AS/NZS 4600
Supplement 1:1998

Cold-formed steel structures—Commentary

(Supplement 1 to AS/NZS 4600:1996)

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee BD/82, Cold-formed Steel Structures. It was approved on behalf of the Council of Standards Australia on 11 September 1998 and on behalf of the Council of Standards New Zealand on 11 September 1998. It was published on 5 November 1998.

The following interests are represented on Committee BD/82:

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Australian Chamber of Commerce and Industry
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PREFACE

This Commentary was prepared by the Joint Standards Australia/Standards New Zealand Committee BD/82, Cold-formed Steel Structures.

The objective of this Commentary is to provide users with background information and guidance to AS/NZS 4600:1996.

The Standard and Commentary are intended for use by design professionals with demonstrated engineering competence in their fields.

In Australia, the Australian Standard for the design of cold-formed steel structural members was first issued in permissible stress format as AS 1538—1974 (Standards Australia, 1974), based mainly on the 1968 edition of the AISI Specification (AISI, 1968), but with modifications to the beam and column design curves to keep them aligned with the Australian Steel Structures Code at that time, ASCA1 (Standards Australia, 1968). It was revised and published in 1988 as AS 1538—1988 (Standards Australia, 1988) and was based mainly on the 1980 edition of the AISI Specification (AISI, 1983), but included some material from the 1986 edition of the AISI Specification (AISI, 1986). In 1996, a limit states version of the cold-formed steel structures Standard was produced by Standards Australia and Standards New Zealand. It was based mainly on the 1996 edition of the AISI Specification (AISI, 1996) but with amendments where necessary to reflect Australian/New Zealand practice.

In this Commentary, AS/NZS 4600:1996 is referred as ‘the Standard’.

To be consistent with the AISI Commentary, referenced documents provided in Appendix A are listed in alphabetical order.

The clause numbers and titles used in this Commentary are the same as those in AS/NZS 4600, except that they are prefixed by the letter ‘C’. To avoid possible confusion between the Commentary and the Standard, a Commentary clause is referred to as ‘Clause C....’ in accordance with Standards Australia/Standards New Zealand policy.

CONTENTS

Page

INTRODUCTION

Cold-formed steel members have been used economically for building construction and other applications (Winter 1959a, 1959b; Yu 1991; Hancock 1998). These types of sections are cold-formed from steel sheet, strip, plate or flat bar in roll-forming machines or by press brake or bending operations. The thicknesses of steel sheets or strip generally used for cold-formed steel structural members range from 0.4 mm to about 6.4 mm. Steel plates and bars as thick as 25 mm can be cold-formed successfully into structural shapes and their design is covered by the Standard.

In general, cold-formed steel structural members can offer the following advantages for building construction (Winter, 1970; Yu, 1991):

(a) Light members can be manufactured for relatively light loads or short spans, or both.

(b) Unusual sectional configurations can be produced economically by cold-forming operations and consequently favourable strength-to-weight ratios can be obtained.

(c) Load-carrying panels and decks can provide useful surfaces for floor, roof and wall construction, and in some cases they can also provide enclosed cells for electrical and other conduits.

(d) Panels and decks not only withstand loads normal to their surfaces, but they can also act as shear diaphragms to resist forces in their own planes if they are adequately interconnected to each other and to supporting members.

The use of cold-formed steel members in building construction began in about the 1850s. However, in the United States such steel members were not widely used in buildings until the publication of the first edition of the American Iron and Steel Institute Specification in 1946 (AISI, 1946). This first design Standard was primarily based on the research work sponsored by AISI at Cornell University since 1939. It was revised subsequently by the AISI Committee in 1956, 1960, 1962, 1968, 1980 and 1986 to reflect the technical developments and the results of continuing research. In 1991, AISI published the first edition of the *Load and Resistance Factor Design Specification for Cold-formed Steel Structural Members* (AISI, 1991). Both *allowable stress design* (ASD) and *load and resistance factor design* (LRFD) *specifications* were combined into a single document in 1996.

