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# Improving Social and Economic Sustainability with Rammed Earth Building in Rural Areas of China

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THEME 5.2: HERITAGE REVITALISATION AND VALORISATION

## Summary

China has been undergoing tremendous development and implementing construction projects in rural areas over the past decade. Under the conventional rural modernization development model, numerous vernacular buildings, such as rammed-earth buildings, are being replaced by brick–concrete buildings. However, this endeavor shows that brick–concrete building is not a good solution, particularly in mountainous rural areas, such as Southwest China. The social and ecnomic value of rammed-earth construction has been neglected in the course of rural development. The Ma'anqiao Village post-earthquake reconstruction project shows that an innovated rammed-earth building can provide a safe and comfortable living environment, as well as improve social and ecnomic sustainability, which is significant for sustainable rural development.

Figure 1. Ma'anqiao Village before reconstruction

## Introduction

As early as the 1970s, critiques of rural modernization were already emerging in Europe and other developed regions. Numerous scholars and practitioners determined that social and economic sustainability is important in sustainable rural development.

Social and economic sustainability is also important in the post-earthquake reconstruction of rural areas in Southwest China. After the 2008 earthquake in Sichuan Province, the villagers encountered several challenges during the reconstruction process, including increased prices of conventional building materials, poor transportation facilities, low income, and low educational level (Figure 1).

Accordingly, a village reconstruction and demonstration project was launched in Ma'anqiao Village in Sichuan Province. This project adhered to the concepts of sustainable development and endogenous rural development. Innovations based on local traditional building technology included improved seismic performance, indoor environmental quality, and cost efficiency. Rural infrastructure was improved to provide an enhanced living environment. Most importantly, villagers were completely engaged and empowered. (Figure 2).

Figure 2. Ma'anqiao Village after reconstruction

## Methodology and results

The reconstruction process and result of the Ma'anqiao reconstruction project were compared with those of the nearby Jiulong Village reconstruction project, which is a typical project that followed the rural modernization model. The benefit and achievement of the Ma'anqiao project in terms of social and economic sustainability are highlighted through the following cross comparison.

1. During the early stage of the Ma'anqiao project, site investigations and surveys were conducted to completely understand the local condition and needs of the residents. Based on the investigation, the villagers were provided with a reconstruction DIY manual involving 12 prototype housing designs that they could refer to according to their respective needs (Figure 3).

Meanwhile, the Jiulong Village reconstruction followed a top–down strategy. All reconstruction houses used the same design and layout, which were considerably small to provide enough space for an agricultural lifestyle.

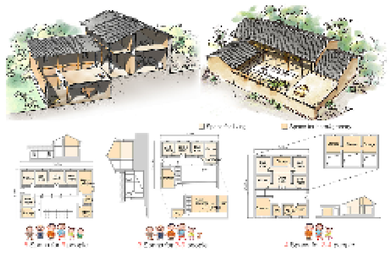

Figure 3. Innovative building design with flexibility

2. In the Ma'anqiao project, local and recycled materials from the seismic ruins were utilized to rebuild houses in-situ. Therefore, the reconstruction cost was reduced significantly. Moreover, the original pattern and special structure of the community were retained to protect the sense of belonging of the residents.

Instead of in-situ reconstruction, the Jiulong project rebuilt the village on a new parcel of land using bricks and concrete. The reconstruction cost of the brick–concrete houses is higher than that of the rammed-earth houses. The community outdoor space was also boring and lacked greenery (Figure 4 and 5).

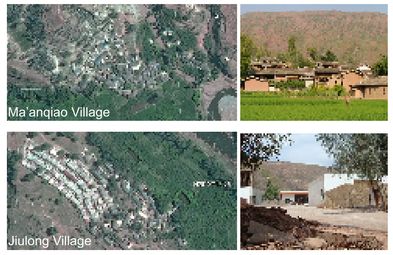


Figure 4. Pattern and special structure of Ma'anqiao Vilage after reconstruction

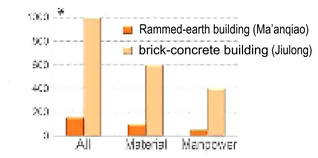


Figure 5. Reconstruction cost comparison

3. In the reconstruction stage, residents from each family were organized to build the prototype house (Figure 6). The innovated anti-seismic rammed-earth building technology was transferred to the villagers by doing and practicing together. The villagers could learn the technology immediately because they are familiar with earth-building construction. Furthermore, the innovated method was easy to understand and follow using simple tools.

