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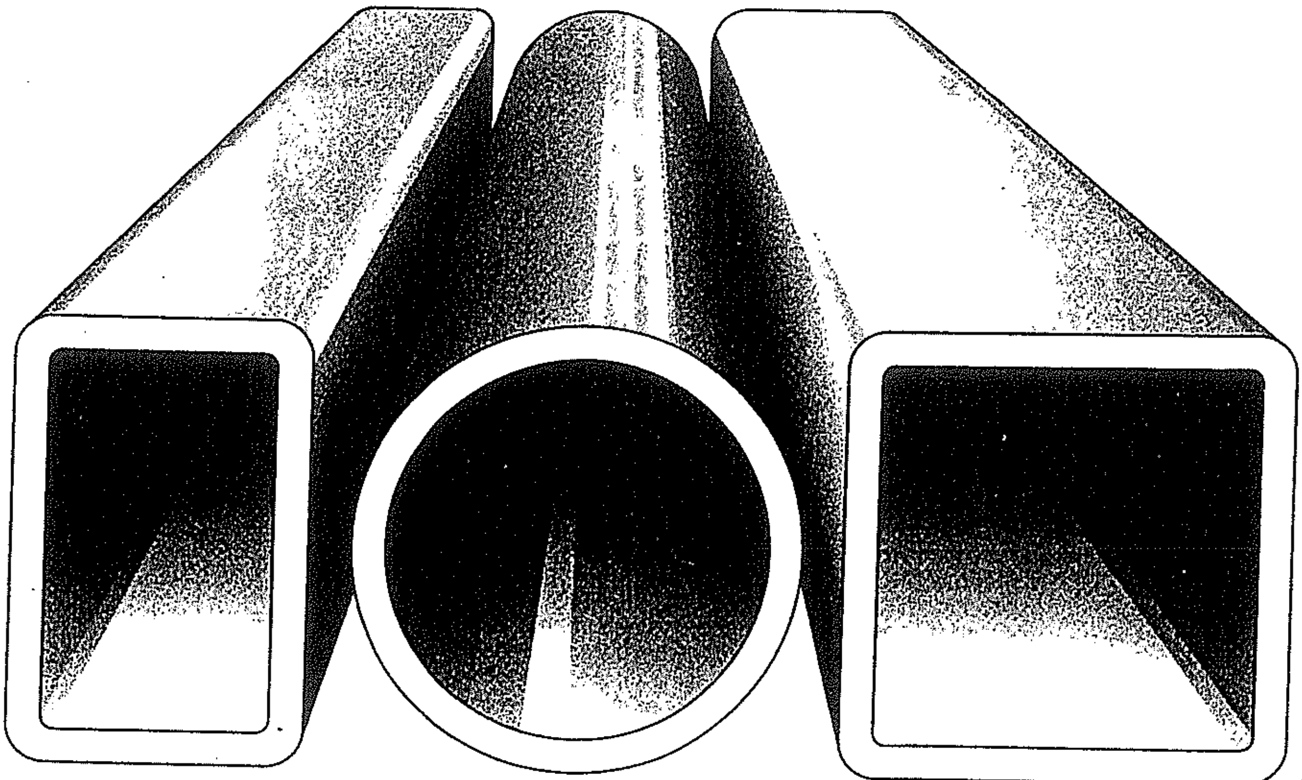
design capacity tables for structural steel hollow sections

1st edition



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LIMIT STATES EDITION TO AS 4100-1990 $S^* \leq \phi R_u$

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Enquiries should be addressed to the publisher:

Australian Institute of Steel Construction

Business address –
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Postal address –
P.O. Box 434, Milsons Point, NSW, 2061, Australia.

FIRST EDITION 1992

DISCLAIMER

DESIGN CAPACITY TABLES
FOR STRUCTURAL STEEL HOLLOW SECTIONS

TABLE OF CONTENTS

Foreword

The Australian Institute of Steel Construction (AISC) was formed in 1962 to serve the interests of all concerned in the design, specification, fabrication, and erection of steel structures.

Today, the AISC is a national body whose purpose is to promote and optimise the use of fabricated structural steel through engineering, research, and the dissemination of knowledge to specifiers, fabricators, and suppliers.

Its activities are directed towards fostering the economic and efficient use of steel in buildings, bridges, civil engineering projects, pressure vessels, pipelines, marine and offshore structures, and other fabricated forms.

The Institute is a non-profit organisation which is primarily financed by membership dues.

Engineers, architects, and others interested in steel construction are invited to make use of the Institute's services.

The Design Capacity Tables for Structural Steel Hollow Sections were prepared for publication by the Tubular Structures Development Group to aid designers in the selection and economical use of hollow sections in steel structures.

The Tubular Structures Development Group consists of the AISC, Tubemakers of Australia Limited, Structural Products Division, and Palmer Tube Mills (Aust.) Pty Ltd. The aim of the group is to encourage the efficient use of steel hollow sections in construction.

Acknowledgments

In the compilation of the *Design Capacity Tables for Structural Steel Hollow Sections - First Edition*, AISC acknowledges with grateful thanks the contribution and assistance of the following organisations and individuals:

- AISC – Technical Services
- Tubemakers of Australia Limited, Structural Products Division
- Palmer Tube Mills (Aust.) Pty Ltd
- and all those who gave constructive comment and advice on the technical and editorial content of the document.

Preface

The first edition of the *Design Capacity Tables for Structural Steel Hollow Sections* (DCTHS) is to be used as a design aid when complying with the limit states code *AS 4100-1990: Steel Structures*, published by Standards Australia.

This publication supplements the *AISC Design Capacity Tables for Structural Steel* (DCT). The DCTHS presents similar data as that included in the DCT for hollow sections complying with the material standard *AS 1163-1991: Structural Steel Hollow Sections*. Significant additions in this publication include:

– a method to convert the tabulated limit states design capacities to safe working loads

– section properties for hollow sections with a wall thickness less than 3 mm and design capacities for designing to the member design provisions of AS 4100. (Hollow sections less than 3 mm thick are not considered in the DCT.)

– tables for telescoping hollow sections

– a set of tables for all design section capacities

– maximum design load tables for strength and serviceability limit states including simply supported, continuous, fixed end, and cantilever beams

Improved table presentation coupled with informative text on the use of this publication will enhance the use of structural steel hollow sections when designing to AS 4100.

AISC 1992.

INTRODUCTION

Steel Structures Standard

The tables in this publication have been calculated in conformity with the requirements of the Australian Standard AS 4100–1990: Steel Structures (published by Standards Australia), and as far as possible, the nomenclature and symbols used throughout are the same as those adopted in this Standard. In these notes and in the tables:

- "the Steel Structures Code" (or simply "the Code") and AS 4100 refer to AS 4100–1990
- "the Tables" or "Tables" refer to this edition of the Design Capacity Tables for Structural Steel Hollow Sections.

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], [2], [3] undertaken over a number of years has confirmed that cold-formed hollow sections meet the inherent requirements of AS 4100.

Clause 1.1 of AS 4100 excludes material other than packers less than 3 mm thick. For sections less than 3 mm thick designers are required to refer to AS 1538–1988: Cold-Formed Steel Structures Code, which at this stage is still based on a permissible stress method of design.

A range of tests[1], [2], [3] conducted on hollow sections less than 3 mm thick have shown that the member design rules in AS 4100 can be used to determine the behaviour of these thin structural hollow sections manufactured to AS 1163.

In order to provide a consistent approach to design in the tables, hollow sections less than 3 mm thick, are presented in these tables as complying with the design rules appearing in AS 4100 although this code does not cover sections less than 3 mm thick. Therefore designers should where necessary, satisfy themselves as to the adequacy of members less than 3 mm thick, by verification as outlined in AS 1538.

Further research[4], [5], [6] has shown that the mechanical properties of cold-formed hollow sections are not reduced by a wide range of welding operations. The grade designations of cold-formed hollow sections based on yield strength are also not affected by hot dip galvanising.

Reference Standards

"AS 4100" refers to AS 4100–1990: Steel Structures

"AS 1163" refers to AS 1163–1991: Structural Steel Hollow Sections

"AS 1538" refers to AS 1538–1988: Cold–Formed Steel Structures Code

"AS 1554.1" refers to AS 1554.1–1980: Structural Steel Welding

"AS 1170" refers to AS 1170–1989: SAA Loading Code

"AS 1650" refers to AS 1650–1989: Hot–Dipped Galvanized Coatings on Ferrous Articles

LIMIT STATES DESIGN USING THESE TABLES

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 for structural steel are considered in these tables - strength limit state, and where applicable, serviceability limit state.

Australian Standard AS 4100–1990: Steel Structures introduces a limit states approach to structural steel design within Australia. The code follows a semi-probabilistic limit states basis presented in a deterministic format.

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

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

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

Design action effects (S^*) are the actions (e.g. design bending moments, shear forces, axial loads) computed from the design actions or design loads using an acceptable method of analysis. These effects are identified by a superscript (*) 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 Sections 5 to 8, as appropriate, in AS 4100.

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

The corresponding design action effect (S^*) is the design bending moment (M^*) which is determined by:

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

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 requirement for limit state design the following relationship must be satisfied,

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

The maximum design bending moment is therefore equal to the design section moment capacity ($M^* = \phi M_s$), and the **maximum design load** is that design load (W_L^*) which corresponds to the maximum design bending moment. It should be noted that in this instance the bending capacity of the beam may not be the only criteria in the strength limit state which needs to be considered. (eg. shear capacity, bearing capacity).

The DCTHS gives values of **design capacity** (ϕR_u) and **maximum design load** (W^*), where applicable, determined in accordance with AS 4100. When using these tables, the designer must determine the relevant *strength limit state* **design action** (W^*) and/or the corresponding **design action effects** (S^*) to ensure that the *strength limit state* requirements of AS 4100 are satisfied. Other limit states (e.g. serviceability, fatigue) must also be considered by the designer. Section 8 of the tables contains design aids for checking the serviceability limit state for some specific beam load and support configurations.

GENERAL NOTES ON THE TABLES

Table Contents and Usage

For the commonly available Australian structural steel hollow sections, tables are provided for:

(i) **section dimensions** and **section properties**, i.e:

– Dimensions and Properties (PART 1)
– Surface Areas (PART 1)
– Properties for Assessing Section Capacity to AS 4100 (PART 1)
– Properties for Fire Design (PART 1)
– Telescoping Sections (PART 1)

(ii) **design capacity** (ϕR_u) for:

– Section Capacities (PART 3)
– Members Subject to Bending (PART 4)
– Members Subject to Axial Compression (PART 5)
– Members Subject to Axial Tension (PART 6)

(iii) **elastic buckling load** (N_{om}) (PART 7)

(iv) **maximum design load** (W^*) for:

– Strength Limit State (W_L^*) for Beams (PART 8)
– Serviceability Limit State (W_S^*) for Beams (PART 8)
(simply supported, continuous, fixed end, and cantilever beams)

Acceptable methods of analysis for determining the **design action effects** are described in Section 4 of AS 4100 and PART 2 of this publication. Information relevant to such methods of analysis is presented briefly in PART 7 of this publication.

Range of Sections

The tables cover the full range of hollow sections, manufactured in accordance with AS 1163, which are generally available and commonly used in Australia. The following grades of structural steel hollow sections are detailed in AS 1163.

Australian Standard	Steel Grade	Yield Stress f_y MPa	Tensile Strength f_u MPa
AS 1163	C250 and C250L0	250	320
	C350 and C350L0	350	430
	C450 and C450L0	450	500

The grade designation (e.g. C250) is based on the nominal minimum yield strength of the steel (in MPa). The prefix 'C' is used before the value of the nominal yield strength of the steel to indicate that the section is cold-formed. AS 1163 only considers cold-formed structural steel hollow sections. The suffix 'L0' denotes impact properties at 0° C as specified in AS 1163.

In these notes and in the tables:

– Grade "C250" refers to **both** C250 and C250L0

– Grade "C350" refers to **both** C350 and C350L0

– Grade "C450" refers to **both** C450 and C450L0

Specifications

Hollow sections produced in Australia are manufactured by cold-forming and high frequency Electric Resistance Welding (ERW). The ERW process allows cold-formed hollow sections to be welded at ambient temperatures without subsequent stress relieving.

The structural hollow sections produced in Australia are generally manufactured and tested to meet the requirements of one or more of the following specifications:

AS 1163-1991: Structural Steel Hollow Sections

AS 1450-1983: Steel Tubes for Mechanical Purposes

AS 1074-1989: Steel Tubes and Tubulars for Ordinary Service

API5L-1990: Steel Linepipe

However the Tables only apply to those hollow sections manufactured in accordance with AS 1163.

Availability

The sections listed in the tables are normally readily available from steel distributors ex-stock in standard lengths. However, the availability should be checked for the larger sizes, for large tonnages of individual sections, or for non-standard lengths.

The standard lengths given in the table below are produced by Palmer Tube Mills (Aust.) Pty Ltd and Tubemakers of Australia Limited, Structural Products Division, although each manufacturer may not produce all of the sizes and stock lengths shown. Sections may be ordered in other lengths ex mill rollings subject to the manufacturers' length limitations and minimum order requirements.

Section Type	Sizes	Standard Lengths (m)
Circular Hollow Sections Grade *C250*	13.5 O.D. 17.2 O.D. to 165.1 O.D. 508.0 O.D. to 610.0 O.D.	5.8 6.5 6.0, 9.0, and 12.0
Circular Hollow Sections Grade *C350*	21.3 O.D. to 88.9 O.D. 114.3 O.D. to 457.0 O.D.	6.5 6.5 and 12.0
Rectangular Hollow Sections Grade *C350*	50 x 20 to 150 x 50 150 x 100 to 250 x 150	8.0 8.0 and 12.0
Rectangular Hollow Sections Grade *C450*	50 x 20 to 125 x 75 x 2.8 125 x 75 x 3.3 and 125 x 75 x 3.8	8.0 8.0 and 12.0
Square Hollow Sections Grade *C350*	13 x 13 to 25 x 25 30 x 30 to 89 x 89 100 x 100 to 250 x 250	6.5 8.0 8.0 and 12.0
Square Hollow Sections Grade *C450*	25 x 25 30 x 30 to 100 x 100	6.5 8.0

Hollow sections in grades C250L0, C350L0, and C450L0 have equivalent or superior performance to grades C250, C350 and C450 respectively. The "L0" grades are the most readily available grades from the manufacturers.

Hollow sections are readily available in black, painted, and galvanized finishes. The galvanized finishes available are:

- Continuously hot-dipped galvanized.
  (min. 300 g/m^2 on each surface to the requirements of AS 1650)
- Z275 for hollow sections fabricated from continuously hot-dipped galvanized steel sheet.
  (275 g/m^2 total on both surfaces to AS 1650)
- Continuously hot-dipped galvanized – external surface only.
  (min. 180 g/m^2 to AS 1650)
- Continuously hot-dipped galvanized – external surface only.
  (min. 100 g/m^2)

Welding

The following consumables are recommended by AS 1554.1–1980 when welding hollow sections in steel grade C250 and C350. AS 1554.1 is currently being revised to include C450 grade steel.

		C250	C350	C450*
Manual metal–arc	(MMAW)	E41XX E48XX	E41XX E48XX	E48XX
Gas metal–arc (known as MIG)	(GMAW)	W50X	W50X	W50X
Submerged arc	(SAW)	W40X W50X	W40X W50X	–
Flux–cored arc	(FCAW)	W40X W50X	W40X W50X	–

* Note: C450 grade steel has not yet been included in AS 1554.1–1980, but tests[5],[6] have shown that E48XX and W50X consumables are satisfactory for providing the following requirements so that strength and ductility are met:

1) The yield and tensile strengths of the welding consumable are greater than the nominal values of the C450 steel

2) Welding consumables are grade 2 (or higher) depositing welds giving Charpy notch impact toughness of 47 J at 0° C.

Check with local suppliers for consumables satisfying these requirements.

The above recommendations apply to predominantly statically loaded structures but also in broad principle to dynamically loaded structures subject to moderate cyclic loads, as specified in AS 4100: Section 11 – Fatigue.

Properties of Steel

The properties of steel adopted in the Tables are shown below.

Property	Symbol	Value
Elastic Modulus	E	200×10^3 MPa
Shear Modulus	G	80×10^3 MPa
Density	ρ	7850 kg/m^3
Poisson's Ratio	ν	0.25
Coefficient of Thermal Expansion	α_T	11.7×10^{-6} per ° C

References

[1] Hasan, S.W., Hancock, G.J., "Plastic Bending Tests of Cold-Formed Rectangular Hollow Sections", *Steel Construction*, AISC, Vol. 23, No. 4, 1989.

[2] Key, P.W., Hasan, S.W., Hancock, G.J., "Column Behaviour of Cold-Formed Hollow Sections", *Journal of Structural Engineering*, ASCE, Vol. 114, AISC, No. 2, 1988.

[3] Zhao, X.L., Hancock, G.J., "Tests to Determine Plate Slenderness Limits for Cold-Formed Rectangular Hollow Sections of Grade C450", *Steel Construction*, AISC, Vol. 25, No. 4, 1990.

[4] HERA, "Investigation of the Brittle Fracture Resistance of Cold-Formed Rectangular Hollow Section. (Part 2)", *HERA Report R4–39*, Auckland Industrial Development Division Department of Scientific and Industrial Research, 1987.

[5] Corderoy, D.J.H., Landy, R.J., "Weldability Trials with Grade C450 RHS Structural Tubing", *Second National Structural Engineering Conference*, The Institution of Engineers Australia, 1990.

[6] Corderoy, D.J.H., Dempsey, R.I., Landy, R.J., "Welding Aspects of Grade C450L0 Structural Hollow Sections", *Welding Towards 2000 Conference Proceedings*, Welding Technology Institute of Australia, 1991.

CONVERSION TO SAFE WORKING LOADS

The design capacities given in these tables are limit states design capacities calculated in accordance with AS 4100, and must be equal to or greater than the design action effect (e.g. bending moment, shear force, axial force) resulting from the design loads. *These design loads are not working loads,* but are obtained by factoring the nominal (working) loads applied to the structure in accordance with the loading code AS 1170.

For working stress design, working load capacities (safe working loads) based on a load factor of 1.5 as used for the live load component of dead and live load in AS 1170.1, may be obtained using:

$$\text{safe working load} = \frac{\text{maximum design load from tables}}{1.5}$$

or

$$\text{safe working load} = \frac{\text{design capacity from tables}}{1.5}$$

LIST OF PRINCIPAL SYMBOLS USED IN THE TABLES

A_e	effective area of a cross-section
A_g	gross area of a cross-section
A_n	net area of a cross-section
b	width of a section
b_e	effective width of a plate element
b_b, b_{bf}, b_{bw}, b_s	bearing widths defined in Section 4.3.2
C	torsional section modulus
c_m	factor for unequal moments
d	depth of a section
d_e	effective outside diameter of a circular hollow section
d_o	outside diameter of a circular hollow section
d_w	depth of web
d_1	clear depth between flanges
E	Young's modulus of elasticity
f_u	tensile strength used in design
f_y	yield stress used in design
f^*_{va}	average design shear stress in the web
f^*_{vm}	maximum design shear stress in the web
G	shear modulus of elasticity; or nominal dead load
I	second moment of area of a cross-section
I_w	warping section constant
I_x	I about the cross-sectional major principal x-axis
I_y	I about the cross-sectional minor principal y-axis
J	torsional section constant
k_e	member effective length factor
k_f	form factor for members subject to axial compression
k_l	load height effective length factor
k_r	effective length factor for restraint against lateral rotation
k_{sm}	exposed surface area to mass ratio
k_t	correction factor for distribution of forces in a tension member; or twist restraint effective length factor
L	span or member length; or segment or sub-segment length
L_e	effective length of a compression member; or effective length of a laterally unsupported flexural member
M_b	nominal member moment capacity
M_{bx}	M_b about major principal x-axis
M_{ix}	nominal in-plane member moment capacity about major principal x-axis
M_{iy}	nominal in-plane member moment capacity about minor principal y-axis
M_o	reference elastic buckling moment for a member subject to bending
M_{oa}	amended elastic buckling moment for a member subject to bending
M_{ox}	nominal out-of-plane member moment capacity about major principal x-axis

M_{rx}	M_s about major principal x-axis reduced by axial force	
M_{ry}	M_s about minor principal y-axis reduced by axial force	
M_s	nominal section moment capacity	
M_{sx}	M_s about major principal x-axis	
M_{sy}	M_s about minor principal y-axis	
M_z	nominal torsional moment section capacity	
M^*	design bending moment	
M_m^*	maximum calculated design bending moment along the length of a member or in a segment	
M_x^*	design bending moment about major principal x-axis	
M_y^*	design bending moment about minor principal y-axis	
M_z^*	design torsional moment	
N_c	nominal member capacity in compression	
N_{cx}	N_c for member buckling about major principal x-axis	
N_{cy}	N_c for member buckling about minor principal y-axis	
N_{om}	elastic flexural buckling load of a member	
N_{omb}	N_{om} for a braced member	
N_{omx}	$\dfrac{\pi^2 EI_x}{(k_e L)^2}$	N_{om} about major principal x-axis
N_{omy}	$\dfrac{\pi^2 EI_x}{(k_e L)^2}$	N_{om} about minor principal y-axis
N_s	nominal section capacity of a concentrically loaded compression member	
N_t	nominal section capacity in tension	
N^*	design axial force, tensile or compressive	
P	applied load	
R_b	nominal bearing capacity of a web	
R_{bb}	nominal bearing buckling capacity	
R_{by}	nominal bearing yield capacity	
R_u	nominal capacity	
r	radius of gyration	
r_{ext}	external corner radius	
r_x	radius of gyration about major principal x-axis	
r_y	radius of gyration about minor principal y-axis	
R^*	design bearing force	
S	plastic section modulus	
S_x	S about major principal x-axis	
S_y	S about minor principal y-axis	
S^*	design action effect	
t	thickness of a section	
t_f	thickness of a flange	
t_w	thickness of a web	
V_u	nominal shear capacity of a web with a uniform shear stress distribution	

V_v	nominal shear capacity of a web
V_{vx}	V_v of a member in the major principal x-axis direction
V_{vy}	V_v of a member in the minor principal y-axis direction
V^*	design shear force
W	applied load
W^*	design action
$W_L{}^*$	strength limit state maximum design load
$W_S{}^*$	serviceability limit state maximum design load
Z	elastic section modulus
Z_e	effective section modulus
Z_{ex}	Z_e for bending about major principal x-axis
Z_{ey}	Z_e for bending about minor principal y-axis
Z_n	Z for bending about n-axis
Z_x	Z for bending about major principal x-axis
Z_y	Z for bending about minor principal y-axis
α_a	compression member factor (as defined in Clause 6.3.3 of AS 4100)
α_b	compression member section constant (as defined in Clause 6.3.3 of AS 4100)
α_c	compression member slenderness reduction factor
α_m	moment modification factor for bending
α_s	slenderness reduction factor
α_T	coefficient of thermal expansion for steel
β_m	ratio of smaller to larger bending moments at the ends of a member
Δ	deflection of a member
δ_b	moment amplification factor for a braced member
δ_m	moment amplification factor, taken as the greater of δ_b and δ_s
δ_s	moment amplification factor for a sway member
η	compression member imperfection factor (as defined in Clause 6.3.3 of AS 4100)
θ	angle of twist per unit length slenderness ratio
λ_c	elastic buckling load factor
λ_e	plate element slenderness
λ_{ed}	plate element deformation slenderness limit
λ_{ep}	plate element plasticity slenderness limit
λ_{ey}	plate element yield slenderness limit
λ_n	modified compression member slenderness
ν	Poisson's ratio
ξ	compression member factor (as defined in Clause 6.3.3 of AS 4100)
π	pi ($\approx$ 3.14159)
ρ	density of a material
ϕ	capacity factor

PART 1 SECTION PROPERTIES

PAGE

TABLES

NOTE: SEE PAGE (Ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES

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PART 1 SECTION PROPERTIES

1.1 Introduction

The section property tables include all relevant section dimensions and properties necessary for assessing steel structures in accordance with AS 4100. The structural hollow sections included in these tables are:

– Circular Hollow Sections	Grade C250 and C350
– Rectangular Hollow Sections	Grade C350 and C450
– Square Hollow Sections	Grade C350 and C450

*The size ranges considered for the above hollow sections are based on the normative ranges listed in **AS 1163**. For **an explanation of this standard** in terms of these Tables **reference must be made to "General Notes on the Tables"** in particular to "Range of Sections" [see page (ix)]. The grades include the L0 grades as described in "Range of Sections".*

1.2 Section Property Tables

For each group of structural hollow sections the tables include:

- Dimensions and Properties
- Properties for Assessing Section Capacity to AS 4100

1.2.1 Dimensions and Properties

The tables give standard dimensions and properties for the structural steel hollow sections listed in Section 1.1. The second moments of area are required for serviceability calculations and the radii of gyration are required for assessing member stability. The elastic and plastic section moduli for bending about the various axes are also tabulated. These are utilised in an intermediate step to determine the effective section modulus for flexural design to AS 4100. The elastic section moduli are also used in the determination of elastic stresses where design for fatigue must be considered, or where the stress state at serviceability loads may need to be checked. The torsion constants are used in determining the torsional moment and angle of twist per unit length.

The general format of these tables follows that of the equivalent tables contained in the current "Design Capacity Tables for Structural Steel"-1st Edition.

1.2.1.1 Torsion Constants

The torsional inertia constant (J) and the torsional modulus constant (C) for square and rectangular hollow sections are defined as follows:

$$J = \left(t^3 \frac{h}{3} + 2kA_h\right)$$

$$C = \left(\frac{t^3 \frac{h}{3} + 2kA_h}{t + \frac{k}{t}}\right)$$

where
$$R_c = \frac{R_o + R_i}{2}$$
$$h = 2[(b-t) + (d-t)] - 2R_c(4-\pi)$$
$$A_h = (b-t)(d-t) - R_c^{\,2}(4-\pi)$$
$$k = \frac{2A_h t}{h}$$

and
t = specified thickness of section
b = width of section
d = depth of section
R_o = outer corner radius
R_i = inner corner radius
R_c = mean corner radius
h = length of the mid-contour
A_h = area enclosed by h
k = integration constant

as shown in Figure 1.2.1.1

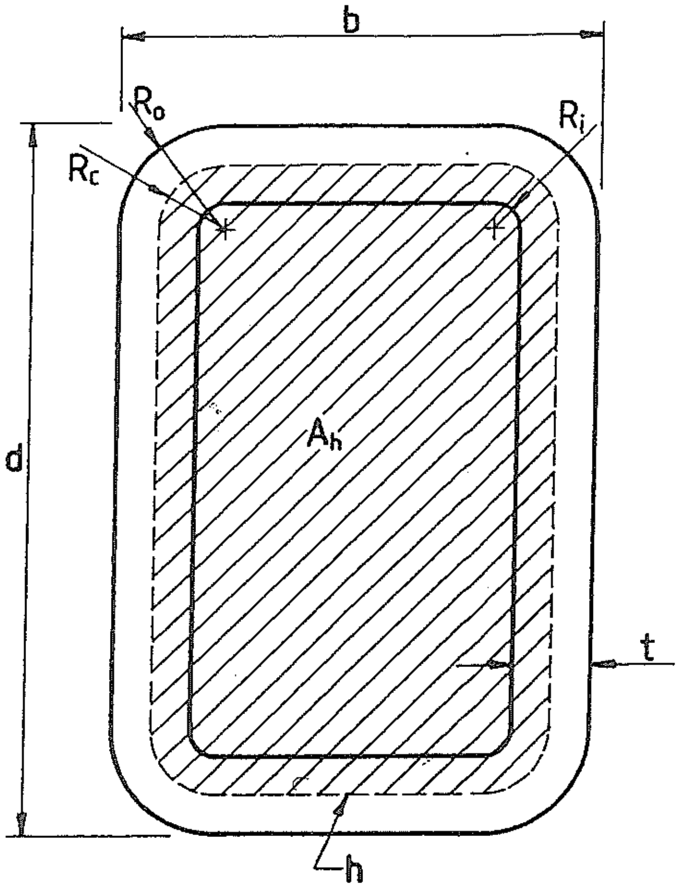


Figure 1.2.1.1: Parameters for Calculation of Torsion Constants

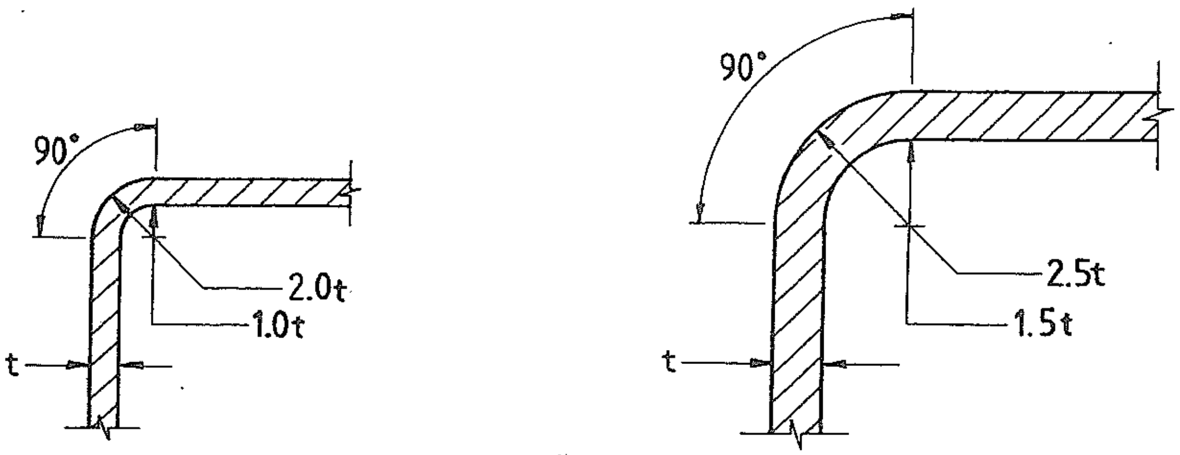
The information contained in Section 1.2.1.1 was extracted from:

- International Standard ISO 657/XIV, "Hot–rolled steel sections – Part XIV : Hot–finished structural hollow sections – Dimensions and sectional properties", 1977.

1.2.1.2 Corner Radii

The section properties presented in this publication are calculated in accordance with AS 1163.

Figure 1.2.1.2 shows the corner radii detail used in determining section properties. However it should be noted that the actual corner geometry may vary from that shown.



a) thickness less than 3.0 mm

b) thickness 3.0 mm and greater

Figure 1.2.1.2: Corner Geometry for Determining Section Properties

1.2.2 Surface Areas

Surface area data may be used in estimating quantities of protective coatings. Tables 1.2–1 to 1.2–6 include values of external surface area per metre and external surface area per tonne.

1.2.3 Properties for Assessing Section Capacities

These properties are necessary for calculating the section capacities of the structural hollow sections in accordance with AS 4100. The effective section moduli, "compactness" of section, and the form factor are tabulated according to steel grade.

1.2.3.1 Compactness

In Clauses 5.2.3, 5.2.4, and 5.2.5 of AS 4100, sections are described as **compact, non-compact** or **slender**. This type of categorisation provides a measure of the relative importance of yielding and local buckling on the effective section modulus.

The tables include a column headed "compactness" where the compactness or otherwise of the sections is indicated for a given axis of bending as follows:

C compact
N non-compact
S slender

These terms are important with respect to selecting the methods of analysis that may be used to determine the design action effects (see Clause 4.5 of AS 4100) or in using the provisions of Section 8 of AS 4100 for designing members subject to combined actions. Clause 4.5 of AS 4100 does not currently permit plastic analysis when designing with structural hollow sections and further research is required to determine the suitability of plastic analysis in the design of hollow sections.

1.2.3.2 Effective Section Modulus

Subsequent to the evaluation of "compactness" the effective section modulus (Z_e) is also tabulated. Z_e is determined by the requirements of Clauses 5.2.2 to 5.2.5 inclusive, of AS 4100 and is used in the calculation of the nominal section moment capacity (M_s) as defined in Clause 5.2.1 of AS 4100.

Table 1.2.3.2 gives values of plate element slenderness limits for structural hollow sections used in the determination of Z_e in Tables 1.2–1 to 1.2–6. It should be noted that the deformation limit (λ_{ed}) is never exceeded for hollow sections manufactured in accordance with AS 1163 and therefore noticeable deformations will not occur under service loadings.

Section	Element	Residual Stresses	Plasticity Limit λ_{ep}	Yield Limit λ_{ey}	Deformation Limit λ_{ed}
RHS, SHS	Compression Flange	CF	30	40	90
	Web	CF	82	115	–
CHS	–	CF	50	120	–

Table 1.2.3.2: Plate Element Slenderness Limits for Members Subject to Bending

The CF residual stress classification is used for all sections as they are manufactured in Australia by the cold forming process.

1.2.3.3 Form Factor

The form factor (k_f) determined in accordance with Clause 6.2.2 of AS 4100 is given by:

$$k_f = \frac{A_e}{A_g}$$

where A_g = gross cross-sectional area
A_e = effective area

A_e was calculated by summing the effective areas of the individual elements whose effective widths are specified:

for RHS and SHS by $$b_e = b\left(\frac{\lambda_{ey}}{\lambda_e}\right) \le b$$

and for CHS as the lesser of $$d_e = d_o\sqrt{\left(\frac{\lambda_{ey}}{\lambda_e}\right)} \le d_o$$

and $$d_e = d_o\left(\frac{3\lambda_{ey}}{\lambda_e}\right)^2$$

where d_e = effective outside diameter of CHS (Clause 6.2.4 of AS 4100)
b_e = effective width of section (Clause 6.2.4 of AS 4100)
b = full width of section
d_o = outside diameter of CHS
λ_{ey} = yield slenderness limit (see Table 1.2.3.3)
λ_e = plate element slenderness (see Table 1.2.3.3)

Table 1.2.3.3: Plate Element Slenderness Limits for Members Subject to Axial Compression

Section	Residual Stresses	Yield Slenderness Limit λ_{ey}	Plate Element Slenderness λ_e
RHS, SHS	CF	40	$\frac{b}{t}\sqrt{\left(\frac{f_y}{250}\right)}$
CHS	CF	82	$\frac{d_o}{t}\left(\frac{f_y}{250}\right)$

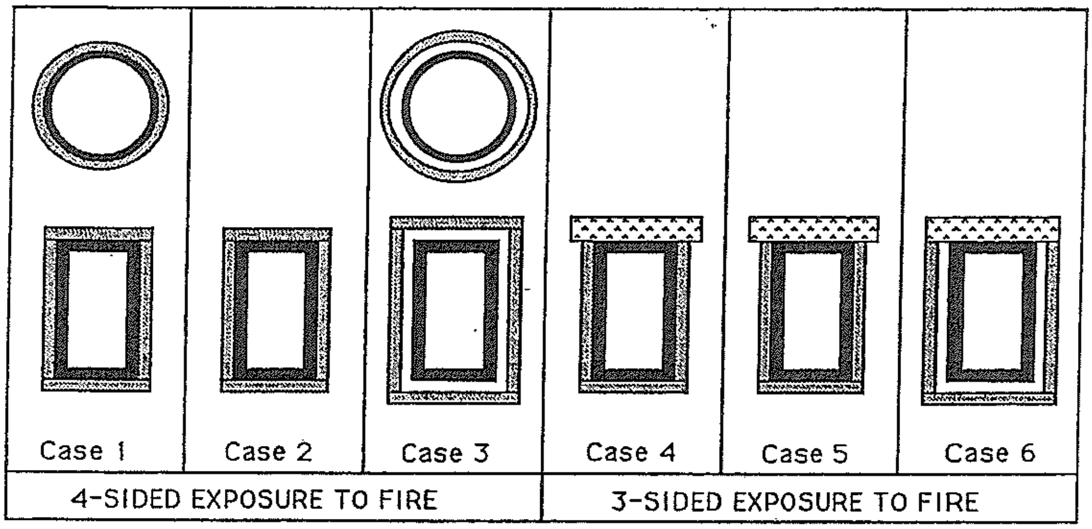
k_f must be known in order to determine the nominal section capacity of a concentrically loaded compression member (N_s) as defined in Clause 6.2.1 of AS 4100. The calculation of k_f indicates the degree to which the column section will buckle locally before squashing (i.e. k_f = 1.0 signifies a column section which will yield rather than buckle locally in a short or stub column test). A knowledge of k_f is also important when using the provisions of Section 8 of AS 4100 for designing members subject to combined actions.

1.3 Properties for Fire Design

To assist in the design of the structural steel hollow sections for fire resistance in accordance with Section 12 of AS 4100, values of the exposed surface area to mass ratio (k_{sm}) are tabulated for the various cases shown in Figure 1.3.

For **unprotected structural hollow sections** the values of k_{sm} corresponding to four- and three- sided exposure should be taken as those corresponding to Cases 1 and 4 respectively. In these instances fire protection is necessary where a fire rating is required.

For members requiring the addition of fire protection materials, the "Handbook of Fire Protection Materials for Structural Steel" published by *AISC* [1] may be consulted to determine the thickness of proprietary materials required for a given value of k_{sm} and Fire-Resistance Level. In the *AISC* Handbook, the exposed surface area to mass ratio (E) may be taken as equivalent to k_{sm}.



Cases of fire exposure considered:

1 = Profile-protected
2 = Total Perimeter, Box-protected, No Gap
3 = Total Perimeter, Box-protected, 25 mm Gap
4 = Top Flange Excluded, Profile-protected
5 = Top Flange Excluded, Box-protected, No Gap
6 = Top Flange Excluded, Box-protected, 25 mm Gap

Figure 1.3: Cases for Calculation of Exposed Surface Area to Mass Ratio

Suggested references for Fire Design:

[1] Proe, D.J., Bennetts, I.D., Thomas, I.R., Szeto, W.T., "Handbook of Fire Protection Materials for Structural Steel", *Australian Institute of Steel Construction*, 1990.

[2] Bennetts, I.D., Proe, D.J., Thomas, I.R., "Guidelines for Assessment of Fire Resistance of Structural Steel Members", *Australian Institute of Steel Construction*, 1987.

1.4 Telescoping Sections

1.4.1 Scope

The tables of telescoping sections provided can be used to determine hollow sections which are suitable for telescoping.

1.4.2 Method

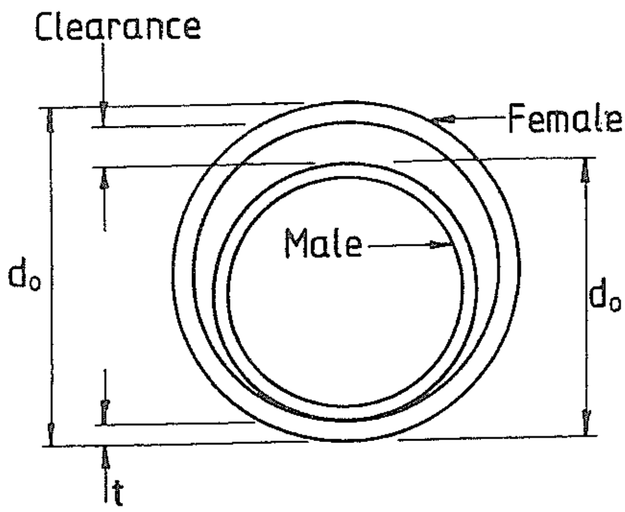
Total available clearance is tabulated to allow designers to select sections with suitable clearance for the type of fit required. Sections with clearances less than 2.0 mm are shown **bold** in the tables. Figure 1.4.2 shows typical telescoping data required to select appropriate sections.

All calculations used in preparation of the tables are based on the nominal dimensions of hollow sections and manufacturing tolerances specified in AS 1163. Owing to dimensional tolerances permitted within that standard actual clearances of sections manufactured to this specification will vary marginally from the values tabulated.

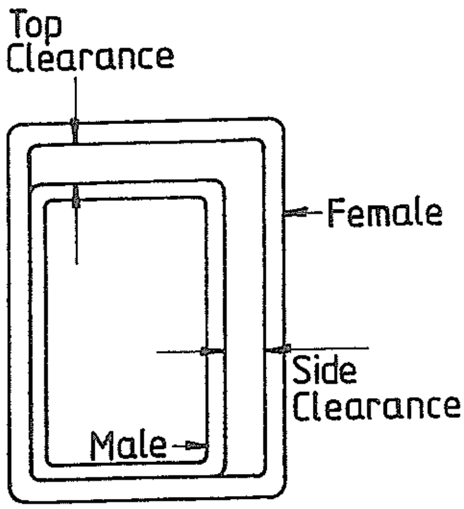
For tight fits, varying corner radii and internal weld heights can affect telescoping of sections and it is recommended that some form of testing is carried out prior to committing material. Where telescoping over some length is required, additional clearance may be needed to allow for straightness of the section.

Telescoping of SHS and RHS where the female (outer) has a larger wall thickness requires careful consideration of corner clearances due to the larger corner radii of the thicker section.

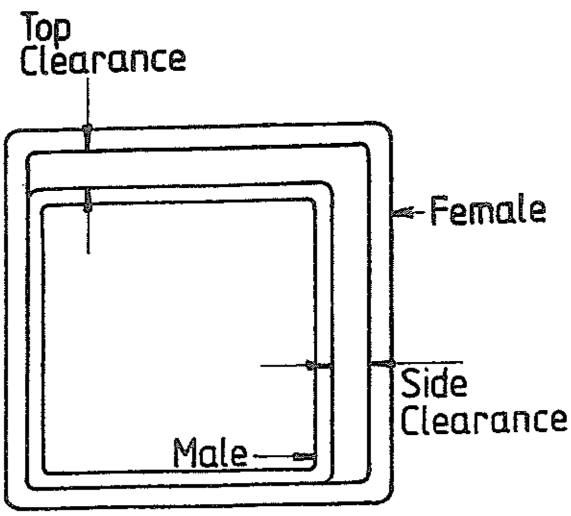
Typical corner geometry may differ from that used for calculation of section properties and reference should be made to individual manufacturers.



a) **CHS**



b) **RHS**



c) **SHS**

Figure 14.2: Telescoping Data

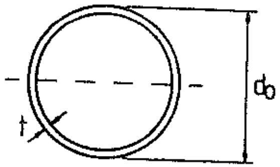
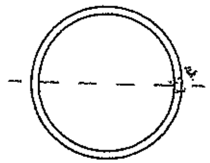


TABLE 1.2 – 1(1)

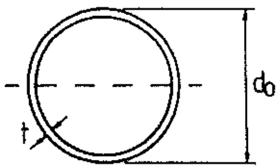
DIMENSIONS AND PROPERTIES

CIRCULAR HOLLOW SECTIONS: GRADE C250



Designation d_o (mm)	Designation t (mm)	Mass per m (kg/m)	External Surface Area per m (m^2/m)	External Surface Area per t (m^2/t)	$\frac{d_o}{t}$	Gross Section Area A_g (mm^2)	About any axis I ($10^6 mm^4$)	About any axis Z ($10^3 mm^3$)	About any axis S ($10^3 mm^3$)	About any axis r (mm)	Torsion Constant J ($10^6 mm^4$)	Torsion Modulus C ($10^3 mm^3$)	Form Factor k_f	About any axis Compactness (C,N,S)	About any axis Z_e ($10^3 mm^3$)
610.0 x	12.7 CHS	187	1.92	10.2	48.0	23800	1060	3490	4530	211	2130	6970	1.00	C	4530
	9.5 CHS	141	1.92	13.6	64.2	17900	808	2650	3430	212	1620	5300	1.00	N	3270
	6.4 CHS	95.3	1.92	20.1	95.3	12100	553	1810	2330	213	1110	3620	0.927	N	2000
508.0 x	12.7 CHS	155	1.60	10.3	40.0	19800	606	2390	3120	175	1210	4770	1.00	C	3120
	9.5 CHS	117	1.60	13.7	53.5	14900	462	1820	2360	176	925	3640	1.00	N	2330
	6.4 CHS	79.2	1.60	20.2	79.4	10100	317	1250	1610	177	634	2500	1.00	N	1460
165.1 x	5.4 CHS	21.3	0.519	24.4	30.6	2710	8.65	105	138	56.5	17.3	209	1.00	C	138
	5.0 CHS	19.7	0.519	26.3	33.0	2510	8.07	97.7	128	56.6	16.1	195	1.00	C	128
139.7 x	5.4 CHS	17.9	0.439	24.5	25.9	2280	5.14	73.7	97.4	47.5	10.3	147	1.00	C	97.4
	5.0 CHS	16.6	0.439	26.4	27.9	2120	4.81	68.8	90.8	47.7	9.61	138	1.00	C	90.8
114.3 x	5.4 CHS	14.5	0.359	24.8	21.2	1850	2.75	48.0	64.1	38.5	5.49	96.1	1.00	C	64.1
	4.5 CHS	12.2	0.359	29.5	25.4	1550	2.34	41.0	54.3	38.9	4.69	82.0	1.00	C	54.3
101.6 x	5.0 CHS	11.9	0.319	26.8	20.3	1520	1.77	34.9	46.7	34.2	3.55	69.9	1.00	C	46.7
	4.0 CHS	9.63	0.319	33.2	25.4	1230	1.46	28.8	38.1	34.5	2.93	57.6	1.00	C	38.1
88.9 x	5.9 CHS	12.1	0.279	23.1	15.1	1540	1.33	30.0	40.7	29.4	2.66	59.9	1.00	C	40.7
	5.0 CHS	10.3	0.279	27.0	17.8	1320	1.16	26.2	35.2	29.7	2.33	52.4	1.00	C	35.2
	4.0 CHS	8.38	0.279	33.3	22.2	1070	0.963	21.7	28.9	30.0	1.93	43.3	1.00	C	28.9
76.1 x	5.9 CHS	10.2	0.239	23.4	12.9	1300	0.807	21.2	29.1	24.9	1.61	42.4	1.00	C	29.1
	4.5 CHS	7.95	0.239	30.1	16.9	1010	0.651	17.1	23.1	25.4	1.30	34.2	1.00	C	23.1
	3.6 CHS	6.44	0.239	37.1	21.1	820	0.540	14.2	18.9	25.7	1.08	28.4	1.00	C	18.9
60.3 x	5.4 CHS	7.31	0.189	25.9	11.2	931	0.354	11.8	16.3	19.5	0.709	23.5	1.00	C	16.3
	4.5 CHS	6.19	0.189	30.6	13.4	789	0.309	10.2	14.0	19.8	0.618	20.5	1.00	C	14.0
	3.6 CHS	5.03	0.189	37.6	16.8	641	0.259	8.58	11.6	20.1	0.517	17.2	1.00	C	11.6

Notes:
1. For Grade C250 f_y = 250 MPa and and f_u = 320 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C250 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.



