POLICY TOOLS FOR HOUSING EARTHQUAKE SAFETY

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ABSTRACT:

There are several effective tools to reduce or prevent life and property losses during an earthquake. The experiences from past earthquakes show that effective implementation of earthquake resistant codes can reduce the losses significantly. This is because the collapse of houses is often the single largest cause of human deaths and economic losses resulting from earthquakes. However, there are many vulnerable houses with structural deficiencies in a number of developing countries situated in earthquake prone regions in the world. These vulnerable houses are constructed using traditional techniques without the aid of an architect or engineer. The research seeks to tackle this situation and to protect vulnerable people from possible future disasters. The first challenge is to define the process that is appropriate for individual country contexts. The second challenge is to disseminate the code to communities. It is verified that effective building code implementation requires not only the capable national institutions for strict enforcement but also means to engage community people through disseminating the information and involving professionals for community consultations.

KEYWORDS: Building code, enforcement, awareness raising, capacity building, policy development

1. INTRODUCTION

Earthquakes kill thousands of people every year around the world and millions are still exposed to threats from earthquakes because of the vulnerable environment they are living in. Notwithstanding the tremendous increase in disaster risk reduction initiatives, programs to raise awareness among people and advancement of knowledge and technology for earthquake safe constructions, risk from earthquake has not reduced. There is urgent need to translate advancement in knowledge into practical initiatives, replicate good practices from anywhere to vulnerable areas everywhere and help build a resilient community against the disasters.

Earthquake disaster is interplay of natural hazard, which is beyond human control, and vulnerability, which is created by people. The vulnerability and hence impact of earthquakes on livelihood of people can be reduced by measures such as adherence to earthquake resistant building design and construction standards, proper land use planning and education and training for risk evasion. However, the risk is ever increasing as rapid urbanization in developing countries is adding extra pressure on building construction and measures to reduce earthquake risks often get low priority. Although developed countries also face risk from earthquakes, the problems in developed countries and developing countries are different in their scope and magnitude. Most developing countries have established a building control system, aiming to prevent loss of life and property in earthquakes. However, the system seldom functions effectively because of lack of awareness among communities, lack of capacity of implementing authorities and lack of regulatory mechanism for effective implementation, monitoring and reviewing.

2. FRAMEWORK OF HESI PROJECT

In January 2007 United Nations Centre for Regional Development (UNCRD) Disaster Management Planning Hyogo Office launched a project titled “Housing Earthquake Safety Initiative (HESI)”. The project aims to

improve the safety of houses and protect them from earthquake disaster through effective implementation of building code. The project is implemented in Algeria, Indonesia, Nepal and Peru. The conceptual framework of implementation of HESI in the larger policy framework is shown in Fig. 1. Although building code is only a part of large dialogue of building safety, it is important and key element. Under this initiative, UNCRD will provide an international information exchange platform to share policy experiences. The activities included perception and implementation gap analysis of target countries, awareness raising among the stakeholders, developing policy recommendations on improving safety of houses and developing capacity of national and local officials to implement building safety regulations effectively. One of the major activities envisaged in HESI is creation of platform for networking, information exchange, sharing of knowledge and sharing of good practices in mitigating earthquake risk throughout the world.

