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Urbanization, Earthquake Vulnerabilities & National Building Code

Ramesh Prasad Singh

Dr. K. N. Modi University, Newai, Rajasthan, India
Email : rameshntnu@gmail.com

ABSTRACT

The paper deals with urbanization trends and the threat of earthquake disaster in the urban areas and the status of the implementation of Nepal National Building Code 1994. Earthquakes have always been a serious threat for the population of Nepal. Nepal hasexperienced a large number of devastating earthquakes in the past. Three earthquakes of similar size occurred in Kathmandu Valley in the 19th Century: in 1810, 1833, and 1866 A.D. The devastating earthquake of 8.34 R-scale, which occurred in Nepal, was Nepal-Bihar (i.e. One state of India) earthquake of 1934 A.D., the locally damaging earthquake of 1988, 2011 and the recent earthquakes of 25th April,2015 are among major earthquakes in Nepal. Around 20,000 people have lost their lives in major earthquakes of Nepal. Several monuments of Outstanding Universal Value inside and outside Kathmandu valley were collapsed.The continuous additions and alteration processes due to factors like modernization, population growth etc. have made the settlement more vulnerable to the earthquake. In the valley, poor quality of construction of buildings and infrastructure were also observed as the main cause of structural vulnerability. Prevalence of non-engineered construction, poor quality control of materials and construction mechanism make the construction poor enough even for normal Conditions. Lack of awareness, and concentration of knowledge and skills only in academic centers contribute to the vulnerabilities. Three types of vulnerabilities (i.e. Physical, Social and Institutional) are analyzed in this paper. The paper illustrates recent urban planning approach 'periodic planning& Integrated action planning' of the Municipality – the recognized 'urban' areas in Nepal along with integrated approach on building construction through implementation of NBC for new buildings and retrofitting for existing buildings. The paper concludes with recommendation on Disaster resilient settlement in the urban areas.

KEYWORDS: Earthquake, National Building Code, Urbanization, Vulnerabilities

Corresponding Author-

Ramesh Prasad Singh
Dr. K. N. Modi University, Newai, Rajasthan, India
Email : rameshntnu@gmail.com

INTRODUCTION

The urban population of Nepal is about 42.0 %of total population of Nepal. The urban population growth rate per annum is about 3 time higher than the national average. Between 1952 and 2001,the number of urban settlements in Nepal grew from 10 to 58 while their share in the country's population increased from 2.6 to 14.4%.Within a year, the number of urban settlements has reached 217. This trend shows the rapid growth of urbanization. Based on the prevailing growth rate, the urban population is assumed to reach around 50% by 2021. The term 'urban' is used for the declared municipality whether their structure is visible in terms of density or not. In this way, the urban becomes an administrative guided attribute, regardless of the available infrastructure and services and the heterogeneity of social and culture significance to satisfy 'urban' in an international arena[1].

In Nepal, about 2/3rd of urban population is concentrated only in 1/3 rd of the municipalities, majority in Kathmandu Valley. Now, the fastest growing localities are situated near the major population centre, close to highways and in the vicinity of Indian Boarder. Increasing population in the urban areas obviously fails to supply the basic urban facilities to meet ever increasing demand.

Although the planning process in Nepal started from 1956, there was little effort for integrated development of Kathmandu and elsewhere in Nepal. After the fifth periodic plan(1975-80), the focus was on the regional development plan, it was realized that the growing population of the urban areas of Nepal would pose a threat to the planned development of the cities, so planning of the cities in accordance with the population growth was realized. In the seventh plan(1985-90).The government decided to collect detailed information of the urban areas so that the cities could be developed to living places. The policies and plans of the eighth plan(1992-97) focused on the preparation of national level master plan. In ninth (1997-2002) and tenth plan(2002-2007), many policies and strategies in relation to the urban areas development were developed but were not implemented effectively[2].

The government in 3-year interim plan (2007) only accepted the lack of urban development policy, lack of coordination among the urban agencies and unhealthy competition between Town Development Committee and municipalities due to overlapping roles and responsibilities.

