

# Study on the Renewal Tactics of Residential Suitability of Jinjiang Cabin Based on Thermal Comfort

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**Abstract.** This article from the climate characteristics of Jinjiang cabin in, in the form of field measurements, understand the wooden building thermal comfort, the traditional village residential suitability problem in the process of reform and renewal, puts forward the concept of traditional dwellings combining with regional characteristics. Put forward the palisade structure transformation, node optimization, heating means to improve the technology strategy, from the external structure optimization to improve internal heat source to find a way to live for, make traditional local-style dwelling houses building get sustainable development. The research of the project provides a method and basis for the protection and renewal of the traditional wooden house building in Jilin province, which provides some reference for the sustainable development of the settlement building.

## 1. Jinjiang village traditional residence status

### 1.1. The Basic Situation of the Wooden House.

Jinjiang cabin is called "the changbai mountain hut under" the plant is located in fusong county of jilin province jiang town. There are 15 families in the village, a total of 27 people. villages were found in May 1988 and began the nearly 20 years of exploration and investigation, has now become China's protection of non-material heritage village. Jinjiang wooden house is built on the mountain, the building is located in the southern slope, can resist the winter dominant wind. The wooden house was laid out in a courtyard, and the south side was the front yard, and the side was decorated with miscellaneous objects. The main plane is the rectangle between the second and the third open Spaces, in the middle is the kitchen, the side is the bedroom, the indoor heat source is the fire kang, the partition wall is the fire wall, the upper part is the wooden partition wall. Facade is a form of civil union, and some of the wooden structures are decorative.

### 1.2. Construction Status of Cabin Enclosure

Jinjiang wooden house is a manchu - style wooden house, building local materials, villagers build themselves. The wood is jointed in a mortise. The exterior wall material is the red pine of the mountain, the wall inside and outside USES the yellow mud that adds the straw to be mixed evenly. The Windows have a wooden window, and the north and south walls have open Windows. The roof is covered with shingles and is topped with beams or stones.



**Figure 1.** Building Status**Figure 2.** Indoor Fire Kang**Figure 3.** Interior Fire Walls

### 1.3. Winter Heating Facilities

The fire kang and the fire wall are the heating facilities of the wooden house, and now the wooden house has only a one-bedroom fire kang, its width is about 1.6 -- 1.8 meters, and the height is about 0.6 -- 0.7 meters. The fire kang is basically six kang ways to ensure the heat. The fire wall is the same as the heating system.

## 2. Analysis on the influence factors of thermal of comfort in Jinjiang cabin

### 2.1. Individual Factors

Body temperature is 36.5 °C (axillary's temperature) in areas such as the feel more comfortable. The amount of activity in human body determines the amount of heat produced by the body's metabolism, qm, and the radiant heat transfer of the human body and the surrounding surface, which refers to the process of exchanging heat between the human body and the environment. The body's temperature is determined by the amount of heat produced and consumed by itself, and the amount of heat exchanged between the body and the surrounding environment. In the indoor, the human body's activity is small, and the heat exchange with the surrounding environment becomes the main factor affecting the human thermal comfort.

### 2.2. Indoor Thermal Comfort Index.

Indoor thermal environment evaluation criteria include indoor air temperature, average radiation temperature, indoor wind speed and indoor air humidity. The northeast area is relatively dry and the building closeness is relatively good, the indoor wind speed and humidity are negligible. Winter indoor appropriate temperature of 16-22 °C, the temperature is below 16 °C can cause damage to the certain function of human body. Professor at the university of Denmark industrial P.O.F anger (according to the international organization for standardization ISO study formulated the ISO 7730 standard and puts forward the forecast percentage dissatisfied with PPD index to represent the percentage of people dissatisfied with the thermal environment. In pmv-0.5 -- 0.5 and PPD, 10% is indoor comfort zone, whereas when the PPD index is greater than 10%, the human body has not reached the requirement of thermal comfort when the average body feels slightly cold or slightly hot.