In Australia, the Australian Standard for the design of cold-formed steel structural members was first issued in permissible stress format as AS 1538—1974 (Standards Australia, 1974) based mainly on the 1968 edition of the AISI Specification (AISI, 1968) but with modifications to the beam and column design curves to keep them aligned with the Australian Steel Structures Code at that time, ASCA1 (Standards Australia, 1968). It was revised and published in 1988 as AS 1538—1988 (Standards Australia, 1988) and was based mainly on the 1980 edition of the AISI Specification (AISI, 1983) but included some material from the 1986 edition of the AISI Specification (AISI, 1986). In 1996, a joint Australian/New Zealand limit states version of the cold-formed steel structures Standard was produced by Standards Australia and Standards New Zealand. It was based mainly on the 1996 edition of the AISI Specification (AISI, 1996) but with amendments, where necessary, to reflect Australian/New Zealand practice.

During the period from 1958 through to 1983, AISI published Commentaries on several editions of the AISI design specification, which were prepared by Professor George Winter of Cornell University in 1958, 1961, 1962, and 1970. In the 1983, 1986 and 1996 editions, the format used for the AISI Commentary has been changed in that the same section numbers are used in the AISI Commentary as in the AISI Specification. As for previous editions of the AISI Commentary, this document contains a brief presentation of the characteristics and the performance of cold-formed steel members. In addition, it provides a record of the reasoning behind and the justification for various provisions of the Standard. A cross-reference is provided between various design provisions and the published research data. This Commentary to AS/NZS 4600:1996 is based mainly on the 1996 edition of the Commentary to the AISI Specification, and has been amended, where necessary, to reflect the differences between the AISI Specification and AS/NZS 4600.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Cold-formed steel structures—Commentary
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SECTION C1 SCOPE AND GENERAL

C1.1 SCOPE The cross-sectional configurations, manufacturing processes and fabrication practices of cold-formed steel structural members differ in several respects from those of hot-rolled steel shapes. For cold-formed steel sections, the forming process is performed at, or near, room temperature by the use of bending brakes, press brakes or roll-forming machines. Some of the significant differences between cold-formed sections and hot-rolled shapes are—

(a) absence of the residual stresses caused by uneven cooling due to hot-rolling;

(b) lack of corner fillets;

(c) presence of increased yield strength with decreased proportional limit and ductility resulting from cold forming;

(d) presence of cold-reducing stresses when cold-rolled steel stock has not been fully annealed;

(e) prevalence of elements having large width-to-thickness ratios and, hence, subject to local buckling in compression;

(f) rounded corners; and

(g) stress-strain curves can be either sharp-yielding type or gradual-yielding type.

AS/NZS 4600 (Standards Australia/Standards New Zealand, 1996) is limited to the design of steel structural members cold-formed from carbon or low-alloy sheet, strip, plate or bar. The design is to be in accordance with the limit states design method.

The Standard is applicable only to cold-formed sections not more than 25 mm in thickness. Research conducted at the University of Missouri-Rolla (Yu, Liu, and McKinney, 1973b and 1974) has verified the applicability of the Standard's provisions for such cases.

In view of the fact that most of the design provisions have been developed on the experimental work subject to static loading, the Standard is intended for the design of cold-formed steel structural members to be used for load-carrying purposes in buildings. For structures other than buildings, appropriate allowances should be made for dynamic effects. The Standard does not apply to the design of structures subject to fire or fatigue since insufficient data was available on these phenomena for cold-formed members during its preparation.

C1.2 REFERENCED DOCUMENTS The Standards listed in Appendix A are subject to revision from time to time and the current issue should always be used. The currency of any Standard may be checked with Standards Australia or Standards New Zealand.

C1.3 DEFINITIONS Many of the definitions in Clause 1.3 are self-explanatory. In New Zealand, terms used in limit state design may differ from those used in Australia. These are included in brackets. Those definitions that are not self-explanatory or that are not defined in Clause 1.3 are briefly discussed in this Clause.

