Thinking of Country House Based on the Concept of Green Development: Take Nanyang, Henan as an example

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Abstract: With the introduction of a series of policies such as rural revitalization, beautiful rural areas, and a comprehensive well-off society, the concept of green development of rural housing has attracted widespread attention. The green development of rural houses can effectively slow down the speed of global climate warming, reduce environmental pollution, reduce energy consumption of buildings and achieve sustainable development of buildings. Based on a field survey in a village in Nanyang City, this article summarizes the current problems of rural housing development, and combines current green development concepts, local lifestyles and living habits, and puts forward some practical suggestions for rural construction and development; the green of rural housing Urbanization can better promote rural construction and provide relevant references for the long-term sustainable development of rural housing in the future.

1. Introduction

In recent years, energy resources and other issues have attracted widespread attention. In order to actively respond to global warming, environmental pollution and energy consumption issues, and vigorously develop green buildings, "energy saving and emission reduction" has become a global common strategic choice[1]. Energy is mainly used in industrial production, transportation and construction industries. According to statistics from the International Energy Agency, building energy consumption accounts for about 32% of the world's energy consumption [2].

Facing the current increasingly severe environmental problems, various countries in the world have taken active countermeasures accordingly. For example, the United States, the United Kingdom, Germany, Japan, etc. have all put forward a series of specific energy-saving solutions, and successively put forward a series of concepts. Such as passive ultra-low energy buildings, near-zero energy buildings, high-capacity buildings, etc. At the same time, China clearly requires the achievement of energy-saving and emission-reduction binding targets in the "Green Building Action Plan" and proposes to complete the Build 1 billion square meters of green buildings and complete 50 million square meters of energy-saving renovation of existing residential buildings in areas with hot summers and cold winters. [3] China is a developing country and a large agricultural country. The most important and most important task is rural issues. Local countries have also issued a series of policies, such as rural revitalization, beautiful villages, etc. with vigorously promoting green development as the main line, comprehensive consideration of building energy conservation, resource conservation and environmental protection, etc. are to alleviate the contradictions in China’s rural areas and improve the people. Effective ways of living conditions, reducing environmental pollution, and promoting sustainable development [4].

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The report of the 19th National Congress of the Communist Party of China focused on the goal of the farmers to lead a better life. It firmly grasped the major problem of the unbalanced and inadequate rural development in our country. The road to rural green development" [5] is included in the general requirements of the rural revitalization strategy. As a primitive form of rural housing, it has a certain effect on the development of society. Under this general requirement, it is necessary to vigorously promote the green development of rural housing; however, as China’s most populous province-Henan Province, the overall development is relatively slow, especially in Nanyang City, a populous city in Henan Province. At present, the weak concept of green development in various rural villages in Nanyang area and the prominent rural ecological environment problems restrict the advancement of rural green development roads [5]; Complex complexes lack uniform guidance and are mostly built according to their own wishes. Problems such as low indoor comfort and poor appearance abound.

2. Green concept summary classification

As a hot vocabulary, "green" has attracted widespread attention and gradually integrated into all aspects of life. For the green concept of rural houses, it involves the surrounding environment, materials, construction forms and other responses to people’s long-term natural living habits and lifestyles; reasonable site planning and design, and proper handling of people, buildings, buildings, etc. The relationship between the three of the environment can not only greatly reduce the energy consumption of the residence, but also improve the comfort level, thereby promoting the green, ecological and sustainable development of rural residences.

2.1. The connotation of the green concept

The green development concept is reflected in the building's life cycle, saving resources to the greatest extent, protecting the environment and reducing pollution, providing people with healthy, comfortable and efficient use of space, and achieving harmonious symbiosis with nature [4]. The green concept pays more attention to energy consumption, economy and other aspects, is a comprehensive manifestation of people and the environment, and is a construction method to achieve sustainable development.

2.2. Green Technology Classification

In order to reduce the consumption of energy resources as much as possible and promote the development of green, ecological and sustainable development, scholars have successively proposed a variety of green technologies with "passive priority and active supplement". The summary of green technologies and their roles (Table 1) is as follows:

| technology                  | effect                                                                 |
|-----------------------------|------------------------------------------------------------------------|
| wall energy saving          | Wall energy-saving measures greatly improve the insulation performance of building walls, thereby reducing building energy consumption |
| wall energy saving for doors and windows | Doors and windows with energy-saving materials or energy-saving measures can effectively reduce the building's indoor energy consumption |
| rainwater collecting        | After the rainwater is treated, the groundwater and surface water sources are supplemented by ground penetration |
| natural ventilation         | Natural ventilation can reduce building energy consumption, improve air quality, and increase indoor comfort |
| renewable energy material saving | Such as ground source heat pump heating and cooling; solar energy; photovoltaic light heating; wind power generation, etc. |

