

# Chapter 1

## INTRODUCTION TO STEEL FRAMING

### *Chapter Contents*

- 1.1. *Scope and Application*
- 1.2. *Historical Development*
- 1.3. *Design and Construction*
- 1.4. *Materials*
  - 1.4.1. *General*
  - 1.4.2. *Cold rolled metallic coated steel*
  - 1.4.3. *Steel hollow sections*
  - 1.4.4. *Connectors*
- 1.5. *Structural Design Criteria, Characteristics and Assumptions*
  - 1.5.1. *Criteria*
  - 1.5.2. *Characteristics and assumptions*
  - 1.5.3. *Earthquake design*
  - 1.5.4. *Use of testing*
  - 1.5.5. *Use of software*
  - 1.5.6. *Cold formed steel structural design*
- 1.6. *Regulatory Compliance*
- 1.7. *Environmental Sustainability*
  - 1.7.1. *Impacts of building materials on environmental sustainability*
  - 1.7.2. *Environmentally responsible design*
  - 1.7.3. *Sustainability assessment: building materials and buildings*
- 1.8. *Overview of Handbook*

### 1.1. SCOPE AND APPLICATION

The NASH Standard – Residential and Low-rise Steel Framing Part 1: Design Criteria [1.1] sets out the design criteria for the design of a low-rise steel frame (<8.5m in height). This Standard is referenced in both volumes of the Building Code of Australia (BCA) [1.2] and is referred to in this Handbook as the NASH Standard Part 1.

This Handbook gives guidance for designers on the application of the NASH Standard Part 1 together with some advice on structural modelling and other important issues involved in the design of steel framing.

The structural design of members is in accordance with AS/NZS 4600 Cold-formed steel structures [1.3] and AS 4100 Steel structures [1.4]. For more detailed guidance on the use and application of these standards, references [2.1] and [2.2] are recommended. This Handbook concentrates on issues relating to the design of steel framing as shown in Figure 1.1. For consistency and ease of use, the terminology used in the Handbook is similar to that used in timber framing and is listed in Appendix A. Note however that construction terminology may vary slightly from region to region.

The Handbook is comprehensively referenced. Unqualified Chapter, Section, Table and Figure references refer to items in this Handbook.

