Building with EARTH

Region	**Asia and the Pacific**
Award Scheme	**World Habitat Awards**
Sustainable Development Goals	**Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable**

Summary

Training local craftspeople in advanced earth construction in rural China People in rural China have lived in earthen homes for thousands of years. The country's recent economic boom and rapid urbanisation, however, has led to a shift away from traditional construction techniques in favour of concrete and brick design. Earthen homes have become a symbol of rural poverty and earthen building expertise in these communities is slowly being lost.

Background and Objective

Construction with earthen materials is one of the oldest traditional building techniques in the world and has been used for several thousand years in China, where at least 100 million people still live in earth dwellings. China's recent economic growth and rapid urbanisation has led to a shift away from traditional rammed-earth building practices in favour of concrete and brick design. As a result, rural building expertise is being lost and traditional earth buildings have become a symbol of poverty – a negative stereotype reinforced by government policies to move poor rural households out of earthen dwellings. Since 2008 there have been several catastrophic earthquakes in China which have destroyed many old earthen buildings and contributed to the view that they are unsafe. Most local governments and villagers have subsequently rebuilt or repaired earthen homes using concrete and brick. The Building with EARTH project is challenging China's modern construction methods with a new model that mixes traditional rammed-earth building techniques with scientific research to produce environmentally sustainable homes that are less expensive, less time-consuming to build and offer superior earthquake resistance. Villagers are trained in locally adapted construction methods, providing much-needed work and growing the local market for earthen homes. The project began in 2011 in Macha Village in Huining County, Gansu Province, with the construction of a Village Centre and 32 prototype houses. Since then, building demonstrations and extensions have taken place in 19 more villages and seven cities across 23 different regions. Beneficiaries of the new homes are mostly from poor rural villages and those living in dilapidated houses in urgent need of rebuilding. Around 655 villagers are already living in new earthen homes and the project aims to have housed 1,636 people by the end of 2020. Building with EARTH is a partnership project and is co-ordinated by Wu Zhi Qiao (Bridge to China) Charitable Foundation (WZQCF); delivered by Beijing University of Civil Engineering and Architecture (BUCEA) and Xi'an University of Architecture and Technology (XUAUT); and supported by the Ministry of Housing and Urban-Rural Development of China (MOHURD).

Actions and Implementation

Like many Chinese villages, Macha Village has suffered significant decline in population as residents move to urban areas for work and a better standard of living. The Building with EARTH project aims to improve the quality of life and provide economic stability for residents in poor rural communities by creating a self-sufficient market for new earthen homes. At the beginning of each project, academics are embedded within the community, living there for at least six months, to learn and adapt traditional building methods alongside local craftspeople. These adapted techniques include the use of handheld earth-ramming tools – which have been shown to improve mechanical and waterproofing performance of earthen homes – and strengthened bamboo shuttering systems, using local bamboo, plywood, shape steel and tension screws. In villages like Macha, which are located in the Loess Valley earthquake zone, building methods are further modified with features that improve resistance to seismic activity. These include capping the span, storeys, and floor height of the rammed-earth house, and the use of timber or concrete structural columns and ring beams in the walls. The modified building method can be delivered by three people, whereas, traditionally, six were needed. A demonstration house is built to provide training for local tradespeople, who can go on to work in surrounding villages building new homes and benefitting financially. The average cost of an earth house is $95 USD per square metre when purchasing all materials (excluding earth) and labour. In Macha Village the homes are approximately 60-80 square metres, giving a total construction cost of around $5,670-7,560 USD. This is about two-thirds of the cost of a conventional house. Beneficiaries generally pay for around 20% of the construction costs ($1,134-1,512 USD). In cases where this is too difficult, they contribute the equivalent cost in labourers (usually male relatives or neighbours) and recycled materials, such as stone and timber, from their old house. The remaining construction costs are funded through government housing subsidies (40%) and the WZQCF (40%). The total cost of the Building with EARTH project up to February 2019 was $1,476,354 USD, including $599,067 USD raised by the WZQCF. The remaining funding came from MOHURD ($223,248 USD), local governments in the Loess Valley region ($356,748 USD), Beijing University of Civil Engineering and Architecture and Xi'an University of Architecture and Technology ($297,290 USD).

Despite its successes, the project does face some challenges. Villagers can be sceptical about earthen buildings due to the prevailing negative stereotypes. A strong desire for an urban lifestyle has led some villagers who have adopted the technique to decorate their homes with paint and tiles, which can create technical problems. Some local governments choose mass construction projects over eco-alternatives because they have high poverty relief targets to meet by 2020. For this reason, there are six villages where demonstration homes have been built but this has not led to further rammed-earth construction. Limitations on funding have also contributed to a failure to build further homes after the demonstration, for example some local government housing subsidies are only available if conventional building codes and regulations are met.

Outcomes and Impacts

Women, older people and children typically spend more time in the home and suffer most from the effects of poor building design. Families living in new earthen homes are better protected from excess heat and cold, which can contribute to poor cardiovascular and respiratory health. During winter in Macha Village, indoor temperatures are on average 5°C higher than in concrete and brick houses, meaning residents spend less on fuel, reducing their living costs. During summer, rammed-earth buildings are on average 7°C cooler. The project has also encouraged community cohesion in the village through the provision of a communal building containing a health clinic, nursery, library, stage, shop and a multi-functional hall. Training craftspeople has helped to strengthen the economic resilience of the rural communities in which Building with EARTH has worked. So far, more than 400 villagers have received training. Craftspeople are able to find work locally, instead of migrating to cities, and the benefits go directly to local communities, rather than contractors and large building companies from outer urban areas. The ability to build their own homes using free local natural materials further promotes self-reliance among villagers and reduces the need to borrow money. When the Building with EARTH project began in 2011, the average annual net income of a Macha villager was $280 USD. In 2018, that figure had risen by 82% to $509 USD. The project has clear environmental benefits, too. More than 80% of the materials needed to build an earthen home (earth, sand, gravel and timber) can be collected locally without much transportation. The earthen home construction process produces 80% less waste than a conventional concrete and brick build and also produces 20-25% fewer carbon emissions.

Conclusion

A further 292 buildings are expected to be completed by late 2020. Over the next five years, the project will undertake further research into traditional earth construction, through funding from BUCEA and central government. Two new base sites will be built in southern and eastern rural China, using funding from central government and WZQCF. Training for local craftspeople, professionals, government officials and the general public will continue, also funded by WZQCF. The Chinese government plans to publish a national standard for rammed-earth design and construction later this year. Official notices issued by Building with EARTH partner MOHURD, demonstrating what has been achieved through the project and encouraging transfer of the model, have contributed significantly to changing the mindset of government officials. With this remarkable change in stance towards earthen dwellings, the Building with EARTH project is transforming a symbol of rural poverty into a sustainable solution.