The Recovery and Conservation of a Historic District Post-earthquake
A Case Study of Zhaohua in Sichuan Province in China

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Abstract
This is a case study on the restoration of historic buildings in the historic town Zhaohua, which was damaged in the 5/12 Sichuan Earthquake. Based on post-earthquake investigations of damage and the restoration of historic buildings in Zhaohua, the authors described the restoration conditions of historic buildings both during and following the recovery process. The purpose of this paper is to analyze the restoration methods of historic buildings, in order to preserve the historic district after the earthquake. The authors summarize by suggesting that governments should make a restoration plan which provides for the long term (5-10 years), and focus on not only cultural properties, but also undesignated historic buildings in the historic district.

Keywords: Sichuan earthquake; historic district; conservation; restoration; through type timber frame

1. Introduction
On May 12, 2008, the 5/12 Sichuan Earthquake killed 69,226 people, 374,643 were injured, and 17,923 were listed as missing (based on August 25, 2008 statistics). Four hundred and seventeen cities or towns are located in the affected area. More than three years post-earthquake, Zhaohua town is still undergoing a recovery process.

This paper looks at the case of Zhaohua, an historic town in Sichuan Province, where historic buildings were severely damaged. Based on several surveys of historic buildings in Zhaohua from July 2008 to July 2011, their experiences with restoration recovery are traced, to see how the historic buildings have been restored and how the financial support was rendered.

This research is an approach to the study of the restoration plan in the long term of historic buildings, including designated historic buildings in cultural properties and undesignated historic buildings, recovery and conservation of the historic environment post-disaster. In particular, this research will improve the conservation management of restoration and subsidy after a disaster in China. It is hoped that the restoration process in Zhaohua can offer lessons for historic district recovery in other contexts, including the Great East Japan Earthquake of March 11, 2011.

2. Overview of Historic Town – Zhaohua
2.1 Position and History
Zhaohua town has more than 2300 years of history. It is located in the northeast of Sichuan province, and belongs to the Yuanba zone in Guangyuan city. This places it about 220 kilometers away from the epicenter of Wenchuan County of the 5/12 Sichuan Earthquake, which is on the edge of the earthquake zone of the seismic belt. The position of Zhaohua is shown in Fig.1. In December 2008, Zhaohua was designated as an Historic and Cultural town by the Chinese government.

In this planning, the historic district area was determined as 29ha, where 2,750 people live (based on 2006 statistics). Nine cultural property units, which were designated by the province or municipality, and 191 undesignated historic buildings and 220 new buildings, which were built after 1949, are located in this district. In December of 2008, Zhaohua was designated as an Historic and Culturally Famous Town by the Chinese government.
2.2 Historic District in Zhaohua

The area of the historic district in Zhaohua is 10.4ha. This was investigated and determined in the Detailed Planning of the Zhaohua Historic District, which was under the guidance of the National Historic City Research Center of Tongji University from April to October 2006. At present, 2,750 people live in the historic district (based on 2006 statistics). The layout of Zhaohua is shown in Fig.2.

2.3 Historic Buildings in Zhaohua

Before the earthquake in 2008, 232 historic buildings, built before 1949 and 220 new buildings, built after 1949, were located in the historic district. The main structure of historic buildings is wooden "through type timber frame". Forty-one historic buildings, which belong to the cultural property, and 191 undesignated historic buildings were designated by the province or municipality.

3. Damaged Condition in the Earthquake

After the earthquake in 2008, according to the criterion documents, the damaged civil buildings were classified into three sections: severely damaged building, partially damaged building, and slightly damaged building. The damage condition of historic buildings was shown in Fig.3.

In designated historic buildings, the number of severely damaged buildings was 5, accounting for 12%, the number of partially damaged buildings was 9, accounting for 22%; and the number of slightly damaged buildings was 27, accounting for 66% (Table 1.). Of the 191 undesignated historic buildings, the number of severely damaged buildings was 41, accounting for 21%, the number of partially damaged buildings was 34, accounting for 33% and the number of slightly damaged buildings was 85, accounting for 45% (Table 2.).

4. Recovery of Historic Buildings

4.1 Principles of Conservation and Restoration

In the detailed planning of Zhaohua, it is described: "the designated historic buildings (in the cultural properties) require daily maintenance, reinforcement and restoration; undesignated historic buildings require improvement. Improvement means restoration, preservation and adjustment of the internal layout and facilities, rather than changing the appearance of the characteristics".

Meanwhile, the assessment of building facades was provided and restoration principles of building facades...
on both sides of main streets were described. The characteristics of elements in the historic buildings, such as the roof, the walls and the door, were assessed. Following that, restoration measures, including the standard of the material, the color and height of buildings, pattern of the doors and windows were rendered in the planning. The pattern of the facades and control of building height are shown in Fig.4.