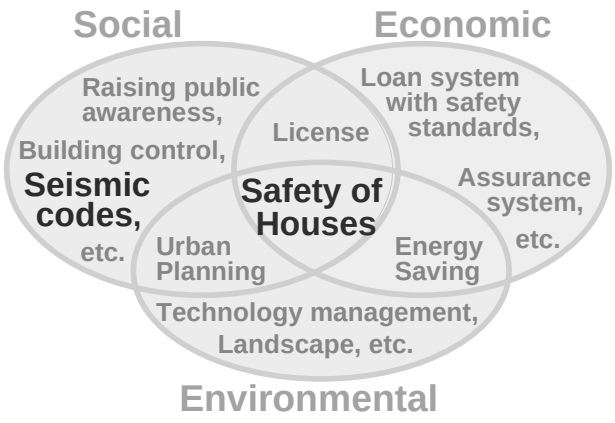

Fig. 1: Conceptual policy framework of building safety

The project aims to improve structural safety of houses to reduce impact of earthquakes in life and livelihood of people through effective implementation of building safety regulations. Because the collapse of buildings and houses is the single largest cause of human deaths and economic losses resulting from earthquakes, anti-seismic building code dissemination (ABCD) and effective enforcement of control systems can reduce the loss significantly. Although many earthquake prone countries now have building codes, there is serious challenge for effective implementation of the codes because of lack of awareness, lack of institutional mechanism for implementation and insufficient capacity of authorities.

The HESI project attempts to rectify the situation through its 4 core activities: system evaluation, awareness raising, policy development and capacity development. In November 2006, a pre-survey on building code enforcement was conducted involving a number of countries in the world. The responses obtained uncovered the existence of vulnerable houses spread in a number of earthquake prone countries. In Peru, for instance, non-engineered houses, which are built without proper structural safety considerations, account for 60 percent of the total building stock in the country. The survey also found that although many responding countries indicated that they have building codes in place, the codes are not effectively implemented due to a number of problems including lack of capacity of building officials and low level of awareness among public and building professionals on the code itself or the safety aspects of houses.

Table 1: Key issues from Building Code survey in target countries

Implementation system - No government program to disseminate code (Indonesia) - Absence of effective field monitoring/ inspection (Nepal) - Partial geographic coverage (Peru) - Insufficient penalty system (Japan)	Building code - Need for simplification (Bangladesh) - Unsatisfactory coverage of building details (Thailand) - Need for revision (Nepal) - Too frequent change of codes (Japan)
Capacity of local governments - Inability to evaluate performance based design (Nepal) - Insufficient training of technical personnel (Indonesia, Nepal)	Capacity of stakeholders - No opportunity to learn code (Algeria, Nepal, Indonesia) - Lack of motivation among professionals (Nepal)
Socio-economic obstacles - Lack of knowledge among public about code (Nepal) - Negligence and unwillingness of house owners to apply earthquake safe techniques (Nepal) - Retrofitting not affordable for poor people (Indonesia)	Target countries that provided reply to the questionnaire: Algeria, Bangladesh, Indonesia, Iran, Japan, Nepal, Peru, Rumania, Thailand, USA,

The survey found that almost all of the respondents have a building code in force. At the same time, the

differences were found in the process and requirements for obtaining building permits across countries. It also raised a number of implementation-related problems encountered in many of the responding countries. Some of the key issues found from the survey is summarized in the Table 1.

The HESI project consists of four core activities: 1) system evaluation, 2) awareness raising, 3) policy development, and 4) capacity development. The first activity aims to collect information relating to housing safety from the perspective of building code implementation. The second activity aims to raise awareness among stakeholders of housing safety, including officials from national governments and local governments, building professionals and house owners on the code as a tool to ensure the safety of house as well as the need to construct houses according to the code. The third activity aims to develop policies to disseminate building code more effectively within local governments, building professionals and communities. The fourth activity aims to develop capacity of government officials, engineers and technicians involved in housing construction in their roles to enforce the code.

