



Study on the Disaster Harm and Pattern of Chinese Housing in Villages and Towns with Typical Building Structures and the Countermeasures

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Abstract

Based on 499 effective questionnaires in China, this paper firstly analyzes and concludes the type characteristics, spatial distribution, and combined characteristics of typical village and town housing's building structure in China. Secondly, this paper studies the features and sorts of chief disasters in China and the harms on village and town housing. Finally, this paper summarizes the main factors that cause the disasters and the disaster pattern, and puts forward relevant countermeasures.

Keywords: Housing in villages and towns, Typical building structures, Harms of disaster, Disaster pattern

Some Chinese scholars have already studied the influencing factors that affect the safety of village and town housing (Huijun Gao, Guihua Xu & Xiaoli Wu, 2002; Zijiang Yang, 2007; Jingang Yuan, 2006; Enping Jin & Wei Ren, 2007) and sorts of main disasters that exert effects on village and town housing, including earthquake (Liqun Yao & Hao Sun, 2000; Shuguang Wu & Yejun Chang, 2001; Huijuan Wu, 2005), flood (Hailing Sun, 1999; Guihui Zhong, Shuguang Liu & Donghui Huang, 2008), typhoon (Qiang Xu, 2004), and fire (Lizhen Wu, 2007). Based on these studies, this paper designs a questionnaire and completes a national survey. Finally get 499 effective questionnaires. In specific, 50 pieces are from Huabei, 84 from Huadong, 77 from Zhongnan, 51 from Xinan, 36 from Xibei, and 201 from Dongbei. Based on these questionnaires, this paper advances these opinions as follow.

1. The typical building structure of China's village and town housing

1.1 The type of China village and town housing's typical building structure

(1) The main characteristics of China's village and town housing construction

The primary characteristic of China's village and town housing construction is disordered construction management. Most houses are designed by owners. And construction materials are not qualified. Therefore, China's village and town housing has complicated structures.

(2) Define the basic type of China village and town housing's typical construction structure

Based on a wide survey on village and town housing in China, this paper starts from construction materials and bearing structure, classifying China village and town housing's typical construction structure into four types, namely earth-wood-stone structure, masonry structure, brick-concrete structure, and reinforced concrete structure.

Define the basic type and the structural characteristics

a. Earth-wood-stone structure

In construction, earth and stone are used to maintain the external structure. Wood is used to support the house vertically. It mainly includes earth-wood structure, wood-stone structure, and earth-wood-stone structure.

b. Masonry structure

It consists of bricks, stones, or sorts of blocks.

c. Brick-concrete structure

It is to use bricks as a vertical bearing structure, reinforced concrete board as a horizontal bearing structure. If the block structure includes concretes, it also belongs to this type.

d. Reinforced concrete structure

The main bearing structure, such as pillars, beams, boards, stairs, and roofs, is made of reinforced concrete.

The status of main structure

In the 499 questionnaires, the earth-wood-stone structure occupies the largest proportion in villages and towns (31.66%), then the masonry structure (26.45%), and finally the brick-concrete structure (30.26%). The reinforced concrete structure is not a dominating structure at present.

1.2 The spatial distribution characteristics of China village and town housing's typical building structure

According to the 499 questionnaires, the main village and town housing structure in different areas is various. Considering the percentage of dominating housing structure, Huabei is mainly brick-concrete structure, masonry structure, and earth-wood-stone structure; Huadong is mainly earth-wood-stone structure, then masonry structure and brick-concrete structure; Zhongnan is mainly masonry structure and earth-wood-stone structure, and then brick-concrete structure; Xinan is mainly earth-wood-stone structure, and then brick-concrete structure, masonry structure, and reinforced concrete structure; Xibei is mainly earth-wood-stone structure, then masonry structure; Dongbei is mainly brick-concrete structure, then masonry structure and earth-wood-stone structure (see Table 1).

2. The disaster harms on China's village and town housing

2.1 The types and characteristics of disasters for China's village and town housing

(1) Disasters' types and frequency of emergence

In China the village and town housing mainly faces these disasters, including earthquake, flood, fire, typhoon, sandstorm, wind-hail-snow disaster, and mountain landslide. The debris flow, termite, and tsunami serves as threats for small spatial areas (see Table 3). It reflects China's complicated natural conditions. Although some disasters are not popular, they exert significant harms on local areas.

