

Risk zoning of the urban shelter in earthquake

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ABSTRACT

In order to deal with the huge threat and loss caused by the earthquake, established the evaluation system and model, and the risk zoning map is drawn according to the study of the vulnerability of Xicheng District's streets. According to the spatial coupling relationship between social vulnerability and physical vulnerability, drawn the comprehensive risk zoning map of Shichahai street as a typical case. The results show that Xicheng District and Shichahai street have their own vulnerability, which is very different from the social vulnerability and physical vulnerability of different streets and communities.

Keywords

Urban earthquake, Social vulnerability, Physical vulnerability, Coupling study, Comprehensive risk zoning map

INTRODUCTION

City is the human - - the function of the system of strong coupling and urban vulnerability analysis should not only considering all kinds of building / structure anti disaster ability, also need to consider the layout of the urban population and in the disaster behavior characteristics. Therefore, the vulnerability analysis of city must consider the social vulnerability of the population as the main object and the physical vulnerability of the object as the main object. The concept of vulnerability was originally used in the ecological environment, mainly refers to the sensitivity of the system to interfere with the ability to recover. In recent years, the concept of vulnerability began to appear in the disaster, social crisis and the analysis of emergencies, mainly refers to the human society and other systems in the impact of disaster response and recovery ability.

URBAN VULNERABILITY RESEARCH

Vulnerability research status

The city earthquake disaster is very serious in China. The regional degree earthquake intensity VII China accounted for the national total area of more than 40%. According to statistics, more than 50 million population of large and medium cities a total of 61 in the seismic intensity of VII degrees above areas are 33, accounting for 54% (Wang et al., 2004), of which more than 100 million people in mega cities, such as Beijing, Urumqi, Xian, Haikou and other mostly located in the seismic intensity VIII degrees above areas (Zhang and Wang, 2001).

Once the city has an earthquake, any link out of control will have a devastating consequences. Therefore, only by fully understanding the vulnerability of the city, can it provide reliable basis for the city earthquake disaster reduction. Vulnerability is usually the damage of the bearing bodies under the earthquake action (Wang and Jiang, 2005). The characteristics of China's urban development and urban disaster, has great significance to our country urban safety and social sustainable development to establish a sound evaluation index of urban disaster emergency capability, is the priority of our country urban safety and disaster prevention at present (Tie and Tang, 2005).

The population vulnerability assessment of the earthquake disaster, whether in earthquake emergency or in the economic and social development plan, is a very important content (Li and Wang, 2010; Li and Jiang, 2000; Pan

et al., 2007).

United States did the integrated risk assessment on 10 kinds of natural disasters, such as floods, tsunamis, storm surges and tornadoes. Japan, Britain and other countries did the comprehensive evaluation of typhoons, floods, tsunamis and other disasters. The Federal Emergency Management Agency (FEMA) and the National Academy of Building Sciences (NIBS) jointly developed a risk assessment software system (HAZUS) for earthquakes, floods and hurricanes. Comprehensive consideration of all kinds of disasters that the city is facing, to study the urban vulnerability analysis technology research and development of urban risk evaluation system, to provide comprehensive risk awareness and decision-making basis for urban management, which is the important development trend of international risk assessment techniques.

In order to reduce the degree of urban vulnerability, the city should strengthen the city response to the disaster and the city own disaster management ability. At present, the trend of the development of international disaster management is the risk management alternative to disaster management. Domestic and relevant scholars in the city for the vulnerability of the body, a clear assessment of regional vulnerability assessment methods and evaluation methods, the region's vulnerability indicators, etc.. Domestic disaster risk assessment mainly includes three aspects: one is the risk analysis, the two is the vulnerability analysis, the three is the expected loss analysis. Among them, the risk analysis is the premise, the vulnerability analysis is the foundation, the expected loss analysis is the core.

Different vulnerability definitions have different evaluation index system and evaluation method. From the current domestic and foreign research situation, the definition of vulnerability can be divided into three categories: one, using the body itself index to reflect the characteristics of the disaster bearing body; another definition of common features is to link the natural phenomenon and social consequences, or think is the two series of interconnected system function, or think should be superimposed. Third category, with the social consequences of natural phenomena to define the concept of vulnerability. The views of scholars in our country belong to the third category, but they have their own opinions, which means the distribution of the social and economic level of the disaster areas and the capacity of the disaster bearing capacity, and it also refers to the people of the specific community and the people who have the property of natural disasters.

Characteristics of urban earthquake disaster

(1) urban earthquake casualties and economic losses, on the environment damage serious, type a unique, often accompanied by secondary disasters.

