The morphological characteristics and self-construction mode of rural dwellings in the suburbs of Tianjin - Taking Xijingyu village of Tianjin city in China as an example

Lijun Wang and Xuyang Sun
Tianjin University, Tianjin, China
wljjudy@tju.edu, 1017621846@qq.com

Abstract: In this paper, taking Xijingyu village of Tianjin city in China as an example, through on-site field investigations about traditional stone dwellings there, we summed up their morphological characteristics from the points of site selection, overall layout, functional organization and construction craft. During this process, we analyzed the regional living wisdom they contained. Then, we summarized the current situation of the self-construction of vernacular dwellings in Xijingyu village and discussed their self-construction mode. Finally, in view of local actual situation, we offered some appropriate and reasonable proposals for the self-construction mode of the dwellings there. We did this to help record, extract and inherit the traditional regional living wisdom for Xijingyu village, and to provide academic guidance for contemporary self-construction of dwellings. This research can also be taken as reference for the study of rural residential houses in others villages around Tianjin.

Keywords: Xijingyu village; dwelling; morphology; self-construction.

1. Introduction

There are a lot of dwellings that are well worth our exploration in the suburbs of Tianjin. Four kinds of them are collected by Chinese traditional dwellings type published by Chinese Ministry of Housing and Urban-Rural Development. They are the side-yard dwelling that Shijia dwelling in Yangliuqing represents, the adobe house that the houses in Wangjiaying Village, Duliu town and Fengjia village, Liangtou town represent, the brick house that Zhangjia dwelling and Houshi dwelling represent and the stone house that the houses in Xijingyu village, Yuyang town, Jixian county represent. Xijingyu village was famous for its stone rural culture and it becomes the first "Chinese historic and cultural village" in Tianjin(Yang, 2015). In this paper, we regard the vernacular dwellings in Xijingyu village as the research objects.
2. Basic situation of Xijingyu village in brief

Figure 1: the location of Xijingyu village (source: Google map added the marks by authors, 2016)

Xijingyu village formed in Qing Dynasty is located 2.5 kilometers away from Jixian town of Tianjin city (Figure 1). The geographical position of this village belongs to the cold area in our country. So the winter there is cold and dry, and the summer is warm and humid.

On the other hand, the whole village also belongs to the Ancient World National Geological Park. It is located on the mountain made of stone and built by the stones with distinct regional features: roads paved with stones, houses built by stones, together with the ubiquitous grinding stones and stone mills. The village became a veritable "Stone Village" (Figure 2).

Figure 2: the "Stone Village" (source: photographed by authors, 2016)

The morphology of the dwellings there did not change much since they were built and the life-style of the villagers was simple and unsophisticated (Yang, 2015). Therefore, the emphasis of our research is the morphological characteristics of these dwellings instead of the morphological evolution.
3. Research of morphological characteristics of the dwellings

3.1. Site selection

Villagers in Xijingyu build their houses conforming to the lie of mountain, so the houses are stacked from top to bottom, which reflect the adaptation to the land form.

Villagers also consider the influence of climate when they decide the locations of the houses. The prevailing wind there is north wind in winter. During the survey, we find that most old stone houses are located on the sunny slope of Bobo Mountain so the cold north wind can be stopped by the mountain in winter. At the same time, the houses can receive sunshine more adequately and obtain better nontechnical environment. The wisdom in site selection fits well with the principle of “Negative yin-yang hold” in Chinese Fengshui theory. (Figure 3)

![Figure 3: The advantage of location in cold winter (source: drawn by authors, 2016)](image)

In addition, the houses there are almost built in the places with rich water, excellent terrain and pleasant natural environment. The superiority in location can make dwellings have good micro climate. The advantages of good micro climate can reinforce the region climate characteristics, and make the living environment more satisfactory.

Site selection is the first step in residential construction, and it well reflects the regional wisdom which is significant reference for contemporary self-construction.

3.2. Spatial layout and function organization

3.2.1. Specific morphology of spatial layout and function organization

Xijingyu village is well away from the city, which avoids the constructive destruction brought by the urbanization, so the stone dwellings remain relatively intact. We visited the village and carried on detailed investigations, especially for the five dwellings blow.
Table 1: The induction and analysis about the five dwellings (source: drawn by authors, 2016)

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Location</th>
<th>Photos</th>
<th>Arrangement Form</th>
<th>Function Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling 1</td>
<td><img src="image1" alt="Location" /></td>
<td><img src="image2" alt="Photos" /></td>
<td><img src="image3" alt="Arrangement" /></td>
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<td>Dwelling 2</td>
<td><img src="image5" alt="Location" /></td>
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<tr>
<td>Dwelling 3</td>
<td><img src="image9" alt="Location" /></td>
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<td>Dwelling 4</td>
<td><img src="image13" alt="Location" /></td>
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<td>Dwelling 5</td>
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According to the table above, we can know that the traditional stone dwellings are courtyard houses in which buildings are organized and centred on the courtyard. The courtyard is indispensable space in local farming culture. Not only does it provide quiet dwelling environment for the villagers, but also it
creates space for some producing activities that could be completed at home (such as airing crop and peeling the skin of the corn).

