NEPAL NATIONAL BUILDING CODE

NBC 000 : 1994

REQUIREMENTS FOR STATE-OF-THE ART DESIGN AN INTRODUCTION

Government of Nepal
Ministry of Physical Planning and Works
Department of Urban Development and Building Construction
Babar Mahal, Kathmandu, NEPAL
Reprinted : 2064

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तत्कालिन श्री ५ को सरकार (मन्त्रिपरिषद्) को मिति २०६०।४।१२ को निर्णयानुसार स्वीकृत

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Preface

This Nepal National Building Code was prepared during 1993 as part of a bigger project to mitigate the effect of earthquakes on the building of Nepal.

In 1988 the Ministry of Housing and Physical Planning (MHPP), conscious of the growing needs of Nepal's urban and shelter sectors, requested technical assistance from the United Nations Development Programme and their executing agency, United Nations Centre for Human Settlements (UNCHS).

A programme of Policy and Technical Support was set up within the Ministry (UNDP Project NEP/88/054) and a number of activities have been undertaken within this framework.

The 1988 earthquake in Nepal, and the resulting deaths and damage to both housing and schools, again drew attention to the need for changes and improvement in current building construction and design methods.

Until now, Nepal has not had any regulations or documents of its own setting out either requirements or good practice for achieving satisfactory strength in buildings.

In late 1991 the MHPP and UNCHS requested proposals for the development of such regulations and documents from international organisations in response to terms of reference prepared by a panel of experts.

This document has been prepared by the subcontractor's team working within the Department of Building, the team including members of the Department and the MHPP. As part of the proposed management and implementation strategy, it has been prepared so as to conform with the general presentation requirements of the Nepal Bureau of Standards and Metrology.

The subproject has been undertaken under the aegis of an Advisory Panel to the MHPP.

The Advisory Panel consisted of :

Mr. UB Malla, Joint Secretary, MHPP	Chairman
Director General, Department of Building (Mr. LR Upadhyay)	Member
Mr. AR Pant, Under Secretary, MHPP	Member
Director General, Department of Mines & Geology (Mr. PL Shrestha)	Member
Director General, Nepal Bureau of Standards & Metrology (Mr. PB Manandhar)	Member
Dean, Institute of Engineering, Tribhuvan University (Dr. SB Mathe)	Member
Project Chief, Earthquake Areas Rehabilitation & Reconstruction Project	Member
President, Nepal Engineers Association	Member
Law Officer, MHPP (Mr. RB Dange)	Member
Representative, Society of Consulting Architectural & Engineering Firms (SCAEF)	Member
Representative, Society of Nepalese Architects (SONA)	Member
Deputy Director General, Department of Building,	

(Mr. JP Pradhan) Member-Secretary

The Subcontractor was BECA WORLEY INTERNATIONAL CONSULTANTS LTD. of New Zealand in conjunction with subconsultants who included :

Golder Associates Ltd., Canada
SILT Consultants P. Ltd., Nepal
TAEC Consult (P.) Ltd., Nepal
Urban Regional Research, USA

A number of individual subconsultants and HMGN counterparts also provided input to the draft Standards and other documents making up this Code. A particularly important contribution was made by Dr.AS Arya, Professor Emeritus, University of Roorkee, India.

Revisions and Updated to this code came from:

Mr. Purna P.Kadariya, DG, DUDBC
Mr. Kishore Thapa, DDG, DUDBC
Mr. Mani Ratna Tuladhar, Sr. Div. Engineer, DUDBC
Mr. Jyoti Prasad Pradhan, Ex. DG, DOB
Mr. Bhubaneswor Lal Shrestha, Ex. DDG, DOB
Mr. Uttam Shrestha, Architect, Architects' Module Pvt.Ltd.
Mr. Manohar Lal Rajbhandhari, Sr. Structural Engineer, MR Associates
Mr. Amrit Man Tuladhar, Civil Engineer, DUDBC

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0. Foreword

This National Building Code is the first such document prepared in Nepal and it is intended that its implementation be enforced through the Parliamentary Bill Act and concerned, local authority by-laws.

Most countries which have successfully implemented building controls have only achieved it over a very long period which is normally measured in decades.