Two central institutions seem to be responsible for planning and development of the urban area. The Ministry of Federal Affairs and Local Development (MoFALD) administers and coordinates all the municipalities in all aspects of development–physical, social, environmental, and economical, whereas, the Ministry of Urban Development (MoUD) through the Department of Urban Development and

Building Construction (DUDBC) acts as a central agency working to achieve balanced national urban structure, promote safe and economically vibrant urban environment and to promote effective urban management. It also takes responsibility of housing sector for the promotion of planned development through providing affordable, adequate and safe shelter to all income groups and of the building sector to promote safe, economical and environmental friendly buildings that can display the indigenous character[3].

The urban structure is the combination of buildings, infrastructure, and open spaces. Several inter-related institutions are involved in the development and maintenance of these urban areas. The argument is always strong that we have scattered policies and we lack instruments to enable mobilization and harmonization of these interconnected urban investments. Similarly, we lack national view on urban issue and development[4].

Most of the urban areas in Nepal have been a symbol of unplanned and unmanaged settlements. Prevalence of and increasing informal housing, uncontrolled and haphazard urban sprawl, poor, even deteriorating urban infrastructures, weak implementation of Nepal National Building code, social degradation, and cultural consequences: entry of alien cultures, loss of national cultural identity are the major challenges faced due to the urbanization in Nepal. There is a great challenge for the government to manage the haphazard growth of urban areas and to make the urban settlements disaster resilient.

THREAT OF EARTHQUAKE DISASTER

Earthquakes have always been a serious threat for the population of Nepal. Nepal has experienced a large number of devastating earthquakes in the past. The recent earthquake of 7.6 R-scale occurred in 25th April, 2015 which was in Barpakepicenter ofGorkha District. In this earthquake, about 8,600 people lost their life and around 21,850 people were injured. In terms of physical structures,more than 5,00,000 private buildings and 1000 government buildings were damaged completely. Around 2,70,000 private buildings and 3,000 government buildings were partially damaged[1].Several monuments of Outstanding Universal Value inside and outside Kathmandu valley are collapsed including 51 m. height renowned Bhimsen Sthambha (i.e.Dharhara)

In the past, 6.9 R-scale earthquake occurred in 18th September, 2011 which was inTaplejung District of Nepal. In this earthquake, six people lost their life and around 6000 buildings were completely collapsed whereas approximately 20000 buildings were collapsed partially. Three earthquakes of similar size occurred in Kathmandu Valley in the 19th Century: in 1810, 1833, and 1866

A.D. The devastating earthquake of 8.34 R-scale, which occurred in Nepal, was Nepal-Bihar (i.e. One state of India) earthquake of 1934 A.D. and the locally damaging earthquake of 1988 are among major earthquakes in Nepal[2]. Around 11,000 people have lost their lives in major earthquakes of Nepal[5].

The seismic records of the region, which extends back to 1680, 1407, 1259 and 1253 A.D., suggest that the probability of another devastating earthquake like the recent earthquake will occur in next 75-80 years. However, people need to be alert in terms of safety because the scientific research is still unable to determine the date and magnitude of occurring earthquake.

After the earthquake of 1988, the government initiated National Building Code (NBC). Building Act 1998 came in action only in 2006 & Building Regulation 2009 has been approved for effective implantation of NBC[6].

During this Barpak earthquake 2015, the buildings that have followed general building construction guidelines and building code were not significantly damaged. Buildings located at thick soil deposit were severely damaged (i.e. along Dhapasi–Kalanki corridor of the valley).

In the valley, out of 530 number of assessed damaged buildings from the earthquake through the technical team of DUDBC which included government hospital (83 numbers),government /semi government buildings outside and inside Sigh nadurbar Complex(398 numbers), Apartment and group housing (39 numbers) and very special office building and residence which include the building of President, Deputy President, Prime minister, Chief justice and chairperson of constituent assembly (10 numbers), only 10 percent buildings were found unsafe and 25 percent buildings have moderate degree of damage that could be used with some restriction and 65 percent buildings were found safe for use. The assessment was carried out through rapid visual assessment.