Disasters have different frequencies of emergence. Usually, the most serious disaster for village and town housing in different areas happen every two or five years. The frequency of more than one time per year or one time per year is also common (see Table 4). The second serious disaster for village and town housing in different areas happen every 15 years, 5-10 years, more times every year, or one time every 2-5 years. The frequency of one time every two years or 5-10 years also accounts for a large proportion (see Table 5). Therefore, the most serious disaster has higher frequency and exerts more serious damages on housing. The second serious disaster happens every longer period. But combined with the most serious disaster, the second serious disaster can generate considerable pressure on village and town housing.

(2) Regional analysis of disasters

All disasters are regional. According to the number of disasters in questionnaires, we get these conclusions.

Main disasters in Huabei are flood, fire, sandstorm, and wind-hail-snow disaster, in Huadong flood, typhoon, fire, earthquake, and mountain landslide, in Zhongnan flood, fire, earthquake, termite, and wind-hail-snow disaster, in Xinan flood, earthquake, fire, wind-hail-snow disaster, and mountain landslide, in Xibei earthquake, fire, flood, sandstorm, and wind-hail-snow disaster, in Dongbei fire, flood, earthquake, wind-hail-snow disaster, and sandstorm (see Figure 2). In addition, we should notice that regional disasters may combine in different forms, which makes disasters be diversified and complicated in China.

2.2 Disaster harms on village and town housing

Different typical housing structure can resist disasters to a different degree. The earth-wood-stone can be ruined easily. More than one half earth-wood-stone structured housing has been damaged after disasters in 46.56% villages and towns (see Figure 3). Earthquake, flood, and fire are the most dominating disasters. The masonry structure and the brick-concrete structure are stronger than the earth-wood-stone structure. Here, the masonry structure mainly suffers from flood, fire, earthquake, and wind-hail-snow disasters. The brick-concrete structure mainly suffers from flood, fire, sandstorm, and wind-hail-snow disasters. The strongest is the reinforced concrete structure, which can resist almost all disasters to certain degree (see Figure 4).

3. Disaster pattern of China's village and town housing

3.1 The meaning of disaster pattern and the main factors

(1) The meanings of disaster pattern

Here it especially means all conditions after the disaster, including damages, ruins, and even human death.

In this paper the disaster pattern especially means that sorts of factors contribute to the harms on village and town housing by certain mechanism.

(2) Main factors

In researches, this paper concludes that the main factors that cause disasters for village and town housing can be sorted into three aspects:

- ① Defects of village and town housing: seldom follow technological standards and can not resist disasters effectively.
- ② Grades of disasters: different grade means different harms.
- ③ More key factors: people's recognition and capability of preventing disaster, guidance for housing construction, quality management and supervision evaluation.

3.2 The typical disaster pattern for China's village and town housing

(1) Poor consciousness of disaster prevention ----- short of subjectivity

This research especially focuses on the construction standards, housing construction workers, housing quality certificate and evaluation, and wealth insurance. Results are as follow:

- ① Almost 100% village and town housing does not follow any construction standard. In special, people do not combine the housing structure with the consciousness of disaster prevention. In China, many houses are built by local farmers, without geological researches and specialized designs. They build houses just according to subjective imagination. In the construction, no specialized workers but only local workers or friends and relatives join in. Houses are not qualified, not mention the disaster prevention in the technological aspect. Therefore, once there is a disaster, village and town housing will suffer a lot. People and wealth will be harmed seriously.
- ② Once houses are completed, there is no quality certification and evaluation. And there is no necessary maintenance, protection, and update. Only less than 10% research objects get the wealth insurance. The insurance covers a narrow scope, which is not effective.

Random construction leads to these defects of housing structure as follow:

- ① In housing structure construction, most materials are from local area and not qualified.
- ② There are regional disaster harms. And the disaster prevention capability is poor. For example, some village and town housing is full of straws, and wood, which indicates a fire risk. For some houses, because of carelessness in construction, they are easy to be ruined in earthquake.

