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Handbook on Building Code Implementation: Learning from Experience of Lalitpur Sub-Metropolitan City, Nepal

Handbook

Building Code Implementation

Learning from Experience of Lalitpur Sub-Metropolitan City, Nepal

Lalitpur
Sub-Metropolitan City
NEPAL

UNCRD
United Nations Centre for Regional Development
Disaster Management Planning Hyogo Office

Handbook on
Building Code Implementation

Learning from Experience of Lalitpur Sub-Metropolitan City, Nepal

Lalitpur Sub-Metropolitan City

UNCRD

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Disaster Management Planning Hyogo Office

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Front: Field Training
Back: Awareness Event conducted on "Earthquake Day", Jan 16th, 2008
(Pictures taken by Niyam Maharjan)

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Mission Statement of UN/DESA

The Department of Economic and Social Affairs of the United Nations Secretariat is a vital interface between global policies in the economic, social and environmental spheres and national action. The Department works in three main interlinked areas: (a) it compiles, generates and analyses a wide range of economic, social and environmental data and information on which State Members of the United Nations draw to review common problems and to take stock of policy options; (b) it facilitates the negotiations of Member States in many intergovernmental bodies on joint courses of action to address ongoing or emerging global challenges; and (c) it advises interested Governments on the ways and means of translating policy frameworks developed in United Nations conferences and summits into programmes at the country level and, through technical assistance, helps built national capacities.

Foreword

Lalitpur Sub-Metropolitan City (LSMC) had announced the implementation of Nepal National Building Code (NBC) in building permit process on the occasion of Earthquake Safety Day on 16th January, 2003. So LSMC became the first and leading municipality in Nepal to implement NBC and it was done before the implementation of NBC was made mandatory by the Government for all municipalities. The decision was historic in the sense that it not only encouraged the government to enforce NBC but also guided other municipalities on the necessity of building code implementation. It also proved that implementation of NBC is practical. At the beginning, implementation of NBC was carried out by Technical Cell (Group of Municipal Engineers & Engineers from Department of Urban Development and Building Construction and other organizations). "Earthquake Safety Section" was established in November 2003 and it is working together with "Building Permit Section" for effective implementation of NBC since its establishment.

LSMC is pleased to publish this booklet to share experience of the Municipality in different aspects of implementation of building code. I take this opportunity to appreciate effort of UNCRD Disaster Management Planning Hyogo Office to prepare and publish this booklet. The booklet, I believe, will be useful tool not only for other municipalities in Nepal but also for Municipalities in other developing countries struggling with implementation of Building Code.

Krishna Prasad Devkota
Chief and Executive Officer
Lalitpur Sub-Metropolitan City

Foreword

Earthquakes kill thousands of people each and majority of the death is caused by collapse of buildings. Effective implementation of building codes can prevent collapse of these buildings and thousands of lives can be saved from earthquakes. Although most of the earthquake prone countries have now building codes, implementation of the building code is poor and many unsafe buildings are still being raised. Realizing importance of effective implementation of building code in earthquake risk reduction, UNCRD implemented project Housing Earthquake Safety Initiatives (HESI) from 2007 with the funding from the Government of Japan. The project is being currently implemented in four countries: Algeria, Indonesia, Nepal and Peru.

In Nepal, UNCRD has conducted series of training programs and workshops in collaboration with the government, municipalities and other stakeholders. This booklet on Experience of Lalitpur Sub-Metropolitan City is another milestone in those series of activities. LSMC has been exemplary not only in its enthusiasm to initiate the implementation of code but also in its approach. This booklet, I believe, will be useful for other municipalities and practitioners who are willing to implement building code.

I take this opportunity also to thank the contributors and editors who have put great effort in developing this booklet.

Shoichi Ando
Coordinator
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Part I: Background Information

1-1. Background of Nepal National Building Code

The Department of Urban Development and Building Construction (DUDBC) of the Ministry of Physical Planning and Works (MPPW) developed the Nepal National Building Code (NBC) in 1993 with the assistance of the United Nations Development Programme and United Nations Centre for Human Settlement (UN-HABITAT). NBC went into force when the Building Construction System Improvement Committee (established by the Building Act 1998) authorized MPPW to implement the code. The Ministry published a notice in the Gazette in 2006 and the implementation of NBC became mandatory in all Municipalities and some Village Development Committees (VDCs) in Nepal.

In 2002, prior to the formal entry into force of the code, Lalitpur Sub-Metropolitan City (LSMC) initiated the implementation of NBC, becoming the first Municipality in Nepal to implement NBC. Kathmandu Metropolitan City followed in 2006 and Dharan Municipality in 2007. It is expected that other municipalities take similar steps to implement NBC in the future.

Table 1: Legal arrangement summary matrix

Legal mechanism	Responsible Institutes	Envisaged role
Building Act 1998 (Rev. 2007)	Building Construction System Improvement Committee	Devise Building Code, facilitate enforcement, disseminate code, monitor implementation, revise code
	MPPW	Approve the Building Code
		Publish notice of mandatory implementation of Building Code
	DUDBC	Implement Building Code in areas outside of Municipal jurisdiction
		Supervise compliance with Building Code
	Municipalities	Ensure compliance with Building Code
Local Self Governance Act 1999 (Decentralization Act)	Municipalities	Building permit (does not include provision of Building Code)
	House owners in municipal areas	Comply with municipal rules and secure formal building permit before construction
National Building Code – 2003	All concerned	Approved NBC
Notice of MPPW in Nepal Gazette (Feb. 13, 2006)	58 Municipalities, 28 District Headquarters, 81 VDCs	Implementation of Building Act

1-2. Provisions of NBC

Nepal National Building Code has 23 parts. The first part NBC 000 is "Requirements for State-of-the Art Design: An Introduction", which lays out general provisions of the individual building codes. The following is the complete list of codes in NBC.

Table 2: List of codes in NBC

Code Number	Code Title
NBC 000: 1994	Requirements for State-of-the-Art Design: An Introduction
NBC 101: 1994	Materials Specifications
NBC 102: 1994	Unit Weight of Materials
NBC 103: 1994	Occupancy Load
NBC 104: 1994	Wind Load
NBC 105: 1994	Seismic Design of Buildings in Nepal
NBC 106: 1994	Snow Load
NBC 107: 1994	Provisional Recommendation on Fire Safety
NBC 108: 1994	Site Consideration for Seismic Hazards
NBC 109: 1994	Masonry: Unreinforced
NBC 110: 1994	Plain and Reinforced Concrete
NBC 111: 1994	Steel
NBC 112: 1994	Timber
NBC 113: 1994	Aluminium
NBC 114: 1994	Construction Safety
NBC 201: 1994	Mandatory Rules of Thumb: Reinforced Concrete Buildings With Masonry Infill
NBC 202: 1994	Mandatory Rules of Thumb: Load Bearing Masonry
NBC 203: 1994	Guidelines for Earthquake Resistant Building Construction: Low Strength Masonry
NBC 204: 1994	Guidelines for Earthquake Resistant Building Construction: Earthen Building (EB)
NBC 205: 1994	Mandatory Rules of Thumb: Reinforced Concrete Buildings Without Masonry Infill
NBC 206: 2003	Architectural Design Requirements
NBC 207: 2003	Electrical Design Requirements for (Public Buildings)
NBC 208: 2003	Sanitary and Plumbing Design Requirements

NBC 000 categorizes design and construction of buildings into four types according to their level of sophistication.

- International state-of-the-art
- Professionally engineered structures
- Buildings of restricted size designed to simple Rules-of-Thumb
- Remote rural buildings where control in impractical

The major thrust of the code is aimed at the typical and most common buildings currently being constructed in Nepal. It does not suggest as being practical for everyday consideration the sophisticated design philosophies and analytical techniques that appear in the building codes of developed countries. Under the first category **International State-of-the-Art**, if consultants ensure that their designs meet the corresponding international standard, the designs are considered to be in conformity with NBC. The second level refers to **Professionally engineered structures** and covers all usual structures such as hospitals, meetings halls, factories, warehouses, multi-storey buildings and residential buildings.

The third category refers to **Buildings of restricted size designed with simple Rules-of-Thumb**, and mostly applies to remote areas where simpler buildings are prominent.

The explanatory documents are such that an experienced overseer will be able to understand them and present sufficient details at the time of permit application to prove to a skilled appraiser at the Local Authority that the requirements have been met. The requirements are in terms of limits on spans and heights, minimum reinforcing and member sizes, positioning of earthquake-resisting elements and other such rules.