Buildings are expected to damage in a major earthquake but collapse of buildings leading to fatalities is neither expected nor acceptable. So each of our preparedness has to be aligned to save building user rather than to save the buildings. The main cause of the collapse of the buildings was due to two main reasons during the earthquake, 2015.

The first one is buildings planned, conceived and constructed by owners without any input from engineers. Buildings not designed by an engineer can have critical structural weaknesses leading to a serious collapse; (which applies to most collapsed buildings in the recent earthquake).

Similarly, the second reason is buildings designed by an engineer but constructed differently; for example, it is common in Nepal to add extra floors on top of a building that has been designed as a 2-3 storey building. Similarly, the quality of materials (concrete and reinforcing steel) were been found deficient in many buildings[7].

In and outside the valley, poor quality of construction of buildings and infrastructure were also observed as the main cause of structural vulnerability. Prevalence of non-engineered construction, poor quality control of materials and construction mechanism make the construction poor enough even for normal Conditions. Lack of awareness, and concentration of knowledge and skills only in academic centers contribute to the vulnerabilities.

MATERIALS AND METHOD

During the study period, Semi-structures questionnaire, building vulnerability assessment sheets and criteria & checklist for key informants were prepared as well as observations at the field level were collected. Documents relevant to the study were also collected from the concerned offices and authorities. Pre-interaction meeting before mobilizing into the site was conducted with the concerned authorities and house owners to be familiar with the problems and the site. Similarly, literature on vulnerability, earthquake responsive plan, assessment procedure etc was reviewed for finalization of data collection tools and techniques[7].

Study Area

The study area is the Kathmandu Durbar Square, one the protected monument zone of Kathamndu Valley. It consists of a cluster of courtyards houses, each one originally belonging to one family. Due to development and fragmentation of the courtyards and the houses within them**,** original structure is changing. However, there are still a few of the courtyards remaining relatively original, without any newly constructed buildings threatening the open space which reflects a fusion of artistic and architectural traditions between the period 1500-1800 AD[3]. One can also still see family relations within some of the courtyards, even if the houses are subdivided and changed, or even reconstructed. The area is strong not in physical, but also in historical matters. Most of the residents living around this tole are Newars, one of the multi-ethnic inhabitants, which have evolved cultural identity in the valley

.Majority of the people living today in this area are, the Sthapits and Shakya of Newars groups. Major religious events have uniquely survived in this area[7,8].

