BOTTOM- UP APPROACH FOR BUILDING CODE IMPLEMENTATION IN NEPAL

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ABSTRACT :

The building code of Nepal was prepared in 1994 but it was implemented in 2001 in one of the municipality first, which clearly marked a sign on the bottom- up approach on the success of implementation and increasing the code compliance rate. Now the coverage of code implementation has been increased with the experience of first municipality. Hence the bottom- up approach which includes dissemination of proper techniques and guidelines to the ground stake holders, awareness raising motivation and capacity building activities among general public is the most for successful implementation of building code.

This paper intends to share the experiences of implementing building code in Nepal for improving seismic performance of buildings including discussion on key issues and bottom up approaches as well lessons learned from past .We believe that this paper will be very much useful for sharing the Nepal's experience on Bottom up approaches on Building code implementation for the countries in south Asia as well as the other Developing countries in the world.

KEYWORDS: Community, Stakeholders, awareness, Implementation, Training

1. UNDERSTANDING THE BUILDING CODE

Building code is a minimum standard fixed by each country for the construction of buildings and structures as per the identified hazard and economical acceptance level of each of the country. This is a document which should be revised/ updated in due course of time as per the available technology and materials.

Building Code what does it mean for Nepal?

National Building code provides both regulations and guidelines for the construction of buildings in all areas of Nepal. Building code for Nepal can be defined as process of improving seismic performance of buildings meeting acceptable level of safety as prescribed by Nepal standard. Ideally this is the situation where we have to reach but we do have practice of using non engineering materials as mud mortar and sundried brick which is not acceptable for any earthquake resistant construction. Due to lack of resources with the people we have to accept the traditional materials and built upon the situation we need to gradually convince people on risk and change the traditional practice with some improvement.
The four different levels of sophistication of design and construction that are being addressed in Nepal National Building code are :

A. International State of the art
B. Professionally Engineered structures

C. International State of the art
D. Professionally Engineered structures
E. Buildings of restricted size designed to simple rules of thumb
F. Remote rural Buildings where control is impractical

Each of the four levels of Nepal National Building code is as follows

A. International state of the art
Are those buildings which are designed with sophisticated design philosophies and analytical techniques that are appearing in the codes of more wealthy countries? Nepalese Engineers and International consultants can apply those methods using different codes then of Nepal but these structures should meet the Nepalese requirements with respect to minimum design load and configuration.

B. Professionally Engineered Structures
This contains the standard code requirements that all professionally qualified engineers will recognize and must meet as a minimum when designing structures in Nepal.

C. Mandatory Rules of Thumb

It is not practically possible in Nepalese context that all the small buildings be designed for strength by a professional Engineer. Therefore for buildings not exceeding certain simple criteria as to height, number of storey, and floor area, mandatory rule of thumb can be used which is also a part of building code. The explanatory documents are such that an experienced junior engineer is able to understand them and present sufficient details at the time of permit application and construction process.

The requirements are in terms of limits on span and heights, minimum reinforcement and member seizes, positioning of earthquake resisting elements etc.

D. Guideline for remote rural Buildings

These guidelines address about a dozen typical building styles that have been condensed from an inventory of buildings carried out in 1993.These guidelines focuses on those changes that should be made to current practices to improve the seismic resistant of these buildings which are not subject to modern quantitative analysis and rational design consideration. These structures are normally of earthen construction (unfired masonry, mud mortar, rubble, dry stone etc).

So in reality we can see that situation which eventually makes building none engineered. Some of those situations are

- architectural and structural design but no supervision in process/ quality
- Designed Architectural only but not supervised or partially supervised
- No design and no supervision but engineered materials used
- Owner Built

2.ELEMENTS OF BUILDING PRODUCTION MECHANISM

There are three distinct types of building construction mechanism in practice in Nepal. Figure 1 shows the distribution of the construction process for residential buildings of Kathmandu valley. A prevalence of built by owners with employment of local masons is seen. The owner-built structures are all non-engineered.

