



## NEPAL BUILDING CODE - NEED, DEVELOPMENT PHILOSOPHY AND MEANS OF IMPLEMENTATION

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### SUMMARY

In the absence of an appropriate building code of its own, most buildings in Nepal were, and are still being, planned and constructed with little or no regard for seismic safety. The need for change and improvement in the prevailing building design and construction methods was recognised. Accordingly, a Building Code Development Project was launched in 1992. The objectives of the project, among others, included the development of regulations and design documents for use by the planners and engineers in order to improve the seismic safety aspects of the existing buildings and to suggest safer building design and construction practices to be introduced/enforced gradually in Nepal.

The development of a Nepal Building Code within the overall framework of the Building Code Development Project involved seismic hazard mapping and risk assessment, the development of an implementation management plan that included institutional and legal framework requirements, studies of alternative building materials and technologies, and a comprehensive plan for training, public awareness and dissemination of the materials of the Code. Four distinct levels of good building practices considered in the code were: the current state-of-art design; professionally-engineered design; pre-engineered construction; and guidelines for non-engineered construction. It is argued that a progressive move from the prevailing non-engineered construction to pre-engineered construction, and then finally to 100 % engineered buildings, is the best course of action for the implementation of Code - instead of a radical move from nothing to everything. The approach for the development and implementation of a building code suggested in the paper could be applicable to other countries experiencing similar difficulties in introducing safer seismic construction practice.

### INTRODUCTION

Nepal has a recorded history of earthquake occurrences and related deaths, as well as damage, from 1255 AD. Some 18 000 buildings either collapsed or were damaged in the earthquake of 1833 (Magnitude 7.7 on Richter Scale with maximum intensity MM X). The 1934 Bihar – Nepal earthquake (magnitude 8.3 on the Richter Scale, maximum intensity MM X), caused the destruction/damage of 207 248 buildings (collapsed: 80 893; damaged: 126 355) (Rana, 1991). Unfortunately, after the resumption of normal life, the whole issue was once again easily forgotten. Experiences were not institutionalized and internalized by the government in any of its policies in order to minimize possible problems in the future.

After the 1988 Udaypur (eastern Nepal) earthquake (magnitude 6.4 on Richter Scale), which killed 721 people, injured 6553 and damaged or destroyed 66 541 buildings (collapses: 22 695, damaged: 43 846) (Thapa, 1989), His Majesty's Government of Nepal, with the assistance of the World Bank and the United Nations Development Programme (UNDP), initiated an "Earthquake Affected Areas Reconstruction and Rehabilitation Project (EAARRP)". The project provided technical and financial assistance to the affected to reconstruct

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damaged/collapsed residential buildings, and undertook the reconstruction of schools and other public buildings. One of its objectives was to disseminate information on earthquake-resistant construction technology and to institutionalise the experiences gained.

The deaths and damage caused by the 1988 earthquake drew the attention of the policy-makers towards the need for changes and improvements in the existing building construction and design methods in Nepal. The Ministry of Housing and Physical Planning (MHPP) requested technical assistance from UNDP. Subsequently, a programme of "*Policy and Technical Support*" was set up within the MHPP with UNDP assistance. One of the sub-components of the programme was the development of "*regulations and documents for achieving satisfactory strengths in buildings*". These included a draft National Buildings Code to set out requirements and/or good practice, and a management plan for its introduction. The management plan was to provide recommendations for both institutional and legal frameworks. A comprehensive plan for the necessary training and public-awareness-raising for the effective implementation of the code was prepared within the overall framework for the programme. Other complementary works undertaken in conjunction with the formulation of the building code included:

1. Seismic Hazard Mapping and Risk Assessment, and
2. Development of Alternative Building Materials and Technologies.

### **ANALYSIS OF EXISTING SITUATION**

To date, most residential buildings (even in urban areas of Nepal) do not receive any rational design for strength. Even though most municipalities (58 altogether) do have a system of granting building permits, there is no provision in them for strength criteria. The building permit process only takes into account compliance related to planning (ground coverage, FAR) and building by-laws (height, provision of toilet, liquid waste disposal). Kathmandu and Lalitpur municipalities now require some structural drawings (not design) for buildings with more than three storeys or a 1000 sq. ft. plinth area. Thus, there is poor institutional and technical capacity within the local authorities for implementing strength-related provisions if they were to be introduced to the building permit process.

