EFFECTIVE IMPLEMENTATION OF BUILDING CODE FOR SAFE CITIES: A CASE STUDY OF HOUSING EARTHQUAKE SAFETY INITIATIVE PROJECT

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Abstract: The population living in urban areas is increasing rapidly and it is estimated that more than half of the world's human population will be living in towns and cities by 2008. One of the major challenges for these urban areas is to provide safe accommodation for the growing population. In earthquake prone countries it's more challenging, as collapse of houses and buildings is the major cause for the loss of lives and property. Growing demand and rapid pace of development may lead to construction of unsafe house where thousands of people get trapped in the event of an earthquake. The experiences from past earthquakes show that effective implementation of earthquake resistant codes can reduce the losses significantly.

In this context, UNCRD launched a three year project on Housing Earthquake Safety Initiative (HESI) in 2007 which aims to improve structural safety of houses to prevent damages and safeguard people's lives, property and livelihood from earthquakes through effective implementation of building safety regulations. The HESI project envisages intervention in policy areas in social, economic and environmental for the effective implementation of building codes. The project is currently being implemented in Algeria, Indonesia, Nepal and Peru. This paper describes implementation of HESI in the four project countries, its outcome and lessons learned from the project which can be relevant for effective implementation of building codes in other countries as well.

Keywords: Housing Earthquake Safety Initiative, HESI, building code, safe cities, UNCRD

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. Earthquake disaster is interplay of natural hazard, which is beyond human control, and vulnerability, which is created by people. 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.

The collapse of houses and buildings is the single largest cause of human deaths and economic losses resulting from earthquakes. It is obvious that regulations that ensure the structural safety of buildings play a key role in preventing these losses. 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. Many existing and new built houses in developing countries have structural deficiencies which render the buildings vulnerable to earthquake. Therefore, there is an 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.