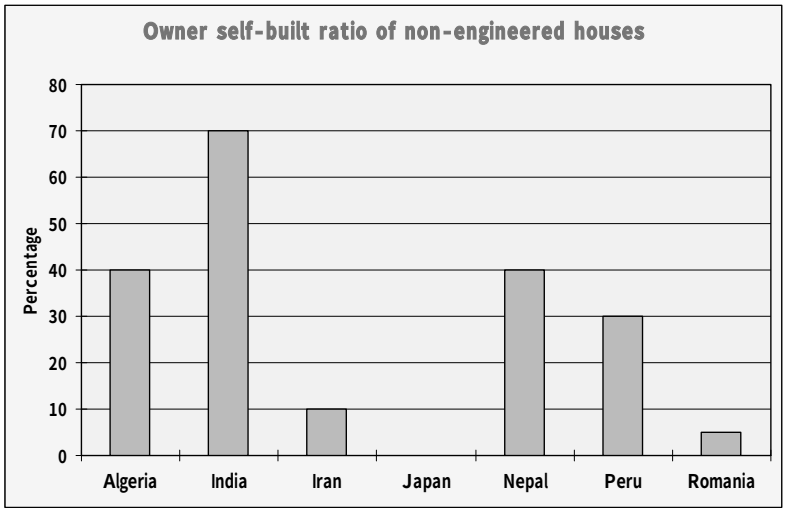

Fig. 2: Data from Questionnaire (Owner self-built ratio)

3. URBAN RISKS AND BUILDING CODE

Urban environment or built-environment is mainly composed of individual buildings. Performance of buildings against hazards including earthquakes and strong wind plays important roles to build and maintain a regional society. The function of buildings embraces; 1) to provide livelihoods and safe living environment for regional society, 2) to activate and provide economic activities for industries and office workers, 3) to formulate long-term contribution to the culture and stabilization of the society and community, and 4) to support social functions such as schools, hospitals and other facilities. Thus, most built-environment of urban area is covered with buildings. Therefore vulnerable buildings directly imply high urban risks in many cases including the case of China in 1976, Armenia in 1988, Iran in 1990, Kobe in 1995, Turkey in 1999, India in 2001, Bam, Iran in 2003, Pakistan in 2005, Java in 2006, Peru in 2007, and China 2008.

Many experiences show that the vulnerable groups such as children, physically challenged persons and citizens in advanced age are affected more severely from disasters and need to be provided extra attention. Therefore, regional development paradigm emphasizes the importance of improvement of public building facilities and private ones including individual houses. Capacity building of human resources for building construction at regional level and financial basis for education and establishment of capacity building systems are the key policies. Relevant governments need to appropriate the budget for enforcement and/or retrofitting of public facilities considering a comprehensive program for the regional development. Regional disaster management as a part of regional development program requires disaster risk management in the school, hospital and other public buildings particularly in the earthquake and other strong hazard prone regions. Under the recent decentralized governance conditions, building control and public construction authority and policy makers in the region need to cooperate in a well-organized manner to cope with regional issues. The regional society is expected to join and support the regional decision through processes of participation, involvement, and cooperation. Many cases and efforts indicate that there are various issues and challenges to achieve such objectives.

4. HESI'S APPROACH

Although building code is a technical document to be used by technical persons, the stakeholders responsible for enacting, managing, implementing and observing the building code are at different levels from general public to the national government. Even though legal provisions make the building code mandatory and non-compliance to it subject to legal actions, control is not a practical approach to implement building code. This fact can be observed from the implementation of building code in different countries. In Nepal, it has been mandatory from 2005 in all Municipalities to implement the building code. However, only three out of 58 municipalities have initiated the process. Peru has long history of enactment of building code, but there is significant gap in implementation in the field. This is true for many other developing countries as well.

Fig. 3 shows the pyramid of stakeholders who are directly related to or affected by building code implementation and effectiveness of compliance and control over them. Only in the top part of the pyramid legal control is possible and that, too, to a limited extent only. Down in the pyramid the mass affected by implementation of building code is large but control is less practical. For example, the implementing agencies or municipal authorities can be brought to justice if they don't comply with implementation of code but punishment for thousands of house owners is not practical. Therefore, implementation of building code requires more compliance than control as shown in Fig. 3. Furthermore, compliance is distributed evenly through out the pyramid whereas control is effective only in higher region of the pyramid.