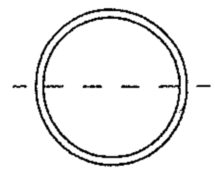


TABLE 1.2 – 1(2)

DIMENSIONS AND PROPERTIES

CIRCULAR HOLLOW SECTIONS: GRADE C250

DIMENSIONS AND RATIOS						PROPERTIES							PROPERTIES FOR DESIGN TO AS 4100		
Designation		Mass per m	External Surface Area		$\frac{d_o}{t}$	Gross Section Area	About any axis				Torsion Constant	Torsion Modulus	Form Factor	About any axis	
d_o	t		per m	per t		A_g	I	Z	S	r	J	C	k_f	Compactness	Z_e
mm	mm	kg/m	m^2/m	m^2/t		mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$		(C,N,S)	$10^3 mm^3$
48.3 x	5.4 CHS	5.71	0.152	26.6	8.9	728	0.170	7.04	9.99	15.3	0.340	14.1	1.00	C	9.99
	4.0 CHS	4.37	0.152	34.7	12.1	557	0.138	5.70	7.87	15.7	0.275	11.4	1.00	C	7.87
	3.2 CHS	3.56	0.152	42.6	15.1	453	0.116	4.80	6.52	16.0	0.232	9.59	1.00	C	6.52
42.4 x	4.9 CHS	4.53	0.133	29.4	8.7	577	0.103	4.87	6.93	13.4	0.206	9.74	1.00	C	6.93
	4.0 CHS	3.79	0.133	35.2	10.6	483	0.0899	4.24	5.92	13.6	0.180	8.48	1.00	C	5.92
	3.2 CHS	3.09	0.133	43.1	13.3	394	0.0762	3.59	4.93	13.9	0.152	7.19	1.00	C	4.93
33.7 x	4.5 CHS	3.24	0.106	32.7	7.5	413	0.0450	2.67	3.87	10.4	0.0901	5.35	1.00	C	3.87
	4.0 CHS	2.93	0.106	36.1	8.4	373	0.0419	2.49	3.55	10.6	0.0838	4.97	1.00	C	3.55
	3.2 CHS	2.41	0.106	44.0	10.5	307	0.0360	2.14	2.99	10.8	0.0721	4.28	1.00	C	2.99
26.9 x	4.0 CHS	2.26	0.0845	37.4	6.7	288	0.0194	1.45	2.12	8.22	0.0389	2.89	1.00	C	2.12
	3.2 CHS	1.87	0.0845	45.2	8.4	238	0.0170	1.27	1.81	8.46	0.0341	2.53	1.00	C	1.81
	2.6 CHS	1.56	0.0845	54.2	10.3	198	0.0148	1.10	1.54	8.64	0.0296	2.20	1.00	C	1.54
21.3 x	3.6 CHS	1.57	0.0669	42.6	5.9	200	0.00816	0.767	1.14	6.39	0.0163	1.53	1.00	C	1.14
	3.2 CHS	1.43	0.0669	46.8	6.7	182	0.00768	0.722	1.06	6.50	0.0154	1.44	1.00	C	1.06
	2.6 CHS	1.20	0.0669	55.8	8.2	153	0.00681	0.639	0.915	6.68	0.0136	1.28	1.00	C	0.915
17.2 x	2.9 CHS	1.02	0.0540	52.8	5.9	130	0.00347	0.403	0.601	5.16	0.00693	0.806	1.00	C	0.601
	2.3 CHS	0.845	0.0540	63.9	7.5	108	0.00306	0.356	0.515	5.33	0.00612	0.711	1.00	C	0.515
13.5 x	2.9 CHS	0.758	0.0424	55.9	4.7	96.6	0.00146	0.216	0.334	3.89	0.00292	0.432	1.00	C	0.334
	2.3 CHS	0.635	0.0424	66.8	5.9	80.9	0.00132	0.196	0.293	4.04	0.00264	0.392	1.00	C	0.293

Notes: 1. For Grade C250 f_y = 250 MPa and and f_u = 320 MPa.
f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C250 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

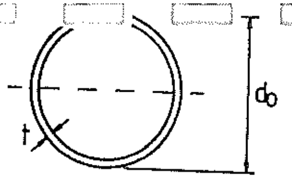
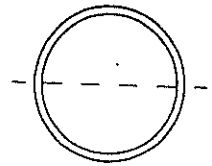


TABLE 1.2 – 2(1)

DIMENSIONS AND PROPERTIES

CIRCULAR HOLLOW SECTIONS: GRADE C350



Designation d_o (mm)	t (mm)	Mass per m (kg/m)	External Surface Area per m (m^2/m)	External Surface Area per t (m^2/t)	$\frac{d_o}{t}$	Gross Section Area A_g (mm^2)	I ($10^6 mm^4$)	Z ($10^3 mm^3$)	S ($10^3 mm^3$)	r (mm)	Torsion Constant J ($10^6 mm^4$)	Torsion Modulus C ($10^3 mm^3$)	Form Factor k_f	Compactness (C,N,S)	Z_e ($10^3 mm^3$)
457.0 x	12.7 CHS	139	1.44	10.3	36.0	17700	438	1920	2510	157	876	3830	1.00	N	2500
	9.5 CHS	105	1.44	13.7	48.1	13400	334	1460	1900	158	669	2930	1.00	N	1790
	6.4 CHS	71.1	1.44	20.2	71.4	9060	230	1010	1300	159	460	2010	0.904	N	1090
406.4 x	12.7 CHS	123	1.28	10.4	32.0	15700	305	1500	1970	139	609	3000	1.00	C	1970
	9.5 CHS	93.0	1.28	13.7	42.8	11800	233	1150	1500	140	467	2300	1.00	N	1450
	6.4 CHS	63.1	1.28	20.2	63.5	8040	161	792	1020	141	322	1580	0.960	N	895
355.6 x	12.7 CHS	107	1.12	10.4	28.0	13700	201	1130	1490	121	403	2260	1.00	C	1490
	9.5 CHS	81.1	1.12	13.8	37.4	10300	155	871	1140	122	310	1740	1.00	N	1130
	6.4 CHS	55.1	1.12	20.3	55.6	7020	107	602	781	123	214	1200	1.00	N	710
323.9 x	12.7 CHS	97.5	1.02	10.4	25.5	12400	151	930	1230	110	301	1860	1.00	C	1230
	9.5 CHS	73.7	1.02	13.8	34.1	9380	116	717	939	111	232	1430	1.00	C	939
	6.4 CHS	50.1	1.02	20.3	50.6	6380	80.5	497	645	112	161	994	1.00	N	601
273.1 x	9.3 CHS	60.5	0.858	14.2	29.4	7710	67.1	492	647	93.3	134	983	1.00	C	647
	6.4 CHS	42.1	0.858	20.4	42.7	5360	47.7	349	455	94.3	95.4	699	1.00	N	441
	4.8 CHS	31.8	0.858	27.0	56.9	4050	36.4	267	346	94.9	72.8	533	1.00	N	312
219.1 x	8.2 CHS	42.6	0.688	16.1	26.7	5430	30.3	276	365	74.6	60.5	552	1.00	C	365
	6.4 CHS	33.6	0.688	20.5	34.2	4280	24.2	221	290	75.2	48.4	442	1.00	C	290
	4.8 CHS	25.4	0.688	27.1	45.6	3230	18.6	169	220	75.8	37.1	339	1.00	N	210
168.3 x	7.1 CHS	28.2	0.529	18.7	23.7	3600	11.7	139	185	57.0	23.4	278	1.00	C	185
	6.4 CHS	25.6	0.529	20.7	26.3	3260	10.7	127	168	57.3	21.4	254	1.00	C	168
	4.8 CHS	19.4	0.529	27.3	35.1	2470	8.25	98.0	128	57.8	16.5	196	1.00	C	128
165.1 x	3.5 CHS	13.9	0.519	37.2	47.2	1780	5.80	70.3	91.4	57.1	11.6	141	1.00	N	86.6
	3.0 CHS	12.0	0.519	43.2	55.0	1530	5.02	60.8	78.8	57.3	10.0	122	1.00	N	71.9
139.7 x	3.5 CHS	11.8	0.439	37.3	39.9	1500	3.47	49.7	64.9	48.2	6.95	99.5	1.00	N	63.7
	3.0 CHS	10.1	0.439	43.4	46.6	1290	3.01	43.1	56.1	48.3	6.02	86.2	1.00	N	53.3
114.3 x	6.0 CHS	16.0	0.359	22.4	19.1	2040	3.00	52.5	70.4	38.3	6.00	105	1.00	C	70.4
	4.8 CHS	13.0	0.359	27.7	23.8	1650	2.48	43.4	57.6	38.8	4.96	86.8	1.00	C	57.6
	3.6 CHS	9.83	0.359	36.5	31.8	1250	1.92	33.6	44.1	39.2	3.84	67.2	1.00	C	44.1
	3.2 CHS	8.77	0.359	41.0	35.7	1120	1.72	30.2	39.5	39.3	3.45	60.4	1.00	N	39.5

Notes:
1. For Grade C350 f_y = 350 MPa and f_u = 430 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

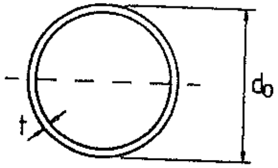
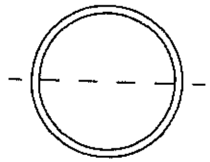


TABLE 1.2 – 2(2)

DIMENSIONS AND PROPERTIES

CIRCULAR HOLLOW SECTIONS: GRADE C350



DIMENSIONS AND RATIOS						PROPERTIES							PROPERTIES FOR DESIGN TO AS 4100		
Designation		Mass per m	External Surface Area		$\frac{d_o}{t}$	Gross Section Area	About any axis				Torsion Constant	Torsion Modulus	Form Factor	About any axis	
d_o	t		per m	per t		A_g	I	Z	S	r	J	C	k_f	Compactness	Z_e
mm	mm	kg/m	m^2/m	m^2/t		mm^2	10^6mm^4	10^3mm^3	10^3mm^3	mm	10^6mm^4	10^3mm^3		(C,N,S)	10^3mm^3
101.6 x	3.2 CHS	7.77	0.319	41.1	31.8	989	1.20	23.6	31.0	34.8	2.40	47.2	1.00	C	31.0
	2.6 CHS	6.35	0.319	50.3	39.1	809	0.991	19.5	25.5	35.0	1.98	39.0	1.00	N	25.1
88.9 x	5.5 CHS	11.3	0.279	24.7	16.2	1440	1.26	28.3	38.3	29.6	2.52	56.6	1.00	C	38.3
	4.8 CHS	9.96	0.279	28.1	18.5	1270	1.12	25.3	34.0	29.8	2.25	50.6	1.00	C	34.0
	3.2 CHS	6.76	0.279	41.3	27.8	862	0.792	17.8	23.5	30.3	1.58	35.6	1.00	C	23.5
	2.6 CHS	5.53	0.279	50.5	34.2	705	0.657	14.8	19.4	30.5	1.31	29.6	1.00	C	19.4
76.1 x	3.2 CHS	5.75	0.239	41.6	23.8	733	0.488	12.8	17.0	25.8	0.976	25.6	1.00	C	17.0
	2.3 CHS	4.19	0.239	57.1	33.1	533	0.363	9.55	12.5	26.1	0.727	19.1	1.00	C	12.5
60.3 x	2.9 CHS	4.11	0.189	46.1	20.8	523	0.216	7.16	9.56	20.3	0.432	14.3	1.00	C	9.56
	2.3 CHS	3.29	0.189	57.6	26.2	419	0.177	5.85	7.74	20.5	0.353	11.7	1.00	C	7.74
48.3 x	2.9 CHS	3.25	0.152	46.7	16.7	414	0.107	1.43	5.99	16.1	0.214	8.86	1.00	C	5.99
	2.3 CHS	2.61	0.152	58.2	21.0	332	0.0881	3.65	4.87	16.3	0.176	7.30	1.00	C	4.87
42.4 x	2.6 CHS	2.55	0.133	52.2	16.3	325	0.0646	3.05	4.12	14.1	0.129	6.10	1.00	C	4.12
	2.0 CHS	1.99	0.133	66.8	21.2	254	0.0519	2.45	3.27	14.3	0.104	4.90	1.00	C	3.27
33.7 x	2.6 CHS	1.99	0.106	53.1	13.0	254	0.0309	1.84	2.52	11.0	0.0619	3.67	1.00	C	2.52
	2.0 CHS	1.56	0.106	67.7	16.9	199	0.0251	1.49	2.01	11.2	0.0502	2.98	1.00	C	2.01
26.9 x	2.3 CHS	1.40	0.0845	60.6	11.7	178	0.0136	1.01	1.40	8.74	0.0271	2.02	1.00	C	1.40
	2.0 CHS	1.23	0.0845	68.8	13.5	156	0.0122	0.907	1.24	8.83	0.0244	1.81	1.00	C	1.24
21.3 x	2.0 CHS	0.952	0.0669	70.3	10.7	121	0.00571	0.536	0.748	6.86	0.0114	1.07	1.00	C	0.748

Notes:
1. For Grade C350 f_y = 350 MPa and and f_u = 430 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

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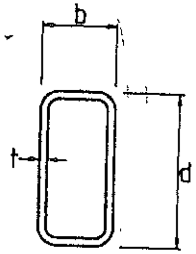
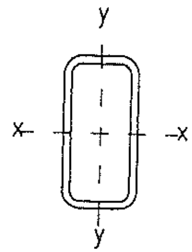


TABLE 1.2–3(1)

DIMENSIONS AND PROPERTIES
RECTANGULAR HOLLOW SECTIONS: GRADE C350



DIMENSIONS AND RATIOS									PROPERTIES											PROPERTIES FOR DESIGN TO AS 4100					
Designation			Mass per m	External Surface Area		$\frac{b-2t}{t}$	$\frac{d-2t}{t}$	Gross Section Area	About x-axis				About y-axis				Torsion Constant	Torsion Modulus	Form Factor	About x-axis		About y-axis		
d	b	t		per m	per t			A_g	I_x	Z_x	S_x	r_x	I_y	Z_y	S_y	r_y	J	C	k_f	Compact-ness	Z_{ex}	Compact-ness	Z_{ey}
mm	mm	mm	kg/m	m^2/m	m^2/t			mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$		(C,N,S)	$10^3 mm^3$	(C,N,S)	$10^3 mm^3$
250 x	150 x	9.0 RHS	51.8	0.761	14.7	14.7	25.8	6600	53.7	430	533	90.2	24.3	324	375	60.7	56.0	554	1.00	C	533	N	373
		6.0 RHS	35.6	0.774	21.8	23.0	39.7	4530	38.4	307	374	92.0	17.5	233	264	62.2	39.0	395	0.907	C	374	S	208
		5.0 RHS	29.9	0.779	26.0	28.0	48.0	3810	32.7	262	317	92.6	15.0	199	224	62.6	33.0	337	0.814	N	300	S	156
200 x	100 x	9.0 RHS	37.7	0.561	14.9	9.11	20.2	4800	22.8	228	293	68.9	7.64	153	180	39.9	19.9	272	1.00	C	293	C	180
		6.0 RHS	26.2	0.574	22.0	14.7	31.3	3330	16.7	167	210	70.8	5.69	114	130	41.3	14.2	200	1.00	C	210	N	119
		5.0 RHS	22.1	0.579	26.2	18.0	38.0	2810	14.4	144	179	71.5	4.92	98.3	111	41.8	12.1	172	0.925	C	179	S	90.1
		4.0 RHS	17.9	0.583	32.5	23.0	48.0	2280	11.9	119	147	72.1	4.07	81.5	91.0	42.3	9.89	142	0.801	C	147	S	63.1
150 x	100 x	6.0 RHS	21.4	0.474	22.1	14.7	23.0	2730	8.17	109	134	54.7	4.36	87.3	102	40.0	9.51	147	1.00	C	134	C	102
		5.0 RHS	18.2	0.479	26.3	18.0	28.0	2310	7.07	94.3	115	55.3	3.79	75.7	87.3	40.4	8.12	127	1.00	C	115	N	83.6
		4.0 RHS	14.8	0.483	32.7	23.0	35.5	1880	5.87	78.2	94.6	55.9	3.15	63.0	71.8	40.9	6.64	105	0.971	C	94.6	S	60.9
150 x	50 x	5.0 RHS	14.2	0.379	26.6	8.00	28.0	1810	4.44	59.2	78.9	49.5	0.765	30.6	35.7	20.5	2.30	56.8	1.00	C	78.9	N	34.1
		4.0 RHS	11.6	0.383	32.9	10.5	35.5	1480	3.74	49.8	65.4	50.2	0.653	26.1	29.8	21.0	1.93	48.2	0.963	C	65.4	S	25.1
		3.0 RHS	8.96	0.390	43.5	14.7	48.0	1140	2.99	39.8	51.4	51.2	0.526	21.1	23.5	21.5	1.50	38.3	0.776	C	51.4	S	16.0
125 x	75 x	6.0 RHS	16.7	0.374	22.4	10.5	18.8	2130	4.16	66.6	84.2	44.2	1.87	50.0	59.1	29.6	4.44	86.2	1.00	C	84.2	C	59.1
		5.0 RHS	14.2	0.379	26.6	13.0	23.0	1810	3.64	58.3	72.7	44.8	1.65	43.9	51.1	30.1	4.44	86.2	1.00	C	72.7	C	51.1
		4.0 RHS	11.6	0.383	32.9	16.8	29.3	1480	3.05	48.9	60.3	45.4	1.39	37.0	42.4	30.6	3.16	63.0	1.00	C	60.3	N	39.9
		3.0 RHS	8.96	0.390	43.5	23.0	39.7	1140	2.43	38.9	47.3	46.1	1.11	29.5	33.3	31.1	2.43	49.5	0.908	C	47.3	S	26.3
100 x	50 x	6.0 RHS	12.0	0.274	22.8	6.33	14.7	1530	1.71	34.2	45.3	33.4	0.567	22.7	27.7	19.2	1.53	40.9	1.00	C	45.3	C	27.7
		5.0 RHS	10.3	0.279	27.0	8.00	18.0	1310	1.53	30.6	39.8	34.1	0.511	20.4	24.4	19.7	1.35	36.5	1.00	C	39.8	C	24.4
		4.0 RHS	8.49	0.283	33.3	10.5	23.0	1080	1.31	26.1	33.4	34.8	0.441	17.6	20.6	20.2	1.13	31.2	1.00	C	33.4	C	20.6
		3.5 RHS	7.53	0.285	37.9	12.3	26.6	959	1.18	23.6	29.9	35.1	0.400	16.0	18.5	20.4	1.01	28.2	1.00	C	29.9	N	18.1
		3.0 RHS	6.60	0.290	43.9	14.7	31.3	841	1.06	21.3	26.7	35.6	0.361	14.4	16.4	20.7	0.886	25.0	1.00	C	26.7	N	15.0
		2.5 RHS	5.56	0.291	52.4	18.0	38.0	709	0.912	18.2	22.7	35.9	0.311	12.4	14.0	20.9	0.754	21.5	0.926	C	22.7	S	11.4
		2.0 RHS	4.50	0.293	65.1	23.0	48.0	574	0.750	15.0	18.5	36.2	0.257	10.3	11.5	21.2	0.616	17.7	0.802	C	18.5	S	7.98

Notes:
1. For Grade C350 f_y = 350 MPa and and f_u = 430 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

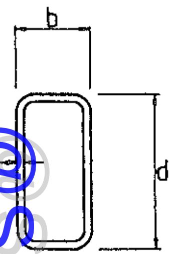
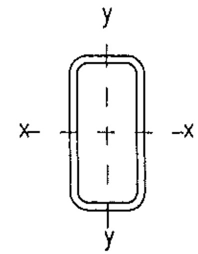


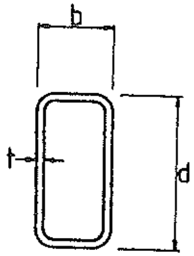
TABLE 1.2–3(2)

DIMENSIONS AND PROPERTIES
RECTANGULAR HOLLOW SECTIONS: GRADE C350



Designation d × b × t (mm × mm × mm)	Mass per m (kg/m)	External Surface Area per m (m^2/m)	External Surface Area per t (m^2/t)	$\frac{b-2t}{t}$	$\frac{d-2t}{t}$	Gross Section Area A_g (mm^2)	About x-axis I_x ($10^6 mm^4$)	Z_x ($10^3 mm^3$)	S_x ($10^3 mm^3$)	r_x (mm)	About y-axis I_y ($10^6 mm^4$)	Z_y ($10^3 mm^3$)	S_y ($10^3 mm^3$)	r_y (mm)	Torsion Constant J ($10^6 mm^4$)	Torsion Modulus C ($10^3 mm^3$)	Form Factor k_f	About x-axis Compactness (C,N,S)	Z_{ex} ($10^3 mm^3$)	About y-axis Compactness (C,N,S)	Z_{ey} ($10^3 mm^3$)
75 x 50 x 6.0 RHS	9.67	0.224	23.2	6.33	10.5	1230	0.800	21.3	28.1	25.5	0.421	16.9	21.1	18.5	1.01	29.3	1.00	C	28.1	C	21.1
5.0 RHS	8.35	0.229	27.4	8.00	13.0	1060	0.726	19.4	24.9	26.1	0.384	15.4	18.8	19.0	0.891	26.4	1.00	C	24.9	C	18.8
4.0 RHS	6.92	0.233	33.7	10.5	16.8	881	0.630	16.8	21.1	26.7	0.335	13.4	16.0	19.5	0.754	22.7	1.00	C	21.1	C	16.0
3.0 RHS	5.42	0.240	44.2	14.7	23.0	691	0.522	13.9	17.1	27.5	0.278	11.1	12.9	20.0	0.593	18.4	1.00	C	17.1	C	12.9
2.5 RHS	4.58	0.241	52.7	18.0	28.0	584	0.450	12.0	14.6	27.7	0.240	9.60	11.0	20.3	0.505	15.9	1.00	C	14.6	N	10.6
2.0 RHS	3.72	0.243	65.4	23.0	35.5	474	0.372	9.91	12.0	28.0	0.199	7.96	9.06	20.5	0.414	13.1	0.971	C	12.0	S	7.70
75 x 25 x 2.5 RHS	3.60	0.191	53.1	8.00	28.0	459	0.285	7.60	10.1	24.9	0.0487	3.89	4.53	10.3	0.144	7.14	1.00	C	10.1	N	4.33
2.0 RHS	2.93	0.193	65.8	10.5	35.5	374	0.238	6.36	8.31	25.3	0.0414	3.31	3.77	10.5	0.120	6.04	0.964	C	8.31	S	3.18
1.6 RHS	2.38	0.195	81.7	13.6	44.9	303	0.197	5.26	6.81	25.5	0.0347	2.78	3.11	10.7	0.0993	5.05	0.813	C	6.81	S	2.22
65 x 35 x 3.0 RHS	4.25	0.190	44.7	9.67	19.7	541	0.281	8.65	11.0	22.8	0.106	6.04	7.11	14.0	0.259	10.4	1.00	C	11.0	C	7.11
2.5 RHS	3.60	0.191	53.1	12.0	24.0	459	0.244	7.52	9.45	23.1	0.0926	5.29	6.13	14.2	0.223	9.10	1.00	C	9.45	C	6.13
2.0 RHS	2.93	0.193	65.8	15.5	30.5	374	0.204	6.28	7.80	23.4	0.0778	4.44	5.07	14.4	0.184	7.62	1.00	C	7.80	N	4.69
50 x 25 x 3.0 RHS	3.07	0.140	45.5	6.33	14.7	391	0.112	4.47	5.86	16.9	0.0367	2.93	3.56	9.69	0.0964	5.18	1.00	C	5.86	C	3.56
2.5 RHS	2.62	0.141	54.0	8.00	18.0	334	0.0989	3.95	5.11	17.2	0.0328	2.62	3.12	9.91	0.0843	4.60	1.00	C	5.11	C	3.12
2.0 RHS	2.15	0.143	66.6	10.5	23.0	274	0.0838	3.35	4.26	17.5	0.0281	2.25	2.62	10.1	0.0706	3.92	1.00	C	4.26	C	2.62
1.6 RHS	1.75	0.145	82.5	13.6	29.3	223	0.0702	2.81	3.53	17.7	0.0237	1.90	2.17	10.3	0.0585	3.29	1.00	C	3.53	N	2.05
50 x 20 x 3.0 RHS	2.83	0.130	45.8	4.67	14.7	361	0.0951	3.81	5.16	16.2	0.0212	2.12	2.63	7.67	0.0620	3.88	1.00	C	5.16	C	2.63
2.5 RHS	2.42	0.131	54.2	6.00	18.0	309	0.0848	3.39	4.51	16.6	0.0192	1.92	2.32	7.89	0.0550	3.49	1.00	C	4.51	C	2.32
2.0 RHS	1.99	0.133	66.8	8.00	23.0	254	0.0723	2.89	3.78	16.9	0.0167	1.67	1.96	8.11	0.0466	3.00	1.00	C	3.78	C	1.96
1.6 RHS	1.63	0.135	82.7	10.5	29.3	207	0.0608	2.43	3.14	17.1	0.0142	1.42	1.63	8.29	0.0389	2.55	1.00	C	3.14	N	1.54

Notes:
1. For Grade C350 f_y = 350 MPa and and f_u = 430 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.



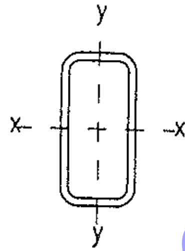


TABLE 1.2–4

DIMENSIONS AND PROPERTIES
RECTANGULAR HOLLOW SECTIONS: GRADE C450

DIMENSIONS AND RATIOS						PROPERTIES												PROPERTIES FOR DESIGN TO AS 4100				
Designation d b t	Mass per m	External Surface Area per m	External Surface Area per t	(b – 2t)/t	(d – 2t)/t	Gross Section Area A_g	About x-axis I_x	Z_x	S_x	r_x	About y-axis I_y	Z_y	S_y	r_y	Torsion Constant J	Torsion Modulus C	Form Factor k_f	About x-axis Compactness	Z_{ex}	About y-axis Compactness	Z_{ey}
mm mm mm	kg/m	m^2/m	m^2/t			mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$		(C,N,S)	$10^3 mm^3$	(C,N,S)	$10^3 mm^3$
125 x 75 x 3.8 RHS	11.1	0.384	34.6	17.7	30.9	1410	2.93	46.8	57.7	45.5	1.33	35.5	40.6	30.7	3.02	60.4	0.978	C	57.7	S	34.6
3.3 RHS	9.73	0.386	39.7	20.7	35.9	1240	2.60	41.6	50.9	45.8	1.19	31.6	35.9	30.9	2.66	53.6	0.893	C	50.9	S	27.7
2.8 RHS	8.39	0.390	46.5	24.8	42.6	1070	2.29	36.6	44.4	46.2	1.04	27.8	31.3	31.2	2.28	46.6	0.812	N	41.8	S	21.7
2.3 RHS	6.95	0.392	56.4	30.6	52.3	885	1.92	30.6	37.0	46.5	0.875	23.3	26.1	31.4	1.90	39.1	0.721	C	30.2	S	16.1
100 x 50 x 3.3 RHS	7.14	0.288	40.1	13.2	28.3	909	1.13	22.6	28.5	35.2	0.383	15.3	17.6	20.5	0.964	26.9	1.00	C	28.5	N	15.8
2.8 RHS	6.19	0.290	46.9	15.9	33.7	788	1.00	20.1	25.1	35.7	0.341	13.6	15.5	20.8	0.834	23.6	0.922	C	25.1	S	12.5
2.3 RHS	5.14	0.292	56.8	19.7	41.5	655	0.848	17.0	21.0	36.0	0.290	11.6	13.0	21.0	0.699	20.0	0.812	C	21.0	S	9.12
75 x 50 x 2.8 RHS	5.09	0.240	47.2	15.9	24.8	648	0.493	13.2	16.1	27.6	0.263	10.5	12.2	20.1	0.558	17.4	1.00	C	16.1	N	11.6
2.3 RHS	4.24	0.242	57.1	19.7	30.6	540	0.419	11.2	13.6	27.9	0.224	8.96	10.3	20.4	0.469	14.8	0.984	C	13.6	S	8.80
65 x 35 x 2.8 RHS	3.99	0.190	47.7	10.5	21.2	508	0.267	8.21	10.4	22.9	0.101	5.75	6.73	14.1	0.245	9.92	1.00	C	10.4	C	6.73
2.3 RHS	3.34	0.192	57.6	13.2	26.3	425	0.229	7.04	8.81	23.2	0.0869	4.96	5.72	14.3	0.208	8.53	1.00	C	8.81	N	5.32
50 x 25 x 2.8 RHS	2.89	0.140	48.5	6.93	15.9	368	0.107	4.27	5.57	17.0	0.0352	2.82	3.39	9.78	0.0917	4.96	1.00	C	5.57	C	3.39
2.3 RHS	2.44	0.142	58.4	8.87	19.7	310	0.0931	3.72	4.78	17.3	0.0310	2.48	2.92	10.0	0.0790	4.34	1.00	C	4.78	C	2.92
50 x 20 x 2.8 RHS	2.67	0.130	48.8	5.14	15.9	340	0.0912	3.65	4.91	16.4	0.0205	2.05	2.51	7.76	0.594	3.73	1.00	C	4.91	C	2.51
2.3 RHS	2.25	0.132	58.6	6.70	19.7	287	0.0800	3.20	4.23	16.7	0.0183	1.83	2.18	7.98	0.0518	3.31	1.00	C	4.23	C	2.18

Notes: 1. For Grade C450 f_y = 450 MPa and and f_u = 500 MPa.
f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C450 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

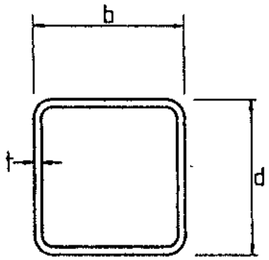
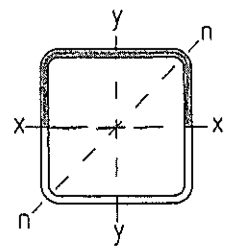


TABLE 1.2 – 5(1)

DIMENSIONS AND PROPERTIES

SQUARE HOLLOW SECTIONS: GRADE C350



DIMENSIONS AND RATIOS					PROPERTIES								PROPERTIES FOR DESIGN TO AS 4100		
Designation d b t	Mass per m	External Surface Area per m	External Surface Area per t	$\frac{b-2t}{t}$	Gross Section Area A_g	About x-, y-, and n-axis I_x	Z_x	Z_n	S_x	r_x	Torsion Constant J	Torsion Modulus C	Form Factor k_f	About x- and y-axis Compactness	Z_e
mm mm mm	kg/m	m^2/m	m^2/t		mm^2	10^6mm^4	10^3mm^3	10^3mm^3	10^3mm^3	mm	10^6mm^4	10^3mm^3		(C,N,S)	10^3mm^3
250 x 250 x 9.0 SHS	65.9	0.961	14.8	25.8	8400	79.8	639	477	750	97.5	129	972	1.00	N	744
6.0 SHS	45.0	0.974	21.7	39.7	5730	56.2	450	330	521	99.0	88.7	681	0.853	S	409
200 x 200 x 9.0 SHS	51.8	0.761	14.7	20.2	6600	39.2	392	297	465	77.1	64.5	599	1.00	C	465
6.0 SHS	35.6	0.774	21.8	31.3	4530	28.0	280	207	327	78.6	44.8	425	1.00	N	294
5.0 SHS	29.9	0.779	26.0	38.0	3810	23.9	239	175	277	79.1	37.8	362	0.890	S	223
150 x 150 x 9.0 SHS	37.7	0.561	14.9	14.7	4800	15.4	205	159	248	56.6	26.1	316	1.00	C	248
6.0 SHS	26.2	0.574	22.0	23.0	3330	11.3	150	113	178	58.2	18.4	229	1.00	C	178
5.0 SHS	22.1	0.579	28.2	28.0	2810	9.70	129	96.1	151	58.7	15.6	197	1.00	N	144
125 x 125 x 9.0 SHS	30.6	0.461	15.1	11.9	3900	8.38	134	106	165	46.4	14.5	208	1.00	C	165
6.0 SHS	21.4	0.474	22.1	18.8	2730	6.29	101	76.5	120	48.0	10.4	154	1.00	C	120
5.0 SHS	18.2	0.479	26.3	23.0	2310	5.44	87.1	65.4	103	48.5	8.87	133	1.00	C	103
4.0 SHS	14.8	0.483	32.7	29.3	1880	4.52	72.3	53.6	84.5	49.0	7.25	110	1.00	N	78.9
100 x 100 x 9.0 SHS	23.5	0.361	15.4	9.11	3000	3.91	78.1	63.6	98.6	36.1	7.00	123	1.00	C	98.6
6.0 SHS	16.7	0.374	22.4	14.7	2130	3.04	60.7	47.1	73.5	37.7	5.15	93.6	1.00	C	73.5
5.0 SHS	14.2	0.379	26.6	18.0	1810	2.66	53.1	40.5	63.5	38.3	4.42	81.4	1.00	C	63.5
4.0 SHS	11.6	0.383	32.9	23.0	1480	2.23	44.6	33.5	52.6	38.8	3.63	68.0	1.00	C	52.6
3.0 SHS	8.96	0.390	43.5	31.3	1140	1.77	35.4	26.0	41.2	39.4	2.79	53.2	1.00	N	37.1
89 x 89 x 6.0 SHS	14.6	0.330	22.5	12.8	1870	2.06	46.2	36.3	56.6	33.2	3.54	71.6	1.00	C	56.6
5.0 SHS	12.5	0.334	26.7	15.8	1590	1.81	40.7	31.4	49.1	33.7	3.05	62.7	1.00	C	49.1
3.5 SHS	9.06	0.341	37.6	23.4	1150	1.37	30.9	23.2	36.5	34.5	2.24	47.1	1.00	C	36.5
75 x 75 x 6.0 SHS	12.0	0.274	22.8	10.5	1530	1.16	30.9	24.7	38.4	27.5	2.04	48.2	1.00	C	38.4
5.0 SHS	10.3	0.279	27.0	13.0	1310	1.03	27.5	21.6	33.6	28.0	1.77	42.6	1.00	C	33.6
4.0 SHS	8.49	0.283	33.3	16.8	1080	0.882	23.5	18.0	28.2	28.6	1.48	36.1	1.00	C	28.2
3.5 SHS	7.53	0.285	37.9	19.4	959	0.797	21.3	16.1	25.3	28.8	1.32	32.5	1.00	C	25.3
3.0 SHS	6.60	0.290	43.9	23.0	841	0.716	19.1	14.2	22.5	29.2	1.15	28.7	1.00	C	22.5
2.5 SHS	5.56	0.291	52.4	28.0	709	0.614	16.4	12.0	19.1	29.4	0.971	24.6	1.00	N	18.3

Notes:
1. For Grade C350 f_y = 350 MPa and and f_u = 430 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

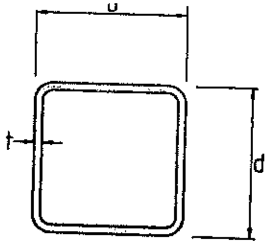
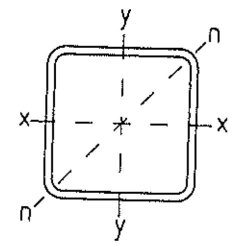


TABLE 1.2 – 5(2)

DIMENSIONS AND PROPERTIES

SQUARE HOLLOW SECTIONS: GRADE C350



DIMENSIONS AND RATIOS					PROPERTIES								PROPERTIES FOR DESIGN – TO AS 4100		
Designation	Mass per m	External Surface Area		$\frac{b-2t}{t}$	Gross Section Area	About x-, y-, and n-axis					Torsion Constant	Torsion Modulus	Form Factor	About x- and y-axis	
d b t		per m	per t		A_g	I_x	Z_x	Z_n	S_x	r_x	J	C	k_f	Compactness	Z_e
mm mm mm	kg/m	m^2/m	m^2/t		mm^2	10^6mm^4	10^3mm^3	10^3mm^3	10^3mm^3	mm	10^6mm^4	10^3mm^3		(C,N,S)	10^3mm^3
65 x 65 x 6.0 SHS	10.1	0.234	23.1	8.83	1290	0.706	21.7	17.8	27.5	23.4	1.27	34.2	1.00	C	27.5
5.0 SHS	8.75	0.239	27.3	11.0	1110	0.638	19.6	15.6	24.3	23.9	1.12	30.6	1.00	C	24.3
4.0 SHS	7.23	0.243	33.6	14.3	921	0.552	17.0	13.2	20.6	24.5	0.939	26.2	1.00	C	20.6
3.0 SHS	5.66	0.250	44.1	19.7	721	0.454	14.0	10.4	16.6	25.1	0.733	21.0	1.00	C	16.6
2.5 SHS	4.78	0.251	52.6	24.0	609	0.391	12.0	8.91	14.1	25.3	0.624	18.1	1.00	C	14.1
2.0 SHS	3.88	0.253	65.3	30.5	494	0.323	9.94	7.29	11.6	25.6	0.509	14.9	1.00	N	10.6
50 x 50 x 5.0 SHS	6.39	0.179	27.9	8.00	814	0.257	10.3	8.51	13.2	17.8	0.469	16.3	1.00	C	13.2
4.0 SHS	5.35	0.183	34.2	10.5	681	0.229	9.15	7.33	11.4	18.3	0.403	14.3	1.00	C	11.4
3.0 SHS	4.25	0.190	44.7	14.7	541	0.195	7.79	5.92	9.39	19.0	0.321	11.8	1.00	C	9.39
2.5 SHS	3.60	0.191	53.1	18.0	459	0.169	6.78	5.09	8.07	19.2	0.275	10.2	1.00	C	8.07
2.0 SHS	2.93	0.193	65.8	23.0	374	0.141	5.66	4.20	6.66	19.5	0.226	8.51	1.00	C	6.66
1.6 SHS	2.38	0.195	81.7	29.3	303	0.117	4.68	3.44	5.46	19.6	0.185	7.03	1.00	N	5.10
40 x 40 x 4.0 SHS	4.09	0.143	34.9	8.00	521	0.105	5.26	4.36	6.74	14.2	0.192	8.33	1.00	C	6.74
3.0 SHS	3.30	0.150	45.3	11.3	421	0.0932	4.66	3.61	5.72	14.9	0.158	7.07	1.00	C	5.72
2.5 SHS	2.82	0.151	53.7	14.0	359	0.0822	4.11	3.13	4.97	15.1	0.136	6.21	1.00	C	4.97
2.0 SHS	2.31	0.153	66.4	18.0	294	0.0694	3.47	2.61	4.13	15.4	0.113	5.23	1.00	C	4.13
1.6 SHS	1.88	0.155	82.3	23.0	239	0.0579	2.90	2.15	3.41	15.6	0.0927	4.36	1.00	C	3.41
35 x 35 x 3.0 SHS	2.83	0.130	45.8	9.67	361	0.0595	3.40	2.67	4.23	12.8	0.102	5.18	1.00	C	4.23
2.5 SHS	2.42	0.131	54.2	12.0	309	0.0529	3.02	2.33	3.69	13.1	0.0889	4.58	1.00	C	3.69
2.0 SHS	1.99	0.133	66.8	15.5	254	0.0451	2.58	1.95	3.09	13.3	0.0741	3.89	1.00	C	3.09
1.6 SHS	1.63	0.135	82.7	19.9	207	0.0379	2.16	1.62	2.57	13.5	0.0611	3.26	1.00	C	2.57
30 x 30 x 3.0 SHS	2.36	0.110	46.5	8.0	301	0.0350	2.34	1.87	2.96	10.8	0.0615	3.58	1.00	C	2.96
2.5 SHS	2.03	0.111	54.8	10.0	259	0.0316	2.10	1.65	2.61	11.0	0.0540	3.20	1.00	C	2.61
2.0 SHS	1.68	0.113	67.4	13.0	214	0.0272	1.81	1.39	2.21	11.3	0.0454	2.75	1.00	C	2.21
1.6 SHS	1.38	0.115	83.3	16.8	175	0.0231	1.54	1.16	1.84	11.5	0.0377	2.32	1.00	C	1.84
25 x 25 x 3.0 SHS	1.89	0.0897	47.4	6.33	241	0.0184	1.47	1.21	1.91	8.74	0.0333	2.27	1.00	C	1.91
2.5 SHS	1.64	0.0914	55.7	8.00	209	0.0169	1.35	1.08	1.71	8.99	0.0297	2.07	1.00	C	1.71
2.0 SHS	1.36	0.0931	68.3	10.5	174	0.0148	1.19	0.926	1.47	9.24	0.0253	1.80	1.00	C	1.47
1.6 SHS	1.12	0.0945	84.1	13.6	143	0.0128	1.02	0.780	1.24	9.44	0.0212	1.54	1.00	C	1.24
20 x 20 x 1.6 SHS	0.873	0.0745	85.4	10.5	111	0.00608	0.608	0.474	0.751	7.39	0.0103	0.924	1.00	C	0.751

Notes: 1. For Grade C350 f_y = 350 MPa and and f_u = 430 MPa.
f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C350 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

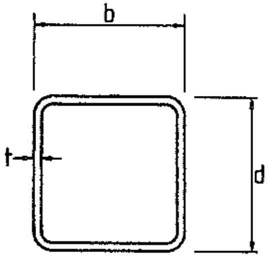
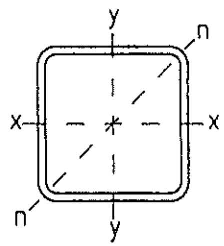


TABLE 1.2 – 6

DIMENSIONS AND PROPERTIES
SQUARE HOLLOW SECTIONS: GRADE C450



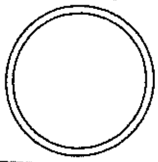
DIMENSIONS AND RATIOS					PROPERTIES								PROPERTIES FOR DESIGN – TO AS 4100		
Designation d b t	Mass per m	External Surface Area per m	External Surface Area per t	$\frac{b-2t}{t}$	Gross Section Area A_g	About x-, y-, and n-axis I_x	Z_x	Z_n	S_x	r_x	Torsion Constant J	Torsion Modulus C	Form Factor k_f	About x- and y-axis Compactness	Z_e
mm mm mm	kg/m	m^2/m	m^2/t		mm^2	10^6mm^4	10^3mm^3	10^3mm^3	10^3mm^3	mm	10^6mm^4	10^3mm^3		(C,N,S)	10^3mm^3
100 x 100 x 3.8 SHS	11.1	0.384	34.6	24.3	1410	2.14	42.7	32.0	50.3	38.9	3.47	65.1	1.00	N	48.3
3.3 SHS	9.73	0.386	39.7	28.3	1240	1.90	38.0	28.2	44.5	39.2	3.05	57.7	1.00	N	39.3
2.8 SHS	8.39	0.390	46.5	33.7	1070	1.67	33.3	24.4	38.7	39.5	2.61	50.0	0.886	S	31.0
2.3 SHS	6.95	0.392	56.4	41.5	885	1.40	27.9	20.3	32.3	39.7	2.17	41.9	0.721	S	23.1
75 x 75 x 3.3 SHS	7.14	0.286	40.1	20.7	909	0.761	20.3	15.3	24.1	28.9	1.25	31.0	1.00	C	24.1
2.8 SHS	6.19	0.290	46.9	24.8	788	0.676	18.0	13.3	21.2	29.3	1.08	27.1	1.00	N	20.1
2.3 SHS	5.14	0.292	56.8	30.6	655	0.571	15.2	11.2	17.7	29.5	0.900	22.9	0.974	S	15.0
65 x 65 x 2.8 SHS	5.31	0.250	47.2	21.2	676	0.429	13.2	9.84	15.6	25.2	0.690	19.9	1.00	C	15.6
2.3 SHS	4.42	0.252	57.0	26.3	563	0.364	11.2	8.27	13.1	25.4	0.579	16.9	1.00	N	12.1
50 x 50 x 2.8 SHS	3.99	0.190	47.7	15.9	508	0.185	7.40	5.60	8.87	19.1	0.303	11.2	1.00	C	8.87
2.3 SHS	3.34	0.192	57.6	19.7	425	0.159	6.34	4.74	7.52	19.3	0.256	9.55	1.00	C	7.52
40 x 40 x 2.8 SHS	3.11	0.150	48.3	12.3	396	0.0890	4.45	3.43	5.43	15.0	0.149	6.74	1.00	C	5.43
2.3 SHS	2.62	0.152	58.1	15.4	333	0.0773	3.86	2.93	4.64	15.2	0.127	5.83	1.00	C	4.64
35 x 35 x 2.8 SHS	2.67	0.130	48.8	10.5	340	0.0570	3.26	2.54	4.02	12.9	0.097	4.95	1.00	C	4.02
2.3 SHS	2.25	0.132	58.6	13.2	287	0.0499	2.85	2.19	3.46	13.2	0.0831	4.32	1.00	C	3.46
30 x 30 x 2.8 SHS	2.23	0.110	49.4	8.71	284	0.0337	2.25	1.79	2.83	10.9	0.0586	3.44	1.00	C	2.83
2.3 SHS	1.89	0.112	59.2	11.0	241	0.0299	2.00	1.55	2.45	11.1	0.0507	3.03	1.00	C	2.45
25 x 25 x 2.3 SHS	1.53	0.0921	60.1	8.87	195	0.0161	1.29	1.02	1.62	9.09	0.0280	1.97	1.00	C	1.62

Notes:
1. For Grade C450 f_y = 450 MPa and and f_u = 500 MPa.
   f_y = yield stress used in design; f_u = tensile strength used in design; as defined in AS 4100.
2. Grade C450 to AS 1163 is cold formed and therefore is allocated the CF residual stresses classification in AS 4100.
3. C = Compact Section; N = Non-compact Section; S = Slender Section; as defined in AS 4100.

TABLE 1.3-1

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
CIRCULAR HOLLOW SECTIONS: GRADE C250

1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP



Designation d_o	t	Mass per m	1	2	3	4	5	6
mm	mm	kg/m						
610.0 x	12.7 CHS	187	10.2	—	11.1	—	—	—
	9.5 CHS	141	13.6	—	14.7	—	—	—
	6.4 CHS	95.3	20.1	—	21.8	—	—	—
508.0 x	12.7 CHS	155	10.3	—	11.3	—	—	—
	9.5 CHS	117	13.7	—	15.0	—	—	—
	6.4 CHS	79.2	20.2	—	22.1	—	—	—
165.1 x	5.4 CHS	21.3	24.4	—	31.8	—	—	—
	5.0 CHS	19.7	26.3	—	34.2	—	—	—
139.7 x	5.4 CHS	17.9	24.5	—	33.3	—	—	—
	5.0 CHS	16.6	26.4	—	35.9	—	—	—
114.3 x	5.4 CHS	14.5	24.8	—	35.6	—	—	—
	4.5 CHS	12.2	29.5	—	42.4	—	—	—
101.6 x	5.0 CHS	11.9	26.8	—	40.0	—	—	—
	4.0 CHS	9.63	33.2	—	49.5	—	—	—
88.9 x	5.9 CHS	12.1	23.1	—	36.1	—	—	—
	5.0 CHS	10.3	27.0	—	42.2	—	—	—
	4.0 CHS	8.38	33.3	—	52.1	—	—	—
76.1 x	5.9 CHS	10.2	23.4	—	38.8	—	—	—
	4.5 CHS	7.95	30.1	—	49.9	—	—	—
	3.6 CHS	6.44	37.1	—	61.5	—	—	—
60.3 x	5.4 CHS	7.31	25.9	—	47.4	—	—	—
	4.5 CHS	6.19	30.6	—	56.0	—	—	—
	3.6 CHS	5.03	37.6	—	68.8	—	—	—
48.3 x	5.4 CHS	5.71	26.6	—	54.1	—	—	—
	4.0 CHS	4.37	34.7	—	70.7	—	—	—
	3.2 CHS	3.56	42.6	—	86.8	—	—	—
42.4 x	4.9 CHS	4.53	29.4	—	64.1	—	—	—
	4.0 CHS	3.79	35.2	—	76.6	—	—	—
	3.2 CHS	3.09	43.1	—	93.8	—	—	—
33.7 x	4.5 CHS	3.24	32.7	—	81.1	—	—	—
	4.0 CHS	2.93	36.1	—	89.8	—	—	—
	3.2 CHS	2.41	44.0	—	109	—	—	—
26.9 x	4.0 CHS	2.26	37.4	—	107	—	—	—
	3.2 CHS	1.87	45.2	—	129	—	—	—
	2.6 CHS	1.56	54.2	—	155	—	—	—
21.3 x	3.6 CHS	1.57	42.6	—	143	—	—	—
	3.2 CHS	1.43	46.8	—	157	—	—	—
	2.6 CHS	1.20	55.8	—	187	—	—	—
17.2 x	2.9 CHS	1.02	52.8	—	206	—	—	—
	2.3 CHS	0.845	63.9	—	250	—	—	—
13.5 x	2.9 CHS	0.758	55.9	—	263	—	—	—
	2.3 CHS	0.635	66.8	—	314	—	—	—

See page 1-7 for details on cases of fire exposure considered.