The fourth category is **guidelines for remote rural buildings**. These guidelines address about a dozen typical building styles that have been condensed from an inventory of approximately fifty-five building types surveyed in 1993. In the form of diagrams and descriptions aimed at technical advisors, house owners and lay-men, these guidelines emphasize those changes that should be made to current practices to improve the seismic resistance of these buildings not subject to modern quantitative analysis and rational design consideration. These structures are normally of earthen construction (e.g. unburned masonry, mud-mortar, rubble, dry stone, wattle and daub). Whereas these recommendations are described as guidelines, it is intended to be mandatory for such structures built in areas controlled by a building permit-issuing local authority.

Table 3: Classification of NBC according to their use

SN	Type of Building Code	Purpose
1	International State-of-Art Applicable codes: NBC 000	Applicable to large building structures. The structures must comply with existing international state-of-the-art building codes
2	Professionally Engineered Buildings Applicable codes: NBC 101, NBC 107, NBC 113 NBC 102, NBC 108, NBC 114 NBC 103, NBC 109, NBC 206 NBC 104, NBC 110, NBC 207 NBC 105, NBC 111, NBC 208 NBC 106, NBC 112	Buildings designed and constructed under supervision of engineers, buildings with plinth area more than 1,000 sq. ft., buildings having more than 3 stories, buildings with span more than 4.5 m and buildings with irregular shapes
3	Mandatory Rules of Thumb Applicable codes: NBC 201, NBC 202, NBC 205	Buildings of plinth area less than 1,000 sq. ft., less than 3 stories, buildings having span less than 4.5 m and regular buildings designed and constructed by technicians in the areas where professional engineers' service is not available
4	Guidelines of Remote Rural Buildings (Low Strength Masonry/ Earthen Buildings	Buildings constructed by local masons in remote areas and not more than 2 stories

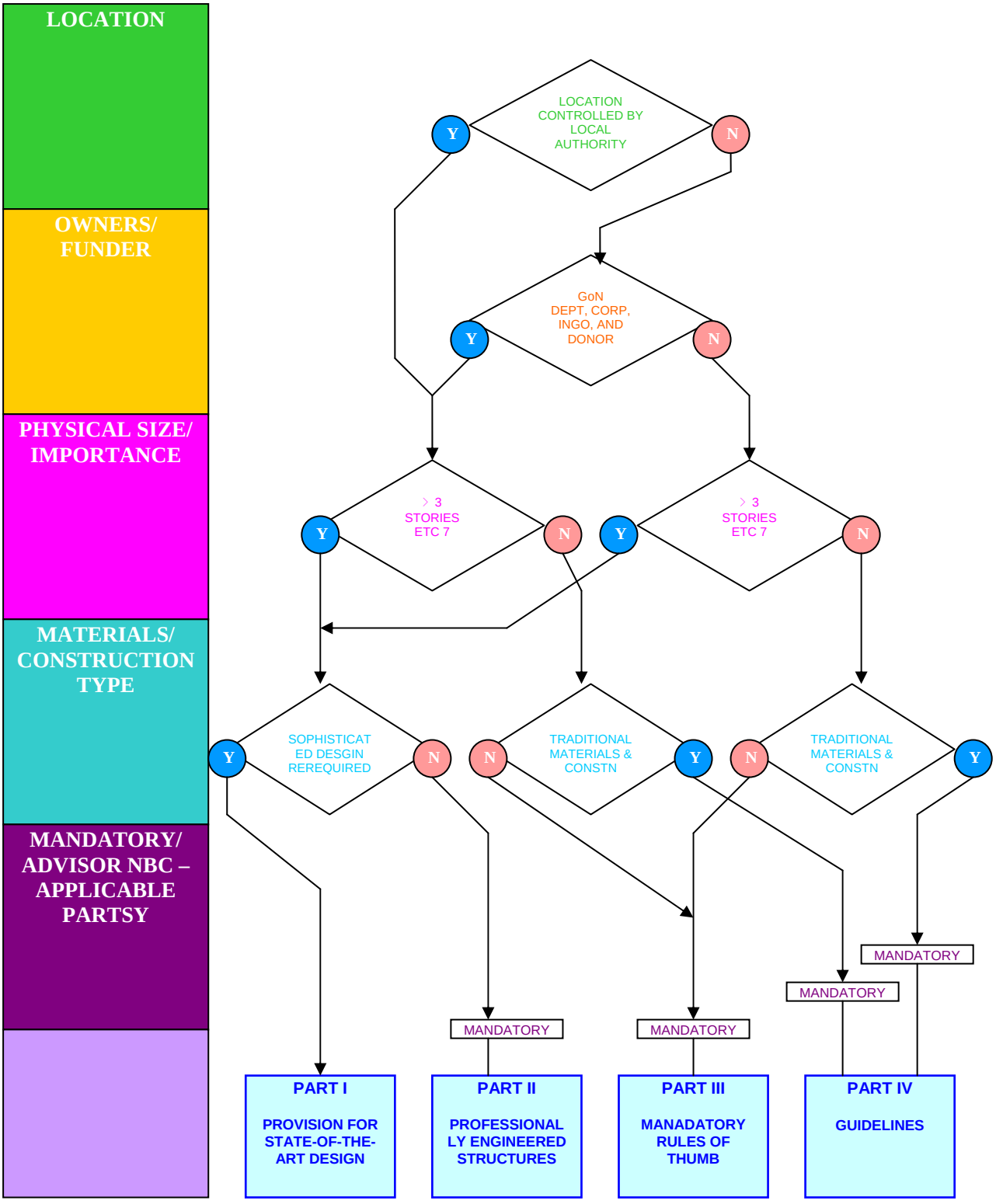


Figure 1: Flow Chart Showing the Minimum Design Requirements (Source: NBC 000, 1993)

Part II: Building Code Implementation in Lalitpur

2-1. Lalitpur Sub-Metropolitan City

Lalitpur Sub-Metropolitan City (LSMC), also known as Patan, is one of the three historic cities along with Kathmandu and Bhaktapur in Kathamndu Valley. The City with an area of 15.43 sq. km. houses many famous places such as Patan Durbar-Square, Krishna Mandir and five storied pagodas. The city is home to an estimated two hundred thousand people. The city along with the rest of Kathmandu Valley has experience of earthquakes in an interval of about 50-100 years, and the recent major earthquake being that of 1934. The 1934 earthquake killed more than 4,000 people in Kathmandu Valley and more than 2,000 people in Patan alone, the largest number in any single city.

The city is located over a plateau like area with its outer edges fanning out with gentle slopes towards the rivers that form its boundaries. This is in consonance with the traditional settlement planning philosophy where the settlements were located on relatively higher ground preserving the relatively fertile agricultural land that surrounded it. LSMC is divided into 22 smaller units called ward.

2-2. Building Code Implementation in LSMC

On the occasion of Earthquake Safety Day on January 16, 2003, LSMC announced its plan to implement NBC in all of its building permit process. LSMC became the first municipality in Nepal to implement NBC and it was done before the implementation was made mandatory. The decision was historic in the sense that it not only awakened the government to enforce NBC but also encouraged other municipalities on the necessity of building code implementation. It also proved that implementation of NBC can be done by determination irrespective of legal constraints.

Earthquake Safety Section

Initially application of NBC was carried out by the Technical Cell formed under the Engineering Sub-Committee to look after regular building permit process. The cell was composed of a group of Municipal engineers, engineers from DUDBC, NSET, NESF and NEA and was functional for six months. The applications for building permit were first verified for conformity with building by-laws. Then, they were checked by the Technical Cell for conformity with NBC. However, it was soon realized that a separate section was needed in order to increase the efficiency and performance. On November 27, 2003, Earthquake Safety Section was established. It worked in consultation with the Earthquake Safety Committee (ESC), which was comprised of engineers from DUDBC, academics and other professionals to help LSMC in technical matters related to NBC.

The organization chart for initial arrangement and the current arrangement for checking compliance with NBC are shown schematically in the following figure (Detailed organization chart of LSMC is given in Annex – I).

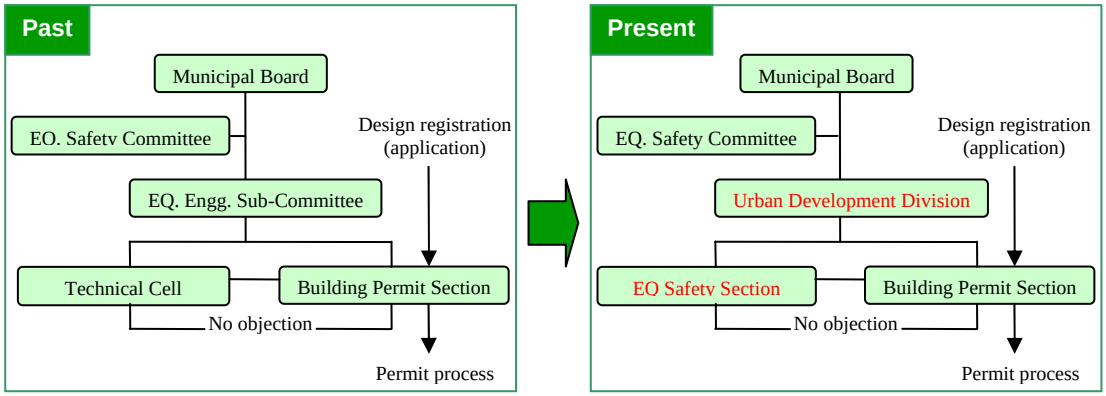


Figure 2: Change in the municipal organization structure (Past and present)

Following boxes explain the role divisions among the Building Permit and Earthquake Safety Sections and House owners.