On the professional front, too, there is no system of controlling the professional standards of engineers/designers through reference to professional qualifications/ membership or by legal means. More than 98 % of the buildings in Nepal are built by owner-builders who follow the advice of local craftsmen. Both of them are not aware of the possible disastrous consequences from an imminent earthquake. Neither do they have any access to information related to safer building practices and incorporation of simple earthquake-resisting features at nominal extra cost. Even the building construction projects funded by national and multilateral agencies do not spell out any requirements related to seismic safety when they hand over the terms of reference to their consultants.

### **CODE DEVELOPMENT CONCEPT**

In the absence of even a simple infrastructure for the implementation of a code, it was considered rational to make a very cautious beginning. The concept, therefore, was to move from nothing to something. It is recognised that code development is the beginning of a process, which should be continuous and ongoing. The provisions of a code should make it possible for its incremental application. This recognises the need to gradually move from a non-engineered level to pre-engineered or semi-engineered levels, and then finally to a 100 % engineered level for significant structures in at least the metropolitan areas.

The concept accordingly visualized four levels of application (depending either upon the level of capability or the importance of building and its location). The four levels are:

- *International State-of-Art*: While the major thrust of the code is aimed at the typical and most common buildings currently erected in Nepal, it would not be practical to bar anyone who can produce a sophisticated design following philosophies and analytical techniques that appear in the codes of more developed countries - provided that minimum standards set for Nepal are also met.

- *Professionally-Engineered Structures:* These are the standard code requirements that all professionally qualified engineers will recognize and follow when designing structures in Nepal. It covers all major structures such as hospitals, meeting halls, factories, multi-storey buildings and larger residential buildings.
- *Rules of Thumb :* (Pre-engineered for defined building types): This section recognizes that it is not practical at present to insist that professionals design all small buildings. Therefore, for classes of buildings constructed of modern materials (concrete, steel) but not exceeding certain simple criteria as to height, configuration, number of storeys and floor area, mandatory rules-of-thumb are provided. The requirements are in terms of maximum spans, minimum reinforcing and member sizes, positioning of earthquake-resisting elements and other such rules. The explanatory documents are such that an experienced overseer or mason should be able to understand them and present sufficient details at the time of permit application to prove to a non-technical appraiser at the local authority that the requirements are being met.
- *Advisory Guidelines* (Non-engineered construction employing traditional materials and skills): These guidelines are based on the analysis of some 50 typical prevailing building types in Nepal constructed by employing tradition/vernacular materials and skills. They have been developed for improved construction for enhanced seismic safety. These 50 buildings were surveyed and documented to determine their vulnerability in materials and skills. Two guidelines have been developed; one dealing with low-strength masonry and another dealing with earthen structures. The guidelines provide simple rules for improving seismic safety of buildings.

It was recommended that the codes be made: (i) mandatory for all types of public buildings to be built throughout Nepal; (ii) mandatory for all residential buildings to be built in municipal and urban areas where a building permit process exists, and; (iii) advisory for residential buildings in rural areas.

Considering the time frame of 12 months allowed for the development of the code, and the level of primary and secondary information available within Nepal required for the development of various specific standards, some standards have been adapted from Indian Standards. These ones need to be read in conjunction with the relevant Indian standard.