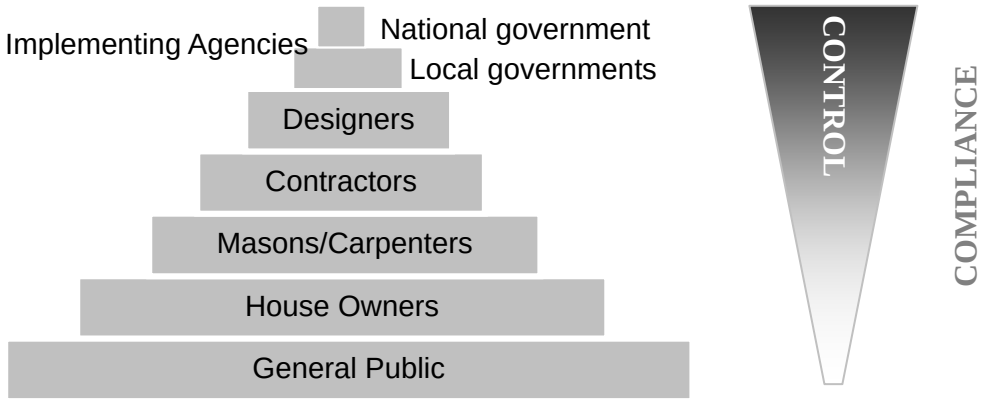

Fig. 3 Stakeholders' pyramid and effectiveness of control in building code implementation

5. AWARENESS RAISING / CAPACITY BUILDING

Compliance is difficult to achieve without awareness. House owner who is aware of the practical measures to reduce earthquake risk in building prefers to follow the standard which is not only cost effective but also saves life in case of earthquakes. A large group of general public who is aware of the impending disaster of sitting in vulnerable buildings, not only comply with the building code provisions but also create demand for trained technicians, trained masons and trained builders. Therefore awareness raising and capacity buildings are inter-related tasks and features as one of the key components in the approach of HESI for effective implementation of the building code.

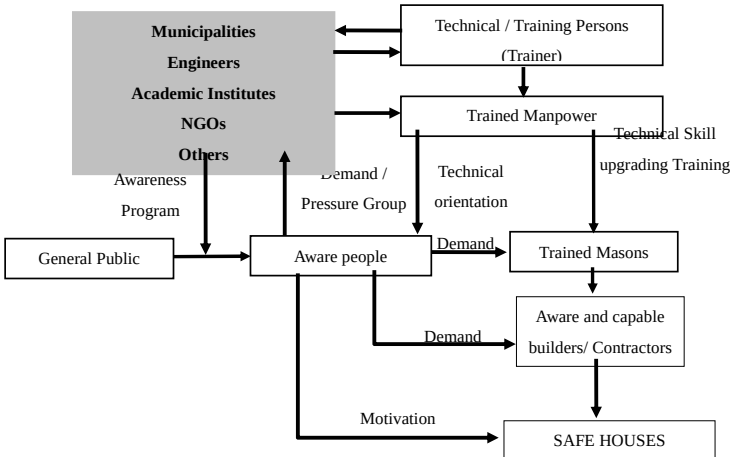

Fig. 4 Link of awareness raising and capacity building

The schematic diagram shown in Fig. 4 depicts relation between capacity development and awareness raising. Implementing institutes, academic institutes, NGOs and others can not only train technical persons but also campaign for awareness raising in the general public. Aware public creates demand for trained masons and technical persons which will be motivation to conduct trainings in large scale. A large pool of trained masons may sometimes be enough in complying with provisions in the code for earthquake resistant construction in cities where very few buildings are large buildings.

The awareness of general public has three parts: first, they know the risk and try all means to reduce the risk; second, they know that incorporating earthquake resistant measures in new construction doesn't increase the cost significantly; and third, they know that such measures need to be considered from the very beginning of construction i.e. from the planning process. Once house owners have this awareness there will be increased demand for trained technicians and masons. In order to cater to the public demand, a large pool of trained technicians and masons is required and this process requires a well planned approach as shown in Fig. 5. From top to bottom the number of required trained persons increases by geometric ratio. Therefore, capacity building requires a systematic approach where first tier of trainers are developed who can serve as trainers for next tier. This approach is effective not only in developing large mass of trained manpower but also in developing such manpower in a short time.