### 2.3. Geographical Factors

Climate has a very important influence on human thermal comfort. Month average temperature 10 °C or higher changbai mountain region. The duration of sunshine is greater than 6 hours, which is no more than 225 days. Annual sunshine hours between 2200-3000 hours. Jinjiang wooden house is located in the vicinity of the valley, the temperature difference is larger, the average temperature outside the winter is below 20 degrees.

### 3. Research on thermal comfort of Jinjiang log cabin

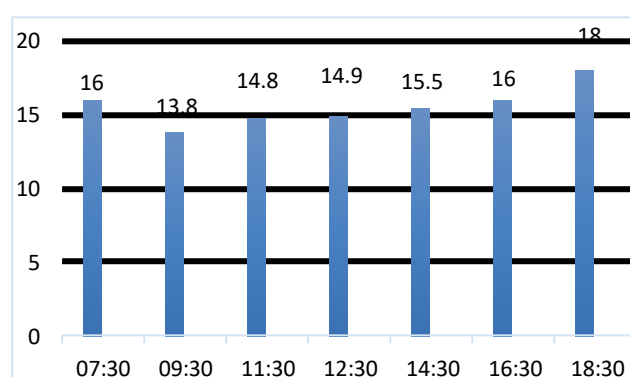
#### 3.1. Questionnaire Survey

Through questionnaire survey and field survey, the author investigates the building thermal comfort of Jinjiang wooden house. The questionnaire includes the factors such as temperature, humidity, wind sensation, etc. Of the 45 recycled questionnaires, 32% said it was dry and 23 % felt moderate. 33 % of people feel indoor temperatures are not comfortable, and only 23% feel comfortable inside.

#### 3.2. Temperature Measurement

We measured one of the homes for 24 hours, measured in two hours as a unit, and got 12 sets of data. The measured point is in the resident bedroom, because in the cold winter, residents stay in the bedroom longer. This measures the temperature change in the building. The survey data are as follows Figure 4.

According to the data, Jinjiang cabin, indoor temperature can't meet the requirements of the human body thermal comfort, even for the feeling of indoor thermal environment is the most comfortable, also will still have 5% satisfaction, not of the body's thermal comfort level is very low, so the wooden indoor thermal comfort is poor and has impact on the lives of local residents.