Thereafter, the villagers rebuilt their respective houses using the innovated construction method. They exchanged labors within the community and assisted one another during the reconstruction stage; hence, labor cost was significantly reduced. This technology can also become a source of livelihood for the local residents in the future. This strategy empowered them and improved local employment significantly. The confidence and self-identity of the villagers were improved during this process. Moreover, this endeavor reinforced social relationships within the community.

The reconstruction in Jiulong Village was conducted by a contractor from outside the village because the local villagers were unfamiliar with the brick-concrete building design and construction. The traditional rammed-earth building technology was already abandoned.

Figure 6. Prototype house construction

4. In Ma'anqiao Village, good thermal performance with passive design of daylight and natural ventilation resulted in low energy consumption, that is, low operational costs were indicated during the operation stage. By contrast, the brick–concrete houses in Jiulong Village had considerably low thermal performance. These houses required additional cooling energy during the hot summer months. Therefore, the operational cost was significantly high (Figure 7).

5. In the community improvement stage, a village center was built by hiring the villagers. This strategy increased their income and provided public service facilities and a center courtyard for the community (Figure 8). The villagers could enjoy the public communication space and celebrate their traditional festivals in the courtyard. By contrast, Jiulong Village lacked a public space and service facilities.

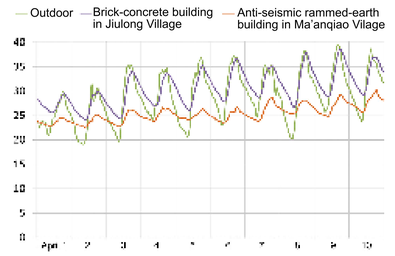


Figure 7. Air temperature measurement result comparison

Figure 8. Village center and its courtyard

6. Public engagement throughout the entire reconstruction process indicated that the villagers were respected and completely involved in this undertaking. The result of the questionnaire survey showed that the villagers were satisfied with their living environment after the reconstruction. However, the satisfaction level of the villagers in Jiulong Village was lower than that of the villagers in Ma'anqiao Village (Figure 9).

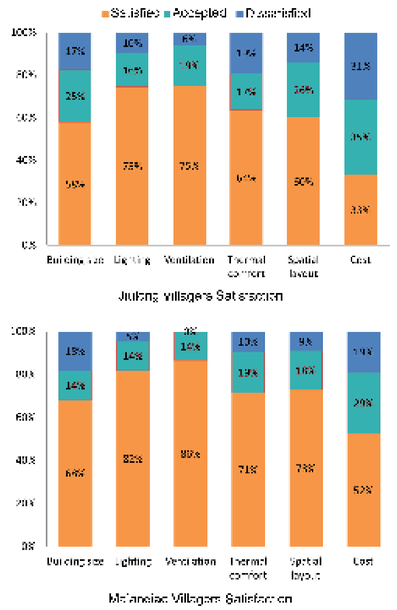


Figure 9. Villagers satisfaction comparison

## Conclusions

After the reconstruction, the community was socially empowered because of the development of new skills that enhanced their future employment opportunities. The villagers also learned to show considerable respect for their culture and heritage. Moreover, the villagers did not need to become migrant workers in the cities to afford reconstruction cost or to search for an improved living environment. Hence, their lives were not destroyed by the disaster but became convenient and comfortable.

The Ma'anqiao reconstruction project showed that apart from the benefits of low environmental impact, rammed-earth buildings have immense social and ecnomic benefits, particularly for poor rural areas, such as Southwest China. The reconstruction strategy could mitigate the disadvantages of rural modernization model with a bottom–up manner and endogenous development. To improve socioeconomic sustainability, the objectives should be clarified in the beginning and the entire construction process needs to be organized systematically and strategically.