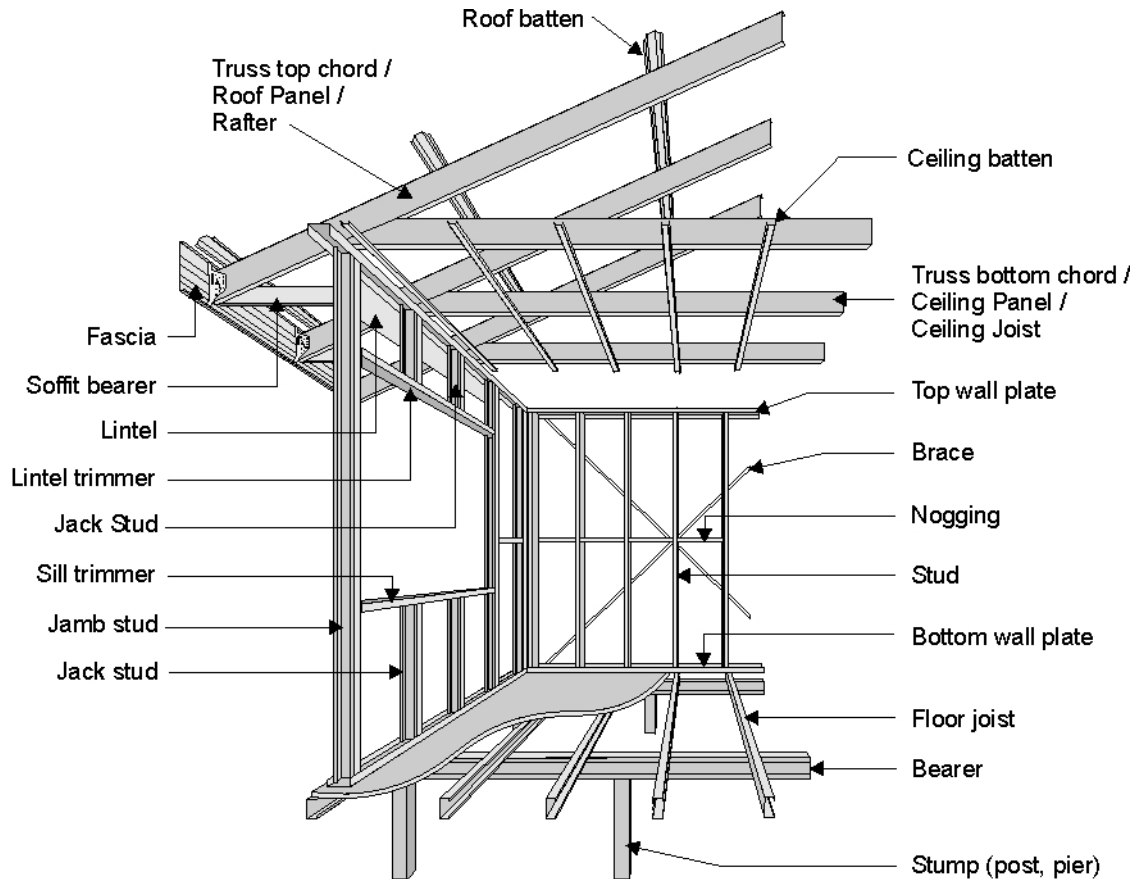


Fig. 1.1 Typical framing

## 1.2. HISTORICAL DEVELOPMENT

The first steel framed house was built in Australia in the early 1940's according to newspaper reports. However, around that time steel was more commonly used as cladding material for roofs and walls rather than in framing. Many efforts to create steel framing systems were attempted from the 1950s with varying degrees of success. AISC and NASH issued 'Structural Performance Requirements for Domestic Steel Framing' in 1991 [4.1]. This was the first documented guidance in Australia on the structural design of a steel framed house (in both Allowable Working Stress and Limit States Design). This document was later converted into an Australian Standard 'AS 3623-1993 Domestic Metal Framing' [1.5]. In 2005, NASH prepared a completely new standard known as the NASH Standard Residential and Low-rise Steel Framing Part 1: Design Criteria.

## 1.3. DESIGN AND CONSTRUCTION

The design of a steel structural frame can be carried out using a wide range of sections and components from various suppliers. Alternatively a proprietary framing system can be used. In either case the framing system should comply with the NASH Standard Part 1.

As most sections are produced through rollforming, this provides a wide scope to refine the design of the section to produce an economical solution. For small quantities it may be economical to press the section. However when developing a system it should be realised that the material cost only represents about one third of the total cost of the framing system. Other items that need to be considered when developing a system include [2.3]:

- Business environment
- Regulatory environment
- Market demand
- Production machinery eg. rollformer – capital and operating costs
- Connection methods
- Accessories and details
- Design for transport – minimize damage and maximize amount per load
- Time to install
- Tolerances of components, assembled frame and structure being connected to eg. concrete slab
- Occupational health and safety requirements
- Compatibility with other items eg. plasterboard
- Software capability
- Site issues eg. modifications and rectification

## 1.4. MATERIALS

### 1.4.1. General

The two most common steels used for steel framing are cold rolled metallic coated steel strip to AS 1397 [1.6] and steel hollow sections to AS 1163 [1.7]. Other steels may be used provided they meet the requirements of AS 4100 or AS/NZS 4600. Both AS 4100 and AS/NZS 4600 specify very low design values for unidentified steels and place limitations on their use.

### 1.4.2. Cold rolled metallic coated steel

Cold rolled steel coils are produced from hot rolled coils which are cold rolled to further reduce their thickness before being run through a molten metallic bath of zinc, aluminium/zinc or other zinc alloys to provide corrosion protection. The wide coil is then slit into a number of narrower coils to suit the section profiles. The final strength of the steel strip depends on steel chemistry, rolling sequence, strip thickness and heat treatment.

In accordance with AS 1397, the steel designation shall comprise, in sequence, the following elements:

- The number of the Australian Standard
- The steel grade
- The coating class and surface finish

Example: AS 1397/G550 AZ150

Example: AS 1397/G2 Z275

In addition, the dimensions thickness, width and length need to be specified together with appropriate tolerances in accordance with AS/NZS 1365.

