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Research Article

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Test study of the thermal environment about new and old two types of rural houses in QiLian mountain northern foothills area-taking Hongwansi town In Sunan as a measurement object

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ABSTRACT

This study aimed to analyze the summer and winter indoor thermal environment of new and old two types of rural houses in QiLian Mountain northern foothills area. The method of analysis is field testing, include indoor air temperature and humidity, outdoor air temperature and humidity .The result shows the relationship between indoor thermal environment and envelope materials, heating methods, location of rooms. In addition, the influence was Quantified in 1～2° C in summer, 10～15° C in winter. Finally, advice put forward to promote the indoor thermal environment.

Keywords: QiLian Mountain northern foothills, Rural houses, Energy-saving, Thermal environment, Field test

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INTRODUCTION

In this paper the selected base in Sunan, hongwansi town, Qilian Mountain northern foothills, Zhangye City. Existing residential indoor thermal environment largely ignored the evolution and development of new and old houses. Thermal environmental shortcomings of the field investigation and analysis of new and old residential areas, not only to improve the quality of living, but is intended to guide regional houses to go to energy-saving, low-carbon path of development [1]. Obvious plateaus climatic characteristics: about the annual average temperature 3.6 ° C, cool in summer and cold in winter [2]. A cold region in the thermal partition. Such climatic characteristics determine the area residential climate design natural ventilation in summer, demand heating insulation in winter [3,4]. Therefore, the two old and new houses for local, conducted a test of thermal environment.

1. Object of study

With the implementation of the state's settlement policy in the local Yugu herders, establish different types of houses. From the actual research, summed up the two kinds of living Type: bungalows and high-rise residential.

1.1 The ordinary cottage residential

The ordinary cottage is set for the test room. Ordinary cottage walls as the combination of brick walls, three side walls, a brick wall. Brick wall thickness is 240mm and earth wall thickness is 300mm. Roof are wood purling system(board wide is 1.5~2cm,earth wide is 3~4cm,tile is on top) The size of double glazing wooden windows is 1.5m×1.5m in outer wall. (Fig. 1).

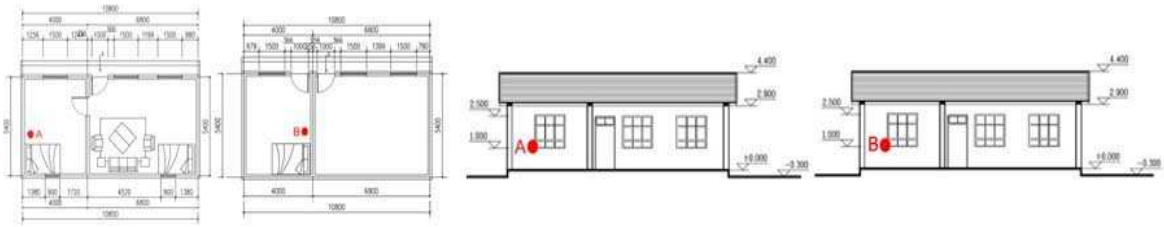
1.2 The multi-storey residential:

The multi-storey residential settings for contrast room. The high-rise residential outer wall made of 3 mm brick without insulation layer. Its position is 6 floors of two-layer intermediate. The interior wall is the east-west direction. Floor is 200mm in-situ concrete. Outside the windows size are C1（1.5m×1.67m）; C2（2.4m×1.97m）; C（

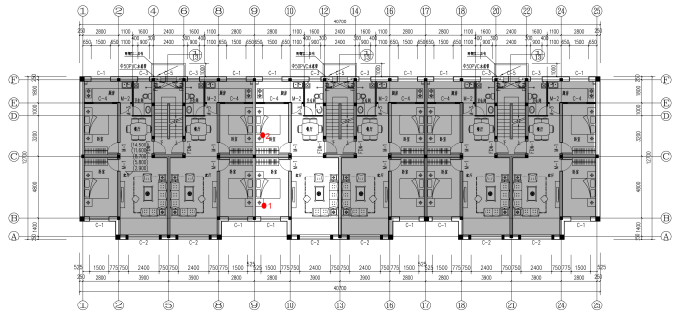
0.9m×1.67m）.They are double glass aluminum alloy windows.(Fig. 2).

