Construction of green housing design methods for ancient villages in southwest minority areas

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Abstract. In order to actively cope with the upgrading of global climate change, through the analysis and research on the key technologies of low energy consumption of green residential buildings in ancient villages of ethnic minorities in Southwest China, this paper expounds the key technology of low energy consumption housing design in traditional villages. From five aspects of "safety and durability, health and comfort, life convenience, resource conservation, environment livability", the new edition of "green building evaluation system" is interpreted in detail. Based on the overall analysis of the ecological technology strategy of Chinese traditional villages, this paper puts forward some feasible design optimization strategies and measures with low energy consumption green technology for the short board of traditional houses. Finally, combined with the characteristics of traditional village residential buildings, the paper puts forward a green evaluation method combining qualitative and quantitative design elements of low-energy residential buildings. Combined with the current situation of ecological environment in China, a new design method of low energy consumption housing in traditional Chinese villages is developed by combining the characteristics of traditional wisdom and key technologies of green building. This paper introduces the feasibility of the method system, and provides reference for other ancient villages in the construction of new houses in the future.

1. Introduction

With the continuous development of the rural economy, the renovation and expansion of traditional houses and the construction of new houses, not only a lot of energy wasted in the implementation process, but also caused many environmental pollution problems. This has made the development of rural houses to low-energy green buildings a trend. The Ministry of Housing and Urban-Rural Development issued the "Thirteenth Five-Year Plan on Building Energy Conservation and Green Building Development" document to promote the gradual expansion of renewable energy building applications and achieve new breakthroughs in rural building energy conservation. In recent years, many scholars have made great achievements in the research of low-energy green buildings. For example, Song Yehao et al. (2013) put forward the passive design strategy of Chinese local green buildings based on the principle of adapting to local conditions and the design concept of suitability. Then, from the perspective of geographical environment and climate adaptability, the key concepts of low-energy consumption in residential houses in Jiangnan Water Village are developed (Yang Weiju, Gao Qing, 2017).

But in a true sense, in order to achieve better sustainable development of beautiful villages, a more scientific and systematic response strategy is needed. One of the best ways is to combine with green building technology. To improve the green residential design system of ancient villages in my country through the key technologies of green building design, it plays an important role in improving the humane environment and ecological environment of traditional villages. The effective application of
the key technologies of green buildings to the design of traditional village houses to achieve the ultimate healthy houses is the direction and goal strongly advocated by designers.

2. Current situation analysis of ancient villages residences

2.1. Overview of southwest minority residences

The southwest minority residence is an original ecological housing system, and its traditional residence is closely related to the natural environment and humanistic characteristics of the area. The formation of traditional dwellings is related to life customs, historical culture, social economy, etc. It is also affected by natural conditions such as geographical environment and climatic conditions. Therefore, this paper takes the traditional green villages of southwest minority nationalities as a case study object to be representative and valuable.

The biggest characteristic of the traditional village residence is the coexistence of man and nature, endowing it with unique regional cultural characteristics. Under the climatic adaptability conditions of the southwest minority nationalities, the residence will exert its maximum primitive ecological technology advantages, and combine the characteristics of the ecological environment to promote the realization of key technologies for low energy consumption of green houses. Especially for traditional houses, green technology is used to optimize the design and update the plan. Due to factors such as climatic conditions, customs and topography, traditional houses have prominent regional cultural characteristics (Figure 1).

![Figure 1. The present situation of dong nationality's traditional houses](Chart Source: Self-photography)

2.2. Analysis of the plane layout of village residence

The spatial layout, architectural form, structural materials, and orientation of the traditional houses of ethnic minorities in Southwest China are deeply affected by environmental characteristics. The layout of traditional houses is adapted to local conditions and ecologically livable. Traditional houses pay attention to the use of natural environmental conditions, combine with the terrain, and live in harmony with nature. For example, traditional residential houses are mostly closely integrated with rivers and mountains and forests, which is in line with the traditional wisdom and ecological nature view in today's green residential technology system [6].