**Figure 4.** Temperature Change of Traditional Cabin 24h

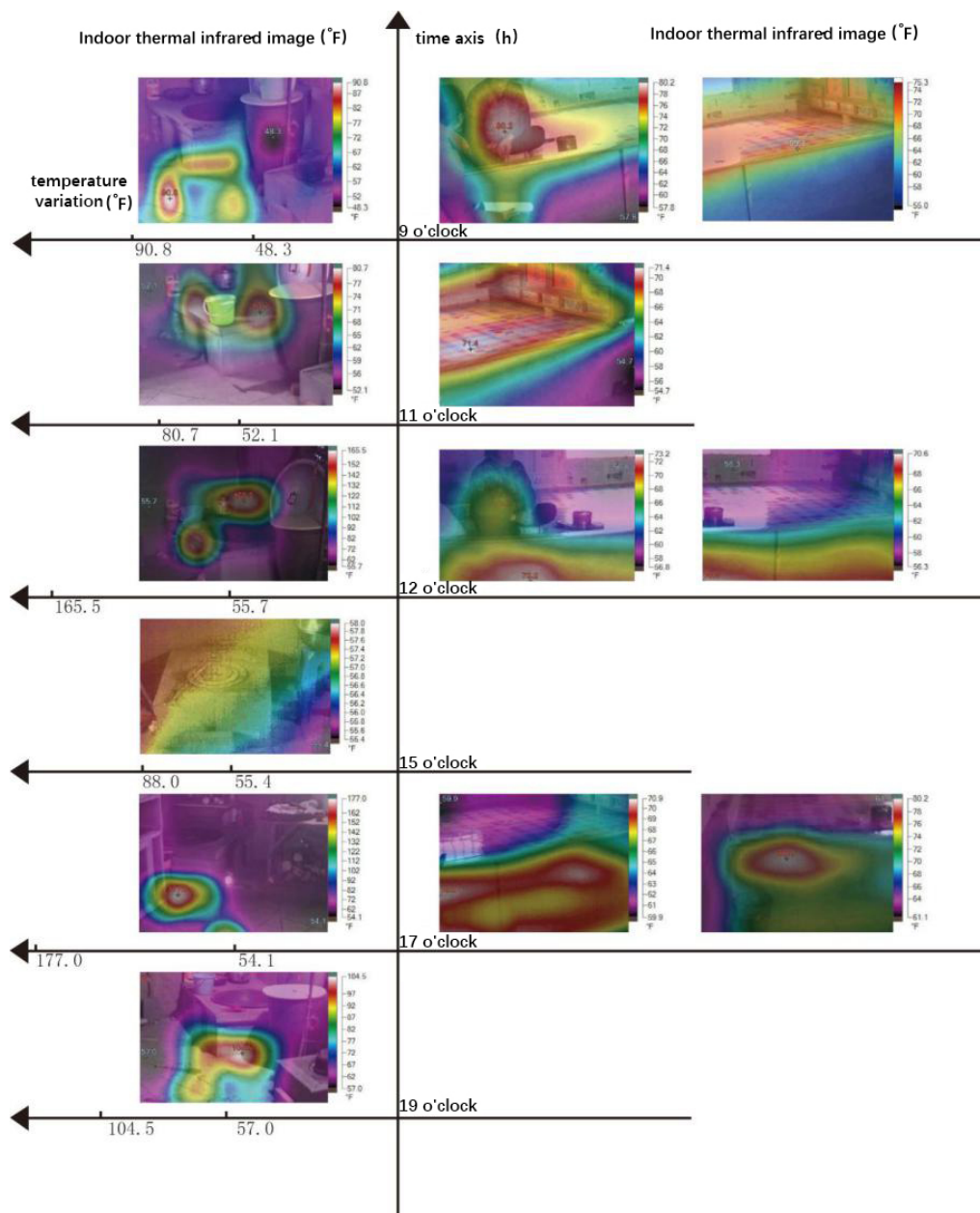
#### 3.3. Thermal Radiation Analysis of Infrared Imaging Devices

It can be seen from the analysis diagram of Infrared Imaging Devices that the human body, the fire kang and the hearth are the largest heat source in the room, and heat exchange with the surrounding wall.

Analysis by figure 5, hearth and the surrounding radiation surface temperature from 80.6 °C to 9 °C, fire resistance and low temperature from 26.8 °C to 26.8 °C. The internal temperature difference of the building is large, and the surface temperature of the building envelope is low and the heat exchange with the indoor heat source is occurred. From the above data and images we see Jinjiang cabin basic short of human living environment temperature minimum comfortable temperature 18 °C, building external structure also affect indoor temperature.

#### 3.4. Existing Problem Analysis

The reasons for the poor thermal comfort of Jinjiang are mainly manifested in the poor airtight performance of the building as a whole, and the construction of the enclosure structure is relatively low, thus reducing the overall thermal insulation performance of the building. Some building nodes have thermal bridge phenomenon. The problems of single heating mode, large loss of energy consumption and low thermal efficiency make the indoor thermal environment of buildings worse.



**Figure 5.** Infrared Thermal Image of Stove and Kang

#### 4. The strategy of the suitability renewal and reconstruction of Jinjiang wooden house

##### 4.1. The Principle of Renewal and Transformation

As a unique architectural form of Manchu, the traditional wooden house is unique in the construction of cheap construction, and the public has a sense of identity in the form of folk houses. It is important to preserve and protect the traditional dwellings.

The principle of repairing old and old, the replacement of wood and the application of modern high-tech materials on the basis of retaining its original manual process and construction method.

The principle of protecting innovation, using the existing technology and materials to propose innovative ways to the building of the wooden house, to ensure the use of comfortable and safe house.

The principle of ecological circulation makes the whole structure of the wooden house have the function of ecological circulation, do not make construction waste and digest and reuse the existing construction waste.