BUILDING PERMIT SECTION

- To check/ verify architectural drawings/ designs as per building by-laws and register the file;
- Notice to neighbors and field verification of plot/ access roads and other legal documents;
- Submit Field Verification Report;
- Recommend for building permit to the Executive Officer/ Mayor;
- To check and verify at Tie Beam level as per by-laws;
- To check and verify buildings for Completion Certificate as per by-laws;
- To monitor construction fields regularly;
- To inform city dwellers about the permit and planning processes; and
- To formulate new systems/ mechanisms for effective enforcement of building by-laws.

EARTHQUAKE SAFETY SECTION

- To check/ verify structural drawings/ designs as per NBC and to recommend "No Objection" for further process of Building Permit:
- To give suggestions to house owners and masons regarding earthquake safe technology in building constructions ;
- To monitor construction fields regularly;
- To conduct training/ orientation programs to designers, technicians, contractors and house owners;
- To carry out awareness programs on earthquake safety to general public;
- To coordinate between ward level Disaster Management Committees with Municipal Level Committee;
- To work closely together with supporting organizations like DUDBC and UN agencies for earthquake risk reduction and preparedness; and
- To formulate new program proposals for effective implementation of NBC.

HOUSE OWNERS

- To prepare and submit structural design and drawings as per NBC;
- To follow the suggestions/ comments given by the Earthquake Safety Section in design as well as in the construction;
- To apply earthquake safe techniques in construction field as per approved design;
- To use the quality construction materials in the field;
- To give special attention to quality of construction works and to make it mandatory to use vibrator, Mixtures, Compactors etc.;
- To carry out construction under the supervision of skilled technicians; and
- To employ trained masons in construction.

Table 4: Number of permit applications and staff profile of Building Permit and Earthquake Safety Sections

Building Permit Section

	Applications for permit	Engineer	Jr. Eng.	Technician	Administrative staff	Total # of staff
2003	1,199	1	4	1	8	14
2004	1,042	1	4	1	8	14
2005	1,512	1	4	1	8	14
2006	1,669	1	4	1	9	15
2007	1,275	1	4	1	9	15

Earthquake Safety Section

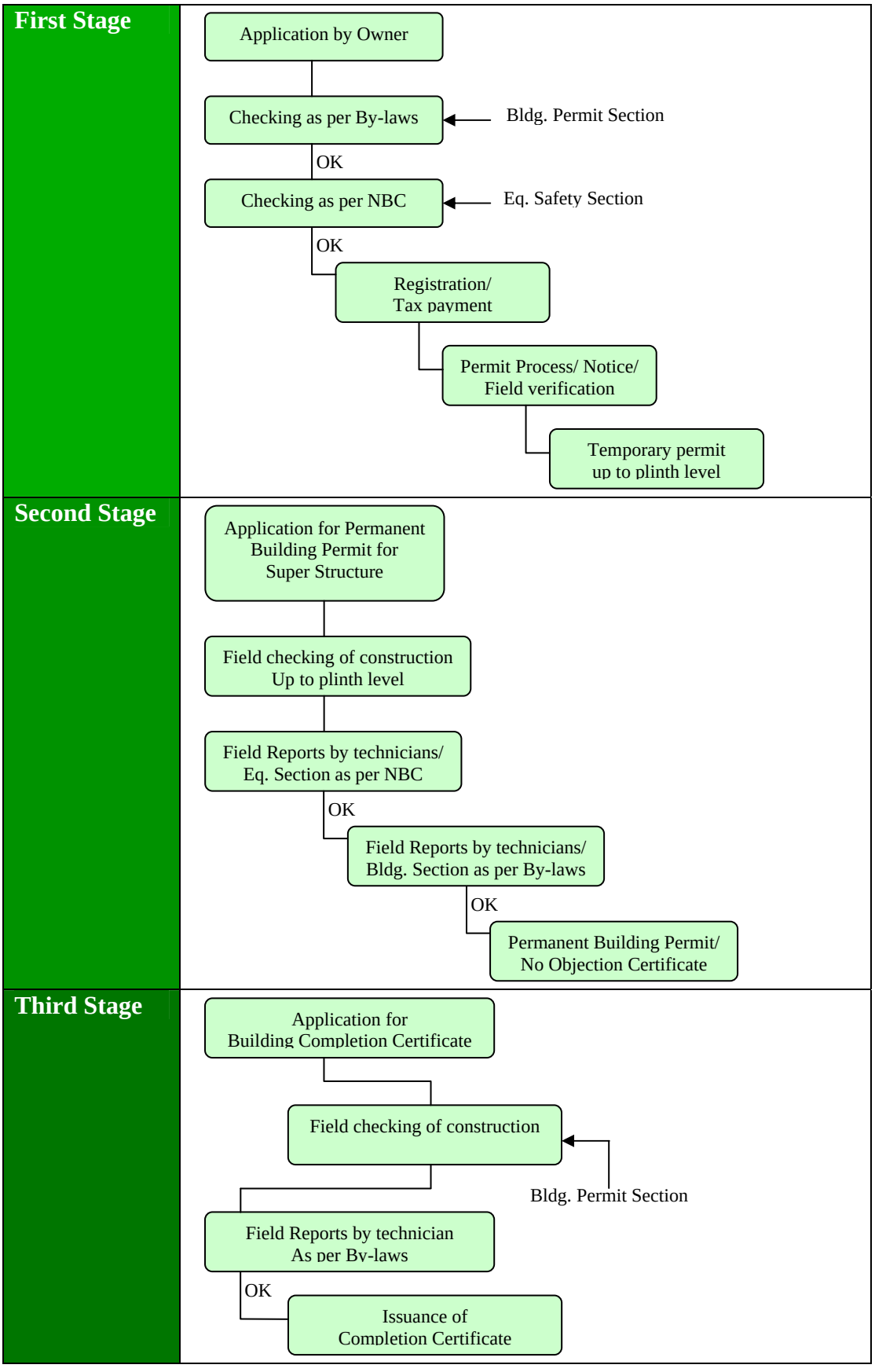
	# of permit applications	Engineer	Jr. Eng.	Technician	Administrative staff	Total # of staff
2003	1,199	1	1	-	2	4
2004	1,042	1	3	-	3	7
2005	1,512	1	3	-	3	7
2006	1,669	1	3	-	5	9
2007	1,275	1	2	-	5	8

Stage-wise Building Permit Process

The building permit process is designed in three stages. First stage starts with application by owner and ends with Temporary Permit for construction up to Plinth Level. In the second stage, the house owner applies for permanent permit and field checking is done jointly by the Building Permit Section and Earthquake Safety Section. If the construction is in conformity with by-laws and NBC, permanent building permit is issued. Finally, field checking is conducted at different stages of construction and the Completion Certificate is issued to the owner. The process is shown in the table in the next page.

The three-stage implementation process is a standard approach for the effective implementation of NBC. However, LSMC had to drop the three-stage process to two stage for certain duration due to complaints of house owners on lengthy permit process (Refer Figure 3 in page 14 for the flowchart). Currently, LSMC has been taking different strategy i.e., to minimize the circle of controlling system and increase the circle of compliance on building code (Refer Lecture by Mr. Kishore Thapa in Appendix V). So LSMC has been carrying mass awareness campaign to general public, orientation classes to house owners and series of technical training programs to masons, engineers/designers. LSMC expects the house owners, masons and designers/supervisors themselves to follow building code and carry constructions according to the approved structural designs and drawings. However, technical persons from the Earthquake Safety Section often visit the construction sites for inspection and to provide advices to masons, supervisors and owners on earthquake safety measures for houses.

The detailed building permit process currently followed is shown on page 9.