(2) The complicated disaster

- ① Different disasters serve as different challenges for houses. A good example is the Wenchuan earthquake. Although we have already concluded that the earth-wood-stone structure is easy to be damaged, the wood structured house is a special example. In Wenchuan earthquake, many casualties are caused by the collapse of buildings. Some traditional wood structured houses are ruined but not collapse completely. Wood structured houses are flexible. The box structure can separate powers. Its light structure and strong flexibility can help it resist instant shocks and periodical damages. Therefore, in earthquake, it can absorb less power and still sit there due to its better flexibility.
- ② Many areas face more than two disasters. The disasters have different frequencies and harms, which means higher disaster prevention requirements for village and town housing structure. For example, if an area suffers from frequent earthquake, it should build more wood structured houses. But once there is flood, debris flow, or typhoon, the wood structure will suffer a lot. Therefore, for the village and town where there are more disasters, the housing structure is a problem.
- ③ Disasters at different grades happen at different frequencies. High-grade disaster happens at a lower frequency. It is easy to be neglected. The disaster prevention measures and standards may be ignored. Therefore, once high-grade disaster happens, the harms are significant and cover a wider space.

(3) The guidance, management, and supervision evaluation system for village and town housing are not perfect.

This research focuses on village and town housing's guidance, management, and supervision evaluation. Results show that the construction and maintenance of village and town housing are short of perfect guidance, management, and supervision evaluation, which completely proves that in China the village and town housing construction guidance, management, and supervision evaluation system are extremely imperfect, short of rules and laws.

The three aspects mentioned above exert negative effects on each other in many fields, concerning housing structure construction and management, which finally causes the disaster pattern for China's village and town housing (see Figure 5).

4. Measures for improving the safety of China's village and town housing

4.1 Improve residents' consciousness of disaster prevention

By means of periodical popularization, introducing the disaster prevention knowledge and the disaster harms on village and town housing, improve villagers' consciousness of disaster prevention. In building and designing houses, strengthen the disaster prevention capabilities by following present national standards or regional standards, emphasizing on the quality of houses. Keep pre-warning on the safety of houses. Lay more stresses on houses' maintenance, update, and re-construction.

4.2 Set up local standards for village and town housing construction structure

According to local economic development, set up standards for village and town housing construction structure, considering the disasters harms, people's income, and different typical structures. Take the uniqueness of village and town housing and construction workers into consideration, the standards should be easy to carry out.

4.3 Perfect the village and town housing construction guidance, management, and supervision evaluation system

The construction guidance is the key for village and town housing's structural design, technological application, and structural safety. The management system can insure the village and town housing's construction quality and materials' quality. The supervision and evaluation system can help to popularize the quality evaluation and condition evaluation of village and town housing, repairing and re-building the houses with poor safety more reasonably.

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Table 1. Percentage of main village and town housing structure in different areas (%).

	Huabei	Huadong	Zhongnan	Xinan	Xibei	Dongbei
Earth-wood-stone structure	24.00	40.48	32.47	39.22	52.78	23.88
Masonry structure	30.00	26.19	36.36	17.65	25.00	24.38
Brick-concrete structure	36.00	20.24	23.38	25.49	13.89	39.80
Reinforced concrete structure	10.00	13.10	7.79	17.65	8.33	11.94
Total	100.00	100.00	100.00	100.00	100.00	100.00

Table 2. Main disasters for village and town housing.

	Earthquake	Flood	Fire	Typhoon	Sandstorm	Wind-hail-snow disaster	Mountain landslide	Debris flow	Termite	Tsunami
Number of questionnaires in which it is regarded as the most serious disaster	90	141	101	29	48	58	21	3	8	0
Number of questionnaires in which it is regarded as the second serious disaster	46	129	85	34	49	79	52	14	9	2

Table 3. Questionnaires and percentage of the most serious disaster's frequency of emergence.

Frequency	More than one time every year	One time per year	One time every two years	One time every 2-5 years	One time every 5-10 years	One time every 5-15 years	One time every more than 15 years
Percentage (%)	19.24	12.83	7.41	22.04	15.23	7.41	15.83

Table 4. Questionnaires and percentage of the second serious disaster's frequency of emergence.