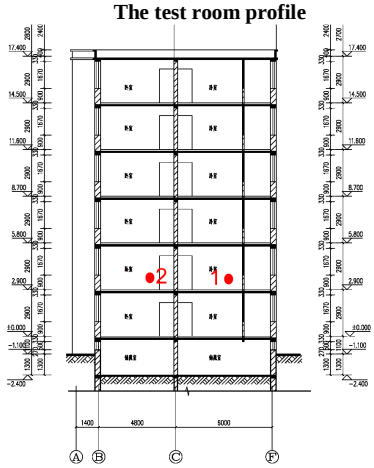
Fig. 1 The test room-The ordinary cottage residential

Fig. 2 The contrast room——The high-rise residential



The test room plans **The test room profile**





The contrast room plans **The contrast room profile**

Fig. 3 Test room and the layout of contrast room measuring point

2. Testing program

The test time and laboratory equipment:

The summer testing time from 15 to August 17, 2011 at 12:00 on the 17th. 48 hours of continuous records. The winter testing time from 12 to February 14, 2012 at 13:00 on the 17th. 48 hours of continuous records. Laboratory equipment for the TR-72ui temperature and humidity recorder. The test data is air temperature and humidity .

The test point arrangement:
Test point arrangement shown in (Fig. 3). Five measuring points are A-B of test room and 1-2 of contrast room. They are arranged in a frequently used room and 1M off the ground.

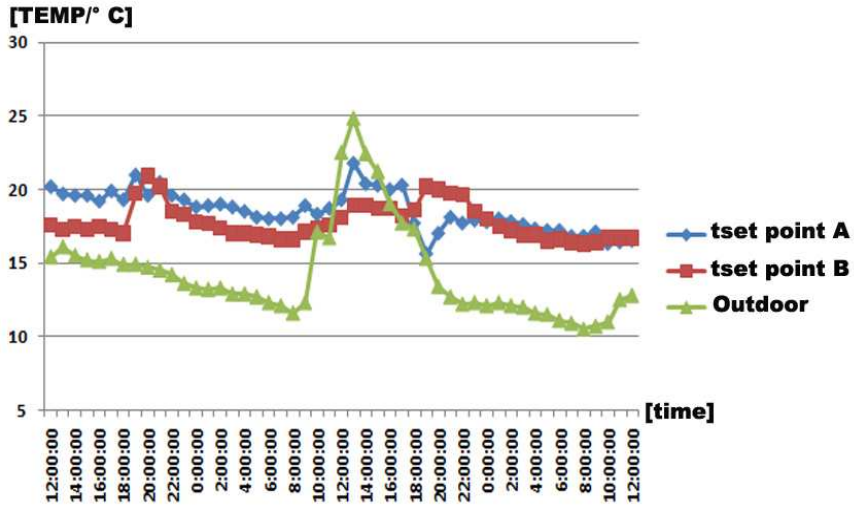


Figure 4 summer test room measuring point hourly temperature comparison chart

3. Test results

3.1 The test results of test room

Table 1 is respectively on the temperature of the test room to the south and east to the room 48 hours by measuring in summer. The test results shown in Figure 3. Measuring point A is located in the main house, facing south, noon 12:00-14:00 higher temperatures, as high as 22 ° C; 6:00-8:00 am the lowest temperature as low as 16.8 ° C; average temperature of 19.1° C. Measuring point B is located in the east wing, take the east, 14:00-16:00 pm the highest temperature up to 20.2° C; 6:00-8:00 lowest temperature as low as 15.6 ° C; average temperature of 18.5° C.

Table 2 is respectively on the temperature of the test room to the south and east to the room 48 hours by measuring in winter. The test results shown in Figure 3. Measuring point A is located in the main house, facing south, noon 14:00-16:00 higher temperatures, as high as 13.6 ° C; 7:00-9:00 am the lowest temperature as low as 2.8 ° C; average temperature of 7.5° C. Measuring point B is located in the east wing, take the east, 21:00-23:00 pm the highest temperature up to 2.68° C; 5:00-7:00 lowest temperature as low as -1.91 ° C; average temperature of -0.02° C.