First Stage
Application by Owner
Checking as per By-laws
Bldg. Permit Section
OK
Checking as per NBC
Eq. Safety Section
OK
Registration/
Tax payment
Permit Process/ Notice/
Field verification
Temporary permit
up to plinth level
Second Stage
Application for Permanent
Building Permit for
Super Structure
Field checking of construction
Up to plinth level
Field Reports by technicians/
Eq. Section as per NBC
OK
Field Reports by technicians/
Bldg. Section as per By-laws
OK
Permanent Building Permit/
No Objection Certificate
Third Stage
Application for
Building Completion Certificate
Field checking of construction
Bldg. Permit Section
Field Reports by technician
As per By-laws
OK
Issuance of
Completion Certificate

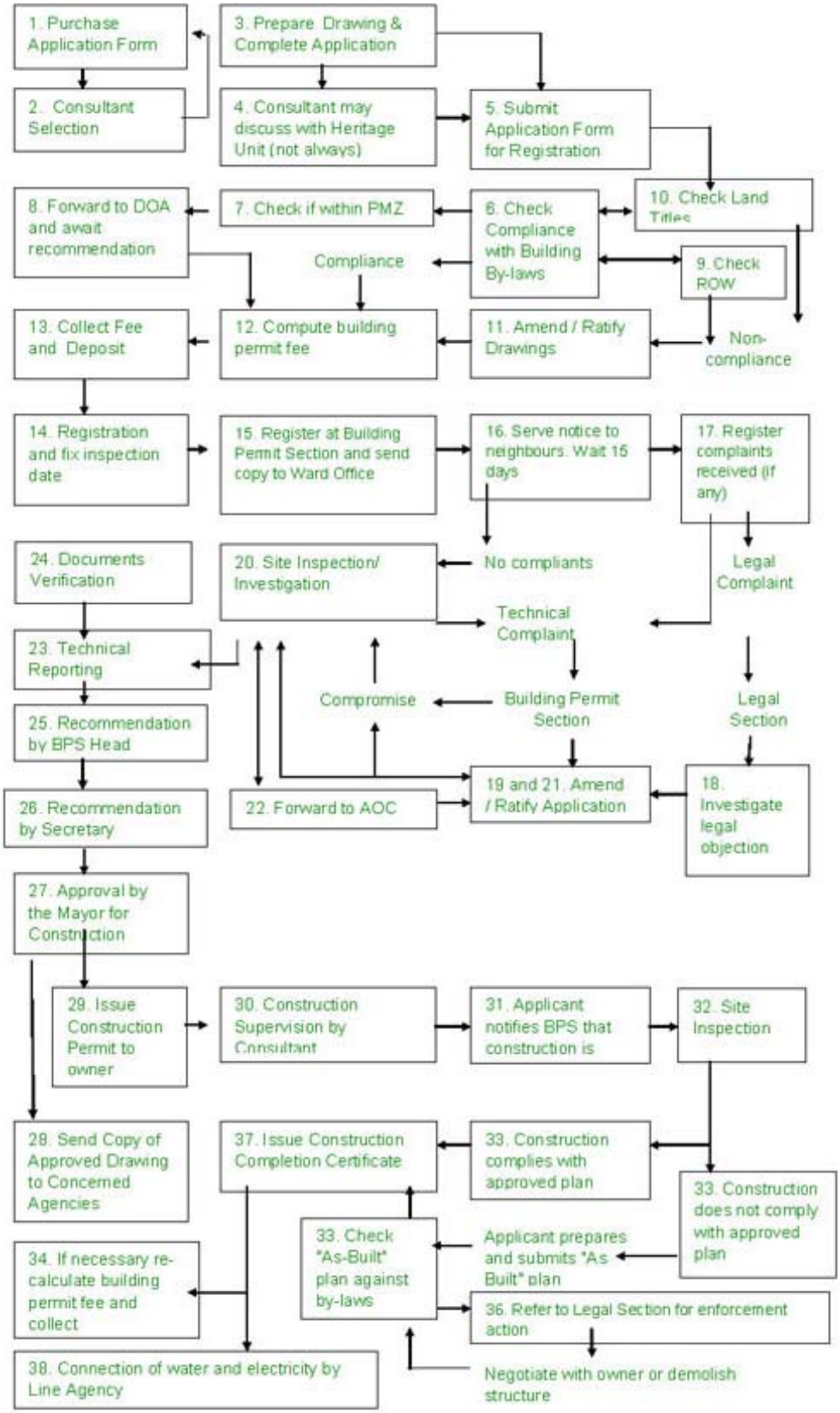


Figure 3: Flowchart of current Building Permit Process in LSMC

Supporting Documents

General Guidelines on Building Permit and Earthquake Safety published by LSMC is the guiding document which has all the necessary guidelines and forms necessary for the building permit process. The document is informative and comprehensive as it not only outlines the necessary process but also provides information about relevant building codes, roles and responsibilities of different sections in the Municipality, designers and house owners.

Content of the guidelines is as follows:

Section A: General
Flow-chart of building permit process
Outline of Town Development Standard (This describes allowable maximum coverage area, Floor area ratio and others)
Salient points to be considered by house owners before application for permit
Salient points to be considered by designers Drawing description Drawing sheet format Contents of site-plan
Documents to be submitted For new construction For floor addition For dismantling the old structure and building new one For extension of permit For completion certificate For transferring ownership For reimbursing deposits
General conditions to be met during construction
Outline of Registration fee
Section B: Earthquake Safety
Background on why Earthquake Safety is important
Outline of activities for implementation of Building Codes
Procedure for implementing NBC Brief introduction Types of NBC and their purpose
Classification of buildings
Process of Earthquake Safety Section
Implementation process
Duties and responsibilities
Outline of design procedures
Duties and responsibilities of house owners
Duties and responsibilities of designers
Format of structural design calculation report
Section C: Documents to be submitted by House Owners/ Designers
Application for field visit
Field Inspection card up to Plinth Level Framed structure Load bearing structure
Application for permanent building permit (No-objection certificate)
Field inspection card
Building construction report (To be filled by Supervisors/ Designers)
Application for extension of duration
Application for completion certificate
Application for reimbursement of deposit

Training Programs

LSMC frequently provides training to engineers and masons on earthquake safe construction practices. The first **Masons Training on Earthquake Resistant Building Construction** was conducted from September 02-06, 2004 with participation of 28 masons. The masons who participated in the training have established an organization named "Lalitpur Earthquake Resistant Constructors Group" with strong commitment to work together hand in hand with LSMC to achieve the goal of earthquake safe city. The group has been giving additional support on the task to implement NBC in the field. With support of DUDBC and other organizations, more than 200 local masons working in Lalitpur have been trained so far.

1st Mason Training Program on Earthquake Resistance Construction of Buildings (2004/9/2-6)

Load Bearing Wall

Frame Structure

Training programs on earthquake risk reduction have also been conducted for technicians and designers of the Municipality. Designers and supervisors play a vital role for the effective implementation of the Building Code in construction. They need to take responsibility for motivating and convincing house owners and constructors to apply earthquake resistant techniques by utilizing their technical knowledge and skill.

Besides the design and construction training, trainings on Disaster Risk Management have been conducted to community volunteers. They have also been trained on Vulnerability and Capacity Assessment at the community level. The training programs have been effective and in some wards action plans for disaster risk minimization have been prepared by community volunteers.

Training for municipal Engineers and Registered Designers

Onsite consultation for house owners and constructors


Public awareness programs

LSMC is conducting awareness programs as an important part of the earthquake safety program which has resulted in significant public interest in the area of earthquake safe buildings. The awareness programs include Earthquake Safety Day Celebration, Exhibition of Earthquake Safety, publications, radio programs and interactions with public.

Awareness program on earthquake preparedness for school children

Awareness program for women's group


Earthquake Safety Day in 2008


Shake table test during Earthquake Safety Day in 2008

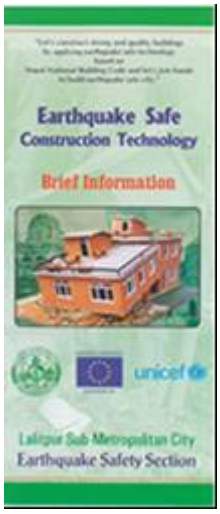

Full scale models prepared by Masons' group during ESD 2008

Publications

Lalitpur has prepared a number of publications including a manual on Earthquake Preparedness and guidelines on Construction of Earthquake Safe Buildings. Many of these initiatives were taken in collaboration with international organizations.

Guidelines and Manuals

Poster prepared by Earthquake Safety Section



Brochure on Earthquake Safe Construction Technology

Hoarding Board with earthquake preparedness message at Lalitpur Municipality

Motto of Earthquake Safety Section (LSMC) is "Let's construct strong and quality buildings by applying earthquake safe technology based on Nepal National Building Code and let's join hands to build earthquake safe city."