#### 4.2. *Methods of Suitability Renewal and Reconstruction*

**4.2.1. Material Protection.** The timber of the traditional wooden house is red pine, in 1999 the state council listed the red pine tree as the national secondary key to protect wild plants. The reuse of wood is also a healthy way to deal with the basic treatment of wood by carbonization.

**Optimization of Enclosure Structure.**

The bright room of Jinjiang village cabin is the indoor public space, keeping the traditional practice of the combination of the roof truss and the slime mud to remain unchanged, and add modern thermal insulation materials and waterproof rolling materials.

On the thermal insulation material of the exterior wall of the building, the protective layer closest to the outer skin color of the cabin is selected. Compared with EPS and mineral cotton, polyurethane hard foam has better insulation effect. It has the characteristics of thin coating and good insulation performance, as shown in the following table:

#### 4.3. *Tables*

**Table 1.** Comparison of Material Thickness

Material	PU hard foam plastics	EPS	Mineral wool	cork	concrete	Ordinary brick
Thickness(mm)	25	40	45	140	380	860

Wooden building foundation USES the extension foundation, to the bottom of the stone as a building foundation, reinforced concrete binding on that rock, with the traditional wooden house was built in stone, can rise to stable structures, moisture-proof insulation.

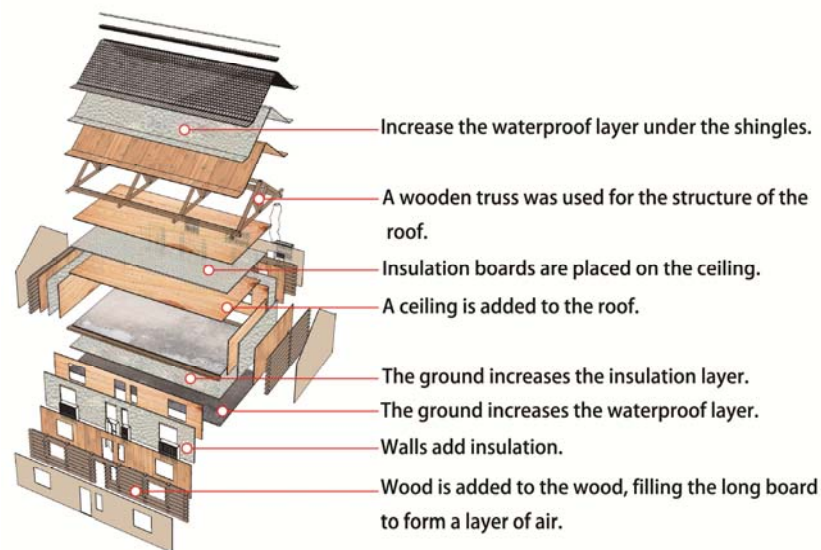
**4.3.1. Key Nodes.** The wall is intersected with the eaves, and between the wall of the wooden house and the eaves are pressed and waterproof rolling material, and then the slide is daubed on it. And to improve the end of the eaves, the outside of the wooden shingles in the form of tenon and tenon in the form of a slightly small wooden bar, on the top of the thick tip, into a prismatic shape. This component does not affect the appearance but can also improve the interior of the eaves to a certain extent.

Between the wall and the foundation, the wood is connected with the building foundation with waterproof rolling material, and the insulation layer is added on the inside, and the waterproof material is coated on the outside.

Between the window and the window sill, a thin aluminum sheet with a slope between the cabin window and the window is installed as a pan, sealed with sealant and applied to the surface with mud (figure 6).

**4.3.2. Indoor Heat Source Transformation.** Cabin heating fuel can be replaced with new energy, such as wood pellet fuel, gas, circulation of hot water for heating fuel, increase the clean energy as the main form of fire resistance and passive solar energy plumbing kang, improve the thermal efficiency of heat source.





**Figure 6.** Architecture Optimization Explosion Diagram

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## 5. Summary

By studying the improvement methods of the structure and the thermal insulation structure of the building, the paper improves the overall thermal performance of the building and guarantees the residents' thermal comfort. In order to develop the improved wooden houses with the original wooden house features of Changbai Mountain, the paper also puts forward some reasonable Suggestions on the thermal insulation and heating methods of traditional wooden houses.

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