ABSTRACT: In order to understand the status quo of traditional villages human settlement in the district of South China, this thesis, with typical Banliang Village as a research subject, in combination with case investigation and on-site test, analyzes the factors influencing the human settlement of traditional villages from three perspectives as the space of street-lane, the layout of functional space, and the construction of enclosure structure. After arranging and analyzing results, it was found that: there is the “cold lane” phenomenon in traditional villages, where the narrower the lane way is, the faster the wind speed, and the more obvious the valley effect; the open-type climate buffer zone like the central room of peoplele’s residence can weaken the influence of natural climate on the main space; the thermal environment of traditional villages is superior than that of common modern residence.

KEYWORDS: South Hunan district; Traditional villages; Human settlement

FOREWORD

With the development of national economy, the living standards of broad rural residents have been remarkably improved. However, influenced by new values, modern life style, as well as cultural diversity, traditional villages are faced with many difficult problems, such as cultural inheritance, dwellings’ protection and future development, etc. These problems are even more prominent in under-developed regions. Currently, traditional villages still remain as the carriers of the main living space in the majority rural areas of China. Their distinctive ethnic characteristics and geographical features reflect local customs and practices, as well as residential models, and adapt to regional environment and climate condition. Their ways of survival and development are directly related to the improvement of rural human settlement and the heritage of traditional regional culture.

South Hunan is referred to Hengyang, Chenzhou, and Yongzhou, these three
regions in the south of Hunan Province, where there is a large number of traditional villages, with 21 of them being enlisted in *The Directory of Chinese Traditional Village*. The previous research of the traditional villages in South Hunan region was more focused on humanity and history, while less on ecological experience and technical support. Therefore, in order to profoundly investigate the primitive human settlement, which is rich and simple of this region’s traditional villages [1], the author, embarking himself on the perspective of architectural technology, fully explores the advantages and improvements in earnest hope of traditional residences in adapting to regional climate after comparative research of the indoor thermal environment of traditional and newly-built residents composed of bricks and concrete in the summertime of 2015.

This paper probes into the contributions and limits of the structure and distribution of traditional villages to the application of local regional climate by quantitative results with actual measurement, and provides fundamental references to the improvements and renewal of the traditional villages’ human settlement.

1 THE BACKGROUD OF TESTS

1.1 The Buildings for Tests

This test picked out two representative and well-preserved buildings in the Village as samples. One was a black brick dwelling (Picture 1), while the other was a raw soil one. In order to compare their effects of interior thermal environment, another local modern residence in representative (built in 2005) was also selected out to test its interior temperature and humidity.

![Figure 1 Traditional Black Brick Dwellings Plane and Test Point Analysis.](image)

1.2 The Time and Instruments for Tests

In order to make the data tested persuasive, the time for tests was chosen from Jul. 21st to Aug. 10th, the hottest period in summer, lasting 20 days.

Parameters and instruments for tests are indicated in chart I, and the sites for tests are indicated in Picture 5. Portable meteorological station was set up in 9m high roof, without obstacles around. Self-recording thermometer was placed 1.5m above the ground, with aluminum foil wrapped to prevent the light radiation from affecting temperature measured [2]. The height to test interior wind speed was 1.5m. The tests began at 9:00 and 15:00 every day, and the data were recorded at an interval of 20s.
within 2 min. Before testing, all the testing instruments were re-calibrated, and some instruments on site were readjusted to zero before every test to ensure the accuracy of data tested.

Chart I. Parameters and Instruments for Tests.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Models and Instruments</th>
<th>Accuracy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior temperature</td>
<td>NHQXZ602, Portable meteorological station</td>
<td>±0.2℃</td>
<td>Self-recording at 10 min interval</td>
</tr>
<tr>
<td>Interior temperature</td>
<td>WZY-2, Self-recording thermometer and hygroscope</td>
<td>±0.3℃</td>
<td>Self-recording at 5 min interval</td>
</tr>
<tr>
<td>Interior wind speed</td>
<td>QDF-6, hot wire anemometer</td>
<td>±3% m/s</td>
<td>Manual recording</td>
</tr>
</tbody>
</table>

2 Analysis into the Influencing Factors of Traditional Villages’ Human Settlement

2.1 The Influence of Street-lane Space on Human Settlement

Laneway wind. The ventilation of cold lane is mainly referred to the stack-ventilation formed in the upward mobility of air inside the lane, which is caused by the hot air outside the lane under the influence of wind pressure to conduct heat exchange with cold air and lead to the variations in density difference. In daytime, “street” is exposed longer to heat than lane is, with broader heated surface. The temperature of air inside street increases more and the elevated inflation forms low pressure. While the temperature of air inside the lane is relatively lower with relatively higher air pressure. Besides, since the heat conduction of blue flagstone surface and black brick walls is less, the air inside the lane is made to naturally flow into the inside of the street to supplement, thus forming lane wind. In the evening, “street way” is more spacious than lane, with faster heat dissipation, relatively lower air temperature, and relatively higher air pressure. While the lane inside is relatively close, with high air temperature, relatively lower air pressure, thus forming street wind.