Achievements

- Increasing awareness on earthquake safety techniques
- Significant improvements in Structural drawings
- Improvements in constructions significantly
- Formation of “Lalitpur Earthquake Resistant Constructor's Group”
- Designers are more conscious in structural designs than before
- Increasing support from National/International Organizations

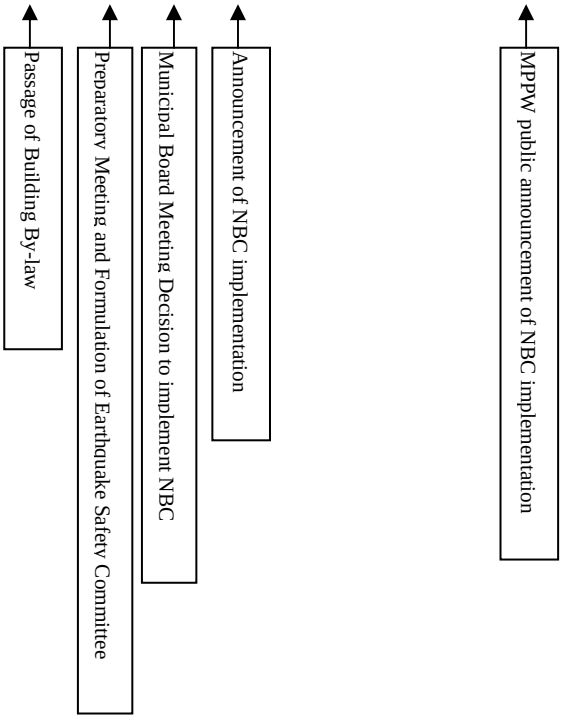
2-3. Timeline of events relating to NBC implementation in LSMC in Nepal

Prior to the initiation of NBC implementation as well as after the start of implementation in 2003, LSMC has taken a number of crucial steps. Some of the events took place involving other organizations, both national and international. The following table provides a summary of important developments in the process of NBC implementation.

Table 5: Summary of major events in NBC implementation

Date	Event within Municipality	Involvement of other organizations (DUDBC, NSET etc.)
1993	New Building by-law implemented	Kathmandu ValleyTown Development Committee, MoPPW, Municipalities of Kathmandu Valley
2002	Initiation of NBC implementation	
	Preparatory meetings chaired by Deputy Mayor	DUDBC, NSET, NESF, SCAEF
	Formulation of Earthquake Safety Committee chaired by Mayor	DUDBC, NSET, NESF, SCAEF
2002 July 15	Decision made by Municipal Board Meeting (the last meeting of People's representative at the end of their tenure] to implement NBC	
2002 Dec	Re Decision made by Municipal Board Meeting (Board of government officials-No elected bodies) to implement NBC	
2003 Jan 8	One day interaction Workshop on NBC implementation involving designers, former people's representatives and other stakeholders	DUDBC, NSET, NESF, SCAEF
2003 Jan.	Announcement of NBC implementation	
2003 May	Formation of Technical Cell tasked to implement NBC	Engineering Sub-Committee (DUDBC, NSET, NESF and NEA)
2003 Nov.	Transformation of Technical Cell into Earthquake Safety Section	DUDBC, academics and professionals
2003	Orientation classes to house owners weekly	NSET
2004 Sep	First masons' training	DUDBC, NSET, Lutheran World Federation
2005 May	First training of engineers	DUDBC, NSET
2007 Jan	10 day training to municipal engineers and designers together	ESI, CITC
2007	First awareness program to community people	UNICEF, DIPECHO
	First awareness program to school children	UNICEF, DIPECHO
2007	Building Bye-laws revised	Kathmandu Valley Town Development Committee, MoPPW, Municipalities of Kathmandu Valley
2008	TOT for school teacher	UNICEF Water, Sanitation and Hygiene (WASH) Programme
2008 August	Training on Structural Analysis and Earthquake Resistant Design of Buildings using SAP 2000 and NBC for municipal engineers and designers	UNICEF WASH Programme
Since 2008 August	School earthquake Safety Program including drilling	UNICEF WASH Programme and JICA

Activity	2001	2002	2003	2004	2005	2006	2007	2008
Preparation for NBC implementation								
Initiation of NBC implementation								
Implementation of NBC								
Technical Cell in force								
Earthquake Safety Section in force								
Weekly orientation classes to house owners								
Masons' training								
Training of Engineers								
Public awareness program								
Seminar on Mega structure for designers, professional and engineering students								



2-4. Issues and useful information for NBC implementation

Lalitpur Municipality is a pioneer is building code implementation in Nepal and offers a number of valuable lessons to be learned for other municipalities. However, the NBC implementation has not been free from challenges. The following boxes provide information on the problems Lalitpur Municipality has encountered, potential problems other municipalities might face, and useful information for other municipalities which are or will start implementing NBC in the future.

Experience of LSMC

Public perception that engineers are trouble makers

House owners are being given orientation and suggestions for Earthquake safe constructions. Trained masons are convincing the public about the role of technical supervision for quality, economical and safe constructions. Engineers are being trained for safe design and safe construction practices. They are being oriented for their social responsibility, professional ethic and need of changing in attitude and behavior with house owners and constructors. In this way public perception that engineers are trouble makers has been removed gradually.

What if code/ approved design is not followed?

LSMC has been applying policy in each step to convince and motivate people to follow code and approved design through various means: counseling, orientation, media, IEC materials. And LSMC is very clear in its strategy and vision that NBC has been implemented not to penalize people for not following the codes but to aware people for earthquake safe constructions to build earthquake safe city.

Addition of stories in existing unsafe buildings

There are tendency of adding stories in existing unsafe building because Building Byelaws allow the addition as per floor area. But building code does not allow unsafe additions. LSMC has made practical decision allowing addition not more than three stories (Up to MRT level) and demoralizing people go for unsafe haphazard additions.

Potential problems other municipalities might encounter

1. Resource constraint
2. Lack of capacity of technical manpower
3. Lack of motivation of technicians and contractors
4. Internal resistance to implement NBC (Lack of support for implementation)
5. Legal conflict with Local Self Governance Act 1999 (No mention of building code)

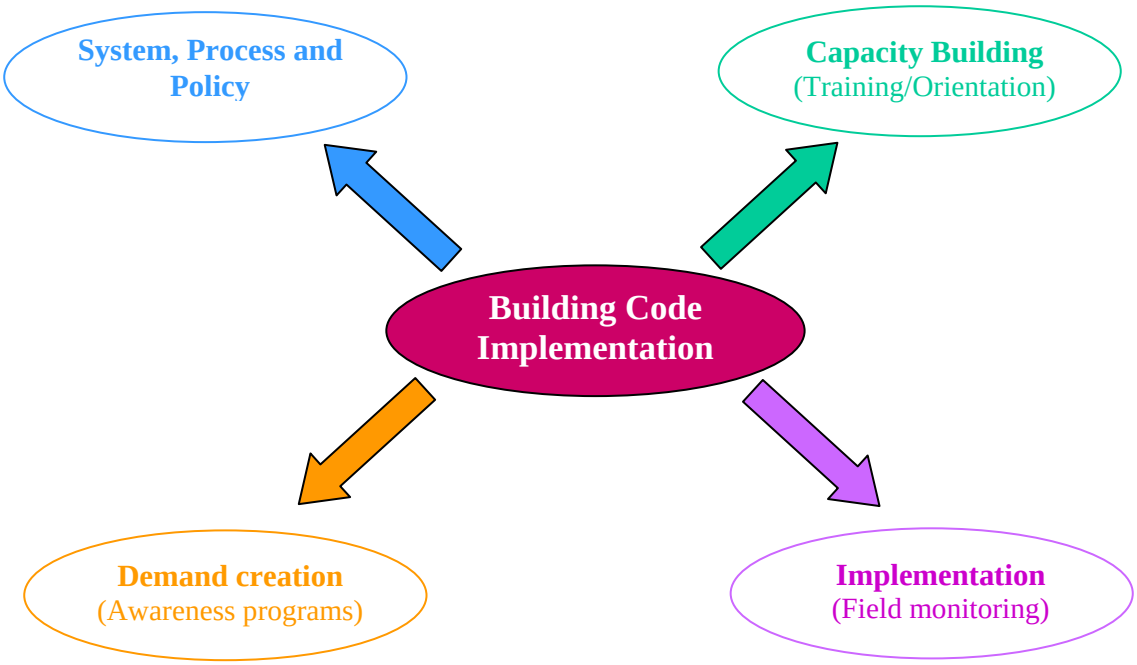
Useful information for other municipalities

1. Start NBC with minimum criteria
2. Not strict (Flexible) in design drawings at initial period to make house owners/ designers familiar with NBC
3. To make permit process as fast as possible to assure house owners that it's not a lengthy and difficult process
4. Gradually make tight in design/ drawings by introducing new formats and systems
5. Immediately start weekly orientation classes to house owners along with their designer/ constructor/ masons
6. To motivate municipal technicians (especially Junior Engineers) for NBC implementation
7. Motivate and convince board representative of municipality from political parties
8. Take support from DUDBC/NSET and others to convince CEO and local leaders, civil society, TLOs
9. Training program to engineers/ designers/ masons parallel to NBC application
10. Mass awareness program
11. Information dissemination through IEC materials

Part III: Action plan for Building Code Implementation

The experience of building code implementation in Nepal demonstrates that legal mechanism alone is not sufficient for effective implementation of NBC. Although the legal provision makes all municipalities and some Village Development Committees (VDCs) responsible to implement the code, it has achieved limited success. One of the decisive factors in effective implementation of NBC is capacity of the municipalities. Another equally important aspect is political will of the municipal authorities to start the process. Awareness on earthquake safety among municipal authorities and general public can create conducive environment for making a political decision to implement NBC.