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2.3. Summary of the green concept
The emergence of rural housing is created by villagers using local materials, technical methods, adaptation to local production and life, natural ecological environment, aesthetic concepts, folk customs and other conditions, cohesive a lot of wisdom and wealth [6]; based on the greening of rural housing the development concept is summarized (Table 2).

| factor        | way                                              |
|---------------|--------------------------------------------------|
| climate       | Site master plan, microclimate design            |
| surroundings  | Design of the courtyard and its residential door green landscape |
| energy saving | Thermal insulation, window and ventilation design of the envelope structure |
| cost          | Reasonably carry out functional partitioning and structure selection |
| energy        | Full use of solar energy and biomass energy      |
| material      | Reuse of waste materials                         |

3. Analysis on the Application of Green Concept in Nanyang Area

3.1. The geographical and climatic characteristics of Nanyang
Nanyang City is a city under the jurisdiction of Henan Province. It is located at 32.95°N latitude and 112.53°E longitude. It belongs to a hot summer and cold winter area and a transitional area from subtropical to temperate zone. The climate has certain characteristics, four distinct seasons, short spring and autumn seasons, summer and winter. The festival is long; the hot period in summer is generally about 4 months, from mid-May to mid-September, and the daily average temperature can exceed 28°C. The cold period in winter is generally about 3 months, from late November to late February of the following year, and the daily average temperature is below 13°C. The hottest time of the year is July, and the coldest time is January. The duration of the muggy weather in the year is generally 3-4 months [7] (Figure 1-2); therefore, the winter is particularly cold and dry, and the summer extremely hot.

![Figure 1. Distribution of the highest and lowest temperature in Nanyang](source: The picture comes from China Meteorological Data Network)
3.2. The development of local rural housing

Figure 2. Distribution of precipitation in Nanyang area
Source: The picture comes from China Meteorological Data Network

Figure 3. Country house status map
Through field research, most of the local rural houses adopt brick-concrete structure, single-story flat roof, courtyard form, and layout form of sitting north and south (Figure 3-4), in order to strive for a good orientation, but partly due to considerations such as site and feng shui. The east-west orientation has led to a certain degree of randomness in the construction of houses, most of which are designed by the villagers according to their own wishes, without the guidance of professional designers; the walls are usually 240-thick brick-concrete structures, and the roofs are directly used. It is a cast-in-place reinforced concrete floor. The doors and windows are in ordinary forms, and the installation of doors and windows is simple, and the gap between the doors and windows and the wall is large; in summer, the room is sultry and unbearable, and air conditioning is needed for most of the time. In winter, the room is cool and dry, and most of them need to use electric fans, electric stoves, electric blankets, heating and air conditioning and other heating methods for heating; because the villagers seriously lack consideration of green and energy saving, this has caused Waste of a lot of energy resources.

3.3. A summary of the problems in the development of rural housing
Combining the unique climate characteristics of the hot summer and cold winter areas and the living habits and lifestyles of rural villagers in Nanyang, the issues that have been clearly concentrated in the survey of rural housing are summarized as follows:

- The roof structure is simple and the heat transfer coefficient is large, which seriously affects the indoor thermal comfort; usually the roof is directly cast with reinforced concrete, which absorbs a lot of heat in summer and becomes the main heat transfer component in summer, making the indoor sultry and unbearable, which seriously affects the interior comfort.
- The outer wall has no thermal insulation measures, and the heat transfer coefficient is relatively large; and part of it is used as the west wall, which increases the entry of indoor heat in summer and the loss of indoor heat in winter.

Figure 4. Country house floor plan
Most rooms use one-way windows, which cannot form natural ventilation and affect the thermal perception; even when the temperature is not too high, the lack of natural convection results in low indoor comfort.

The windows do not have thermal insulation measures, and the cold air infiltration is serious; most of the single-layer plastic-steel windows have a large heat transfer coefficient, and there is often condensation in winter, and there is a large gap between the window and the wall during installation, and the wind seepage is serious.

Most of the doors use ordinary iron doors, which have a very large heat transfer coefficient; the gap between the door and the wall is large during installation, and more energy is transferred.

The microclimate design is poor, and most of the courtyards use hard pavement inside and outside, lacking green landscape design.

4. Suggestions for the development of Nanyang rural residences under the green concept

By summarizing the problems in the current rural housing development process and analyzing the unique development characteristics of Nanyang area, pay more attention to some details in the construction of rural housing. A little adjustment can significantly improve the indoor comfort and save money. A large amount of energy and resources can make rural housing develop in the direction of greening, realize the green, ecological and sustainable rural housing, and create a more livable rural environment. In the process of construction or renovation of existing buildings, in addition to the thermal insulation of the envelope structure, attention should also be paid to the design of the overall environment of the site, the design of some microclimates, the use of renewable energy, the use of waste materials, etc. [8]; Now the green development suggestions suitable for rural houses in Nanyang area (Figure 5) are summarized as follows:

- Passive priority. Combining the characteristics of the countryside, according to the principle of "passive priority", the layout of the building should adapt to local conditions, avoid unfavorable factors as much as possible, and meet the requirements of building ventilation, lighting and heating by using natural energy to achieve the purpose of building energy saving; for the roof As well as external walls, appropriate insulation measures can be added. In rural areas, there are a lot of straw, straw, etc. which are good and cheap insulation materials; the roof can be selected as a double roof with a ventilated layer in the middle, and natural wind can take away most of it. The heat introduced into the room through the roof can also be made into a planted roof, which uses the transpiration effect of plants to take away a lot of heat; for the outer wall, some climbing plants can be planted, which can provide good heat insulation in summer; for windows, Replace single-layer glass windows with double-layer glass windows, and treat the surrounding gaps reasonably to improve the air-tightness of the windows; for doors, replace the commonly used iron doors with wooden doors with smaller heat transfer coefficients or other heat-preserving doors.

- Adjust measures to local conditions. Combining with the characteristics of rural development, under the premise of respecting local living habits and lifestyles, the site is designed according to local conditions, and the influence of orientation, etc. is fully considered. For the courtyard and the outside of the residence, the green landscape layout is rationally arranged through shelf and layout. Black shading nets, etc. can play a good heat insulation effect.

- Make full use of renewable energy and waste materials. Rural areas are rich in resources and ample land, which can be fully utilized to reduce energy consumption during production and life. Solar energy can be fully utilized. Solar water heaters can be placed on the roof to form a certain shadow and reduce transmission. The heat entering the room; the country has a large amount of straw, branches and leaves, etc. which can be fully utilized as a good renewable energy for daily production and life; the country has sufficient manure, which can be combined with biogas technology. It is applied to cooking, lighting, heating and other life production; recycling of waste materials, the village has a large number of abandoned tiles, which can be fully utilized in the process of construction and transformation.
In short, in the process of construction and transformation of rural houses, only a little attention needs to be paid to the thermal insulation measures of the outer envelope structure, and the overall green landscape design of the site as well as the utilization of renewable energy and waste materials can be significantly improved. It can save a lot of energy and resources, reduce environmental pollution, and achieve the sustainable development goals of rural houses [9].

5. Conclusions
Based on the field investigation of rural houses in Nanyang area, this article combines the local natural climate characteristics, natural resource conditions, economic development status, people's long-term living habits and lifestyles, and systematically summarizes the problems in its current construction, and Combining with the actual situation, it puts forward feasible suggestions suitable for the green development concept of rural houses. The development of the country reflects the progress and development of the country. The country is not only the focus of development but also the difficulty of development. The country has huge development advantages. It is reasonable to organically combine the concept, technology and actual development of green development, and correctly handle the development and development of the country. The relationship between people and the environment, and always run through the whole process of rural revitalization and beautiful rural construction, so that it can promote the construction of a well-off society in an all-round way, take a green development path suitable for rural construction, and create a more ecological and suitable Residential, sustainable rural housing.

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References
[1] Xu Wei, Liu Zhijian, Chen Xi, et al. Thoughts on the development of "near-zero energy-consumption buildings" in my country [J]. Architecture Science, 2016, 32(4):1-5.
[2] Roaf S, Brotas L, Nicol F. Counting the costs of comfort [J]. Building Research & Information, 2015, 43(3):269-273.
[3] The General Office of the State Council of the Central People's Government of the People's Republic of China. Notice on forwarding the green building action plan of the Ministry of Housing and Urban-Rural Development of the Development and Reform Commission [EB/OL]. (2013-08-11) [2014-01-15].

[4] Beijing Municipal Science and Technology Promotion Center for Housing and Urban-Rural Development. Green building evaluation standard: GB/T50378-2006[S]. Beijing: China Construction Industry Press, 2006.

[5] Duan Yanfeng. The era value, realistic dilemma and path choice of China's rural green development in the new era [J]. Journal of Agricultural and Forestry Economic Management, 2020, 19 (01): 118-125.

[6] Cao Baozhu, Zhao Yueming, Duan Wenfeng. Feasibility analysis of the application of new light steel-straw straw brick energy-saving houses in rural areas in Northeast China [J]. New building materials, 2010, 37(7).

[7] Zheng Fangyuan, Zhao Jingxin, Low energy consumption technology strategy for rural residences in Nanyang area based on climate digital analysis [J]. Journal of Langfang Teachers College (Natural Science Edition). 2019,19(03):85-88.

[8] Gu Linaer Yusufu, Sun Hui. The choice of renewable energy development model and prospects——Taking Xinjiang as an example[J]. Reform and Strategy, 2013, 29(09): 97-100.

[9] You Youneng, Kang Yiting, Ma Jian, et al. Research and development of key technologies for passive ultra-low energy prefabricated buildings in China[J]. Building Science, 2019,35(08): 137-142.