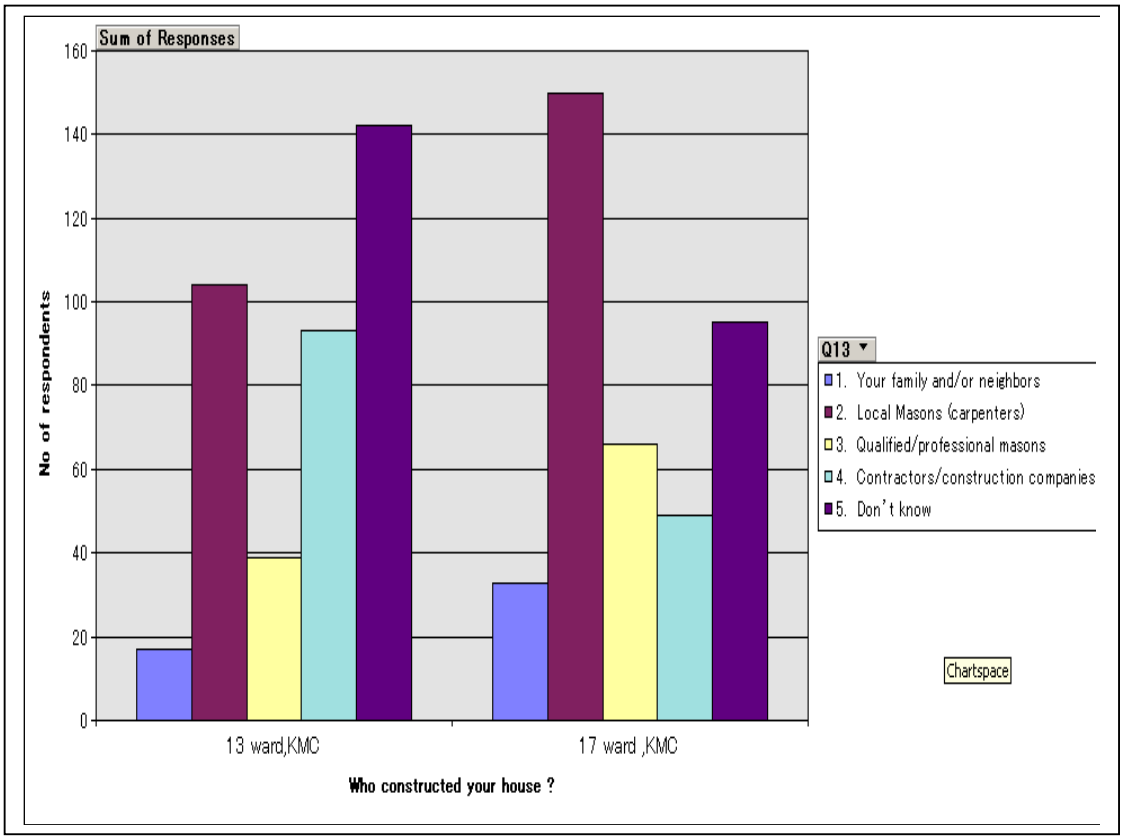


Fig: 1 Risk Perception study 2007, Who constructed your house?

2.1 Engineered Constructions

These are the structures (e.g. buildings) that is designed and constructed as per standard engineered practices. In case of buildings, engineered construction are those that are supposed to have undergone the formal process of regular building permit by the municipal or other pertinent authority. The formal building permit process is supposed to require involvement of an architect/engineer in the design and construction for ensuring compliance to the existing building code and planning bylaws. In Nepal, formal building permit process is implemented only in urban areas. Building code exists but not implemented strictly! Consideration of seismicity on building design depends upon the individual initiative of the designers and the availability of fund. Now the initiative have taken to check the structural design of the building higher than 6 storeys in Kathmandu Metropolitan city under the building permit process but site verification and supervision is still lacking.