#### a) Mechanical properties

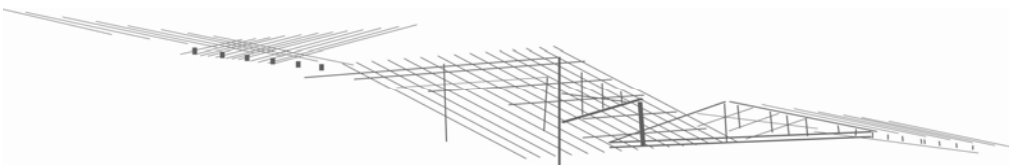
A common strength grade used for steel framing is G550 where G indicates that mechanical properties have been achieved or modified by in line heat treatment prior to hot dipping and 550



PO Box 1085 Hartwell  
Victoria Australia 3124  
ABN: 74 798 162 591  
Phone: 03 9809 1333  
Toll-free: 1800 656 986  
Fax: 03 9809 1399  
[enquiries@nash.asn.au](mailto:enquiries@nash.asn.au)  
[www.nash.asn.au](http://www.nash.asn.au)

# NASH Handbook

## Design of Residential and Low-rise Steel Framing



# ©NASH 2009

ISBN 978-0-646-51133-7

## Important Notice and Disclaimer

The National Association of Steel-Framed Housing (NASH) is committed to enhancing the availability and dissemination of information relating to the development of steel framing. The NASH Handbook – Design of Residential and Low-rise Steel Framing (the Handbook) is provided for general information only and should not be taken as providing specific advice on any issue. In particular, this Handbook is not mandatory or regulatory in nature. Rather, it is designed to assist in making information on this topic readily available.

However, neither NASH nor the groups and/or individuals which have endorsed or been involved in the development of the Handbook, accept any responsibility for the use of the information contained in the Handbook and make no guarantee or representation whatsoever that the information is an exhaustive treatment of the subject matters contained therein or is complete, accurate, up to date or reliable for any particular purpose.

NASH and groups which have endorsed or been involved in the development of the Handbook expressly disclaim all liability for any loss, damage, injury or other consequence, howsoever caused (including without limitation by way of negligence) which may arise directly or indirectly from use of, or reliance on, this Handbook.

Users should exercise their own skill and care with respect to their use of this Handbook and should obtain appropriate professional advice on any specific issues relevant to their circumstances.

In particular, and to avoid doubt, the use of the Handbook does not:

- Guarantee acceptance or accreditation of a design, material or building solution by any entity authorised to do so under any law;
- Mean that a design, material or building solution complies with the Building Code of Australia (BCA);
- Absolve the user from complying with any Local, State, Territory or Australian Government legal requirements.

# Table of Contents

|                   |  |     |
|-------------------|--|-----|
|                   | Preface  | 4   |
|                   | National Association of Steel-Framed Housing Inc (NASH)            | 5   |
|                   | Acknowledgements   | 5   |
| Chapter 1         | Introduction to Steel Framing                                      | 6   |
| Chapter 2         | Roof Systems   | 19  |
| Chapter 3         | Wall Systems   | 30  |
| Chapter 4         | Floor and Subfloor Systems   | 39  |
| Chapter 5         | Bracing Systems  | 46  |
| Chapter 6         | Connectors   | 58  |
| Chapter 7         | Testing  | 81  |
| Chapter 8         | Durability   | 87  |
| Chapter 9         | Fabrication and Construction Practice                              | 96  |
| Chapter 10        | Additional Considerations  | 104 |
| Chapter 11        | References   | 109 |
| <i>Appendices</i> |  |     |
| Appendix A        | Terminology and Abbreviations                                      | 113 |
| Appendix B        | Preliminary Design Considerations                                  | 117 |
| Appendix C        | Connection Design Values Calculated in Accordance with AS/NZS 4600 | 123 |
| Appendix D        | Connector/Connection Design Values Determined from Test Results    | 135 |
| Appendix E        | Fire Construction Details  | 150 |

# Preface

Steel framing is commonly chosen for houses and other forms of low-rise construction as it is:

- Cost effective
- Dimensionally stable
- Non combustible
- Termite and borer proof
- Durable
- Strong but lightweight
- 100 percent recyclable
- Consistent in its properties and performance