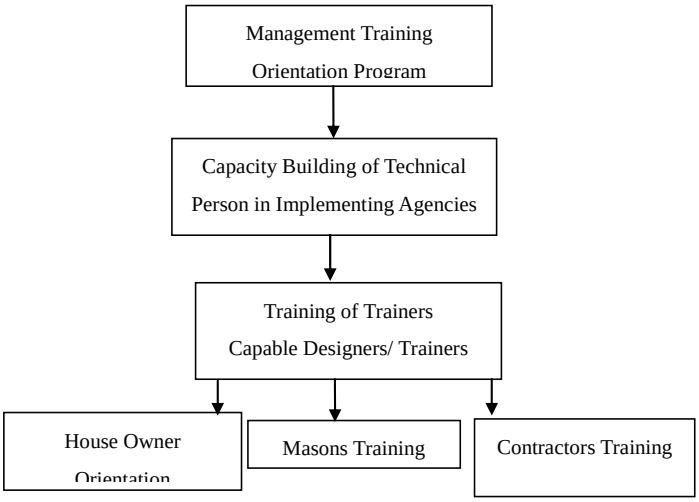

Fig. 5: Flow of capacity building process

The approach discussed in section 3 and 4 are practical approach adopted by HESI in the project countries. A report of training and awareness activity of HESI project in Nepal, one of the project countries, is described in the following section.

6. KEY ISSUES

Disseminating building code is an effective tool to safeguard houses from earthquake disaster. However, a number of challenges are expected as UNCRD implements the HESI project in Algeria, Indonesia, Nepal and Peru. Two selected challenges are mentioned. The first challenge is to define the process that is appropriate for individual country contexts. Each country has diverse stakeholders of housing safety and the relationship among them might differ. Each of them might require a unique coordination approach. The second challenge is to disseminate the code to communities. In order for a building control system to work, there have to be not only knowledgeable, well trained and highly motivated suppliers of building code but also demanders for building code implementation. The system will always have a loophole unless people who pay for houses demand that their houses be made safe. It is imperative to have a system of punishment for violators of the code, and the house owners and other community members can be part of the enforcement body. The role of governments, both national and local, is enormous given the fact that they have to be technically capable to enforce the code as well as to be able to convince and motivate professionals and the public to comply with the building regulation.

Raising awareness on the earthquake-proof buildings and the importance of enforcement of building regulations is one of the core project activities. In this regard, the first national workshop was held in Nepal and Peru in August 2007: 1) to raise awareness among policy makers from the national government and code implementing local governments, and 2) to identify problems that hinder effective building code enforcement. In Nepal, for instance, only three municipalities currently implement the Nepal National Building Code. The two-day

consultative workshop in Nepal was attended by over 70 participants from the Ministry of Physical Planning and Works (MPPW), Ministry of Local Development (MOLD), mayors and executive engineers of 20 municipalities, UNDP, NGOs, academia and the media. The One-day workshop in Peru was held immediately after an earthquake that claimed over 500 lives in August 2007, and was attended by 30 participants from the Ministry of Housing of Peru including Vice-Minister, universities, the media and other relevant institutions.

7. Framework for Building Code Implementation in Nepal and Indonesia

UNCRD in partnership with MOLD, Department of Urban Development and Building Construction (DUDBC)/ MPPW, and National Society for Earthquake Technology –Nepal (NSET) conducted a two–day workshop in Kathmandu on 2-3 August 2007. One of the objectives of the workshop was to find country specific problems in effective implementation of the Nepal National Building Code (NBC). The workshop, attended by senior officials and engineers from the Government of Nepal and municipalities all over the country, underscored the fact that capacity development of local authorities is necessary for effective implementation of the building code. A survey among the participants was conducted which showed that 91 percent of the participants were familiar with the building code before attending the workshop. The survey, however, showed that 53 percent of the attending municipalities do not have building bye-laws for implementation of building code and all of the municipalities expressed their desire to develop building control system in their municipalities. As the second step of the HESI project in Nepal, a training workshop on “Building Code Implementation" was organized on 19-23 May 2008 for engineers/planners/architects from 25 Municipalities all over the country. The workshop was organized by UNCRD in partnership with the DUDBC/ MPPW and NSET.