Frequency	More than one time every year	One time per year	One time every two years	One time every 2-5 years	One time every 5-10 years	One time every 5-15 years	One time every more than 15 years
Percentage (%)	14.83	6.21	11.62	13.43	15.03	11.42	27.45

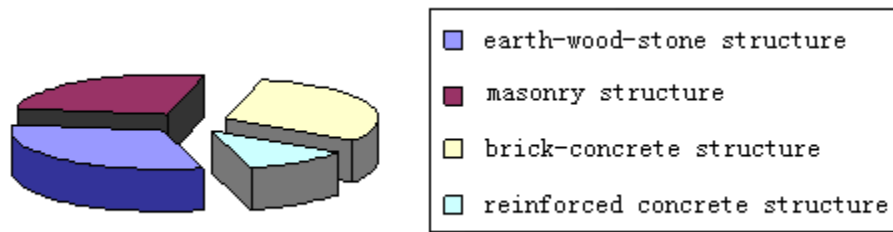


Figure 1. Proportion of Different Type of Typical Village and Town Housing Construction Structure.

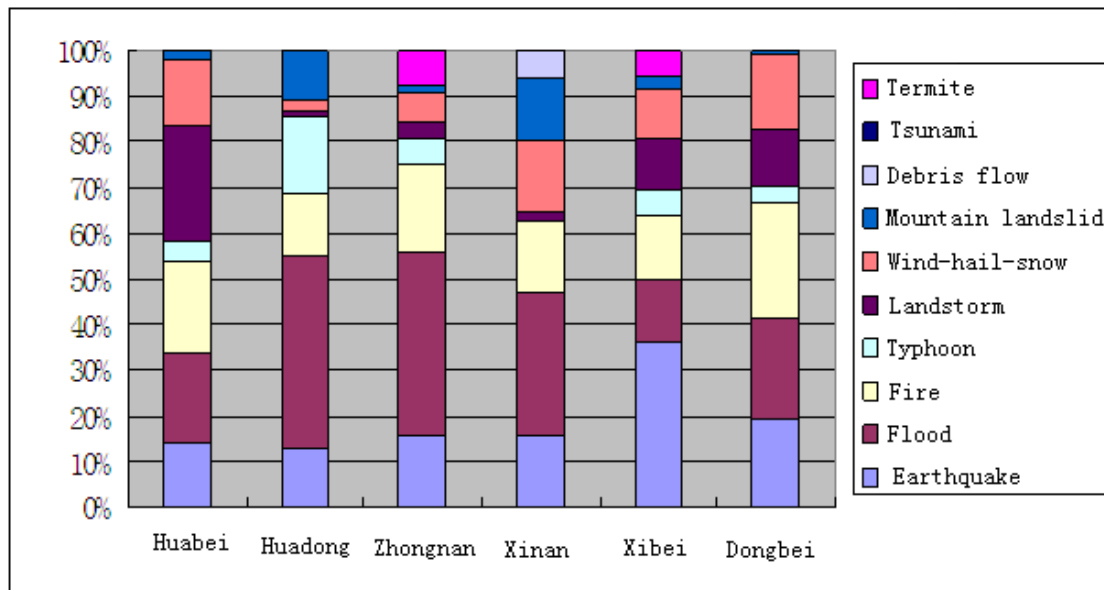


Figure 2. Distribution of Disasters that Exert most Serious Damages on Village and Town Housing.

Notice: Percentages in this figure is calculated from regional statistical data of “the most serious disaster for village and town housing”.

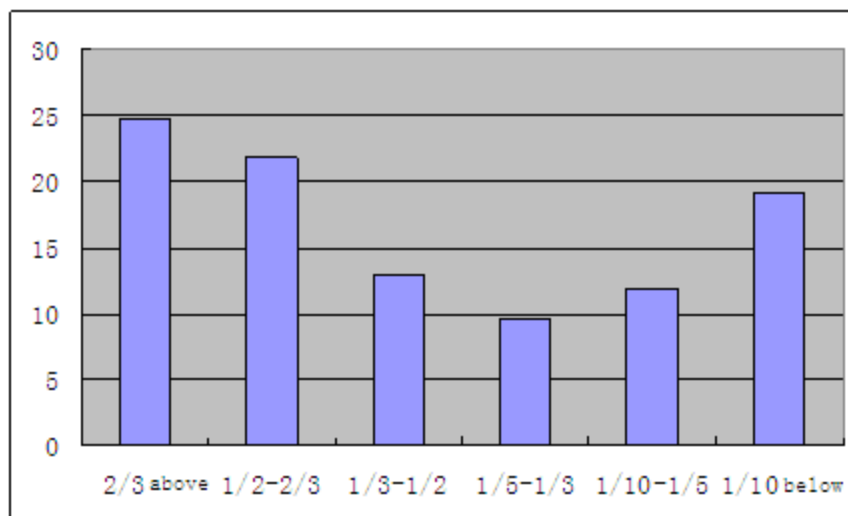


Figure 3. Percentage of Disaster Harms on Earth-Wood-Stone Structured Housing.