The technical documents making up building regulations are normally the subject of a continual process of revision, correction and expansion as per requirements.

There is a strong movement towards uniform standards and many countries have adopted those of the International Standards Organisation in some areas. Where it has been considered appropriate, the adoption of certain Indian Standards, with or without some modification has been made in this document.

The degree to which national building codes and standards are enforced by law varies from country to country. In some countries, the national building code is taken by the law courts as a measure of good practice. India is one of the countries adopting such a system.

This first Nepal National Building Code has been produced by a team of Nepalese and international consulting engineers and architects and is based on the given term of reference.

It deals primarily with matters relating to the strength of buildings. However there are some chapters on site considerations and safety during construction and fire hazards.

Each section of this Code has been drawn up as a draft Standard for possible adoption by the Nepal Bureau of Standards and Metrology. It has been proposed that the future revision and re-issue of these sections be undertaken by the specialist committees brought together on a regular basis by the Bureau. This system which has been adopted in Nepal for a number of years, ensures that all special, general and public interest groups can give their full input to this important regulatory process.

As of recent years, most of the uncontrolled building processes are rapidly producing structures of unacceptable standard and prone to the risk of damage and collapse under earthquake. The designs and personnel involved in the construction industry, industry, therefore, should adopt this code sincerely so as to achieve a meaningful improvement in that standard of building construction in Nepal.

1 Scope

1.1 General

This National Building Code provides both regulations and guidelines for the construction of buildings in all areas of Nepal.

This first version deals primarily with matters of strength. It is intended that, in time, revised versions of the National Building Code will be developed that will also address the wider issues of planning, plumbing, electrical wiring, etc. In the meantime, the designer should observe such by-laws covering these matters as have already been put in place by local authorities. Furthermore, designers should use their professional judgement in recommending to their clients the adoption of appropriate design standards used in similar countries to Nepal when there is yet no Nepalese Standard for these disciplines.

The lack of an appropriate Nepal Standard should not be an excuse for poor design.

The four different levels of sophistication of design and construction that are being addressed in this National Building Code are :

- International state-of-art
- Professionally engineered structures
- Buildings of restricted size designed to simple rules-of-thumb
- Remote rural buildings where control is impractical.

The first part of the Code describes how a potential designer should determine which of the above levels should apply to the structure under consideration.

As the component Standards making up this Code may be revised from time to time and the revisions adopted as part of the Code, the designer should check that the latest version of the Code is being used.

Each of the four levels are introduced below.

1.1.1 International State-of-the-Art (Part I)

Because the major thrust of the Code is aimed at the typical and most common buildings currently being erected in Nepal, it deliberately does not suggest as being practical for everyday consideration the sophisticated design philosophies and analytical techniques that are appearing in the codes of more wealthy countries.

However, it is important that both Nepalese engineers and international consultants who can produce such designs in a routine fashion and can ensure that their designs can be built to the corresponding standards should not be prevented from doing so. Moreover, these structures should be seen to be meeting the Nepalese requirements with respect to minimum design loads and

configuration. There is then no reason for any designer to ignore the Nepal regulations in their entirety.

This part therefore describes some of the philosophy behind the selection of loads (in particular, the earthquake ones) and therefore allows the sophisticated designer and/or international designer to build up a design philosophy consistent with, and encompassing, the basic requirements. The onus shall be on the designer to prove to the permit-issuing authority that the Nepal Code requirements have been met and/or exceeded.

It is important to note that the Nepal National Building Code's requirements for seismic resistant are, in many cases, more onerous than those commonly practiced in other countries of the region.

1.1.2 Professionally Engineered Structures (part II)

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.

Materials, analysis and design, construction safety and site considerations are all covered.

1.1.3 Mandatory Rules-of-Thumb (Part III)

This part recognises that it is not practical in Nepal at present to insist that all small buildings be designed for strength by a professional adviser. Therefore, for classes of buildings not exceeding certain simple criteria as to height, number of stories and floor area, mandatory rules-of-thumb are provided. 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.