2.2Non-engineered Constructions

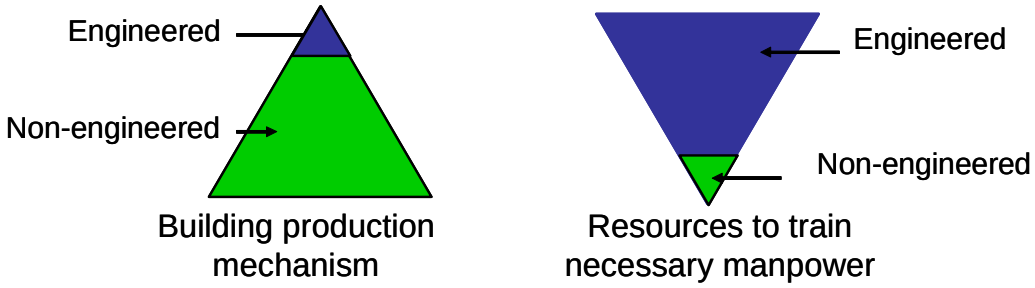
These are physical structures (e.g., buildings) the construction of which usually has not gone through the formal building permit process. It implies that the construction of non-engineered building has not been designed or supervised by an architect/engineer. Such buildings are obviously prevalent in the rural or non-urban (including urbanizing areas in the periphery of municipal areas). Although building by-laws exist and complied within municipal areas, they do not demand structural design considering earthquake effects during building permit process. Thus, a large percentage of the building stock even in Kathmandu Valley is non-engineered as the structural design is not considered in during design and there is no involvement of engineering professionals during construction phase in most of the cases. In the urban areas of Kathmandu, it is estimated that more than

90 percent of existing building stock are non-engineered (partly because there are many old historic buildings), and every year about 5000 more such non-engineered buildings are added.

2.3 Owner-built buildings

These are buildings constructed by the owner at the guidance and with the involvement of a head-mason or a carpenter who lacks any modern knowledge on earthquake resistant construction. Traditional construction materials such as timber, stone rubble or brick (fired or un-burnt) and mud as mortar are used. There is usually no input from any engineer. These are usually rural constructions. However, such constructions are seen also in the poorer part of a city, or in the city suburban areas.

There is an increase in the prevalence of frame-structures nowadays. Unfortunately, many of them are non-engineering, which is a potentially high vulnerability situation.



The ratio of the number of buildings with different construction mechanism and efforts to prepare necessary manpower and documents can be compared with these two inverted triangles (Figure 2). The first triangle shows the ratio of buildings by different construction mechanism and second one the existing resources allocation. For real improvement in the existing earthquake scenario, the picture should be changed by adopting radical methods.

Who is involved in building production?

From the survey of 800 house hold in 2 communities of Kathmandu Valley (Fig 1) shows that most of the buildings were constructed by local masons, as we can see from the resources allocated to train the local mason is negligible so we can guess the quality of the construction process but due to the awareness and masons training from efforts of NSET together with government and other NGO now a day's some changes are coming up on the detailing part. The no of building constructed per year in municipal areas of Kathmandu valley is around 9000 per year and total masons trained in Kathmandu valley in earthquake resistant building construction till July 2008 is around 800 only so availability of trained mason is very low in each building. Looking at the role of the masons they are the one who recommends house owner on materials selection and construction process, methods as in many buildings technical people's involvement is not usual practice.

In city area where building permit is mandatory, the role of engineers and Technicians is to make a plan of Buildings and clear the building permit process. Now in municipalities of Kathmandu especially Kathmandu metropolitan city and Lalitpur Su Metropolitan city the design and drawing requirement is as per the Nepal National building code so some improvement in planning is there. But the role of engineers is mainly limited to design for building permit process at municipalities.

2.4 Quality control issues.

Apart from the engineered buildings all the residential buildings has no mechanism of quality control in materials supplied and process as well as detailing practice. Even in municipalities where there is mechanism to check whether the buildings were designed as per the Building code, they have no mechanism of checking implementation in field. This is the greatest problem in all the sites.

What is building code implementation in Nepal?

Looking at all the practical aspects of Building code implementation in Nepal we have to accept that building code implementation in Nepal means Enhancing culture of safety/ use of knowledge in Building code implementation process. It has to be built upon culture of safety by gradual implementation earthquake resistant elements even in None engineered materials and gradually make safety as a culture.

2.5 Elements of Building code Implementation (Organizational Infrastructure)

As prepared by the building code development project in 1994 there is clear cut vision and road map how to implement building code. As per the management plan for the introduction of a national building code prepared in 1994, some principal recommendations were made which are followings

a. Government of Nepal forms a building Council which represents the principal participants in the building industry. The Building Councils primary roles are: To recommend to the Government and promulgate from time to time what are acceptable building standards (i.e. what constitutes the National Building code) and to ensure that the development of National Building Code continues and is supported both financially and technically.

b. An appropriately staffed unit is set up within central government to support the Building Council.

c. The National Bureau of standards and Metrology, through the Nepal Standards Council, provide the procedural framework for the continued development of those standards making up the National Building code.

d. Government passes a parliamentary act which set up an Engineering council to oversee the maintenance of a register of competent structural engineers.