Mode and stages of implementation are different in different municipalities. Many factors such as construction typology and the availability of human and financial resources determine the building code implementation strategy. However, the basic components for effective implementation of NBC are similar for all types of municipalities. The key components are summarized in the following figure:



3-1. Establishment of process

Implementation of building code requires a well documented and systematic process. In order to ensure smooth implementation of NBC, it is necessary to establish a realistic process. Municipalities with large numbers of building constructions may have to have a separate technical committee for building code implementation whereas municipalities with few numbers of building construction may continue with the same section with or without additional staff. One of the salient features of NBC is its recognition of Mandatory Rules of Thumb (MRT) which simplifies the implementation process significantly in municipalities where large building construction is rare. Therefore, municipalities can start in the first stage

with implementation of MRT. The process should be able to address the requirements of all other three components from capacity building to demand creation.

Capacity Building

Technical capacity
Financial capacity
Resource capacity

Field implementation

One of the important aspects of building code implementation is its effective implementation in practice. Buildings do not perform the way they are designed, but they perform the way they are constructed in the field. Field inspection is one of the key components to ensure earthquake resistant construction. A simple checklist for field inspection is given in Appendix IV. The checklist can be different for different municipalities depending on their needs.

Demand creation

Aware people not only create demand for safe housing, but also help with monitoring in the field. Therefore, awareness raising should be one of the key components of NBC implementation.

3-2. Action plan for municipalities

A group of municipal engineers in Nepal were asked during a training program on "**Framework for Building Code Implementation**" to list actions necessary for implementation of the code (*Detail of the training program and publication is given in next page*). This action plan is able to capture the real problem of municipalities i.e. capacity building. Out of the nine priority actions, three are in training and capacity buildings. Below is the complete list:

Action	Priority
Preparation of implementation process guidelines	**0**
Orientation to the designers	
Training to the technical staffs and consultant overseers	**1**
Preparation of Design Check list	
Computer based structural designing training to designers	**2**
Training on retrofitting design of existing buildings	
Municipal approval of implementing NBC	
Revision of NBC	
Additional code of seismic retrofitting	
Establishment of Monitoring cell	**3**
Preparation of check list for field inspection	**3**
Widening of the scope of MRT	**4**
Preparation of Specification code	
Working permit system to the mason, designers and contractors	
Incorporate the code in the housing loan system	**5**
Celebration of Earthquake safety day	
Publication and distribution of broachers and pamphlets to the house-owners.	
Broadcasting from local media.	
TOT to social mobilisers	
Orientation program to the communities by mobilizing social mobilizers	
Trainings to new masons, contractors and technicians (50 masons, 10 junior engineers, 5 engineers per 100 buildings per year)	**6**
Refresher training to the trained masons, contractors and technicians	
Demonstration model in the municipality	

Construction of Large scale model buildings	
Incorporate the earthquake preparedness curriculum in school	
Incorporate the code in engineering curriculum	
Field supervision made compulsory to the public and Class A buildings	**7**
Field supervision made compulsory to all type of buildings	
Inspection work fully done by the private sectors	
Commitment of Local suppliers and Local Chamber of commerce for supply of quality materials by sensitizing them	**8**
Working permit system to the masons	
Rewarding system to the house owners and the masons who provide quality construction	
Checking of major construction materials according to Nepal standard	

HOUSING EARTHQUAKE SAFETY INITIATIVE (HESI)

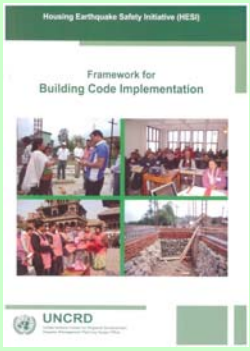
Training Workshop on Framework for Building Code Implementation

19-23 May 2008

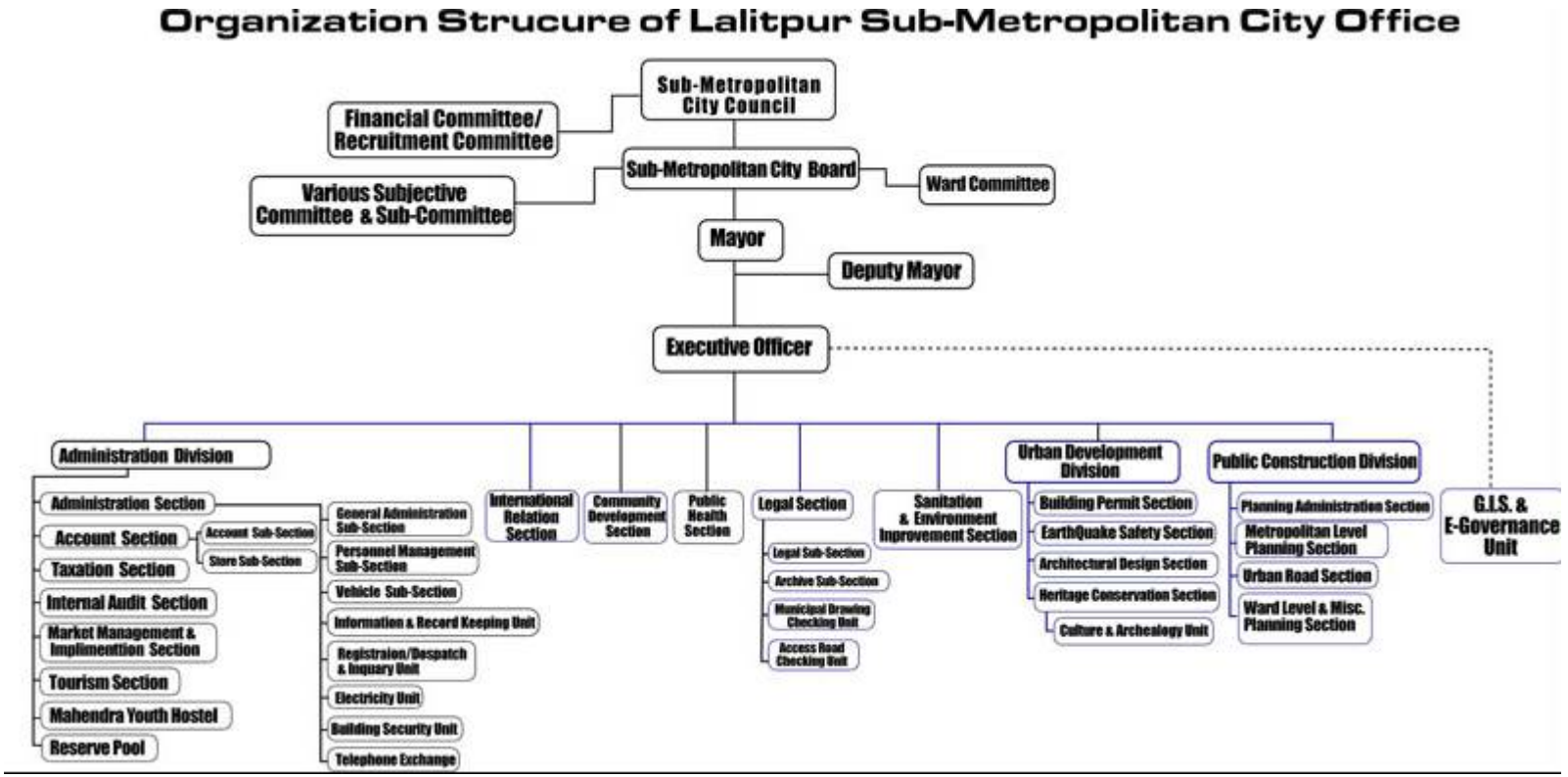
Organized by
Department of Urban Development and Building Construction
United Nations Centre for Regional Development
National Society for Earthquake Technology – Nepal