1.1.4 Guidelines for Remote Rural Buildings (Part IV)

These guidelines address about a dozen typical building styles that have been condensed from an inventory of approximately fifty-five surveyed intensively during 1993. In the form of diagrams and descriptions aimed at the technical advisers to owner/builders in villages, these guidelines emphasized those changes that should be made to current practices to improve the seismic resistance of these building which are not subject to modern quantitative analysis and rational design consideration. These structures are normally of

earthen construction (unfired masonry, mud mortar, rubble, dry stone, wattle and daub, etc).

Whereas these recommendations are described as guidelines, it is intended that it will be mandatory for such structures built in areas controlled by a building permit-issuing local authority to comply with them.

In addition, all such structures erected by departments and agencies of Government of Nepal, regardless of their location in Nepal, should incorporate the recommendations of this section.

HOW TO USE THIS NATIONAL BUILDING CODE

The fundamental documents of this Code are those of Part II- Professionally Engineered Structures. In principle, all structures should be designed to meet the applicable provisions appearing there.

Structures of certain common modern building types which do not exceed prescribed height and plinth area limits will be deemed to have met the part II strength provisions if they have been detailed to the appropriate rules of thumb described in part III of this code.

Structures built of traditional local materials should not exceed three storeys in height. It is preferable that all such structures incorporate strength features, described in the guidelines forming Part IV of this Code. Structures of this type to be built in certain areas of Nepal where local authorities have building permit systems in place will be required to incorporate such details. All such structures funded by Government of Nepal and its agencies, departments and corporations shall incorporate these features, whether or not there is such a local authority requirement.

The strength design of any structure, whether or not it conforms to the limits, areas and building types of the structures permissible under Part III and IV of this Code, will be acceptable if it meets the requirements of Part II- Professionally Engineered Structures of this Code.

Each application for permission to construct a structure designed to international standards or Codes of Practice shall provide detailed proof that the requirements of Part I and II have been met or exceeded both qualitatively and quantitatively.

Figure 1 describes the process that should be followed by a building designer in determining which requirements should be met for a particular structure.