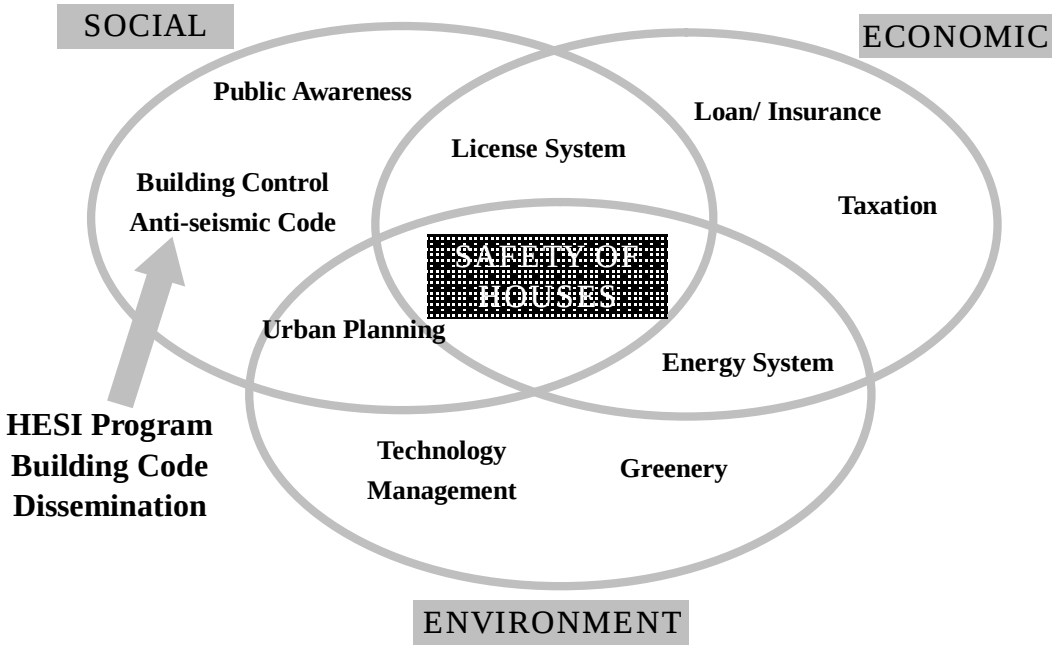

Fig. 1 Conceptual policy framework of Building Safety and HESI intervention

Against this background, United Nations Centre for Regional Development (UNCRD) Disaster Management Planning Hyogo Office initiated Housing Earthquake Safety Initiative (HESI) in four countries: Algeria, Indonesia, Nepal and Peru. HESI was launched with the main objective of identifying country specific problems and promoting the implementation of building safety regulation in four project target countries [1)]. 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 project aims to improve the safety of houses and of people living in them, and ultimately, to assist earthquake prone developing countries to meet the Millennium Development Goals. 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.

2. Objectives and activities

2－1 *Objectives*

The main goal of HESI is to improve the structural safety of houses to prevent damage and safeguard people's lives, property and livelihood from earthquake through effective implementation of building safety regulations.

1. To raise awareness on the importance of implementing building safety regulations effectively to reduce risk of life and property losses caused by earthquakes.
2. To develop policy recommendations on improving the safety of houses, particularly that of traditional houses
3. To develop capacity of national and local government officials to implement building safety regulations effectively

2－2 *Activities*

The HESI project consists of four core activities: 1) system evaluation, 2) awareness raising, 3) policy development, and 4) capacity development (Fig. 2). 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 Four components of HESI activities

Following the launch of the HESI project, UNCRD conducted a questionnaire survey in a number of earthquake prone countries across the world. The formatted questionnaire was sent to experts, professionals and persons responsible for implementation of building in different countries. Target persons were selected from personal list, from mailing list of professional organizations and mailing list of World Housing Encyclopedia. The objective was to collect information on building code and the status of its implementation in each country. So far, 26 responses have been received from national and local governments in 13 countries. 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 following table (Table 1).

Table 1: Key issues from Building Code survey in 13 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 (Algeria,	Capacity of Stakeholders - No opportunity to learn code (Algeria, Nepal, Indonesia)

Nepal) - Insufficient training of technical personnel (Indonesia, Nepal)	- 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)	

The survey underscored the fact that although most of the countries have already established building code, effective implementation of building code is a real challenge for them.

3. HESI's approach in implementation of building code

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.

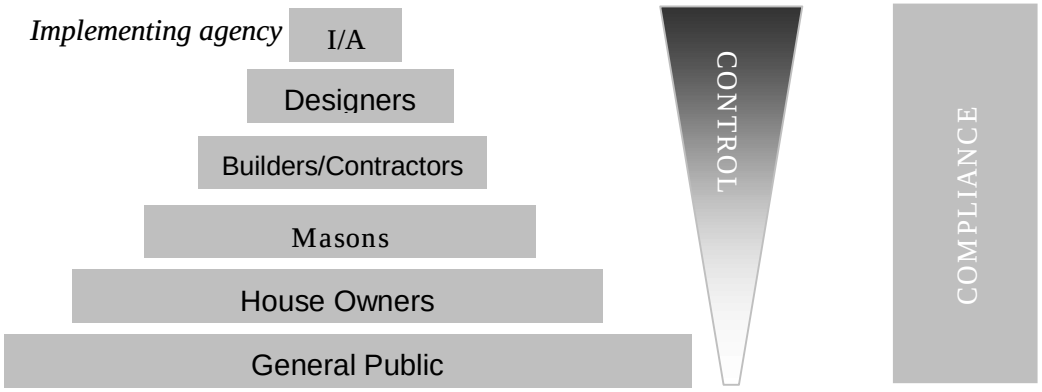

Fig. 3 Stakeholders' pyramid and effectiveness of control and compliance in building code implementation

4. Awareness raising and 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 building are inter-related task and feature as key component in the HESI's approach for effective implementation of the building code.

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.

