



Residents in Ma'anqiao Villager adopted innovative rammed earth construction techniques to build demonstration houses. Photo: WZQ Foundation

Building New Hope from the “Ground” Up

the story of climate-friendly rammed earth construction

by Project partner | **無止橋** 慈善基金
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Note from the Editor: On 30th August 2008, a strong earthquake shook Panzhihua City at the intersection of Sichuan and Yunnan. Situated in Xin'an Township, Huili County, Liangshan Prefecture of Sichuan Province, Ma'anqiao Village was among the hardest hit areas. In response, the author, as part of the team from the Wu Zhi Qiao (Bridge to China) Charitable Foundation (“WZQ Foundation”), carried out a humanitarian mission. The experience has since inspired her exploration of the research on and demonstrations of traditional rammed earth housing, and further motivated her search for possibilities of utilising rammed earth construction for climate change mitigation.

Building new hope from the “ground” up

Following the 2008 Wenchuan Earthquake, a 6.1-magnitude quake tragically rocked Ma'anqiao Village, a remote and isolated village located in Liangshan Prefecture of Sichuan. Most of the houses constructed from earth were found collapsed. Despite the severity of destruction and devastation, the village, unfortunately, did not receive sufficient resources or attention as the world was still dealing with the serious damage that had been caused by the preceding Wenchuan Earthquake.



With transportation routes blocked, how could the village be rebuilt?

At the time, the WZQ Foundation was the first NGO from Hong Kong that dispatched a team to the village for a humanitarian mission. Our journey started with rough, bumpy Jeep and motorbike rides that altogether lasted for more than ten hours. We were received by the local chiefs who then led us onto the bank of a river, which we were told was the destination. As it turned out, the quake-stricken village lay on the other side of the river. What's nowhere to be seen though, was a bridge.

As the local officials were about to explain to us the post-quake situations of the village, Dr. Mu Jun from the WZQ team grabbed hold of a villager nearby and removed the shoes, getting ready to cross the river barefoot, holding their hands together. I didn't hesitate to join them. Yet, the water surged past my waist, with the water current streaming fast and the moss-covered pebbles on the riverbed being extremely slippery. Traversing in a group was the only option. We could only imagine what villagers had to go through every day to deliver daily supplies, not to mention construction materials or machines.

Having arrived on the other side of the river, we followed the elderly man and walked along a muddy road. Along the way were piles of debris and fallen mud

walls with no end in sight. Villagers managed to set up a makeshift shelter with tents and just barely scrapped by by growing vegetables on the mud piles. Villagers from the ethnic groups of Yi and Dai make up the majority of the population in the vicinity. Before the earthquake struck, they would usually build for themselves spacious two-storey houses. As Yi people treat animals and poultry as their household property, they would keep animals such as cows, pigs and chicken in the middle of the courtyard, affording them extra protection. However, maintaining hygiene was a challenge. More questions popped up: How could we get the mess cleaned up in order to start the reconstruction? Where could we find workers? How could we deliver construction materials into the village? How could we raise fund? How could we rebuild the area in a way that would most suit the lifestyle and habits of the villagers? Looking into the eyes of the helpless villagers, we struggled to find any answers.



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1. A large number of houses in the village were destroyed by the earthquake. Photo: WZQ Foundation
2. In the absence of a bridge, villagers could only traverse the river barefoot. It was enormously difficult to transport construction materials into the village. Photo: WZQ Foundation
3. After the earthquake, villagers managed to set up a makeshift shelter. Photo: WZQ Foundation

Traditions have been lost and found; communities rebuilt their lives from earth

If we look back into the history, we'll realise our ancestors had already left us inspirations.

It has long been a traditional practice in some parts of China to use rammed earth for construction. According to archaeological records, people started using earth to build half-covered caves for accommodation as early as the Stone Age. Particularly, house caves (yaodong) in the Loess Plateau area of northwestern China are famous for being comfortably cool during summer and warm during winter. Rammed earth-made walls have also been well-known for their strength. In the past, people would utilise reinforced earth with bamboo slices and filaments, mixing in clay, limestone, sand, and sometimes even glutinous rice water so as to increase the elasticity and waterproofing of the construction (for example, in the case of Fujian Tulou). Repeated compression was also required to enhance its solidness. It is worth noting that rammed earth construction methods were applied to build historical landmarks such as the Great Wall, the internal part of the City Wall of Nanjing and fortresses, making them particularly effective for defensive purposes. Impressively, after hundreds of years, these monuments are still standing as solidly as they used to be. Traditional wisdom and crafts never cease to amaze us!

As time goes by, the delicacy of the traditional crafts has gradually been chipped away. In the case of Ma'anqiao Village, their earth houses had been built in the absence of reinforced earth structures and oftentimes a solid foundation, rendering these accommodations made of rammed earth – which by itself lacks anti-seismic performance – particularly vulnerable to earthquakes. A quake could, ruthlessly, flatten these homes. Thus, it was high on our agenda to assist the villagers in recovering the lost traditional wisdom, and to empower them to build comfortable, affordable and earthquake-resistant houses with locally available and adaptable resources.

Under the organisation and facilitation by the WZQ Foundation, a research team consisting of students and teach-

ers from the Chinese University of Hong Kong and the Xi'an University of Architecture and Technology, worked together with villagers to build rammed earth demonstration houses. It was hoped that through such demonstration, the team could get to experience and understand the conventional methods adopted by local craftsmen, and further improve and consolidate these techniques with scientific technology in terms of ingredient composition, tool, methodology and design; and, on the other hand, that the impacted communities could be empowered by getting engaged in the process of demonstrative construction. Villagers would not be burdened with high costs of delivery of construction materials or labour wage, neither would they be shackled to a life-long loan debt for housing. Community members involved in the construction were also able to re-use some of the wooden pillars and clay walls. Guided by the shining spirit of mutual aid, villagers re-built their homes with community participation and self-initiative, which also helped lay the foundation for resuming a peaceful family life. Aiming to promote these high-tech yet less skill-intensive construction concepts and techniques to other rural areas in China, the WZQ Foundation subsequently published a construction manual.