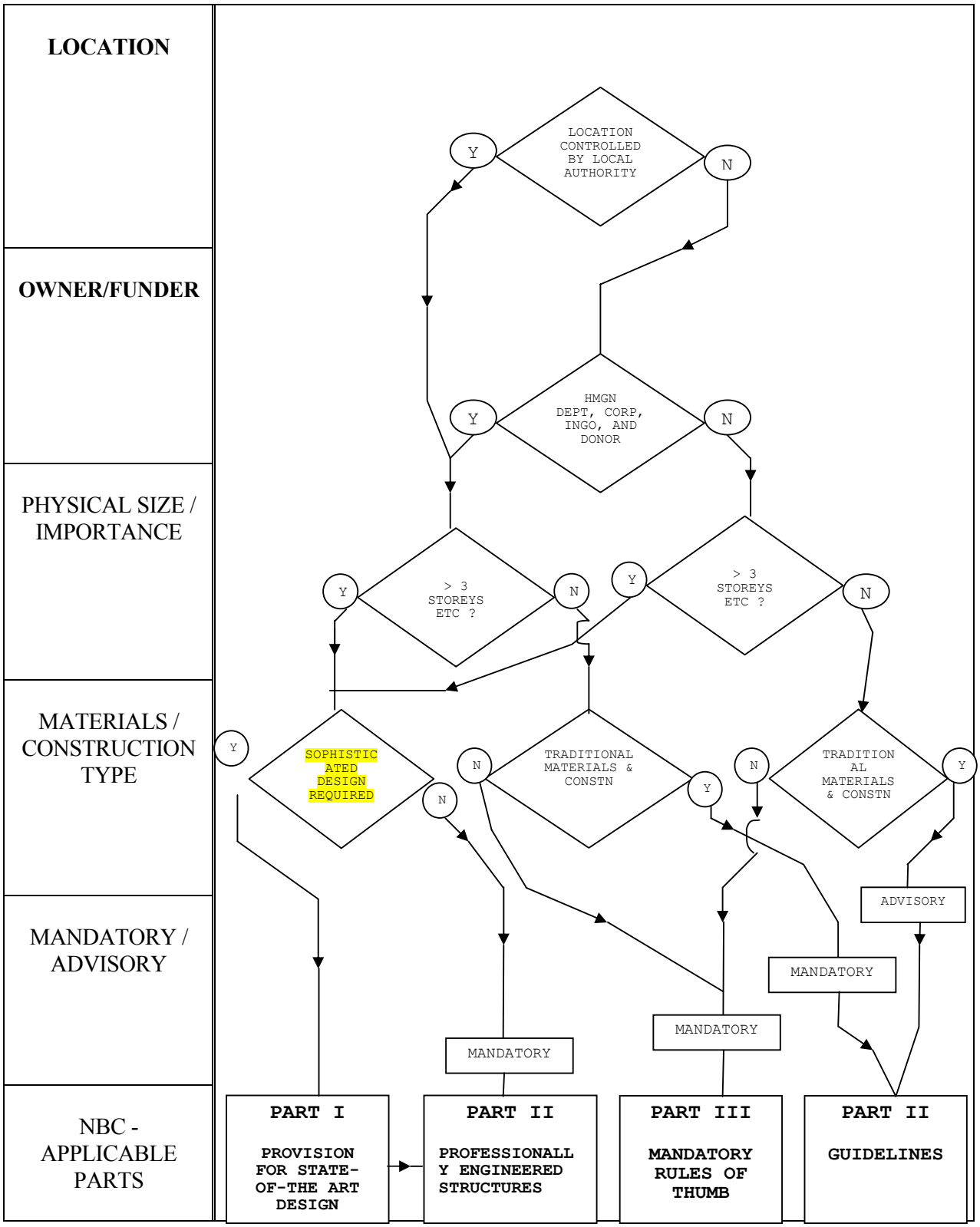

Figure 1: Flow Chart Showing Minimum Design Requirements

PART 1 REQUIREMENTS FOR STATE-OF-THE-ART DESIGN

1.1 Introduction

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 of this Code. The onus is on the designer using alternative methods to demonstrate that the finished structure will meet or exceed, both qualitatively and quantitatively, the requirements of Part II.

The strength provisions of this National Building Code are controlled overall by the aim of increasing the safety of structures in Nepal under earthquake shaking.

The achievement of an acceptable level of safety requires the adoption of sound structural concepts and the realisation of these concepts through appropriate detailed design and the use of materials and construction practices meeting the assumptions used during design.

The designers of structures for Nepal should make sure that they are familiar with the quality of materials and construction practices that will be available to them.

The following sections describe the background to the design practices adopted in part II of this National Building Code.

1.2 Seismic Design

Nepal is a highly seismic country, lying as it does at the interface between two of the world's major tectonic plates. All parts of Nepal are at risk from the effects of severe ground shaking and there have been many reminders of this within living memory. Kathmandu experienced catastrophic damage in 1934 and approximately 60000 mainly residential buildings were severely damaged or collapsed in an earthquake in the East of Nepal in 1988.

The seismic risk in Nepal is greater than in the majority of neighbouring India and Tibet.

A state-of-the-art seismic hazard analysis was undertaken during 1992 and 1993. All available geological evidence, instrumentally-recorded seismic city and historical writings were considered in the formation of the forward-looking model which covered Nepal and extended into neighbouring countries. This model and the resultant risk analysis are comprehensively described in a report prepared as subcomponent I of the UNDP/UNCHS (Habitat)/HMGN subproject NEP/88/054/21.03. Some indicative secondary hazard (landslides and liquefaction) maps for Nepal, and in more details for the Kathmandu Valley, are also described.

Seismic zoning for Nepal was prepared as a result of the risk analysis and is incorporated in the proposed draft standard for Seismic Design of Buildings in Nepal (NBC105). This is one of the documents for professionally engineered design in Part II of this Code.

The return period for the onset of damage for a typical building of ordinary importance has been chosen as 50 years. The return period for the strength of buildings has been chosen as 300 years.

The basic philosophy adopted for seismic design is to :……..

The level of earthquake load for design is calculated from consideration of seismic zone, location, structural type, natural period and foundation soil conditions. Structures with less inherent ductility incur higher design loads.