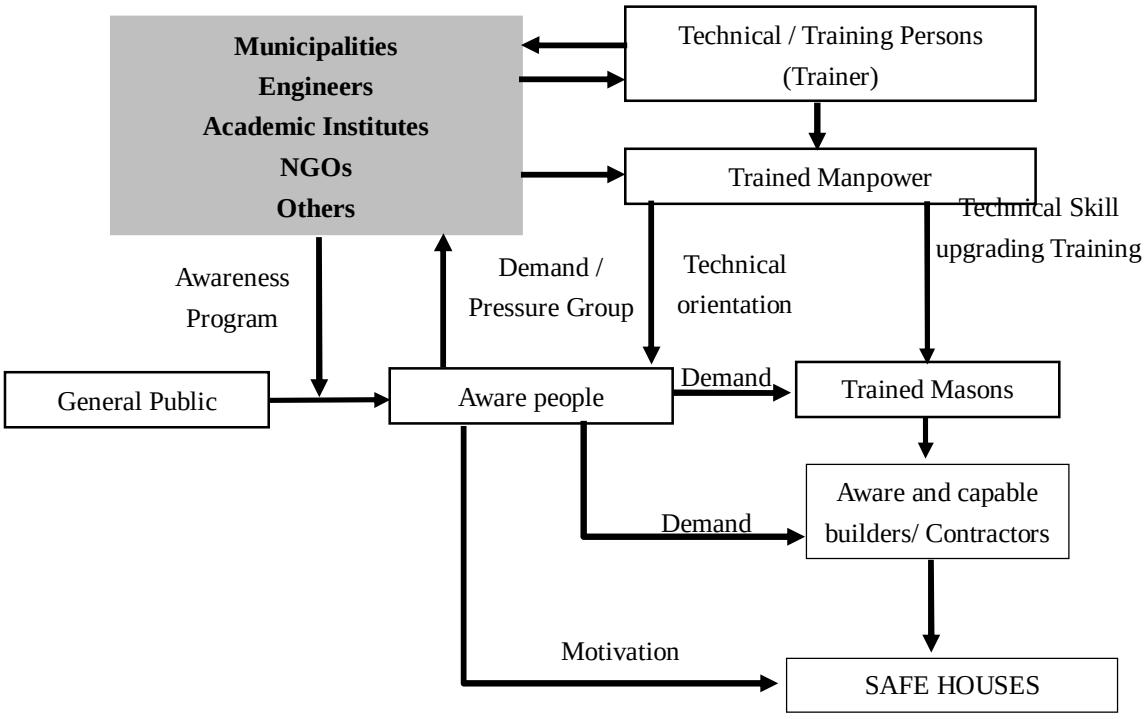

Fig. 4: Schematic representation of link of awareness raising and capacity building in building safe houses
(Adapted and modified from Dixit, 2008[2)])

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 increase 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.

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.