## **INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION AND UPDATING**

As the code preparation is a continual process, it will require the implementation of prepared codes and feedback collection. Updating, upgrading and amending is a must. For all this work, the project envisaged an institutional framework and institutions. These are as follows:

- *a) Nepal Building Council:* There are no existing groups within the central or local government or within the training institutions in Nepal which have the necessary level of experience of implementing, supporting and/or enforcing design rules. Furthermore, agreement on any regulations affecting building construction requires input from key players in the building industry itself. It was therefore recommended that an apex body titled "*The Building Council*" be formed of representatives from key players and policymakers. It was recommended that its permanent secretariat be located within the government's Department of Building. The primary roles of the Building Council would include, among others, recommending to the government, and promulgation from time to time, what are acceptable building standards (i.e., what constitutes the National Buildings Code) and ensuring that the development of the code continues, and is supported financially. It will also play a co-ordinating role for creating the proper infrastructure and climate (awareness-raising, human resources development, technical support, etc.) required to raise the standards of all those involved in the building process to a level sufficient to support the aims of the Council.
- *b) Support Unit/ Department of Building (DoB):* It is envisaged that the Building Council will have a permanent support unit established within the Department of Building, staffed by experts in building regulation development and interpretation. This would be a centre of expertise capable of advising on matters of principle raised by local authorities and building permit applicants. Such a centre would be required as soon as the implementation of the Code begins.

It was proposed that the Building Council would delegate some of its tasks to the support unit. These may include: (i) Organising and co-ordinating training in compliance with the National Building Code, (ii) Providing specialist interpretation of the documents, and (iii) undertaking review of those building permit applications where the subject matter is special and beyond the reasonable resources of a local authority.

The DoB would therefore need strengthening to enable it to develop training packages, conduct training, organise higher education programmes, conduct workshops and orientation, and conduct training-the-trainers programmes. In other words, the department would have to undertake pivotal works for which it has at present neither funding nor appropriate manpower. The department is expected to draw up a detailed action plan following the project team's recommendation on "*Comprehensive Plan for Training and Public Awareness Raising*".

- *c) Code Development by the National Bureau of Standards and Metrology (NBSM):* It was recommended that the NBSM undertake the maintenance and revision of the individual standards contained in the Code. The Support Unit of the Building Council would provide any necessary expert input required and other relevant support. The NBSM would naturally involve other stakeholders in the industry as they already do for other standards they produce. This arrangement would ensure the regular re-evaluation of the standards and the development of new ones by NBSM in its accustomed manner.
- *d) Other Stake-Holders/Partners in Code Implementation:* Implementing the NBC will require teamwork. It is thus necessary to identify the partners and assign appropriate roles for effective and efficient implementation. The most important of these have been identified, and appropriate roles have been defined for them. For example, it has been recommended that the DoB have the lead role in co-ordinating with other institutions. Formulating the building code, relevant Acts, developing training materials, organising training programmes, and developing a monitoring system for the code implementation are other tasks recommended for the DoB.

Similar roles have been defined for other agencies related to planning and construction and implementing codes. The National Building Council, with the assistance from the DoB support unit, is expected to garner necessary support and coordination from all agencies with an interest. These agencies include government departments, bilateral and multilateral agencies, engineering education institutes, professional societies, consulting organisations, etc.

## LEGAL FRAMEWORK

Building standards are to be mandatory, as the government wants them to be enforced. Other standards developed by the NBSM are normally adopted voluntarily by the producers concerned. Consumers are encouraged to use only products which have been granted the Nepal Standard mark. For the government to make the building standards mandatory in any defined area, a legal basis is required. Hence, a "*Building Act*" has been drafted which will also authorise the formation of the Building Council and empower the authorities concerned to ensure compliance with NBC by building developers.

In addition to a *Building Act*, an *Engineers' Council Act* has been drafted. This act will require *design engineers* to be registered. Only registered engineers would be authorised to self-certify their works as meeting the prevailing code requirements. It will help to discipline the profession and, in the long run, promote it.

The third tool is a set of local authority by-laws to enable integration of the strength component in the building permit process. This has been drafted as a model by-law which could be tailored by the concerned local authority (depending upon its institutional and technical capability) to its specific requirements in order to incorporate different levels of strength components in its building permit process.