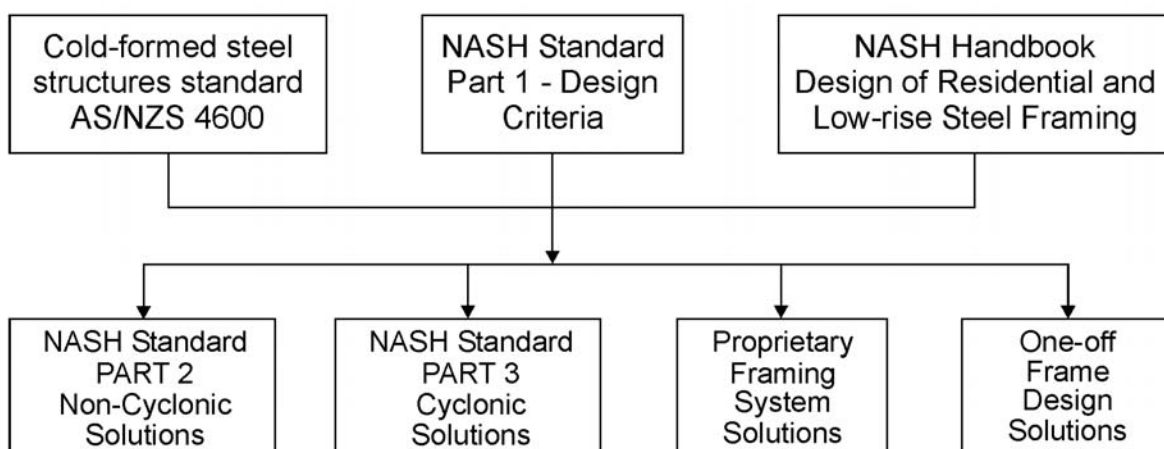
The NASH Standard – Residential and Low-rise Steel Framing Part 1: Design Criteria sets out the design criteria, in terms of structural adequacy and serviceability, for use in the design of low-rise steel framing. This includes houses as well as other low-rise residential and commercial buildings.

This Handbook aims to assist the steel framing designer in the application of the NASH Standard Part 1. However, it does not purport to provide a detailed guide on the use of the Cold-formed steel structures standard AS/NZS 4600 or replace engineering judgement.

The Handbook contains performance data for a number of proprietary components such as screws, rivets, bolts and anchors. This information has been reproduced in Appendices in good faith from information provided by the relevant manufacturers. It has been included to assist the use of the Handbook as a reference for users, but is not exhaustive. Handbook users should contact relevant manufacturers directly for additional performance information.

Two separate Standards (Part 2 & 3) are being developed to provide steel framing span tables and related information and these will be published in due course. The relationship between the Standards and this Handbook is illustrated below.

The NASH web site [www.nash.asn.au](http://www.nash.asn.au) is regularly updated and provides supplementary information to this Handbook.



# National Association of Steel-Framed Housing Inc

NASH is an active industry association centred on light structural framing systems for residential and similar construction. NASH represents the interests of suppliers, fabricators and customers – all those involved in steel framing systems.

NASH's key objectives are to:

- Support the long term growth and sustainability of the steel frame industry.
- Maximise awareness of the steel frame industry in the market place.
- Promote the advantages of steel frames to the building industry and homeowners.

## Acknowledgements

The following companies, organisations and individuals were represented on the industry committee responsible for preparing this Handbook:

### *Australian contributors*

|                 |  |
|-----------------|--|
| Kavitha Mysore  | BlueScope Lysaght  |
| Graeme Stark    | BlueScope Steel  |
| Trevor Clayton  | BlueScope Steel  |
| Lex Somerville  | BMCC Services  |
| Lam Pham        | CSIRO – Sustainable Eco Systems                              |
| David Collinson | ITW Buildex  |
| Ken Watson      | National Association of Steel-Framed Housing Inc             |
| Michael Kelly   | National Association of Steel-Framed Housing Inc             |
| Hayden Dagg     | OneSteel Australian Tube Mills                               |
| Ross Dempsey    | OneSteel Australian Tube Mills                               |
| Andrew Byrne    | Rondo Building Services                                      |
| Subo Gowripalan | Stramit Building Products                                    |
| Greg Anderson   | Structerre Consulting Engineers                              |
| Les McGrath     | TGM Group  |
| Emad Gad        | University of Melbourne / Swinburne University of Technology |
| Bruce Cannon    | Welding Technology Institute of Australia                    |

### *International contributors*

|                  |  |
|------------------|--|
| Gordon Barratt   | NASH New Zealand                                 |
| Hennie de Clercq | Southern African Light Steel Framing Association |

The following companies provided their proprietary data which has been reproduced in Appendix D and Appendix E:

- ITW Buildex
- Bremick Fasteners
- Henrob
- Acument Australia
- Ramset
- Boral Plasterboard.