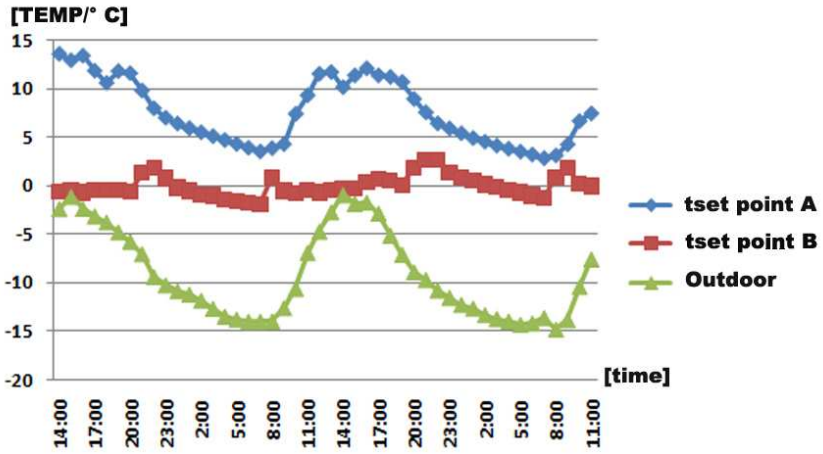


Figure 5 winter test room measuring point hourly temperature comparison chart

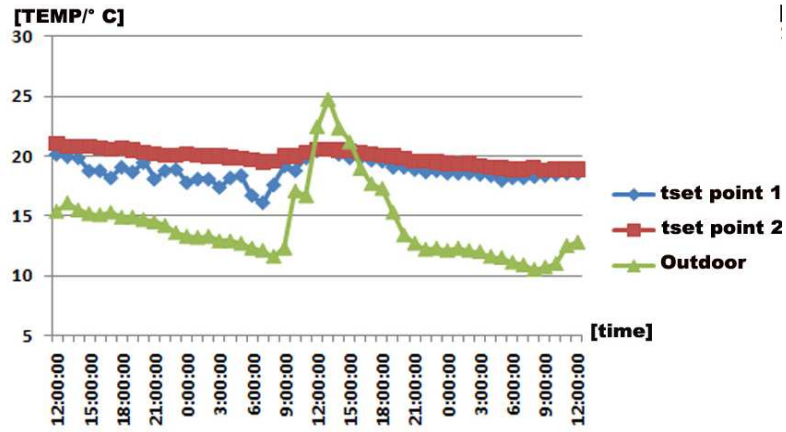


Figure 6 summer contrast room measuring point hourly temperature comparison chart

3.2 The test results of contrast room

Table 3 is respectively on contrast room to the south, north to the room 48 hours by temperature measurement in summer. The test results shown in Figure 3. Measurement point 1 is located in a bedroom to the south, the highest temperature of 22.8 ° C; minimum temperature of 16 ° C; average temperature of 19.2° C. Measuring point 2 is located in a bedroom to the north, the north wall with balcony, the maximum temperature is 22.4 ° C; minimum temperature of 15 ° C; average temperature of 17 ° C.

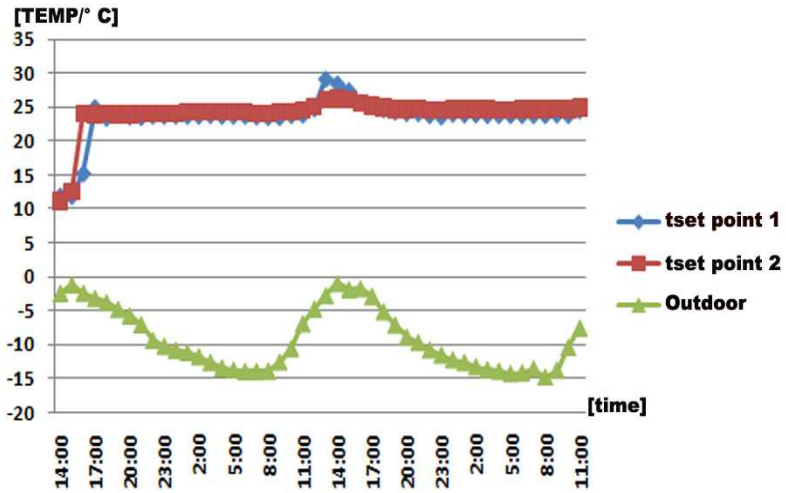


Figure 7 winter contrast room measuring point hourly temperature comparison chart