4.2 Emergency Investigation of Damaged Historic Buildings

In the month after the earthquake, experts made a preliminary investigation of damaged historic buildings. They were working in the Department of Cultural Properties in the Yuanba Zone, which is the upper government of Zhaohua. After that, they made a report to the Sichuan Provincial Cultural Relics Administration, which included the degree of damage to historic buildings in cultural properties and the capital budget required for restoration.

In Oct. 2008, according to the criteria of damaged civil buildings, released by the government of Sichuan Province, an investigation was made of damaged buildings in Zhaohua by the Urban Construction Bureau of the Yuanba Zone. But in this investigation, there was no distinction between the historic buildings and new buildings.

4.3 Facts on the Restoration of Historic Buildings

During the three year recovery process, of the 41 designated historic buildings, the number of un-restored buildings was 16, partially restored buildings 7, and completely restored buildings 18. Adhering to legal guidelines no buildings were demolished or replaced by new buildings. Concerning the 191 undesignated buildings, the number of un-restored buildings was 51, partially restored buildings 66, completely restored buildings 39. Nine buildings were demolished and 26 buildings were replaced by new buildings. The condition of recovery of historic buildings is shown in Table 3. and Fig.5.

4.3.1 Restoration of Designated Historic Buildings:

After the earthquake documents were released regarding the management of restoration and preservation of damaged cultural properties. For instance the "Special Rescue Plan for Conservation and Restoration of Cultural Relics in Sichuan Province", and the "Management Methods for Rescue and Preservation of Cultural Relics in the Sichuan Earthquake", was released by the central government or the Sichuan provisional government two months after the earthquake.

The principles of subsidy management, design of restoration, and approval management of the restoration project were illustrated in these documents. In the restoration process of designated historic buildings, according to these principles, experts for the protection of cultural properties were restoring the damaged buildings.

In the recovery process, 18 buildings were already restored with the original pattern before the earthquake; no buildings were demolished or replaced by new ones. Twenty-three buildings were not restored or only partially restored. It was said by an official in the local

Table 3. Condition of Restoration to Historic Buildings (July 25, 2011 Statistics)

| Type of Historic Building | Completely Restored | Partially Restored | Not Restored | Vacant Land | Replaced by New Building | Total |
|--------------------------|---------------------|--------------------|--------------|-------------|-------------------------|-------|
| Designated Historic Building | 18                  | 7                  | 16           | 0           | 0                       | 41    |
| Undesignated Historic Building | 39                  | 66                 | 51           | 9           | 26                      | 191   |
government that the un-restored buildings would be restored in Oct. 2011.

4.3.2 Restoration of Undesignated Historic Buildings:

In the restoration process of undesignated historic buildings, there are no documents concerning the principles of restoration or subsidy management, released by the national or provincial governments. The management of restoration was based on the detailed planning and management methods made by local government. Obviously, the legal effectiveness of these documents is quite low.

During the recovery process, until July 2011, in the 39 buildings restored completely, only 6 buildings were restored with old materials (Fig.6.). In particular, some wooden or mud walls were replaced by brick with a concrete surface, in order to obtain much better insulation and durability (Fig.7.). Some buildings were restored partially with old materials because of a lack of old material or subsidy (Fig.8.).

The author chose 32 restored buildings, whose owner clearly remembered the time of restoration, to study the time of beginning and duration of the restoration process. The months at the beginning of the restoration and months of restoration are shown in Fig.9. Twenty-two historic buildings were restored after May 2008, i.e. quickly following the earthquake. These are commercial buildings or public buildings. The cost of restoration was paid by the owners or local government.

4.4 Un-restored Conditions of Undesignated Historic Buildings

In the undesignated historic buildings, of the 191 historic buildings, only 39 buildings were restored, and 123 undesignated buildings were not restored or only partially restored, accounting for 64%. The main reasons for the lack of restoration are:

1. Insufficient funds (49 historic buildings)
2. Unused building in the long term (33 historic buildings)
3. Other reasons (7 historic buildings)
4. Restoration not necessary for use (34 historic buildings)

(No records were made for the other 29 buildings because no one lived in them.)

The relationships between the main reasons for the lack of restoration and numbers of un-restored buildings are shown in Fig.10.