After five days of lectures, field visits and group discussions, the municipalities were asked to draft actions which are most essential in their municipalities to implement the building code. The municipalities were divided according to their size, population and number of constructions per year into large (Group A), medium (Group B) and small (Group C). The municipalities recommended series of actions in 5 different aspects of building code implementation: Design aspect, municipal laws and bye-laws, field inspection and monitoring, quality control and capacity building and awareness raising. They further discussed within the groups and came up with priorities of action for building code implementation in large, medium and small sized municipalities. The recommendation is shown in Table 2.

Table 2: Action priority suggested by Large (Group A), Medium (Group B) and Small (Group C) municipalities in Nepal

Priority	Group A	Group B	Group C
1	Preparation of implementation process guidelines	Training to Municipal technical staff for NBC codes	Initiation for preparing/upgrading municipal laws/by laws, approval from board, council and bringing it to action
2	Training to the technical staffs and consultant overseers	International exposure visit to municipal technical staff	Conducting training workshop for municipal technical staffs, consultants, local contractors, masons about MRT/NBC, field inspection and quality control
3	Computer based structural designing training to designers	Public meeting on earthquake disaster management and NBC	Dissemination of MRT, building code through school, media and publications
4	Establishment of Monitoring cell Preparation of check list for field inspection	Training to Mason, bar benders, plumbers, electricians, carpenter, shuttering fixer	Publication of guidelines, MRT in simple Nepali language

Priority	Group A	Group B	Group C
5	Widening of the scope of MRT	Awareness program from local FM, TV, posters, brochure	Establishment of separate section for building permit with sufficient numbers of technical staffs.
6	Incorporate the code in the housing loan system	Awareness program to school teachers, students, health workers, TLO, Police and others	
7	Trainings to new masons, contractors and technicians	Preparation of checklist for field inspection	
8	Field supervision made compulsory to the public and Class A buildings	Updating of municipal building by-laws	

The priorities are almost similar in the sense that they give first priority to capacity building. However, it is important to note that small sized municipalities focus more on implementation of Mandatory Rules of Thumb (MRT). MRT is developed as a part of the building code which has recommended provisions for small and regular types of buildings. As majority of the constructions in small and medium sized municipalities are of this nature, implementation of MRT alone can improve the safety of new constructions significantly. Even the large municipalities are looking for expansion of scope of MRT so that it encompasses the typical construction types prevalent in large cities.

