

Rural existing residential building envelope energy saving in Chengdu

Lingyun Wang ^a, Zhiping Zhao

School of Civil Engineering and Architecture, Southwest Petroleum University, Chengdu 610500, China

^aE-mail:397935913@qq.com

Abstract. According to the actual research and building energy consumption in rural areas of Chengdu Status and peasant economic level, through the study of Chengdu rural status quo of existing residential buildings, the paper proposed energy-saving measures for Chengdu Rural existing residential building envelope. These measures have important implications for improving their living standards, to ease pressure on China's energy and to improve the overall environment in rural areas.

Keywords: Chengdu, building envelope, energy transformation, rural existing buildings.

1. Introduction

Four major industrial energy industry in China such as transportation, construction in our lives, building energy consumption accounts for nearly one-third of total energy consumption, building energy efficiency is considered to be the most promising field of energy has important significance for ease China's energy shortage and improve the ecological environment and the development of the national economy. In a variety of factors that affect the structure of energy consumption in buildings, thermal insulation properties airtight building envelope and the building is one of the two most important factors. To reduce the energy consumption of the building structure, we must enhance the performance of the building envelope insulation structure. With the development of rural economy and people's living standards improve, new construction and renovation of rural housing have increased year by year, the quality of life of rural residents and habitat requirements are increased. Rural housing have increased 600-700 million m² every year nearly 10 years, accounting for 50% of the country's total new housing, [1] but the study of rural housing construction is weak, particularly for natural ecologic fragile, economically underdeveloped areas of research lack of effective energy-saving technical measures, some research and recommend follow the practice of urban residential energy conservation experience, which is seriously out of the actual situation in rural areas.

2. Status quo of existing residential buildings in Chengdu rural areas

Chengdu is located in the western part of China, which has a subtropical humid monsoon climate zone. Climate characteristics are building thermal design partitions, which is hot in summer and cold in winter. In this paper, field research selected in Jintang County, Shuangliu County, Pengzhou and other four villages were randomly visited and questionnaires. The results show that: the area of rural housing are mainly in independent houses and the form of a brick structure. The main building materials are 240 mm thick brick. Most buildings uses flat roofs, wood frame or aluminum frame and single glazed windows and single layer wooden doors. Shape coefficient and ratio of window to wall is too large. Window wall area ratio and shape coefficient are two parameters which have a significant impact on building energy consumption. Due to economic constraints and the technical conditions of people saving consciousness in the construction process of rural housing, which brought a heavy burden of energy because the majority of traditional approach cannot save energy to our society. Therefore, this paper can conduct the energy saving reconstruction about walls, outside doors and windows, roof and floor in rural construction in Chengdu.

3. Houses identified

First existing energy-saving housing should meet house hazards identification grade which is A and B. Second housing risk level is divided into A, B, C, D four grades, Which based on building damage level by the on-site survey. The risk level of the rural house classification in Table 1.

Table 1: Risk level of the rural house

| Classification | Housing expense |
|----------------|---|
| A | Structure to meet the normal requirements, the danger point, the structural safety of buildings were found. |
| B | The basic structure to meet the normal requirements of individual structural members at risk, but does not affect the safety of the main structure, basically meet the normal requirements. |
| C | Part of the load-bearing structure can't meet the normal requirements, partial dangerous situation, constitute a partial dangerous. |
| D | Load-bearing structure can't meet the normal requirements of the overall housing dangerous situation, constitute the entire building dangerous. |

Risk identification process for housing: commission accepted; initial investigation; site risk identification; Check the detector; appraisal rating; treatment is recommended; issue a report.

4. Exterior wall renovation

For exterior walls, the thermal systems of traditional single-wall structure cannot up to the requirements of energy conservation because it had not conducted heat treatment. At present, energy-saving methods of wall masonry structures have four categories: exterior insulation, external wall insulation, wall insulation sandwich integrated insulation. Thermal insulation of external wall is the insulating layer placed on the outside of the main wall, which is the national advocate for heat preservation practices. It can mitigate the effects of the cold bridge phenomenon and reduce the temperature stress of the body wall at the same time.