### **a) *The Draft Building Act: Its salient features include provision for the following:***

- i) Set-up of a *National Building Council or Committee* with responsibility for the determination and updating of a National Building Code, and to assist HMG in its implementation. (This is conceived to be the apex body, and is entrusted with a wide range of responsibilities for the successful implementation of a NBC)

- ii) Classification of buildings into four categories in line with draft NBC philosophy.
- iii) Implementation, supervision and monitoring of compliance.
- iv) Arrangement, classification and authorization of approved design certifiers at different levels - in line with the four levels of the draft NBC.
- v) Arrangements for building permits and building construction.
- vi) Enquiries and response re compliance or otherwise with the NBC provisions by builders, etc.
- Power to prepare and implement regulations/by-laws.

**b) *Draft Engineering Council Act: Its salient features include the following:***

- i) Provision for the formation and management of the Council, with the President of the Nepal Engineers Association as its ex-officio chairman.
- ii) Provision of a registrar with defined functions, duties and authority.
- iii) Provision for the registration of engineers and the issuing of certificates.
- iv) Provision for restrictions on employing a non-registered engineer by HMGN and other agencies.

**c) *Model Local Authority By-laws for Enforcement of the NBC: Its major provisions include:***

- i) Applicability and conditions of application of the Code (level and conditions of building).
- ii) Requirement of the local authority to have a building section headed by a building officer with defined powers, qualifications and functions.
- iii) Requirement for all persons and agencies to obtain building permits prior to undertaking construction, and specification of the documents to be submitted to obtain the same.
- iv) Responsibilities and duties of the owner/ builder.
- v) Inspection during construction by the local authority.
- vi) Connections of utility services to be authorized only to those buildings which have complied with the Code. No transfer of ownership to be permitted for buildings not complying with the provisions of the Code.
- vii) Registration by a local authority of technical personnel (engineers, architects, overseers, etc.) who want to operate within its territory. Only registered technicians to be allowed to prepare the building approval drawings, and to undertake periodic supervision for certification purposes.
- viii) Definition of unsafe buildings and requirements for demolition.

## COMPREHENSIVE PLAN FOR TRAINING AND PUBLIC AWARENESS-RAISING

The acceptance of safety requirements depends upon the awareness level of those involved. Once the consumers are aware, there will be a demand for those professionals and craftsmen who can meet them in building construction. To meet this demand, a co-ordinated plan to develop the required manpower is essential. The project foresaw this demand-supply relationship with respect to safety and prepared a comprehensive plan which is as follows:

- *a) Assumptions:* The intent of the Plan is to bring about positive change in building practices. The multi-faceted process addresses the requirements of large and small buildings, built from either traditional or alternative materials. The strategy and action Plan to execute the Building Code programmes define the long-term and on-going activities necessary to ensure that all construction in Nepal will achieve higher levels of seismic safety. This Plan establishes a local structure for continued education, training, and the provision of technical assistance in seismic-resistant construction.

The second phase of the Plan consists of a long-term implementation strategy. This programme is intended to utilise the products developed by the project over a multi-year time frame.

The Plan creates an educational structure within which efforts to reduce seismic hazards throughout Nepal can be implemented. Legislation and administrative programmes will execute and institutionalize the Code, while training and education will achieve improved seismic resistance of non-engineered structures.

The implementation strategy addresses:

- What institutional steps should be taken to disseminate information.
- Who best should disseminate the information.
- What information should be disseminated - in what physical form.
- How to inform the public that a building code has been developed.

The dissemination programme must communicate with people who have different levels of technical expertise. The educational dissemination programme must, therefore, be available in both print and visual media, in both urban and rural areas. This multi-media form of communication is especially critical because of the high illiteracy rate, compounded by the very low level of expertise with respect to issues pertaining to seismic resistance, among all sectors of the construction industry (among professional, technicians, craftsmen, etc.) in Nepal.

- *b) Objectives:* The underlying objective of the Plan is to reduce damage and life loss from earthquakes in Nepal. The Plan defines the activities required to ensure that higher levels of seismic safety are achieved for all buildings throughout Nepal.

