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Process for Community Acceptance of Earthquake Technology — UNCRD Experiences Applying the Nset Approach of Shake-table Demonstration

Shoichi Ando[1], Yoko Saito[2] and Amod M. Dixit[3]

[1]*Director, International Institute of Seismology and Earthquake Engineering (IISEE), Building Research Institute (BRI), 1 Tachihara, Tsukuba, Ibaraki, Japan.*
E-mail: ando@kenken.go.jp
[2]*Disaster Management Planning Hyogo Office, United Nations Centre for Regional Development (UNCRD), UN DESA, 1-5-2 Wakihama-kaigan-dori, Chu-ku, Kobe city, Hyogo, Japan.*
E-mail: saitoy@hyogo.uncrd.or.jp
[3]*National Society for Earthquake Technology (NSET), Sainbu V.D.C Ward No. 4, Bhainsepati Residential Area, Lalitpur, Nepal.*
E-mail: adixit@nset.org.np

Community Based Disaster Management (CBDM) activities utilizing shake-table demonstration resulted in effective dissemination of earthquake resistant technology as well as in raising public awareness through the experiences of the Disaster Management Planning Hyogo Office of the United Nations Centre for Regional Development (UNCRD). The anticipated users of this implementation technology include community leaders, administrative officers, NGO/NPO project managers, international organizations, architects, engineers, policy makers, motivated researchers, and local residents. The shake-table demonstration focuses on earthquake hazards to help protect human lives, business and livelihoods, buildings, urban areas, rural areas, and cultural heritages.

Keywords: CBDM (community based disaster management), Public awareness, Shake-table demonstration, National Society for Earthquake Technology (NSET), Implementation oriented technology (IOT), Process technology (PT).

1. Background

1.1. *Disaster Events and/or Social Circumstances, which became the Driving Force for Developing the Technology/Knowledge and/or Enhancing its Practice*

The high human casualties of the earthquakes in India (2001), Iran (2003), Pakistan (2005), Indonesia (2006), Peru (2007), and Haiti (2010) are attributed to the collapse of traditional adobe and masonry houses built informally by the homeowners themselves with input from local masons. The buildings did not have the engineering input to be safe from earthquakes. There is large stock of such residential

buildings in seismically active parts of the world and people, particularly in developing countries, continue the practice of building and living in such houses because of socio-economic and technical reasons

2. Technology Information

2.1. *Development of the Technology*

The technology is categorized as implementation oriented technology (IOT) and process technology (PT) (see Figure 1 and 2). It was developed, refined, and demonstrated in Nepal, Japan, Afghanistan, Bangladesh, India, Indonesia, Iran, Pakistan, and Tajikistan. The developers of the technology were the National Society for Earthquake Engineering (NSET) of Nepal and the United Nations Centre for Regional Development (UNCRD)/United Nations Department of Economic and Social Affairs (UN DESA). The technology was developed through the following projects:

- Sustainability in Community Based Disaster Management (CBDM) (2004),
- World Conference on Disaster Reduction in Kobe (2005),
- Urbanization and CBDM (2005–2006) ,
- Gender in CBDM (2007–2009).

The ownership of the technology belongs to NSET and UNCRD.

2.2. *Coverage of the Technology*

The technology can cope with earthquake disasters, especially, damages on human lives, business, livelihood, buildings, and cultural heritages in both urban and rural areas caused by earthquake. The anticipated users of the technology include community leaders, administrative officers, municipalities, NGO/NPO project

Figuer 1 Frame of the shake-table.

Figuer 2 Workers constructing small-scale houses model for a shake-table demonstration.

managers and staff, international organizations (UN organizations and programs, WB, ADRC, EC, etc.), experts, teachers and educators, architects and engineers, information technology specialists, academic institutes, policy makers, motivated researchers, and local residents.

3. Description

3.1. *Feature and Attribute*

The improvement over the traditional construction for earthquake resistance should be simple to adopt so that local craftsmen can easily get the know-how and implement it without difficulty. Awareness of the homeowners is critical for safer construction of non-engineered buildings as the owners themselves frequently carry out the construction of their houses.

UNCRD is committed to providing expertise, opportunities, and ways for communities to be empowered to increase their resilience against disasters. Simultaneously, it aims to impart the CBDM and low-tech safer construction practice at the government level so that both communities and government can sustain efforts at the grass-roots level through the institutionalization of these activities (see Figure 3 and 4).

3.2. *Necessary Process to Implement*

Masons are the technical service providers for non-engineered construction. Urban dwellers may avail of the service of technicians in preparing building layout drawings for municipal approval, if the permit process exists. Hence technicians and masons are key persons in implementing safer construction practice. As capacity building of the community for safer technology, training for these groups is must. Projects have been formulated in such way that hands-on trainings, which are much more effective than classroom lectures for masons, can be provided

Figuer 3 Members of the community awaiting the shake-table demonstration (2003).