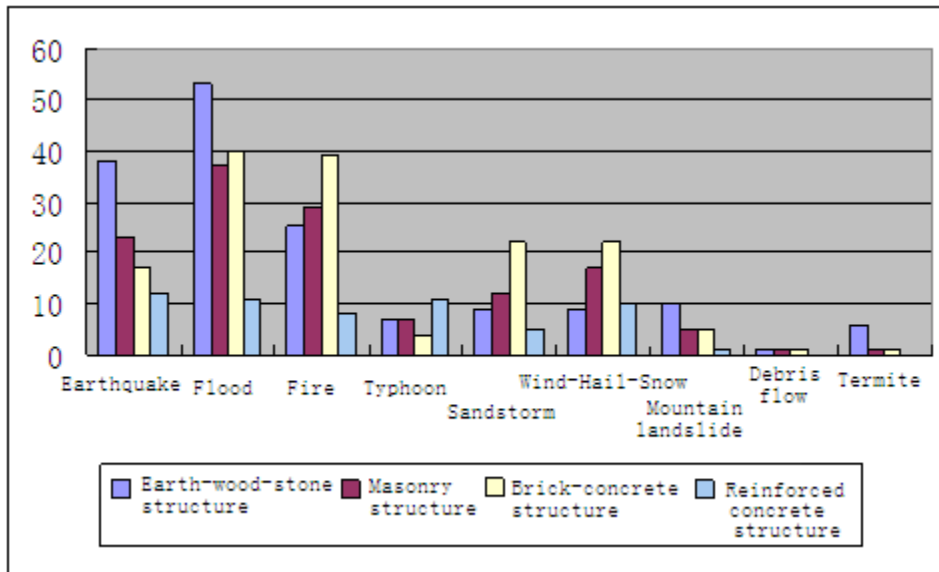


Figure 4. Comparison of Different Disaster's Harms on Typical Village and Town Housing.

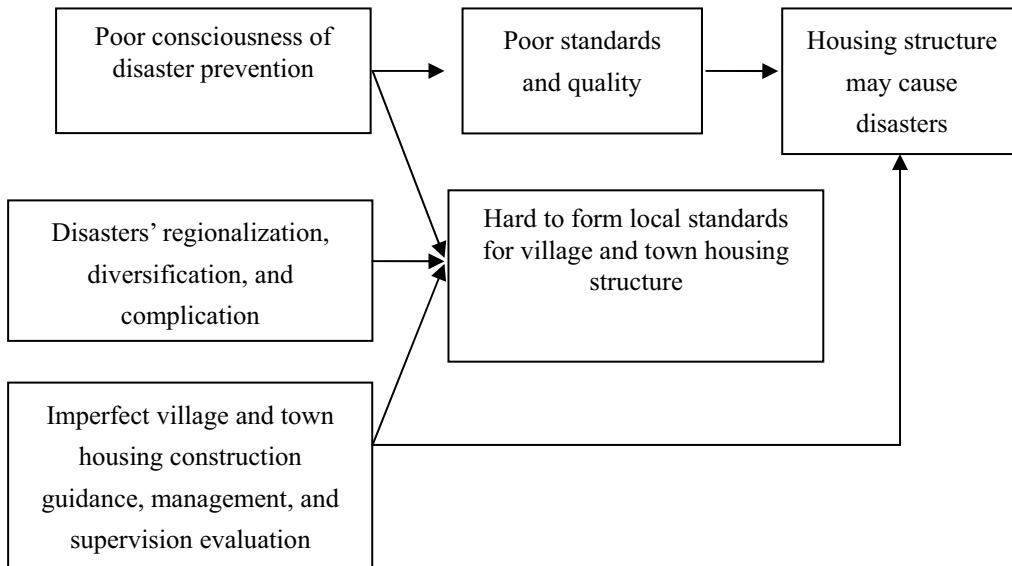


Figure 5. The Disaster Pattern for China's Village and Town Housing