CASE STUDY

Training masons to build seismic-resistant schools

Country: India

Organisation: India's national and state governments, UNDP, World Bank

Hazards: Earthquakes

Keywords: cascading training, rural and remote oversight, community oversight, large-scale

Summary: In 2006, the Uttar Pradesh State Government in India sanctioned a hazard-resistant design for a massive school construction project that aimed to build thousands of schools at the same time. At the time, there was government capacity but local capacity was low, creating a good opportunity to institutionalise a community-based approach. There were too few engineers to be present across thousands of construction sites and many of the schools were remote. This emphasised the need for community involvement.

Because thousands of schools were being built simultaneously, construction oversight was challenging. But the state government saw it as an opportunity to raise the capacity of thousands of communities through cascading training. By 2007, the state government, in partnership with UNDP and with a loan from the World Bank, constructed almost 7,000 seismically safe schools and 82,000 additional classrooms in Uttar Pradesh.

Country and hazard overview

The Indian subcontinent presses into the Eurasian tectonic plate in the north, causing India – along with other nations in the region – to have experienced many small and a few devastating earthquakes during the last century. After witnessing the pattern of earthquakes and other natural hazards that resulted in a series of abrupt but predictable disasters, SEEDS began working with communities, technical universities and government authorities in 1994. They helped communities retrofit unsafe schools and adopted strategies for reducing losses from future crises, using schools as a catalyst for community-wide change.

State-wide school construction program

In 2004, the Uttar Pradesh State Government was planning a massive school construction project in response to the widening education gap. At this time, the UNDP Disaster Risk Management Program (DRMP) as well as the Education for All (EFA) initiative were both underway at a national level. Some UNDP and MoE officials saw the school construction project as a chance for disaster risk reduction and decided to teach the MoE and state government about safer schools.

Influenced in part by devastation in the 2001 Gujarat earthquake – in which 15,000 schools collapsed – and two historic earthquakes in Uttar Pradesh, the state government decided to change their existing school design, which lacked earthquake safety measures. Under the DRMP the Indian Government created the position of National Seismic Adviser who was responsible for updating the existing design. Uttar Pradesh contained multiple levels of seismicity, but given the large scale of the project, the government decided to create a design suitable for the highest earthquake probability in the state.

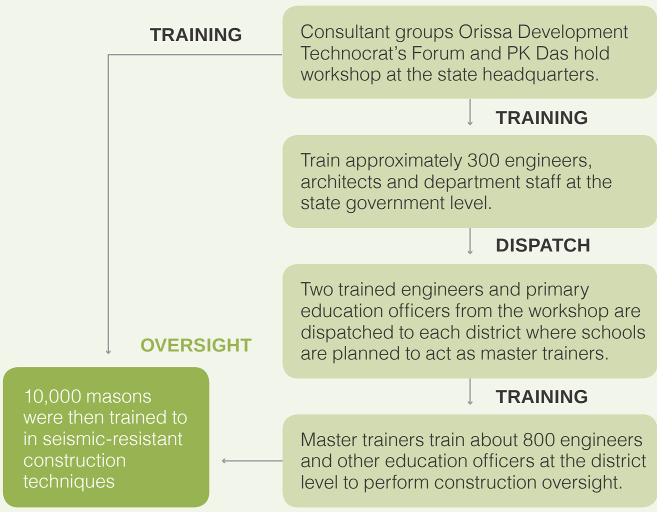
The National Seismic Adviser changed simple features in the school design to increase its seismic resistance. These included:

- Moving doors 60cms from vertical joints.
- Adding rebar to tie foundations and slabs together.
- Placing three horizontal 'earthquake' ring beams that circumscribe the walls (at the foundation, below the window, and above the window).
- Increasing the proportion of cement to sand and stone blast in the foundation.

After determining the changes would add an additional 8 percent to construction costs, the MoE entered a year of negotiations with the World Bank to increase their long-standing loan that had supplemented national and state funding for EFA. With funds in hand, the easy part was over. Now the state needed to train masons to build safer schools.

Challenges: Training masons and inspectors in safe school construction

In 2005, the MoE and MoPW organised a massive cascading training program to teach hazard-resistant construction techniques to their government engineers. These engineers then taught or supervised thousands of contractors and masons at the district level. Amid other DRMP activities, it took a few years to complete the training. In the process, the state government had to deal with a lack of knowledge and the staggering breadth of construction.



When Uttar Pradesh changed its school design to incorporate seismic-resistant features, the state needed to train masons in the new practices. Five-day trainings that included practice on a mock building taught one or two masons for each new school site how to construct earthquake ring beams in the walls. These trained masons then spread the knowledge to other masons on the construction site. Photo: Sanjaya Bhatia.

UNDP hired the consultants ODFT and PK Das to lead five-day trainings for masons in communities where new schools were to be constructed. The first portion of the training was a lecture to introduce masons to hazard-resistant construction and show them new techniques for earthquake safety. The latter portion of the training was the application of all-new, hazard-resistant construction techniques on a mock building, giving the masons a chance to translate the abstract theory into tangible practice. The mock building was only constructed to the window level and was left in the community as a reference for masons to recall what they had learnt. During the training, masons were paid their daily wages. Because of the scope of the project, only one or two masons were trained for each school construction site. However, they were able to pass their newly acquired knowledge to other masons working with them.

Tight quality control

Construction was overseen by trained engineers and implemented by the trained masons. Masons and a school oversight committee knew the stages that required engineering inspection, the criteria for approval, and the tests that would be conducted to ensure quality. Engineers monitored the masons as they poured the foundation, casted earthquake ring beams and placed the roof.

Yet with so much knowledge transfer over such short time, the Uttar Pradesh Government knew the application of the new techniques would be inconsistent and would need further oversight. To solve this problem, the team created a wordless manual with very simple pictorials to show villagers what should be present at the foundation and sill levels. The manuals also showed community members how to determine the quality of cement. Then, the village head was issued pre-stamped postcards with a checklist of poor construction practices. If there was no problem, the village head would send nothing back. But if the government received a postcard, it would immediately send a trained inspector to determine whether a mistake had been made.

Through this method, many errors were caught early, and several buildings were actually torn down after finding irreversible mistakes. If the constructor simply made a mistake, it was corrected. However, if the responsible party was corrupt, the constructor was blacklisted from future government construction projects.

By 2007, the state government had constructed 6,500 seismically safer schools and 40,000 additional classrooms. Programs of this scale only manifest when countries are attempting to fill large gaps in access to education. Even though programs on this scale are rare, they can be an opportunity to infuse new knowledge about hazard-resistant construction principles into communities and government agencies.

Key takeaways

- Countries addressing education gaps can institutionalise hazard-resistant construction into their rollout.
- Cascading training is an effective model for spreading new, hazard-resistant construction techniques to skilled tradespeople.
- During training, new construction techniques need to be tuned to the literacy level of skilled tradespeople
- Training programs should include hands-on practice so skilled tradespeople can apply new concepts.
- Postcard monitoring systems can supplement traditional construction inspection in rural and remote school communities.