TABLE 1.3-2

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
CIRCULAR HOLLOW SECTIONS: GRADE C350

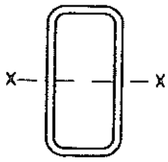
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d_o	t	Mass per m	1	2	3	4	5	6
mm	mm	kg/m						
457.0 x	12.7 CHS	139	10.3	—	11.4	—	—	—
	9.5 CHS	105	13.7	—	15.2	—	—	—
	6.4 CHS	71.1	20.2	—	22.4	—	—	—
406.4 x	12.7 CHS	123	10.4	—	11.6	—	—	—
	9.5 CHS	93.0	13.7	—	15.4	—	—	—
	6.4 CHS	63.1	20.2	—	22.7	—	—	—
355.6 x	12.7 CHS	107	10.4	—	11.9	—	—	—
	9.5 CHS	81.1	13.8	—	15.7	—	—	—
	6.4 CHS	55.1	20.3	—	23.1	—	—	—
323.9 x	12.7 CHS	97.5	10.4	—	12.1	—	—	—
	9.5 CHS	73.7	13.8	—	15.9	—	—	—
	6.4 CHS	50.1	20.3	—	23.4	—	—	—
273.1 x	9.3 CHS	60.5	14.2	—	16.8	—	—	—
	6.4 CHS	42.1	20.4	—	24.1	—	—	—
	4.8 CHS	31.8	27.0	—	32.0	—	—	—
219.1 x	8.2 CHS	42.6	16.1	—	19.8	—	—	—
	6.4 CHS	33.6	20.5	—	25.2	—	—	—
	4.8 CHS	25.4	27.1	—	33.3	—	—	—
168.3 x	7.1 CHS	28.2	18.7	—	24.3	—	—	—
	6.4 CHS	25.6	20.7	—	26.8	—	—	—
	4.8 CHS	19.4	27.3	—	35.4	—	—	—
165.1 x	3.5 CHS	13.9	37.2	—	48.4	—	—	—
	3.0 CHS	12.0	43.2	—	56.3	—	—	—
139.7 x	3.5 CHS	11.8	37.3	—	50.7	—	—	—
	3.0 CHS	10.1	43.4	—	58.9	—	—	—
114.3 x	6.0 CHS	16.0	22.4	—	32.2	—	—	—
	4.8 CHS	13.0	27.7	—	39.8	—	—	—
	3.6 CHS	9.83	36.5	—	52.5	—	—	—
	3.2 CHS	8.77	41.0	—	58.9	—	—	—
101.6 x	3.2 CHS	7.77	41.1	—	61.3	—	—	—
	2.6 CHS	6.35	50.3	—	75.0	—	—	—
88.9 x	5.5 CHS	11.3	24.7	—	38.6	—	—	—
	4.8 CHS	9.96	28.1	—	43.8	—	—	—
	3.2 CHS	6.76	41.3	—	64.5	—	—	—
	2.6 CHS	5.53	50.5	—	78.9	—	—	—
76.1 x	3.2 CHS	5.75	41.6	—	68.9	—	—	—
	2.3 CHS	4.19	57.1	—	94.6	—	—	—
60.3 x	2.9 CHS	4.11	46.1	—	84.4	—	—	—
	2.3 CHS	3.29	57.6	—	105	—	—	—
48.3 x	2.9 CHS	3.25	46.7	—	95.1	—	—	—
	2.3 CHS	2.61	58.2	—	118	—	—	—
42.4 x	2.6 CHS	2.55	52.2	—	114	—	—	—
	2.0 CHS	1.99	66.8	—	146	—	—	—
33.7 x	2.6 CHS	1.99	53.1	—	132	—	—	—
	2.0 CHS	1.56	67.7	—	168	—	—	—
26.9 x	2.3 CHS	1.40	60.6	—	173	—	—	—
	2.0 CHS	1.23	68.8	—	197	—	—	—
21.3 x	2.0 CHS	0.952	70.3	—	235	—	—	—

See page 1-7 for details on cases of fire exposure considered.

TABLE 1.3-3(A)

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
RECTANGULAR HOLLOW SECTIONS: GRADE C350
about x-axis



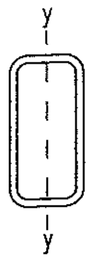
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
250 x 150 x 9.0 RHS	51.8	14.7	15.4	19.3	12.7	12.5	14.5
6.0 RHS	35.6	21.8	22.5	28.1	18.4	18.3	21.1
5.0 RHS	29.9	26.0	26.7	33.4	21.8	21.7	25.0
200 x 100 x 9.0 RHS	37.7	14.9	15.9	21.2	13.4	13.3	15.9
6.0 RHS	26.2	22.0	22.9	30.6	19.3	19.1	22.9
5.0 RHS	22.1	26.2	27.2	36.2	22.8	22.6	27.2
4.0 RHS	17.9	32.5	33.5	44.7	28.1	27.9	33.5
150 x 100 x 6.0 RHS	21.4	22.1	23.3	32.6	18.8	18.6	23.3
5.0 RHS	18.2	26.3	27.5	38.5	22.2	22.0	27.5
4.0 RHS	14.8	32.7	33.9	47.4	27.3	27.1	33.9
150 x 50 x 5.0 RHS	14.2	26.6	28.1	42.1	24.8	24.6	31.6
4.0 RHS	11.6	32.9	34.4	51.6	30.3	30.1	38.7
3.0 RHS	8.96	43.5	44.7	67.0	39.3	39.1	50.2
125 x 75 x 6.0 RHS	16.7	22.4	23.9	35.8	19.7	19.4	25.4
5.0 RHS	14.2	26.6	28.1	42.1	23.1	22.8	29.8
4.0 RHS	11.6	32.9	34.4	51.6	28.2	28.0	36.6
3.0 RHS	8.96	43.5	44.7	67.0	36.5	36.3	47.5
100 x 50 x 6.0 RHS	12.0	22.8	24.9	41.6	21.1	20.8	29.1
5.0 RHS	10.3	27.0	29.1	48.5	24.6	24.2	33.9
4.0 RHS	8.49	33.3	35.4	58.9	29.8	29.5	41.2
3.5 RHS	7.53	37.9	39.9	66.4	33.5	33.2	46.5
3.0 RHS	6.60	43.9	45.5	75.8	38.1	37.9	53.0
2.5 RHS	5.56	52.4	53.9	89.8	45.2	44.9	62.9
2.0 RHS	4.50	65.1	66.6	111	55.8	55.5	77.7
75 x 50 x 6.0 RHS	9.67	23.2	25.8	46.5	21.1	20.7	31.0
5.0 RHS	8.35	27.4	29.9	53.9	24.4	23.9	35.9
4.0 RHS	6.92	33.7	36.1	65.1	29.3	28.9	43.4
3.0 RHS	5.42	44.2	46.1	83.0	37.2	36.9	55.3
2.5 RHS	4.58	52.7	54.5	98.2	43.9	43.6	65.4
2.0 RHS	3.72	65.4	67.2	121	54.1	53.8	80.7
75 x 25 x 2.5 RHS	3.60	53.1	55.5	111	49.0	48.6	76.3
2.0 RHS	2.93	65.8	68.2	136	60.0	59.7	93.7
1.6 RHS	2.38	81.7	84.0	168	73.9	73.5	116
65 x 35 x 3.0 RHS	4.25	44.7	47.1	94.2	39.3	38.9	62.4
2.5 RHS	3.60	53.1	55.5	111	46.2	45.8	73.6
2.0 RHS	2.93	65.8	68.2	136	56.6	56.2	90.3
50 x 25 x 3.0 RHS	3.07	45.5	48.9	114	41.3	40.7	73.3
2.5 RHS	2.62	54.0	57.2	134	48.2	47.7	85.8
2.0 RHS	2.15	66.6	69.8	163	58.7	58.2	105
1.6 RHS	1.75	82.5	85.6	200	71.9	71.4	128
50 x 20 x 3.0 RHS	2.83	45.8	49.4	120	43.0	42.4	77.7
2.5 RHS	2.42	54.2	57.7	140	50.1	49.5	90.7
2.0 RHS	1.99	66.8	70.3	171	60.8	60.3	110
1.6 RHS	1.63	82.7	86.1	209	74.3	73.8	135

See page 1–7 for details on cases of fire exposure considered.

TABLE 1.3-3(B)

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
RECTANGULAR HOLLOW SECTIONS: GRADE C350
about y-axis



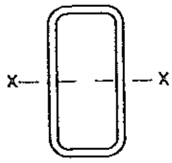
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
250 x 150 x 9.0 RHS	51.8	14.7	15.4	19.3	10.7	10.6	13.0
6.0 RHS	35.6	21.8	22.5	28.1	15.6	15.5	19.0
5.0 RHS	29.9	26.0	26.7	33.4	18.5	18.4	22.5
200 x 100 x 9.0 RHS	37.7	14.9	15.9	21.2	10.8	10.6	13.9
6.0 RHS	26.2	22.0	22.9	30.6	15.5	15.3	20.1
5.0 RHS	22.1	26.2	27.2	36.2	18.3	18.1	23.8
4.0 RHS	17.9	32.5	33.5	44.7	22.5	22.3	29.3
150 x 100 x 6.0 RHS	21.4	22.1	23.3	32.6	16.5	16.3	22.1
5.0 RHS	18.2	26.3	27.5	38.5	19.5	19.3	26.1
4.0 RHS	14.8	32.7	33.9	47.4	23.9	23.7	32.2
150 x 50 x 6.0 RHS	16.7	22.4	23.9	35.8	16.7	16.4	23.9
5.0 RHS	14.2	26.6	28.1	42.1	17.8	17.6	26.3
4.0 RHS	11.6	32.9	34.4	51.6	21.7	21.5	32.3
3.0 RHS	8.96	43.5	44.7	67.0	28.1	27.9	41.9
125 x 75 x 5.0 RHS	14.2	26.6	28.1	42.1	19.6	19.3	28.1
4.0 RHS	11.6	32.9	34.4	51.6	23.9	23.7	34.4
3.0 RHS	8.96	43.5	44.7	67.0	30.9	30.7	44.7
100 x 50 x 6.0 RHS	12.0	22.8	24.9	41.6	17.0	16.6	27.0
5.0 RHS	10.3	27.0	29.1	48.5	19.7	19.4	31.5
4.0 RHS	8.49	33.3	35.4	58.9	23.9	23.6	38.3
3.5 RHS	7.53	37.9	39.9	66.4	26.9	26.6	43.2
3.0 RHS	6.60	43.9	45.5	75.8	30.6	30.3	49.2
2.5 RHS	5.56	52.4	53.9	89.8	36.2	35.9	58.4
2.0 RHS	4.50	65.1	66.6	111	44.7	44.4	72.2
75 x 50 x 6.0 RHS	9.67	23.2	25.8	46.5	18.5	18.1	31.0
5.0 RHS	8.35	27.4	29.9	53.9	21.4	20.9	35.9
4.0 RHS	6.92	33.7	36.1	65.1	25.7	25.3	43.4
3.0 RHS	5.42	44.2	46.1	83.0	32.6	32.3	55.3
2.5 RHS	4.58	52.7	54.5	98.2	38.5	38.2	65.4
2.0 RHS	3.72	65.4	67.2	121	47.4	47.1	80.7
75 x 25 x 2.5 RHS	3.60	53.1	55.5	111	35.1	34.7	69.4
2.0 RHS	2.93	65.8	68.2	136	43.0	42.6	85.2
1.6 RHS	2.38	81.7	84.0	168	52.9	52.5	105
65 x 35 x 3.0 RHS	4.25	44.7	47.1	94.2	32.2	31.8	61.2
2.5 RHS	3.60	53.1	55.5	111	37.9	37.5	72.2
2.0 RHS	2.93	65.8	68.2	136	46.4	46.0	88.6
50 x 25 x 3.0 RHS	3.07	45.5	48.9	114	33.1	32.6	73.3
2.5 RHS	2.62	54.0	57.2	134	38.7	38.2	85.8
2.0 RHS	2.15	66.6	69.8	163	47.1	46.5	105
1.6 RHS	1.75	82.5	85.6	200	57.6	57.1	128
50 x 20 x 3.0 RHS	2.83	45.8	49.4	120	32.4	31.8	75.9
2.5 RHS	2.42	54.2	57.7	140	37.7	37.1	88.7
2.0 RHS	1.99	66.8	70.3	171	45.8	45.2	108
1.6 RHS	1.63	82.7	86.1	209	55.9	55.3	132

See page 1–7 for details on cases of fire exposure considered.

TABLE 1.3-4(A)

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
RECTANGULAR HOLLOW SECTIONS: GRADE C450
about x–axis



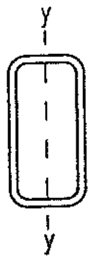
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
125 x 75 x 3.8 RHS	11.1	34.6	36.1	54.1	29.5	29.3	38.3
3.3 RHS	9.73	39.7	41.1	61.7	33.7	33.4	43.7
2.8 RHS	8.39	46.5	47.7	71.5	38.9	38.7	50.7
2.3 RHS	6.95	56.4	57.6	86.3	47.0	46.8	61.2
100 x 50 x 3.3 RHS	7.14	40.1	42.0	70.1	35.4	35.0	49.0
2.8 RHS	6.19	46.9	48.5	80.8	40.6	40.4	56.5
2.3 RHS	5.14	56.8	58.3	97.2	48.9	48.6	68.0
75 x 50 x 2.8 RHS	5.09	47.2	49.1	88.4	39.6	39.3	58.9
2.3 RHS	4.24	57.1	59.0	106	47.5	47.2	70.7
65 x 35 x 2.8 RHS	3.99	47.7	50.1	100	41.7	41.3	66.4
2.3 RHS	3.34	57.6	59.9	120	49.8	49.4	79.4
50 x 25 x 2.8 RHS	2.89	48.5	51.9	121	43.8	43.2	77.8
2.3 RHS	2.44	58.4	61.6	144	51.9	51.3	92.4
50 x 20 x 2.8 RHS	2.67	48.8	52.4	127	45.5	44.9	82.3
2.3 RHS	2.25	58.6	62.1	151	53.8	53.2	97.6

See page 1–7 for details on cases of fire exposure considered.

TABLE 1.3-4(B)

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
RECTANGULAR HOLLOW SECTIONS: GRADE C450
about y–axis



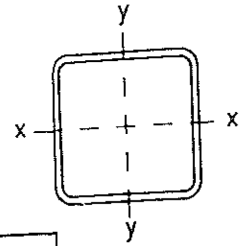
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
125 x 75 x 3.8 RHS	11.1	34.6	36.1	54.1	25.0	24.8	33.8
3.3 RHS	9.73	39.7	41.1	61.7	28.5	28.3	38.6
2.8 RHS	8.39	46.5	47.7	71.5	33.0	32.8	44.7
2.3 RHS	6.95	56.4	57.6	86.3	39.8	39.6	54.0
100 x 50 x 3.3 RHS	7.14	40.1	42.0	70.1	28.4	28.0	42.0
2.8 RHS	6.19	46.9	48.5	80.8	32.6	32.3	48.5
2.3 RHS	5.14	56.8	58.3	97.2	39.1	38.9	58.3
75 x 50 x 2.8 RHS	5.09	47.2	49.1	88.4	34.7	34.4	54.0
2.3 RHS	4.24	57.1	59.0	106	41.6	41.3	64.8
65 x 35 x 2.8 RHS	3.99	47.7	50.1	100	34.2	33.8	58.9
2.3 RHS	3.34	57.6	59.9	120	40.8	40.4	70.4
50 x 25 x 2.8 RHS	2.89	48.5	51.9	121	35.1	34.6	69.1
2.3 RHS	2.44	58.4	61.6	144	41.6	41.1	82.1
50 x 20 x 2.8 RHS	2.67	48.8	52.4	127	34.3	33.7	71.1
2.3 RHS	2.25	58.6	62.1	151	40.5	39.9	84.3

See page 1–7 for details on cases of fire exposure considered.

TABLE 1.3-5

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
SQUARE HOLLOW SECTIONS: GRADE C350
about x– and y–axis



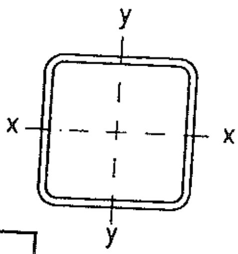
1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
250 x 250 x 9.0 SHS	65.9	14.6	15.2	18.2	11.5	11.4	12.9
6.0 SHS	45.0	21.7	22.2	26.7	16.8	16.7	18.9
200 x 200 x 9.0 SHS	51.8	14.7	15.4	19.3	11.7	11.6	13.5
6.0 SHS	35.6	21.8	22.5	28.1	17.0	16.9	19.7
5.0 SHS	29.9	26.0	26.7	33.4	20.2	20.0	23.4
150 x 150 x 9.0 SHS	37.7	14.9	15.9	21.2	12.1	11.9	14.6
6.0 SHS	26.2	22.0	22.9	30.6	17.4	17.2	21.0
5.0 SHS	22.1	26.2	27.2	36.2	20.5	20.4	24.9
125 x 125 x 9.0 SHS	30.6	15.1	16.3	22.9	12.5	12.3	15.5
6.0 SHS	21.4	22.1	23.3	32.6	17.7	17.5	22.1
5.0 SHS	18.2	26.3	27.5	38.5	20.8	20.6	26.1
4.0 SHS	14.8	32.7	33.9	47.4	25.6	25.4	32.2
100 x 100 x 9.0 SHS	23.5	15.4	17.0	25.5	13.0	12.7	17.0
6.0 SHS	16.7	22.4	23.9	35.8	18.2	17.9	23.9
5.0 SHS	14.2	26.6	28.1	42.1	21.3	21.1	28.1
4.0 SHS	11.6	32.9	34.4	51.6	26.0	25.8	34.4
3.0 SHS	8.96	43.5	44.7	67.0	33.7	33.5	44.7
89 x 89 x 6.0 SHS	14.6	22.5	24.3	37.9	18.5	18.2	25.0
5.0 SHS	12.5	26.7	28.5	44.5	21.6	21.3	29.3
3.5 SHS	9.06	37.6	39.3	61.4	29.7	29.5	40.5
75 x 75 x 6.0 SHS	12.0	22.8	24.9	41.6	19.1	18.7	27.0
5.0 SHS	10.3	27.0	29.1	48.5	22.2	21.8	31.5
4.0 SHS	8.49	33.3	35.4	58.9	26.8	26.5	38.3
3.5 SHS	7.53	37.9	39.9	66.4	30.2	29.9	43.2
3.0 SHS	6.60	43.9	45.5	75.8	34.3	34.1	49.2
2.5 SHS	5.56	52.4	53.9	89.8	40.7	40.4	58.4
65 x 65 x 6.0 SHS	10.1	23.1	25.6	45.3	19.6	19.2	29.1
5.0 SHS	8.75	27.3	29.7	52.6	22.7	22.3	33.7
4.0 SHS	7.23	33.6	36.0	63.6	27.4	27.0	40.8
3.0 SHS	5.66	44.1	45.9	81.3	34.8	34.5	52.1
2.5 SHS	4.78	52.6	54.4	96.2	41.1	40.8	61.7
2.0 SHS	3.88	65.3	67.1	119	50.6	50.3	76.1
50 x 50 x 5.0 SHS	6.39	27.9	31.3	62.6	24.0	23.5	39.1
4.0 SHS	5.35	34.2	37.4	74.8	28.6	28.1	46.8
3.0 SHS	4.25	44.7	47.1	94.2	35.7	35.3	58.9
2.5 SHS	3.60	53.1	55.5	111	42.0	41.6	69.4
2.0 SHS	2.93	65.8	68.2	136	51.5	51.1	85.2
1.6 SHS	2.38	81.7	84.0	168	63.4	63.0	105
40 x 40 x 4.0 SHS	4.09	34.9	39.1	88.0	30.0	29.3	53.8
3.0 SHS	3.30	45.3	48.4	109	36.8	36.3	66.6
2.5 SHS	2.82	53.7	56.8	128	43.1	42.6	78.1
2.0 SHS	2.31	66.4	69.4	156	52.5	52.0	95.4
1.6 SHS	1.88	82.3	85.2	192	64.4	63.9	117
35 x 35 x 3.0 SHS	2.83	45.8	49.4	120	37.7	37.1	72.4
2.5 SHS	2.42	54.2	57.7	140	43.9	43.3	84.5
2.0 SHS	1.99	66.8	70.3	171	53.3	52.7	103
1.6 SHS	1.63	82.7	86.1	209	65.1	64.6	126
30 x 30 x 3.0 SHS	2.36	46.5	50.8	136	38.8	38.1	80.5
2.5 SHS	2.03	54.8	59.0	157	45.0	44.3	93.5
2.0 SHS	1.68	67.4	71.5	191	54.3	53.7	113
1.6 SHS	1.38	83.3	87.3	233	66.1	65.5	138
25 x 25 x 3.0 SHS	1.89	47.4	52.9	159	40.6	39.7	92.6
2.5 SHS	1.64	55.7	61.0	183	46.6	45.7	107
2.0 SHS	1.36	68.3	73.3	220	55.8	55.0	128
1.6 SHS	1.12	84.1	89.0	267	67.5	66.7	156
20 x 20 x 1.6 SHS	0.873	85.4	91.7	321	69.8	68.8	183

See page 1–7 for details on cases of fire exposure considered.

TABLE 1.3-6

FIRE ENGINEERING DESIGN
EXPOSED SURFACE AREA TO MASS RATIO (m^2/t)
SQUARE HOLLOW SECTIONS: GRADE C450
about x– and y–axis



1 = TOTAL PERIMETER, PROFILE-PROTECTED
2 = TOTAL PERIMETER, BOX-PROTECTED, NO GAP
3 = TOTAL PERIMETER, BOX-PROTECTED, 25mm GAP
4 = TOP FLANGE EXCLUDED, PROFILE-PROTECTED
5 = TOP FLANGE EXCLUDED, BOX-PROTECTED, NO GAP
6 = TOP FLANGE EXCLUDED, BOX-PROTECTED, 25mm GAP

Designation d b t	Mass per m	1	2	3	4	5	6
mm mm mm	kg/m						
100 x 100 x 3.8 SHS	11.1	34.6	36.1	54.1	27.3	27.1	36.1
3.3 SHS	9.73	39.7	41.1	61.7	31.1	30.8	41.1
2.8 SHS	8.39	46.5	47.7	71.5	36.0	35.8	47.7
2.3 SHS	6.95	56.4	57.6	86.3	43.4	43.2	57.6
75 x 75 x 3.3 SHS	7.14	40.1	42.0	70.1	31.9	31.5	45.5
2.8 SHS	6.19	46.9	48.5	80.8	36.6	36.4	52.5
2.3 SHS	5.14	56.8	58.3	97.2	44.0	43.7	63.2
65 x 65 x 2.8 SHS	5.31	47.2	49.0	86.6	37.0	36.7	55.6
2.3 SHS	4.42	57.0	58.8	104	44.4	44.1	66.7
50 x 50 x 2.8 SHS	3.99	47.7	50.1	100	38.0	37.6	62.6
2.3 SHS	3.34	57.6	59.9	120	45.3	44.9	74.9
40 x 40 x 2.8 SHS	3.11	48.3	51.4	116	39.1	38.6	70.7
2.3 SHS	2.62	58.1	61.2	138	46.4	45.9	84.1
35 x 35 x 2.8 SHS	2.67	48.8	52.4	127	39.9	39.3	76.7
2.3 SHS	2.25	58.6	62.1	151	47.1	46.6	90.9
30 x 30 x 2.8 SHS	2.23	49.4	53.7	143	41.0	40.3	85.1
2.3 SHS	1.89	59.2	63.4	169	48.2	47.5	100
25 x 25 x 2.3 SHS	1.53	60.1	65.3	196	49.8	48.9	114

See page 1–7 for details on cases of fire exposure considered.

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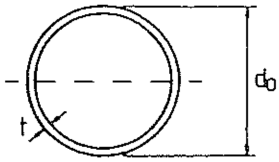
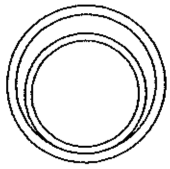
TABLE 1.4-1



TELESCOPING INFORMATION
CIRCULAR HOLLOW SECTIONS



Female (Outer) d_o x t (mm x mm)	Male (Inner) d_o (mm)	Clearance (mm)
165.1 x 5.4 CHS	139.7	11.6
5.0 CHS	139.7	12.4
3.5 CHS	139.7	15.4
3.0 CHS	139.7	16.4
139.7 x 5.4 CHS	114.3	12.1
5.0 CHS	114.3	12.9
3.5 CHS	114.3	15.9
3.0 CHS	114.3	16.9
114.3 x 6.0 CHS	88.9	11.4
5.4 CHS	88.9	12.6
4.8 CHS	**101.6**	**0.9**
4.5 CHS	**101.6**	**1.5**
3.6 CHS	101.6	3.3
3.2 CHS	101.6	4.1
101.6 x 5.0 CHS	**88.9**	**0.8**
4.0 CHS	88.9	2.8
3.2 CHS	88.9	4.4
2.6 CHS	88.9	5.6
88.9 x 5.9 CHS	60.3	15.3
5.5 CHS	**76.1**	**0.2**
5.0 CHS	**76.1**	**1.2**
4.8 CHS	**76.1**	**1.6**
4.0 CHS	76.1	3.2
3.2 CHS	76.1	4.8
76.1 x 5.9 CHS	60.3	2.6
4.5 CHS	60.3	5.4
3.6 CHS	60.3	7.2
3.2 CHS	60.3	8.0
2.6 CHS	60.3	9.2
2.3 CHS	60.3	9.8
60.3 x 5.4 CHS	**48.3**	**0.2**
4.5 CHS	48.3	2.0
3.6 CHS	48.3	3.8
2.9 CHS	48.3	5.2
2.3 CHS	48.3	6.4

Female (Outer) d_o x t (mm x mm)	Male (Inner) d_o (mm)	Clearance (mm)
48.3 x 5.4 CHS	33.7	2.6
4.0 CHS	33.7	5.4
3.2 CHS	33.7	7.0
2.9 CHS	33.7	7.6
2.3 CHS	**42.4**	**0.1**
42.4 x 4.9 CHS	26.9	4.5
4.0 CHS	26.9	6.3
3.2 CHS	**33.7**	**1.1**
2.6 CHS	33.7	2.3
2.0 CHS	33.7	3.5
33.7 x 4.5 CHS	21.3	2.2
4.0 CHS	21.3	3.2
3.2 CHS	21.3	4.8
2.6 CHS	**26.9**	**0.4**
2.0 CHS	**26.9**	**1.6**
26.9 x 4.0 CHS	**17.2**	**0.5**
3.2 CHS	17.2	2.1
2.6 CHS	17.2	3.3
2.3 CHS	17.2	3.9
2.0 CHS	21.3	0.4
21.3 x 3.6 CHS	—	—
3.2 CHS	**13.5**	**0.2**
2.6 CHS	**13.5**	**1.4**
2.0 CHS	13.5	2.6
17.2 x 2.9 CHS	NO SECTION AVAILABLE	
2.3 CHS		
13.5 x 2.9 CHS	NO SECTION AVAILABLE	
2.3 CHS		

Note: Clearance = (AS 1163 Min $d_o - 2t$) – (AS 1163 Max d_o)
CHS is not a precision tube and all dimensions shown in this chart, although in accordance with the specifications, may vary marginally. Internal weld bead may need to be considered when a close fit is required.
SIZES WITH A CLEARANCE LESS THAN 2.0 mm ARE SHOWN BOLD IN THE CHARTS.
For tight fits it is recommended that some form of testing is carried out prior to committing material. Where telescoping over some length is required, additional allowance may be needed for straightness.

HOW TO USE THIS CHART

1. Select the size of Female (or Outer) member closest to your requirements from the left hand column.
2. Depending on the application select the clearance required between the two members. Members may need to slide freely inside each other, or be locked with a pin, spot welded or fixed with wedges. This means, in some cases, a 'sloppy' fit may be suitable, while for others the tightest fit possible may be more appropriate.
3. Having selected the most suitable clearance for your application, take the appropriate size of the Male (Inner) section from the centre column, e.g.

Female Section (Outer)	Male Section (Inner)	Clearance mm
76.1 x 5.9	60.3	2.6

   Note that the clearance is the total available difference between member dimensions, not the gap on both sides.
4. Where two telescoping sections are being used, thickness should be similar and will be determined by normal structural requirements. If a third section is to be used consideration of both clearance and thickness within the size list available may be required.
5. Pipe may need to be fixed against twisting by welding or bolting.
6. Press Fit: for short pieces with no need for separation or sliding an interference fit can be achieved using the available ductility of the steel.

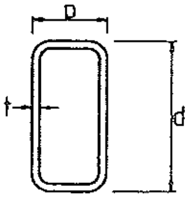
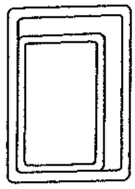


TABLE 1.4-2

TELESCOPING INFORMATION
RECTANGULAR HOLLOW SECTIONS



Female (Outer) d x b x t	Nominal Clearance Top	Nominal Clearance Side	Male (Inner) d	Male (Inner) b
mm mm mm	mm	mm	mm	mm
250 x 150 x 9.0 RHS	40.0	40.0	200	100
6.0 RHS	38.0	38.0	200	100
5.0 RHS	32.0	32.0	200	100
200 x 100 x 9.0 RHS	42.0	42.0	150	50
6.0 RHS	40.0	40.0	150	50
5.0 RHS	38.0	38.0	150	50
4.0 RHS	32.0	32.0	150	50
150 x 100 x 6.0 RHS	17.0	17.0	125	75
5.0 RHS	15.0	15.0	125	75
4.0 RHS	13.0	13.0	125	75
125 x 75 x 6.0 RHS	13.0	13.0	100	50
5.0 RHS	15.0	15.0	100	50
4.0 RHS	17.0	17.0	100	50
3.8 RHS	17.4	17.4	100	50
3.3 RHS	18.4	18.4	100	50
3.0 RHS	19.0	19.0	100	50
2.8 RHS	19.4	19.4	100	50
2.3 RHS	20.4	20.4	100	50
100 x 50 x 6.0 RHS	23.0	3.0	65	35
5.0 RHS	25.0	5.0	65	35
4.0 RHS	27.0	7.0	65	35
3.5 RHS	28.0	8.0	65	35
3.3 RHS	28.4	8.4	65	35
3.0 RHS	29.0	9.0	65	35
2.8 RHS	29.4	9.4	65	35
2.5 RHS	30.0	10.0	65	35
2.3 RHS	30.4	10.4	65	35
2.0 RHS	31.0	11.0	65	35
100 x 50 x 6.0 RHS	13.0	13.0	75	25
5.0 RHS	15.0	15.0	75	25
4.0 RHS	17.0	17.0	75	25
3.5 RHS	18.0	18.0	75	25
3.3 RHS	18.4	18.4	75	25
3.0 RHS	19.0	19.0	75	25
2.8 RHS	19.4	19.4	75	25
2.5 RHS	20.0	20.0	75	25
2.3 RHS	20.4	20.4	75	25
2.0 RHS	21.0	21.0	75	25

Female (Outer) d x b x t	Nominal Clearance Top	Nominal Clearance Side	Male (Inner) d	Male (Inner) b
mm mm mm	mm	mm	mm	mm
75 x 50 x 6.0 RHS	13.0	13.0	50	25
5.0 RHS	**0.0**	5.0	**65**	**35**
4.0 RHS	2.0	7.0	65	35
3.0 RHS	4.0	9.0	65	35
2.8 RHS	4.4	9.4	65	35
2.5 RHS	5.0	10.0	65	35
2.3 RHS	5.4	10.4	65	35
2.0 RHS	6.0	11.0	65	35
75 x 25 x 2.5 RHS	20.0	**0.0**	**50**	**20**
2.0 RHS	21.0	**1.0**	**50**	**20**
1.6 RHS	21.8	**1.8**	**50**	**20**
65 x 35 x 3.0 RHS	9.0	4.0	50	25
2.8 RHS	9.4	4.4	50	25
2.5 RHS	10.0	5.0	50	25
2.3 RHS	10.4	5.4	50	25
2.0 RHS	11.0	6.0	50	25
50 x 25 x 3.0 RHS	NO SECTION AVAILBLE			
2.8 RHS				
2.5 RHS				
2.3 RHS				
2.0 RHS				
1.6 RHS				
50 x 20 x 3.0 RHS	NO SECTION AVAILABLE			
2.8 RHS				
2.5 RHS				
2.3 RHS				
2.0 RHS				
1.6 RHS				

Note: RHS is not a precision tube and all dimensions shown in this chart, although in accordance with the specifications, may vary marginally. Varying corner radii and the internal weld bead may need to be considered when a closer fit is required.
SIZES WITH A CLEARANCE LESS THAN 2.0 mm ARE SHOWN BOLDER IN THE CHARTS.
For tight fits it is recommended that some form of testing is carried out prior to committing material.
Where telescoping over some length is required, additional allowance may be needed for straightness.

HOW TO USE THIS CHART

1. Select the size of Female (or Outer) member closest to your requirements from the left hand column.
2. Depending on the application select the clearance required between the two members.
   Members may need to slide freely inside each other, or be locked with a pin, spot welded or fixed with wedges.
   This means, in some cases, a 'sloppy' fit may be suitable, while for others the tightest fit possible may be more appropriate.
3. Having selected the most suitable clearance for your application, take the appropriate size of the Male (Inner) section from the right hand column, eg.

Female Section (Outer)	Clearance mm	Male Section (Inner)
75 x 50 x 3.0	4.0 x 9.0	65 x 35

   Note that the clearance is the total available difference between member dimensions, not the gap on both sides.
4. Where two telescoping sections are being used, thickness should be similar and will be determined by normal structural requirements. If a third section is to be used consideration of both clearance and thickness within the size list available may be required.
5. RHS has the obvious advantage that its shape prevents rotation of the section.
6. Press Fit: for short pieces with no need for separation or sliding an interference fit can be achieved using the available ductility of the steel. Sizes where clearance is shown as 0.0 may occasionally require press fit.

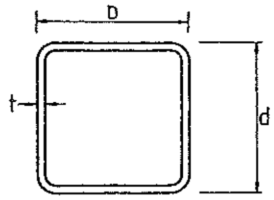
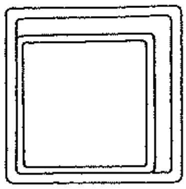


TABLE 1.4-3

TELESCOPING INFORMATION
SQUARE HOLLOW SECTIONS



Female (Outer) d b t	Nominal Clearance Top	Nominal Clearance Side	Male (Inner) d	Male (Inner) b
mm mm mm	mm	mm	mm	mm
250 x 250 x 9.0 SHS	32.0	32.0	200	200
6.0 SHS	38.0	38.0	200	200
200 x 200 x 9.0 SHS	32.0	32.0	150	150
6.0 SHS	38.0	38.0	150	150
5.0 SHS	40.0	40.0	150	150
150 x 150 x 9.0 SHS	7.0	7.0	125	125
6.0 SHS	13.0	13.0	125	125
5.0 SHS	15.0	15.0	125	125
125 x 125 x 9.0 SHS	7.0	7.0	100	100
6.0 SHS	13.0	13.0	100	100
5.0 SHS	15.0	15.0	100	100
4.0 SHS	17.0	17.0	100	100
100 x 100 x 9.0 SHS	7.0	7.0	75	75
6.0 SHS	13.0	13.0	75	75
5.0 SHS	1.1	1.1	89	89
4.0 SHS	3.1	3.1	89	89
3.8 SHS	3.5	3.5	89	89
3.3 SHS	4.5	4.5	89	89
3.0 SHS	5.1	5.1	89	89
2.8 SHS	5.5	5.5	89	89
2.3 SHS	6.5	6.5	89	89
89 x 89 x 6.0 SHS	**1.9**	**1.9**	**75**	**75**
5.0 SHS	3.9	3.9	75	75
3.5 SHS	6.9	6.9	75	75
75 x 75 x 6.0 SHS	13.0	13.0	50	50
5.0 SHS	**0.0**	**0.0**	**65**	**65**
4.0 SHS	2.0	2.0	65	65
3.3 SHS	3.4	3.4	65	65
3.0 SHS	4.0	4.0	65	65
2.8 SHS	4.4	4.4	65	65
2.5 SHS	5.0	5.0	65	65
2.3 SHS	5.4	5.4	65	65
3.5 SHS	3.0	3.0	65	65
65 x 65 x 6.0 SHS	3.0	3.0	50	50
5.0 SHS	5.0	5.0	50	50
4.0 SHS	7.0	7.0	50	50
3.0 SHS	9.0	9.0	50	50
2.8 SHS	9.4	9.4	50	50
2.5 SHS	10.0	10.0	50	50
2.3 SHS	10.4	10.4	50	50
2.0 SHS	11.0	11.0	50	50

Female (Outer) d b t	Nominal Clearance Top	Nominal Clearance Side	Male (Inner) d	Male (Inner) b
mm mm mm	mm	mm	mm	mm
50 x 50 x 5.0 SHS	**0.0**	**0.0**	**40**	**40**
4.0 SHS	2.0	2.0	40	40
3.0 SHS	4.0	4.0	40	40
2.8 SHS	4.4	4.4	40	40
2.5 SHS	5.0	5.0	40	40
2.3 SHS	5.4	5.4	40	40
2.0 SHS	6.0	6.0	40	40
1.6 SHS	6.8	6.8	40	40
40 x 40 x 4.0 SHS	2.0	2.0	30	30
3.0 SHS	4.0	4.0	30	30
2.8 SHS	4.4	4.4	30	30
2.5 SHS	**0.0**	**0.0**	**35**	**35**
2.3 SHS	**0.4**	**0.4**	**35**	**35**
2.0 SHS	**1.0**	**1.0**	**35**	**35**
1.6 SHS	**1.8**	**1.8**	**35**	**35**
35 x 35 x 3.0 SHS	4.0	4.0	25	25
2.8 SHS	4.4	4.4	25	25
2.5 SHS	**0.0**	**0.0**	**30**	**30**
2.3 SHS	**0.4**	**0.4**	**30**	**30**
2.0 SHS	**1.0**	**1.0**	**30**	**30**
1.6 SHS	**1.8**	**1.8**	**30**	**30**
30 x 30 x 3.0 SHS	4.0	4.0	20	20
2.8 SHS	4.4	4.4	20	20
2.5 SHS	**0.0**	**0.0**	**25**	**25**
2.3 SHS	**0.4**	**0.4**	**25**	**25**
2.0 SHS	**1.0**	**1.0**	**25**	**25**
1.6 SHS	**1.8**	**1.8**	**25**	**25**
25 x 25 x 3.0 SHS	4.0	4.0	15	15
2.5 SHS	**0.0**	**0.0**	**20**	**20**
2.3 SHS	**0.4**	**0.4**	**20**	**20**
2.0 SHS	**1.0**	**1.0**	**20**	**20**
1.6 SHS	**1.8**	**1.8**	**20**	**20**
20 x 20 x 1.6 SHS	**1.8**	**1.8**	**15**	**15**
15 x 15 x 1.8 SHS	NO SECTION AVAILABLE			
13 x 13 x 1.8 SHS	NO SECTION AVAILABLE			

Note: SHS is not a precision tube and all dimensions shown in this chart, although in accordance with the specifications, may vary marginally. Varying corner radii and the internal weld bead may need to be considered when a closer fit is required.
SIZES WITH A CLEARANCE LESS THAN 2.0 mm ARE SHOWN BOLDER IN THE CHARTS.
For tight fits it is recommended that some form of testing is carried out prior to committing material.
Where telescoping over some length is required, additional allowance may be needed for straightness.

HOW TO USE THIS CHART

1. Select the size of Female (or Outer) member closest to your requirements from the left hand column.
2. Depending on the application select the clearance required between the two members. Members may need to slide freely inside each other, or be locked with a pin, spot welded or fixed with wedges. This means, in some cases, a 'sloppy' fit may be suitable, while for others the tightest fit possible may be more appropriate.
3. Having selected the most suitable clearance for your application, take the appropriate size of the Male (Inner) section from the right hand column, eg.

Female Section (Outer)	Clearance mm	Male Section (Inner)
75 x 75 x 3.0	4.0 x 4.0	65 x 65

Note that the clearance is the total available difference between member dimensions, not the gap on both sides.

4. Where two telescoping sections are being used, thickness should be similar and will be determined by normal structural requirements. If a third section is to be used consideration of both clearance and thickness within the size list available may be required.
5. SHS has the obvious advantage that its shape prevents rotation of the section.
6. Press Fit: for short pieces with no need for separation or sliding an interference fit can be achieved using the available ductility of the steel. Sizes where clearance is shown as 0.0 may occasionally require press fit.

PART 2 DETERMINATION OF DESIGN ACTION EFFECTS

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PART 2 DETERMINATION OF DESIGN ACTION EFFECTS

2.1 Methods of Analysis

The methods of structural analysis that are recognised in AS 4100 and most likely to be used for structural hollow sections are:

a) First-order elastic analysis

b) First-order elastic analysis with moment amplification (Clause 4.4.2 of AS 4100)

c) Second-order elastic analysis in accordance with Appendix E of AS 4100

Plastic analysis is currently not permitted by AS 4100 for structural steel hollow sections, although research[1], [2] has already been performed to establish the suitability of square and rectangular hollow sections.

2.2 Second-Order Effects

When combined bending and axial compression forces are present in members, SECOND-ORDER EFFECTS must be considered. Second-order bending moments are often classified as PΔ which arise from the relative end displacements (Δ), or as Pδ which arise from the member deflecting (δ) from a straight line joining the member's ends (Figure 2.2). In **braced frames** the relative member end displacements (Δ) are small, and consideration is only given to the Pδ effects. In **sway frames** the PΔ effects are often more significant than the Pδ effects.

2.3 Use of Tables

The tabulated values in PARTS 4, 5, and 6 may be used for design in those cases where second-order effects:

– can be neglected

– are accounted for using moment amplification factors in conjunction with a first-order elastic analysis

– are accounted for in a second-order elastic analysis

[1] Hasan, S.W., Hancock, G.J., "Plastic Bending Tests of Cold–Formed Rectangular Hollow Sections", *Steel Construction*, AISC, Vol. 23, No.4, 1989.

[2] Zhao, X.L., Hancock, G.J., "Tests to Determine Plate Slenderness Limits for Cold–Formed Rectangular Hollow Sections of Grade C450", *Steel Construction*, AISC, Vol. 25, No. 4 1990.

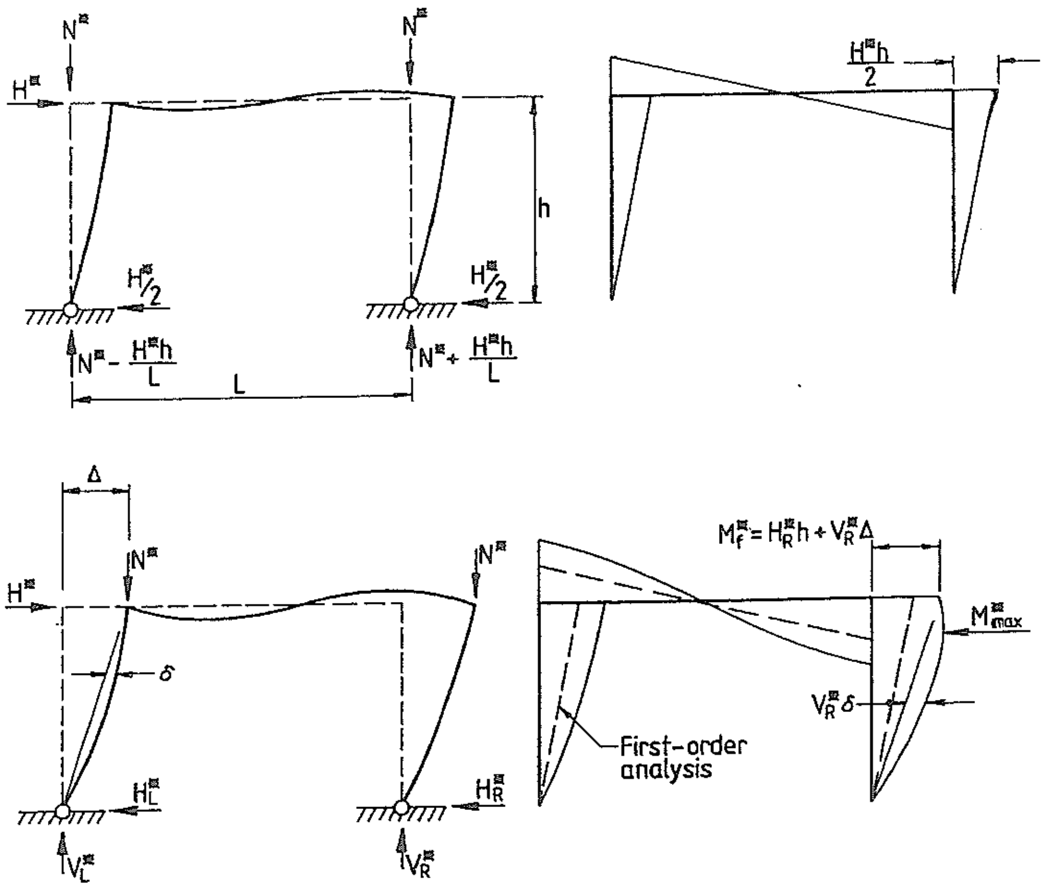

Figure 2.2: First-order Analysis and Second-order Behaviour

2.4 Use of Analysis Methods

2.4.1 First-order Elastic Analysis

This method can be used to analyse members which do not have second order effects. They are members with:

- bending moments only
- axial tension force only
- combined bending moments and tension force

2.4.2 First-order Elastic Analysis with Moment Amplification

This method can be used to analyse members with combined bending and axial compression and when the moment amplification factors δ_b or δ_s (see Clauses 4.4.2.2 and 4.4.2.3 of AS 4100) are less than 1.4 (i.e. when second-order effects are less than 40 %). The maximum moment in the member M_m^*, as determined by the first-order elastic analysis, is multiplied by the moment amplification factor δ_b or δ_s. See PART 7, Figures 7.3(1) and 7.3(2) for the determination of δ_b and δ_s respectively.

2.4.3 Second-order Elastic Analysis in Accordance with Appendix E of AS 4100

This method can be used to analyse members with combined bending and axial compression and must be used when the moment amplification factors δ_b or δ_s are greater than 1.4 (i.e. when second-order effects are greater than 40 %).

A suitable computer analysis program is normally used due to the iterative nature of this analysis.

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PART 3 SECTION CAPACITIES

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES.

PART 3 SECTION CAPACITIES

3.1 Scope

The following tables give values of design section capacities for axial tension (ϕN_t), axial compression (ϕN_s), moment (ϕM_s), shear (ϕV_v) and torsional moment (ϕM_z).

3.2 Method

The determination of each of the design section capacities (Tables 3.1-1 to 3.1-6) is detailed in Sections 3.2.1 to 3.2.5. PART 3 of the Tables contains design **section** capacities whilst PART 4 to PART 6 contain design **member** capacities. Section capacities give the maximum capacity of a section subjected to design action effects. Member capacities are determined by reducing the section capacities by factors accounting for restraints and loading conditions.

3.2.1 Design Section Capacity for Axial Tension

The design section capacity for axial tension (ϕN_t) is determined from Clauses 7.1 and 7.2 of AS 4100 as the *lesser* of

$$\phi N_t = \phi A_g f_y$$

and

$$\phi N_t = \phi 0.85 k_t A_n f_u$$

where ϕ = 0.9 (Table 3.4 of AS 4100)
A_g = gross cross-sectional area
f_y = yield stress used in design
k_t = 1.0
A_n = net section area
= A_g
= gross cross-sectional area (assuming full perimeter welded connections with no penetrations or holes)
f_u = tensile strength used in design

3.2.2 Design Section Capacity for Axial Compression

The design section capacity for axial compression (ϕN_s) is determined from Clauses 6.1 and 6.2 of AS 4100 as:

$$\phi N_s = \phi k_f A_n f_y$$

where ϕ = 0.9 (Table 3.4 of AS 4100)
k_f = A_e / A_g (see Section 1.2.3.3 and Tables 1.2-1 to 1.2-6)
A_n = net section area
= A_g
= gross cross-sectional area (assuming no penetrations or holes)
f_y = yield stress used in design

3.2.3 Design Moment Section Capacity

The design moment section capacity (ϕM_s) is determined from Clauses 5.1 and 5.2.1 of AS 4100 as:

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

where ϕ = 0.9 (Table 3.4 of AS 4100)
f_y = yield stress used in design
Z_e = effective section modulus (see Section 1.2.3.2 and Tables 1.2–1 to 1.2–6).

Values of the design section moment capacity (ϕM_s) can be found in the tables for members bent about either principal x– or y–axis. It should be noted that the design member capacity in the minor principal y–axis is the design section capacity (ϕM_{sy}). For members which are fully restrained against flexural buckling the design member moment capacity equals the full section moment capacity (ϕM_s).