Unusual structures, water retention structures, bridges and earthworks are not specifically covered by this Code. For these, special studies should be undertaken based on the principles embodied in the relevant sections of the Nepal National Building Code.

1.3 Other Loads

Occupancy and other environmental (wind and snow) loads have been addressed by proposed draft Nepalese Standards which adopt the corresponding Indian Standards, with adjustments for the particular Nepalese topology where appropriate. The loading described in these Nepalese Standards shall be used for all engineered structures in Nepal except for when more reliable and comprehensive data is available for the specific site.

The draft Nepalese Standard for Wind Load (NBC 104) Provides references to what recorded wind data is available for Nepal.

Information on maximum and minimum temperatures in Nepal are to be found in the proposed draft Nepalese Standard for Steel Design (NBC 111) which modifies the Indian Standard IS 800:1984.

1.4 Materials

The principal construction materials addressed so far by the Nepal National Building Code are Reinforced Concrete, Steel and Reinforced Masonry. The philosophies addressed by the Standards or Codes of practice for each are outlined below.

1.4.1 Reinforced Concrete

A modified version of the Indian Standard 1S 456:1978 has been adopted. This provides design rules in accordance with the principles of Limit State Design.

No specific calculations are required to justify the ductility level chosen within the Nepal Seismic Design Standard (NBC 105). Instead, detailing in accordance with the requirements of IS 4326 (Code of Practice for Earthquake Resistant Design and Construction of Buildings is required. These provisions will introduce general ductility into the reinforced concrete members of a frame, but will not necessarily lead to the predictable hierarchy

of failure that would be achievable under the much more onerous capacity design approach.

For any other standard to be acceptable for the design of a professionally engineered structure in Nepal, it must be shown to be at least as good as that described above.

1.4.2 Steel

A working stress method of design is prescribed by reference to a slightly modified version of the Indian Standard 1S 800:1984.

1.4.3 Masonry

The use of burnt-brick-in-cement-mortar masonry as a structural element in a highly seismic country like Nepal is not preferred and alternative materials should be chosen wherever possible.

However, it is inevitable that such masonry structures of limited size should be able to be built in Nepal. A draft code of practice (NBC 109: *Unreinforced Masonry*) has been developed specially for Nepal conditions. This sets out detailing rules whereby the inclusion of non-calculated reinforcing steel both within the brickwork and in reinforced concrete bands and lintels will improve the seismic resistance of such structures. It must be accepted, however, that the seismic performance of a structure so detailed may be less satisfactory than that of a comparable structure in reinforced concrete or structural steel designed in accordance with the Nepal Standards for those materials.

On the other hand, the use of suitably reinforced and grouted hollow concrete block masonry is to be encouraged in Nepal. While no specific document has yet been incorporated in this Code for the rational design of such structural elements, there are a number of international documents, which could be used to determine typical strengths of this type of construction.

Ungrounded concrete masonry in cement mortar should be considered in the same manner as burnt-brick masonry.

PART II PROFESSIONALLY ENGINEERED STRUCTURES

II.1 Introduction

This part describes the minimum standard, which shall be met by all structures, which are required to be designed strength-wise by rational scientific methods.

Stand-alone documents in the form of proposed draft Nepalese Standards address each of the aspects so far developed for Nepal.

The documents covering Site Considerations (NBC 108) and Fire Safety (NBC 107) are largely couched in advisory terms at this stage of their development.

A document on Construction Safety (NBC 114) has been included. Many of the recommendations of this document are also advisory.

Certain types of structure conforming to specific limits of area, height and configuration may be instead detailed to the Mandatory Rules-of-Thumb described in part III of this National Building Code.

Structures to be built with traditional materials and by traditional methods are usually very difficult, or impractical, to design rationally because of the variability of materials and construction methods. Guidelines addressing the important strength features to be included in such structures are presented in part IV of this Code.

The following aspects have been covered by the documents making up this Part:

Site Consideration (NBC 108)

Materials

- **Materials Specification**
- **Unit Weight of Materials**

Load Derivation

- **Occupancy Load**
- **Wind Load**
- **Earthquake Loads and Design**
- **Snow Load**

Design Requirements

- **Masonry: Unreinforced**
- **Plain and Reinforced Concrete**