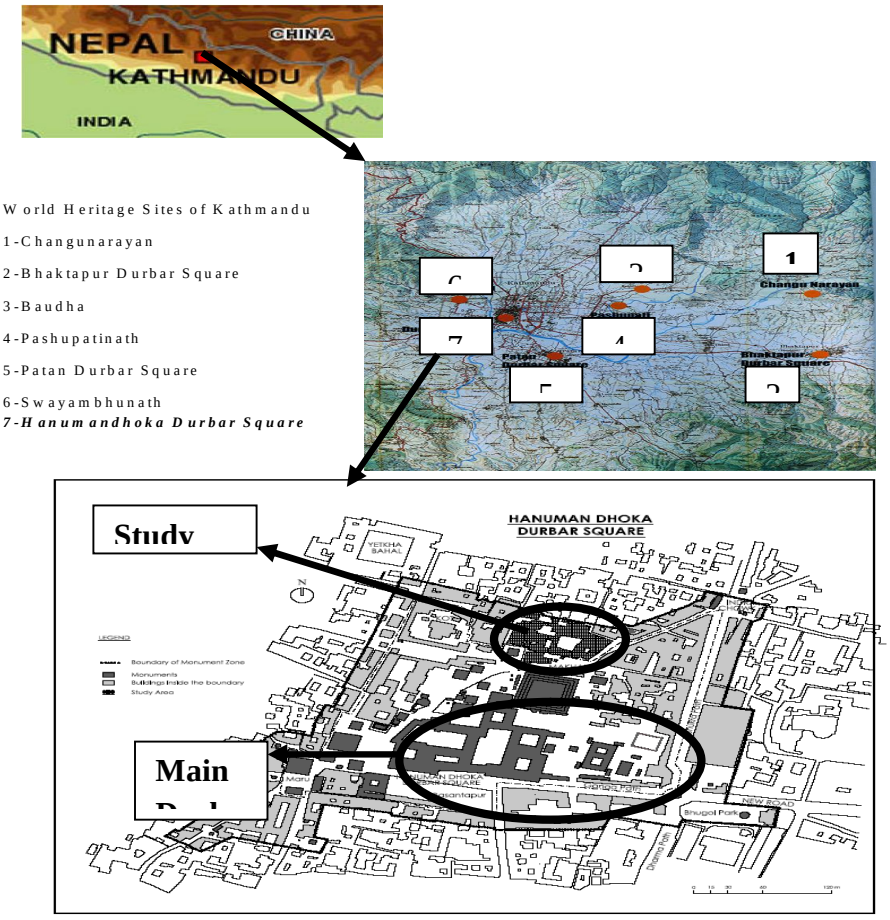

Figure 1: Study Area of this study: Humandhoka Durbar Square

RESULT & DISCUSSION

I. Vulnerability Issues in Urban Context

Poor quality of construction of buildings and infrastructure is the main cause of structural vulnerability. Prevalence of non-engineered construction (>90%), poor quality control of materials and construction mechanism make the construction poor enough even for normalConditions. Lack of awareness, and concentration of knowledge and skills only in academic centers contribute to the vulnerabilities. Development of settlements and public services in hazardous areas and marginal lands, because of the lack of proper land use assessment or theImplementation of the land use policies, are yet another source of vulnerabilities.

Nepalese Social Context is characterized by a transformation of the combined family to the nuclear family structure and sharing property. Housing as a minimum means, in many cases in urban conditions, families are forced to share their buildings. In disaster terminology, it is vulnerable to the people and family[4]. The study observed the Vulnerability issues in the case of Kathmandu Durbar Square,one the protected monument zone and core setting of Kathmandu valley as below:

Three different types of vulnerability are important in this case.

The first one is **Physical Vulnerability**. It is characterized by unchanged or non-renewed physical settings, but incremental to minimum facilities.

Following observed factors in the study area which are responsible for making the setting physically vulnerable.

Vertical sub-division of houses and ownership structure

Rapid population growth, coupled with gradual breakdown of traditional extended family into nuclear family units, has caused families to split their dwellings. Due to changes in ownership patterns, subdivision of houses has lead to more focus outward and less social interaction within the chowk. This physical sub-division of interior space is also read on the exterior of the building, and thus changes in historic character. Due to population growth, modernization, as well as expensive land prices, houses tend to be vertically oriented and people add illegal vertical extension to their houses. Apart from this, new, tall, concrete, cantilevered buildings often encroach on public space and spoil the harmony of the streetscape. Due to the above effects, inhabitants of the area are losing their collective vision of the settlement as a city of Newar tradition. Figure 6.1 shows the construction of modern tall buildings after demolition of traditional buildings. The reason behind this is that people who make good money prefer to construct modern reinforced concrete buildings which they think as the symbol of higher status within the society. In addition to this, due to increase in population among the family members, they undertake vertical subdivision rather than a horizontal one. While the floor area is reduced, height is substantially increased to incorporate family members.As a result of addition of floors, such structures become very vulnerable to lateral forces from the earthquake. The restrictions from the government are a maximum

building height of 35 feet, with a maximum floor height of eight feet. There are a lot of houses exceeding these restrictions. The houses differ from only one floor, all the way up to seven. In addition to the above, some of the houses have been divided into 2-3 households but still these are in the name of one-man ownership of the families. The houses used to be divided into three main households, belonging to three different families. Still today, these are in ownership of the families. But they have been divided among brothers in three generations, causing vertical subdivision of the houses.