(2) there are many kinds of secondary disasters in the earthquake, which are great variety of sudden, strong, damaging degree, long duration and far-reaching influence.

Urban vulnerability

(1) the dynamic nature of the study of the traditional geological and other vulnerability is that the system is static, however, because of the continuous aging of the urban system, constantly updated and reinforced, the urban system is not static, but in time and space, but this evolution may be to a higher level of development process. Therefore, whether in the city itself, or for the city's vulnerability research we will face greater challenges.

(2) delay: when subject to subsystem of the disaster of a direct impact on the interference signal is issued, the rest of the subsystem of general interference of interference factor to after a period of time will be given feedback, namely to response interference a delay, this time may interference factor in the accumulation of energy, but it also reduce our urban vulnerability provides the opportunity, we need to do is first time found directly affected by the disaster, the impact of the subsystem and interference factor, and cut off from the other subsystems of the association or intercept the interference factor of energy transfer channel.

(3) the transmission of a subsystem, in the event of a sudden event, is the cause of the real danger of the city's vulnerability, as a result of the correlation between the urban internal system and its ability to pass the damage to the other subsystems.

Urban vulnerability research

For a city, the greater the size, the higher the degree of development, and once the disaster, it will be the greater the loss. In order to understand the urban disaster reduction management, we must consider the city's vulnerability. In particular, the city's vulnerability includes the following 4 aspects: population, economy, building, lifeline engineering.

Analysis on risk zoning of urban earthquake shelters

Taking refuge in the disaster occurred in the emergency evacuation and emergency evacuation and other important functions, can effectively reduce the loss of life and property. Proposals for disaster prevention and mitigation, is now in the western city in the rose garden, West postern green, Wanshou Park, Changchun Park Court, south axis green Zhenwu, Cui Fang Yuan green, green xiannongtan God outside warehouse, Feng Xuan Park 8 established earthquake emergency shelters, as shown in Table 1.

Table 1 The earthquake emergency shelters of Xicheng District

Name	Area (M ²)	Capacity	Classes	District	Population
Rose Park	36178	13419	III	De sheng	124369
Xi bian men greenbelt	34552	12894	III	Yue tan	154897
Wan shou Park	47000	15000	I	Bai zhi fang	95268
Chang chun yuan Park	14000	6000	III	Guang an men nei	89843
South-Central axis greenbelt	110678	47000	III	Tian qiao	54436
Cui fang yuan greenbelt	10062	4600	III	Yue tan	154897
Agriculture temple greenbelt	9895	4598	II	Tian qiao	54436
Feng xuan Park	47271	15000	III	Bai zhi fang	95268

Accessibility evaluation of the place of Shelter

In the process of escaping from the disaster, people can arrive at the place of refuge in time, and it is a key problem to measure the efficiency of the service. The accessibility of the place of refuge is the convenience for people to get to the place of refuge in a limited time after the disaster. Different service radius (time) may lead to the results of the reachability evaluation, and the coverage rate of the reachable range of different time in the different time can be used to characterize the accessibility of emergency shelter.

$$A_{t_0} = \frac{\sum_1 S_{i,t < t_0}}{S} \quad (1)$$

Among them, A_{t_0} is the research area of emergency refuge within the t_0 time, $S_{i,t < t_0}$ said the study within the first I refuge, the corresponding area in the t_0 time, S for the evaluation of the total area, T_0 , respectively, according to 12sec, 1min, 5min.

Degree of enrichment in the shelter

Taking into account the refuge is to provide temporary refuge sites after the earthquake, in addition to consider people after the disaster to timely emergency shelter, should also consider the matching of shelter and the local population, that is to consider the shelter loading conditions. The use of the index, that is, the study area of the per capita area of refuge, to reflect the area of refuge in the carrying capacity, the calculation formula is as follows:

$$r_j = \frac{\sum_{i=1}^n s_{ij} * e_i}{p_j} \quad (2)$$

Among them, R_j is the j -th study area per capita area of evacuation, J is the study area emergency refuge sites of the total area, I is the i -th emergency shelter. E_i is the effective area conversion coefficient of the green space, park, etc., according to the Beijing center city earthquake and emergency refuge place (outdoor) planning program, the coefficient is about 0.6, P_j is the service population in the study area.

THE SHELTER VULNERABILITY IN XICHENG DISTRICT

According to the distribution of the places of refuge in Xicheng District, combined with the area of the refuge, the number of people, the categories of the places of refuge and the distance from the place of refuge, the vulnerability of each street in Xicheng District is divided into 4 levels, and the distribution of the vulnerable areas in Xicheng District is obtained, as shown in Figure 1.