Table 4 is respectively on contrast room to the south, north to the room 48 hours by temperature measurement in winter. The test results shown in Figure 3. Measurement point 1 is located in a bedroom to the south, the highest temperature of 29.2 ° C; minimum temperature of 11.8 ° C; average temperature of 23.5° C. Measuring point 2 is located in a bedroom to the north, the north wall with balcony, the maximum temperature is 26.2 ° C; minimum temperature of 11.1 ° C; average temperature of 24 ° C.

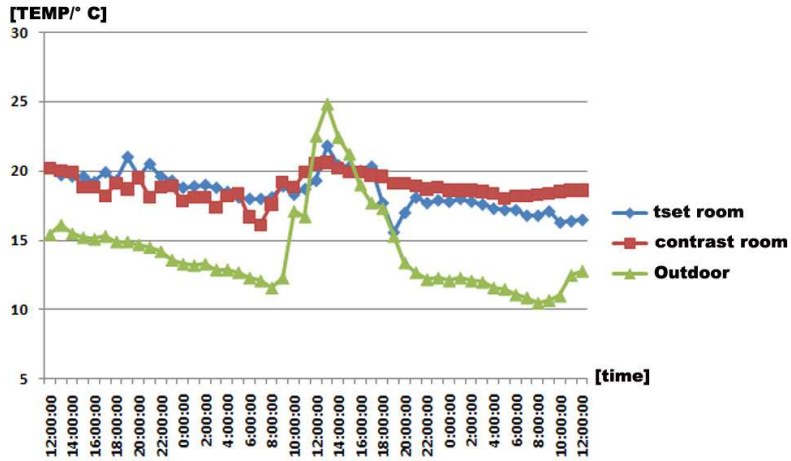


Figure 8 summer old and new residential measuring point hourly temperature comparison chart

4. Date analysis

4.1 The causes of the temperature conditions about test room and contrast room

Table5 is temperature comparison chart of the test room and by comparison landlord bedroom, two room temperature fluctuations, the highest contrast room temperature 22.8 ° C; minimum temperature of 19.5 ° C; average temperature of 20.5 ° C; test room a maximum temperature of 20.2 ° C; minimum temperature of 15.6 ° C; average temperature18.5 ° C. Obviously, in summer different building in the same toward the room temperature fluctuations, compared to room an average of nearly 2 ° C higher than the temperature of the test room. And rural residents to keep doors and windows open the living habits in summer.

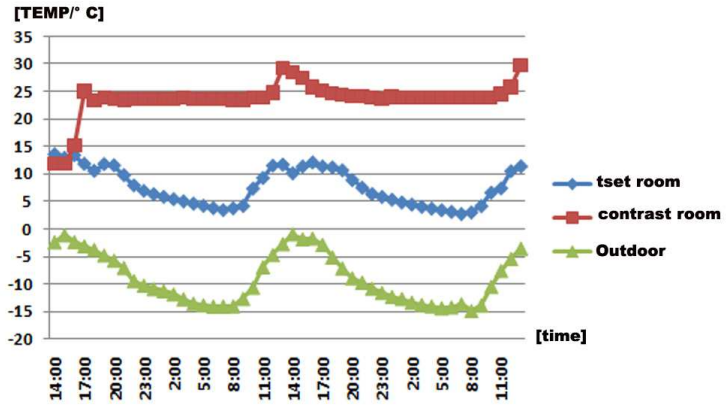


Figure 9 winter old and new residential measuring point hourly temperature comparison chart

Table 6 is temperature comparison chart of the test room and by comparison landlord bedroom, two room temperature fluctuations, the highest contrast room temperature 29.2 ° C; minimum temperature of 11.8 ° C; average temperature of 23.5 ° C; test room a maximum temperature of 13.6 ° C; minimum temperature of 2.8° C; average temperature7.5 ° C. Obviously, in winter different building in the same toward the room temperature fluctuations, compared to room an average of nearly 4.3° C higher than the temperature of the test room. The new residential areas use central heating is better than old residential areas with traditional fire heating. And rural residents wall materials for thermal insulation is also the reason of poor.