In the traditional village residential building layout layout, space design, building materials and other aspects to save energy, fully and effectively use natural resources, and dig out the ecological value of natural resources. Many excellent construction technologies in traditional houses reflect natural ecological energy-saving technologies, such as warm in winter and cool in summer and automatic adjustment. The effective utilization of resources in this respect and the breakthrough of key technologies for green houses are worthy of extensive promotion and reference. [7] The specific layout types of traditional southwest minority village residences (Table 1) are shown.
Table 1. The residential types of ancient villages of ethnic minorities in Southwest China.

| Dotted layout | Linear layout | Planar layout |
|---------------|---------------|---------------|

Table 1: Self-made (Partial references)

It can be seen from Table 1 that the village houses are organically integrated with the natural environment and respect the natural layout rules. Reasonably adopt residential ecological construction technology that conforms to the natural environment, pursue the use of natural conditions, provide humans with maximum livable conditions, and create laws based on the premise of low energy consumption.

2.3 Current status and problems of ancient village houses

In the ethnic minority areas of Southwest China, quite a few ancient villages have insufficient protection, and the basic functions of the houses can no longer meet the needs of modern people. For example, the use of lighting, ventilation, and heating and ventilation in village houses generally have certain defects and problems. It reflects the current status and problems of village residences, the arrangements are shown in Table 2.

Table 2: Analysis on the current situation and problems of ancient village houses.

| Classification          | Current situation and problems                                      | Measures and methods                                           |
|-------------------------|----------------------------------------------------------------------|----------------------------------------------------------------|
| Ancient village residence | ● The residence remains relatively complete, but some functions are missing.  
                             ● It has been left unused for a long time and has not been repaired in time.  
                             ● Insufficient protection and lack of scientific countermeasures. | ● Carry out appropriate transformation, increase the layout of HVAC, network, etc.  
                             ● Establish protection research teams and expert evaluation teams. |
| New village residence   | ● There is a lack of scientific planning and design, which is inconsistent with the original residential style and has a single appearance.  
                             ● Unreasonable residential functions, lack of energy-saving technology, and waste of resources. | ● According to the characteristics of traditional dwellings, scientific planning and design are carried out.  
                             ● Energy-saving materials and energy-saving measures are adopted to develop green technology with low energy consumption. |

Table 2: Self-made (Partial references)

3. Construction of green design method system of ancient village residence

3.1 Relationship between residence and climate, geographical environment and natural resources

In order to be able to adapt to changes in the regional climate, most of the ancient villages of ethnic minorities in southwestern China are usually built in places with water and farmland. Through the reasonable construction of residential space and structural forms, the spatial form of the ancient villages in the village has regional characteristics and meets the various elements that adapt to the regional climate. The spatial layout and classification are combined with the characteristics of the climate, and
the ecological green technology is flexibly used to create a livable environment, maintain the harmonious development of the ancient village residence and the natural environment, and highlight its unique rural regional culture [8]. Therefore, as long as the ancient village residences embody green designs that conform to the regional climate, natural ecology, and low energy consumption, the natural environment will show its regional characteristics. Thus, a green residential system for ancient villages with "regional culture, characteristic culture, and livable environment" that responds to climate change was constructed (Figure 2).

![Figure 2. Green residential system in ancient villages](chart_source_self-made)

The regional culture in the above figure is mainly analyzed from the location of the residence, considering the design concept of the residential building according to the characteristics of the region, and highlighting the geographical and climatic characteristics of the residence. The characteristic culture is mainly positioned from the inherent cultural elements of the house, and the use of its traditional cultural elements has brought aura and connotation to the residential architecture. The livable environment and regional climate are optimized through the ecological technology and green design methods of the residential buildings themselves to improve their performance, thereby forming a cultural system of thermal insulation culture, shading culture and both.