Incompatible changes

Another important factor making the structures vulnerable is incompatible changes. Due to the trend of modernization, frame structures have been constructed in the upper floors while the lower floors are of load bearing walls. Some of them can be seen in this neighborhood. Drastic changes are also seen in some of cases where people replace their standing traditional fabrics with modern condition, which in many cases is of poor quality due to the lack of technical knowledge.

Lack of Maintenance

Most of the traditional buildings are even symmetrical in structure and in compatible with traditional setting are going to be vulnerable from the earthquake due to their proper maintenance. Wooden structure members are in the stage of deterioration due to their improper protection. There are many reasons for remaining the buildings unmaintained. Some of them are followings.

i) In many cases, people prefer to demolish the houses because they think maintenance and conservation is too expensive.
ii) A lot of people do not feel its importance
iii) Some of them are not doing due to the lack of financial resources
iv) The workmanship is of poor quality because of inadequate skills, knowledge and supervision.
v) The government doesn't require control over the quality of construction work.

In addition to the above, the areas are found more vulnerable during the earthquake disaster due to the following causes.

- **Hanging electric wires:** Fire may cause during the earthquake.
- **Narrow and unmaintained escape route:** The escape routes are so narrow at some places that it would be difficult to pass one person easily. In some of the escapes routes, wooden members

seemed to fall from the top of escape routes which are obviously vulnerable during earthquake disaster.

- **Lack of maintenance of open spaces:** There are a lot of courtyards where people directly throw waste water and solid waste out of the windows. These courtyards seemed to be like dumping place of solid waste. In addition, the disposed solid waste at the courtyard make the courtyard slippery, which might be one of the reason for human injuries at the time of emergency escape.

Followings are the main vulnerabilities of individual observed buildings:

a) Brick masonry with mud joints:

These are brick masonry buildings with fired bricks in mud mortar. The floor is made of wood or wood and mud. Most of these buildings vary from 2-4 stories and the storey height of is lower (1.8 m) than the modern buildings (2.7 m)

The vulnerability of these buildings is due to the following reasons[5]. One of more these features are found in many buildings of these types.

De-lamination of walls: Vertical separation of internal and external leaves through the middle of wall thickness occurs when there is no proper bonding element connecting these two parts. Under shaking conditions, the wall becomes unstable and easily disturbed resulting in total collapse.

Weak corners and junctions: Weak junctions are the result of improper bonds between cross walls. The wall perpendicular to the direction of earthquake force splits with the walls normal to them and may subsequently topple down**.**

Lack of integrity between load bearing elements: Due to no proper connection between different components of a building like wall, roof, and floor, the system does not acts as a single load resisting system. In this case local deformation occurs causing partial or total collapse of the building.

Lack of diaphragm and lateral restraining members: The main function of a horizontal element is to distribute and transfer horizontal seismic load to the vertical load-bearing element that is the wall below it. If there is no proper connection between different components of floor, it could not distribute the horizontal load to the wall resulting dislocation of wall.

Large and unsymmetrical openings: Large openings weaken the masonry walls against vertical as well as create soft storey effect for horizontal seismic load**.**

Long unsupported wall length: Long unsupported wall has greater slenderness ratio in horizontal plane, which reduces the compressive strength. Such wall is subjected to large bending moment at its mid span during face load. This leads to excessive bending stresses leading to plane deformation of the wall resulting in its failure.

b) Brick masonry with cement /lime mortar:

These are load bearing brick masonry buildings with fired bricks in cement or lime mortar for the wall construction. Use of lime is found only in older historic building when there was no common use of cement. Foundation of these buildings is strip footing built up with stone masonry with mud mortar or brick work in cement sand mortar. These buildings in Kathmandu valley have been constructed for the last 30 years[6]. The following are the main weaknesses in the materials and unreinforced masonry constructions and other reasons for the extensive damage of such buildings[7]. One of more these features are found in many buildings of these types.