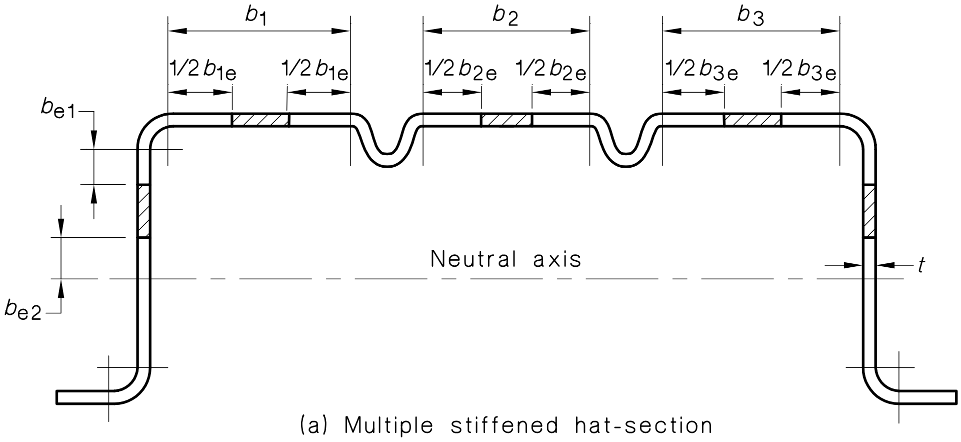
C1.3.13 Distortional buckling—the mode of distortional buckling is included for the first time in AS/NZS 4600. Figure C1.3(4)(a) shows distortional buckling for a compression member, and Figure C1.3(b) for a flexural member. Appendix D gives equations to compute elastic distortional buckling stresses.

C1.3.14 Effective design width—the effective design width is a concept that takes account of local buckling and post-buckling strength for compression elements. The effect of shear lag on short, wide flanges is also handled by using an effective design width. These matters are treated in Section 2, and the corresponding effective widths are discussed in the Commentary on that Section.

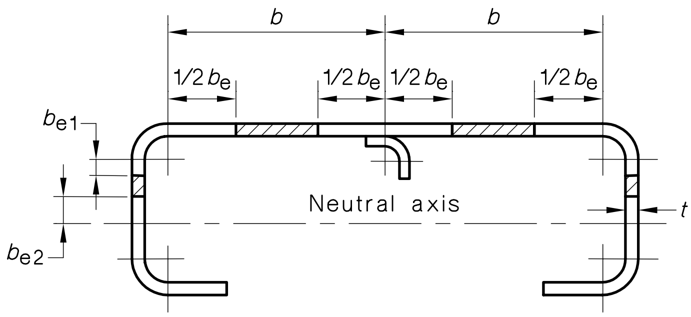
C1.3.17 Flexural-torsional buckling—the 1968 edition of the AISI Specification and AS 1538—1974 pioneered methods for calculating column loads of cold-formed steel sections prone to buckle by simultaneous twisting and bending. This complex behaviour may result in lower column loads than would result from primary buckling by flexure alone (Trahair, 1993).

C1.3.19 Limit state—limit states design (LSD) is a method of designing structural components such that the applicable limit state is not exceeded when the structure is subjected to all appropriate load combinations as specified in Clause 1.6.1.

C1.3.23 Multiple-stiffened elements—multiple-stiffened elements of two sections are shown in Figure C1.3(1). Each of the two outer sub-elements shown in Figure C1.3(1)(a) are stiffened by a web and an intermediate stiffener while the middle sub-element is stiffened by two intermediate stiffeners. The two sub-elements shown in Figure C1.3(1)(b) are stiffened by a web and the attached intermediate middle stiffener.



(a) Multiple stiffened hat-section



(b) Multiple stiffened inverted U-section

Flexural members, such as beams

FIGURE C1.3(1) MULTIPLE-STIFFENED COMPRESSION ELEMENTS