4.2 The causes of the humidity conditions about test room and contrast room

Table7 is humidity comparison chart for the test room and the bedroom of contrast landlord , In one day, two-room humidity fluctuations consistent contrast room humidity of 60%; a minimum of 45%; an average of 52%; The highest test room humidity 70%; a minimum of 57%; an average of 63%. Seen, in summer different buildings in the same towards the room humidity fluctuations, compared to housing on average 10% lower than the test room temperature. The ordinary cottage is a single ground, floor moisture doing is not good. The multi-storey residential is non-hygroscopic effect.

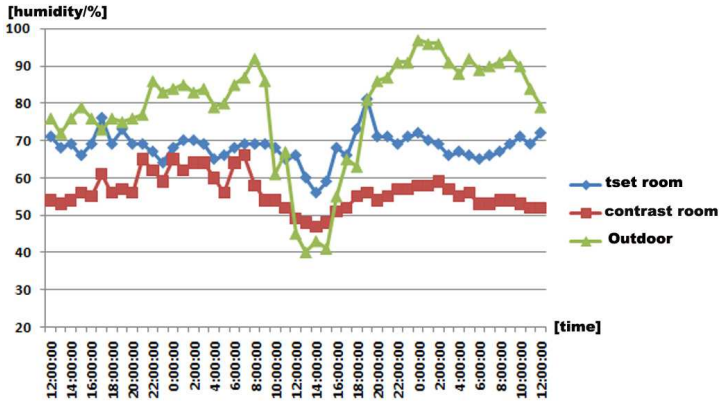


Figure 10 summer old and new residential measuring point hourly humidity comparison chart

Table 8 is humidity comparison chart for the test room and the bedroom of contrast landlord , In one day, two-room humidity fluctuations consistent contrast room humidity of 25%; a minimum of 11%; an average of 17%; The highest test room humidity 31.8%; a minimum of 12%; an average of 19.7%. Seen, in winter different buildings in the same towards the room humidity fluctuations, compared to housing on average 2.7% lower than the test room temperature. The ordinary cottage and the multi-storey humidity differences are small heating is the reason.

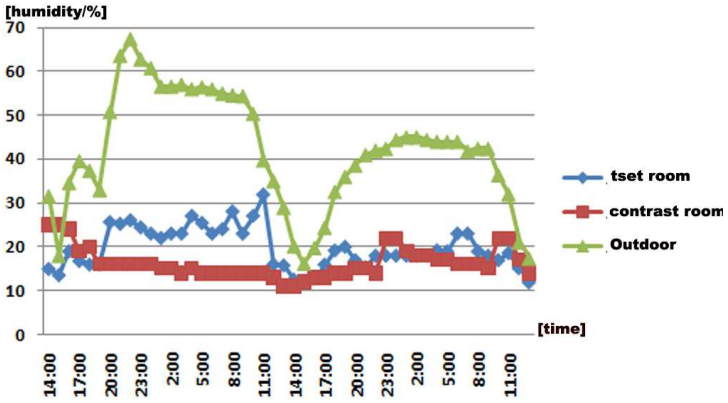


Figure 11 winter old and new residential measuring point hourly humidity comparison chart

CONCLUSION

In summary, the data analysis for summer and winter by testing confirmed the area residential climate design natural ventilation in summer, demand heating insulation in winter. But the residential areas of the Qilian Mountains northern foothills region and the local climate in particular correspond directly to architectural forms, still using the ordinary mode of living, lack of initiative to deal with the local climate to meet the living comfort of the building means. Including the new multi-storey residential is also on this point is not perfect, behind the residential model to adapt to the local climate to meet the residents living in comfort and save energy.

Acknowledgements
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