Training Modules

Module 1: Opening Ceremony and Introductory Module
Module 2: Understanding the Building Codes, Building by-laws, Building regulations and their provisions
Module 3A: Experiences from Building Code Implementation in Nepal and Japan (Achievements and lessons) – Experience of Japan
Module 3B: Experiences from Building Code Implementation in Nepal an Japan (Achievements and lessons) – Experience of other Countries
Module 4: Lessons from Experiences of Building Code Implementation
Module 5: On-site Observation of Building Code Implementation Process, Field Practices
Module 6: Evaluation of Existing Practices
Module 7: What next for Building Code Implementation ?
Module 8: Closing and Evaluation



Appendix I


Organization Strucure of Lalitpur Sub-Metropolitan City Office
Sub-Metropolitan City Council
Financial Committee/ Recruitment Committee
Sub-Metropolitan City Board
Ward Committee
Various Subjective Committee & Sub-Committee
Mayor
Deputy Mayor
Executive Officer
Administration Division
Administration Section
Account Section
Account Sub-Section
Store Sub-Section
Taxation Section
Internal Audit Section
Market Management & Implimenttion Section
Tourism Section
Mahendra Youth Hostel
Reserve Pool
General Administration Sub-Section
Personnel Management Sub-Section
Vehicle Sub-Section
Information & Record Keeping Unit
Registraion/Despatch & Inquary Unit
Electricity Unit
Building Security Unit
Telephone Exchange
International Relation Section
Community Development Section
Public Health Section
Legal Section
Legal Sub-Section
Archive Sub-Section
Municipal Drawing Checking Unit
Access Road Checking Unit
Sanitation & Environment Improvement Section
Urban Development Division
Building Permit Section
EarthQuake Safety Section
Architoctural Design Section
Heritage Conservation Section
Culture & Archealogy Unit
Public Construction Division
Planning Administration Section
Metropolitan Level Planning Section
Urban Road Section
Ward Level & Misc. Planning Section
G.I.S. & E-Governance Unit

Appendix II: Sample of Masons' training program conducted by LSMC

Five days masons' training program (DUDBC/NSET Model)

Mason Training Program

on

"Earthquake Resistant Construction of Buildings"

Program Schedule

Day 1 **Opening Session**				
Time	**Module**	**Session**	**Topic**	**Resource Person**
10:00 – 10:15			**Registration/ taking Seats**	
10:15 – 10:20				
10:20 – 10:25				
10:25 – 10:35				
10:35 – 10:40				
10:40 – 10:45				
10:45 – 10:50				
10:50 – 11:00				
11:00 – 11:45			Tea/ Snacks	
II. Fundamentals				
11:45 – 12:30			Course overview, introduction, expectations by participants	
12:30 – 13:15	M1	S1	Overview of earthquake/ effects/ Demo	
13:15 – 14:00			Lunch Break	
14:00 – 14:15	Video	V1	Video	
14:15 – 15:00	M1	S2	Earthquake Preparedness	
15:00 – 15:45	M2	S1	Structural systems of Buildings/ Site selection	
15:45 – 16:00			Tea Break	
16:00 – 16:45	M2	S2	Building Configuration/ Layout	

Day 2

Time	Module	Session	Topic	Resource Person
9:45 – 10:00			Previous day review	
10:00 – 11:30	Exercise	E1	Exercise on planning and layout of building	
11:30 – 11: 45			Tea Break	
III. Construction of Load Bearing Buildings (Brick, stone, block Masonry)				
11:45 - 12:30	M3	S1	Foundation Construction	
12:30 - 13:15	M3	S2	Construction of walls	
13:15 - 14:00			Lunch Break	
14:00 – 14:15			Refreshment	
14:15 – 15:00	M3	S3	Floor and Roof Construction	
IV. Construction of Frame Structure Buildings (RCC Framed)				
15:00 – 15:45	M4	S1	Construction of foundation	
15:45 – 16:00			Tea Break	
16:00 – 16:45	M4	S2	Beams and Columns Construction	

Day 3

9:45 – 10:00			Previous day review	
10:00 – 10:45	M4	S3	Floor and Roof Construction	
10:45 - 11:00			Tea Break	
11:00 – 13:15	E2	S1	Exercise on parts of building construction	
13:15 – 14:00			Lunch Break	
14:00 - 16:45	E2	S1	Exercise continue	

Day 4

V. Construction Materials

Time	Module	Session	Topic	Resource Person
9:45 – 10:00			Previous day review	
10:00 – 10:45	M5	S1	Appropriate Technology/ Alternative building materials	
10:45 – 11:00			Tea Break	
11:00 – 11:45	M6	S1	Types Property and Quality of Construction Materials	
11:45 – 12:30	M6	S2	Quality control and workman ship in Construction	
12:30 – 13:15	Video	V2	Video show and discussion	
13:15 - 14:00			Lunch Break	
14: 00 – 14:15			Refreshment	

14:15 - 15:00	M7	S1	Retrofitting of existing buildings	
15:00 – 15:45	M7	S2	NBC and Role of masons	
15:45 – 16:00			Tea Break	
16:00 – 16: 45	Q/ A	Q/A	Questions / Answers and discussion	

Day 5

9:45 – 10:00			Previous day review	
10:00 - 13:00			Site visit of under construction buildings	
13:00 - 13:45			Lunch Break	
13.45 – 15:00			Group discussion/ evaluation/ feed back	
15:00 - 16:00			Certificates distribution and closing	

Training for Masons on Earthquake Resistant Construction of Buildings

Items Checklist and Cost Estimation Sheet (Based on Training in Lalitpur)

Numbers of participants: 35 Duration: 5 days

S. no.	Item	Unit	Qty	Remarks
1	**Human Resource**			
1.1	Training Coordinator	Person day	7.0	
1.2	Trainer/engineer	Person day	15.0	
1.3	Construction technician	Person day	5.0	
1.4	Logistic support staff	Person day	5.0	
2	**DSA**			
3	**Travel transport**			
3.1	Local transport	trip	8.0	
4	**Class room supplies**			
4.1	Note book	nos	30.0	
4.2	Pen, pencil eraser	nos	30.0	
4.3	scale	nos	30.0	
4.4	Measuring tape	nos	30.0	
4.5	Masking tape	roll	5.0	
4.6	Marker pen	nos	5.0	
4.7	News print	sheet	50.0	
4.8	banner	nos	1.0	
4.9	certificate	nos	32.0	
4.10	Logistic, printing coping	nos	35.0	
4.11	Name tag	nos	35.0	
4.12	Bag with visibility	nos	35.0	
4.13	Reading material	set	30.0	
5	**Teaching equipment**			
5.2	Multi media	days	5.0	
5.4	Laptop	days	5.0	
5.5	Camera/photo	days	5.0	
6	**Materials for practical sessions**			
6.1	**Tools**			
6.1.1	Hammer .5 kg	nos		

S. no.	Item	Unit	Qty	Remarks
			8.0	
6.1.2	Chisel	nos	8.0	
6.1.3	Shovel	nos	8.0	
6.1.4	Head pan	nos	8.0	
6.1.5	MS plate	nos	4.0	
6.1.6	Hammer 5 kg	nos	4.0	
6.1.7	Die/cutter	set	4.0	
6.1.8	Trowel	nos	8.0	
6.1.9	Thread	roll	8.0	
6.1.10	saw	nos	4.0	
6.1.11	Transportation	trip	1.0	
6.2	**Construction materials**			
6.2.1	Cement	bag	2.0	
6.2.2	Sand	m3	1.0	
6.2.3	Bricks	nos	1,000.0	
6.2.4	MS Bar	kg	400.0	
6.2.5	Binding wire	kg	3.5	
6.2.6	Timber	cft		
6.2.7	Metal strips	nos		
6.2.8	Nails	kg		
6.2.9	Transportation	trip	1.0	
7	**Others**			
7.1	Training venue	days	5.0	
7.2	Food and refreshment	person days	210.0	
7.3	Daily allowances	person days	150.0	
7.4	Communication	ls	1.0	
7.5	Advertisement	event	-	
	***Total* Cost** (excluding Allowances for Resource Persons / support staffs and DSA)			
	***Total cost* (**including Allowances for Resource Persons / support staffs and miscellaneous cost)			

Appendix III: Sample of public awareness raising program conducted by LSMC

Awareness Program to Community People on Earthquake Risk reduction and Preparedness
Total Number of participants: 50-60 Duration: Half day

Program schedule

Session	Topic	Duration	Remark
Session I:	Overview of earthquake/ effects/ Demo	90 minutes	
	Tea and Snacks	30 minutes	
Session II	Earthquake Preparedness Tips for preparedness/safety i) before earthquake ii) during earthquake iii) after earthquake	90 minutes	
	Distribution of IEC materials (brochure, Posters, booklets etc.)	30 minutes	
	Question/ Answers		

