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The maximum design loads and design capacities listed in this publication are based on the limit states design method of AS 4100 and the factored limit states design actions and combinations considered within AS/NZS 1170. Hence, much of the information contained herein will only be of use to persons familiar with the limit states design method and the use of:

- AS 4100: Steel structures
- AS/NZS 1170: Structural design actions

See Section 2.1 for the specific Material Standard (AS 1163) referred to by the section type and steel grade in these Tables.

See page (ii) for the appropriate use of this publication.

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Design Capacity Tables for Structural Steel Hollow Sections

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1.1 General

1.1.1 Steel Structures Standard

The tables in this publication have been calculated in accordance with the Australian Standard AS 4100–1998: Steel Structures. As far as possible, the notation and terminology used are the same as those adopted in that Standard.

Cold-formed hollow sections manufactured in accordance with Australian Standard AS 1163–1991: Structural Steel Hollow Sections are included within the scope of AS 4100. Extensive research [1.1,1.2,1.3] undertaken over a number of years has confirmed that cold-formed hollow sections compliant with AS 1163 meet the inherent requirements of AS 4100. Cold-formed hollow sections may also be designed to AS/NZS 4600–1996: Cold-Formed Steel Structures which is outside of the scope of this publication.

1.1.2 Reference Standards

“AS 1074” refers to AS 1074–1989: Steel tubes and tubulars for ordinary service

“AS 1163” refers to AS 1163–1991: Structural steel hollow sections

“AS/NZS 1170” refers to AS/NZS 1170–2002: Structural design actions

“AS/NZS 1554.1” refers to AS/NZS 1554.1–2000: Structural steel welding – Welding of steel structures

“AS 4100” refers to AS 4100–1998: Steel structures

“AS/NZS 4600” refers to AS/NZS 4600–1996: Cold-formed steel structures

“AS/NZS 4792” refers to AS/NZS 4792–1999: Hot-dip galvanized (zinc) coatings on hollow sections, applied by a continuous or a specialized process

1.1.3 Table Format and Usage

Within this publication the terms “Table” and “Tables” refer to information in this edition and volume of the Design Capacity Tables for Structural Steel Hollow Sections by Smorgon Steel Tube Mills.

A brief list of the Tables’ contents is provided in Section 1.5. It should be noted that the main

tables listing design capacities and other member information are listed at the end of the initial text portion of each Part of this publication. The main tables will generally be placed within a numerical sequence – e.g. Table 5.1 series (Maximum Design Loads for Simply Supported Beams with Full Lateral Restraint), Table 5.2 series (Design Section Moment and Web Capacities), Table 5.3 series (Design Moment Capacities for Members without Full Lateral Restraint), etc. Any table listed in the (initial) text portion of each Part of this Publication will have a “T” before the Table number – e.g. Table T2.1 in Section 2.2.

1.2 Range of Structural Steel Grades and Sections

The Tables contain information on the currently available (at the time of publication) structural steel hollow sections supplied by Smorgon Steel Tube Mills (SSTM) which fully comply with AS 1163. Section 2 should be consulted for further details on the structural steel hollow sections considered in the Tables.

Reference should also be made to the Smorgon Steel Tube Mills Quick Reference Product Availability Guide (QRPAG) for information on the **availability** of the **listed sections** and associated **finishes**. The QRPAG is found at the beginning of this publication. **It is highly recommended** that readers always ensure that they are using current information on the SSTM product range. This can be verified by comparing the **document revision date** (noted at the bottom of the page) with the **current version date** of each publication. The **current version date** of the QRPAG, this and other SSTM publications can be obtained by referring to www.smorgonsteel.com.au/tubemills or by contacting SSTM (the contact details are noted at the bottom of the page).

1.3 Units

The units in the Tables are consistent with those in the SI (metric) system. The base units utilised in the Tables are newton (N) for force, metre (m) for length, and kilogram (kg) for mass. Where noted, stress is expressed in megapascals (MPa).

With some minor exceptions, all values in the Tables are rounded to three (3) significant figures.

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1.4 Limit States Design using these Tables

AS 4100 sets out the minimum requirements for the design, fabrication and erection of steelwork in accordance with the limit states design method and follows a semi-probabilistic limit state approach presented in a deterministic format.

Definition of limit states – When a structure or part of a structure is rendered unfit for use it reaches a 'limit state'. In this state it ceases to perform the functions or to satisfy the conditions for which it was designed. Relevant limit states for structural steel include strength, serviceability, stability, fatigue, brittle fracture, fire, and earthquake. Only two limit states are considered in the Tables – the strength limit state and, where applicable, the serviceability limit state.