4.5 Financial Support

After the earthquake, the central government...
provided national financial emergency support. For damaged designated historic buildings, the cost would be paid by the special maintenance funds for cultural properties. The central government also provided a maintenance subsidy for other buildings, including undesignated historic buildings. According to the Reconstruction Program of Urban Housing after the Sichuan Wenchuan Earthquake, which was published in September 2008, the subsidy for maintenance would be paid by the Provincial Department of Finance. If the subsidy proved to be insufficient the remainder was to be paid by the local government. For severely damaged buildings, which need to be reconstructed, the Sichuan government would provide an average 25,000 RMB, about 300,000JPY (1RMB=12JPY) as a maintenance subsidy. For other damaged buildings, which need not be reconstructed the subsidies are shown in Table 4. This kind of subsidy was rendered for families, whose buildings were damaged in the earthquake. But, there are not any documents emphasizing that undesignated historic buildings should be treated differently from other new buildings.

Table 4. Subsidy Level of Maintenance

| Damage Level | Slightly damaged | Partially damaged | Severely damaged |
|--------------|------------------|-------------------|------------------|
| Subsidy (RMB)| 1000-3000        | 4000-5000         | 6000-8000        |

In each degree of damage, according to the various damage conditions, the actual subsidy was determined by the local government. In Zhaohua, the actual average subsidy for the families was 1000RMB (slightly damaged), 2000RMB (partially damaged) and 22,000RMB (reconstruction), whose buildings were greatly damaged. The relationships between the average subsidy and the actual cost are shown in Fig.11. For instance the government provided 1000RMB for the slightly damaged buildings, accounting for about 10% of the actual cost, 2000RMB for partially damaged buildings, accounting for about 12% of the actual cost and finally 249,000RMB for reconstruction.

Obviously, the subsidy is quite insufficient for restoration. Additionally, due to the increased demand for labor and materials after the disaster, the price of these increased rapidly. By the end of 2008, inflation due to the world economic crisis further caused the prices to increase. For example, before the earthquake, a piece of a tile was 0.5RMB, but was 1.0RMB post-earthquake. The price of labor was 70RMB per day before the earthquake and 150RMB per day in July 2011. (1RMB=12JPY)

5. Conclusions

From the analysis we can clarify the progress and evaluate the current conditions of recovery in the historic district of Zhaohua town as follows:

① According to the requirements of China's central government, the recovery should be finished two years after the earthquake. However, in the authors' investigation, the analysis shows that, until July 2011, of the 41 designated historic buildings, the number of restored buildings was 18 (44%); of the 191 undesignated historic buildings, the number of restored buildings was 39 (20%).

② Although some principles pertaining to the conservation of historic districts were in place prior to the earthquake, during the process of recovery the government did not forcibly ask the local people to restore every historic building with original materials, additionally there were no legal consequences. This led to 33 undesignated historic buildings restored with new materials, nine buildings were demolished, and 26 buildings were replaced by new buildings.

③ We selected 32 restored undesignated buildings, whose owners clearly recall the time of restoration, to clarify the time of beginning and duration of the restoration. 18 commercial or public buildings were beginning of recovery rapidly following the earthquake with their own spending money.

④ Comparing the actual cost of restoration with financial support, we found that the financial support were accounting for 10% of slightly damaged buildings, 12% of partially damaged buildings and 8.8% of reconstruction buildings. In the undesignated historic buildings, of the 191 historic buildings, 49 (25.7%) historic buildings were not restored because of a lack of enough funds.
In summary, we also found the subsidy in the long term is the most important for the restoration of historic buildings, particularly undesignated historic buildings. It is necessary to make a recovery plan of 5-10 years for the restoration of historic buildings after an earthquake. So the subsidy will be provided in the long term when it is not enough to restore all historic buildings immediately following an earthquake.

Acknowledgement
Special recognition and appreciation goes to Yasufumi Uekita Professor of World Cultural Heritage Studies of the University of Tsukuba in Japan, for his intelligent insights and kind guidance. Also appreciation is due to support by the National Natural Science Support Fund of China. (Contract No. 51008260).

Notes
1 Reference 5)
2 China's historic and cultural town refers to "preserve the rich heritage and great historical value and special or commemorative significance of the Revolutionary towns and villages", which was proposed by the Ministry of Construction and State Cultural Relics Bureau in 2003.
3 Reference 1)
4 Reference 4)
5 Buildings with through type timber frames utilize tile roofing. The building structure consists of columns and beams. A through type timber frame consists of three column wooden frames or five column wooden frames. Across the beam through the column under the crossbar is called a through type timber frame. Its role is to be the connection of beams and columns, ensuring lateral rigidity and stability of the wooden frame.
6 The methods of judging damaged buildings were released in the "technical guidelines of damage identification of rural housing in the Sichuan earthquake", which was published by the Sichuan provincial government on August 1st 2008. In this document, investigators are instructed to inspect the condition of each part of the building construction (i.e. roof, walls, load-bearing) and list the degree of damage. Then an overall degree of damage is given from three classifications: severely damaged building, partially damaged building, and slightly damaged building.
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8 Reference 4)

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