Items Checklist and Cost Estimate Sheet

(Based on awareness program in Lalitpur)

S. no.	Item	Unit	Qty	Rate, NRs.	Amount, NRs.	Remarks
1	**Human Resource**					
1.1	Trainer/engineer	Person day	2.0			
1.2	Logistic support staff	Person day	1.0			
2	**DSA**					
3	**Travel transport**					
3.1	Local transport	trip	1.0			
4	**Class room supplies**					
4.1	Note book	nos	60.0			
4.2	Pen	nos	60.0			
4.3	banner	nos	1.0			
5	**Teaching equipment**					
5.2	Multi media	days	1.0			
5.4	Laptop	days	1.0			
5.5	Camera/photo	days	5.0			
7	**Others**					
7.1	Training venue	days	1.0			
7.2	Food and refreshment	person days	70.0			
7.4	Communication	ls	1.0			
7.5	Advertisement	event	-			
	***Total* Cost**					

Appendix IV: Check list for Field Inspection

Check List for Field Inspection

(BUILDING CODE IMPLEMENTATION PROCESS)

I. General

S. No	Description	Observation in the Field	Remarks
1.	Classification of Building as per NBC	☐A ☐B ☐C ☐D	
2.	Functional Use of Proposed Building	☐ Residential ☐ Commercial ☐ Others.....	
3.	Plinth Area in Sft.		
4.	No. of Storey of Proposed Building		
5.	Total Height of Proposed Building		
6.	Soil type in Foundations		
7.	Adopted Safe Bearing Capacity of soil		
8.	Concrete Grade used for i) Foundations ii) Columns iii) Tie Beams iv) Beam/Slab		
9	Reinforcement Steel Grade		
10	Is the building located in unstable ground? If yes, what type of hazard is there?	☐ Vulnerable buildings in neighborhood ☐ Pounding effect ☐ Access	
11	Site safety issues?	☐ Materials placement ☐ General safety requirements followed ☐ Dangerous material e.g. reinforcement bars, nails thrown here and there ?	
12	Structural System of Proposed Building	☐ RCC Frame Structure ☐ Load Bearing Wall System ☐ Others (Specify.....)	

II. Materials

S. No	Description	Observation in the field	Remarks
1	Sand: Storage Water content General Quality		
2	Brick: Brick quality Cleanliness Water absorption		
3	Cement: Storage Purchased date		
4	Aggregates: Grading Cleanliness Shape		

S. No	Description	Observation in the field	Remarks
5	Reinforcement bar: Quality Rust and physical condition		

III. Construction

S. No	Description	According to actual Construction in Site	Remarks
1	Concrete mix: Ratio Procedure for concrete mixing Water cement ratio Is strength check done?		
	Placement of concrete: Pouring of concrete Compaction Shear key in column		
	Framework/ Centering/ Shuttering : Quality Safety		
	Curing: Done properly?		
	Reinforcement Bending Fabrication Placement		
	Detailing Stirrups Beam/column joint Lap length		
	General Eccentricity Member Connectivity		

IV. For RCC Frame Structure

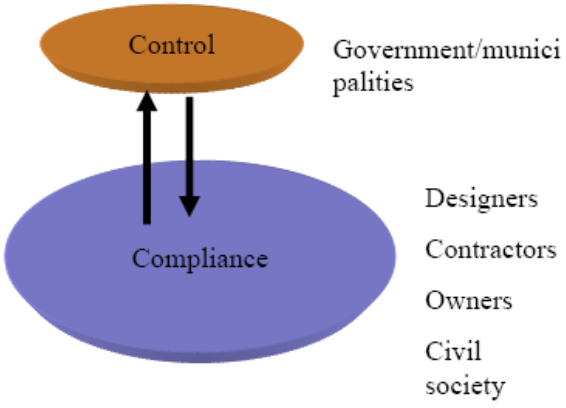
S. No	Description	According to Municipal Approval Drawing	According to actual Construction in Site	Justification for variations
1	Foundation Details i) Depth ii) Sizes with naming: a. Corner b. Mid c. Face d. Others .... iii) Reinforcements dia & spacing for foundations a. Corner b. Mid c. Face			

S. No	Description	According to Municipal Approval Drawing	According to actual Construction in Site	Justification for variations
	d. Others			
2	Column Details i) Height from G. L. to Tie Beam Level (Plinth Height) ii)Floor Height iii) Sizes with naming: a. Corner b. Mid c. Face d. Others .... iv) Reinforcements with naming a. Corner b. Mid c. Face d. Others .... v) Stirrups dia. and Spacing			
3	Earthquake safety features Follows ? • Ties at Joint • Development length / Lap length			
4	Combined Footing Details (if provided) i) Size ii) Reinforcements: Top Jali Bottom Jali			
5	Lower footing Tie Beam (If Provided) i) Size iii) Reinforcement Details iv) Stirrups dia. and Spacing			
6	Plinth Tie Beam i) Size iii) Reinforcement Details iv) Stirrups dia. and Spacing			
7	Column Placing are in Grid?			
8	Quality of Workmanship?			
Other Comments (if any)				

Appendix V: The Lessons and Way Forward for Building Code Implementation by Kishore Thapa, Joint Secretary, Ministry of Physical Planning and Works, Nepal

(Based on Lecture given in HESI Training Programme, on May 19-23, 2008 in Katmandu)

What is a building code?	**A set of standard practice adopted by engineering community for designing and constructing buildings and backed by legislation.** **An engineering tool for ensuring structural safety of buildings and convenience of occupants.**
Legislative framework	**National Building Code of Nepal has been approved by the Government in 2005 through a decision of the cabinet.** **A high level committee has been formed to monitor the implementation process in the country.** **DUDBC, under the Ministry of Physical Planning and Works is the lead agency.**
Building Construction practices in Nepal	**- Ninety percent non-engineered structures and only ten percent engineered. Government and semi-government buildings are engineered where as majority of private buildings are non-engineered.** **- Construction in the private sector is dominated by owner built system.**
Hierarchy of codes	**- National Building Code of Nepal has been structured in the following hierarchy:** **- code of the State of the Art buildings (Class I)** **- codes for professionally engineered structures (Class II)** **- codes for non-engineered buildings which includes smaller buildings that can be designed with Mandatory Rule of Thumb (Class III)** **- guidelines for rural buildings (Class IV)**
Issues and challenges	**- Most of the engineering/ architecture graduates are unaware of the National Building Code of Nepal (NBC)** **- Practicing architects and engineers have not been trained to follow NBC.** **- Training is limited to DUDBC and some municipal engineers** **- Only less than 5200 masons have been trained so far.**
	- Buildings codes need revision and update. **- Building act needs amendment for effective implementation.** **- Only two municipalities (Kathmandu and Lalitpur) are implementing the code and the rest have not ventured to do so due to the lack of technical expertise and political reasons.**
MPPW's experience of Building Code Implementation	**- Implementation of Building code tagged behind due to the delay in the amendment in the Building Act 2055 B.S. The amendment came into effect in 2064 B.S. which paved the way for municipalities to take the responsibilities.**
MPPW's experience of Building Code Implementation	**- The building code implementation committee chaired by the Secretary of Ministry of Physical Planning and Works has not been formed yet due to political situation.** **- The Building Regulation has been drafted but yet to be approved by the government.**

MPPW's experience of Building Code Implementation	- **Municipalities have not been adequately oriented towards the Building Act and the standard operating procedures (Karyabidhi)** - **Training of masons, small contractors and municipal and DUDBC engineers has contributed to implementation and compliance of building code.**
Experience of municipalities	- **Improvements in structural drawing and quality of construction** - **Better awareness among masons and small contractors** - **International and national recognition of the municipality e.g. Lalitpur Sub-metropolitan city**
	- **Monitoring and field visits has not been very effective due to inadequate human resource** - **Unethical practice of designers** - **Quality of construction and compliance of building code are being compromised with the cheaper cost (mostly by the use of unskilled labour).**
Way forward for building code implementation	- **Introduction of the NBC in the curricula of engineering colleges** - **Policy decision by Nepal Engineering Council to follow NBC by all licensed engineers and architects** - **Phase wise implementation in municipalities (as per their capacity)**
	- **Training of engineers, sub engineers and masons in massive scale.** - **Distribution of Building Construction Guidelines.** - **Social awareness programmes at the community level.**
Implementation strategy: More compliance less control	
Major stakeholders and their roles	MPPW/MLD: Updating of codes, monitoring and evaluation of code implementation, technical support to municipalities. Municipality: Inclusion of building code in building permit system, training of masons, small contractors and in-house staff. Academic institutions: Inclusion of building code in curriculum. Professional and civil society: Awareness programmes, peer review, training seminars and publications.