- Very low tensile strength, particularly with poor mortars.
- Weak connection between wall and wall, roof and wall.
- Overall asymmetry in plan and elevation of building.
- Asymmetry due to imbalance in the sizes and positions of openings in the walls.
- Defects in construction such as use of substandard materials, unfilled joints between bricks, not-plumb walls, improper bonding between walls at right angles etc.

The second one is **Social Vulnerability,** which includes formal political structures and the informal systems through which people get things done. Poor societies that are well organized and cohesive can withstand or recover from disasters better than those where there is little or no organization and communities are divided (e.g. by race, religion, class or caste). From the experiences of the Kobe Earthquake1995;It was observed that their friends, families and neighbors, particularly in the places, where the community ties were strong, rescued many people. Also, the neighborhoods, which had higher social capital, the reconstruction and rehabilitation were smooth and faster, with better collective decision making among the communities and better cooperation of the community and local government[2].

Similarly, other is **Institutional Vulnerability**. The current law and system for earthquake risk reduction focus entirely on short-term relief to victims only after the event occurs and have inadequate provisions for public education and information, coordination of response activities, mitigation in pre or post-earthquake environments and management of recovery and constructions. The natural Calamity Act (1982) designates disaster relief committees at national, regional and local level. However, the committees are only for relief actions after the disaster occurs. Moreover, the regional, district and local committees are only constituted by the central government. There is a recognized central focal point for relief (Ministry of Home Affairs-MOHA) but there is no such clear focal point in regard to mitigation and other aspects of disaster management. Even Kathmandu Metropolitan City (KMC) has disaster section; there is no committee formation at ward and tole(i.e. neighborhood level) levels. Still, there is no good linkage between central disaster unit at Ministry level and municipality level. There is no clear boundary between tole levels within the boundary so that the top-down approach overlooks the needs and priorities of people at the traditional setting of tole level.

II. Planning Approach for Disaster resilient urban areas

Periodic Planning Approach

Local Self Governance Act envisaged periodic investment of the municipality is planned. Previous planning exercises were renewed with periodic planning. Periodic planning covered an entire urban mechanism for its physical social and culture development. The core values of period planning are i) Local people are knowledgeable and valuable resource persons of their locality; and ii) Development is a process—mediated by evolving social, economic and political factors. The areas covered by periodic planning are a) Physical Development Plan; b) Social Development Plan; c) Economic Development Plan; d) Financial Development Plan; e) Institutional Development Plan; f) Environmental Management development Plan; and g) Disaster Management Plan. The Periodic Planning approach covers these plans coupled with investments required and mobilization of different sources. This is the only plan which shows disaster management as a part of the periodic plan, and announce fund requirement for the disaster management. Along with these sectors, Periodic Plan recognize long term vision and priority sector of the municipality so that investments is directed in future.

Integrated Action Planning (IAP) as a community based approach

IAP is a planning approach with a limited resource base and aims at directly achieving social, economic as well as physical environment. This approach requires the people's participation. The

formation of means and ends and the mobilization of resources shall be an open process which allows for the beneficiaries' involvement[8]. According to him, IAP calls for an iterative formulation of analysis and advice with which to feed a continuous process of political decision making. Community Action Planning empowers communities to design, implement and manage their own settlement programs. Its methods are participatory, community-based, problem-driven, fast, and designed to inform policy from the grassroots[9]. Their participatory approach catalyzed in Sri Lanka as part of the Million Houses Program, a national-scale participatory program internationally applauded. In Sri Lanka it was applied nation-wide and has become a model emulated in programs internationally. In IAP, problems are identified through rapid data collection and analysis focusing on the analysis of existing projects, resource assessment, institutional assessment and goal and policy analysis. Throughout the process, community consultation and direct participation of the people remain a critical factor[10].

With large part of the communities belonging to low income strata and government with limited resources, , appropriate grass root level technology transfer initiatives should be put in place for creating awareness, appreciation and application models for using disaster resistant and cost effective building technologies. For action planning, the problem solution tree, visioning exercise and role plays which can stimulate discussion of the pros and cons of various alternatives can be used (ibid).The action planning approach as mentioned engages full members of the society with their local knowledge, and capacities. Though poor communities are economically vulnerable, they very often have social, cultural, and political capacities to cope with disasters, which are the greatest assets in disaster management.Local knowledge is instrumentalized and idealized by development experts as well as by their critics, be it as "science" or as "wisdom"[11].

