in winter is the main purpose of building design. Meanwhile, solar energy in Dalian is rich. Making full use of solar energy is the main idea of this building design. Building materials are mainly hollow bricks and polystyrene board, and building envelopes except the south wall are in line with the design standard for energy efficiency 65% of residential building (DB21/T1476-2006).

Tab. 2: Basic information of solar house

House type	Length Width Height /(m)	Shape Coefficient	Floor area/(m <sup>2</sup> )	Ratio of window to wall of south
One story	11.3×6.5×4.5	0.468	75	0.212



(a) Winter



(b) Summer



(c) Heating and cooling methods

Fig.6: Color solar houses

During building design process, in addition to the ideological of the full use of solar energy, local life style and practicality characteristics also are reflected in the choice of solar air collector and design of building single component, as shown in Table 3.

#### 4.2 Building system construction

Building is a complete system. Besides the technology upgrade of building single components, the overall heat transmission and distribution of the building also need to be considered.

Tab. 3: Design idea of components

	Components	Technology characteristics
Color solar air collector		<p>Collector plate can be colored. Dark side for outside in winter, is conducive to fully absorb sunlight, and white side for outside in summer, can overcome collecting heat. Light penetration cover is made of new material to replace traditional solar air collector with glass cover.</p>
Solar air collector and corridor setting		<p>The solar air collectors are installed on west and east wall. The door is setted for reducing the cold air infiltration of north wall in winter, while the corridor is setted as a buffer zone into the room.</p>
Solat fan		<p>The fans controlled by solar panels are installed in upper inlet, and operating condition depend on solar radiation. The solar fans can be operation without conventional energy sources and manual operation, which overcome the low thermal efficiency.</p>
Temperature control air door		<p>Temperature control air door is installed on lower inlet, and opening degree of air door is controlled by the temperature sensor, achieved automatic damper. without manual operation.</p>
Solar Tile		<p>Solar Tile is solar air collector on roof, which collect solar energy for indoor heating in winter, and form "chimney effect" to cool in summer.</p>

From Figure 6, it can be seen that passive heating, heat storage and passive cooling are adopted in this house. Solar air collectors are installed on south, east, west walls and roof, which collect solar energy for indoor

heating in winter, and form "chimney effect" to cool by sun tiles on roof in summer. The heat stored by solar air collector of west Wall is transferred into the bedroom floor, and the thermal mass such as concrete slab and interior walls can shift indoor temperature swings. Hot water is supplied by solar water heater. Kang is used in bedroom which is the Chinese traditional heating method in rural north. Meanwhile, infrared radiation boards are installed in all rooms as the auxiliary heat source.

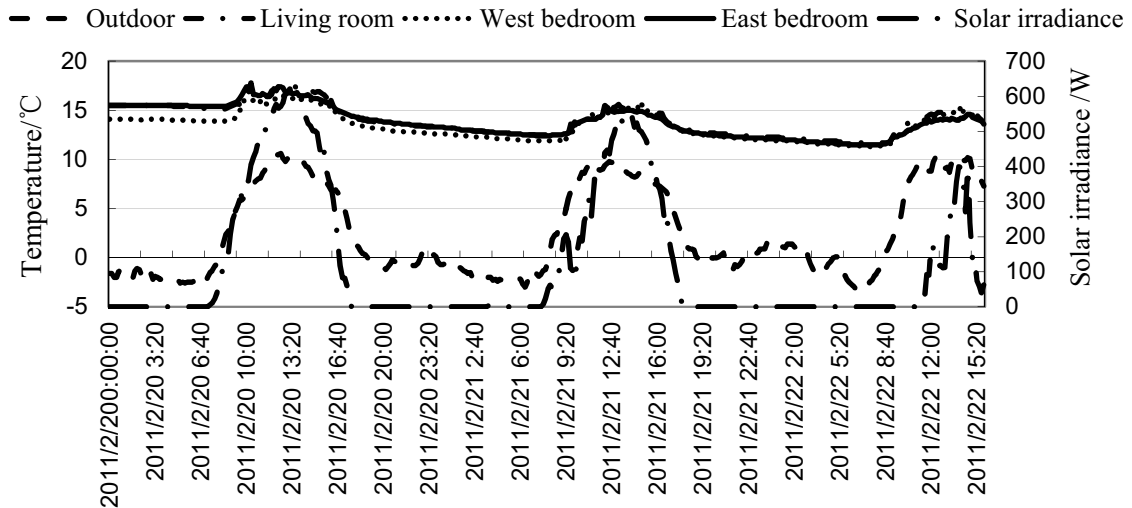


Fig.7: Indoor thermal performance without auxiliary heat source

Figure 7 shows the indoor thermal performance on three consecutive days of solar house under the situation of no auxiliary heat source. The humidity ratio of this house is very big because of the new building. At the same time, the indoor heat source is almost zero with no occupied. Under such situation, the night temperature is kept at 12 °C or more, and daytime maximum temperature of 17 °C or so.

## 5. Conclusions

"Harmony between human beings and nature" philosophy is the basic spirit of ancient Chinese culture and is reflected in cultural, medical and building fields. Through the "Heaven" Philosophical analysis, architectural design should combine with the local natural environment and climate, and consider the lifestyle and adaptive thermal comfort. With economic development, although the traditional houses and modern life have a certain amount of contradiction, local materials and climate responsive measures reflected in the traditional houses are worth to learn. In the end the paper analyzed embody of "Harmony between human beings and nature" on the design of natural adjustment building in the cold area of China. The single component technology and heat transfer strategy of the building overall system can provide some guidance for future low-carbon building development.

## 6. Acknowledgements

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