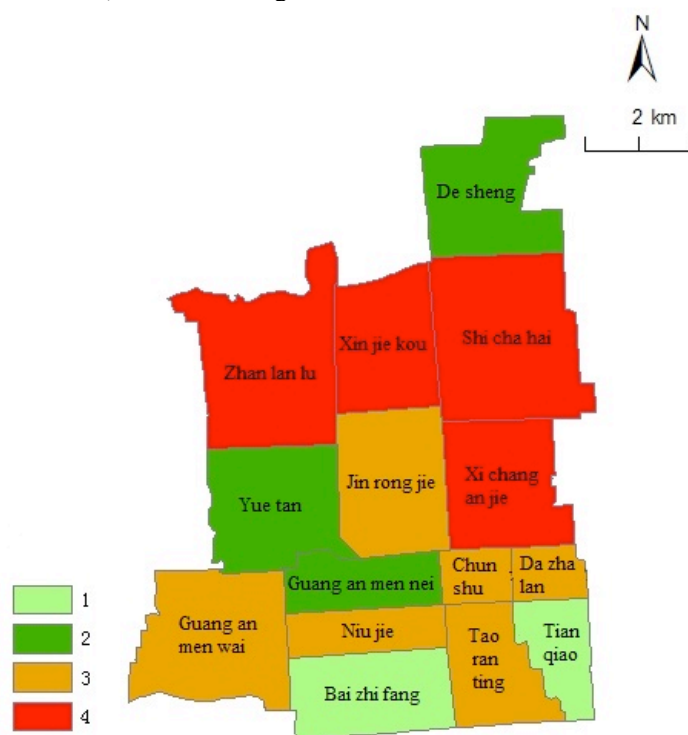


Figure 1 The shelter vulnerability of Xicheng District

TYPICAL CASE ANALYSIS

Shichahai street is located in the northeast of Xicheng District, near Shichahai water system, consisting of the West sea and Houhai sea, 580 square kilometers. Shichahai street, Xicheng District is the old area in Beijing, which has high vulnerability in serious disasters, so we choose this area as the research object.

There is no shelter in Shichahai street, so studied the coupling relationship between the time and space of the population vulnerability and the buildings vulnerability.

The population of the Shichahai Street Community

The collection of the Shichahai street community data analysis except Xihai street, considered the population vulnerability during the daytime in a weekday, to get the population vulnerability zoning map of the Shichahai street, as shown in Figure 2.

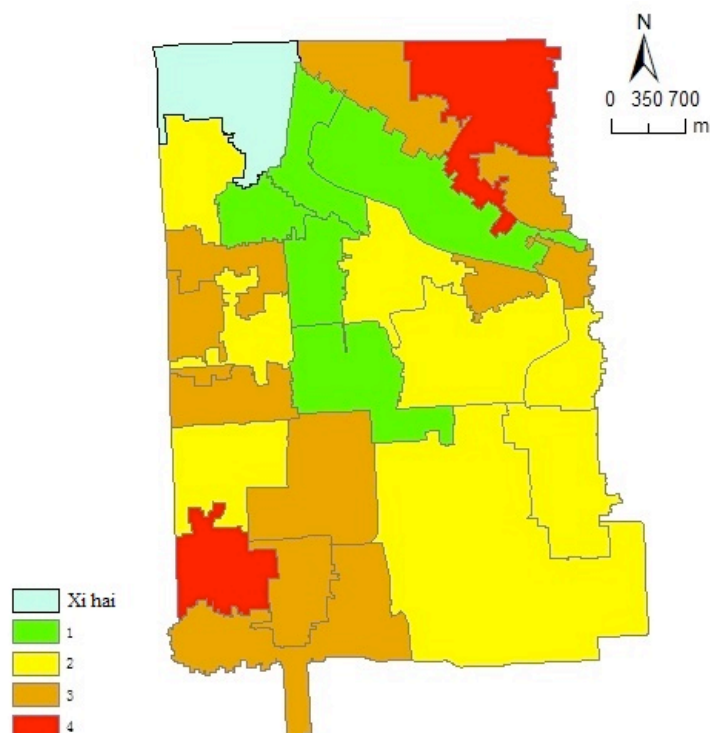


Figure 2 The population vulnerability of Shichahai street

It can be seen from the picture that the population in the northeast and southwest of Shichahai is more vulnerable. The population in the southwest of Shichahai is small, but the proportion of female population is relatively large, which leads to a high vulnerability. The population distribution of each community in the northeast of Shichahai is large, and the population of the aged is more, so the overall vulnerability is higher. The population of other communities is not large, the proportion of female and aged people is relatively low, and the population is relatively low.