3.2.4 Design Shear Capacity of a Web

The design shear capacity of a web (ϕV_v) is determined from Clauses 5.11.3 and 5.11.4 of AS 4100,

for RHS and SHS and as the *lesser* of $\phi V_v = 0.6\, f_y\,(d-2t)\,2t$ (Clause 5.11.4 of AS 4100)

and $\phi V_v = \dfrac{2\phi V_u}{0.9 + \left(\dfrac{f^*_{vm}}{f^*_{va}}\right)}$ (Clause 5.11.3 of AS 4100)

and for CHS $\phi V_v = 0.36\, f_y\, A_g$ (Clause 5.11.4 of AS 4100)

where ϕ = 0.9 (Table 3.4 of AS 4100)
f_y = yield stress used in design
A_e = net section area
= A_g
= gross cross–sectional area (assuming there are no holes larger than those required for fasteners, or that the net area is greater than 0.9 times the gross area)
d = full depth of section
t = thickness of section
V_u = $0.6\, f_y\,(d-2t)\,2t$
f^*_{va} = average design shear stress in the web
f^*_{vm} = maximum design shear stress in the web

The ratio of maximum to average design shear stress in the web (f^*_{vm} / f^*_{va}) for bending about the x–axis, is calulated [1] using:

$$\frac{f^*_{vm}}{f^*_{va}} = \frac{3(2b+d)}{2(3b+d)}$$

where d = full depth of section
b = full width of section

Note: for bending about the y–axis b and d are interchanged in the calculation of the maximum to average design web shear stress ratio. Non–uniform shear stress governs when $d\,/\,b > 0.75$

For calculating the web area, the web depth has been taken as the clear depth between flanges (d_1) for RHS and SHS, and as 0.6 times the gross cross–sectional area ($0.6\,A_g$) for CHS.

[1] Bridge, R.Q., Trahair, N.S., "Thin Wall Beams", *Steel Construction*, AISC, Vol. 15, No. 1, 1981.

3.2.5 Design Torsional Moment Section Capacity

The design torsional moment section capacity (ϕM_z) is determined in accordance with Sections 3.2.5.1 and 3.2.5.2.

3.2.5.1 Introduction

Although AS 4100 makes no provision for the design of members subject to torsion it is nevertheless considered appropriate to supply torsional capabilities for hollow sections in the tables. Hollow sections perform particularly well in torsion and their behaviour under torsional loading is readily analysed by simple procedures. An explanation of torsional effects is provided in the references listed in Section 3.2.5.2.

The general theory of torsion established by Saint-Venant is based on uniform torsion. The theory assumes that all cross-sections rotate as a body around the centre of torsion.

When the torsional moment that is applied is non-uniform, such as when the torsional load is applied midspan between rigid supports or when the free warping of the sections is restricted, then the torsional load is shared between uniform and non-uniform torsion or warping. However in the case of hollow sections the contribution of non-uniform torsion is negligible and sections can be treated as subject to uniform torsion without any significant loss of precision.

3.2.5.2 Method

For hollow sections, torsional actions can be considered using the following formulae:

$$M_z^* \leq \phi M_z$$
$$\phi M_z = \phi\, 0.6\, f_y\, C$$

where M_z^* = design torsional moment
ϕ = 0.9 (Table 3.4 of AS 4100)
ϕM_z = design torsional moment section capacity
f_y = yield stress used in design
C = torsional section modulus

Note: The angle of twist per unit length θ (radians) can be determined using the following formulae:

$$\theta = \frac{M_z^*}{GJ}$$

where M_z^* = design torsional moment for serviceability limit state
G = 80×10^3 MPa
J = torsional section constant

The method for determining the torsion section constants C and J is detailed in Section 1.2.1.1.

Suggested references for design for torsion:

[1] "AS 4100 Supplement 1-1990: Steel Structures Commentary (Supplement to AS 4100-1990)", *Standards Australia*, Section C8.5.

[2] Trahair, N.S., Bradford, M.A., "The Behaviour and Design of Steel Structures", 2nd ed., Chapman and Hall, London, 1988.

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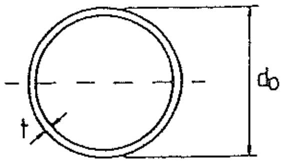
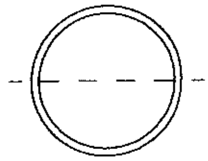


TABLE 3.1–1



DESIGN SECTION CAPACITIES
CIRCULAR HOLLOW SECTIONS: GRADE C250
about any axis

Designation d_o x t	Mass per m	Axial Tension ϕN_t	Axial Compression ϕN_s	Moment ϕM_s	Shear ϕV_v	Torsion ϕM_z
mm mm	kg/m	kN	kN	kNm	kN	kNm
610.0 x 12.7 CHS	187	5360	5360	1020	1930	941
9.5 CHS	141	4030	4030	735	1450	715
6.4 CHS	95.3	2730	2530	449	983	489
508.0 x 12.7 CHS	155	4450	4450	701	1600	645
9.5 CHS	117	3350	3350	525	1210	491
6.4 CHS	79.2	2270	2270	328	817	337
165.1 x 5.4 CHS	21.3	610	610	31.0	219	28.3
5.0 CHS	19.7	566	566	28.8	204	26.4
139.7 x 5.4 CHS	17.9	513	513	21.9	185	19.9
5.0 CHS	16.6	476	476	20.4	171	18.6
114.3 x 5.4 CHS	14.5	416	416	14.4	150	13.0
4.5 CHS	12.2	349	349	12.2	126	11.1
101.6 x 5.0 CHS	11.9	341	341	10.5	123	9.43
4.0 CHS	9.63	276	276	8.58	99.3	7.77
88.9 x 5.9 CHS	12.1	346	346	9.16	125	8.09
5.0 CHS	10.3	297	297	7.93	107	7.07
4.0 CHS	8.38	240	240	6.49	86.4	5.85
76.1 x 5.9 CHS	10.2	293	293	6.56	105	5.73
4.5 CHS	7.95	228	228	5.20	82.0	4.62
3.6 CHS	6.44	184	184	4.26	66.4	3.83
60.3 x 5.4 CHS	7.31	210	210	3.67	75.4	3.17
4.5 CHS	6.19	177	177	3.16	63.9	2.77
3.6 CHS	5.03	144	144	2.61	51.9	2.32
48.3 x 5.4 CHS	5.71	164	164	2.25	59.0	1.90
4.0 CHS	4.37	125	125	1.77	45.1	1.54
3.2 CHS	3.56	102	102	1.47	36.7	1.30
42.4 x 4.9 CHS	4.53	130	130	1.56	46.8	1.31
4.0 CHS	3.79	109	109	1.33	39.1	1.15
3.2 CHS	3.09	88.7	88.7	1.11	31.9	0.970
33.7 x 4.5 CHS	3.24	92.9	92.9	0.870	33.4	0.722
4.0 CHS	2.93	84.0	84.0	0.799	30.2	0.671
3.2 CHS	2.41	69.0	69.0	0.672	24.8	0.578
26.9 x 4.0 CHS	2.26	64.7	64.7	0.477	23.3	0.390
3.2 CHS	1.87	53.6	53.6	0.407	19.3	0.342
2.6 CHS	1.56	44.7	44.7	0.347	16.1	0.297
21.3 x 3.6 CHS	1.57	45.0	45.0	0.257	16.2	0.207
3.2 CHS	1.43	40.9	40.9	0.238	14.7	0.195
2.6 CHS	1.20	34.4	34.4	0.206	12.4	0.173

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $N_t = A_g f_y$ (Clause 7.2 of AS 4100)
3. $N_s = k_f A_g f_y$ (Clause 6.2.1 of AS 4100)
4. $M_s = f_y Z_e$ (Clause 5.2.1 of AS 4100)
5. $V_v = 0.36 f_y A_g$ (Clause 5.11.4 of AS 4100)
6. $M_z = 0.6 f_y C$ (Section 3.2.5 of the Tables)

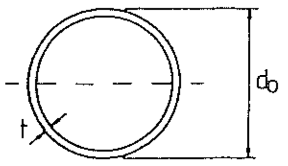
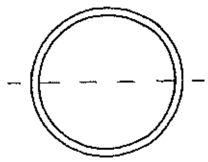


TABLE 3.1–2



DESIGN SECTION CAPACITIES
CIRCULAR HOLLOW SECTIONS: GRADE C350
about any axis

Designation d_o x t	Mass per m	Axial Tension ϕN_t	Axial Compression ϕN_s	Moment ϕM_s	Shear ϕV_v	Torsion ϕM_z
mm mm	kg/m	kN	kN	kNm	kN	kNm
457.0 x 12.7 CHS	139	5580	5580	789	2010	724
9.5 CHS	105	4210	4210	565	1510	553
6.4 CHS	71.1	2850	2580	343	1030	380
406.4 x 12.7 CHS	123	4950	4950	620	1780	567
9.5 CHS	93.0	3730	3730	456	1340	434
6.4 CHS	63.1	2530	2430	282	912	299
355.6 x 12.7 CHS	107	4310	4310	471	1550	428
9.5 CHS	81.1	3250	3250	356	1170	329
6.4 CHS	55.1	2210	2210	224	796	228
323.9 x 12.7 CHS	97.5	3910	3910	388	1410	351
9.5 CHS	73.7	2960	2960	296	1060	271
6.4 CHS	50.1	2010	2010	189	724	188
273.1 x 9.3 CHS	60.5	2430	2430	204	874	186
6.4 CHS	42.1	1690	1690	139	608	132
4.8 CHS	31.8	1270	1270	98.3	459	101
219.1 x 8.2 CHS	42.6	1710	1710	115	616	104
6.4 CHS	33.6	1350	1350	91.2	485	83.5
4.8 CHS	25.4	1020	1020	66.3	366	64.0
168.3 x 7.1 CHS	28.2	1130	1130	58.2	408	52.6
6.4 CHS	25.6	1030	1030	52.9	369	48.0
4.8 CHS	19.4	777	777	40.4	280	37.0
165.1 x 3.5 CHS	13.9	560	560	27.3	201	26.6
3.0 CHS	12.0	481	481	22.6	173	23.0
139.7 x 3.5 CHS	11.8	472	472	20.1	170	18.8
3.0 CHS	10.1	406	406	16.8	146	16.3
114.3 x 6.0 CHS	16.0	643	643	22.2	231	19.9
4.8 CHS	13.0	520	520	18.1	187	16.4
3.6 CHS	9.83	394	394	13.9	142	12.7
3.2 CHS	8.77	352	352	12.4	127	11.4
101.6 x 3.2 CHS	7.77	312	312	9.76	112	8.92
2.6 CHS	6.35	255	255	7.90	91.7	7.38
88.9 x 5.5 CHS	11.3	454	454	12.1	163	10.7
4.8 CHS	9.96	399	399	10.7	144	9.57
3.2 CHS	6.76	271	271	7.41	97.7	6.74
2.6 CHS	5.53	222	222	6.10	79.9	5.59
76.1 x 3.2 CHS	5.75	231	231	5.36	83.1	4.85
2.3 CHS	4.19	168	168	3.95	60.5	3.61
60.3 x 2.9 CHS	4.11	165	165	3.01	59.3	2.71
2.3 CHS	3.29	132	132	2.44	47.5	2.21
48.3 x 2.9 CHS	3.25	130	130	1.89	46.9	1.67
2.3 CHS	2.61	105	105	1.53	37.7	1.38
42.4 x 2.6 CHS	2.55	102	102	1.30	36.9	1.15
2.0 CHS	1.99	80.0	80.0	1.03	28.8	0.926
33.7 x 2.6 CHS	1.99	80.0	80.0	0.794	28.8	0.694
2.0 CHS	1.56	62.7	62.7	0.634	22.6	0.563
26.9 x 2.3 CHS	1.40	56.0	56.0	0.440	20.2	0.381
2.0 CHS	1.23	49.3	49.3	0.391	17.7	0.343
21.3 x 2.0 CHS	0.952	38.2	38.2	0.236	13.8	0.203

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $N_t = A_g f_y$ (Clause 7.2 of AS 4100)
3. $N_s = k_f A_g f_y$ (Clause 6.2.1 of AS 4100)
4. $M_s = f_y Z_e$ (Clause 5.2.1 of AS 4100)
5. $V_v = 0.36 f_y A_g$ (Clause 5.11.4 of AS 4100)
6. $M_z = 0.6 f_y C$ (Section 3.2.5 of the Tables)

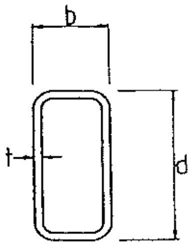
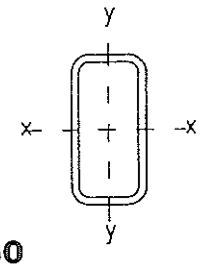


TABLE 3.1–3



DESIGN SECTION CAPACITIES
RECTANGULAR HOLLOW SECTIONS: GRADE C350
about x– and y–axis

Designation d b t	Mass per m	Axial Tension	Axial Compression	Moment x–axis	Moment y–axis	Shear x–axis	Shear y–axis	Torsion
		ϕN_t	ϕN_s	ϕM_{sx}	ϕM_{sy}	ϕV_{vx}	ϕV_{vy}	ϕM_z
mm mm mm	kg/m	kN	kN	kNm	kNm	kN	kN	kNm
250 x 150 x 9.0 RHS	51.8	2080	2080	168	117	759	449	105
6.0 RHS	35.6	1430	1290	118	65.6	519	313	74.7
5.0 RHS	29.9	1200	978	94.4	49.3	436	265	63.6
200 x 100 x 9.0 RHS	37.7	1510	1510	92.4	56.8	590	279	51.4
6.0 RHS	26.2	1050	1050	66.2	37.3	406	200	37.7
5.0 RHS	22.1	886	820	56.5	28.4	342	170	32.4
4.0 RHS	17.9	719	575	46.2	19.9	276	139	26.8
150 x 100 x 6.0 RHS	21.4	861	861	42.3	32.0	303	200	27.7
5.0 RHS	18.2	729	729	36.3	26.3	256	170	23.9
4.0 RHS	14.8	593	575	29.8	19.2	208	139	19.8
150 x 50 x 5.0 RHS	14.2	571	571	24.8	10.7	246	75.6	10.7
4.0 RHS	11.6	467	449	20.6	7.91	200	63.5	9.10
3.0 RHS	8.96	359	279	16.2	5.03	152	49.9	7.23
125 x 75 x 6.0 RHS	16.7	672	672	26.5	18.6	247	143	16.3
5.0 RHS	14.2	571	571	22.9	16.1	209	123	14.2
4.0 RHS	11.6	467	467	19.0	12.6	170	101	11.9
3.0 RHS	8.96	359	326	14.9	8.30	130	78.2	9.35
100 x 50 x 6.0 RHS	12.0	483	483	14.3	8.74	190	86.2	7.73
5.0 RHS	10.3	414	414	12.5	7.69	162	75.6	6.90
4.0 RHS	8.49	341	341	10.5	6.48	132	63.5	5.90
3.5 RHS	7.53	302	302	9.43	5.71	117	56.9	5.33
3.0 RHS	6.60	265	265	8.40	4.73	102	49.9	4.73
2.5 RHS	5.56	223	207	7.14	3.59	85.5	42.5	4.06
2.0 RHS	4.50	181	145	5.83	2.51	69.1	34.8	3.35
75 x 50 x 6.0 RHS	9.67	388	388	8.84	6.66	138	86.2	5.32
5.0 RHS	8.35	335	335	7.84	5.92	119	75.6	4.98
4.0 RHS	6.92	278	278	6.66	5.03	98.0	63.5	4.30
3.0 RHS	5.42	218	218	5.38	4.07	75.7	49.9	3.47
2.5 RHS	4.58	184	184	4.60	3.34	64.0	42.5	3.00
2.0 RHS	3.72	149	145	3.77	2.43	51.9	34.8	2.48
75 x 25 x 2.5 RHS	3.60	145	145	3.17	1.36	61.5	18.9	1.35
2.0 RHS	2.93	118	113	2.62	1.00	49.9	15.9	1.14
1.6 RHS	2.38	95.5	77.6	2.15	0.699	40.4	13.2	0.954
65 x 35 x 3.0 RHS	4.25	170	170	3.46	2.24	64.0	32.9	1.97
2.5 RHS	3.60	145	145	2.98	1.93	54.2	28.3	1.72
2.0 RHS	2.93	118	118	2.46	1.48	44.1	23.4	1.44
50 x 25 x 3.0 RHS	3.07	123	123	1.85	1.12	47.5	21.5	0.979
2.5 RHS	2.62	105	105	1.61	0.982	40.5	18.9	0.869
2.0 RHS	2.15	86.2	86.2	1.34	0.824	33.1	15.9	0.741
1.6 RHS	1.75	70.3	70.3	1.11	0.644	27.0	13.2	0.623
50 x 20 x 3.0 RHS	2.83	114	114	1.62	0.827	46.9	15.9	0.733
2.5 RHS	2.42	97.3	97.3	1.42	0.729	40.0	14.2	0.659
2.0 RHS	1.99	79.9	79.9	1.19	0.616	32.7	12.1	0.568
1.6 RHS	1.63	65.3	65.3	0.989	0.484	26.6	10.2	0.482

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $N_t = A_g f_y$ (Clause 7.2 of AS 4100)
3. $N_s = k_f A_g f_y$ (Clause 6.2.1 of AS 4100)
4. $M_s = f_y Z_e$ (Clause 5.2.1 of AS 4100)
5. V_v (See Section 3.2.4 of the Tables)
6. $M_z = 0.6 f_y C$ (Section 3.2.5 of the Tables)

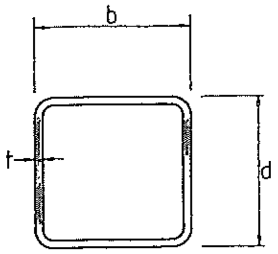
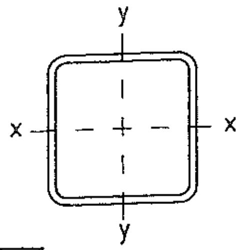


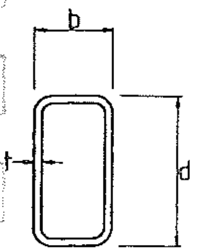
TABLE 3.1–4

DESIGN SECTION CAPACITIES
SQUARE HOLLOW SECTIONS: GRADE C350
about x– and y–axis



Designation d b t (mm mm mm)	Mass per m (kg/m)	Axial Tension ϕN_t (kN)	Axial Compression ϕN_s (kN)	Moment ϕM_s (kNm)	Shear ϕV_v (kN)	Torsion ϕM_z (kNm)
250 x 250 x 9.0 SHS	65.9	2650	2650	234	780	184
6.0 SHS	45.0	1810	1540	129	533	129
200 x 200 x 9.0 SHS	51.8	2080	2080	147	612	113
6.0 SHS	35.6	1430	1430	92.5	421	80.3
5.0 SHS	29.9	1200	1070	70.1	355	68.3
150 x 150 x 9.0 SHS	37.7	1510	1510	78.2	444	59.7
6.0 SHS	26.2	1050	1050	55.9	309	43.3
5.0 SHS	22.1	886	886	45.5	261	37.1
125 x 125 x 9.0 SHS	30.6	1230	1230	52.0	360	39.3
6.0 SHS	21.4	861	861	37.8	253	29.1
5.0 SHS	18.2	729	729	32.4	215	25.1
4.0 SHS	14.8	593	593	24.8	175	20.7
100 x 100 x 9.0 SHS	23.5	944	944	31.0	276	23.2
6.0 SHS	16.7	672	672	23.2	197	17.7
5.0 SHS	14.2	571	571	20.0	168	15.4
4.0 SHS	11.6	467	467	16.6	137	12.8
3.0 SHS	8.96	359	359	11.7	105	10.1
89 x 89 x 6.0 SHS	14.6	588	588	17.8	172	13.5
5.0 SHS	12.5	502	502	15.5	147	11.8
3.5 SHS	9.06	363	363	11.5	107	8.91
75 x 75 x 6.0 SHS	12.0	483	483	12.1	141	9.11
5.0 SHS	10.3	414	414	10.6	121	8.06
4.0 SHS	8.49	341	341	8.90	100	6.83
3.5 SHS	7.53	302	302	7.97	88.9	6.15
3.0 SHS	6.60	265	265	7.08	77.3	5.43
2.5 SHS	5.56	223	223	5.75	65.3	4.65
65 x 65 x 6.0 SHS	10.1	407	407	8.67	119	6.46
5.0 SHS	8.75	351	351	7.66	103	5.78
4.0 SHS	7.23	290	290	6.49	85.1	4.95
3.0 SHS	5.66	227	227	5.22	66.1	3.98
2.5 SHS	4.78	192	192	4.45	56.0	3.42
2.0 SHS	3.88	156	156	3.33	45.5	2.82
50 x 50 x 5.0 SHS	6.39	256	256	4.14	74.7	3.07
4.0 SHS	5.35	215	215	3.59	62.7	2.70
3.0 SHS	4.25	170	170	2.96	49.3	2.22
2.5 SHS	3.60	145	145	2.54	42.0	1.93
2.0 SHS	2.93	118	118	2.10	34.3	1.61
1.6 SHS	2.38	95.5	95.5	1.61	28.0	1.33
40 x 40 x 4.0 SHS	4.09	164	164	2.12	47.8	1.57
3.0 SHS	3.30	133	133	1.80	38.1	1.34
2.5 SHS	2.82	113	113	1.56	32.7	1.17
2.0 SHS	2.31	92.5	92.5	1.30	26.9	0.989
1.6 SHS	1.88	75.3	75.3	1.07	22.0	0.824
35 x 35 x 3.0 SHS	2.83	114	114	1.33	32.5	0.978
2.5 SHS	2.42	97.3	97.3	1.16	28.0	0.866
2.0 SHS	1.99	79.9	79.9	0.975	23.1	0.735
1.6 SHS	1.63	65.3	65.3	0.808	19.0	0.616
30 x 30 x 3.0 SHS	2.36	94.8	94.8	0.932	26.9	0.676
2.5 SHS	2.03	81.6	81.6	0.822	23.3	0.605
2.0 SHS	1.68	67.3	67.3	0.695	19.4	0.519
1.6 SHS	1.38	55.2	55.2	0.580	16.0	0.439
25 x 25 x 3.0 SHS	1.89	75.9	75.9	0.603	21.3	0.430
2.5 SHS	1.64	65.8	65.8	0.539	18.7	0.391
2.0 SHS	1.36	54.7	54.7	0.462	15.7	0.341
1.6 SHS	1.12	45.1	45.1	0.389	13.0	0.292
20 x 20 x 1.6 SHS	0.873	35.0	35.0	0.236	10.0	0.175

Notes: 1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $N_t = A_g f_y$ (Clause 7.2 of AS 4100)
3. $N_s = k_f A_g f_y$ (Clause 6.2.1 of AS 4100)
4. $M_s = f_y Z_e$ (Clause 5.2.1 of AS 4100)
5. V_v (See Section 3.2.4 of the Tables)
6. $M_z = 0.6 f_y C$ (Section 3.2.5 of the Tables)



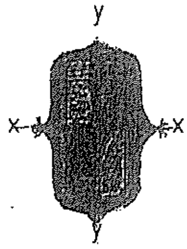
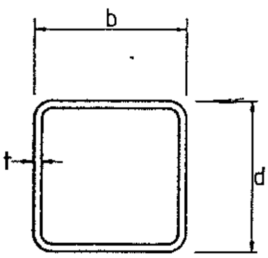


TABLE 3.1–5

DESIGN SECTION CAPACITIES
RECTANGULAR HOLLOW SECTIONS: GRADE C450
about x– and y–axis

Designation d b t	Mass per m	Axial Tension ϕN_t	Axial Compression ϕN_s	Moment x–axis ϕM_{sx}	Moment y–axis ϕM_{sy}	Shear x–axis ϕV_{vx}	Shear y–axis ϕV_{vy}	Torsion ϕM_z
mm mm mm	kg/m	kN	kN	kNm	kNm	kN	kN	kNm
125 x 75 x 3.8 RHS	11.1	540	559	23.3	14.0	209	124	14.7
3.3 RHS	9.73	474	448	20.6	11.2	183	110	13.0
2.8 RHS	8.39	409	351	16.9	8.80	156	94.4	11.3
2.3 RHS	6.95	339	259	12.3	6.50	129	78.7	9.50
100 x 50 x 3.3 RHS	7.14	348	368	11.5	6.39	143	69.6	6.54
2.8 RHS	6.19	302	295	10.2	5.05	122	60.4	5.74
2.3 RHS	5.14	251	215	8.52	3.70	102	50.7	4.86
75 x 50 x 2.8 RHS	5.09	248	263	6.52	4.71	91.4	60.4	4.23
2.3 RHS	4.24	207	215	5.49	3.56	76.2	50.7	3.59
65 x 35 x 2.8 RHS	3.99	194	206	4.21	2.72	77.3	40.0	2.41
2.3 RHS	3.34	163	172	3.57	2.16	64.6	34.0	2.07
50 x 25 x 2.8 RHS	2.89	141	149	2.26	1.37	57.5	26.4	1.21
2.3 RHS	2.44	119	126	1.94	1.18	48.3	22.8	1.05
50 x 20 x 2.8 RHS	2.67	130	138	1.99	1.02	56.8	19.6	0.907
2.3 RHS	2.25	110	116	1.71	0.882	47.7	17.2	0.803

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $N_t = A_g f_y$ (Clause 7.2 of AS 4100)
3. $N_s = k_f A_g f_y$ (Clause 6.2.1 of AS 4100)
4. $M_s = f_y Z_e$ (Clause 5.2.1 of AS 4100)
5. V_v (See Section 3.2.4 of the Tables)
6. $M_z = 0.6 f_y C$ (Section 3.2.5 of the Tables)



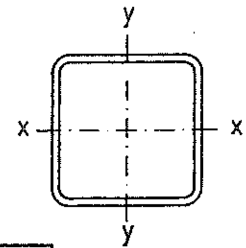


TABLE 3.1–6

DESIGN SECTION CAPACITIES
SQUARE HOLLOW SECTIONS: GRADE C450
about x– and y–axis

Designation d b t	Mass per m	Axial Tension ϕN_t	Axial Compression ϕN_s	Moment ϕM_s	Shear ϕV_v	Torsion ϕM_z
mm mm mm	kg/m	kN	kN	kNm	kNm	kN
100 x 100 x 3.8 SHS	11.1	540	572	19.6	169	15.8
3.3 SHS	9.73	474	502	15.9	148	14.0
2.8 SHS	8.39	409	383	12.5	127	12.2
2.3 SHS	6.95	339	259	9.35	105	10.2
75 x 75 x 3.3 SHS	7.14	348	368	9.75	108	7.54
2.8 SHS	6.19	302	319	8.16	93.3	6.59
2.3 SHS	5.14	251	259	6.07	77.7	5.56
65 x 65 x 2.8 SHS	5.31	259	274	6.32	79.8	4.83
2.3 SHS	4.42	215	228	4.91	66.7	4.10
50 x 50 x 2.8 SHS	3.99	194	206	3.59	59.7	2.71
2.3 SHS	3.34	163	172	3.05	50.1	2.32
40 x 40 x 2.8 SHS	3.11	152	161	2.20	46.2	1.64
2.3 SHS	2.62	127	135	1.88	39.1	1.42
35 x 35 x 2.8 SHS	2.67	130	138	1.63	39.5	1.20
2.3 SHS	2.25	110	116	1.40	33.6	1.05
30 x 30 x 2.8 SHS	2.23	109	115	1.14	32.8	0.835
2.3 SHS	1.89	92.3	97.7	0.994	28.0	0.736
25 x 25 x 2.3 SHS	1.53	74.7	79.1	0.656	22.5	0.479

Notes: Refer to TABLE 3.1–5

PART 4 MEMBERS SUBJECT TO BENDING

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES.

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PART 4 MEMBERS SUBJECT TO BENDING

4.1 Design Moment Capacity for Members Without Full Lateral Restraint

4.1.1 Scope

These tables for RHS *bending about the x-axis* without full lateral restraint have been prepared in accordance with Section 5 of AS 4100. Values of design moment capacity (ϕM_b) are given for various values of effective length (l_e).

CHS and SHS are not included in these tables as they are not susceptible to lateral buckling. The design member moment capacity (ϕM_b) always equals the design section moment capacity (ϕM_s) as given in Tables 3.1-1 to 3.1-2 for CHS and Tables 3.1-5 to 3.1-6 for SHS, except for the extreme case when the load acts far above the shear centre (Clause C5.6.1.4 of the Commentary to AS 4100).

4.1.2 Method

The values of design moment capacity (ϕM_b) are determined in accordance with Clause 5.6.1.4 of AS 4100 as

$$\phi M_b = \phi \alpha_m \alpha_s M_s$$

where ϕ = 0.9 (Table 3.4 of AS 4100)
α_m = 1.0 (Table 5.6.1 of AS 4100 corresponding to the case of uniform moment over the effective length (l_e))

for $l_e \leq$ FLR (FLR = maximum segment length for full lateral restraint as determined in Section 4.1.3)
α_s = 1.0

for $l_e >$ FLR

$$\alpha_s = 0.6\left\{\sqrt{\left[\left(\frac{M_s}{M_{oa}}\right)^2 + 3\right]} - \left(\frac{M_s}{M_{oa}}\right)\right\} \quad \text{(Equation 5.6.1.1(2) of AS 4100)}$$

M_{oa} = amended elastic buckling moment for a member subject to bending
$= M_o$ = reference buckling moment (Clause 5.6.1.1(a)(iv)(A) of AS 4100)

$$= \sqrt{\left(\frac{\pi^2 E I_y}{l_e^2}\right) GJ} \quad \text{(Equation 5.6.1.1(3) of AS 4100)}$$

E = 200×10^3 MPa
I_y = second moment of area about the minor principal y-axis (Tables 1.2-1 to 1.2-6)
G = 80×10^3 MPa
J = torsional section constant (see Section 1.2.1.1 and Tables 1.2-1 to 1.2-6)
l_e = effective length (see Section 4.1.3)
M_s = $f_y Z_e$ (see Section 1.2.3 and Tables 3.1-1 to 3.1-6)
f_y = yield stress used in design
Z_e = effective section modulus (see Section 1.2.3.2 and Tables 1.2-1 to 1.2-6)

4.1.3 Segment Length for Full Restraint

For SHS and RHS a segment without full or partial restraints at both ends may be considered to have full lateral restraint provided its length, as determined in accordance with Clause 5.3.2.4 of AS 4100, satisfies:

$$L \leq (1800 + 1500\beta_m)\left(\frac{b_f}{b_w}\right)\left(\frac{250}{f_y}\right) r_y$$

where L = maximum segment length for full lateral restraint
β_m = −1.0 (Clause 5.3.2.4 of AS 4100)
b_f = b
= width of section
b_w = d
= depth of section
r_y = radius of gyration about minor principal y–axis

The FLR values listed in Tables 4.1–1 to 4.1–4 are calculated using $\beta_m = -1.0$. However $\beta_m = -0.8$ may be used for segments with transverse loads, or β_m may be taken as the ratio of the smaller to larger end moments in the length (L) for segments without transverse loads (positive when the segment is bent in reverse curvature and negative when bent in single curvature).

4.1.4 Effective Length

Before using these tables it is necessary to determine the effective length (L_e), which depends on the restraint against twisting and lateral rotation and the load height. L_e is determined in accordance with Clause 5.6.3 of AS 4100 and given by:

$$L_e = k_t\, k_l\, k_r\, L$$

where k_t = twist restraint factor (Table 4.1.3(1))
k_l = load height factor (Table 4.1.3(2))
k_r = lateral rotation restraint factor (Table 4.1.3(3))
L = length of segment

Table 4.1.4(1): Twist Restraint Factors (k_t)

Restraint Arrangement	Factor (k_t)
FF, FL, LL, FU	1.0
FP, PL, PU	$1+\left[\left(\frac{d_w}{L}\right)\left(\frac{t_f}{2t_w}\right)^3\right]$
PP	$1+\left[2\ \left(\frac{d_w}{L}\right)\left(\frac{t_f}{2t_w}\right)^3\right]$

Table 4.1.4(2): Load Height Factors (k_l) for Gravity Loads

Longitudinal load position	Restraint arrangement	Load height position	
		Shear	Top Flange
Within segment	FF, FP, FL, PP, PL, LL FU, PU	1.0 1.0	1.4 2.0
At segment end	FF, FP, FL, PP, PL, LL FU, PU	1.0 1.0	1.0 2.0

Table 4.1.4(3): Lateral Rotation Restraint Factors (k_r)

Restraint arrangement	Ends with lateral rotation restraints	Factor (k_r)
FU, PU	Any	1.0
FF, FP, FL, PP, PL, LL	None	1.0
FF, FP, FL, PP, PL, LL	One	0.85
FF, FP, FL, PP, PL, LL	Both	0.70

where d_w = depth of web
t_f = thickness of critical flange
t_w = thickness of web
F ≡ fully restrained
L ≡ laterally restrained
P ≡ partially restrained
U ≡ unrestrained

and two of the symbols F, L, P, U are used to indicate the conditions at the ends of the segment. Restraint requirements are detailed in Clause 5.4.3 of AS 4100.

4.1.5 Other Loading and Restraint Conditions

The design moment capacities presented in these tables can be used for other restraints and loading conditions. For these situations the effective length (L_e) corresponding to the relevant conditions must be assessed and the relevant value of α_m determined in accordance with Clause 5.6.1.1(a) of AS 4100. The design moment capacity (ϕM_b) can then be determined as the *lesser* of:

$$\phi M_{sx} = \phi Z_e f_y$$

and

$$\phi M_{bx} = \phi \alpha_m \alpha_s Z_e f_y$$

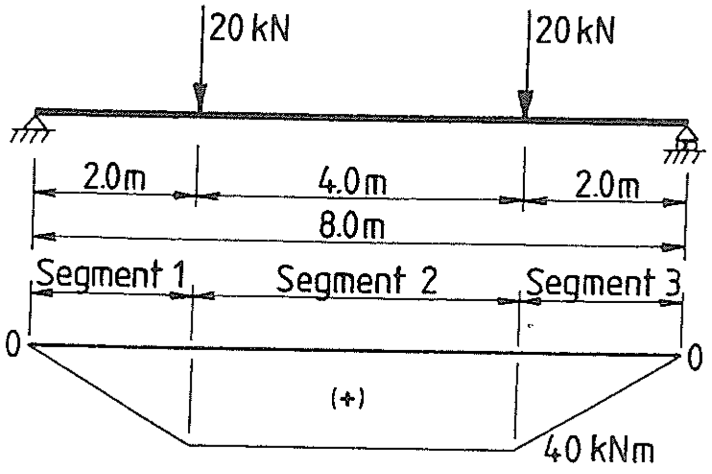
where ϕ = 0.9 (Table 3.4 of AS 4100)
ϕM_{sx} = the design section moment capacity (Tables 3.1–1 to 3.1–6)
ϕM_{bx} = α_m times the value of ($\phi M_b = \phi \alpha_s Z_e f_y$) given in Tables 4.1–1 to 4.1–4
α_m = moment modification factor
$\leq \dfrac{1}{\alpha_s}$
α_s = slenderness reduction factor (see Section 4.1.2)

It should be noted that:

- *$\alpha_m \leq 1.0$ for CHS and SHS as they are not susceptible to lateral buckling and $\alpha_s = 1.0$*
- *generally $\alpha_m \leq 1.0$ for RHS, as these sections (with the exception of 150 x 50 and 75 x 25) are only susceptible to lateral buckling at larger spans (i.e. $\alpha_s < 1.0$)*

4.1.6 Examples

1. A simply supported beam shown below has two concentrated loads applied in such a way that full restraint is provided at the location of the loads. The calculated design load at each point is 20 kN. What size beam is required to support these loads?



Bending Moment Diagram

<u>Design Data:</u>

Design bending moment $M^* = 40$ kNm

<u>Solution:</u>

For beam segment 2:

End restraint condition = FF (fully restrained at both ends of the segment)

Twist restraint factor $k_t = 1.0$ (Table 4.1.3(1))

Load Height Factor $k_l = 1.0$ (Table 4.1.3(2))
(For loading at segment end and top flange loading)

Lateral rotation restraint factor $k_r = 0.7$ (Table 4.1.3(3))

∴ Effective length

$$
\begin{aligned}
L_e &= k_t\, k_l\, k_r\, L \\
&= 1.0 \times 1.0 \times 0.7 \times 4.0 \\
&= 2.8 \text{ m}
\end{aligned}
$$

A rectangular hollow section is the most efficient and most practical hollow section for this application. As a uniform bending moment is applied to segment 2, $\alpha_m = 1.0$ (Table 5.6.1 of AS 4100). Thus alternatives can be read directly from Table 4.1–1(1) for a uniform bending moment of 40 kNm on segment 2 with an effective length (L_e = 2.8 m). They are:

150 x 100 x 6.0 RHS Grade – C350 (21.4 kg/m) ϕM_b = 42.3 kNm $> M^*$
200 x 100 x 4.0 RHS Grade – C350 (17.9 kg/m) ϕM_b = 46.2 kNm $> M^*$

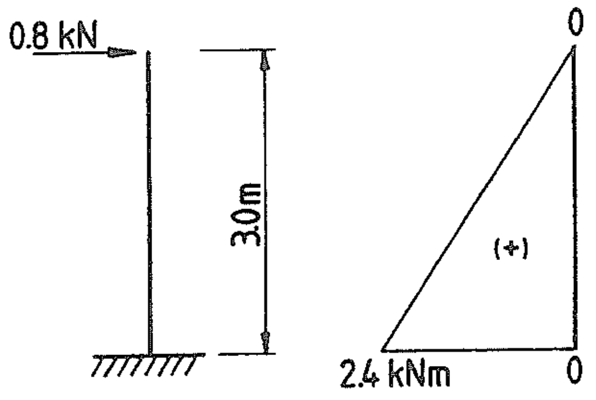
Based on mass select 200 x 100 x 4.0 RHS – Grade C350 (17.9 kg/m). The extra depth will provide incresed stiffness which may be important.

Additional design checks which should be performed are:

- Additional design bending moment due to self-weight
- Shear (Section 4.2)
- Interaction of Shear and Bending (Section 4.2.3)
- Bearing (Section 4.3)
- Bearing and Bending Interaction (Section 4.4)
- Deflection (Section 4.5)

Beam segments 1 and 3 do not have to be checked because they have the same design bending moment and end restraints with a shorter effective length.

2. A free standing sign post which is securely concreted into the ground is required to resist a calculated horizontal design force of 0.8 kN at a height of 3 m. What size CHS is required?



Bending Moment Diagram

<u>Design Data:</u>

Design bending moment M^* = 2.4 kNm

<u>Solution:</u>

The appropriate size of CHS may be selected from the **section** capacity tables in PART 3. The alternatives are:

60.3 x 3.6 CHS – Grade C250 (5.03 kg/m) ϕM_s = 2.61 kNm $> M^*$ (Table 3.1–1)
60.3 x 2.3 CHS – Grade C350 (3.29 kg/m) ϕM_s = 2.44 kNm $> M^*$ (Table 3.1–2)

Based on mass select 60.3 x 2.3 CHS (3.29 kg/m) in Grade C350 steel.

Additional design checks which should be performed are:

- Shear (Section 4.2)
- Interaction of Shear and Bending (Section 4.2.3)
- Deflection (Section 4.5) if it is critical for this type of application

4.2 Design Shear Capacity

4.2.1 Scope

The section capacity tables (Tables 3.1–1 to 3.1–6) include values of design web shear capacity for bending about the x– and y–axis.

4.2.2 Method

The design shear capacity of a web (ϕV_v) is determined from the *lesser* of Clauses 5.11.3 and 5.11.4 of AS 4100 for RHS and SHS, and Clause 5.11.4 of AS 4100 for CHS, as outlined in Section 3.2.4 of this publication.

4.2.3 Interaction of Shear and Bending

The design web shear capacity determined in Section 4.2.2 of the Tables may be significantly reduced when the section is subject to a large bending moment at the same location. The reduced shear capacity (ϕV_{vm}) is determined in accordance with Clause 5.12.3 of AS 4100 as:

$$\phi V_{vm} = \phi V_v \qquad \text{for} \quad M^* \leq 0.75\,\phi M_b$$

or

$$= V_v \left[2.2 - \left(\frac{1.6 M^*}{\phi M_b} \right) \right] \qquad \text{for} \quad 0.75\,\phi M_b \leq M^* \leq \phi M_b$$

where ϕV_v = design web shear capacity (Section 4.2.2)
M^* = design moment capacity
ϕM_b = design member moment capacity (Section 4.1.2)

Note: If $V^* < 0.6\,\phi V_v$ or if $M^* < 0.75\,\phi M_b$ then no check on the interaction of shear and bending is necessary.

4.2.4 Examples

1. Check the shear capacity of the 200 x 100 x 4.0 RHS – Grade C350 beam in Example 1 from Section 4.1.6.

<u>Design Data:</u>

Design shear force $V^* = 20$ kN

<u>Solution:</u>

Design shear capacity of the section

$$\phi V_{vx} = 276 \text{ kN}$$
$$> V^*$$

Therefore the 200 x 100 x 4.0 RHS – Grade C350 is satisfactory.

2. Check the shear capacity of the 60.3 x 2.3 CHS – Grade C350 beam in Example 2 from Section 4.1.6.

<u>Design Data:</u>

Design shear force $V^* = 0.8$ kN

<u>Solution:</u>

Design shear capacity of the section

$$\phi V_v = 47.5 \text{ kN} \qquad \text{(Table 3.1–2)}$$
$$> V^*$$

Therefore the 60.3 x 2.3 CHS – Grade C350 is satisfactory.

3. Check the 200 x 100 x 4.0 RHS – Grade C350 beam in Example 1 from Section 4.1.6 for the interaction of shear and bending.

<u>Design Data:</u>

Design shear force	V^*	= 20 kN	
Design shear capacity	ϕV_{vx}	= 276 kN	(Table 3.1–2)
Design bending moment	M^*	= 40 kNm	
Design member moment capacity	$\phi M_{bx} = \phi M_{sx}$	= 46.2 kNm	(full lateral restraint, $\alpha_s = 1.0$) (Table 3.1–3)

<u>Solution:</u>

$$0.6\ \phi V_{vx} = 0.6 \times 276$$
$$= 166 \text{ kN}$$
$$> V^*$$

Therefore the 200 x 100 4.0 RHS – Grade C350 is satisfactory.

4.3 Design Web Bearing Capacity

4.3.1 Scope

The tables give values of design web bearing yield capacity per unit length ($\phi R_{by}/b_b$) and the design web bearing buckling capacity per unit length ($\phi R_{bb}/b_b$) for SHS and RHS. The tables also include useful parameters used in web bearing design ($5r_{ext}$, b_{bw}, L_e/r).

4.3.2 Method

The design web bearing capacity (ϕR_b) has been determined from Clause 5.13 of AS 4100, with modifications derived from research[1], [2], and taken as the *lesser* of:

$$\phi R_{bb} = \phi\, 2\, \alpha_c\, b_b\, t\, f_y$$

and

$$\phi R_{by} = \phi\, 2\, \alpha_p\, b_b\, t\, f_y$$

where ϕ = 0.9 (Table 3.4 of AS 4100)
ϕR_{bb} = design web bearing buckling capacity (Clause 5.13.4 of AS 4100)
b_b = bearing width (see Figure 4.3.2(2))
t = thickness of section
f_y = yield stress used in design
α_c = member slenderness reduction factor determined in accordance with Section 5.3 of these Tables using k_f = 1.0, α_b = 0.5, and a modified slenderness ratio (L_e/r) derived from research[1], [2]:

$$\frac{L_e}{r} = \frac{\sqrt{12}(d - 2r_{ext})}{t}$$

d = overall depth of section
r_{ext} = external corner radii (See Section 1.2.1.2)

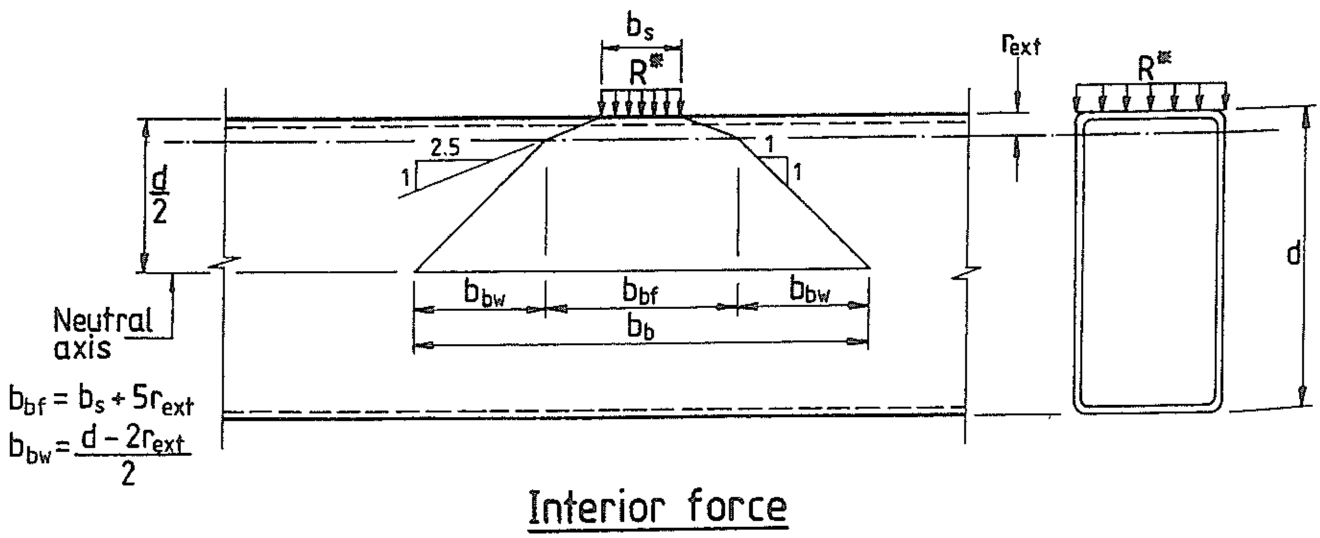


Figure 4.3.2: b_{bf}, b_b for Dispersions of Force Through Flange and Web

and ϕR_{by} = design web bearing yield capacity (Clause 5.13.3 of AS 4100 and proposed design procedures[1], [2])

α_p = load per unit length of mechanism. α_p is determined using an iterative procedure to calculate the values in Tables 4.3–1 to 4.3–4.

$$= \frac{0.5}{k_r}\left[1+\left(1-\alpha_p^2\right)\left(1+\frac{k_r}{k_D}-\left(1-\alpha_p^2\right)\frac{0.25}{k_D^2}\right)\right]$$

$$k_T = 2\frac{r_{ext}}{t} - 1$$

$$k_D = \frac{d}{t} - 2\frac{r_{ext}}{t}$$

α_p can also be calculated using an approximation formula, based on one step iteration, and given as:

$$\alpha_p = \frac{0.5}{k_r}\left[1+\left(1-\alpha_{pm}^2\right)\left(1+\frac{k_r}{k_D}-\left(1-\alpha_{pm}^2\right)\frac{0.25}{k_D^2}\right)\right]$$

where $\alpha_{pm} = \dfrac{1}{k_r} + \dfrac{0.5}{k_D}$

The lesser value of $\phi R_{by}/b_b$ and $\phi R_{bb}/b_b$ is **highlighted in bold type** in the tables.

The length terms for the various situations are illustrated in Figure 4.3.2.

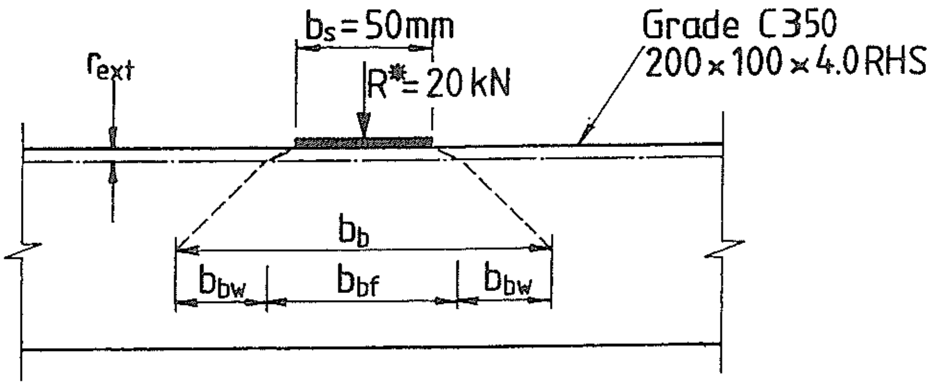
Note that research only considers the development of full dispersion width along the neutral axis and ***does not consider*** *end bearing conditions. This method if used for end bearing may be non–conservative and further research is required.*

[1] Zhao, X.L., Hancock, G.J., "Square and Rectangular Hollow Sections Subject to Combined Actions", *Journal of Structural Engineering*, ASCE, Vol 118, No. 3 , pp 648–668, 1992.