For proper implementation of building code practically, the following should be there.

a) Appropriate Design; the prime focus should be in proper design. There is a saying that a poorly architecturally designed building, a structural engineer can design is just a band aid. So for implementation of Building code this is must.

b) Appropriate mechanism to translate building control mechanism in to practice of building construction with

c) Appropriate materials and quality control mechanism of construction process

d) Knowledgeable persons (capacity/ awareness) and desiring Owners

1. Implementation Methods

After all the discussions we can understand the building code implemented or not implemented

building from the following basis.

- Engineered buildings- which must have designed by group of professional consultants i.e. architecturally designed considering appropriate configuration and structurally designed by structural engineer , constructed in proper land use planning area well trained contractor have constructed and all the building permit process and building code requirements fulfilled.

- Non formal : above Practical Building code implementation 6 points all or some or one of them is lacking

3. SOME EXAMPLES OF BOTTOM UP APPROACHES FOR BUILDING CODE IMPLEMENTATION.

Raising earthquake awareness is a major component for bridging the knowledge gap. By awareness raising myths and fallacies can be eradicated, fatalism can be reduced and community can be convinced of impending seismic risk and way out to mitigate it. NSET has developed innovative ideas to aware people from all walks of life – policy and decision makers, politicians, media, international agencies etc. Of course, the objectives of awareness raising are different for the different target groups: for politicians and high officials, it is to convince them of the necessity to look at disaster risk reduction as a development issue, for the general public it is enabling them to understand the risk and to identify possible measures as specified by National Building code, that could reduce the vulnerability on an incremental basis. Some of this bottom up approaches and activities are discuss in this section.

3.1 On-the-job Mason Training through School Earthquake Safety Program

Different means are employed to transfer the technology to community grass- root. The whole execution of project is designed as a tool of developing skilled manpower in earthquake resistant construction in local level. In all the process of seismic retrofitting and reconstruction, Engineers of NSET work with masons illustrating them the details and complete procedures. The perception of masons seemed much higher, given the instructors (Engineers) themselves do the work at first, telling them reasons behind it. During training, indigenous knowledge and effective techniques gained from their long experiences are duly considered and employed in best possible ways. It makes them work as usual practice, in highest precise level. It is all in form of on-the-job-training. Besides it, separate class room trainings about construction are conducted in the evening at the respective Schools. The presence and participation of villagers and craftsmen is higher as expected attributed to raise awareness level of community people about earthquake. They have seen their future in this ‘modern’ Technology that they should be equipped with and took part in it with much enthusiasm.

3.2 Simplified Masons and Contractors Training

The simplified Masons and Contractors training is a consolidated form of the on-the-job training under school earthquake safety program. This training also follows hierarchical procedure starting from problem identification to end at testing of methods learned. The trainings are basically in form of interaction, Photographs display, site visit and practical model exercises on key elements of seismic safe construction for different building types.

3.3 House Owners Orientation

A weekly program to give advice and orientation about earthquake resistant construction is run for house owners who are going to construct new house. Prevailing and recommended construction techniques are described with the help of photographs, slides show and small physical models. The program is more fruitful to the public who cannot afford engineers for every-day supervision of construction works. The program includes - General Orientation on Earthquake Safety Measures in order to: make understand and accept the importance of the safety

of the building in which the owner is investing, make prepared to pay or spend a little extra for the safety and suggest to hire qualified or experienced designers and skilled tradesmen

3.4 Mobile earthquake safety clinic

Large numbers of new buildings being constructed are still not following fully the provisions of building code in actual construction. The concept of "Mobile Earthquake Safety Clinic" is devised to provide onsite consultation in aspects of earthquake- resistant building construction. A team of earthquake engineer / structural engineer, technician and masons visit different locations / building construction sites in specific areas and provide technical advice. The aim of the clinic is to improve seismic performance of buildings being constructed by the untrained masons. The main objectives of the tool are: To bring knowledge of safer building construction in construction site, Assist Building Code Implementation at Site Level, Monitor Impact of Earthquake Awareness and To stimulate the house owners, builders to consider earthquake risk.

