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A Study on Indoor Thermal Environment of Rural Residence in South Liaoning Province

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Abstract

Targeting at rural residence in south Liaoning province, a continuous test on indoor temperature and atmospheric temperature is made and a questionnaire survey about residents' thermal sense is conducted. Combined with local residents' mode of life, living habit, psychological demand, economic situation and so on, heating design temperature of south Liaoning province is given. It shows that the temperature demand of residents that live in traditional house is lower, which of master bedroom is 12 to 14 centigrade. To newly building, the heating temperature demands of different rooms are different. The heating design temperature of frequently used room ranges from 12 to 14centigrade, and occasionally used room ranges from 10 to 14 centigrade. However the heating design temperature of room which is hardly used is from 9 to 13 centigrade. This paper will offer theoretical basis for new rural construction in south Liaoning province.

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Keywords: Rural; Indoor thermal environment; Heating design temperature

1. Introduction

Northeast China, winter lasts 4 to 6 months. Residents always stay in house during this period so indoor thermal environment leads to an important influence on people's health. With the development of new rural construction and improvement of residents' living quality, indoor thermal environment has raised more and more attention. And residents have a higher demand on it [1-4]. However many studies show that indoor thermal environment in the northeast is still worse. It is very imminent to improve heating. The standard about heating design temperature is

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mostly focus on urban residence yet. For the difference of life mode, wearing, behavioral pattern, economy condition between residents who respectively live in city and country, the standard of heating design temperature of city is different from of which in county correspondingly[5]. Taking residences in south Liaoning province as example, with the respect on local residents' living pattern, traditional habit, psychological need and economy condition, thermal environment standard which is suitable to local rural residence is studied. It can not only improve living standard of residents but also direct design of new rural construction and promote the sustainable development of rural construction.

2. Methods

To learn indoor thermal environment condition and gain residents' thermal sense on indoor temperature, a research focusing on rural residence in Anbo, little town belongs to Liaoning province, is made. And it is carried out through two methods, onsite measurement and subjective questionnaire.

The district is under the stage of new rural construction. Besides typical traditional residences, there is still newly building that unified constructed by government. They are different in plain layout, the size of courtyard, building envelops, heating sources and life mode and so on. Considering that above factors have influences on indoor thermal environment and thermal sense of residents to some extent, both typical traditional residences and newly residences are included in the sample.

In traditional rural house, residents stay in master bedroom at most times. To gain the temperature demand by residents on master bedroom, a continuous temperature test on this room is made focus on 5 typical traditional residences during 19, January to 25, February, 2014. At the same time, surface temperature of building envelop is recorded by FLIR thermal infrared image and a questionnaire survey about thermal sense of residents is made.

Different from traditional house, the newly house has the trend towards urbanization. Besides the common rooms, such as bedroom and kitchen, that only can meet basic living requirement, it also includes other functional rooms, such as washing room, living room, dining room and so on. Considering that the duration and intensity of activity when residents stay in various types of rooms are different, the temperature demand by residents in varied functional rooms also is different. Thus, to thoroughly grasp thermal environment condition and gain residents' demand on different functional rooms, a continuous temperature test on various types of rooms of 3 newly house and a questionnaire survey about thermal sense of residents is made during 24, January to 31, January. Questionnaires are carried out on the premise of local residents' traditional living habit and life mode.

Subjective questionnaire involves following aspects. One is the basic information of residents who participate in survey, such as age, sex, being permanent resident or not and so on. The second aspect is residents' living habits, such as duration of activity, intensity of activity, clothing condition. And the last aspect is residents' thermal sense during the investigation. To learn local people's living pattern, activity condition, clothing condition as far as accurately, research team members live with residents and subjective questionnaires are made every a few hours during the investigation.

3. Results

3.1. Rural residence fundamental information

Thermal performance of building envelope in traditional residences is poor, without insulation measures. Outer wall is in masonry-based, thickness of that is mostly 500 millimetre and heat transfer coefficient is about 3.24 $W/(m^{2}\cdot K)$. Single sash with plastic steel and wood-based materials is more common. And south glazing ratio is about 0.3. Besides, residential roof is mostly sloping, with the purlin sub and rafters as framework. Layout of traditional residence is simple, shown in figure 1. Furthermore, there is a large yard in traditional house to meet the requirements of living, growing vegetables and storing grain.