3.2 Principles of green housing design

Traditional houses include farm houses and vernacular buildings, and their construction process has ecological technology and green building ideas. Mainly focus on the entire life cycle of residential houses and the nature of the natural environment, save natural resources, protect the ecological environment, and highlight its low-energy green technology research and practice. Establish a new green building development model of "people-oriented, environmentally livable, resource saving, performance quality" [9]. At the same time, in order to adapt to the destruction of the natural environment caused by the current global climate deterioration, a new low-energy green technology path is provided.

The ancient villages in the southwest minority areas have different characteristics, and there will be certain differences in the natural environment, economy and culture. According to the basic conditions of the local villages, the design principles of green housing suitable for the local area are constructed. The ancient villages pay more attention to the layout and orientation, the change of terrain and the relationship with the natural environment, and also consider the natural form factors of residential construction. Harmonious coexistence with the natural geographical environment is the purpose of green housing design. It is necessary to maintain the overall relationship between the ancient village residence and nature to the maximum extent according to the characteristics of its regional culture and the development laws of the natural environment [10].
3.3 Green housing design method system

The technical methods of green housing are basically based on: the existing "Green Building Evaluation System" adaptability analysis of near zero energy consumption green evaluation, and then the extraction, qualitative and quantitative evaluation analysis of green elements of traditional houses. The regional characteristics of green technology are closely connected with the area where residential buildings are located. Explore the use of natural conditions and ecological resources to achieve the ecological livability of ancient villages, and the green technology rules based on the premise of consuming the smallest natural resources. According to the location of traditional houses, the use of natural resources, green techniques, and the modeling skills of the microclimate environment, the types of houses can be divided into three types: natural, ecological, and technological. Its green evaluation method should also carry out evaluation rules of different adaptability according to different rural geographical environment characteristics, so as to form a distinct green residential technology system (Figure 3).

Figure 3. The System Framework of Green Village Design Method in Ancient Village
Chart Source: - Self-made

The correlation between the traditional residential cultural elements and green performance is mainly reflected in: five aspects of the new version of "green building evaluation system", "safety and durability, health and comfort, convenience of life, resource conservation, and environmental livability" [11]. Combining the characteristics of traditional houses, a green evaluation method combining qualitative and quantitative design elements of green housing is proposed.

4. Conclusions

In order to solve the key problems of low energy consumption residential technology in ancient villages in China, inadequate utilization of natural resources, environmental pollution and other key issues, this paper carried out a qualitative and quantitative study on the relationship between low energy consumption factors in ancient villages and green energy conservation. This article aims to put forward the research direction of realizing the livable environment of ancient villages in China and the application of green and low-energy technology. At the same time, it proposes a technical optimization plan for low-energy housing in ancient villages in China, and carries out evaluation and certification. An overall analysis of the ecological technology strategy of the green houses in the ancient villages of ethnic minorities in southwestern China was carried out, and on this basis, a number of suitable green technology transformation strategies and methods were proposed for the defects of the ancient village houses. The research results can not only provide guidance for the design of green houses in ancient villages across the country, but also provide references for the renovation of existing traditional houses.

This article addresses the inefficient use of natural resources in ancient villages, insufficient energy conservation and environmental protection, and bottlenecks in the repair of traditional buildings. In the
actual case application, the setting of some evaluation indicators needs to be further improved. In particular, some data measurement on the technology of green houses in ancient villages needs further improvement of efficiency and scientific verification. Through the analysis of this series of practical problems, the innovative research ideas for the construction of green residential technology system in ancient villages in China under the strategy of rural revitalization are put forward. Combined with the current status of my country's ecological environment, by using the characteristics of the combination of Chinese traditional cultural wisdom and natural wisdom and key technologies of green buildings, a new method of green residential technology in ancient villages in China is developed. Research breakthroughs in this area will further provide valuable theoretical references and scientific basis for the green residential technology strategy and sustainable development of ancient villages in China.

Conflicts of Interest
The author declare that there is no conflict of interest regarding the publication of this article.

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