Ten years later, we felt blessed to be back for a revisit and be able to walk on the Wu Zhi Qiao bridge in Ma'anqiao Village again. The rammed earth houses constructed back then have been nicely redecorated, with the interior appearing refreshingly bright. Compared to cement structures, any visitor to a rammed earth architecture could benefit from ambient coolness in summer despite the scorching sun outside and the lack



of air-conditioning. While we were there, the secretary of the village committee Ms. Yang happened to be preparing for a pig slaughter feast. Neighbours and relatives had a blast getting together and savouring the gourmet. Together we had rebuilt houses, human capacity and, more importantly, a home and a community.

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1. A fort built with rammed earth by villagers almost a century ago (in Macha Village, Huining County, Baiyin City, Gansu Province). Photo: WZQ Foundation

2. Community members in Ma'anqiao Village leading a peaceful, new life. Photo: WZQ Foundation

3, 4. While revisiting Ma'anqiao Village, the villagers happened to be preparing for a pig slaughter feast. Photo: WZQ Foundation



Exploring climate-friendly rammed earth construction for sustainable development

China is one of the countries that has suffered most economically from natural disasters, which have also caused considerable human migration. Against the backdrop of climate change and deteriorating extreme weather, disasters are expected to occur more frequently. Vulnerable groups such as the elderly, children and women are particularly susceptible to the impacts of scorching heat and freezing cold. A body of global research indicates that with extreme weather accompanied by humid environments, the morbidity of cardio-vascular and respiratory diseases might surge, which would in turn increase the burden of local medical systems. Houses are where we spend most of our time. It is important that we take action now to boost community capacity in the areas of disaster prevention and response, as well as to create habitats where affordability and safety meet eco-friendliness and suitability in terms of health and comfort.

It is estimated that approximately 60 million people in China currently reside in earth houses of different forms, and that rammed earth houses account for almost 60% of the housing found in places such as Gansu, Yunnan and Tibet. Unfortunately, like in Ma'anqiao Village, many old-fashioned earth houses have been destroyed by earthquakes in recent years, sparking the thought among some people of getting rid of such housing. Yet, instead of replacing them with carbon-unfriendly, more energy-consuming and highly standardised buildings made of cement, other alternatives that are safe, efficient and feasible should be explored. To drive change, it is hoped that stakeholders from all walks of life can collaborate with one another to

promote innovative rammed earth techniques, corresponding regulations and policies, social acceptance as well as market support.

Among numerous industries, the building and construction sector accounts for 36% of the final global energy use and close to 39% of energy-related carbon dioxide emissions. Without recognising the imminent need for immediate actions, it would be highly challenging for us to attain the goal of alleviating global warming set out in the Paris Agreement. New forms of rammed earth construction are full of potentials, and have so far demonstrated outstanding performance, in terms of carbon reduction and energy saving, economic efficiency and social participation throughout the entire life cycle of construction. Some of these new rammed earth buildings are even designed to an earthquake resistance of magnitude 8; their anti-seismic capacity may stack up to that of cement and brick structures!



The further promotion of new rammed earth techniques – which are geared towards advancing and innovating conventional crafts – is believed to be beneficial for mitigating climate change, encouraging local self-initiative, strengthening the resilience of communities (especially the vulnerable) and their adaptability to extreme climate conditions, and hopefully contributing to the United Nations' Sustainable Development Goals.

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1. Traditional rammed earth houses located in the Loess Plateau area of China. Photo: WZQ Foundation
2. The Ma'anqiao Village Community Centre was established by applying the improved rammed earth construction techniques. Photo: WZQ Foundation



Keywords: Innovative rammed earth construction, post-earthquake rebuilding, sustainable architecture, rural village development, community empowerment

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References:

1. 穆鈞. 生土營建傳統的發掘、更新與傳承[J]. 建築學報, 2016, 4: 1-7.
2. 穆鈞, 周鐵鋼. 中國農村住房抽樣調查研究課題報告[R]. 住房和城鄉建設部, 2012.
3. 穆鈞, 周鐵鋼, 等. 授之以漁, 本土營造——四川涼山馬鞍橋村震後重建研究[J]. 建築學報, 2013(12): 10-15.
4. 萬麗, 吳恩融, 穆鈞. 住房和城鄉建設部重點項目——馬鞍橋村災後重建示範. 生態城市與綠色建築[J]. 2011(夏季刊): 58-62.
5. 趙祖華. 現代科學技術概論[M]. 北京: 北京理工大學出版社, 1998.
6. 周鐵鋼, 徐向凱, 穆鈞. 中國農村生土結構農房安全現狀調查[J]. 工業建築, 2013(S1).
7. Moynihan R. (2011). Health in the green economy. *Med J Aust*, 195(6):317.
8. UN Environment and International Energy Agency. (2017). Towards a zero-emission, efficient, and resilient buildings and construction sector. *Global Status Report 2017*. Available from: <https://www.worldgbc.org/news-media/global-status-report-2017>.
9. World Health Organization. (2018). WHO Housing and health guidelines. Available from: <https://www.who.int/publications/item/who-housing-and-health-guidelines>.
10. World Health Organization. (2018). Climate change and health. Available from: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>.



Together we bring hopes,
enrich lives and build for the future

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