Exterior Insulation Advantages:

Exterior insulation can minimize the thermal bridge;

Conducting external insulation, due to the large heat capacity of the internal solid wall, indoor energy accumulator more heat stable at room temperature;

Through the outer insulation to improve interior and exterior surface temperatures can get comfortable thermal environment;

Interior brick walls are protected;

Exterior insulation increases the residential use of the area, and less restrictions on the interior decoration;

External insulation to protect the main structure, to extend the life of the building.

5. Transformation of outside doors and windows

Doors and windows are an important component in the wall of the structure, which have many functions such as lighting, ventilation, decorative and others. The heat transfer coefficient and air exchange volume are large are main reasons cause large energy losses, which is an important part and the weak link in building energy efficiency. So we must take effective measures to improve the thermal insulation performance of windows and doors. Single layer glass of wooden doors and windows and steel doors are major in Chengdu rural buildings. They are instead gradually by a single glass of aluminum doors and windows after 90 years. Air tightness has improved a lot than traditional windows and doors. Which can reduce heat loss, but many seals loses its elasticity and its sealing effect after a few winter. So it needs for energy saving. Transformation can be considered from the following points:

- 1). Select the appropriate windows reasonable type;
- 2). Enhanced airtight doors and windows;
- 3). Use a small box timber heat transfer coefficient;
- 4). The use of energy-saving window type;
- 5). The use of window insulation panels, curtains and foil;



Figure 1: Insulation curtain



Figure 2: The ceiling laid insulation package

Heat-shielding performance of traditional wooden doors can effectively block the heatdissipation. But we need to improvement of construction technology, and strengthening the maintenance, control the sealing of door and framedoor strictly, which can effectively block heat loss. Doors and windows insulation can reduce cold air infiltration and heat loss. Good quality double-glazed replacement windows can greatly improve the thermal performance of windows and doors to reduce heat and cold air infiltration heat loss, but the cost is relatively high. It is suitable for promoting the use of better economic conditions in the region. Application insulation curtain (Figure 1) and paste transparent polyester film is relatively simple method which can improve the insulation performance windows. The method increase the thermal resistance, reducing nighttime outdoor and indoor radiation heat transfer which can reduce cold air infiltration heat load and reduce heat loss which caused by cold air infiltration.

6. Roof and floor renovation

6.1 Roof

Residential roofing basically built in the 1990s in rural of Chengdu, Roof slope are constructed with tiles and 100mm thick concrete which is made by the concrete Rao plate. The human body will be very uncomfortable if the temperature of the roof layer is the same as the outdoor temperature in the summer or a large amount of heat transfer through the roof indoor to outdoor.

Roof insulation rehabilitation programs in rural areas of Chengdu are mainly two: in the powder particles of polystyrene insulation and ceiling laying external insulation package. Outside the powder

particles of polystyrene insulation system and powder particles of polystyrene wall insulation system is the same. Its construction process can refer powder polystyrene particles exterior insulation system. Laying insulation package on the ceiling is relatively simple way (Figure II), as long as the fire ash cooler bag can be laid on the ceiling. This way requires sufficient space for laying on the ceiling, and it need evenly laid on the ceiling to prevent significant cold bridges.

6.2 Ground

For a long time, land surface and cement mortar floor is mostly in rural residential. The floor is strong endothermic insulation performance is poor. Heat lost a lot of heat loss from the ground is the main reason because of any insulation measures, so ground insulation should be set. Strengthening ground thermal insulation and reduce heat transfer on the basis of the external walls of the ground insulation is very important Factor. This article describes two holding ground:

(1) Slag insulation Floors: First, in the upper layer of soil compaction original linoleum made of paper vapor barrier. Second, spread and compacted slag. Third, do the broken bricks concrete pads, the surface layer of cement mortar.

(2) Cement cinder ground: First, in the upper layer of soil compaction original linoleum (or plastic sheeting) as a moisture barrier. Second, spread cinders. Third, do cinder concrete; surface layer of cement asbestos dust (or thick cement mortar).

7. Conclusion

Rural existing buildings for energy saving is large and wide Engineering, which is the emphasis and difficulty of building energy efficiency. The rural economy gradual Increase in Chengdu. Energy-saving work well for farmers can provide economical, comfortable and healthy living environment, which will affect the economic and social benefits.

References

- [1] H.L Zhao, R.M Yu: Chifeng region typical rural residential energy-saving passive simulation, Fujian Architecture & Construction, Vol. 43 (2014) No.3, p.65-68.