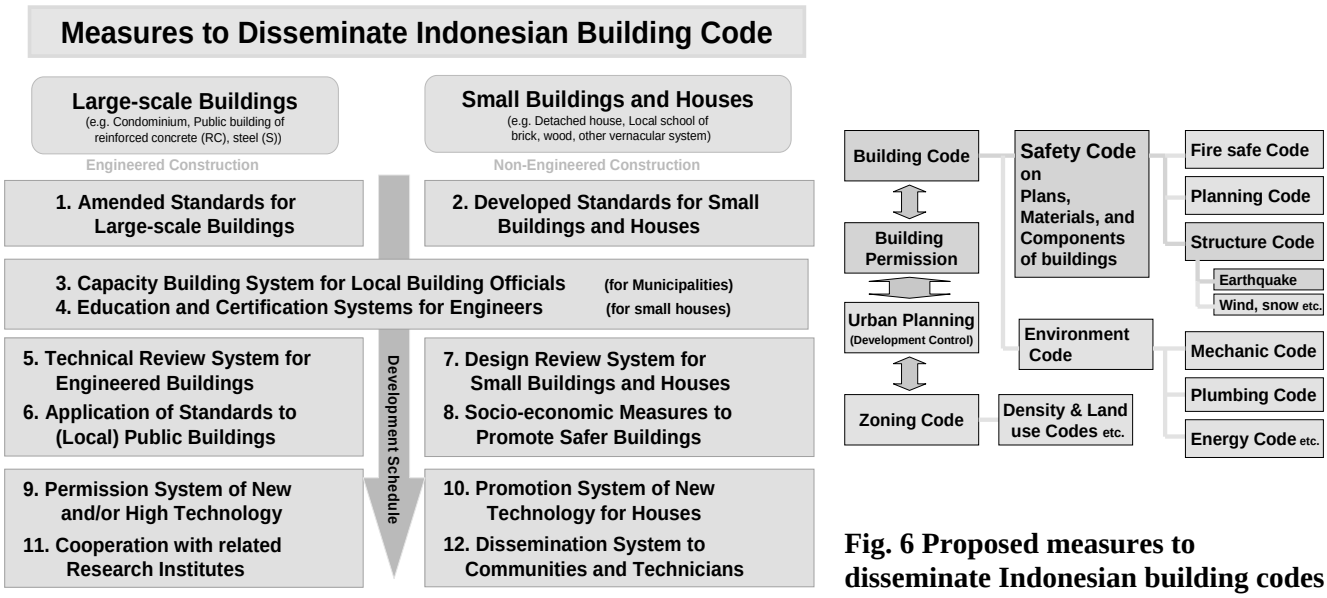

Fig. 6 Proposed measures to disseminate Indonesian building codes

8. CONCLUSIONS

The results and future direction of the HESI project are as follows; in case of Nepal, institutionalization of building code enforcement is expected to result in better coordination between the MPPW and municipalities that are responsible for code implementation. Institutionalization means more periodic and vigorous training activities for municipal engineers, which will have a direct impact on the effectiveness of building code implementation. The Executive Officer of Katmandu Metropolitan City committed to establish a new section for building code enforcement in the near future. Learning from public dissemination initiatives by other municipalities is expected to increase similar activities nationwide. In case of Peru, HESI is expected to contribute to safer housing involving a wide range of stakeholders in the presence of increased awareness of the

need to make houses earthquake resistant following major earthquakes of 8 October 2005 in Pakistan, 27 May 2006 in Java of Indonesia, 15 August 2007 in Peru and 12 May 2008 in China. The final results of HESI will be disseminated during in 2008 and 2009 through various international events including the nest Global Platform for Disaster Risk Reduction (GP/DRR) in 2009.

(Reference) ABCD PROJECT

UNCRD held an expert meeting on Anti-seismic Building Code Dissemination (ABCD) project for Housing Earthquake Safety Initiative (HESI) in Kobe in January 2007. The representatives from India, Indonesia, Japan, Nepal and Peru joined it. The following are the key points raised at the meeting:

- Role of the private sector in building code implementation should be explored including the private sector in building permit process might make the process more efficient. Peer review can be useful if there aren't sufficient municipal engineers to examine all buildings.
- It is required to establish a strategy in order to enforce building code to existing buildings and not only to new constructions in developing and developed countries.
- There is a need for training and capacity development, including the strengthening of existing training institutions towards safer non-engineered housing.
- Guidelines will suffice for non-engineered houses. Technical research should be done to set the minimum specifications such as size, width of walls and the use of columns. They have to be readily understandable for people with no technical background.
- There is an immense need for awareness raising how to educate communities and technicians about the importance of making safer houses. Information hasn't tricked down to communities and individual house owners. Community-based activities are the key.
- There is an issue of setting policy priorities, governments tend to devote more resources for primary health, basic education and infrastructure development and pay little attention to earthquake resistance of non-engineered houses

During the ABCD/HESI project, UNCRD conducted a survey in a number of disaster prone countries across the world. The objective was to collect information on building code and the status of its implementation in each country. Non-engineered houses are constructed using traditional techniques without the aid of an architect or engineer. A widespread presence of non-engineered houses, owner self-built among these in particular, are potentially more dangerous if they are built in crowded cities in the midst of rapid urbanization. Disseminating building code is an effective tool to safeguard houses from earthquake disaster. The most important task for UNCRD is to define the process of disseminating building code effectively in each target country. To that end, community-based activities and engaging officials and experts in the target countries are essential for the successful enforcement.

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