Energy-saving reconstruction of buildings in cold winter and hot summer areas with the green ecological concept

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Abstract. Green ecological concept is a leading thought in this paper. In accordance with the principle of "improving thethermal comfort of the farm house in local conditions", the problems of existing residential buildings in the rural areas of China were studied, where are characterized by cold winter and hot summer. Based on the actual situation of the buildings in these rural areas, the characteristics of rural natural environment and social and economic development in Guanzhong area of Shaanxi province were investigated. Combined with these features, the specific Energy-saving methods were proposed to optimize the design goals and construction methods of the houses in these areas.

1. Introduction
For a long time, the number of residential buildings in China’s rural areas is extremely large. However, the low level of residential construction technology is lack of scientific sound. The local people always neglect the most basic building thermal performance and comfort requirements, which result in low energy utilization, thermal insulation performance and poor comfort. To improve the life quality of the farmers, the living conditions should be focused on, so that the existing residential construction’s Energy-saving transformation in rural become a priority issue. China's vast territory, natural conditions, historical and cultural background, economic development, production, lifestyle and customs are highly different. Therefore, a promotion of energy efficiency of rural existing residential building should be carried out in local areas by transforming the technology.

Optimal design can be defined as studying the problem and finding the best solution to the problem (optimal should be understood as the most satisfying result under given conditions) [1]. Based on the green ecological concept, we carried out a series of field investigations on the existing residential buildings in Guanzhong area of Shaanxi province, and went to the representative Hu County, Weinan, Baoji and other fields to observe the field. Finally, we collected numerous data of the building structure of the existing farm house. Based on the data of structure, space, building materials, energy use and daily work, some specific ways to optimizing design goal of the existing residential buildings in cold winter and hot summer area are discussed. It is expected to provide some reference of value theoretical basis and engineering application method for further energy-saving reconstruction in similar areas.

2. The methods of optimization design of existing buildings in cold winter and hot summer areas
Guanzhong region is located in the cold area of climate zone, having a relatively long winter and summer. The average indoor temperature of the rural areas in winter is about 11.6℃, while that in summer is about 28.10℃ [3]. Energy-saving renovation design should focus on the winter heat
preservation and integrated consideration of summer thermal. Therefore, the specific ways to optimize the design of existing building energy-saving in rural areas are as follows.

2.1 External protection structure of thermal insulation and energy-saving renovation

2.1.1 Wall

Guanzhong area has vast majority farm house, which is characterized by the external walls of brick masonry of solid clay. Changing the external wall construction practices can greatly reduce heat consumption of the wall. It should be advocated to build the external wall as an "external insulation" for the existing construction.

Insulation layers or insulation decoration integration materials are useful treatment, which can avoid building hot bridge, wall winter condensation and block cold bridge, and improve the heating effect and the indoor thermal comfort. They can also protect the main structure, reduce temperature stress and increase the life of the structure and wall insulation construction [4]. The external wall should choose the energy-saving effect, light cheap and suitable materials. Therefore, it is recommended to use the polystyrene board, which is in a good performance, namely, construction convenience and low cost. The accessible and cheap materials (clay plus wheat stalks and rice husk, etc.) in the rural areas of Guanzhong can also be used as external wall insulation materials. These methods can be widely used in energy-saving reconstruction of existing buildings in China.

2.1.2 Roof

In Guanzhong area, most of the existing roofs of agricultural houses are reinforced by concrete and formed as traditional sloping type [5]. The rural areas of the region are large and high-rise, which can be as the aerial layer to keep warm. Roof insulation can be used with the form of ceiling insulation, so that the roof and ceiling between the air layer have an insulating effect, which can improve the roof thermal resistance. In addition, the roof coefficient of heat transfer in winter can be significantly reduced. The slope roof can also be set with ventilation devices, such as skylight, tiger window, and transom, etc., which can improve utilization of slope roof and summer heat insulation effect.

2.1.3 Ground

People in Guanzhong rural areas use the ground as a soil compaction after the cast-in-place concrete, and then cement mortar cover. Many farmers also embed tiles or terrazzo in the ground floor. Compared with the south area in China, the area has less rainfall, lower groundwater level and drier soil. Therefore, it is suggested that the laying of cheap slag and other insulation materials should be under the ground of cushion layer. The ground moisture proof design can reduce surface heat dissipation, which should be pay much more attention.

2.1.4 Doors and Windows

The existing rural residential doors in Guanzhong areas is very large. According to the local customs, opening door in the day time cause indoor and outdoor temperature difference [4]. It is advisable to set foyers to prevent cold air infiltration in winter. The buildings in Guanzhong areas also have a large window, so the window of the heat transfer coefficient is large. It is recommended the space between the inside glass windows and outside windows is about 100mm, which meet the thermal performance indicator [6].