The specific morphology of spatial layout and function organization is the following contents. The principal rooms face to south and have three bays. The middle bay is a hall and its bilateral bays are bedrooms. The capacious front courtyard which is the main courtyard is disposed at the south of the principal rooms and some vegetables grow in it. There are east and west wings on both sides of the front courtyard. Some dwellings just have an east wing or a west wing. On the south of the courtyard, there is the stone wall or the southern rooms which are used to contain agricultural vehicles or deposit sundries. Another courtyard is arranged on the north of the principal rooms. Unlike the front courtyard, it is very small. (Table 1)

3.2.2. Regional living wisdom contained into the spatial layout and function organization

![Diagram](image)

Figure 4: Varying degrees of solar radiant heat different rooms obtain (source: drawn by authors, 2016)

Almost every door and window is open to the main courtyard (the front courtyard) in the dwellings, so the rooms with optimal daylight are the northern rooms. They can also obtain most solar radiant heat. The east wing and west wing are not as good as the northern rooms in this respect and the southern rooms are the worst. Therefore, villagers arrange the principal rooms, which are most frequently used and undertake main living functions like sleeping, cooking and entertaining guests, on the north. The east and west wings are used for dining room or subaltern room. On the other hand, they arrange the rooms used for stockpiling sundries and almost have no requirement for day lighting on the south. (Figure 4)

The spatial layout and function organization above embody local villagers’ living wisdom and should be inherited, extracted and applied in the contemporary self-construction of the dwellings.

3.3. Form and material

Because Xijingyue village is located on the rocky mountain and its soil layer is very thin, the old houses are almost built by the stone, rather than the adobe (Jia et al., 2015). The stone with large thermal inertia and good durability is natural insulation material. It helped local people living through the hard times and was still in use today (Tian Chen Deputy Director).
Most traditional stone houses there have Yingshan Roofs with single lift type, which made up of gray tiles and wooden beams. The heights of most houses are three to four meters and the shapes are cuboids, which make them have a good shape coefficient for heat preservation in winter. (Figure 5)

Figure 5: the form and material(source: drawn and photographed by authors, 2016)

3.3. Construction craft

Besides observation and recordation, we also conducted interviews with local villagers. Through the interviews, we learned that local villagers take delight in finding characteristics and beauty of the stones. They have a special emotion and spirit of craftsman for them. After hundreds of years of life, the native ancient construction craft has been passed down.

First, villagers need to go to the mountain to get stones. It is a difficult and dangerous work, which needs to use the shuttles. In the quarry, they should tap on the stones for good sizes they need, and then pull them to the site.

Then they choose the stones according to the width of the wall. The stones selected should be level off, smooth with straight edge. The average size of the stones is 50 * 60 * 80 cm. The narrower the wall is, the higher the technique requires. Today, there are not much young villagers wanting to learn that, because it is hard and earn little.

Figure 6: the stone wall (source: photographed by authors, 2016)

The last step is masonry. Most stone walls there are built by dry masonry (without any bonding mortar). During the construction process, villagers collocate the stones according to their size. At the
same time, they make the thick stones and thin stones complement each other to balance the pressure from every direction. Piles of stones form the whole wall with this seemingly random method. (Figure 6) What's surprising most people, the walls are so firm that none of them collapsed in Tangshan Earthquake, including the high walls up to six meters.

It is interesting that the special masonry wall is similar to the overlying rock formed hundreds of millions of years ago. Nature seems to be a stonemason that he use this method of masonry building the mountains around Xijingyu village, and the ancients here coincides with nature that they use a similar way build their homes bit by bit. Here, people found the harmonious way to get along with the nature.

4. Research of self-construction mode of local dwellings

4.1. Current situation about self-construction of local dwellings

According to the on-site field investigations, we summarize the current situation about self-construction of local dwellings from three aspects: the spontaneous self-construction of dwellings by local villagers, the meliorative self-construction of dwellings guided by rural reconstruction workers and the transformational self-construction of dwellings aiming to convert them to public space.

4.1.1. The spontaneous self-construction of dwellings by local villagers

To improve their living conditions and expand residential commerce functions, many local villagers abandon old stone houses and build new dwellings by themselves. Most of these newly-built dwellings are brick houses rather than stone ones, and many of them imitate the design of urban residences, such as Europe Style. Some villagers even use the white ceramic tiles as the facades of the houses, or use bright-color roofs (Figure 7).