[2] Zhao, X.L., Hancock, G. J., "Design Formulae for Web Crippling of Rectangular Hollow Sections", *Proceedings*, Third Pacific Structural Steel Conference, Tokyo, Japan, 1992.

4.3.3 Example

1. The design concentrated force of 20 kN on the 200 x 100 x 4.0 RHS – Grade C350 beam in Example 1 of Section 4.1.6 is applied over the full width of the RHS and for a length of 50 mm along the RHS. Check the bearing capacity of the beam.



Design Data:

Design bearing force $R^* = 20$ kN

Stiff bearing length $b_s = 50$ mm

$5r_{ext} = 50.0$ mm (Table 4.3–1(A))

$b_{bw} = 90.0$ mm (Table 4.3–1(A))

Solution:

Bearing length at the edge of the corner radius

$$b_{bf} = b_s + 5r_{ext} = 50 + 50.0 = 100 \text{ mm}$$

Bearing length at the centre of the web

$$b_b = b_{bf} + 2b_{bw} = 100 + (2 \times 90) = 280 \text{ mm}$$

The web bearing capacity (ϕR_b) is the *lesser* of ϕR_{by} and ϕR_{bb}.

From Table 4.3–1(A):

Design web yield capacity $\frac{\phi R_{by}}{b_b} = 0.636$ kN/mm

Design web buckling capacity $\frac{\phi R_{bb}}{b_b} = 0.488$ kN/mm

$$\frac{\phi R_{by}}{b_b} > \frac{\phi R_{bb}}{b_b}$$

Therefore web buckling will govern.

Design web bearing capacity $\phi R_b = \phi R_{bb} = 0.488 \times 280 = 137$ kN $(> R^*)$

Therefore the 200 x 100 x 4.0 RHS – Grade C350 is satisfactory.

4.4 Bending and Bearing Interaction

4.4.1 Method

The design web bearing capacity determined in Section 4.3 of the Tables may be significantly reduced when the section is subject to a large bending moment at the same location. The effect of this interaction of bending and bearing force in hollow sections is not addressed by AS 4100, but suitable interaction equations have been developed from research[1], [2].

The bending and bearing interaction is dependent on the ratio of bearing length to the width of bearing (γ) and the web slenderness (d_1/t). The interaction equation for $\gamma \geq 1.0$ and $(d_1/t) \leq 30$ is:

$$1.2\left(\frac{R^*}{\phi R_b}\right) + \left(\frac{M^*}{\phi M_s}\right) \leq 1.5$$

When $\gamma < 1.0$ and/or $(d_1/t) > 30$ the interaction equation is:

$$0.8\left(\frac{R^*}{\phi R_b}\right) + \left(\frac{M^*}{\phi M_s}\right) \leq 1.0$$

When $\gamma < 1.0$ and $(d_1/t) \leq 30$ or when $\gamma \leq 1.0$ and $(d_1/t) > 30$, the interaction equation is:

$$\left(\frac{R^*}{\phi R_b}\right) + \left(\frac{M^*}{\phi M_s}\right) \leq 1.3$$

where $\gamma = \dfrac{b_s}{b}$

b_s = stiff bearing length (see Figure 4.3.2)
b = width of section
(d_1/t) = web slenderness
d_1 = clear depth between flanges
t = thickness of section
R^* = maximum design bearing force
ϕ = 0.9 (Table 3.4 of AS 4100)
ϕR_b = design web bearing capacity
M^* = maximum design bending moment
ϕM_s = design section moment capacity

Note: these formulae only apply to bearing across the full width of section.

Design aids have not been produced for this interaction because of the numerous bearing lengths which may occur for each section size.

[1] Zhao, X.L., Hancock, G. J., "Square and Rectangular Hollow Sections Subject to Combined Actions", *Journal of Structural Engineering*, ASCE, Vol 118, No. 3 , pp 648–668, 1992.

[2] Zhao, X.L., Hancock, G. J., "Design Formulae for Web Crippling of Rectangular Hollow Sections", *Proceedings*, Third Pacific Structural Steel Conference, Tokyo, Japan, 1992.

4.4.2 Example

1. Considering further Example 1 of Section 4.1.6 and Example 1 of Section 4.3.3 the interaction of bending and bearing is checked for the 200 x 100 x 4.0 RHS – Grade C350 beam.

<u>Design Data:</u>

Design bearing force	$R^* = 20$ kN	
Design web bearing capacity	$\phi R_b = 137$ kN	
Design bending moment	$M^* = 40$ kNm	
Design section moment capacity	$\phi M_s = 46.2$ kNm	(Table 3.1–3)
Stiff bearing length	$b_s = 50$ mm	
Web slenderness	$d_1/t = 48$	

<u>Solution:</u>

$$\gamma = \frac{b_s}{b} = \frac{50}{100} = 0.5 < 1.0$$

$$d_1/t = 48 > 30$$

∴ the interaction equation is

$$0.8\left(\frac{R^*}{\phi R_b}\right) + \left(\frac{M^*}{\phi M_s}\right) \leq 1.0$$

$$0.8\left(\frac{20}{137}\right) + \left(\frac{40}{46.2}\right) = 0.98$$

$$\leq 1.0$$

Therefore the 200 x 100 x 4.0 RHS – Grade C350 is satisfactory

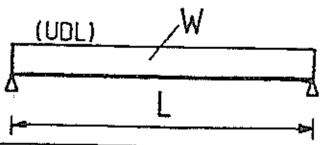
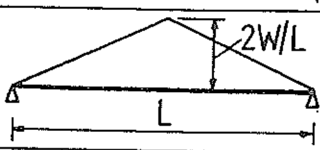
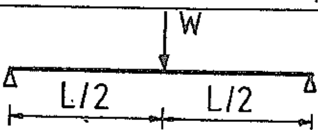
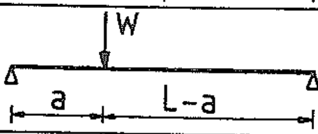
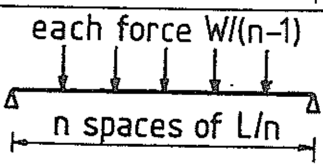
4.5 Calculation of Beam Deflections

Common methods for calculating the elastic deflection of a beam include:-

(i) integration of M/EI diagram
(ii) moment area
(iii) slope deflection
(iv) published solutions for particular cases
(v) approximate or numerical methods (eg. finite elements)

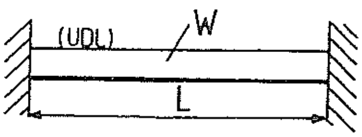
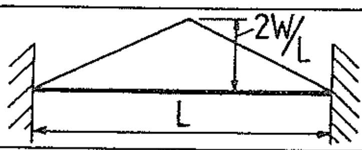
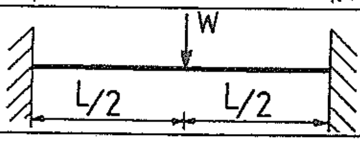
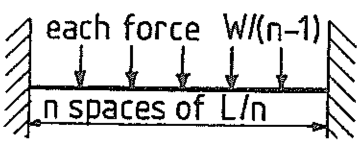
Table 4.5 gives the more commonly used beam deflection formulae. Due to the large range of loading configurations and support conditions considered for beams in design, a more comprehensive set of beam deflection formulae are published in the AISC technical journal "Steel Construction", Volume 26 No. 1 (February 1992).

Table 4.5: Beam Deflection Formulae

SIMPLY SUPPORTED BEAMS	
	$\Delta = \frac{5}{384} \frac{WL^3}{EI}$
	$\Delta = \frac{1}{60} \frac{WL^3}{EI}$
	$\Delta = \frac{1}{48} \frac{WL^3}{EI}$
	$\Delta = \frac{WL^3}{48EI}\left[\frac{3a}{L} - 4\left(\frac{a}{L}\right)^3\right]$
	$\Delta = \frac{k}{192\,(n-1)} \frac{WL^3}{EI}$

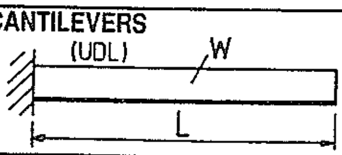
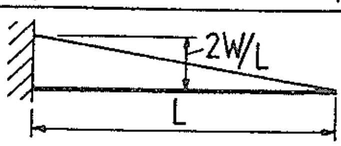
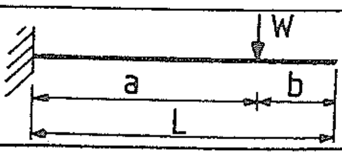
n odd, $k = [n - \frac{1}{n}]\ [3 - \frac{1}{2}(1 - \frac{1}{n^2})]$

n even, $k = n\,[3 - \frac{1}{2}(1 + \frac{4}{n^2})]$

BUILT-IN BEAMS	
	$\Delta = \frac{1}{384} \frac{WL^3}{EI}$
	$\Delta = \frac{1.4}{384} \frac{WL^3}{EI}$
	$\Delta = \frac{1}{192} \frac{WL^3}{EI}$
	$\Delta = \frac{k}{192\,(n-1)} \frac{WL^3}{EI}$

n odd, $k = [n - \frac{1}{n}]\ [1 - \frac{1}{2}(1 - \frac{1}{n^2})]$

n even, $k = [3 - \frac{1}{2}(1 + \frac{4}{n^2})] \times n - [2(n - \frac{1}{n})]$

CANTILEVERS	
	$\Delta = \frac{1}{8} \frac{WL^3}{EI}$
	$\Delta = \frac{1}{15} \frac{WL^3}{EI}$
	$\Delta = \frac{Wa^3}{EI} \frac{1}{3} [1 + \frac{3b}{2a}]$

Where:
Δ = maximum deflection
W = total load on beam
L = span of beam
E = Young's modulus of elasticity
I = second moment of area of cross-section

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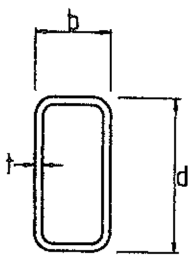
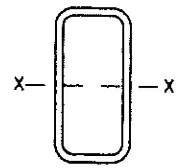


TABLE 4.1 – 1 (1)

DESIGN MOMENT CAPACITIES FOR MEMBERS WITHOUT FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x–axis



Designation d b t	Mass per m	Design Moment Capacities ϕM_b (kNm) Effective Length (L_e) in metres														FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	m
250 x 150 x 9.0 RHS	51.8	168	168	168	168	168	168	168	165	163	162	161	160	159	157	7.81
6.0 RHS	35.6	118	118	118	118	118	118	118	116	115	114	113	112	111	111	7.99
5.0 RHS	29.9	94.4	94.4	94.4	94.4	94.4	94.4	94.4	94.4	92.2	91.6	91.0	90.4	89.8	89.1	8.05
200 x 100 x 9.0 RHS	37.7	92.4	92.4	92.4	92.4	90.4	89.3	88.3	87.2	86.2	85.1	84.1	83.1	82.1	81.2	4.28
6.0 RHS	26.2	66.2	66.2	66.2	66.2	64.8	64.1	63.3	62.6	61.8	61.1	60.4	59.7	59.0	58.3	4.43
5.0 RHS	22.1	56.5	56.5	56.5	56.5	55.3	54.7	54.0	53.4	52.8	52.1	51.5	50.9	50.3	49.8	4.48
4.0 RHS	17.9	46.2	46.2	46.2	46.2	45.3	44.7	44.2	43.7	43.2	42.7	42.2	41.7	41.2	40.8	4.53
150 x 100 x 6.0 RHS	21.4	42.3	42.3	42.3	42.3	42.3	41.3	40.8	40.4	40.0	39.6	39.1	38.7	38.3	37.9	5.71
5.0 RHS	18.2	36.3	36.3	36.3	36.3	36.3	35.4	35.0	34.6	34.3	33.9	33.6	33.2	32.9	32.5	5.78
4.0 RHS	14.8	29.8	29.8	29.8	29.8	29.8	29.1	28.8	28.5	28.2	27.9	27.6	27.3	27.0	26.8	5.85
150 x 50 x 5.0 RHS	14.2	24.8	24.3	23.6	22.9	22.2	21.6	20.9	20.3	19.7	19.2	18.6	18.1	17.6	17.1	1.47
4.0 RHS	11.6	20.6	20.2	19.6	19.0	18.5	17.9	17.4	16.9	16.5	16.0	15.5	15.1	14.7	14.3	1.50
3.0 RHS	8.96	16.2	15.9	15.4	15.0	14.5	14.1	13.7	13.3	13.0	12.6	12.2	11.9	11.6	11.3	1.53
125 x 75 x 6.0 RHS	16.7	26.5	26.5	26.5	26.0	25.6	25.2	24.9	24.5	24.1	23.8	23.4	23.1	22.8	22.4	3.81
5.0 RHS	14.2	22.9	22.9	22.9	22.5	22.1	21.8	21.5	21.2	20.9	20.6	20.3	20.0	19.7	19.4	3.87
4.0 RHS	11.6	19.0	19.0	19.0	18.6	18.3	18.1	17.8	17.6	17.3	17.1	16.8	16.6	16.3	16.1	3.93
3.0 RHS	8.96	14.9	14.9	14.9	14.9	14.4	14.2	14.0	13.8	13.6	13.4	13.2	13.0	12.8	12.6	4.00
100 x 50 x 6.0 RHS	12.0	14.3	14.3	13.8	13.4	13.1	12.8	12.5	12.2	11.9	11.6	11.3	11.1	10.8	10.6	2.06
5.0 RHS	10.3	12.5	12.5	12.1	11.8	11.5	11.3	11.0	10.7	10.5	10.2	9.99	9.75	9.53	9.31	2.11
4.0 RHS	8.49	10.5	10.5	10.2	9.93	9.70	9.47	9.25	9.03	8.82	8.62	8.42	8.23	8.04	7.86	2.16
3.5 RHS	7.53	9.43	9.43	9.12	8.91	8.70	8.50	8.30	8.10	7.92	7.73	7.56	7.38	7.22	7.06	2.19
3.0 RHS	6.60	8.40	8.40	8.12	7.93	7.74	7.56	7.38	7.21	7.04	6.88	6.72	6.57	6.42	6.27	2.22
2.5 RHS	5.56	7.14	7.14	6.91	6.75	6.59	6.44	6.29	6.14	6.00	5.86	5.73	5.60	5.47	5.35	2.24
2.0 RHS	4.50	5.83	5.83	5.64	5.51	5.38	5.26	5.14	5.02	4.90	4.79	4.68	4.58	4.47	4.37	2.27

Notes:
1. $\phi = 0.9$
2. FLR – segment lengths of Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -1.0$
3. Values to the left of the solid line are segment lengths with full lateral restraint.
4. α_s calculated in accordance with Clause 5.6.1.4 of AS 4100
5. $\alpha_m = 1.0$

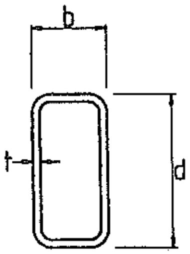
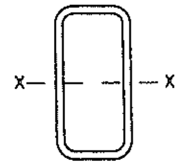


TABLE 4.1 – 1 (2)

DESIGN MOMENT CAPACITIES FOR MEMBERS WITHOUT FULL LATERAL RESTRAINT

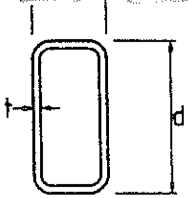
RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x-axis



Designation d b t	Mass per m	Design Moment Capacities ϕM_b (kNm) Effective Length (L_e) in metres														FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	m
100 x 50 x 6.0 RHS	12.0	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.0	13.8	13.6	13.4	13.3	13.1	12.8	2.06
5.0 RHS	10.3	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.2	12.1	12.0	11.8	11.7	11.5	11.3	2.11
4.0 RHS	8.49	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.3	10.2	10.1	9.93	9.82	9.70	9.47	2.16
3.5 RHS	7.53	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.23	9.12	9.01	8.91	8.80	8.70	8.50	2.19
3.0 RHS	6.60	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.22	8.12	8.02	7.93	7.84	7.74	7.56	2.22
2.5 RHS	5.56	7.14	7.14	7.14	7.14	7.14	7.14	7.14	6.99	6.91	6.83	6.75	6.67	6.59	6.44	2.24
2.0 RHS	4.50	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.71	5.64	5.58	5.51	5.45	5.38	5.26	2.27
75 x 50 x 6.0 RHS	9.67	8.84	8.84	8.84	8.84	8.84	8.84	8.84	8.84	8.60	8.51	8.42	8.32	8.23	8.06	2.64
5.0 RHS	8.35	7.84	7.84	7.84	7.84	7.84	7.84	7.84	7.84	7.64	7.56	7.47	7.39	7.32	7.16	2.71
4.0 RHS	6.92	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.49	6.42	6.35	6.29	6.22	6.09	2.78
3.0 RHS	5.42	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.25	5.19	5.13	5.08	5.03	4.92	2.86
2.5 RHS	4.58	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.48	4.43	4.39	4.34	4.29	4.20	2.90
2.0 RHS	3.72	3.77	3.77	3.77	3.77	3.77	3.77	3.77	3.77	3.67	3.64	3.60	3.56	3.52	3.45	2.93
75 x 25 x 2.5 RHS	3.60	3.17	3.15	3.10	3.05	3.01	2.96	2.92	2.83	2.74	2.66	2.58	2.51	2.44	2.30	0.736
2.0 RHS	2.93	2.62	2.62	2.56	2.52	2.49	2.45	2.41	2.34	2.27	2.21	2.14	2.08	2.02	1.91	0.751
1.6 RHS	2.38	2.15	2.15	2.10	2.07	2.04	2.01	1.98	1.93	1.87	1.82	1.77	1.72	1.67	1.58	0.764
65 x 35 x 3.0 RHS	4.25	3.46	3.46	3.46	3.46	3.46	3.39	3.36	3.31	3.25	3.20	3.14	3.09	3.04	2.94	1.61
2.5 RHS	3.60	2.98	2.98	2.98	2.98	2.98	2.92	2.89	2.85	2.80	2.75	2.71	2.66	2.62	2.54	1.64
2.0 RHS	2.93	2.46	2.46	2.46	2.46	2.46	2.41	2.39	2.35	2.31	2.27	2.24	2.20	2.17	2.10	1.66
50 x 25 x 3.0 RHS	3.07	1.85	1.85	1.85	1.80	1.78	1.76	1.74	1.69	1.65	1.61	1.57	1.53	1.50	1.43	1.04
2.5 RHS	2.62	1.61	1.61	1.61	1.57	1.55	1.53	1.51	1.48	1.44	1.41	1.37	1.34	1.31	1.25	1.06
2.0 RHS	2.15	1.34	1.34	1.34	1.31	1.30	1.28	1.27	1.24	1.21	1.18	1.15	1.12	1.10	1.05	1.09
1.6 RHS	1.75	1.11	1.11	1.11	1.09	1.07	1.06	1.05	1.02	0.999	0.976	0.953	0.931	0.909	0.868	1.10
50 x 20 x 3.0 RHS	2.83	1.62	1.60	1.57	1.54	1.52	1.49	1.46	1.41	1.36	1.31	1.27	1.23	1.19	1.11	0.657
2.5 RHS	2.42	1.42	1.40	1.38	1.35	1.33	1.31	1.28	1.24	1.20	1.16	1.12	1.08	1.04	0.976	0.676
2.0 RHS	1.99	1.19	1.18	1.16	1.14	1.12	1.10	1.08	1.04	1.01	0.975	0.943	0.912	0.883	0.827	0.695
1.6 RHS	1.63	0.989	0.976	0.960	0.944	0.928	0.913	0.897	0.868	0.839	0.812	0.786	0.761	0.736	0.691	0.710

Notes:
1. $\phi = 0.9$
2. FLR – segment lengths of Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -1.0$
3. Values to the left of the solid line are segment lengths with full lateral restraint.
4. α_s calculated in accordance with Clause 5.6.1.4 of AS 4100
5. $\alpha_m = 1.0$



DESIGN MOMENT CAPACITIES FOR MEMBERS WITHOUT FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C450

bending about x-axis

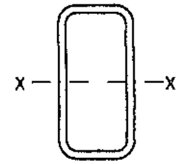


TABLE 4.1 – 2 (1)

Designation d b t	Mass per m	Design Moment Capacities ϕM_b (kNm) Effective Length (L_e) in metres														FLR
mm mm mm	kg/m	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	m
125 x 75 x 3.8 RHS	11.1	23.3	23.3	23.3	23.3	23.3	22.7	22.5	22.3	22.1	21.7	21.3	20.9	20.5	20.1	3.07
3.3 RHS	9.73	20.6	20.6	20.6	20.6	20.6	20.1	19.9	19.7	19.5	19.2	18.8	18.5	18.1	17.8	3.09
2.8 RHS	8.39	16.9	16.9	16.9	16.9	16.9	16.5	16.4	16.3	16.1	15.8	15.6	15.3	15.0	14.8	3.12
2.3 RHS	6.95	12.3	12.3	12.3	12.3	12.3	12.1	12.0	11.9	11.8	11.6	11.4	11.3	11.1	10.9	3.14
100 x 50 x 3.3 RHS	7.14	11.5	11.5	11.3	11.1	10.9	10.8	10.6	10.5	10.3	9.99	9.69	9.41	9.13	8.87	1.71
2.8 RHS	6.19	10.2	10.2	9.93	9.78	9.63	9.48	9.34	9.20	9.06	8.79	8.53	8.28	8.03	7.80	1.73
2.3 RHS	5.14	8.52	8.52	8.33	8.20	8.08	7.95	7.83	7.72	7.60	7.38	7.16	6.95	6.75	6.55	1.75

Notes: Refer to TABLE 4.1 – 2 (2)

TABLE 4.1 – 2 (2)

Designation d b t	Mass per m	Design Moment Capacities ϕM_b (kNm) Effective Length (L_e) in metres														FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	m
100 x 50 x 3.3 RHS	7.14	11.5	11.5	11.5	11.5	11.5	11.4	11.3	11.1	10.9	10.8	10.6	10.5	10.3	9.99	1.71
2.8 RHS	6.19	10.2	10.2	10.2	10.2	10.2	10.0	9.93	9.78	9.63	9.48	9.34	9.20	9.06	8.79	1.73
2.3 RHS	5.14	8.52	8.52	8.52	8.52	8.52	8.52	8.33	8.20	8.08	7.95	7.83	7.72	7.60	7.38	1.75
75 x 50 x 2.8 RHS	5.09	6.52	6.52	6.52	6.52	6.52	6.52	6.52	6.33	6.24	6.16	6.07	5.99	5.91	5.75	2.24
2.3 RHS	4.24	5.49	5.49	5.49	5.49	5.49	5.49	5.49	5.33	5.26	5.19	5.12	5.05	4.98	4.85	2.26
65 x 35 x 2.8 RHS	3.99	4.21	4.21	4.21	4.21	4.10	4.05	4.01	3.93	3.84	3.76	3.68	3.60	3.53	3.38	1.26
2.3 RHS	3.34	3.57	3.57	3.57	3.57	3.48	3.44	3.40	3.33	3.26	3.19	3.13	3.06	3.00	2.87	1.28
50 x 25 x 2.8 RHS	2.89	2.26	2.26	2.20	2.16	2.13	2.10	2.06	2.00	1.94	1.88	1.82	1.76	1.71	1.61	0.815
2.3 RHS	2.44	1.94	1.94	1.89	1.86	1.83	1.80	1.77	1.72	1.67	1.62	1.57	1.52	1.47	1.39	0.833
50 x 20 x 2.8 RHS	2.67	1.99	1.93	1.88	1.84	1.80	1.76	1.72	1.64	1.57	1.51	1.44	1.38	1.32	1.22	0.517
2.3 RHS	2.25	1.71	1.66	1.63	1.59	1.56	1.52	1.49	1.42	1.36	1.31	1.25	1.20	1.15	1.06	0.532

Notes:
1. $\phi = 0.9$
2. FLR – segment lengths of Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -1.0$
3. Values to the left of the solid line are segment lengths with full lateral restraint.
4. α_s calculated in accordance with Clause 5.6.1.4 of AS 4100
5. $\alpha_m = 1.0$

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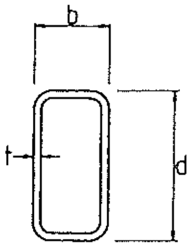


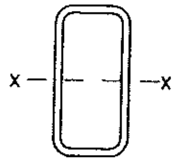
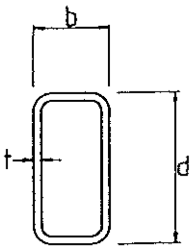


TABLE 4.3–1(A)

DESIGN WEB CAPACITIES OF BEAMS
RECTANGULAR HOLLOW SECTIONS: GRADE C350
about x–axis

Designation d x b x t	Mass per m	ϕV_v	$\phi R_{by}/b_b$	$\phi R_{bb}/b_b$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
250 x 150 x 9.0 RHS	51.8	759	1.48	2.98	113	103	78.9
6.0 RHS	35.6	519	0.962	1.03	75.0	110	127
5.0 RHS	29.9	436	0.795	0.610	62.5	113	156
200 x 100 x 9.0 RHS	37.7	590	1.52	3.83	113	77.5	59.7
6.0 RHS	26.2	406	0.976	1.51	75.0	85.0	98.1
5.0 RHS	22.1	342	0.804	0.923	62.5	87.5	121
4.0 RHS	17.9	276	0.636	0.488	50.0	90.0	156
150 x 100 x 6.0 RHS	21.4	303	1.00	2.26	75.0	60.0	69.3
5.0 RHS	18.2	256	0.819	1.48	62.5	62.5	86.6
4.0 RHS	14.8	208	0.645	0.828	50.0	65.0	113
150 x 50 x 5.0 RHS	14.2	246	0.819	1.48	62.5	62.5	86.6
4.0 RHS	11.6	200	0.645	0.828	50.0	65.0	113
3.0 RHS	8.96	152	0.615	0.353	30.0	69.0	159
125 x 75 x 6.0 RHS	16.7	247	1.02	2.70	75.0	47.5	54.8
5.0 RHS	14.2	209	0.833	1.89	62.5	50.0	69.3
4.0 RHS	11.6	170	0.653	1.12	50.0	52.5	90.9
3.0 RHS	8.96	130	0.619	0.493	30.0	56.5	130
100 x 50 x 6.0 RHS	12.0	190	1.06	3.10	75.0	35.0	40.4
5.0 RHS	10.3	162	0.855	2.32	62.5	37.5	52.0
4.0 RHS	8.49	132	0.666	1.51	50.0	40.0	69.3
3.5 RHS	7.53	117	0.576	1.11	43.8	41.3	81.7
3.0 RHS	6.60	102	0.624	0.721	30.0	44.0	102
2.5 RHS	5.56	85.5	0.516	0.441	25.0	45.0	125
2.0 RHS	4.50	69.1	0.410	0.235	20.0	46.0	159
75 x 50 x 6.0 RHS	9.67	138	1.13	3.45	75.0	22.5	26.0
5.0 RHS	8.35	119	0.899	2.71	62.5	25.0	34.6
4.0 RHS	6.92	98.0	0.691	1.94	50.0	27.5	47.6
3.0 RHS	5.42	75.7	0.634	1.08	30.0	31.5	72.7
2.5 RHS	4.58	64.0	0.523	0.707	25.0	32.5	90.1
2.0 RHS	3.72	51.9	0.414	0.395	20.0	33.5	116
75 x 25 x 2.5 RHS	3.60	61.5	0.523	0.707	25.0	32.5	90.1
2.0 RHS	2.93	49.9	0.414	0.395	20.0	33.5	116
1.6 RHS	2.38	40.4	0.329	0.212	16.0	34.3	149
65 x 35 x 3.0 RHS	4.25	64.0	0.641	1.25	30.0	26.5	61.2
2.5 RHS	3.60	54.2	0.527	0.859	25.0	27.5	76.2
2.0 RHS	2.93	44.1	0.417	0.500	20.0	28.5	98.7
50 x 25 x 3.0 RHS	3.07	47.5	0.657	1.51	30.0	19.0	43.9
2.5 RHS	2.62	40.5	0.538	1.12	25.0	20.0	55.4
2.0 RHS	2.15	33.1	0.423	0.721	20.0	21.0	72.7
1.6 RHS	1.75	27.0	0.334	0.425	16.0	21.8	94.4
50 x 20 x 3.0 RHS	2.83	46.9	0.657	1.51	30.0	19.0	43.9
2.5 RHS	2.42	40.0	0.538	1.12	25.0	20.0	55.4
2.0 RHS	1.99	32.7	0.423	0.721	20.0	21.0	72.7
1.6 RHS	1.63	26.6	0.334	0.425	16.0	21.8	94.4

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext})/t$
3. $\phi R_{by} = 2\phi\, \alpha_p\, b_b\, t\, f_y$
4. $\phi R_{bb} = 2\phi\, \alpha_c\, b_b\, t\, f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$



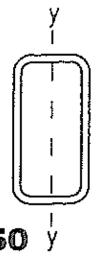


TABLE 4.3–1(B)

DESIGN WEB CAPACITIES OF BEAMS

RECTANGULAR HOLLOW SECTIONS: GRADE C350

about y–axis

Designation d b t	Mass per m	ϕV_v	$\phi R_{by}/b_b$	$\phi R_{bb}/b_b$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
250 x 150 x 9.0 RHS	51.8	449	1.59	4.65	113	52.5	40.4
6.0 RHS	35.6	313	1.00	2.26	75.0	60.0	69.3
5.0 RHS	29.9	265	0.819	1.48	62.5	62.5	86.6
200 x 100 x 9.0 RHS	37.7	279	1.76	5.34	113	27.5	21.2
6.0 RHS	26.2	200	1.06	3.10	75.0	35.0	40.4
5.0 RHS	22.1	170	0.855	2.32	62.5	37.5	52.0
4.0 RHS	17.9	139	0.666	1.51	50.0	40.0	69.3
150 x 100 x 6.0 RHS	21.4	200	1.06	3.10	75.0	35.0	40.4
5.0 RHS	18.2	170	0.855	2.32	62.5	37.5	52.0
4.0 RHS	14.8	139	0.666	1.51	50.0	40.0	69.3
150 x 50 x 5.0 RHS	14.2	75.6	1.02	3.04	62.5	12.5	17.3
4.0 RHS	11.6	63.5	0.754	2.30	50.0	15.0	26.0
3.0 RHS	8.96	49.9	0.657	1.51	30.0	19.0	43.9
125 x 75 x 6.0 RHS	16.7	143	1.13	3.45	75.0	22.5	26.0
5.0 RHS	14.2	123	0.899	2.71	62.5	25.0	34.6
4.0 RHS	11.6	101	0.691	1.94	50.0	27.5	47.6
3.0 RHS	8.96	78.2	0.634	1.08	30.0	31.5	72.7
100 x 50 x 6.0 RHS	12.0	86.2	1.37	3.78	75.0	10.0	11.5
5.0 RHS	10.3	75.6	1.02	3.04	62.5	12.5	17.3
4.0 RHS	8.49	63.5	0.754	2.30	50.0	15.0	26.0
3.5 RHS	7.53	56.9	0.636	1.93	43.8	16.3	32.2
3.0 RHS	6.60	49.9	0.657	1.51	30.0	19.0	43.9
2.5 RHS	5.56	42.5	0.538	1.12	25.0	20.0	55.4
2.0 RHS	4.50	34.8	0.423	0.721	20.0	21.0	72.7
75 x 50 x 6.0 RHS	9.67	86.2	1.37	3.78	75.0	10.0	11.5
5.0 RHS	8.35	75.6	1.02	3.04	62.5	12.5	17.3
4.0 RHS	6.92	63.5	0.754	2.30	50.0	15.0	26.0
3.0 RHS	5.42	49.9	0.657	1.51	30.0	19.0	43.9
2.5 RHS	4.58	42.5	0.538	1.12	25.0	20.0	55.4
2.0 RHS	3.72	34.8	0.423	0.721	20.0	21.0	72.7
75 x 25 x 2.5 RHS	3.60	18.9	0.598	1.49	25.0	7.50	20.8
2.0 RHS	2.93	15.9	0.456	1.12	20.0	8.50	29.4
1.6 RHS	2.38	13.2	0.353	0.828	16.0	9.30	40.3
65 x 35 x 3.0 RHS	4.25	32.9	0.693	1.72	30.0	11.5	26.6
2.5 RHS	3.60	28.3	0.560	1.35	25.0	12.5	34.6
2.0 RHS	2.93	23.4	0.436	0.977	20.0	13.5	46.8
50 x 25 x 3.0 RHS	3.07	21.5	0.759	1.85	30.0	6.50	15.0
2.5 RHS	2.62	18.9	0.598	1.49	25.0	7.50	20.8
2.0 RHS	2.15	15.9	0.456	1.12	20.0	8.50	29.4
1.6 RHS	1.75	13.2	0.353	0.828	16.0	9.30	40.3
50 x 20 x 3.0 RHS	2.83	15.9	0.844	1.89	30.0	4.00	9.24
2.5 RHS	2.42	14.2	0.643	1.55	25.0	5.00	13.9
2.0 RHS	1.99	12.1	0.479	1.19	20.0	6.00	20.8
1.6 RHS	1.63	10.2	0.365	0.899	16.0	6.80	29.4

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext})/t$
3. $\phi R_{by} = 2\phi\ \alpha_p\ b_b\ t\ f_y$
4. $\phi R_{bb} = 2\phi\ \alpha_c\ b_b\ t\ f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$

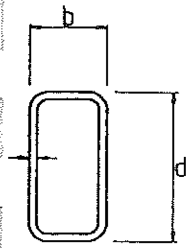
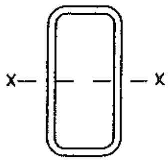


TABLE 4.3–2(A)

DESIGN WEB CAPACITIES OF BEAMS
RECTANGULAR HOLLOW SECTIONS: GRADE C450
about x–axis



Designation d b t	Mass per m	ϕV_v	$\frac{\phi R_{by}}{b_b}$	$\frac{\phi R_{bb}}{b_b}$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
125 x 75 x 3.8 RHS	11.1	209	0.795	1.05	47.5	53.0	96.6
3.3 RHS	9.73	183	0.684	0.708	41.3	54.3	114
2.8 RHS	8.39	156	0.741	0.422	28.0	56.9	141
2.3 RHS	6.95	129	0.605	0.237	23.0	57.9	174
100 x 50 x 3.3 RHS	7.14	143	0.695	1.05	41.3	41.8	87.7
2.8 RHS	6.19	122	0.747	0.637	28.0	44.4	110
2.3 RHS	5.14	102	0.609	0.364	23.0	45.4	137
75 x 50 x 2.8 RHS	5.09	91.4	0.758	1.03	28.0	31.9	78.9
2.3 RHS	4.24	76.2	0.616	0.614	23.0	32.9	99.1
65 x 35 x 2.8 RHS	3.99	77.3	0.765	1.25	28.0	26.9	66.6
2.3 RHS	3.34	64.6	0.621	0.776	23.0	27.9	84.0
50 x 25 x 2.8 RHS	2.89	57.5	0.783	1.63	28.0	19.4	48.0
2.3 RHS	2.44	48.3	0.632	1.11	23.0	20.4	61.5
50 x 20 x 2.8 RHS	2.67	56.8	0.783	1.63	28.0	19.4	48.0
2.3 RHS	2.25	47.7	0.632	1.11	23.0	20.4	61.5

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext})/t$
3. $\phi R_{by} = 2\phi\, \alpha_p\, b_b\, t\, f_y$
4. $\phi R_{bb} = 2\phi\, \alpha_c\, b_b\, t\, f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$

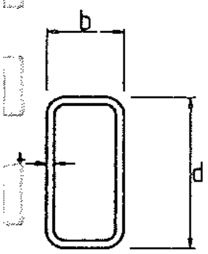
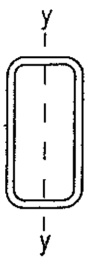


TABLE 4.3–2(B)

DESIGN WEB CAPACITIES OF BEAMS
RECTANGULAR HOLLOW SECTIONS: GRADE C450
about y–axis



Designation d b t	Mass per m	ϕV_v	$\frac{\phi R_{by}}{b_b}$	$\frac{\phi R_{bb}}{b_b}$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
125 x 75 x 3.8 RHS	11.1	124	0.837	2.12	47.5	28.0	51.0
3.3 RHS	9.73	110	0.714	1.59	41.3	29.3	61.4
2.8 RHS	8.39	94.4	0.758	1.03	28.0	31.9	78.9
2.3 RHS	6.95	78.7	0.616	0.614	23.0	32.9	99.1
100 x 50 x 3.3 RHS	7.14	69.6	0.761	2.20	41.3	16.8	35.2
2.8 RHS	6.19	60.4	0.783	1.63	28.0	19.4	48.0
2.3 RHS	5.14	50.7	0.632	1.11	23.0	20.4	61.5
75 x 50 x 2.8 RHS	5.09	60.4	0.783	1.63	28.0	19.4	48.0
2.3 RHS	4.24	50.7	0.632	1.11	23.0	20.4	61.5
65 x 35 x 2.8 RHS	3.99	40.0	0.821	1.97	28.0	11.9	29.4
2.3 RHS	3.34	34.0	0.655	1.48	23.0	12.9	38.9
50 x 25 x 2.8 RHS	2.89	26.4	0.890	2.16	28.0	6.90	17.1
2.3 RHS	2.44	22.8	0.694	1.69	23.0	7.90	23.8
50 x 20 x 2.8 RHS	2.67	19.6	0.974	2.26	28.0	4.40	10.9
2.3 RHS	2.25	17.2	0.737	1.79	23.0	5.40	16.3

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext})/t$
3. $\phi R_{by} = 2\phi\, \alpha_p\, b_b\, t\, f_y$
4. $\phi R_{bb} = 2\phi\, \alpha_c\, b_b\, t\, f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$

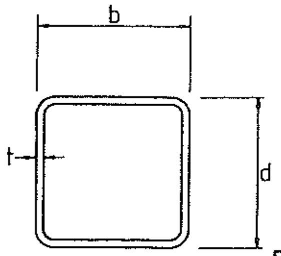
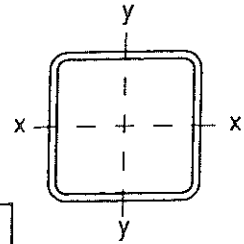


TABLE 4.3–3

DESIGN WEB CAPACITIES OF BEAMS
SQUARE HOLLOW SECTIONS: GRADE C350
about x– and y–axis



Designation d b t	Mass per m	ϕV_v	$\frac{\phi R_{by}}{b_b}$	$\frac{\phi R_{bb}}{b_b}$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
250 x 250 x 9.0 SHS	65.9	780	1.48	2.98	113	103	78.9
6.0 SHS	45.0	533	0.962	1.03	75.0	110	127
200 x 200 x 9.0 SHS	51.8	612	1.52	3.83	113	77.5	59.7
6.0 SHS	35.6	421	0.976	1.51	75.0	85.0	98.1
5.0 SHS	29.9	355	0.804	0.923	62.5	87.5	121
150 x 150 x 9.0 SHS	37.7	444	1.59	4.65	113	52.5	40.4
6.0 SHS	26.2	309	1.00	2.26	75.0	60.0	69.3
5.0 SHS	22.1	261	0.819	1.48	62.5	62.5	86.6
125 x 125 x 9.0 SHS	30.6	360	1.65	5.01	113	40.0	30.8
6.0 SHS	21.4	253	1.02	2.70	75.0	47.5	54.8
5.0 SHS	18.2	215	0.833	1.89	62.5	50.0	69.3
4.0 SHS	14.8	175	0.653	1.12	50.0	52.5	90.9
100 x 100 x 9.0 SHS	23.5	276	1.76	5.34	113	27.5	21.2
6.0 SHS	16.7	197	1.06	3.10	75.0	35.0	40.4
5.0 SHS	14.2	168	0.855	2.32	62.5	37.5	52.0
4.0 SHS	11.6	137	0.666	1.51	50.0	40.0	69.3
3.0 SHS	8.96	105	0.624	0.721	30.0	44.0	102
89 x 89 x 6.0 SHS	14.6	172	1.08	3.26	75.0	29.5	34.0
5.0 SHS	12.5	147	0.871	2.50	62.5	32.0	44.3
3.5 SHS	9.06	107	0.582	1.30	43.8	35.7	70.7
75 x 75 x 6.0 SHS	12.0	141	1.13	3.45	75.0	22.5	26.0
5.0 SHS	10.3	121	0.899	2.71	62.5	25.0	34.6
4.0 SHS	8.49	100	0.691	1.94	50.0	27.5	47.6
3.5 SHS	7.53	88.9	0.593	1.54	43.8	28.8	56.9
3.0 SHS	6.60	77.3	0.634	1.08	30.0	31.5	72.7
2.5 SHS	5.56	65.3	0.523	0.707	25.0	32.5	90.1
65 x 65 x 6.0 SHS	10.1	119	1.19	3.58	75.0	17.5	20.2
5.0 SHS	8.75	103	0.931	2.84	62.5	20.0	27.7
4.0 SHS	7.23	85.1	0.708	2.09	50.0	22.5	39.0
3.0 SHS	5.66	66.1	0.641	1.25	30.0	26.5	61.2
2.5 SHS	4.78	56.0	0.527	0.859	25.0	27.5	76.2
2.0 SHS	3.88	45.5	0.417	0.500	20.0	28.5	98.7
50 x 50 x 5.0 SHS	6.39	74.7	1.02	3.04	62.5	12.5	17.3
4.0 SHS	5.35	62.7	0.754	2.30	50.0	15.0	26.0
3.0 SHS	4.25	49.3	0.657	1.51	30.0	19.0	43.9
2.5 SHS	3.60	42.0	0.538	1.12	25.0	20.0	55.4
2.0 SHS	2.93	34.3	0.423	0.721	20.0	21.0	72.7
1.6 SHS	2.38	28.0	0.334	0.425	16.0	21.8	94.4
40 x 40 x 4.0 SHS	4.09	47.8	0.820	2.43	50.0	10.0	17.3
3.0 SHS	3.30	38.1	0.677	1.65	30.0	14.0	32.3
2.5 SHS	2.82	32.7	0.550	1.28	25.0	15.0	41.6
2.0 SHS	2.31	26.9	0.430	0.894	20.0	16.0	55.4
1.6 SHS	1.88	22.0	0.338	0.577	16.0	16.8	72.7
35 x 35 x 3.0 SHS	2.83	32.5	0.693	1.72	30.0	11.5	26.6
2.5 SHS	2.42	28.0	0.560	1.35	25.0	12.5	34.6
2.0 SHS	1.99	23.1	0.436	0.977	20.0	13.5	46.8
1.6 SHS	1.63	19.0	0.342	0.663	16.0	14.3	61.9
30 x 30 x 3.0 RHS	2.36	26.9	0.718	1.78	30.0	9.00	20.8
2.5 RHS	2.03	23.3	0.575	1.42	25.0	10.0	27.7
2.0 SHS	1.68	19.4	0.444	1.05	20.0	11.0	38.1
1.6 SHS	1.38	16.0	0.346	0.749	16.0	11.8	51.1
25 x 25 x 3.0 SHS	1.89	21.3	0.759	1.85	30.0	6.50	15.0
2.5 SHS	1.64	18.7	0.598	1.49	25.0	7.50	20.8
2.0 SHS	1.36	15.7	0.456	1.12	20.0	8.50	29.4
1.6 SHS	1.12	13.0	0.353	0.828	16.0	9.30	40.3
20 x 20 x 1.6 SHS	0.873	10.0	0.365	0.899	16.0	6.80	29.4

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext}) / t$
3. $\phi R_{by} = 2\phi \, \alpha_p \, b_b \, t \, f_y$
4. $\phi R_{bb} = 2\phi \, \alpha_c \, b_b \, t \, f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$

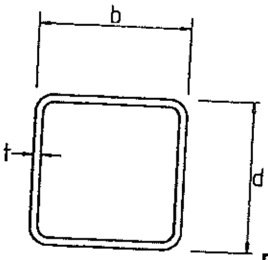
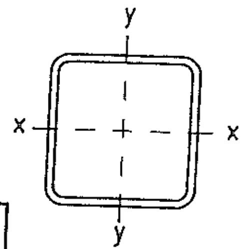


TABLE 4.3–4

DESIGN WEB CAPACITIES OF BEAMS
SQUARE HOLLOW SECTIONS: GRADE C450
about x– and y–axis



Designation d b t	Mass per m	ϕV_v	$\frac{\phi R_{by}}{b_b}$	$\frac{\phi R_{bb}}{b_b}$	Useful Parameters $5r_{ext}$	b_{bw}	L_e/r
mm mm mm	kg/m	kN	kN/mm	kN/mm	mm	mm	mm
100 x 100 x 3.8 SHS	11.1	169	0.810	1.51	47.5	40.5	73.8
3.3 SHS	9.73	148	0.695	1.05	41.3	41.8	87.7
2.8 SHS	8.39	127	0.747	0.637	28.0	44.4	110
2.3 RHS	6.95	105	0.609	0.364	23.0	45.4	137
75 x 75 x 3.3 SHS	7.14	108	0.714	1.59	41.3	29.3	61.4
2.8 SHS	6.19	93.3	0.758	1.03	28.0	31.9	78.9
2.3 SHS	5.14	77.7	0.616	0.614	23.0	32.9	99.1
65 x 65 x 2.8 SHS	5.31	79.8	0.765	1.25	28.0	26.9	66.6
2.3 SHS	4.42	66.7	0.621	0.776	23.0	27.9	84.0
50 x 50 x 2.8 SHS	3.99	59.7	0.783	1.63	28.0	19.4	48.0
2.3 SHS	3.34	50.1	0.632	1.11	23.0	20.4	61.5
40 x 40 x 2.8 SHS	3.11	46.2	0.804	1.86	28.0	14.4	35.6
2.3 SHS	2.62	39.1	0.645	1.36	23.0	15.4	46.4
35 x 35 x 2.8 SHS	2.67	39.5	0.821	1.97	28.0	11.9	29.4
2.3 SHS	2.25	33.6	0.655	1.48	23.0	12.9	38.9
30 x 30 x 2.8 SHS	2.23	32.8	0.847	2.07	28.0	9.40	23.3
2.3 SHS	1.89	28.0	0.670	1.59	23.0	10.4	31.3
25 x 25 x 2.3 SHS	1.53	22.5	0.694	1.69	23.0	7.90	23.8

Notes:
1. $\phi = 0.9$
2. $L_e/r = \sqrt{12}(d - 2r_{ext}) / t$
3. $\phi R_{by} = 2\phi\, \alpha_p\, b_b\, t\, f_y$
4. $\phi R_{bb} = 2\phi\, \alpha_c\, b_b\, t\, f_y$
5. $\alpha_b = 0.5$
6. $k_f = 1.0$

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PART 5 MEMBERS SUBJECT TO AXIAL COMPRESSION

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES

PART 5 MEMBERS SUBJECT TO AXIAL COMPRESSION

5.1 Scope

The following tables and graphs give values of design axial compression capacity for various effective lengths and have been determined using Section 6 of AS 4100.

All loads are assumed to be applied through the centroid of the section and the column capacity is assumed to be associated with flexural buckling about either x– or y–axis.

5.2 Design Capacity for Members Subject to Axial Compression

Values of the design capacity for axial compression (ϕN_c) for buckling about both principal axes, based on the appropriate effective length (L_e) are given in Tables 5.2–1 to 5.2–6. The tables are supplemented by graphs of ϕN_c versus L_e placed consecutively after the tables for each corresponding grade and section.

The tables in this section have been grouped into two series for the rectangular hollow sections:

– the (A) series (e.g. Table 5.2–3(A)) for the member buckling about the x–axis, and

– the (B) series (e.g. Table 5.2–3(B)) for the member buckling about the y–axis.

For each section grade, C350 and C450, the (A) series tables and graphs are immediately followed by the (B) series of tables and graphs.