The Plan assumes that the Building Code and standards for small buildings will be adopted incrementally, with the major population centres taking the lead. Concurrent with the upgrading of professional expertise and craftsmen skills, administrative programmes and legislation are needed to operate and institutionalise the Code. Throughout the implementation process, training of craftsmen and education of owners/ builders will result in the improved seismic resistance of non-engineered structures.

The target audiences are diverse. Recommendations are, therefore, organised according to the time frame required for implementation. The following three benchmark periods are identified:

*Short Term (0 – 3 years) with primary focus on Training and Education:* Key actions suggested in this period include supplementary education for professionals on seismic design, education of government and NGOs' staff regarding seismic resistance and administrative objectives, training of craftsmen, etc.

*Mid Range (3 – 5 years) with primary focus on an increase in expertise to comply with the Code:* Key actions in this period relate to the implementation of the "Rules of Thumb" to serve as guidelines for improved construction, and the adoption of the remaining provisions of Code.

*Long Term (6 – 15 years) with primary focus on a Building Code enforcement structure throughout Nepal:* One of the key actions during this period involves the long-term upgrading of building practices.

A combination of activities are proposed for each time-frame, directed to five distinct (but often overlapping) target groups:

<i>Professionals:</i>	Enhance design expertise
<i>Technicians:</i>	Skill upgrading
<i>Craftsmen:</i>	Skill upgrading
<i>Government Employees:</i>	Awareness of seismic resistance principles
<i>General Public:</i>	Awareness that seismic resistance can be achieved.

## CONCLUSION

In a developing country where most buildings are being constructed by owner-builders, traditional materials and skills predominate, controls for enforcing safer construction practices are non-existent or very, very weak, and where the professions involved in the construction industry are not yet self-regulating with respect to good practice, both the approach and the processes for formulating a building code have to be rather innovative.

The alternative and less desirable dogmatic approach requires the adoption of a more stringent code and its enforcement entirely by statutory means.

The developers of the Nepal Building Code believe that the approach and processes should address the needs at more than one level and take into account the grass-root realities. Policing the application of standards and norms is not possible, nor is it desirable. Rather, a bottom-up approach is required. It must create an awareness that leads to an increase in demand for safer buildings and accompanying skills. It must strengthen capabilities at all levels. Such a plan should be an integral part of the code formulation and implementation process. It should allow some flexibility in how the various levels of safety norms/standards are adopted. These should be applied incrementally in keeping with the varying and increasing need of the target groups and target buildings. Such an approach will create a climate of easier acceptance and will be simpler to implement.

## REFERENCES

1. Chitrakar, G.R., Pandey, M. R., 1986, Historical Earthquakes of Nepal, *Nepal Geological Society News Bulletin*, V. 4, No. 1.
2. Dixit, A. M., 1991, *Geological effects and intensity distribution of the Udaypur (Nepal) earthquake of August 21, 1988*, Journal Nepal geological Soc., V. 7, P. 1-17.
3. -----, 1994, *A Management Plan for the Introduction of a National Building Code*, His Majesty's Govt. of Nepal, UNDP/UNCHS (Habitat), subproject 88/054/21.03.
4. -----, 1992, *Nepal Shelter Sector Background Report*, MHPP, HMG/N, UNCHS (Habitat)/UNDP project Nep/88/054.
5. -----, 1998, *Ninth Five Year plan (1997-2002)*, His majesty's Govt. of Nepal, National Planning Commission.
6. Rana, B. S. J. B. ,1936, *Nepal ko Maha Bhukampa (The great Earthquake of Nepal (in Nepali))*, Sahyogi Prakashan, Kathmandu, Nepal.
7. -----, 1994, *Seismic Vulnerability Assessment for Nepal*, His Majesty's Govt. of Nepal, UNDP/UNCHS (Habitat), subproject 88/054/21.03.
8. -----, 1997, *Statistical Yearbook of Nepal*, His Majesty's Govt. of Nepal, Nepal Central Bureau of Statistics.
9. Thapa, N., 1988, *Bhadau Panch Ko Bhukampa (in Nepali)*, Central Disaster Relief Committee, Nepal.