Shichahai street community building vulnerability

According to the data of the community housing types and architectural structure of the Shichahai street, the vulnerability of the buildings in the community is calculated, the vulnerability of buildings in the Shichahai street as shown in Figure 3.

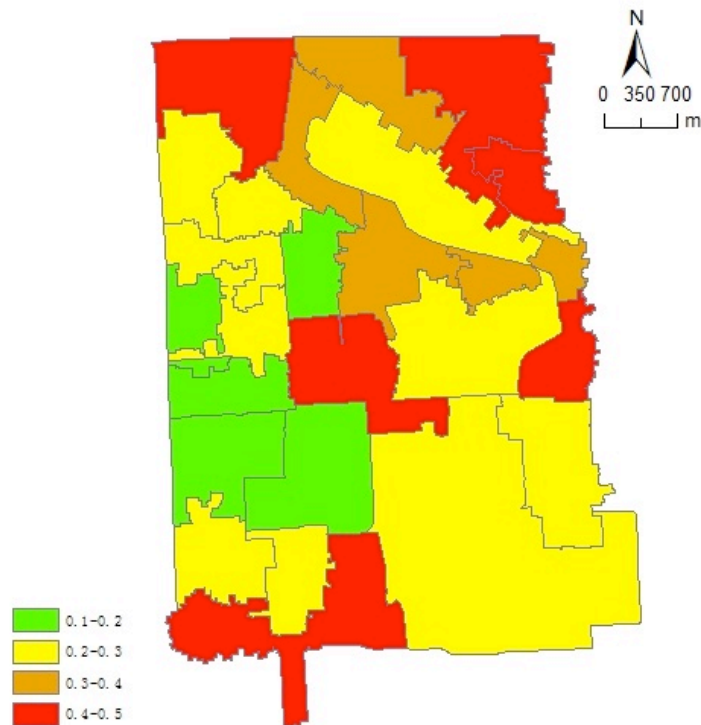


Figure 3 The buildings vulnerability of Shichahai Street

Shichahai street, the main building of the community building, the building is less. From Figure 5, it can be seen that in the northeast of Shichahai, the community building is relatively high, the main reason is that the house is brick soil structure, seismic capacity is relatively poor. Most of the western community housing structure is reinforced concrete, masonry structure, strong earthquake resistance, so building fragile overall on the low side.

The spatiotemporal coupling of the community in Shichahai Street

Combination of Figure 2 and figure 3, it can be drawn from the streets of Shichahai, the vulnerability of the community, as shown in figure 4.

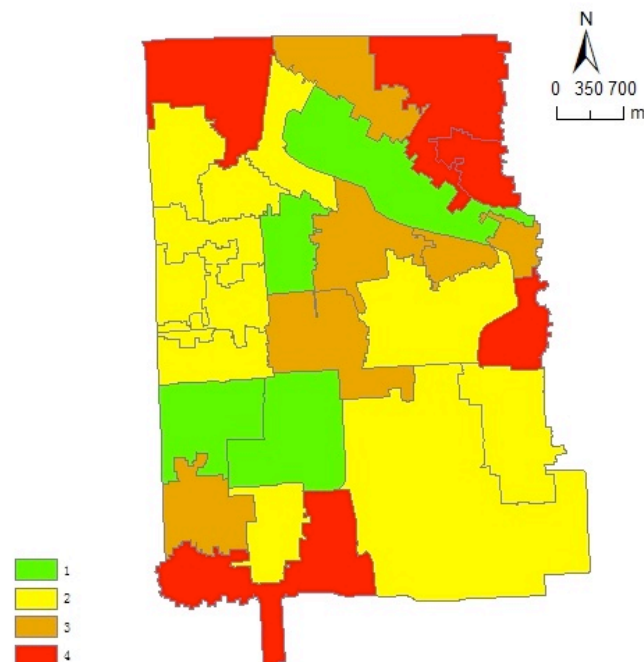


Figure 4 The temporal and spatial coupling of the community in Shichahai Street

From Figure 4, it can be seen that the vulnerability of each community in the northeast of Shichahai is relatively

high, and it is likely to suffer more serious casualties and property damage in the earthquake. In the West and southeast of China, the population of the community is relatively low, so the vulnerability is still relatively low.

CONCLUSION

Through the analysis of the vulnerability of urban earthquake, the paper established the evaluation model of shelter, and analyzed the shelter vulnerability of Xicheng District and Shichahai street. In the risk zoning map, the vulnerability area can be displayed visually, so that the usual emergency management, and to take effective preventive measures in the case of emergency. Targeted prevention and treatment, to fight for more time, will reduce the occurrence of earthquake casualties and property damage to a large extent. Cities always have the higher vulnerability areas, so this study is also applicable to other cities.

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