Figuer 4 A resource person explaining what was happening to the two house models (2007).

Figuer 5 A resource person giving a lecture before the shake-table test in Kobe (2005).

Figuer 6 Model buildings for shake-table test by JICA with NSET in Pakistan (2006).

in a demonstration work. Shake-table tests have also been used as confidence building measure for masons on what they have learned. It requires knowledge on earthquake engineering to explain the damages of buildings to the public; it also needs easily understandable explanation to disseminate the necessary information to the governmental officers and the general public (see Figure 5 and 6).

3.3. *Strengths and Limitations:*

The following are the strengths of the technology.

(i) All participants become easily aware of the danger of collapsed vulnerable houses.
(ii) It is also easily understandable how retrofitting works effectively.
(iii) Masons training can be implemented during the preparation process.

The following are the limitations of the technology:

(i) It will take several weeks to prepare the demonstration model with proper training.
(ii) It may be rather expensive to prepare a shake-table.

3.4. *Lessons Learned through Implementation*

All participants recognized the importance of seismic retrofitting and reinforcement of their own houses after the shake-table demonstration, not only in the urban area but also in the rural area (see Figure 7 and 8).

Figuer 7 Shake-table demonstration in Tajikistan in 2003.

Figuer 8 Workers preparing a house model for a shake-table demonstration in Afghanistan in 2002.

4. Resources Required

4.1. *Facilities and Equipment Required*

Simple test demonstration on a pair of building models, one in the traditional form and another with proposed seismic improvement, prepared at 1:10 (to 1:6) scale and shook on the top of an improvised shake-table is found as a very convincing tool for common people to opt for the seismic resistance system. This methodology was developed by NSET (National Society for Earthquake Technology — Nepal), and UNCRD has used this method with NSET as a CBDM approach in many earthquake-prone countries. With some incremental shaking of the table, the traditional building will collapse and the one with seismic measures will withstand with minimum or no damage.

4.2. *Costs, Organization, Manpower, etc.*

Resource persons from NSET manpower (one project manager, one engineer, and one experienced mason) will train participants such as local masons and engineers. The cost of the full demonstration and training is approximately US$15,000-20,000.

5. Application Examples

Table 1 shows the application example that the technology mentioned in this paper applied in PNY project (Patanka New Life Plan). Table 2 shows the example in Afghanistan. Table 3 shows the example in Bam, Iran and Table 4 shows the example in Dhaka, Bangladesh.

Figure 9 is the pamphlets on shake-table demonstration. These pamphlets explain the process of the shake-table demonstration conducted in Bangladesh.

Table 1 Application example in PNY project.

Project name	PNY project (Patanka New Life Plan)
Place	Patanka village, Gujarat, India
Year	2003
Investor	CODE (NGO in Kobe), SEEDS, and other organizations
People involved	Manu Gupta (SEEDS), Earthquake Disaster Mitigation Research Center (EDM), National Center for People's Action in Disaster Preparedness (NCPDP), NSET, UNCRD
Monetary costs incurred	Joint project implementation by SEEDS, EDM, NCPDP, NSET, and UNCRD
Total workload required	See Patanka New Life Plan (PNY); The report summarizing the purpose, the methods, and the activities of the PNY project http://www.hyogo.uncrd.or.jp/publication/pdf/Report/PNYPDF/PNY.pdf

Table 2 Application example of Afghanistan Shake-table Demonstration.

Project name	Afghanistan Shake-table Demonstration
Place	Kabul, Afghanistan
Year	2003
Investor	Afghanistan government, UNCRD
People involved	Ministry of Urban Development and Housing, Afghanistan; Prof. Anand S. Arya, India; Kabul University; NSET; UNCRD
Monetary costs	CODE (NGO in Kobe), NSET, UNCRD
Total workload required	See Guidelines for Earthquake Resistant Design, Construction, and Retrofitting of Buildings in Afghanistan, UNCRD Hyogo (http://www.hyogo.uncrd.or.jp/publication/pdf/Guide/GuideLine.pdf)

Table 3 Application example in Bam Shake-table Demonstration.

Project name	Bam Shake-table Demonstration
Place	Bam, Kerman province, Iran
Year	2004
Investor	CODE (NGO in Kobe), UNCRD
People involved	Iranian Ministries, NSET, PWJ, CODE, UNCRD

Table 4 Application example in Bangladesh Shake-table Demonstration.

Project name	Bangladesh Shake-table Demonstration
Place	Dhaka, Bangladesh
Year	2007
Investor	UNCRD
People involved	Bangladesh government, NSET, BDPC, UNCRD

Figure 9 Shake-table demonstration pamphlet.

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