4.1.2. The meliorative self-construction of dwellings guided by rural reconstruction workers

In the course of the surveys, we find that there are some rural reconstruction workers in Xijingyu village. They rent some old stone dwellings and guide the villagers to improve and optimize them by professional design and cutting-edge technology. The improvement of Dwellings No.1 is a comparatively typical case. The meliorative methods include: ① adding 240mm brick wall on the indoor side of the original stone wall and pressing them close together to improve the performance of heat preservation; ② converting the primary outworn external windows into late-model windows with good leakproofness and maintaining similar styles; ③ hiding water pipes and electric wires in the walls to make interior space tidy and setting up the connections at correct place to make them user-friendly. (Figure 8)
4.1.3. The transformational self-construction of dwellings aiming to convert them to public space

Rural reconstruction workers also guide villagers to replace the function of old stone dwellings. For example, one of them is transformed into a book bar. The transforming methods include: ① reinforcing the outer edge of original stone wall with concrete and making them have design aesthetics by contrasting the inerratic outer edge with the irregular stones in the wall; ② reserving the original wooden beams and brushing the anti-corrosion paint on them; ③ opening up some external walls to transform the indoor space to half-indoor space with the purpose of realizing dialogue with the environment. (Figure 9)

4.2. The analysis and discussion about the self-construction mode of local dwellings

4.2.1. Abandoning stone houses is not a good idea

Abandoning old stone houses and turning to build new dwellings which are like urban residential houses is not a good idea, although old stone houses are difficult to meet the contemporary living demand of the villagers (Figure 10). As is known to all, these old stone houses have high historical value and abandon them will make irreversible damage to the precious heritage. Besides that, it is not desirable to blindly imitate city residential houses, ignoring locals living habits and unique wisdom of regional residential construction. Because it will not only lose the unique regional characteristic of Xijingyu and affect the overall style of the whole stone village, but also reduce the living quality of villagers.
4.2.2. “In use” should be correct way in which traditional stone dwellings realize contemporary regeneration.

Besides the deserted old stone dwellings, we find another extremity: some dwellings which are protected excessively. Some of the old stone houses with high historical value were restored meticulously since Xijingyu village became the "Chinese historic and cultural village". Then they were preserved with the doors locked and gradually became the "specimen of dwelling". Neither being deserted nor becoming “specimen” should be normalcy for these old dwellings in the contemporary era. They were the existence originally filled with the flavor of rural life, and they would lose the source of vitality once nobody living in them. In addition, the sturdiness and durability of the stone houses are very well, so it is possible to live in them comfortably without destroying their historical value through rational design and melioration.

4.2.3. How to make the old stone houses used better through appropriate self-construction

- Enhancing durability and convenience with the help of modern technology

It should not be contrary for modern construction technology and traditional stone houses. Conversely, they can complement each other. Integrating modern construction technology into the self-construction of traditional stone houses could enhance their durability and convenience, such as brushing anti-corrosion paint on the wooden, adding brick wall inwardly and replacing the original windows with similar-style airtight windows.

- Solving the regional technological problem creatively by ingenious design

The whole village is located on the stone, so it is very difficult to excavate pipelines. In the book bar transformation above, the designer combines the landscape design with the drainage.

The yard is divided into a number of polygons to form the landscape and the grooves at the tangent of the polygons is used as drainage canals. The discharge water in the drainage canals is brought into the reservoir in a corner of the yard by the tiny height difference. Then the discharge water in the reservoir will drain away thoroughly by the cave. So the drainage is arranged on the ground rather than under the ground in that creative way. (Figure 11) The grooves solve the problem while being used as divisional boundaries of the landscape.

The idea of solving technological problems by ingenious design has enlightenment and reference for the self-construction of traditional stone houses. In addition, the problem of exposed pipelines in the streets could be solved in a similar manner.
5. Brief summary

The research about morphological characteristics and self-construction mode of dwellings in the suburbs of Tianjin is grand. In this paper, we take Xijingyu village as specific region and study on the morphological characteristics and self-construction mode of the dwellings particularly by information access, field survey and academic analysis. We hope that our research could make a contribution to the conservation and construction of the dwellings there.

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References

He, Y. The Visit to the Stone Village in Yuyang Town, China Tourism News, 013.
Tian Chen  Deputy Director, P. a. P. S. i. U. P. S., School of Architecture, Tianjin University, China Timeless Villages in Yuyang Town and a Galaxy of Advanced Culture in Jixian County, China Culture Daily, 005.