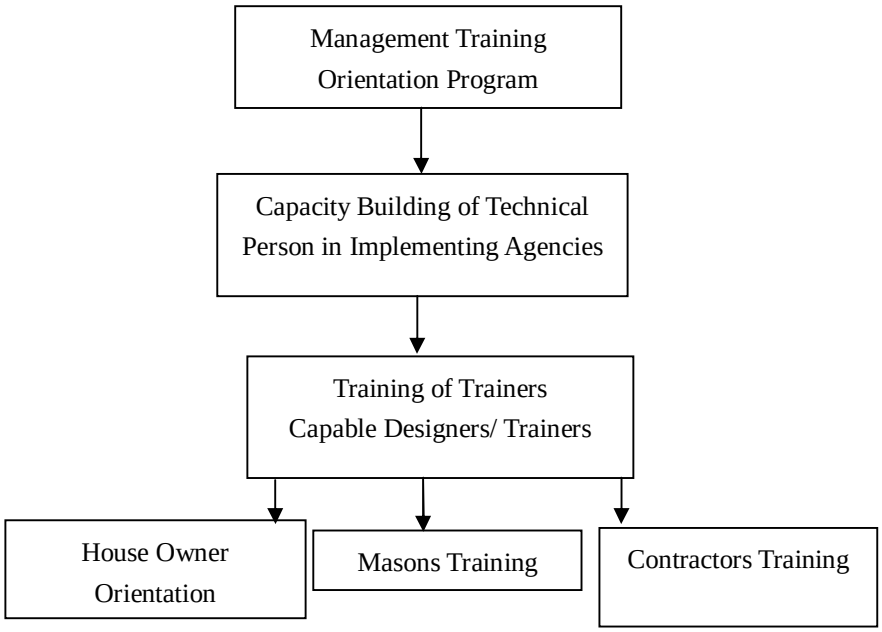

Fig. 5: Flow of capacity building process

5. Framework for Building Code Implementation in Nepal

UNCRD in partnership with Ministry of Local Development (MOLD), Department of Urban Development and Building Construction (DUDBC)/ Ministry of Physical Planning and Works, 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 Department of Urban Development and Building Construction (DUDBC)/ Ministry of Physical Planning and Works and National Society for Earthquake Technology–Nepal (NSET).

The main objective of the training program was to prepare a framework for building code implementation in each participating municipality. It was also designed to enable participants to:

- Become familiarized with various requirements of building codes, building regulations, building/planning by-laws for ensuring safe building construction and proper city development;
- Become familiarized with the building control system (building permit process) to ensure the safe construction of buildings being carried out in several cities of Nepal and other countries and to review such practices by field visits; and
- Guide/facilitate in developing a general broad framework for implementation of the building control system suitable for large, medium, small municipalities of Nepal based on the current and potential institutional arrangements and capacity, and suggest an action plan.

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**[1]	**Group B**	**Group C**
1	Preparation of implementation process guidelines[2]	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[3], 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	Training to Mason, bar benders, plumbers, electricians, carpenter,	Publication of guidelines, MRT in simple Nepali language

[1] Group A: Large municipalities, Group B: Medium municipalities, Group C: Small universities

[2] Group A started numbering from 0.

[3] MRT: Mandatory Rules of Thumb; NBC: National Building Code

Priority	Group A[1]	Group B	Group C
	for field inspection	shuttering fixer (20 Nos. per 100 buildings per year)	
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[4], Police and others	
7	Trainings to new masons, contractors and technicians (50 masons, 10 junior engineers, 5 engineers per 100 buildings per year)	Preparation of checklist for field inspection	
8	Field supervision made compulsory to the public and Class A buildings	Updating of municipal building by-laws	
9	Commitment of Local suppliers and Local Chamber of commerce for supply of quality materials by sensitizing them	Decision for Implementation of NBC	

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.

The conclusions arrived from the two events, problem identification workshop in 2007 and training workshop in 2008, are very important in order to understand the process of building code implementation in developing countries. Some of the general conclusions from the two workshops are summarized below:

- Mandatory Rules of Thumb can help much for enhancing seismic safety of buildings in urban Nepal
- Checklist for Class B buildings for capable municipalities, for others some support to check design should be provided
- Capacity Building appears to be priority one action required for building code implementation.

[4] TLO: Tole (Village) Level Organization

- In order to incorporate building permit process in the Building Code existing system can be modified and clearer legal provisions can be devised.
- Political and social acceptability of the urgency to implement BC and the roles of municipal, DUDBC, Engineering Council, Professional associations, academia in its implementation needs to be understood and enhanced.
- Awareness raising programs creates demand and in turn can help channel political will for effective implementation of the code.
- Municipal engineering professionals have pivotal role in developing systems for effective implementation of BC by :
  - Creating Demand
  - Establishing system for addressing the needs

6. Conclusion

Safety of houses against earthquakes increases significantly if provisions of earthquake resistant buildings codes are complied with. Although most of the developing countries prone to earthquakes have enacted earthquake resistant building codes, they are struggling with implementation of the code. Housing Earthquake Safety Initiative (HESI) is launched to help developing countries in effective enforcement of the building code. The activities under HESI are system evaluation, capacity development, policy development and awareness raising. The approach taken by HESI is to work with municipalities and local governments in evaluating the system, in creating environment conducive for building code implementation and in capacity development of technical persons. Development of a practical framework of building code implementation has been achieved and the process can be replicated in other countries as well.

Reference

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