III. Implementation of National building code

After the earthquake of 1988, thegovernment initiated National Building Code (NBC). Building Act 1998 came in action only in 2006& Building Regulation 2009 has been approved for effective implantation of NBC.

As Building code recognize 4 types of building practices in Nepal. The coverage of code for each type of building is tabulated below.

Table 1: Hierarchies of Building Code

S. N.	Building Code Type	Level
Part I	**International State of Art –** NBC 000	This part addresses the considerations that should be taken into account by designers who wish to design structures for Nepal by alternative methods to those described in Part II
Part II	**Professionally Engineered Buildings:** NBC 101 to NBC 114 (14 Volumes) and NBC 206 to NBC 208 (3 Volumes)	This contains the standard code requirements that all professionally qualified engineers will recognize and must meet as a minimum when designing structures in Nepal. It covers all usual structures such as hospitals meeting halls factories, warehouses, multi-story buildings and residential buildings.
Part III	**Mandatory Rules of Thumb** NBC 201; NBC 202; NBC 205	This part recognizes that it is not practical in Nepal at present to insist that all small buildings be designed for strength by a professional adviser. The requirements are in terms of limits on spans, heights, minimum reinforcing, member sizes etc.
Part IV	**Guidelines for Remote Rural** NBC 203; NBC 204	This document address about a typical building styles with illustration aimed at the technical advisors to owner/builders in villages

We are in a situation where approximately ninety percentage of private buildings are non-engineered structure. Mainly Government and semi-government buildings and big shopping malls and commercial complexes are engineered situated side by side of the majority of non-engineered private buildings. Building is still not a commodity product but a product of periodic increment of the owner who builds from the knowledge acquired from the society. The Government recognizes the move and provoked clearly in the building code with four categories of the buildings as i) International State of Art; ii) Professionally Engineered Buildings; iii) Building of restricted size designed to simple rules of thumb (Mandatory Rules of Thumb); and iv) Remote rural building where control is impractical (Guidelines for Remote Rural Buildings).

DUDBC under the Ministry of Urban Development has been recognized as the lead agency for the implementation of NBC and Building Act. The implementation of NBC is coined with the implementation (completed in 2010) of Earthquake Risk Reduction and Recovery Preparedness Program – ERRRP in five municipalities – Biratnagar, Hetauda ,Pokhara, Birendranagar t& Dhangadhi and continuing trainings to technicians, masons along with technical support to the municipalities in Building Permit Process .

In addition, immediately after the 2015earthquake, DUDBC took a proactive role in providing training (together with NEA and with the help of national and international experts) of the damage assessment to the engineering community.

In May-June immediately after the earthquake, about 800 engineers were trained on damage assessment and repair of buildings in different parts of the country. Currently, a comprehensive training program on Building Seismic Assessment and Strengthening is underway in Kathmandu. In future, such training should be conducted in other regions as it is equally important for engineers working in public and private sectors outside the capital.

During implementation of NBC, the recognition of NBC issue has become an agenda for disaster compliance at municipalities. It started with compliance of building code to the government buildings covering the health buildings, school buildings as well as reconstruction buildings built through Ministry of Peace and Reconstruction. There are various improvements in building permit process in municipalities. It has also created high level awareness among small contractors, masons and dwelling owner through campaign, publications. Thus Building Act is revised accordingly to empower municipalities in their building permit and for effective service delivery. In addition to this, on the job trainings are initiated from DUDBC in different municipalities for the effective implementation of NBC.

At present, NBC is being implemented in 26 municipalities out of 217 municipalities. The Ministry of Federal Affairs and Local Development in coordination with Ministry of Urban Development has initiated the process to implement NBC in all municipalities as well as 1000 number of households through the publication of notice in Gazette according to Building Act, 1998 (with revision).