The window and the wall should be warm and sealed. Therefore, it is necessary to improve the tightness of the windows and doors and strengthen the perimeter of doors and the seal of the windows. It is suggested that the farmers should not use ordinary flat glass in their windows and doors.

In addition, it should promote education and other ways to teach the local villagers to often open doors and windows in winter daytime. Thus, they can open the window in the morning and close the window in the evening and use thick curtains and other insulation practices all night.
2.2 Energy use

2.2.1 Heating
Guanzhong Farming house always uses the traditional Kang heating in winter. On the basis of traditional heated Kang, the Kang body structure is simplified, so that the heat dissipation time is prolonged. A highly efficient and energy-saving Kang is also recommended, the popular name of that is "Hang Kang". A machine is put in the traditional big Kang foundation, which make the Kang to burn the material to produce the energy to be full. The combined heat efficiency can be increased to 70%, and the temperature of the Kang is even. This method is worth of popularizing.

2.2.2 Solar energy utilization
The total sunshine times in Guanzhong area are above 2000 hours, which provides necessary conditions for solar energy utilization. However, according to the author's investigation, most of the rural residential areas of the solar energy use quite less and the form is very single (mainly in the installation of water heaters by solar). In the new village of Weinan, the proportion of local farmers who have installed solar water heaters is only about 20%. Although many villagers have the intention to install, they have not yet fulfilled their aspirations because of the limited economic capacity. Therefore, there is still plenty room for solar power development.

2.2.3 Biogas
Biogas is not only used to solve the problem of rural fuel shortage, but also can be used for heating and lighting comprehensive utilization. It is recommended to multiple households to concentrate on the construction of efficient biogas facilities, centralized management and efficient utilization of resources, so that biogas facilities can use high energy efficiency to provide efficient, clean and safe biogas energy for vast number of farmers.

2.2.4 Heat-cooled in summer
Electric fans are mostly used in homes in Guanzhong areas in summer, because there are few other cooling facilities. It is appropriate to use external shading to block the heat outside. In winter, the inner shading (such as curtains of thick fabric) can be used to block the loss of heat from the interior of the building. The interior and exterior shading can be used rationally to achieve better heat insulation effect. Curtains with reflectivity and low light transmittance can play a very good shade effect, reducing indoor temperature in summer.

2.3 Environment improvement of outside

2.3.1 Greening
Strengthening greening can significantly improve indoor temperature. It should plant certain number trees in the courtyard, such as persimmon, walnut, apricot, and so on, which are suitable for Guanzhong region. With their huge canopy, these trees provide the residents a huge "sunshade" in summer. It can also plant ivy and other rattan plants on walls, which put "cool clothes" on exterior walls of the residential buildings. But in combination with the geographical and climatic characteristics, the green type and the green density should be preferred appropriately, because it is necessary to avoid affecting indoor ventilation and guarantee the winter sunshine and lighting [7].

2.3.2 Renovation of the outdoor site
It is appropriate to reduce the original cement floor of outside. In addition, the addition of ground of seepage concrete not only can reduce strong reflection of the summer sun, but also can quickly leakage the rain to the underground, which effectively improves the microclimate. Therefore, it is recommended that the courtyard should be less "hard bedded" and more "soft bedded" and create a good outdoor environment.
2.4 Security and health environment

2.4.1 Earthquake resistance and pollution prevention
The seismic performance of the Energy-saving structure should conform to the standard. Safety and environmental protection of natural materials should be applied as much as possible. Reducing radiation and harmful gas pollution will create a safe and small environment [8].

2.4.2 Waste disposal
The energy-saving transformation should be performed in the garbage collection, so that "waste" to the environment is to be minimize pollution [9].

2.4.3 Noise and visual pollution prevention
The new material with excellent sound insulation should be used in the transformation. Indoor noise should be less than 40db. The shielded measures of the external air conditioner and the noise should be considered in the design.

3. Conclusion
The countryside in Guanzhong area was chose as a breakthrough of this research topic. The green ecological idea and the energy-saving renovation idea of "improving the thermal comfort of the farm house according to local conditions" were choose as a leading thought. The theory and method of optimization design are highly operable, which can be applied to the similar regions in the whole country, and may expect to obtain considerable social, economic and environmental benefits. However, the rural housing Energy-saving work still need a long time, vast number of scientific research and design works and support of government-related policies to be popular.

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