5.3 Method

The design axial compression member capacity is obtained from Clauses 6.3 of AS 4100 and is given by:

$$\phi N_c = \phi \alpha_c N_s$$
$$\leq \phi N_s$$

where ϕ = 0.9 (Table 3.4 of AS 4100)
$\phi N_s = \phi k_f A_n f_y$ (see Section 3.2.2 and Tables 3.1–1 to 3.1–6)
$k_f = A_e / A_g$ (see Section 1.2.3.3 and Clause 6.2.2 of AS 4100)
A_n = net section area
= A_g
= gross cross–sectional area (assumed no penetration or holes)
f_y = yield stress used in design
α_c = member slenderness reduction factor

According to Clause 6.3.3 of AS 4100, α_c depends on the modified slenderness reduction factor (λ_n) and the member section constant (α_b). The member slenderness reduction factor (α_c) is determined from Clause 6.3.3 of AS 4100 and taken as:

$$\alpha_c = \xi \left\{1 - \sqrt{\left[1 - \left(\frac{90}{\xi\lambda}\right)^2\right]}\right\}$$

where
$$\xi = \frac{\left(\frac{\lambda}{90}\right)^2 + 1 + \eta}{2\left(\frac{\lambda}{90}\right)^2}$$

$$\lambda = \lambda_n + \alpha_a\alpha_b$$

$$\eta = 0.00326(\lambda - 13.5) \geq 0$$

$$\lambda_n = \left(\frac{L_e}{r}\right)\sqrt{(k_f)}\sqrt{\left(\frac{f_y}{250}\right)}$$

$$\alpha_a = \frac{2100(\lambda_n - 13.5)}{\lambda_n^2 - 15.3\lambda_n + 2050}$$

$\alpha_b = -0.5$ (Table 5.3)

$\left(\frac{L_e}{r}\right)$ = geometrical slenderness ratio

L_e = effective length of a compression member (see Section 5.4)
r = radius of gyration (see tables 1.2–1 to 1.2–6)
k_f = form factor (see Section 1.2.3.3 and Tables 1.2–1 to 1.2–6)
f_y = yield stress used in design

Note: the member capacity equals the section capacity ($\phi N_c = \phi N_s$) when the effective length ($L_e = 0$). The residual stress classification used in determining k_f is shown in Table 5.3 and is described in Section 1.2.3.3 of the Tables.

Table 5.3

Section	**Residual Stresses**	**Yield Slenderness Limit** λ_{ey}	α_b $k_f = 1.0$	α_b $k_f < 1.0$
RHS, SHS	CF	40	−0.5	−0.5
CHS	CF	82	−0.5	−0.5

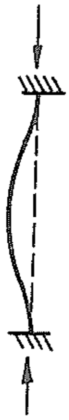
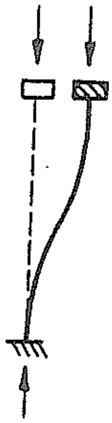
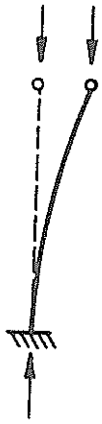
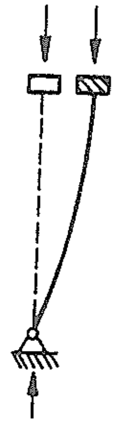
5.4 Effective Length

Before using these tables and graphs it is necessary to determine the effective length, which depends on the rotational and translational restraints at the ends of the member and is determined using the following formula:

$$L_e = k_e L$$

The member effective length factor (k_e) (Clause 6.3.2 of AS 4100) can be determined using Clause 4.6.3 of AS 4100 or by a rational frame buckling analysis as described in Clause 4.7 of AS 4100. Information relevant to assessing k_e, for members in frames using Clause 4.6 of AS 4100, is reproduced in Part 7 of this publication. For members with idealised end restraints k_e is given in Table 5.4.

Table 5.4: Effective Length Factors for Members for Idealised Conditions of End Restraint

	Braced Member			Sway Member		
Buckled Shape						
Effective length factor (k_e)	0.7	0.85	1.0	1.2	2.2	2.2
Symbols for end restraint conditions	= Rotation fixed, translation fixed = Rotation free, translation fixed			= Rotation fixed, translation free = Rotation free, translation free		

Advice on the determination of effective lengths of members in trusses and girders is not covered in AS 4100, but suitable equations have been developed in research [1]. The following equations are applicable for:

- welded joints with gap or partial overlap
- bracing members welded along the full perimeter
- no cropping or flattening of the ends of the bracings

In all cases $L_e / L \geq 0.5$

(i) Chord: circular
Bracing: circular

$$\frac{L_e}{L} = 2.20\left(\frac{d_1^{\,2}}{Ld_o}\right)^{0.25} \leq 0.75$$

(ii) Chord: square
Bracing: circular

$$\frac{L_e}{L} = 2.35\left(\frac{d_1^{\,2}}{Lb_o}\right)^{0.25} \leq 0.75$$

(iii) Chord: square
Bracing: square

$$\frac{L_e}{L} = 2.30\left(\frac{b_1^{\,2}}{Lb_o}\right)^{0.25} \leq 0.75$$

where L_e = effective length of a compression member
L = distance between intersection points of chord and web centre lines (see Figure 5.4)
d_o = outside diameter of a circular chord member
d_1 = outside diameter of a circular bracing member
b_o = external width of a square chord member
b_1 = external width of a square bracing member

The effective length of members in a pitched roof can be determined from the reference[2] below.

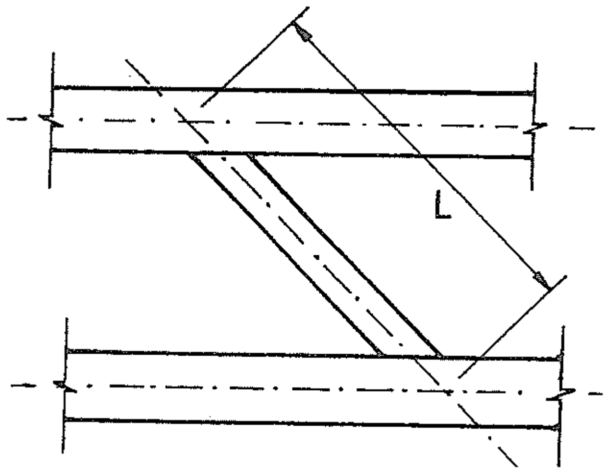


Figure 5.4:

[1] Rondal, J., "Effective Lengths of Tubular Lattice Girder Members Statistical Tests", *CIDECT Re... 3 K – 90/3 Final Report*, University of Liege, 1990.

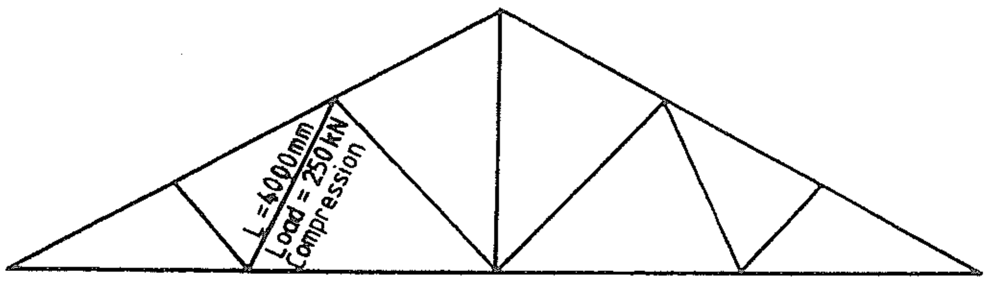
[2] Fraser, D.J., "Stability of Pitched Roof Frames", *Transaction of The Institution of Engi... Australia, Civil Engineering*, Vol. CE28, No. 1, 1986.

5.5 Modes of Buckling

Although it is also possible for some doubly symmetric sections to buckle in a torsional mode, this is not the governing buckling mode for hollow sections.

5.6 Example

1. A compression member in a truss, shown below, is to resist a concentrically applied axial compression force of 250 kN. End connections are full perimeter welded gap joints, with chord and web members being the same size and shape. Circular hollow section web members have profiled ends.



<u>Design Data:</u>

$N^* = 250$ kN

<u>Solution:</u>

Effective length

for $d_1 = d_o$ $(d_1 > 54 \text{ mm})$
and $b_1 = b_o$ $(b_1 > 45 \text{ mm})$

$$L_e = 0.75 \times 4.0 \quad \text{(Section 5.4)}$$
$$= 3.0 \text{ m}$$

Selecting a hollow section with the least mass from Tables 5.2–1 to 5.2–6, the alternatives are:

101.6 x 5.0 CHS – Grade C250	(11.9 kg/m)	$\phi N_c = 236 > N^*$	(Table 5.2–1(2))
114.3 x 3.2 CHS – Grade C350	(8.77 kg/m)	$\phi N_c = 237 > N^*$	(Table 5.2–2(2))
100 x 100 x 3.0 SHS – Grade C350	(8.96 kg/m)	$\phi N_c = 242 > N^*$	(Table 5.2–5(1))
100 x 100 x 2.8 SHS – Grade C450	(8.39 kg/m)	$\phi N_c = 242 > N^*$	(Table 5.2–6(1))

Based on mass select 100 x 100 x 2.8 SHS – Grade C450 (8.39 kg/m).

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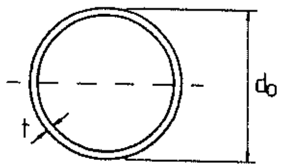
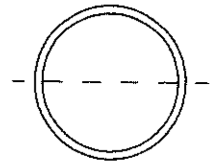
TABLE 5.2 – 1 (1)



DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION

CIRCULAR HOLLOW SECTIONS: GRADE C250

buckling about any axis



Designation d_o t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN)													
		Effective Length (L_e) in metres													
mm mm	kg/m	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
610.0 x 12.7 CHS	187	5360	5360	5360	5360	5310	5260	5210	5150	5080	5000	4910	4700	4450	4150
9.5 CHS	141	4030	4030	4030	4030	4000	3960	3920	3870	3820	3760	3690	3540	3350	3130
6.4 CHS	95.3	2530	2530	2530	2530	2510	2490	2470	2440	2410	2370	2340	2250	2140	2020
508.0 x 12.7 CHS	155	4450	4450	4450	4420	4370	4320	4250	4180	4100	4000	3890	3640	3320	2960
9.5 CHS	117	3350	3350	3350	3330	3290	3250	3210	3150	3090	3020	2940	2750	2510	2240
6.4 CHS	79.2	2270	2270	2270	2260	2230	2210	2170	2140	2100	2050	1990	1870	1710	1530

Notes:
1. ϕ = 0.9
2. ϕN_c = $\phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. α_b = −0.5 (Table 6.3.3 of AS 4100)

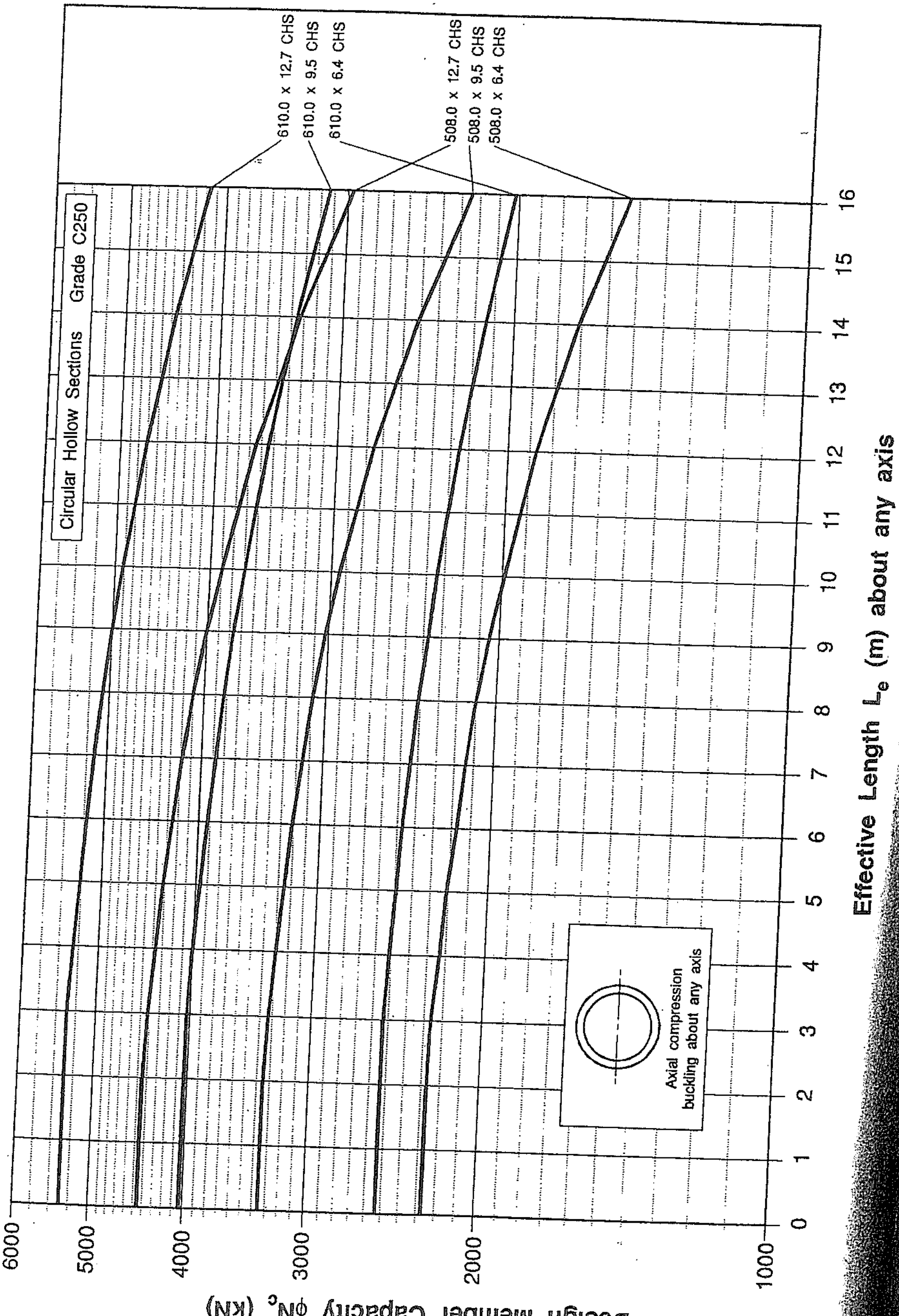
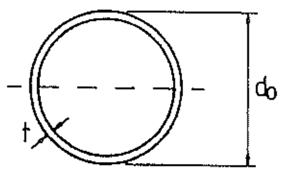
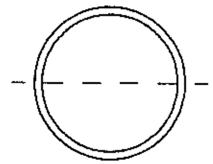

Circular Hollow Sections Grade C250
610.0 x 12.7 CHS
610.0 x 9.5 CHS
610.0 x 6.4 CHS
508.0 x 12.7 CHS
508.0 x 9.5 CHS
508.0 x 6.4 CHS
Axial compression buckling about any axis
Effective Length L_e (m) about any axis
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Design Member Capacity ϕN_c (kN)
6000
5000
4000
3000
2000
1000

TABLE 5.2 – 1 (2)

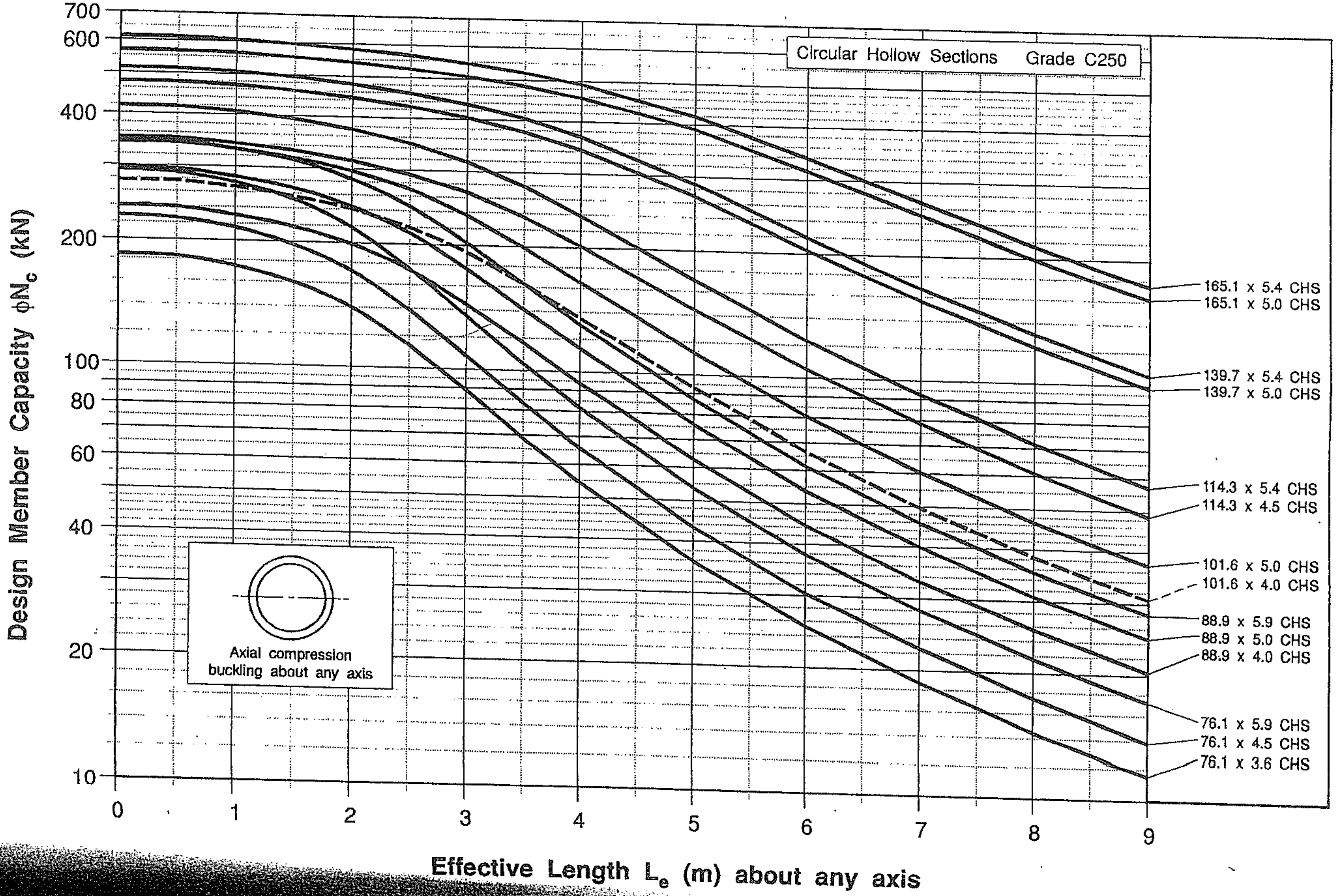


DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
CIRCULAR HOLLOW SECTIONS: GRADE C250
buckling about any axis



Designation d_o t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) Effective Length (L_e) in metres													
mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0
165.1 x 5.4 CHS	21.3	610	610	605	595	581	565	544	520	490	418	338	268	214	173
5.0 CHS	19.7	566	566	562	552	540	524	506	483	456	389	315	250	199	161
139.7 x 5.4 CHS	17.9	513	513	506	494	479	459	434	404	368	288	219	167	131	105
5.0 CHS	16.6	476	476	470	459	445	426	403	375	342	269	204	156	122	98.0
114.3 x 5.4 CHS	14.5	416	416	406	392	373	348	316	278	238	170	123	92.2	71.5	57.0
4.5 CHS	12.2	349	349	341	330	314	293	267	235	202	144	105	78.6	61.0	48.6
101.6 x 5.0 CHS	11.9	341	341	331	317	297	270	236	199	165	113	80.8	60.3	46.6	37.1
4.0 CHS	9.63	276	276	268	256	241	219	193	163	135	92.9	66.5	49.6	38.4	30.6
88.9 x 5.9 CHS	12.1	346	344	331	312	284	246	203	163	130	86.9	61.5	45.7	35.3	28.1
5.0 CHS	10.3	297	295	284	268	244	213	176	141	114	75.9	53.7	40.0	30.8	24.5
4.0 CHS	8.38	240	239	230	217	199	174	144	117	93.7	62.7	44.4	33.0	25.5	20.3
76.1 x 5.9 CHS	10.2	293	289	275	252	218	175	135	104	81.7	53.6	37.8	28.0	21.6	17.2
4.5 CHS	7.95	228	225	215	197	172	139	108	83.5	65.7	43.2	30.4	22.6	17.4	13.8
3.6 CHS	6.44	184	183	174	160	140	114	89.0	69.0	54.4	35.8	25.2	18.7	14.4	11.5

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)



Circular Hollow Sections Grade C250
Design Member Capacity ϕN_c (kN)
700
600
400
200
100
80
60
40
20
10
Effective Length L_e (m) about any axis
0
1
2
3
4
5
6
7
8
9
165.1 x 5.4 CHS
165.1 x 5.0 CHS
139.7 x 5.4 CHS
139.7 x 5.0 CHS
114.3 x 5.4 CHS
114.3 x 4.5 CHS
101.6 x 5.0 CHS
101.6 x 4.0 CHS
88.9 x 5.9 CHS
88.9 x 5.0 CHS
88.9 x 4.0 CHS
76.1 x 5.9 CHS
76.1 x 4.5 CHS
76.1 x 3.6 CHS
Axial compression buckling about any axis

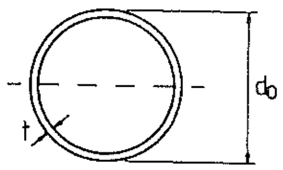
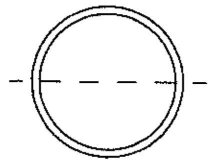


TABLE 5.2 – 1 (3)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
CIRCULAR HOLLOW SECTIONS: GRADE C250
buckling about any axis



Designation d_o × t (mm × mm)	Mass per m (kg/m)	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
		Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres													
76.1 x 5.9 CHS	10.2	293	293	289	283	275	265	252	236	218	175	135	104	81.7	53.6
4.5 CHS	7.95	228	228	225	221	215	207	197	186	172	139	108	83.5	65.7	43.2
3.6 CHS	6.44	184	184	183	179	174	168	160	151	140	114	89.0	69.0	54.4	35.8
60.3 x 5.4 CHS	7.31	210	210	205	198	189	176	161	142	122	87.2	63.3	47.5	36.9	24.0
4.5 CHS	6.19	177	177	174	168	160	150	137	122	105	75.7	55.0	41.4	32.1	20.9
3.6 CHS	5.03	144	144	141	137	131	123	113	100	87.1	63.0	46.0	34.6	26.8	17.5
48.3 x 5.4 CHS	5.71	164	163	157	149	137	120	101	81.6	65.8	44.2	31.3	23.3	18.0	11.7
4.0 CHS	4.37	125	125	121	114	106	93.9	79.5	65.1	52.8	35.6	25.3	18.8	14.5	9.43
3.2 CHS	3.56	102	102	98.4	93.5	86.7	77.3	65.9	54.3	44.2	29.9	21.2	15.8	12.2	7.93
42.4 x 4.9 CHS	4.53	130	129	123	114	101	84.3	66.7	52.2	41.3	27.2	19.2	14.3	11.0	7.12
4.0 CHS	3.79	109	108	103	96.1	85.7	72.0	57.5	45.2	35.8	23.7	16.7	12.4	9.58	6.20
3.2 CHS	3.09	88.7	88.0	84.4	78.9	70.7	59.9	48.2	38.0	30.2	20.0	14.2	10.5	8.11	5.25
33.7 x 4.5 CHS	3.24	92.9	91.1	84.8	74.2	58.7	43.2	31.7	24.0	18.6	12.1	8.52	6.31	4.86	3.14
4.0 CHS	2.93	84.0	82.5	76.9	67.6	53.9	40.0	29.4	22.2	17.3	11.3	7.92	5.87	4.52	2.92
3.2 CHS	2.41	69.0	67.8	63.5	56.2	45.4	34.0	25.2	19.1	14.8	9.69	6.81	5.04	3.88	2.51
26.9 x 4.0 CHS	2.26	64.7	62.6	55.6	43.1	29.3	20.0	14.2	10.6	8.19	5.31	3.72	2.75	2.12	1.37
3.2 CHS	1.87	53.6	51.9	46.4	36.7	25.4	17.4	12.4	9.27	7.17	4.65	3.26	2.41	1.85	1.20
2.6 CHS	1.56	44.7	43.3	38.9	31.2	21.9	15.1	10.8	8.05	6.22	4.04	2.83	2.09	1.61	1.04
21.3 x 3.6 CHS	1.57	45.0	42.5	34.1	21.6	13.2	8.66	6.10	4.53	3.49	2.26	1.58	1.17	0.897	0.578
3.2 CHS	1.43	40.9	38.7	31.4	20.2	12.4	8.14	5.74	4.26	3.28	2.12	1.49	1.10	0.844	0.544
2.6 CHS	1.20	34.4	32.6	26.8	17.6	10.9	7.19	5.07	3.76	2.90	1.88	1.31	0.971	0.747	0.481

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)

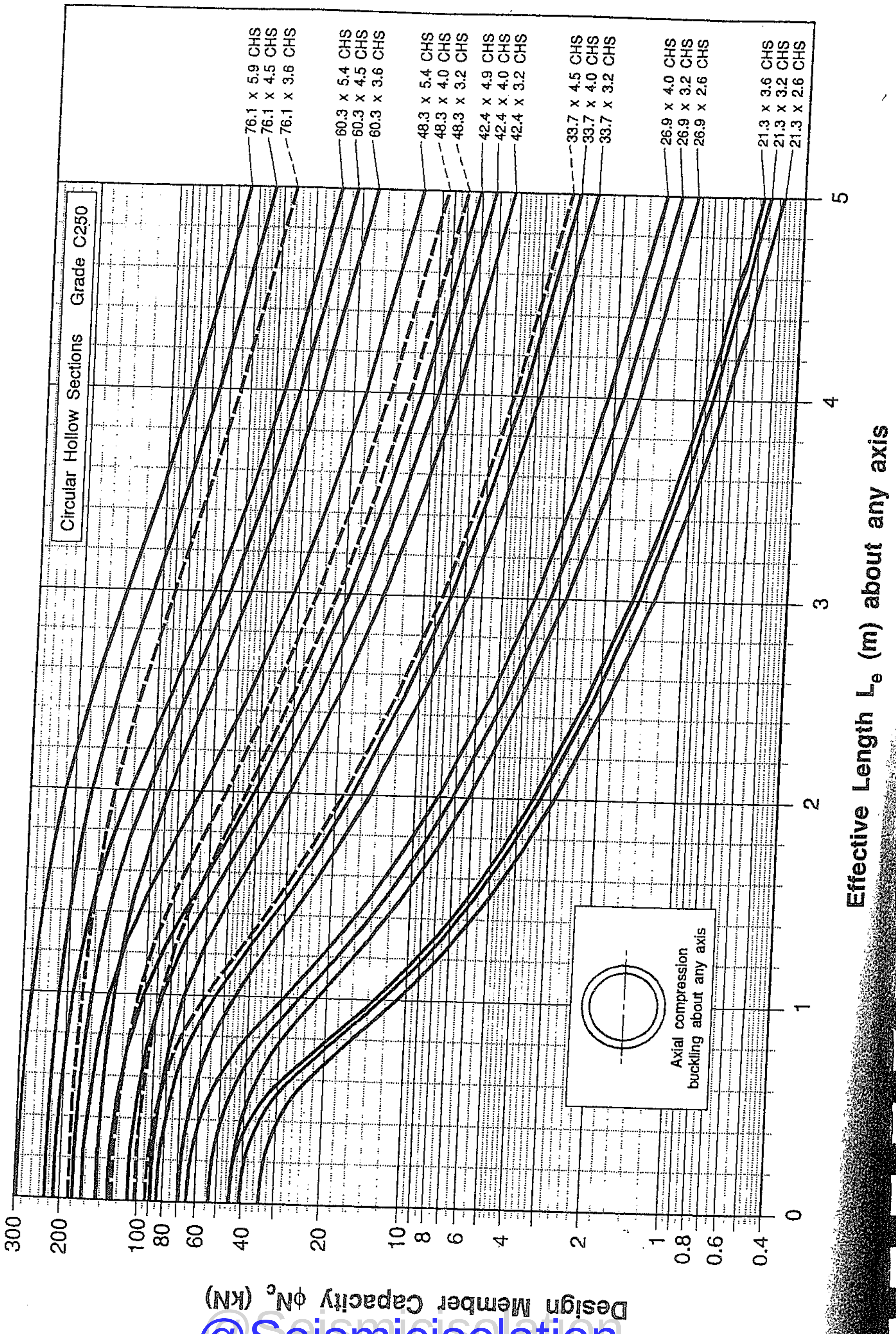
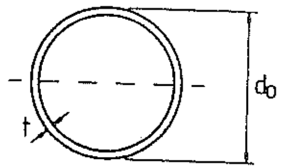
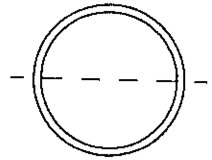

Circular Hollow Sections Grade C250
76.1 x 5.9 CHS
76.1 x 4.5 CHS
76.1 x 3.6 CHS
60.3 x 5.4 CHS
60.3 x 4.5 CHS
60.3 x 3.6 CHS
48.3 x 5.4 CHS
48.3 x 4.0 CHS
48.3 x 3.2 CHS
42.4 x 4.9 CHS
42.4 x 4.0 CHS
42.4 x 3.2 CHS
33.7 x 4.5 CHS
33.7 x 4.0 CHS
33.7 x 3.2 CHS
26.9 x 4.0 CHS
26.9 x 3.2 CHS
26.9 x 2.6 CHS
21.3 x 3.6 CHS
21.3 x 3.2 CHS
21.3 x 2.6 CHS
Axial compression buckling about any axis
300
200
100
80
60
40
20
10
8
6
4
2
1
0.8
0.6
0.4
0
1
2
3
4
5
Effective Length L_e (m) about any axis
Design Member Capacity ϕN_c (kN)

TABLE 5.2 – 2 (1)

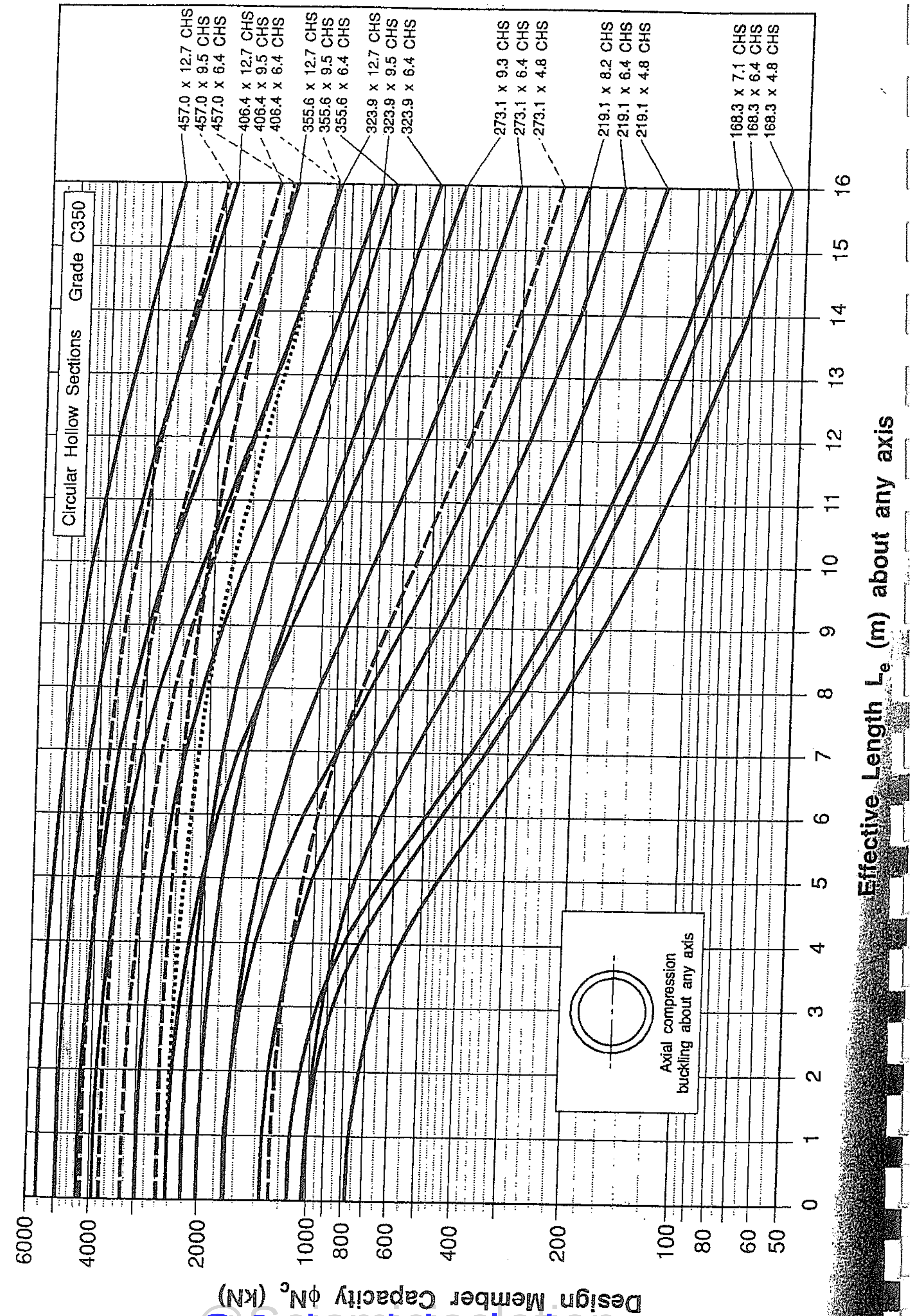




DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION CIRCULAR HOLLOW SECTIONS: GRADE C350 buckling about any axis

Designation d_o × t (mm × mm)	Mass per m (kg/m)	Design Capacities for Axial Compression ϕN_c (kN), Effective Length (L_e) in metres: 0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
457.0 x 12.7 CHS	139	5580	5580	5570	5490	5400	5290	5150	4990	4810	4590	4340	3750	3130	2570
9.5 CHS	105	4210	4210	4200	4140	4070	3990	3890	3770	3630	3470	3280	2850	2380	1960
6.4 CHS	71.1	2580	2580	2580	2550	2510	2460	2410	2340	2270	2180	2080	1840	1570	1310
406.4 x 12.7 CHS	123	4950	4950	4920	4840	4740	4610	4460	4280	4060	3810	3520	2900	2320	1860
9.5 CHS	93.0	3730	3730	3710	3650	3580	3480	3370	3230	3070	2890	2670	2210	1770	1420
6.4 CHS	63.1	2430	2430	2420	2380	2340	2280	2210	2130	2030	1910	1780	1490	1210	973
355.6 x 12.7 CHS	107	4310	4310	4270	4180	4070	3920	3750	3530	3270	2980	2670	2080	1610	1270
9.5 CHS	81.1	3250	3250	3220	3160	3070	2970	2840	2680	2490	2270	2030	1590	1230	973
6.4 CHS	55.1	2210	2210	2190	2150	2090	2020	1930	1830	1700	1550	1400	1090	852	672
323.9 x 12.7 CHS	97.5	3910	3910	3860	3760	3640	3480	3280	3040	2750	2440	2140	1610	1230	961
9.5 CHS	73.7	2960	2960	2920	2850	2750	2640	2490	2310	2100	1870	1640	1240	946	740
6.4 CHS	50.1	2010	2010	1980	1940	1880	1800	1700	1580	1440	1280	1130	856	655	512
273.1 x 9.3 CHS	60.5	2430	2430	2380	2300	2190	2050	1870	1660	1430	1220	1030	748	562	436
6.4 CHS	42.1	1690	1690	1650	1600	1530	1430	1310	1170	1010	859	728	530	399	310
4.8 CHS	31.8	1270	1270	1250	1210	1150	1080	994	885	767	654	555	404	304	236
219.1 x 8.2 CHS	42.6	1710	1700	1650	1570	1450	1290	1090	893	724	591	489	347	259	200
6.4 CHS	33.6	1350	1340	1300	1230	1140	1020	865	711	578	472	391	278	207	160
4.8 CHS	25.4	1020	1010	982	934	865	773	659	543	442	362	299	213	158	122
168.3 x 7.1 CHS	28.2	1130	1120	1060	964	822	649	495	380	297	238	195	137	102	78.4
6.4 CHS	25.6	1030	1010	960	874	746	591	451	346	271	217	178	125	92.8	71.6
4.8 CHS	19.4	777	767	728	664	570	453	347	267	209	168	137	96.6	71.6	55.2

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)



Circular Hollow Sections Grade C350
457.0 x 12.7 CHS
457.0 x 9.5 CHS
457.0 x 6.4 CHS
406.4 x 12.7 CHS
406.4 x 9.5 CHS
406.4 x 6.4 CHS
355.6 x 12.7 CHS
355.6 x 9.5 CHS
355.6 x 6.4 CHS
323.9 x 12.7 CHS
323.9 x 9.5 CHS
323.9 x 6.4 CHS
273.1 x 9.3 CHS
273.1 x 6.4 CHS
273.1 x 4.8 CHS
219.1 x 8.2 CHS
219.1 x 6.4 CHS
219.1 x 4.8 CHS
168.3 x 7.1 CHS
168.3 x 6.4 CHS
168.3 x 4.8 CHS
Axial compression buckling about any axis
Effective Length L_e (m) about any axis
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Design Member Capacity ϕN_c (kN)
6000
4000
2000
1000
800
600
400
200
100
80
60
50

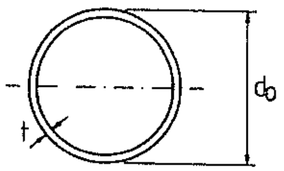
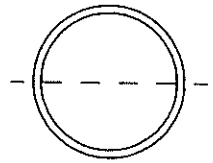


TABLE 5.2 – 2 (2)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION CIRCULAR HOLLOW SECTIONS: GRADE C350

buckling about any axis



Designation d_o mm	t mm	Mass per m kg/m	Design Capacities for Axial Compression ϕN_c (kN), Effective Length (L_e) in metres: 0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0
168.3 x	7.1 CHS	28.2	1130	1130	1120	1090	1060	1020	964	899	822	649	495	380	297	238
	6.4 CHS	25.6	1030	1030	1010	990	960	922	874	816	746	591	451	346	271	217
	4.8 CHS	19.4	777	777	767	750	728	700	664	621	570	453	347	267	209	168
165.1 x	3.5 CHS	13.9	560	560	553	540	524	503	477	445	407	322	245	188	147	118
	3.0 CHS	12.0	481	481	475	465	451	433	410	383	351	278	212	163	127	102
139.7 x	3.5 CHS	11.8	472	472	462	448	429	403	371	332	289	211	154	116	90.0	71.8
	3.0 CHS	10.1	406	406	398	386	369	348	320	287	250	182	133	100	78.0	62.2
114.3 x	6.0 CHS	16.0	643	641	621	591	549	492	422	349	285	193	137	102	79.2	63.0
	4.8 CHS	13.0	520	519	503	479	446	401	345	286	234	159	113	84.5	65.3	52.0
	3.6 CHS	9.83	394	393	381	364	339	306	264	220	181	123	87.7	65.4	50.6	40.2
	3.2 CHS	8.77	352	351	340	325	303	273	237	197	162	110	78.8	58.7	45.4	36.1
101.6 x	3.2 CHS	7.77	312	310	298	281	256	222	183	146	117	78.2	55.4	41.2	31.8	25.3
	2.6 CHS	6.35	255	253	244	230	210	182	150	121	96.8	64.7	45.8	34.0	26.3	20.9
88.9 x	5.5 CHS	11.3	454	449	427	391	338	272	210	162	127	83.6	58.9	43.7	33.7	26.8
	4.8 CHS	9.96	399	395	376	345	299	242	187	145	114	74.7	52.6	39.0	30.1	23.9
	3.2 CHS	6.76	271	269	256	236	206	168	131	101	79.8	52.5	37.0	27.4	21.2	16.8
	2.6 CHS	5.53	222	220	210	193	169	138	108	83.9	66.1	43.5	30.7	22.8	17.5	13.9
76.1 x	3.2 CHS	5.75	231	227	213	188	153	115	85.1	64.5	50.2	32.8	23.0	17.0	13.1	10.4
	2.3 CHS	4.19	168	165	155	138	113	85.0	63.2	47.9	37.4	24.4	17.1	12.7	9.78	7.77

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)

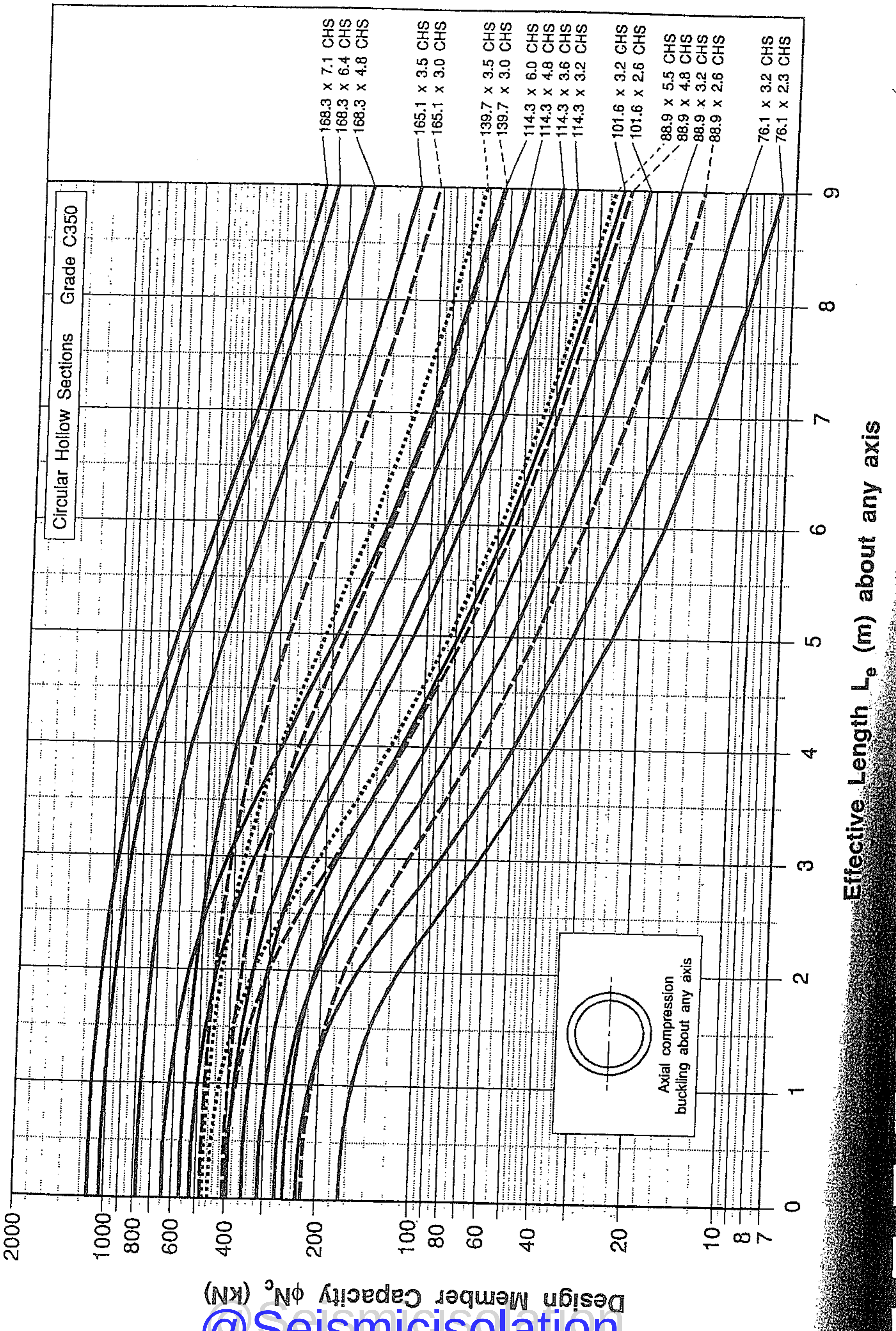
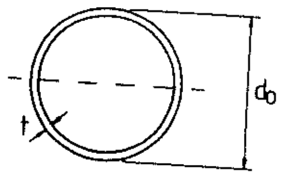
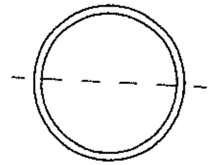

Circular Hollow Sections Grade C350
168.3 x 7.1 CHS
168.3 x 6.4 CHS
168.3 x 4.8 CHS
165.1 x 3.5 CHS
165.1 x 3.0 CHS
139.7 x 3.5 CHS
139.7 x 3.0 CHS
114.3 x 6.0 CHS
114.3 x 4.8 CHS
114.3 x 3.6 CHS
114.3 x 3.2 CHS
101.6 x 3.2 CHS
101.6 x 2.6 CHS
88.9 x 5.5 CHS
88.9 x 4.8 CHS
88.9 x 3.2 CHS
88.9 x 2.6 CHS
76.1 x 3.2 CHS
76.1 x 2.3 CHS
Axial compression buckling about any axis
2000
1000
800
600
400
200
100
80
60
40
20
10
8
7
Design Member Capacity φNc (kN)
0
1
2
3
4
5
6
7
8
9
Effective Length Le (m) about any axis

TABLE 5.2 – 2 (3)



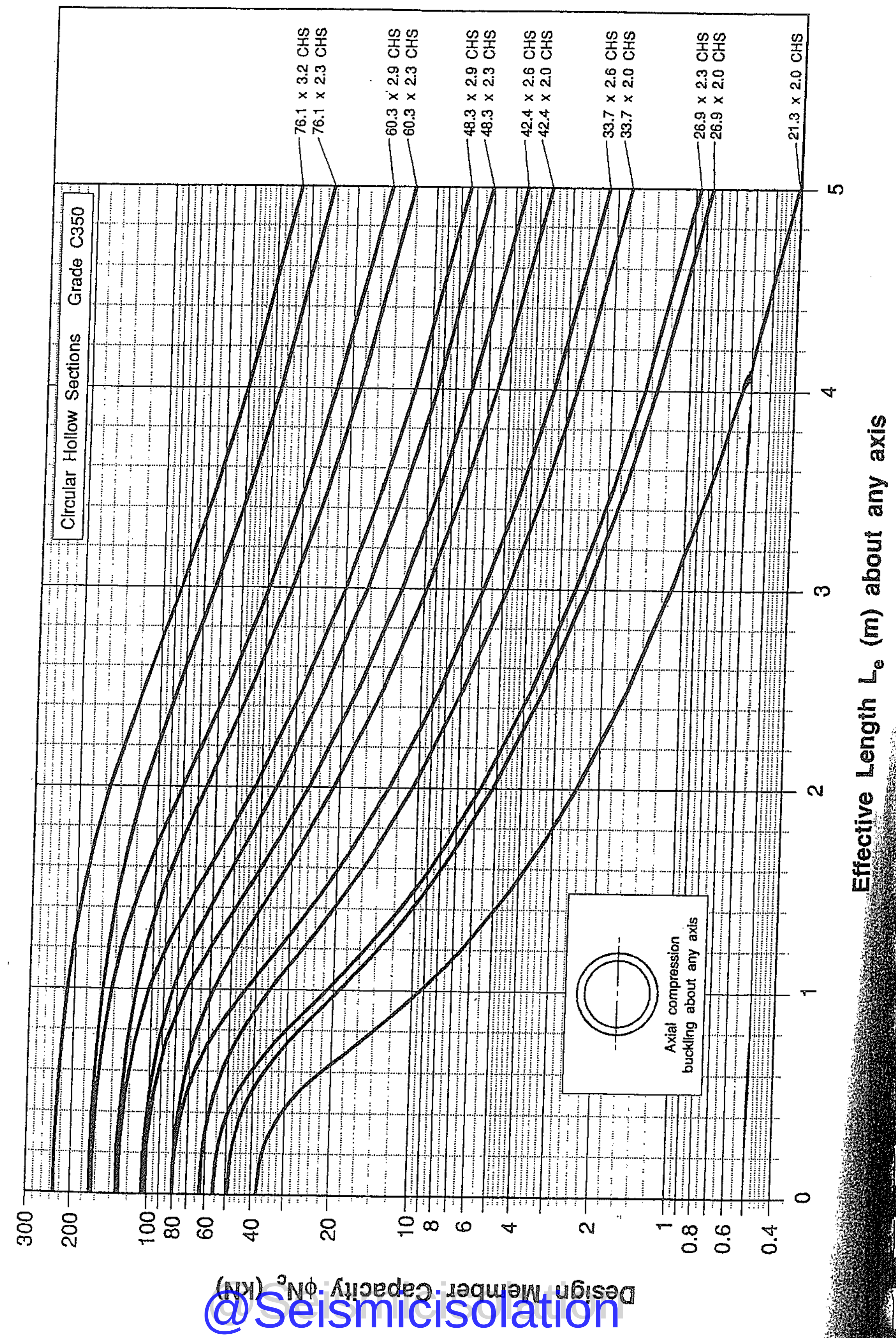
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION CIRCULAR HOLLOW SECTIONS: GRADE C350

buckling about any axis



Designation d_o × t (mm × mm)	Mass per m (kg/m)	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres: 0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
76.1 x 3.2 CHS	5.75	231	231	227	221	213	202	188	172	153	115	85.1	64.5	50.2	32.8
2.3 CHS	4.19	168	168	165	161	155	147	138	126	113	85.0	63.2	47.9	37.4	24.4
60.3 x 2.9 CHS	4.11	165	164	160	153	143	131	114	96.6	80.0	54.9	39.3	29.3	22.7	14.7
2.3 CHS	3.29	132	132	128	123	115	105	92.5	78.4	65.1	44.8	32.1	23.9	18.5	12.0
48.3 x 2.9 CHS	3.25	130	129	124	115	103	86.0	68.5	53.8	42.6	28.2	19.9	14.8	11.4	7.38
2.3 CHS	2.61	105	104	99.6	92.9	83.1	70.0	56.1	44.1	35.0	23.2	16.4	12.2	9.38	6.07
42.4 x 2.6 CHS	2.55	102	101	95.6	86.8	73.6	57.8	43.9	33.6	26.3	17.2	12.1	9.00	6.93	4.48
2.0 CHS	1.99	80.0	79.0	74.8	68.1	58.1	46.0	35.1	26.9	21.1	13.8	9.74	7.22	5.56	3.60
33.7 x 2.6 CHS	1.99	80.0	78.0	71.3	59.5	43.8	30.9	22.3	16.7	12.9	8.39	5.89	4.36	3.35	2.16
2.0 CHS	1.56	62.7	61.3	56.1	47.2	35.2	24.9	18.0	13.5	10.5	6.81	4.78	3.53	2.72	1.76
26.9 x 2.3 CHS	1.40	56.0	53.6	46.0	33.0	21.2	14.2	10.0	7.45	5.75	3.73	2.61	1.93	1.48	0.956
2.0 CHS	1.23	49.3	47.3	40.7	29.4	19.0	12.7	9.01	6.70	5.17	3.35	2.35	1.73	1.33	0.860
21.3 x 2.0 CHS	0.952	38.2	35.5	26.8	15.6	9.33	6.10	4.29	3.18	2.45	1.58	1.11	0.818	0.629	0.405