The compliance of NBC is always became principle for new buildings, but for the existing buildings , the retrofitting approaches are used with (re) strengthening building elements with jacketing columns, and retrofitting other elements of the existing structure.

Main advantages of the retrofitting of the structure over the reconstructions are:

- Involved costs are low
- Time for construction involves 3-4 months
- Disturbance to the regular function is low
- Disposal of scrapped materials is not a big problem
- New technology, so there is new excitement
- Reliability is high

The traditional urban fabric of the setting is being threatened at an alarming stage due to demolition and poor adaptation of new construction. Due to population growth, modernization as well as expensive land process, houses tend to be vertically oriented and people add illegal vertical extension to their houses. Apart from this, new tall, concrete and cantilevered buildings often encroach on public space and spoil the harmony of the streetscape as well make the setting vulnerable from the earthquake.

Three types of vulnerability are found in the setting -Physical, Social and Institutional. The factors: lack of maintenance, vertical subdivision of houses, addition of more floors, lack of escape route maintenance and open spaces, hanging electric wires, narrow streets, no connection between wall and floor and incompatible construction are responsible for making the setting more vulnerable in physical aspects. Out of the above factors, lack of maintenance was found to be the most important cause of vulnerability followed by addition of more floors. Modern constructions that are of poor quality, in some cases, are more vulnerable than the existing traditional fabric.

The social vulnerability is found to be increasing in this Newari society due to the lack of social cooperation between the members of the community. Social and economic segregation within the settlement make the difficult for the community to reach collective decisions on matters of common values and interests. The existing social network determined by joint family and neighborhood units is broken since the individual households are separated. These separations of nuclear households also impose the problem on size of land-holdings. In very small size of lands, they erect the new houses that are vulnerable to the earthquake threat. Poor societies that are well organized and cohesive can withstand or recover from disasters better than those where there is little or no organization and communities are divided.

The current top-down approach of the government system for earthquake risk mitigation overlooks the priority and needs of the local people. It fails to meet the appropriate and vital humanitarian needs. Moreover, it increases requirements for unnecessary external resources and creates general dissatisfaction over performance despite exceptional management measures employed. This is due to the fact that the community, as the primary stakeholder and recipient of the direct impact of disasters, was not given the chance to participate in the process of decision-making and implementation of activities.

The major interventions under the building codes are: the effective inclusion in building permit process, establishment of peer review and certification of construction practices and implementation of land use planning measures. The code has been initiated to update from the last year 2011.

Some of the issues related to Implementation of NNBC are a) unaware Engineering graduates and architects; b) feeling of more costly construction among the local people an practitioners; c) lack of coordination among the authorities; d) lack of engineers in some of the municipalities and unawareness and lack of knowledge of structural design and building code; and e) need of revisions and update of NNBC itself. Thus, we still need to orient municipalities, along with increased training to contractors, masons coupled with evaluations on compliance to building code practice.

CONCLUSION

Urban Planning should be linked with a functioning and prosperous community with less vulnerable to different types of risks. There are many municipalities, which are very rural in nature where provision of minimum infrastructures and facilities are not met. The new municipalities should be declared not only based on the population threshold. Population, Population density, growth rate, location advantage, provision of road connectivity, commercial activities as well as minimum infrastructures within the urban areas would be the classification criteria for declaring the further municipalities.

The government should focus on compact settlement with proper risk sensitive land use plan rather than scattered settlement to build disaster resilient community.National Building code should be made mandatory in all declared municipalities as well as urbanizing Village Development Committees. There should bealso made policy decision of Nepal Engineering Council to follow NBC on all registered engineers and architects.Code need to be updated as earliest possible (which is in the process). Continuous awareness program, trainings, seminars, and workshops need to organize for all kinds of professionals. Existinginfrastructures should be improved through the retrofitting techniquesThere should be mandatory provision of open spaces for disaster management in newly construction buildings. Grass root organization need to be strengthened for developing the community disaster resilient

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