In order to know about the wind speed of transitional and open space, this research conducted actual measurement of the wind speed of lane way and central room [3]. The test points of interior wind speed, as indicated in Picture 4, are outdoors, lane way 1, lane way 2, and central room. The reason is that residents are accustomed to these places for activities in summer, and the speed of wind directly influences the comfort degree of human body. Chart 3 lists the average wind speed within 2 min of all the testing points from July 28th to July 30th. It can be drawn from chart II that: the wind speed of lane way is about as comfortable for human body as 0.3 m/sec, and basically higher than that of central room, with the maximum of 0.54 m/s. This is because lane way is narrow, and its valley effect is able to accelerate the wind mobility, which is an extra benefit brought by high density distribution; the average wind speed of lane way 2 is faster than that of lane way 1, which illustrates that in traditional villages, the narrower the lane way is, the faster the wind speed, and the more apparent of its valley effect. Central room’s wind speed remains relatively stable, basically 0.1~0.2 m/sec even on the condition when the outdoor wind speed is relatively low (only 0.04 m/ s). And this is because central room faces open to the courtyard, which makes it possible to improve the interior natural ventilation.
2.2 The Influence of the Functional Space Layout on Human Settlement

The interior temperature of each and every space of dwellings is indicated in picture 2. The diurnal temperature of all the interior space is generally lower than the exterior temperature, in contrast to the night. Compared with exterior temperature, the one inside the rooms remain quite stable with obviously smaller amplitude of fluctuation. This demonstrates that as transitional space, the central room effectively lessens the effects of scorching exterior climate on the interior main living space. The temperature of transitional space is higher than that of room in the daytime, due to the natural ventilation of transitional space in the daytime results in its more likelihood to be influenced by exterior climate. The interior temperature of bedroom 1 is apparently higher than bedroom 2’s. In addition to the solar radiation exposing to the south of bedroom 1, its west-oriented walls are also influenced by solar radiation. With the problem of west sunshine in this region being especially prominent, the interior temperature is high. However, bedroom 2 only has its south-oriented walls exposed to solar radiation, and thus its interior temperature is lower than bedroom 1’s. These phenomena illustrate that the transitional space inside traditional dwellings, which serves as the “buffer zone” for climate, weakens the influence of natural climate on the main space used inside the buildings.

2.3 The Influence of the Enclosure Structure Construction on Human Settlement

The interior thermal environment test of different enclosure structures[4]. Based on the principle of being heated, becoming similar indoors, the rooms’ interior temperature of traditional dwellings and modern architecture is compared, with actual measurement results shown as picture 3. Generally speaking, the temperature
inside the rooms of traditional dwellings is constantly lower than that of the modern architecture, while raw soil dwellings’ lower than black brick dwellings’. The maximum and average of raw soil dwellings is 2.19 °C and 1.79 °C lower than that of modern architecture, which is 1.63 °C and 0.89 °C higher than that of black brick dwellings. The fluctuation amplitude of temperature inside traditional raw soil dwellings is 2.7°C, while that of modern architecture reaches 3.9 °C. This confirms the conclusions drawn from previous research: The thermal transmission index of adobe wall, black brick and modern architecture’s enclosure structure is 1.27 W/m²·K、1.77 W/m²·K and 3.15 W/m²·K in respective. And their thermal inertia index is 5.17、3.62 and 2.47 respectively. With better thermal performance than that of modern brick wall, the traditional dwellings’ wall, with better heat preservation and prevention effects, as well as shading design, enables its lower interior temperature compared with modern architecture’s in the summertime. Furthermore, one of the reasons that the interior temperature is relatively higher is the larger window-wall ration of modern architecture. When making use of traditional dwellings, local residents prefer to stay in the transitional space, which is opening and shading, to pursuit the comfortable natural ventilation. After moving to modern residence, residents increase the size of the bedroom opening to pursuit natural ventilation due to a lack of transitional space, plus the inconsideration of shading design, eventually resulting in the uncomfortable interior thermal environment [5]. Henceforth, when designing modern rural residences, it is a principle in need of attention to adopt proper window-wall ration and also to add suitable shading.

![Figure 3. Thermal Environment among Traditional Dwellings and Modern Architecture.](image)

3 Conclusions

The ancient, simple and elegant traditional villages in South Hunan contain profound connotations of culture and wisdom, simple ecological thinking in all respects to demonstrate harmonious human group settlement. Its spatial distribution and functional division of traditional villages imply habitable wisdom, and simple architectural technique reveals the radiance of ecology. How to artfully raise the primitive construction system of traditional villages to the living objectives satisfying modern people to sustain the development and conform to the new development demand? How to make the spatial relationship and morphological characteristics of traditional villages suitable to new life requirements, and its functions and operating mechanism conform to new value standards? How to enable the physical environment
of traditional villages to fit the living quality standards of modern people, etc.? If these problems can be effectively activated, reorganized and integrated by us, it will develop actively [9]. Furthermore, it will greatly protect and improve its living environment and spatial pattern of history, create rural human settlement featuring local characteristics, and meanwhile provide modern rural construction with feasible planning ideas and design methods to promote the rural reconstruction.

References