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Circular Hollow Sections Grade C350
76.1 x 3.2 CHS
76.1 x 2.3 CHS
60.3 x 2.9 CHS
60.3 x 2.3 CHS
48.3 x 2.9 CHS
48.3 x 2.3 CHS
42.4 x 2.6 CHS
42.4 x 2.0 CHS
33.7 x 2.6 CHS
33.7 x 2.0 CHS
26.9 x 2.3 CHS
26.9 x 2.0 CHS
21.3 x 2.0 CHS
Axial compression buckling about any axis
Design Member Capacity ϕN_c (kN)
300
200
100
80
60
40
20
10
8
6
4
2
1
0.8
0.6
0.4
Effective Length L_e (m) about any axis
0
1
2
3
4
5

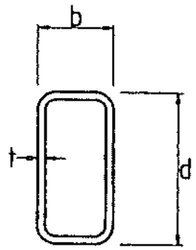
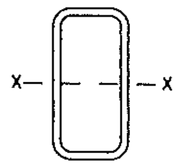


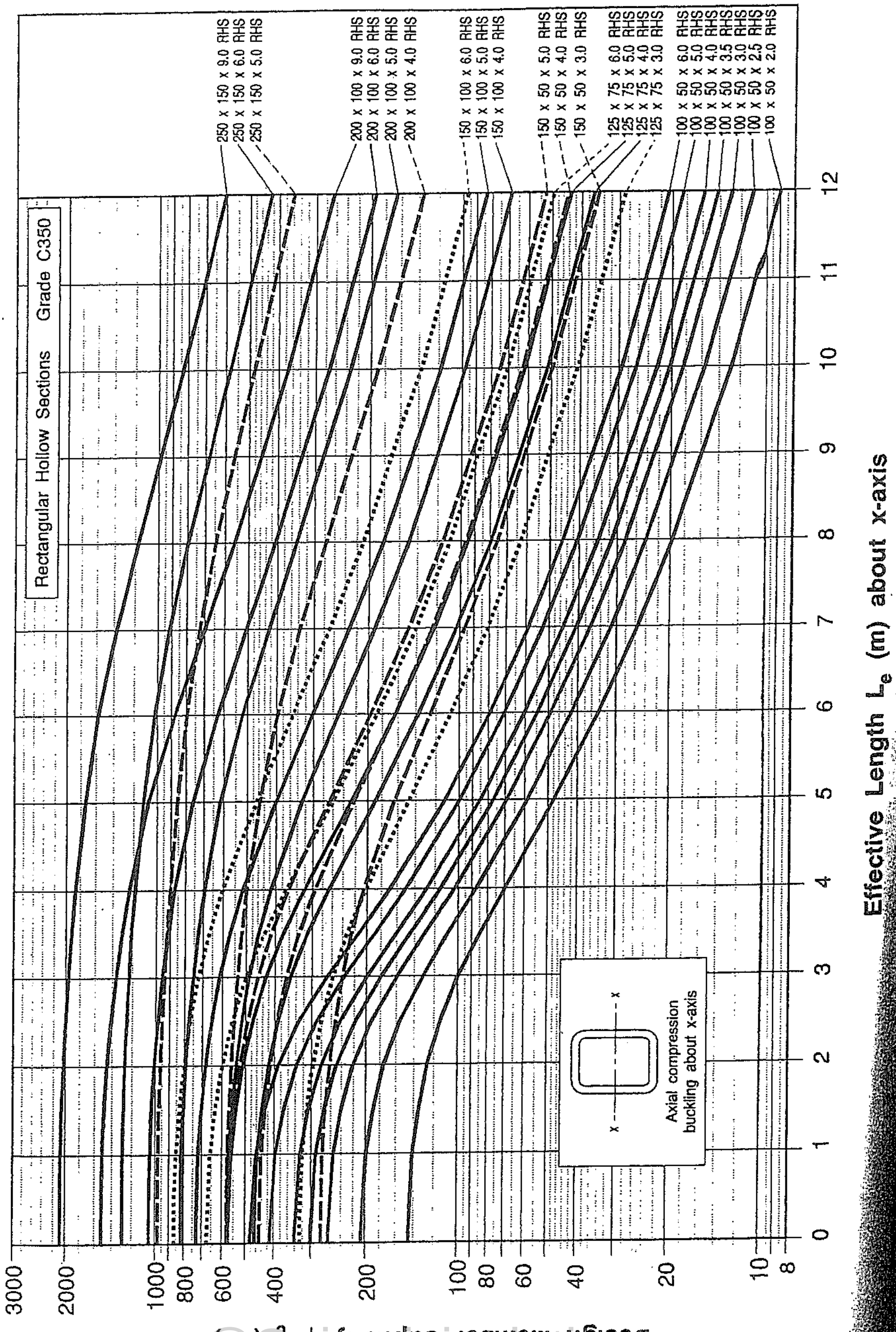
TABLE 5.2 – 3 (1)(A)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
RECTANGULAR HOLLOW SECTIONS: GRADE C350
buckling about x–axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10.0	12.0
250 x 150 x 9.0 RHS	51.8	2080	2080	2060	2030	2000	1960	1910	1860	1730	1570	1370	1170	832	602
6.0 RHS	35.6	1290	1290	1280	1270	1250	1230	1210	1180	1110	1020	914	797	581	425
5.0 RHS	29.9	978	978	972	961	949	935	918	900	854	796	725	644	482	357
200 x 100 x 9.0 RHS	37.7	1510	1500	1480	1450	1410	1360	1300	1230	1070	873	698	558	372	263
6.0 RHS	26.2	1050	1040	1030	1010	981	950	913	868	758	628	506	407	272	193
5.0 RHS	22.1	820	817	805	790	772	750	723	692	614	520	425	345	232	165
4.0 RHS	17.9	575	574	567	558	547	533	518	500	454	396	334	276	189	135
150 x 100 x 6.0 RHS	21.4	861	849	828	800	765	721	666	603	466	351	267	209	137	96.1
5.0 RHS	18.2	729	719	702	679	650	613	568	515	400	302	231	180	118	83.1
4.0 RHS	14.8	575	568	555	538	516	489	455	415	327	249	191	149	97.8	68.8
150 x 50 x 5.0 RHS	14.2	571	561	544	522	493	457	412	362	266	196	148	115	74.8	52.5
4.0 RHS	11.6	449	442	430	413	392	365	332	295	221	163	124	96.2	62.8	44.1
3.0 RHS	8.96	279	276	270	262	251	239	224	205	164	125	96.5	75.7	49.7	35.0
125 x 75 x 6.0 RHS	16.7	672	655	631	598	555	500	435	368	259	187	140	109	70.6	49.5
5.0 RHS	14.2	571	558	538	511	475	429	375	319	226	163	122	94.9	61.7	43.3
4.0 RHS	11.6	467	456	440	418	390	354	311	266	189	137	103	79.5	51.7	36.3
3.0 RHS	8.96	326	320	310	297	279	257	231	201	147	107	80.9	62.9	41.0	28.7
100 x 50 x 6.0 RHS	12.0	483	460	431	388	331	268	212	169	112	79.3	58.9	45.4	29.4	20.6
5.0 RHS	10.3	414	396	371	336	289	236	188	150	100	70.7	52.6	40.6	26.3	18.4
4.0 RHS	8.49	341	326	307	279	242	199	160	128	85.3	60.4	44.9	34.7	22.4	15.7
3.5 RHS	7.53	302	290	273	249	216	179	144	115	77.0	54.5	40.6	31.3	20.3	14.2
3.0 RHS	6.60	265	254	240	220	192	159	129	103	69.3	49.1	36.5	28.2	18.3	12.8
2.5 RHS	5.56	207	199	189	175	155	131	108	87.4	58.9	41.9	31.2	24.1	15.6	10.9
2.0 RHS	4.50	145	141	134	126	114	100	84.3	69.6	47.8	34.1	25.5	19.7	12.8	8.96

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Rectangular Hollow Sections Grade C350
250 x 150 x 9.0 RHS
250 x 150 x 6.0 RHS
250 x 150 x 5.0 RHS
200 x 100 x 9.0 RHS
200 x 100 x 6.0 RHS
200 x 100 x 5.0 RHS
200 x 100 x 4.0 RHS
150 x 100 x 6.0 RHS
150 x 100 x 5.0 RHS
150 x 100 x 4.0 RHS
150 x 50 x 5.0 RHS
150 x 50 x 4.0 RHS
150 x 50 x 3.0 RHS
125 x 75 x 6.0 RHS
125 x 75 x 5.0 RHS
125 x 75 x 4.0 RHS
125 x 75 x 3.0 RHS
100 x 50 x 6.0 RHS
100 x 50 x 5.0 RHS
100 x 50 x 4.0 RHS
100 x 50 x 3.5 RHS
100 x 50 x 3.0 RHS
100 x 50 x 2.5 RHS
100 x 50 x 2.0 RHS
Axial compression buckling about x-axis
x
x
Design Member Capacity φNc (kN)
3000
2000
1000
800
600
400
200
100
80
60
40
20
10
8
Effective Length Le (m) about x-axis
0
1
2
3
4
5
6
7
8
9
10
11
12

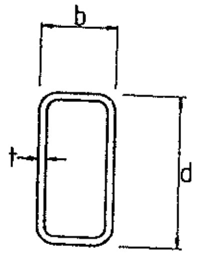
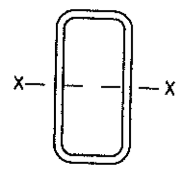


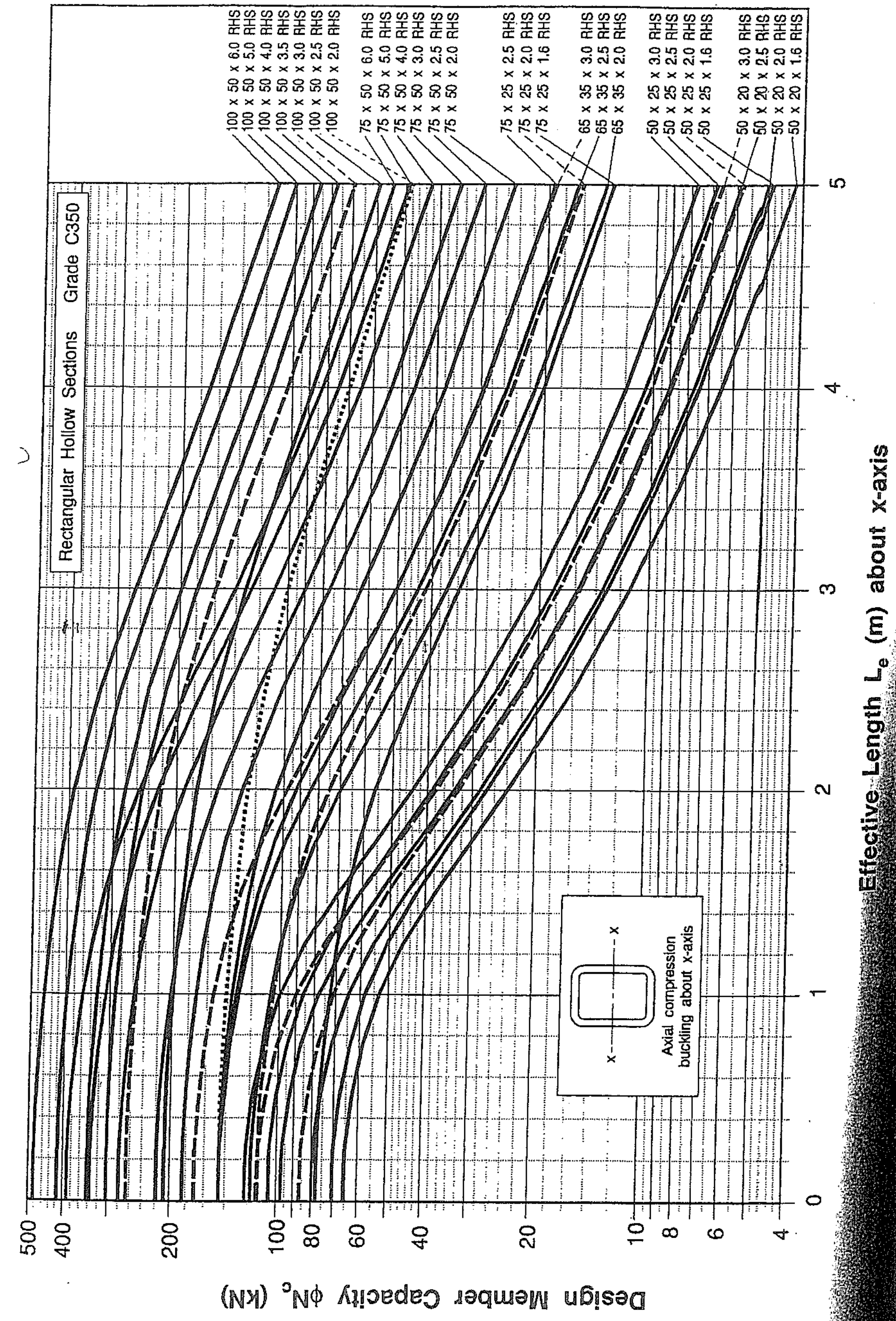
TABLE 5.2 – 3 (2)(A)

DESIGN MEMBER CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
RECTANGULAR HOLLOW SECTIONS: GRADE C350
buckling about x–axis



Designation d b t	Mass per m	Design Member Capacities for Axial Compression ϕN_c (kN)													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
100 x 50 x 6.0 RHS	12.0	483	483	479	471	460	447	431	411	388	331	268	212	169	112
5.0 RHS	10.3	414	414	411	404	396	385	371	355	336	289	236	188	150	100
4.0 RHS	8.49	341	341	339	333	326	317	307	294	279	242	199	160	128	85.3
3.5 RHS	7.53	302	302	300	296	290	282	273	262	249	216	179	144	115	77.0
3.0 RHS	6.60	265	265	263	259	254	248	240	231	220	192	159	129	103	69.3
2.5 RHS	5.56	207	207	206	203	199	195	189	182	175	155	131	108	87.4	58.9
2.0 RHS	4.50	145	145	145	143	141	138	134	130	126	114	100	84.3	69.6	47.8
75 x 50 x 6.0 RHS	9.67	388	388	382	371	357	338	315	286	254	189	140	106	82.4	53.8
5.0 RHS	8.35	335	335	330	321	309	294	275	252	225	170	126	95.7	74.6	48.7
4.0 RHS	6.92	278	278	273	266	257	245	230	212	190	145	109	82.8	64.6	42.2
3.0 RHS	5.42	218	218	215	209	202	194	183	169	153	119	89.4	68.2	53.3	34.9
2.5 RHS	4.58	184	184	181	177	171	164	155	144	130	102	76.8	58.7	45.9	30.0
2.0 RHS	3.72	145	145	143	140	136	130	123	115	105	82.7	62.9	48.3	37.8	24.8
75 x 25 x 2.5 RHS	3.60	145	145	142	138	132	125	116	105	92.2	68.2	50.2	37.9	29.5	19.2
2.0 RHS	2.93	113	113	112	108	104	99.1	92.5	84.3	74.9	56.2	41.6	31.5	24.5	16.0
1.6 RHS	2.38	77.6	77.6	76.7	74.9	72.6	69.6	65.9	61.4	56.0	44.0	33.5	25.6	20.1	13.2
65 x 35 x 3.0 RHS	4.25	170	170	166	161	153	143	130	114	97.5	69.4	50.3	37.7	29.3	19.0
2.5 RHS	3.60	145	145	141	137	130	122	111	97.9	84.1	60.2	43.7	32.8	25.4	16.5
2.0 RHS	2.93	118	118	115	111	106	99.6	91.0	80.6	69.6	50.0	36.3	27.3	21.2	13.8
50 x 25 x 3.0 RHS	3.07	123	122	118	110	99.6	85.4	69.4	55.2	44.0	29.3	20.7	15.4	11.9	7.68
2.5 RHS	2.62	105	105	101	94.6	85.9	74.1	60.7	48.5	38.8	25.9	18.3	13.6	10.5	6.79
2.0 RHS	2.15	86.2	85.7	82.6	77.8	70.9	61.6	50.9	40.8	32.7	21.9	15.5	11.5	8.89	5.76
1.6 RHS	1.75	70.3	69.9	67.4	63.6	58.2	50.8	42.2	34.0	27.3	18.3	13.0	9.63	7.44	4.82
50 x 20 x 3.0 RHS	2.83	114	113	108	101	90.0	75.8	60.6	47.7	37.8	25.0	17.7	13.1	10.1	6.56
2.5 RHS	2.42	97.3	96.6	92.7	86.7	77.9	66.2	53.4	42.2	33.6	22.3	15.7	11.7	9.02	5.84
2.0 RHS	1.99	79.9	79.4	76.3	71.5	64.6	55.3	45.0	35.7	28.5	19.0	13.4	9.96	7.68	4.97
1.6 RHS	1.63	65.3	64.9	62.4	58.6	53.2	45.8	37.5	29.9	23.9	15.9	11.3	8.37	6.46	4.18

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Rectangular Hollow Sections Grade C350
100 x 50 x 6.0 RHS
100 x 50 x 5.0 RHS
100 x 50 x 4.0 RHS
100 x 50 x 3.5 RHS
100 x 50 x 3.0 RHS
100 x 50 x 2.5 RHS
100 x 50 x 2.0 RHS
75 x 50 x 6.0 RHS
75 x 50 x 5.0 RHS
75 x 50 x 4.0 RHS
75 x 50 x 3.0 RHS
75 x 50 x 2.5 RHS
75 x 50 x 2.0 RHS
75 x 25 x 2.5 RHS
75 x 25 x 2.0 RHS
75 x 25 x 1.6 RHS
65 x 35 x 3.0 RHS
65 x 35 x 2.5 RHS
65 x 35 x 2.0 RHS
50 x 25 x 3.0 RHS
50 x 25 x 2.5 RHS
50 x 25 x 2.0 RHS
50 x 25 x 1.6 RHS
50 x 20 x 3.0 RHS
50 x 20 x 2.5 RHS
50 x 20 x 2.0 RHS
50 x 20 x 1.6 RHS
x
x
Axial compression buckling about x-axis
500
400
200
100
80
60
40
20
10
8
6
4
Design Member Capacity φNc (kN)
0
1
2
3
4
5
Effective Length Le (m) about x-axis

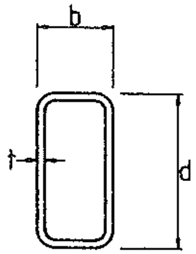


TABLE 5.2 – 3 (1)(B)

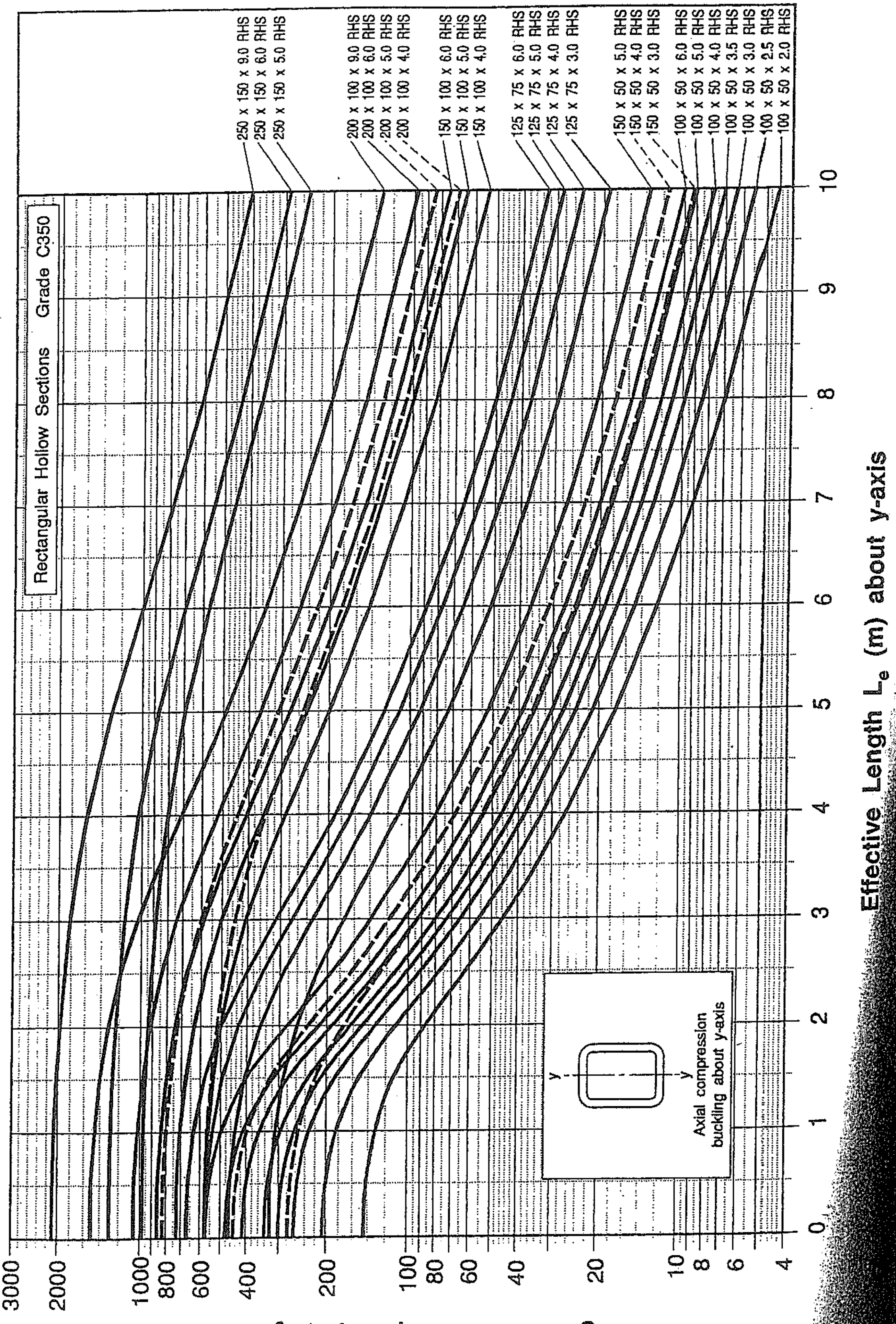
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION

RECTANGULAR HOLLOW SECTIONS: GRADE C350

buckling about y-axis

Designation d b t (mm mm mm)	Mass per m (kg/m)	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres: 0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10.0
250 x 150 x 9.0 RHS	51.8	2080	2080	2060	2020	1960	1890	1810	1700	1580	1290	1000	778	612	403
6.0 RHS	35.6	1290	1290	1280	1260	1230	1190	1150	1090	1030	868	695	548	435	288
5.0 RHS	29.9	978	978	972	956	936	911	881	845	801	694	571	457	366	244
200 x 100 x 9.0 RHS	37.7	1510	1510	1460	1400	1310	1190	1030	866	713	488	348	260	201	130
6.0 RHS	26.2	1050	1050	1020	977	918	840	740	629	523	361	258	193	149	96.9
5.0 RHS	22.1	820	820	799	769	728	673	602	521	440	308	222	166	128	83.4
4.0 RHS	17.9	575	575	563	545	521	489	448	398	344	249	181	136	106	68.8
150 x 100 x 6.0 RHS	21.4	861	859	834	797	745	676	588	494	407	279	199	148	115	74.4
5.0 RHS	18.2	729	728	707	676	634	576	504	425	351	241	172	129	99.5	64.5
4.0 RHS	14.8	575	575	559	536	504	461	407	347	289	200	143	107	82.6	53.6
150 x 50 x 5.0 RHS	14.2	571	555	499	401	282	194	139	104	80.3	52.1	36.5	27.0	20.8	13.4
4.0 RHS	11.6	449	437	397	326	236	164	118	88.3	68.3	44.4	31.1	23.0	17.7	11.4
3.0 RHS	8.96	279	273	254	221	174	127	93.0	70.1	54.5	35.5	24.9	18.5	14.2	9.18
125 x 75 x 6.0 RHS	16.7	672	664	632	579	502	404	312	241	189	124	87.7	65.0	50.1	32.4
5.0 RHS	14.2	571	566	539	496	432	351	272	211	166	109	76.9	57.1	44.0	28.5
4.0 RHS	11.6	467	462	441	407	356	292	228	177	139	91.9	64.7	48.0	37.0	24.0
3.0 RHS	8.96	326	324	310	290	259	219	175	138	110	72.7	51.3	38.1	29.4	19.0
100 x 50 x 6.0 RHS	12.0	483	466	413	318	215	146	104	77.4	59.8	38.8	27.2	20.1	15.5	9.97
5.0 RHS	10.3	414	401	357	279	192	131	93.3	69.6	53.8	34.9	24.4	18.1	13.9	8.97
4.0 RHS	8.49	341	330	296	235	164	112	80.3	59.9	46.3	30.1	21.1	15.6	12.0	7.73
3.5 RHS	7.53	302	293	263	211	148	102	72.8	54.3	42.0	27.3	19.1	14.1	10.9	7.02
3.0 RHS	6.60	265	257	232	187	132	91.4	65.4	48.9	37.8	24.5	17.2	12.7	9.80	6.32
2.5 RHS	5.56	207	201	184	152	111	77.8	56.0	41.9	32.5	21.1	14.8	10.9	8.42	5.44
2.0 RHS	4.50	145	142	131	113	86.8	62.7	45.7	34.3	26.7	17.3	12.2	9.01	6.94	4.48

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Rectangular Hollow Sections Grade C350
250 x 150 x 9.0 RHS
250 x 150 x 6.0 RHS
250 x 150 x 5.0 RHS
200 x 100 x 9.0 RHS
200 x 100 x 6.0 RHS
200 x 100 x 5.0 RHS
200 x 100 x 4.0 RHS
150 x 100 x 6.0 RHS
150 x 100 x 5.0 RHS
150 x 100 x 4.0 RHS
125 x 75 x 6.0 RHS
125 x 75 x 5.0 RHS
125 x 75 x 4.0 RHS
125 x 75 x 3.0 RHS
150 x 50 x 5.0 RHS
150 x 50 x 4.0 RHS
150 x 50 x 3.0 RHS
100 x 50 x 6.0 RHS
100 x 50 x 5.0 RHS
100 x 50 x 4.0 RHS
100 x 50 x 3.5 RHS
100 x 50 x 3.0 RHS
100 x 50 x 2.5 RHS
100 x 50 x 2.0 RHS
y
y
Axial compression buckling about y-axis
Effective Length L_e (m) about y-axis
0
1
2
3
4
5
6
7
8
9
10
Design Member Capacity $\phi_c N_c$ (kN)
3000
2000
1000
800
600
400
200
100
80
60
40
20
10
8
6
4

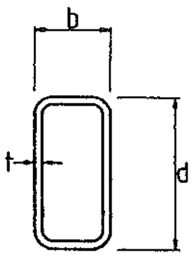
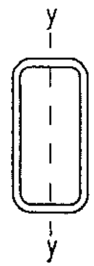


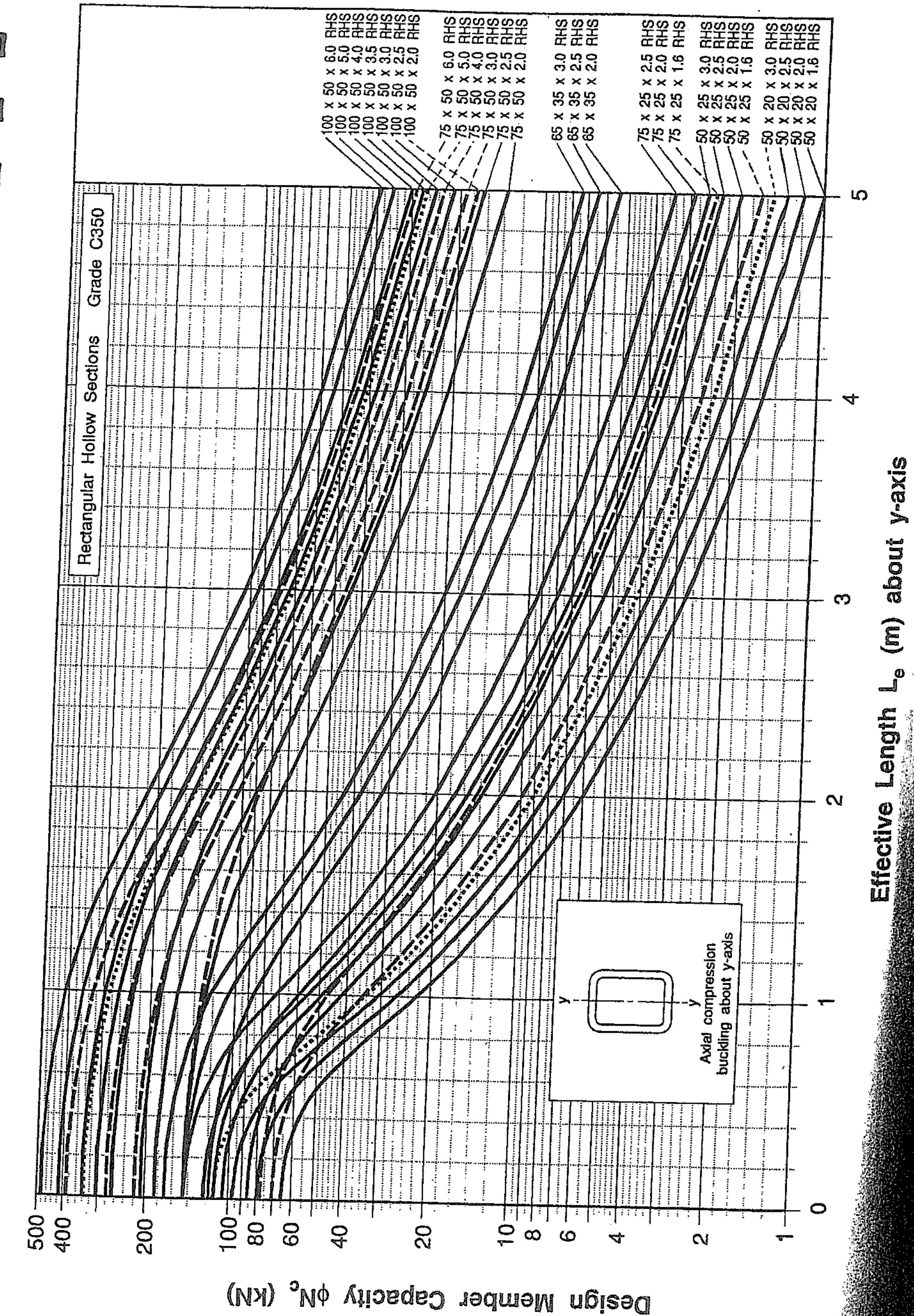
TABLE 5.2 – 3 (2)(B)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
RECTANGULAR HOLLOW SECTIONS: GRADE C350
buckling about y–axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN)													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
100 x 50 x 6.0 RHS	12.0	483	481	466	444	413	370	318	263	215	146	104	77.4	59.8	38.8
5.0 RHS	10.3	414	413	401	382	357	322	279	233	192	131	93.3	69.6	53.8	34.9
4.0 RHS	8.49	341	340	330	316	296	269	235	198	164	112	80.3	59.9	46.3	30.1
3.5 RHS	7.53	302	302	293	281	263	240	211	178	148	102	72.8	54.3	42.0	27.3
3.0 RHS	6.60	265	265	257	247	232	212	187	159	132	91.4	65.4	48.9	37.8	24.5
2.5 RHS	5.56	207	207	201	194	184	170	152	132	111	77.8	56.0	41.9	32.5	21.1
2.0 RHS	4.50	145	145	142	137	131	123	113	100	86.8	62.7	45.7	34.3	26.7	17.3
75 x 50 x 6.0 RHS	9.67	388	387	374	354	327	290	245	200	162	109	77.5	57.5	44.5	28.9
5.0 RHS	8.35	335	334	323	308	285	255	218	179	146	99.0	70.4	52.4	40.5	26.3
4.0 RHS	6.92	278	277	268	256	238	215	185	154	126	85.9	61.2	45.6	35.3	22.9
3.0 RHS	5.42	218	217	211	202	189	171	149	125	103	70.8	50.6	37.7	29.2	18.9
2.5 RHS	4.58	184	184	178	171	160	146	127	108	89.0	61.1	43.7	32.6	25.2	16.4
2.0 RHS	3.72	145	145	141	135	127	116	103	87.5	72.9	50.4	36.1	27.0	20.9	13.6
75 x 25 x 2.5 RHS	3.60	145	140	126	102	71.6	49.4	35.4	26.4	20.4	13.3	9.29	6.87	5.29	3.41
2.0 RHS	2.93	113	110	100	82.4	59.6	41.6	29.9	22.4	17.3	11.2	7.88	5.83	4.49	2.90
1.6 RHS	2.38	77.6	76.0	70.3	60.6	46.8	33.8	24.7	18.5	14.4	9.37	6.58	4.87	3.75	2.42
65 x 35 x 3.0 RHS	4.25	170	168	159	144	122	95.1	72.0	55.1	43.1	28.2	19.9	14.7	11.3	7.33
2.5 RHS	3.60	145	143	135	123	105	82.4	62.7	48.1	37.7	24.7	17.4	12.9	9.93	6.42
2.0 RHS	2.93	118	116	110	101	86.2	68.5	52.4	40.3	31.6	20.7	14.6	10.8	8.33	5.39
50 x 25 x 3.0 RHS	3.07	123	119	105	81.6	55.4	37.7	26.8	20.0	15.5	10.0	7.02	5.19	4.00	2.58
2.5 RHS	2.62	105	102	90.8	71.3	49.1	33.5	23.9	17.8	13.8	8.95	6.27	4.64	3.57	2.30
2.0 RHS	2.15	86.2	83.6	75.0	59.7	41.7	28.6	20.5	15.3	11.8	7.66	5.37	3.97	3.06	1.97
1.6 RHS	1.75	70.3	68.3	61.5	49.5	34.9	24.1	17.2	12.9	9.96	6.46	4.53	3.35	2.58	1.66
50 x 20 x 3.0 RHS	2.83	114	107	87.0	55.7	34.1	22.5	15.9	11.8	9.07	5.87	4.10	3.03	2.33	1.50
2.5 RHS	2.42	97.3	92.2	75.8	49.8	30.8	20.3	14.3	10.6	8.20	5.31	3.71	2.74	2.11	1.36
2.0 RHS	1.99	79.9	76.0	63.3	42.5	26.5	17.6	12.4	9.21	7.11	4.60	3.22	2.38	1.83	1.18
1.6 RHS	1.63	65.3	62.2	52.3	35.8	22.5	14.9	10.6	7.84	6.05	3.92	2.74	2.03	1.56	1.00

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Rectangular Hollow Sections Grade C350
100 x 50 x 6.0 RHS
100 x 50 x 5.0 RHS
100 x 50 x 4.0 RHS
100 x 50 x 3.5 RHS
100 x 50 x 3.0 RHS
100 x 50 x 2.5 RHS
100 x 50 x 2.0 RHS
75 x 50 x 6.0 RHS
75 x 50 x 5.0 RHS
75 x 50 x 4.0 RHS
75 x 50 x 3.0 RHS
75 x 50 x 2.5 RHS
75 x 50 x 2.0 RHS
65 x 35 x 3.0 RHS
65 x 35 x 2.5 RHS
65 x 35 x 2.0 RHS
75 x 25 x 2.5 RHS
75 x 25 x 2.0 RHS
75 x 25 x 1.6 RHS
50 x 25 x 3.0 RHS
50 x 25 x 2.5 RHS
50 x 25 x 2.0 RHS
50 x 25 x 1.6 RHS
50 x 20 x 3.0 RHS
50 x 20 x 2.5 RHS
50 x 20 x 2.0 RHS
50 x 20 x 1.6 RHS
y
y
Axial compression buckling about y-axis
0
1
2
3
4
5
Effective Length L_e (m) about y-axis
500
400
200
100
80
60
40
20
10
8
6
4
2
1
Design Member Capacity ϕN_c (kN)

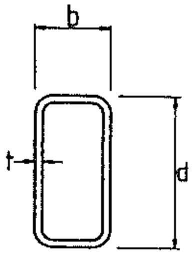
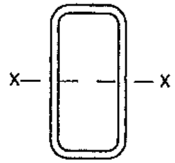


TABLE 5.2 – 4 (1)(A)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
RECTANGULAR HOLLOW SECTIONS: GRADE C450
buckling about x-axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
125 x 75 x 3.8 RHS	11.1	559	559	543	519	487	443	388	328	271	224	186	133	99.4	76.9
3.3 RHS	9.73	448	448	436	419	396	365	325	280	235	196	164	118	87.9	68.1
2.8 RHS	8.39	351	351	343	331	315	293	266	233	199	168	141	102	76.8	59.5
2.3 RHS	6.95	259	259	253	246	235	221	204	183	159	136	116	84.8	63.9	49.6
100 x 50 x 3.3 RHS	7.14	368	365	348	322	284	234	184	143	113	91.0	74.6	52.6	39.0	30.1
2.8 RHS	6.19	295	292	280	262	235	198	159	126	99.7	80.5	66.1	46.7	34.7	26.7
2.3 RHS	5.14	215	214	206	195	178	155	128	103	82.7	67.1	55.3	39.2	29.1	22.5

Notes: Refer to TABLE 5.2–4 (2)(A)

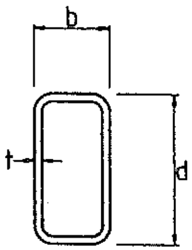
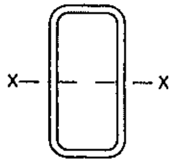


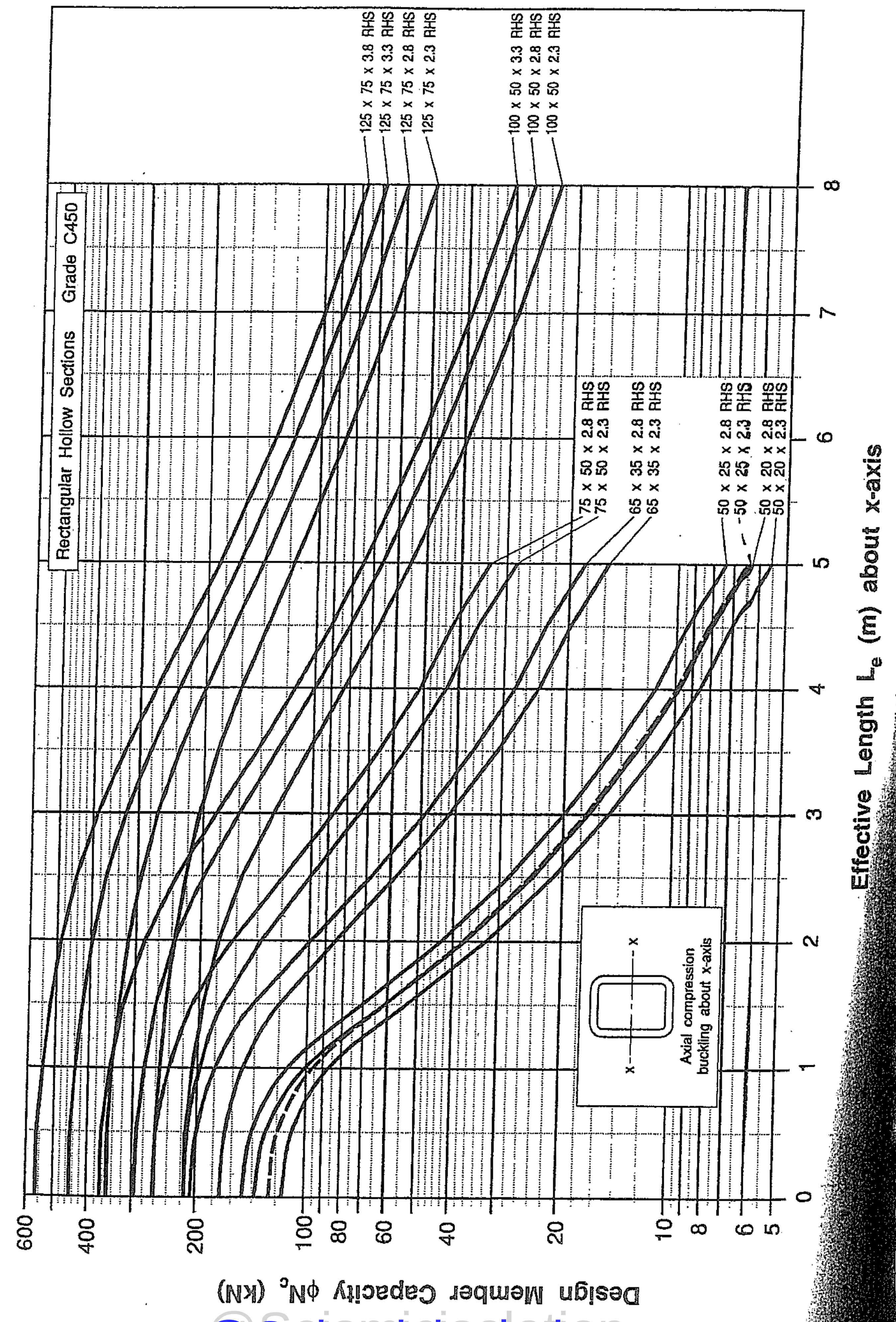
TABLE 5.2 – 4 (2)(A)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
RECTANGULAR HOLLOW SECTIONS: GRADE C450
buckling about x-axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
100 x 50 x 3.3 RHS	7.14	368	368	365	358	348	337	322	305	284	234	184	143	113	74.6
2.8 RHS	6.19	295	295	292	287	280	272	262	249	235	198	159	126	99.7	66.1
2.3 RHS	5.14	215	215	214	211	206	201	195	187	178	155	128	103	82.7	55.3
75 x 50 x 2.8 RHS	5.09	263	263	258	250	239	225	208	187	163	119	87.2	65.8	51.1	33.3
2.3 RHS	4.24	215	215	211	205	197	186	172	155	136	100	73.8	55.7	43.3	28.2
65 x 35 x 2.8 RHS	3.99	206	206	200	191	179	163	142	120	99.1	68.0	48.6	36.3	28.0	18.2
2.3 RHS	3.34	172	172	167	160	150	137	120	102	84.5	58.1	41.6	31.1	24.0	15.6
50 x 25 x 2.8 RHS	2.89	149	148	141	129	113	91.3	70.8	54.8	43.1	28.4	20.0	14.8	11.4	7.39
2.3 RHS	2.44	126	124	119	109	95.9	78.4	61.2	47.5	37.5	24.7	17.4	12.9	9.95	6.43
50 x 20 x 2.8 RHS	2.67	138	136	129	118	101	80.3	61.4	47.2	37.0	24.3	17.1	12.7	9.77	6.32
2.3 RHS	2.25	116	115	109	100	86.5	69.4	53.5	41.2	32.4	21.3	15.0	11.1	8.57	5.54

Notes:
1. ϕ = 0.9
2. ϕN_c = $\phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. α_b = 0.5 (Table 6.3.3 of AS 4100)



Rectangular Hollow Sections Grade C450
125 x 75 x 3.8 RHS
125 x 75 x 3.3 RHS
125 x 75 x 2.8 RHS
125 x 75 x 2.3 RHS
100 x 50 x 3.3 RHS
100 x 50 x 2.8 RHS
100 x 50 x 2.3 RHS
75 x 50 x 2.8 RHS
75 x 50 x 2.3 RHS
65 x 35 x 2.8 RHS
65 x 35 x 2.3 RHS
50 x 25 x 2.8 RHS
50 x 25 x 2.3 RHS
50 x 20 x 2.8 RHS
50 x 20 x 2.3 RHS
Axial compression buckling about x-axis
x
x
Design Member Capacity ϕNc (kN)
600
400
200
100
80
60
40
20
10
8
6
5
Effective Length Le (m) about x-axis
0
1
2
3
4
5
6
7
8

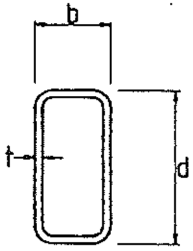
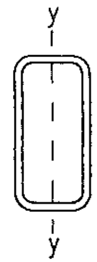


TABLE 5.2 – 4 (1)(B)

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION RECTANGULAR HOLLOW SECTIONS: GRADE C450

buckling about y–axis



Designation d b t (mm mm mm)	Mass per m (kg/m)	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres: 0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
125 x 75 x 3.8 RHS	11.1	559	552	520	469	392	303	228	174	136	109	89.0	62.6	46.4	35.7
3.3 RHS	9.73	448	443	420	383	328	261	200	153	120	96.5	78.9	55.6	41.2	31.8
2.8 RHS	8.39	351	348	332	306	268	219	171	133	105	84.2	69.0	48.6	36.1	27.8
2.3 RHS	6.95	259	257	246	229	205	173	139	109	86.9	70.1	57.6	40.7	30.2	23.3
100 x 50 x 3.3 RHS	7.14	368	354	307	226	148	99.4	70.5	52.5	40.5	32.2	26.3	18.4	13.6	10.5
2.8 RHS	6.19	295	284	251	192	130	87.8	62.5	46.6	36.0	28.6	23.3	16.3	12.1	9.30
2.3 RHS	5.14	215	209	188	151	107	73.5	52.6	39.3	30.4	24.2	19.7	13.8	10.2	7.87

Notes: Refer to TABLE 5.2–4 (2)(B)

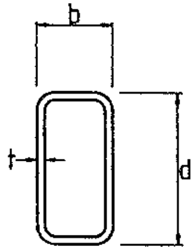
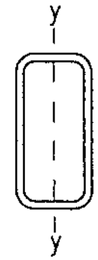


TABLE 5.2 – 4 (2)(B)