Limit states design requires structural members and connections to be proportioned such that the **design action effect** (S^*) resulting from the **design action** (W^*), is less than or equal to the **design capacity** (ϕR_u) i.e.

$$S^* \leq \phi R_u$$

Design action or **design load** (W^*) is the combination of the nominal actions or loads imposed upon the structure (e.g. transverse loads on a beam) multiplied by the appropriate load factors as specified in AS/NZS 1170 (Structural design actions). These design actions/loads are identified by an asterisk (*) after the appropriate action/load (e.g. W^* is the maximum design transverse load on a beam).

Design action effects (S^*) are the actions (e.g. design bending moments, shear forces, axial loads) calculated from the **design actions** or **design loads** using an acceptable method of analysis (Section 4 of AS 4100). These effects are identified by an asterisk (*) after the appropriate action effect (e.g. M^* describes the design bending moment).

Design capacity (ϕR_u) is the product of the nominal capacity (R_u) and the appropriate capacity factor (ϕ) found in Table 3.4 of AS 4100. R_u is determined from the characteristic values and specified parameters found in Sections 5 to 9 of AS 4100.

For example, consider the strength limit state design of a simply supported beam which has full lateral restraint subject to a total transverse **design load** (W^*) distributed uniformly along the beam.

For flexure, the appropriate **design action effect** (S^*) is the **design bending moment** (M^*) which is determined by:

$$M^* = \frac{W^* L}{8}$$

where L = span of the beam.

In this case the **design capacity** (ϕR_u) is equal to the **design section moment capacity** (ϕM_s), given by:

$$\phi M_s = \phi f_y Z_e$$

where ϕ = the capacity factor

f_y = yield stress used in design

Z_e = effective section modulus

To satisfy the strength limit state, the following relationship (equivalent to $S^* \leq \phi R_u$) is used:

$$M^* \leq \phi M_s$$

The **maximum design bending moment** (M^*) is therefore equal to the **design section moment capacity** (ϕM_s), and the **maximum design load** is that **design load** (W^*) which corresponds to the maximum M^* . (It should be noted that other checks on the beam may be necessary – e.g. shear capacity, bearing capacity, etc).

When considering external loads, in the context of this publication, the **maximum design load** (W^*) must be greater than or equal to the imposed **design load** (W^*).

Where applicable, the Tables give values of **design capacity** (ϕR_u) and **maximum design load** (W^*) determined in accordance with AS 4100. When using the Tables, the designer must determine the relevant *strength limit state design action* (W^*) and/or corresponding **design action effect** (S^*) to ensure that the strength limit state requirements of AS 4100 are satisfied. Where relevant, other limit states (e.g. serviceability, fatigue, etc) must also be considered by the designer. Some useful information for checking the serviceability limit state is included in the Tables.

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1.5 Table Contents

For the range of structural steel grades and sections considered, tables are provided for:

- (i) section dimensions and section properties:
 - Dimensions and Properties (PART 3)
 - Fire Engineering Design (PART 3)
 - Telescoping Information (PART 3)
- (ii) design capacity (ϕR_u) for:
 - Members Subject to Bending (PART 5)
 - Members Subject to Axial Compression (PART 6)
 - Members Subject to Axial Tension (PART 7)
 - Members Subject to Combined Actions (PART 8)
- (iii) maximum design load (W^*) for:
 - Strength Limit State (W^*_s) for Beams (PART 5)
 - Serviceability Limit State (W^*_s) for Beams (PART 5)

Acceptable methods of analysis for determining the design action effects are described in Section 4 of AS 4100 and material relevant to some of these methods of analysis is briefly presented in Part 4 of this publication.

1.6 References

- [1.1] Hasan, S.W. and Hancock, G.J., "Plastic Bending Tests of Cold-Formed Rectangular Hollow Sections", Steel Construction, Vol. 23, No. 4, Australian Institute of Steel Construction, 1989 (Note: AISC is now ASI – Australian Steel Institute).
- [1.2] Key, P.W., Hasan, S.W. and Hancock, G.J., "Column Behaviour of Cold-Formed Hollow Sections", Journal of Structural Engineering, American Society of Civil Engineers, Vol. 114, No. 2, 1988.
- [1.3] Zhao, X.L. and Hancock, G.J., "Tests to Determine Plate Slenderness Limits for Cold-Formed Rectangular Hollow Sections of Grade C450", Steel Construction, Vol. 25, No. 4, Australian Institute of Steel Construction, 1991 (Note: AISC is now ASI – Australian Steel Institute).

See Section 1.1.2 for details on reference Standards.

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