NEPAL NATIONAL BUILDING CODE

NBC 113 : 1994

ALUMINIUM

His Majesty's Government of Nepal
Ministry of Physical Planning and Works
Department of Urban Development and Building Construction
Babar Mahal, Kathmandu, NEPAL
2060

N E P A L   N A T I O N A L   B U I L D I N G   C O D E

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This publication represents a standard of good practice and therefore takes the form of recommendations. Compliance with it does not confer immunity from relevant legal requirements, including bylaws

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

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Preface

This Nepal Standard was prepared during 1993 as part of a project to prepare a draft National Building Code for 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
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0. Foreword

This document is not intended to be a definitive design standard. Rather it is a series of guidelines intended only for the designer of simple aluminium structures. Although the use of aluminium as a structural material in Nepal is likely to grow in the future, the current usage does not yet justify the preparation of a detailed Nepal Standard covering construction in aluminium.

Designers wishing to use aluminium as a structural material are referred to the relevant codes of other countries.

1 Guidelines for the Design of Aluminium Structures

1.1 Strength

Aluminium is always alloyed with minor quantities of other metals for structural use. A wide variety of yield and ultimate strengths are available, depending on the alloy. It is important that designers ensure that the particular alloy they have assumed during their design is that used for construction.

The stress-strain curves for aluminium alloys do not have a clearly defined yield point and therefore the yield strength is defined as the 0.2 % proof stress.

Most aluminium alloys will retain their mechanical properties at temperatures up to 100 °C. However, extended exposure to higher temperatures will lead to a loss in strength. Limited, short-term exposure to high temperatures can be used to assist in bending, etc, without significant loss in mechanical properties.

Under earthquake and wind loading, permissible stress increases similar to those defined for steel structures may be used.

Many welding alloys have much lower mechanical properties than the parent material and are often the limiting factor in determining the permissible stresses in a structure.

1.2 Modulus of Elasticity

The modulus of elasticity of aluminium can be as low as 35 percent of that of steel. Thus, deflections will be larger than for similar sections in steel.

The lower modulus of elasticity also means that aluminium sections are likely to be more prone to buckling problems than are steel sections. Twisting of columns, which is not usually a problem with steel sections, needs to be considered for

aluminium sections. Generally, the distance between lateral restraining members will need to be less for aluminium beams.

1.3 Creep

When designing in aluminium, as for other materials, designers should bear in mind the effects of long-term creep. Generally, design to established codes such as the SAA Aluminium Structures Code will prevent problems with long-term creep.

1.4 Thermal Expansion and Contraction

Aluminium alloys have a relatively high coefficient of thermal expansion and therefore aluminium tends to move to a greater extent than other materials. In structures incorporating other materials in conjunction with aluminium, designers must make allowance for the different expansions and contractions in the jointing systems, etc, to avoid additional stresses.

1.5 Fatigue

Members which are subjected to fluctuations in stress (which need only be a small percentage of the mean stress) may suffer from fatigue failure. The initiation of fatigue cracks is due primarily to stress concentrations introduced by detailing. In the absence of specific requirements for aluminium, it is suggested that the general rules for steel structures subjected to stress fluctuations are followed.

1.6 Corrosion Protection

Although most aluminium alloys have a high resistance to corrosion due to the formation of a thin transparent oxide outer layer, care must be taken to avoid contact with dissimilar materials. Separation can be achieved by painting, but reference should be made to appropriate sources for suitable paint types. The correct paint will depend on the type of metal to be separated and the exposure environment, i.e. marine, soil, concrete-encasement, etc.

Precautions must be taken to avoid water collection/pounding. Where practical, structural members should be shaped or orientated to provide adequate drainage. Aluminium, like other materials, can suffer premature corrosion if cracks, crevices or unsealed lips which entrap moisture are created.

Generally, stainless steel, galvanised and electro-galvanised fastenings can be satisfactorily used with aluminium. However, in severe conditions, e.g. marine environment, de-passivation of the stainless steel can occur - leading to rapid corrosion.

2 Guidelines for the Fabrication of Aluminium Structures

2.1 Laying Out

The scribing of set-out marks into the metal surface should be avoided as such marks can lead to stress raisers in highly-stressed members.

In high temperature conditions, such as outside in hot weather, allowances should be made for the different rates of thermal expansion of the aluminium and measuring devices, particularly where high accuracy is required.

2.2 Welding

Surfaces to be joined should be well prepared to minimise weld contamination by retained oxide. Adequate and correctly proportioned gas flow and proper shielding of the work area should be achieved to prevent disturbance due to wind. Care should be taken to select the correct wire or rod size and type to match the design requirements.

2.3 Mechanical Jointing

When bolting, riveting or screwing aluminium, care must be taken to ensure adequate bearing is provided and the fastener head dimensions are adequate.

2.4 Heating

Structural aluminium sections should not be heated, except that in order to ease bending, heating to a temperature not exceeding 200 °C for a period not exceeding 30 minutes may be carried out. Such heating should only be allowed where sufficient controls and supervision are in place to ensure that the above temperature and time limits are adhered to.

ADDITIONAL REFERENCES :

Other useful references are:

- Engineers Handbook - Aluminium - Design Data, The Aluminium Development Council of Australia (Limited)

- Arya, A.S. and Ajmami, J.L., Design of Steel Structures, Fourth Edition, 1989 (Chapter 12 covering Aluminium Structures).