3.5 Shaking Table Demonstration

This low-tech innovation has been highly effective in educating people about the structural shifts in buildings during earthquakes and for raising awareness about safe building construction. The Shake-Table is essentially a building built to a given scale and mounted on a table which is put through certain force to see the effects of similar jolts that buildings go through during an earthquake. NSET demonstrated its first Shake-table in January 1999. It has so far been demonstrated in many countries of the Asia-Pacific region including Afghanistan, India, Indonesia, Iran, Pakistan, and Tajikistan. NSET has also assisted many partner institutions to design their own Shake-Tables to spread awareness on safe building construction. NSET also supported UNCRD in the organization of special sessions on Shake-Table demonstration at the World Conference in Disaster Reduction (WCDR), Kobe, Japan in January 2005.

3.6 Earthquake Safety Calendar

A step of building code implementation is publication of calendar with simple earthquake resistant construction technique, and is the most effective and successful event. Many municipalities, inside and outside the valley, are now using our calendar during their building permit process. The number of involvement of different municipalities per year is increasing.

3.7 Earthquake Safety Day

At NSET's request, Government of Nepal declared January 15 (or 16) as the Earthquake Safety Day of Nepal, and established an Earthquake Safety Day National Committee for observing the Day annually throughout Nepal. ESD National Committee draws representatives from all emergency response organizations and critical facilities management. Following are the different activities of Earthquake Safety Day,

- Symposium, Awareness speech by the Minister, ESD Rally, High Level Meeting, Annual press conference.
- Earthquake Safety Exhibition with Shake table demonstration, Real scale models, historical photographs of past earthquakes, disaster management related works, methods and products by various organizations (national/international), Government and Non government.
- Children essay / paintings competition, street drama on earthquake safety
- Distribution of numerous publications such as information leaflets, calendars, and posters to the public
- Public talks about Kathmandu Valley's Earthquake Risk , Radio/TV Programs

3.8 TV/Radio

To get to the doorsteps of the people, several local radio and TV stations are airing earthquake safety and

preparedness messages on a regular basis. NSET has established collaboration with local FM Radios for mass education on earthquake safety. The program targets the homeowners and convinces them on the possibility and affordability of making their homes earthquake-resistant, and making their family.

4. LESSONS LEARNT

Institutionalization is long-term process

To achieve better seismic performance of buildings the approach and processes should address the needs at more than one level and take into account the grass-root realities. It must create an awareness that leads to increased demand for safer buildings and skills. It must strengthen capabilities at all levels. It should allow some flexibility in how the various levels of safety norms/standards are adopted.

Incremental safety approach works

Although, inherently weak materials and its improper use and poor construction technology/skill make the owner built buildings unsafe and earthquakes in Nepal are recurrent leading to high casualty, destruction and economic losses. It is almost impossible to change the construction scenario at once. It is a foregone fact that buildings will continue to be constructed by using locally available construction materials and that non-engineered buildings will continue to prevail at least in the foreseeable future.

Thus, the appropriate technology should be developed or transferred. For example, instead of changing very high strength construction material or applying higher technology in construction, stitching the walls, providing bands, tying roofs and floors and vertical rods at corners etc. in case of masonry buildings, and improving ductile detailing, and workmanship in case of RC buildings are important than adopting new construction material.

Programs like School Earthquake Safety Program (SESP) should be continued

In all the villages where SESP has conducted, the house owners of respective locality have been replicating the construction methods employed in school building to construct their private houses without intervention from NSET-Nepal. Except some minor features, newly constructed houses adopt all basic earthquake resistant construction technology like bands, wall stitching, vertical tensile rods etc.

Implication

Owner Driven approach on rural reconstruction of Earthquake affected areas of Pakistan after 8 October, 2005 earthquake shows that bottom up approach is more effective for making culture of safety where all the building construction stakeholders are aware and construction technicians were trained. So Bottom up approach prepares all stakeholders for making safer community during and after the disaster.

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