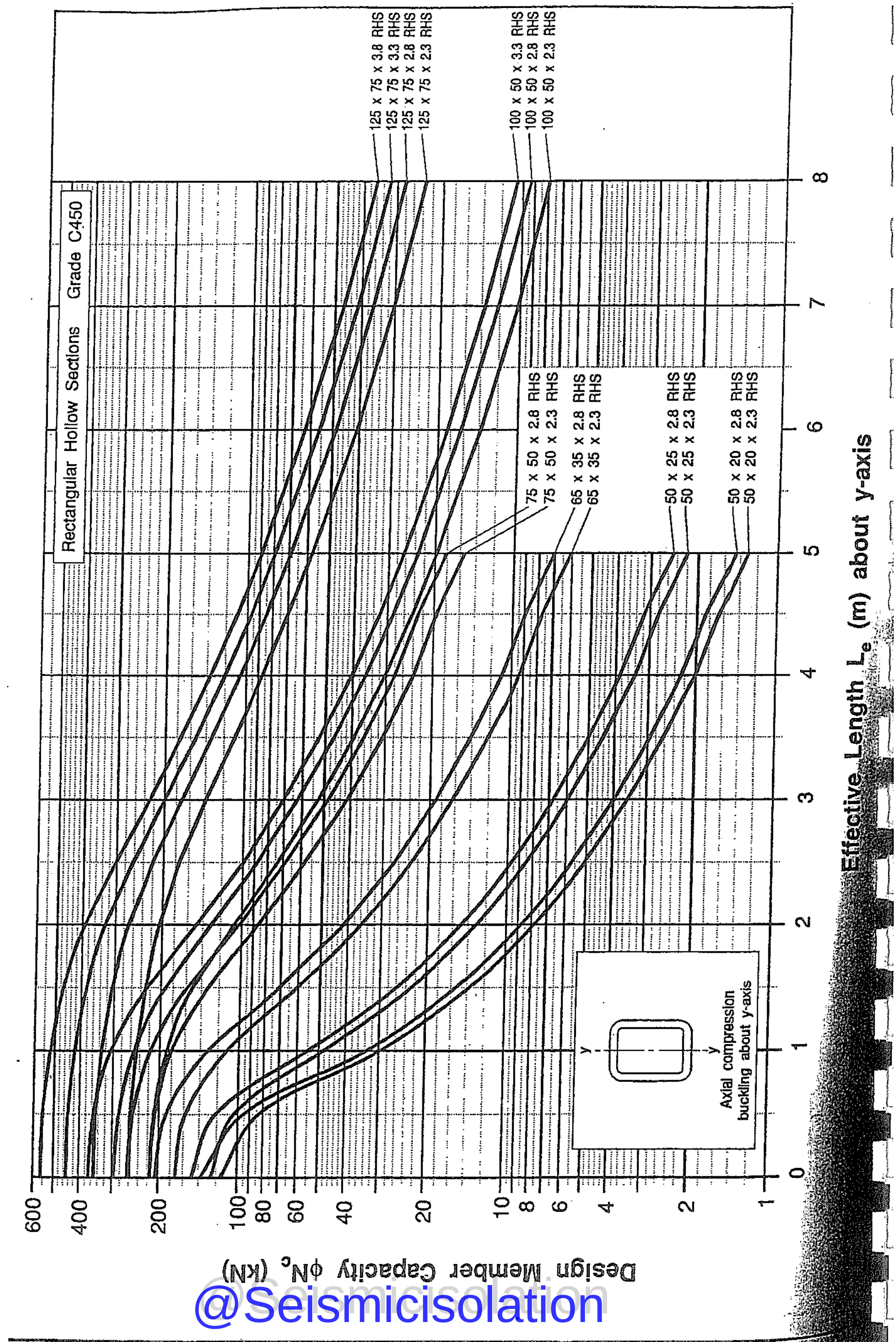
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION RECTANGULAR HOLLOW SECTIONS: GRADE C450

buckling about y–axis



Designation d b t (mm mm mm)	Mass per m (kg/m)	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres: 0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
100 x 50 x 3.3 RHS	7.14	368	366	354	335	307	270	226	184	148	99.4	70.5	52.5	40.5	26.3
2.8 RHS	6.19	295	294	284	271	251	225	192	159	130	87.8	62.5	46.6	36.0	23.3
2.3 RHS	5.14	215	215	209	200	188	172	151	128	107	73.5	52.6	39.3	30.4	19.7
75 x 50 x 2.8 RHS	5.09	263	261	252	238	217	190	158	127	102	68.5	48.5	36.1	27.9	18.0
2.3 RHS	4.24	215	214	207	196	180	158	132	107	86.7	58.2	41.3	30.7	23.7	15.4
65 x 35 x 2.8 RHS	3.99	206	202	188	165	131	96.4	70.9	53.5	41.6	27.1	19.0	14.1	10.9	7.01
2.3 RHS	3.34	172	169	158	139	111	82.6	60.9	46.1	35.9	23.4	16.4	12.2	9.37	6.05
50 x 25 x 2.8 RHS	2.89	149	143	122	86.4	55.2	36.8	26.1	19.4	14.9	9.68	6.78	5.01	3.85	2.48
2.3 RHS	2.44	126	120	104	74.8	48.4	32.3	22.9	17.0	13.1	8.51	5.96	4.41	3.39	2.19
50 x 20 x 2.8 RHS	2.67	138	128	96.6	56.2	33.5	21.9	15.4	11.4	8.80	5.69	3.98	2.94	2.26	1.45
2.3 RHS	2.25	116	109	83.5	49.7	29.8	19.5	13.7	10.2	7.84	5.07	3.54	2.62	2.01	1.30

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Rectangular Hollow Sections Grade C450
125 x 75 x 3.8 RHS
125 x 75 x 3.3 RHS
125 x 75 x 2.8 RHS
125 x 75 x 2.3 RHS
100 x 50 x 3.3 RHS
100 x 50 x 2.8 RHS
100 x 50 x 2.3 RHS
75 x 50 x 2.8 RHS
75 x 50 x 2.3 RHS
65 x 35 x 2.8 RHS
65 x 35 x 2.3 RHS
50 x 25 x 2.8 RHS
50 x 25 x 2.3 RHS
50 x 20 x 2.8 RHS
50 x 20 x 2.3 RHS
Axial compression buckling about y-axis
y
y
Effective Length L_e (m) about y-axis
Design Member Capacity ϕN_c (kN)
0
1
2
3
4
5
6
7
8
600
400
200
100
80
60
40
20
10
8
6
4
2
1

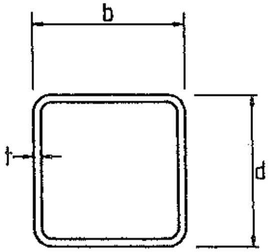
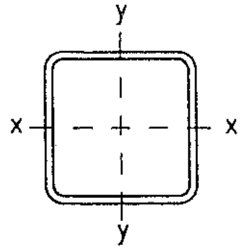


TABLE 5.2 – 5 (1)

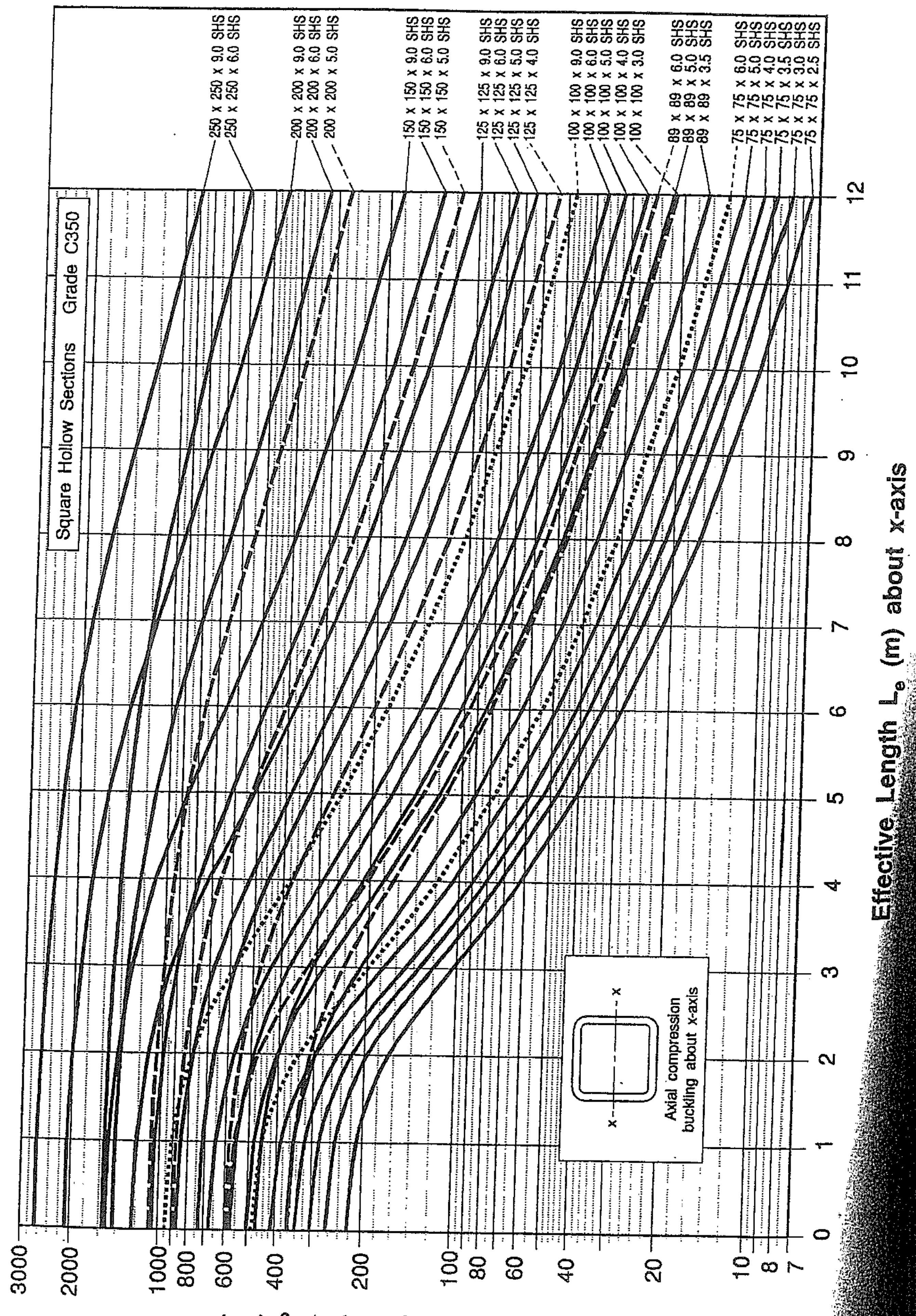
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION SQUARE HOLLOW SECTIONS: GRADE C350

buckling about x– and y–axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN)													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10.0	12.0
250 x 250 x 9.0 SHS	65.9	2650	2650	2620	2590	2560	2520	2470	2410	2270	2100	1880	1650	1200	882
6.0 SHS	45.0	1540	1540	1530	1520	1500	1480	1450	1430	1360	1280	1180	1060	810	607
200 x 200 x 9.0 SHS	51.8	2080	2070	2040	2010	1960	1910	1850	1780	1600	1370	1140	928	630	448
6.0 SHS	35.6	1430	1420	1400	1380	1350	1320	1280	1230	1110	960	801	658	449	320
5.0 SHS	29.9	1070	1070	1060	1040	1020	998	971	940	862	763	652	544	377	271
150 x 150 x 9.0 SHS	37.7	1510	1490	1460	1410	1350	1280	1190	1090	857	652	500	391	256	180
6.0 SHS	26.2	1050	1040	1010	985	947	900	842	774	617	474	364	286	188	132
5.0 SHS	22.1	886	876	857	833	801	762	714	658	527	406	313	245	161	114
125 x 125 x 9.0 SHS	30.6	1230	1200	1160	1110	1040	944	835	718	515	374	281	218	142	99.4
6.0 SHS	21.4	861	843	817	781	735	676	604	525	382	279	210	163	106	74.5
5.0 SHS	18.2	729	715	693	663	625	576	516	451	329	241	181	141	91.8	64.4
4.0 SHS	14.8	593	581	564	540	510	471	424	371	272	199	150	117	76.1	53.4
100 x 100 x 9.0 SHS	23.5	944	907	858	787	692	579	469	378	254	180	134	103	67.0	46.9
6.0 SHS	16.7	672	648	616	570	508	433	356	290	196	139	104	80.2	51.9	36.4
5.0 SHS	14.2	571	552	525	488	437	374	309	252	171	122	90.7	70.1	45.4	31.8
4.0 SHS	11.6	467	451	430	400	360	310	257	210	143	102	76.0	58.7	38.1	26.7
3.0 SHS	8.96	359	348	332	310	280	242	202	166	113	80.8	60.3	46.6	30.2	21.2
89 x 89 x 6.0 SHS	14.6	588	560	524	471	400	323	256	203	135	95.4	70.8	54.7	35.4	24.8
5.0 SHS	12.5	502	479	449	405	347	282	224	179	119	83.9	62.4	48.1	31.1	21.8
3.5 SHS	9.06	363	348	327	297	257	211	168	135	89.8	63.6	47.2	36.5	23.6	16.5
75 x 75 x 6.0 SHS	12.0	483	449	405	340	263	198	151	118	77.4	54.4	40.3	31.1	20.1	14.0
5.0 SHS	10.3	414	386	350	296	232	176	134	105	68.9	48.5	35.9	27.7	17.9	12.5
4.0 SHS	8.49	341	319	290	247	196	149	114	89.7	58.8	41.4	30.7	23.6	15.3	10.7
3.5 SHS	7.53	302	283	258	221	176	134	103	80.9	53.1	37.4	27.7	21.4	13.8	9.66
3.0 SHS	6.60	265	249	227	196	156	120	92.5	72.6	47.6	33.5	24.9	19.2	12.4	8.67
2.5 SHS	5.56	223	210	192	166	133	103	79.1	62.1	40.8	28.7	21.3	16.4	10.6	7.43

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)


Square Hollow Sections Grade C350
250 x 250 x 9.0 SHS
250 x 250 x 6.0 SHS
200 x 200 x 9.0 SHS
200 x 200 x 6.0 SHS
200 x 200 x 5.0 SHS
150 x 150 x 9.0 SHS
150 x 150 x 6.0 SHS
150 x 150 x 5.0 SHS
125 x 125 x 9.0 SHS
125 x 125 x 6.0 SHS
125 x 125 x 5.0 SHS
125 x 125 x 4.0 SHS
100 x 100 x 9.0 SHS
100 x 100 x 6.0 SHS
100 x 100 x 5.0 SHS
100 x 100 x 4.0 SHS
100 x 100 x 3.0 SHS
89 x 89 x 6.0 SHS
89 x 89 x 5.0 SHS
89 x 89 x 3.5 SHS
75 x 75 x 6.0 SHS
75 x 75 x 5.0 SHS
75 x 75 x 4.0 SHS
75 x 75 x 3.5 SHS
75 x 75 x 3.0 SHS
75 x 75 x 2.5 SHS
x
x
Axial compression buckling about x-axis
3000
2000
1000
800
600
400
200
100
80
60
40
20
10
8
7
Design Member Capacity ϕN_c (kN)
0
1
2
3
4
5
6
7
8
9
10
11
12
Effective Length L_e (m) about x-axis

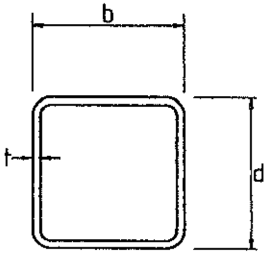
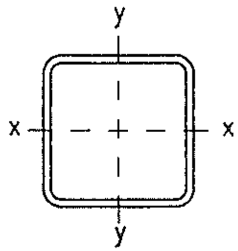


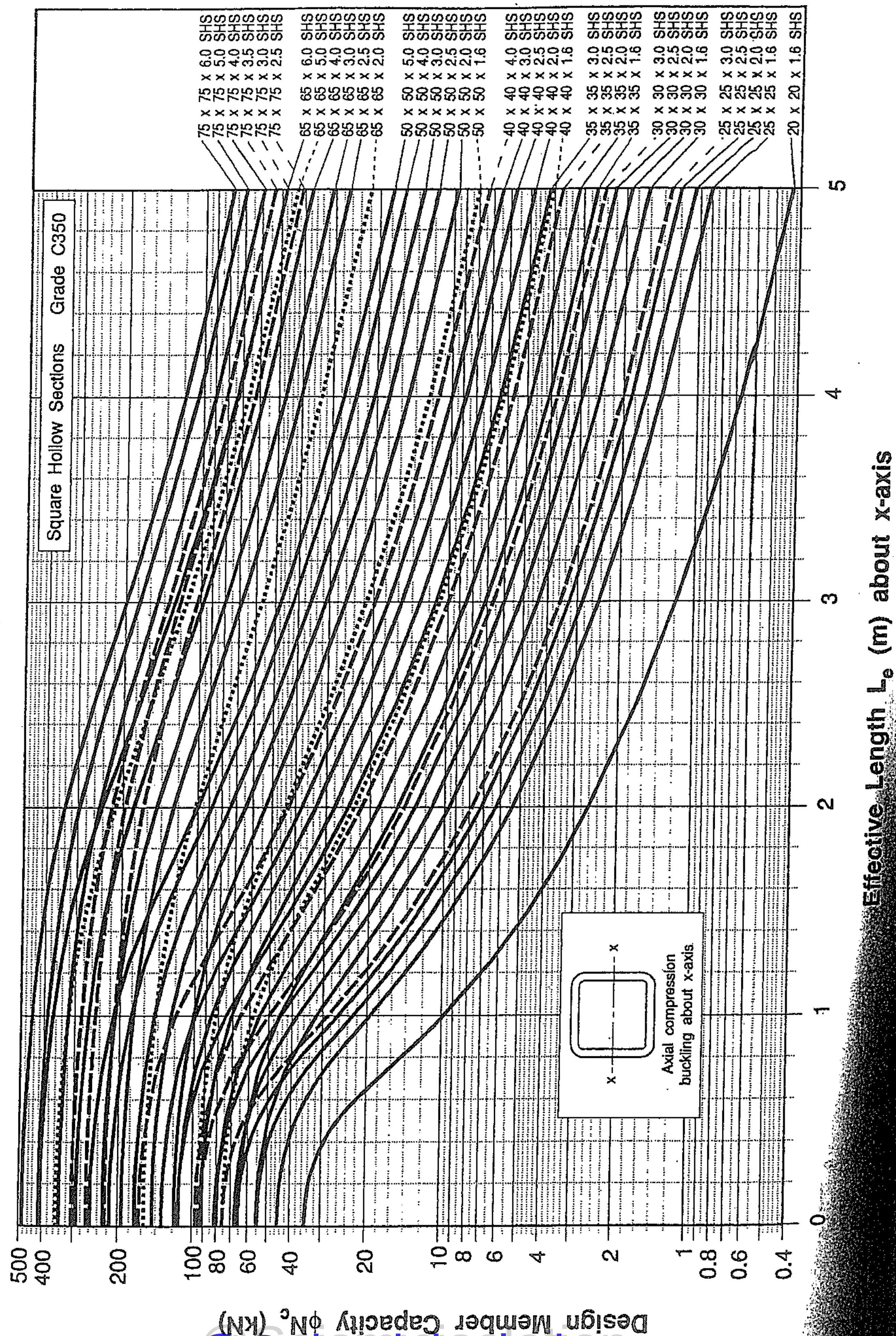
TABLE 5.2 – 5 (2)

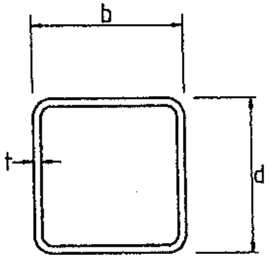
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
SQUARE HOLLOW SECTIONS: GRADE C350
buckling about x– and y–axis



Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) — Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
75 x 75 x 6.0 SHS	12.0	483	483	476	464	449	430	405	375	340	263	198	151	118	77.4
5.0 SHS	10.3	414	414	409	399	386	370	350	325	296	232	176	134	105	68.9
4.0 SHS	8.49	341	341	336	329	319	306	290	271	247	196	149	114	89.7	58.8
3.5 SHS	7.53	302	302	298	292	283	272	258	241	221	176	134	103	80.9	53.1
3.0 SHS	6.60	265	265	262	256	249	239	227	213	196	156	120	92.5	72.6	47.6
2.5 SHS	5.56	223	223	221	216	210	202	192	180	166	133	103	79.1	62.1	40.8
65 x 65 x 6.0 SHS	10.1	407	407	398	385	368	344	315	279	241	173	126	94.6	73.4	47.7
5.0 SHS	8.75	351	351	344	333	318	299	275	246	214	155	113	85.2	66.2	43.1
4.0 SHS	7.23	290	290	285	276	265	250	230	207	181	133	97.4	73.5	57.1	37.2
3.0 SHS	5.66	227	227	223	217	208	197	183	166	146	108	79.7	60.3	46.9	30.6
2.5 SHS	4.78	192	192	188	183	176	167	155	141	125	92.8	68.5	51.8	40.3	26.3
2.0 SHS	3.88	156	156	153	149	143	136	126	115	102	76.3	56.5	42.7	33.3	21.7
50 x 50 x 5.0 SHS	6.39	256	255	246	232	212	186	154	124	100	66.9	47.4	35.3	27.2	17.6
4.0 SHS	5.35	215	214	206	196	180	159	134	109	88.1	59.3	42.1	31.3	24.2	15.7
3.0 SHS	4.25	170	170	164	156	145	129	110	91.0	74.1	50.2	35.7	26.6	20.5	13.3
2.5 SHS	3.60	145	144	140	133	124	111	95.0	78.7	64.2	43.6	31.0	23.1	17.9	11.6
2.0 SHS	2.93	118	117	114	108	101	90.9	78.4	65.2	53.4	36.3	25.9	19.3	14.9	9.66
1.6 SHS	2.38	95.5	95.3	92.4	88.2	82.2	74.2	64.2	53.6	44.0	30.0	21.4	15.9	12.3	7.99
40 x 40 x 4.0 SHS	4.09	164	162	153	140	119	93.6	71.3	54.7	42.8	28.1	19.7	14.6	11.3	7.29
3.0 SHS	3.30	133	131	125	115	99.4	80.2	62.0	47.9	37.7	24.8	17.4	12.9	9.97	6.45
2.5 SHS	2.82	113	112	107	98.2	85.7	69.8	54.3	42.1	33.1	21.8	15.4	11.4	8.78	5.68
2.0 SHS	2.31	92.5	91.6	87.4	80.7	70.9	58.1	45.5	35.4	27.9	18.4	13.0	9.61	7.41	4.79
1.6 SHS	1.88	75.3	74.6	71.3	66.0	58.2	48.0	37.8	29.4	23.2	15.3	10.8	8.02	6.19	4.00
35 x 35 x 3.0 SHS	2.83	114	112	105	92.5	74.9	56.1	41.5	31.5	24.5	16.0	11.2	8.32	6.41	4.14
2.5 SHS	2.42	97.3	95.7	89.8	79.9	65.4	49.4	36.8	27.9	21.7	14.2	9.97	7.39	5.69	3.68
2.0 SHS	1.99	79.9	78.7	74.0	66.2	54.7	41.7	31.2	23.7	18.5	12.1	8.49	6.29	4.85	3.13
1.6 SHS	1.63	65.3	64.3	60.6	54.4	45.2	34.8	26.1	19.9	15.5	10.1	7.13	5.28	4.07	2.63
30 x 30 x 3.0 SHS	2.36	94.8	92.3	83.9	69.2	50.3	35.2	25.3	18.9	14.7	9.52	6.68	4.94	3.80	2.45
2.5 SHS	2.03	81.6	79.5	72.7	60.6	44.7	31.5	22.7	17.0	13.2	8.56	6.01	4.44	3.42	2.21
2.0 SHS	1.68	67.3	65.7	60.3	50.8	38.0	27.0	19.5	14.6	11.3	7.38	5.17	3.83	2.95	1.90
1.6 SHS	1.38	55.2	53.9	49.6	42.2	31.9	22.8	16.5	12.4	9.61	6.25	4.38	3.25	2.50	1.61
25 x 25 x 3.0 SHS	1.89	75.9	72.7	62.4	44.7	28.8	19.2	13.6	10.1	7.81	5.06	3.54	2.62	2.01	1.30
2.5 SHS	1.64	65.8	63.2	54.8	40.2	26.2	17.6	12.5	9.27	7.16	4.64	3.25	2.40	1.85	1.19
2.0 SHS	1.36	54.7	52.7	46.1	34.5	22.8	15.4	10.9	8.12	6.27	4.06	2.85	2.10	1.62	1.04
1.6 SHS	1.12	45.1	43.5	38.3	29.1	19.5	13.2	9.36	6.97	5.38	3.49	2.44	1.81	1.39	0.897
20 x 20 x 1.6 SHS	0.873	35.0	32.9	26.1	16.2	9.83	6.46	4.55	3.37	2.60	1.68	1.18	0.869	0.668	0.430

Notes: 1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)


Square Hollow Sections Grade C350
75 x 75 x 6.0 SHS
75 x 75 x 5.0 SHS
75 x 75 x 4.0 SHS
75 x 75 x 3.5 SHS
75 x 75 x 3.0 SHS
75 x 75 x 2.5 SHS
65 x 65 x 6.0 SHS
65 x 65 x 5.0 SHS
65 x 65 x 4.0 SHS
65 x 65 x 3.0 SHS
65 x 65 x 2.5 SHS
65 x 65 x 2.0 SHS
50 x 50 x 5.0 SHS
50 x 50 x 4.0 SHS
50 x 50 x 3.0 SHS
50 x 50 x 2.5 SHS
50 x 50 x 2.0 SHS
50 x 50 x 1.6 SHS
40 x 40 x 4.0 SHS
40 x 40 x 3.0 SHS
40 x 40 x 2.5 SHS
40 x 40 x 2.0 SHS
40 x 40 x 1.6 SHS
35 x 35 x 3.0 SHS
35 x 35 x 2.5 SHS
35 x 35 x 2.0 SHS
35 x 35 x 1.6 SHS
30 x 30 x 3.0 SHS
30 x 30 x 2.5 SHS
30 x 30 x 2.0 SHS
30 x 30 x 1.6 SHS
25 x 25 x 3.0 SHS
25 x 25 x 2.5 SHS
25 x 25 x 2.0 SHS
25 x 25 x 1.6 SHS
20 x 20 x 1.6 SHS
Axial compression buckling about x-axis
x
x
Design Member Capacity φNc (kN)
500 400 200 100 80 60 40 20 10 8 6 4 2 1 0.8 0.6 0.4
Effective Length Le (m) about x-axis
0 1 2 3 4 5



DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL COMPRESSION
SQUARE HOLLOW SECTIONS: GRADE C450
buckling about x– and y–axis

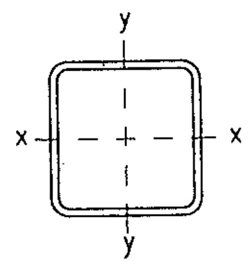


TABLE 5.2 – 6 (1)

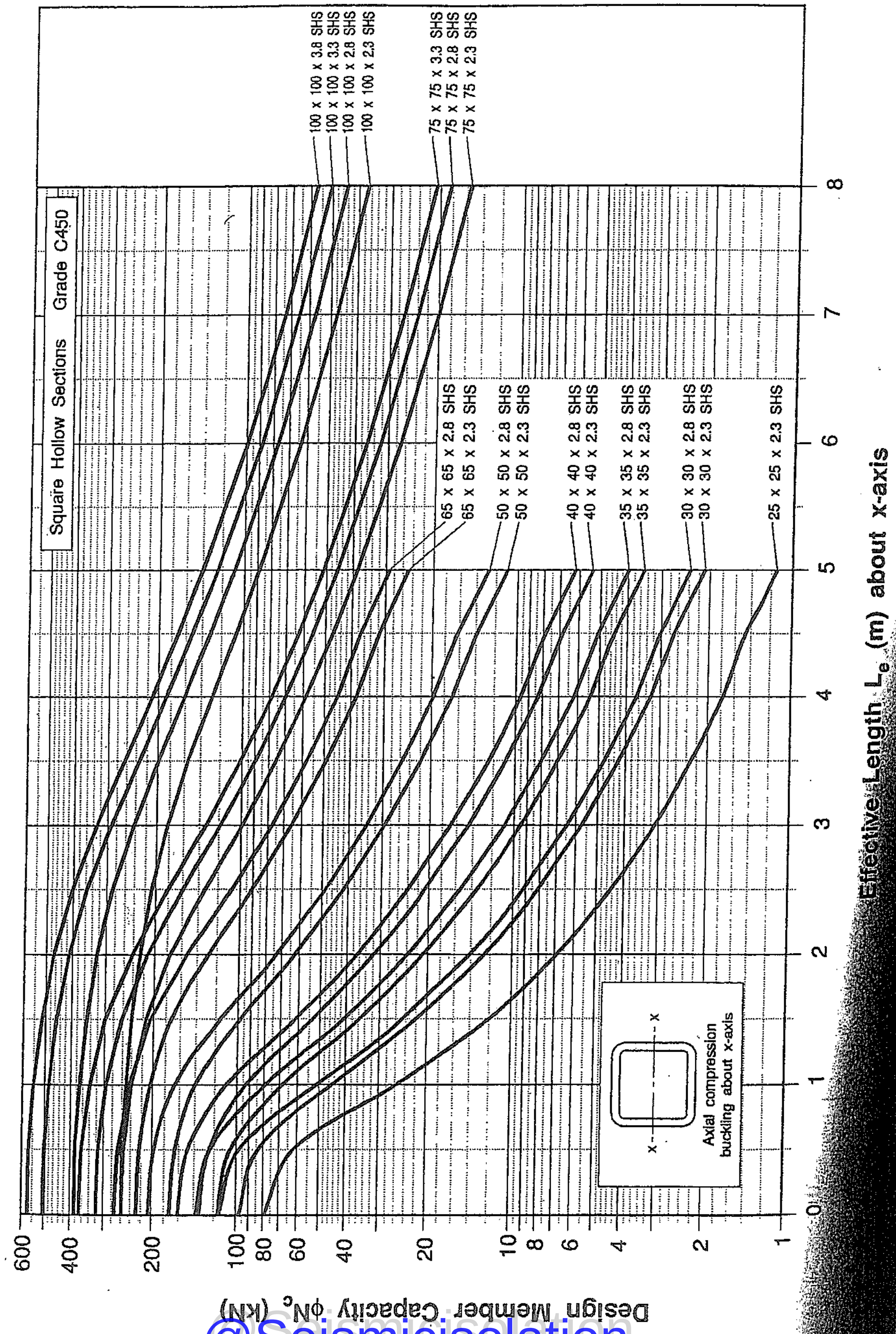
Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
100 x 100 x 3.8 SHS	11.1	572	569	547	514	466	402	329	263	210	170	140	98.9	73.5	56.7
3.3 SHS	9.73	502	499	480	452	410	355	291	233	186	151	124	87.9	65.3	50.4
2.8 SHS	8.39	383	382	369	350	323	286	242	198	160	131	108	76.6	57.0	44.0
2.3 SHS	6.95	259	258	251	241	226	207	182	155	128	106	88.6	63.4	47.4	36.7
75 x 75 x 3.3 SHS	7.14	368	362	338	299	241	180	133	101	78.4	62.7	51.2	35.9	26.6	20.5
2.8 SHS	6.19	319	314	294	261	212	159	118	89.3	69.6	55.6	45.4	31.9	23.6	18.2
2.3 SHS	5.14	259	255	239	213	175	133	99.0	75.2	58.6	46.9	38.3	26.9	19.9	15.4

Notes: Refer to TABLE 5.2 – 6 (2)

TABLE 5.2 – 6 (2)

Designation d b t	Mass per m	Design Capacities for Axial Compression ϕN_c (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
75 x 75 x 3.3 SHS	7.14	368	368	362	352	338	321	299	272	241	180	133	101	78.4	51.2
2.8 SHS	6.19	319	319	314	305	294	279	261	238	212	159	118	89.3	69.6	45.4
2.3 SHS	5.14	259	259	255	248	239	228	213	195	175	133	99.0	75.2	58.6	38.3
65 x 65 x 2.8 SHS	5.31	274	274	267	258	244	227	205	178	152	107	77.2	57.8	44.8	29.1
2.3 SHS	4.42	228	228	223	215	204	190	172	150	128	90.5	65.4	49.0	38.0	24.7
50 x 50 x 2.8 SHS	3.99	206	205	197	184	166	142	115	91.5	73.0	48.5	34.3	25.5	19.7	12.7
2.3 SHS	3.34	172	171	165	154	140	120	98.1	78.1	62.4	41.5	29.4	21.8	16.8	10.9
40 x 40 x 2.8 SHS	3.11	161	158	148	133	109	82.7	61.7	46.9	36.5	23.9	16.8	12.4	9.58	6.19
2.3 SHS	2.62	135	133	125	112	92.9	71.2	53.3	40.6	31.7	20.7	14.5	10.8	8.31	5.37
35 x 35 x 2.8 SHS	2.67	138	135	124	105	79.0	56.3	40.8	30.6	23.7	15.4	10.8	8.01	6.17	3.98
2.3 SHS	2.25	116	114	105	89.6	68.3	49.0	35.6	26.8	20.8	13.5	9.47	7.01	5.40	3.49
30 x 30 x 2.8 SHS	2.23	115	111	98.4	75.7	51.2	34.7	24.7	18.4	14.2	9.23	6.46	4.78	3.68	2.37
2.3 SHS	1.89	97.7	94.5	84.1	65.7	45.0	30.7	21.9	16.3	12.6	8.17	5.73	4.24	3.26	2.10
25 x 25 x 2.3 SHS	1.53	79.1	75.1	62.2	41.4	25.7	17.0	12.0	8.92	6.88	4.45	3.12	2.30	1.77	1.14

Notes:
1. $\phi = 0.9$
2. $\phi N_c = \phi \alpha_c N_s$ (Clause 6.3.3 of AS 4100)
3. $\alpha_b = -0.5$ (Table 6.3.3 of AS 4100)



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PART 6 MEMBERS SUBJECT TO AXIAL TENSION

PAGE

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES

PART 6 MEMBERS SUBJECT TO AXIAL TENSION

6.1 Scope

Tables 6.1–1 to 6.1–6 give values of design section capacity for axial tension determined in accordance with Section 7 of AS 4100.

The tables give values of design capacity for the various grades and types of structural steel hollow sections with full perimeter welded connections.

6.2 Method

The design section capacity for axial tension (ϕN_t) has been determined from Clause 7.2 of AS 4100 and taken as the *lesser* of:

$$\phi N_t = \phi A_g f_y$$

and

$$\phi N_t = \phi (0.85)\, k_t A_n f_u$$

where ϕ = 0.9
f_y = yield stress used in design
A_n = net section area
= A_g
= gross cross–sectional area (for full perimeter welded connections)
f_u = ultimate strength used in design
k_t = 1.0 (Clause 7.3.1 of AS 4100)

The lesser value of $\phi N_t = \phi A_g f_y$ and $\phi N_t = \phi (0.85) A_g f_u$ is **highlighted in bold type** in the tables.

Note: for grades C250 and C350 $\phi N_t = \phi A_g f_y$ is always less than $\phi N_t = \phi (0.85) A_g f_u$ but for grade C450 $\phi N_t = \phi (0.85) A_g f_u$ is the lesser value of ϕN_t.

For sections reduced by penetrations or holes, the value of ϕN_t can be determined from the tables as the lesser value of:

$$\phi N_t = \phi A_g f_y$$

and

$$\phi N_t = \phi (0.85)\, A_g\, f_u\, (A_n / A_g)$$

where A_n = net section area
k_t = tension correction factor (Clause 7.3.1 of AS 4100)

Values of A_g are tabulated in Tables 6.1–1 to 6.1–6.

Note that all the values in Tables 6.1–1 to 6.1–6 assume $k_t = 1.0$.

6.3 Examples

1. A tension member with a full perimeter welded connection is subjected to an axial tension force of 150 kN. Design a suitable RHS tension member.

Design Data:

$N^* = 150$ kN
$k_t = 1.0$ (for a full perimeter welded connection)

Solution:

Select a suitable RHS member from Tables 6.1–3 and 6.1–4. The alternatives are:

65 x 35 x 3.0 RHS – Grade C350 (4.25 kg/m) $\phi N_t = 170 > N^*$
65 x 35 x 2.3 RHS – Grade C450 (3.34 kg/m) $\phi N_t = 163 > N^*$

Choose 65 x 35 x 2.3 RHS Grade C450 (3.34 kg/m) because it is more economical based on mass.

2. Select a CHS section for a tension wind brace to transmit a design force of 92 kN. A flattened end connection with a single line of M20 Grade 8.8/s bolts is to be used.

Design Data:

$N^* = 92$ kN
Bolt hole diameter = 22 mm
For this type of connection the design capacity should be reduced by 20% to avoid progressive flattening of the CHS.

Solution:

Try 60.3 x 2.9 CHS – Grade C350

Gross area of section $A_g = 523\ \text{mm}^2$ (Table 6.1–2)

Area removed by hole $= 2 \times 22 \times 2.9$
$= 128\ \text{mm}^2$

Net area of section $A_n = 523 - 128$
$= 395\ \text{mm}^2$

Section capacity $\phi N_t = \phi N_t\,(2)\left(\dfrac{A_n}{A_g}\right)$ (Table 6.1–2)

$= 172\left(\dfrac{395}{528}\right)$

$= 129$ kN (< $\phi N_t(1) = 165$ kN from Table 6.1–2)

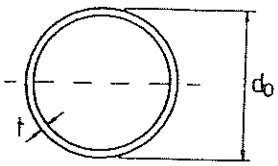
Section capacity reduced by 20% $= 0.8 \times 129$
$= 103$ kN (> N^*)

Note: $k_t = 1.0$ is assumed for the flatttened end connection.

$\therefore$ 60.3 x 2.9 CHS – Grade C250 is a suitable section.

TABLE 6.1–1

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION
CIRCULAR HOLLOW SECTIONS
GRADE C250



Designation d_o	t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	Axial Tension ϕN_t $\phi N_t(2)$	Gross Section Area A_g
mm	mm	kg/m	kN	kN	mm^2
610.0 x	12.7 CHS	187	**5360**	5830	23800
	9.5 CHS	141	**4030**	4390	17900
	6.4 CHS	95.3	**2730**	2970	12100
508.0 x	12.7 CHS	155	**4450**	4840	19800
	9.5 CHS	117	**3350**	3640	14900
	6.4 CHS	79.2	**2270**	2470	10100
165.1 x	5.4 CHS	21.3	**610**	663	2710
	5.0 CHS	19.7	**566**	616	2510
139.7 x	5.4 CHS	17.9	**513**	558	2280
	5.0 CHS	16.6	**476**	518	2120
114.3 x	5.4 CHS	14.5	**416**	452	1850
	4.5 CHS	12.2	**349**	380	1550
101.6 x	5.0 CHS	11.9	**341**	371	1520
	4.0 CHS	9.63	**276**	300	1230
88.9 x	5.9 CHS	12.1	**346**	377	1540
	5.0 CHS	10.3	**297**	323	1320
	4.0 CHS	8.38	**240**	261	1070
76.1 x	5.9 CHS	10.2	**293**	319	1300
	4.5 CHS	7.95	**228**	248	1010
	3.6 CHS	6.44	**184**	201	820
60.3 x	5.4 CHS	7.31	**210**	228	931
	4.5 CHS	6.19	**177**	193	789
	3.6 CHS	5.03	**144**	157	641
48.3 x	5.4 CHS	5.71	**164**	178	728
	4.0 CHS	4.37	**125**	136	557
	3.2 CHS	3.56	**102**	111	453
42.4 x	4.9 CHS	4.53	**130**	141	577
	4.0 CHS	3.79	**109**	118	483
	3.2 CHS	3.09	**88.7**	96.5	394
33.7 x	4.5 CHS	3.24	**92.9**	101	413
	4.0 CHS	2.93	**84.0**	91.4	373
	3.2 CHS	2.41	**69.0**	75.1	307
26.9 x	4.0 CHS	2.26	**64.7**	70.4	288
	3.2 CHS	1.87	**53.6**	58.3	238
	2.6 CHS	1.56	**44.7**	48.6	198
21.3 x	3.6 CHS	1.57	**45.0**	49.0	200
	3.2 CHS	1.43	**40.9**	44.5	182
	2.6 CHS	1.20	**34.4**	37.4	153

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85\ A_g f_u$ (Clause 7.2 of AS 4100)

TABLE 6.1–2

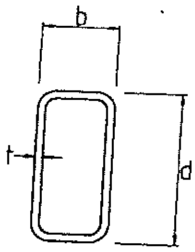
DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION
CIRCULAR HOLLOW SECTIONS
GRADE C350

Designation d_o	t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	Axial Tension ϕN_t $\phi N_t(2)$	Gross Section Area A_g
mm	mm	kg/m	kN	kN	mm^2
457.0 x	12.7 CHS	139	**5580**	5830	17700
	9.5 CHS	105	**4210**	4390	13400
	6.4 CHS	71.1	**2850**	2980	9060
406.4 x	12.7 CHS	123	**4950**	5170	15700
	9.5 CHS	93.0	**3730**	3900	11800
	6.4 CHS	63.1	**2530**	2650	8040
355.6 x	12.7 CHS	107	**4310**	4500	13700
	9.5 CHS	81.1	**3250**	3400	10300
	6.4 CHS	55.1	**2210**	2310	7020
323.9 x	12.7 CHS	97.5	**3910**	4080	12400
	9.5 CHS	73.7	**2960**	3090	9380
	6.4 CHS	50.1	**2010**	2100	6380
273.1 x	9.3 CHS	60.5	**2430**	2540	7710
	6.4 CHS	42.1	**1690**	1760	5360
	4.8 CHS	31.8	**1270**	1330	4050
219.1 x	8.2 CHS	42.6	**1710**	1790	5430
	6.4 CHS	33.6	**1350**	1410	4280
	4.8 CHS	25.4	**1020**	1060	3230
168.3 x	7.1 CHS	28.2	**1130**	1180	3600
	6.4 CHS	25.6	**1030**	1070	3260
	4.8 CHS	19.4	**777**	811	2470
165.1 x	3.5 CHS	13.9	**560**	585	1780
	3.0 CHS	12.0	**481**	503	1530
139.7 x	3.5 CHS	11.8	**472**	493	1500
	3.0 CHS	10.1	**406**	424	1290
114.3 x	6.0 CHS	16.0	**643**	672	2040
	4.8 CHS	13.0	**520**	543	1650
	3.6 CHS	9.83	**394**	412	1250
	3.2 CHS	8.77	**352**	367	1120
101.6 x	3.2 CHS	7.77	**312**	325	989
	2.6 CHS	6.35	**255**	266	809
88.9 x	5.5 CHS	11.3	**454**	474	1440
	4.8 CHS	9.96	**399**	417	1270
	3.2 CHS	6.76	**271**	283	862
	2.6 CHS	5.53	**222**	232	705
76.1 x	3.2 CHS	5.75	**231**	241	733
	2.3 CHS	4.19	**168**	175	533
60.3 x	2.9 CHS	4.11	**165**	172	523
	2.3 CHS	3.29	**132**	138	419
48.3 x	2.9 CHS	3.25	**130**	136	414
	2.3 CHS	2.61	**105**	109	332
42.4 x	2.6 CHS	2.55	**102**	107	325
	2.0 CHS	1.99	**80.0**	83.5	254
33.7 x	2.6 CHS	1.99	**80.0**	83.6	254
	2.0 CHS	1.56	**62.7**	65.5	199
26.9 x	2.3 CHS	1.40	**56.0**	58.5	178
	2.0 CHS	1.23	**49.3**	51.5	156
21.3 x	2.0 CHS	0.952	**38.2**	39.9	121

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85\ A_g f_u$ (Clause 7.2 of AS 4100)

TABLE 6.1–3

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION
RECTANGULAR HOLLOW SECTIONS
GRADE C350



Designation d b t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	$\phi N_t(2)$	Gross Section Area A_g
mm mm mm	kg/m	kN	kN	mm^2
250 x 150 x 9.0 RHS	51.8	2080	2170	6600
6.0 RHS	35.6	1430	1490	4350
5.0 RHS	29.9	1200	1250	3810
200 x 100 x 9.0 RHS	37.7	1510	1580	4800
6.0 RHS	26.2	1050	1100	3330
5.0 RHS	22.1	886	926	2810
4.0 RHS	17.9	719	750	2280
150 x 100 x 6.0 RHS	21.4	861	899	2730
5.0 RHS	18.2	729	761	2310
4.0 RHS	14.8	593	619	1880
150 x 50 x 5.0 RHS	14.2	571	597	1810
4.0 RHS	11.6	467	487	1480
3.0 RHS	8.96	359	375	1140
125 x 75 x 6.0 RHS	16.7	672	701	2130
5.0 RHS	14.2	571	597	1810
4.0 RHS	11.6	467	487	1480
3.0 RHS	8.96	359	375	1140
100 x 50 x 6.0 RHS	12.0	483	504	1530
5.0 RHS	10.3	414	432	1310
4.0 RHS	8.49	341	356	1080
3.5 RHS	7.53	302	315	959
3.0 RHS	6.60	265	277	841
2.5 RHS	5.56	223	233	709
2.0 RHS	4.50	181	189	574
75 x 50 x 6.0 RHS	9.67	388	405	1230
5.0 RHS	8.35	335	350	1060
4.0 RHS	6.92	278	290	881
3.0 RHS	5.42	218	227	691
2.5 RHS	4.58	184	192	584
2.0 RHS	3.72	149	156	474
75 x 25 x 2.5 RHS	3.60	145	151	459
2.0 RHS	2.93	118	123	374
1.6 RHS	2.38	95.5	99.7	303
65 x 35 x 3.0 RHS	4.25	170	178	541
2.5 RHS	3.60	145	151	459
2.0 RHS	2.93	118	123	374
50 x 25 x 3.0 RHS	3.07	123	129	391
2.5 RHS	2.62	105	110	334
2.0 RHS	2.15	86.2	90.0	274
1.6 RHS	1.75	70.3	73.4	223
50 x 20 x 3.0 RHS	2.83	114	119	361
2.5 RHS	2.42	97.3	102	309
2.0 RHS	1.99	79.9	83.5	254
1.6 RHS	1.63	65.3	68.1	207

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85\ A_g f_u$ (Clause 7.2 of AS 4100)

TABLE 6.1–4

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION
RECTANGULAR HOLLOW SECTIONS
GRADE C450

Designation d b t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	$\phi N_t(2)$	Gross Section Area A_g
mm mm mm	kg/m	kN	kN	mm^2
125 x 75 x 3.8 RHS	11.1	572	540	1410
3.3 RHS	9.73	502	474	1240
2.8 RHS	8.39	433	409	1070
2.3 RHS	6.95	359	339	885
100 x 50 x 3.3 RHS	7.14	368	348	909
2.8 RHS	6.19	319	302	788
2.3 RHS	5.14	265	251	655
75 x 50 x 2.8 RHS	5.09	263	248	648
2.3 RHS	4.24	219	207	540
65 x 35 x 2.8 RHS	3.99	206	194	508
2.3 RHS	3.34	172	163	425
50 x 25 x 2.8 RHS	2.89	149	141	368
2.3 RHS	2.44	126	119	310
50 x 20 x 2.8 RHS	2.67	138	130	340

Notes:
1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85\ A_g f_u$ (Clause 7.2 of AS 4100)

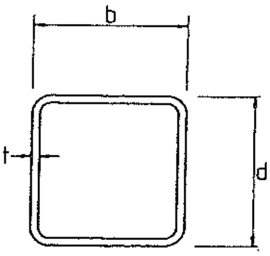


TABLE 6.1–5

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION SQUARE HOLLOW SECTIONS GRADE C350

Designation d b t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	$\phi N_t(2)$	Gross Section Area A_g
mm mm mm	kg/m	kN	kN	mm^2
250 x 250 x 9.0 SHS	65.9	2650	2760	8400
6.0 SHS	45.0	1810	1890	5730
200 x 200 x 9.0 SHS	51.8	2080	2170	6600
6.0 SHS	35.6	1430	1490	4530
5.0 SHS	29.9	1200	1250	3810
150 x 150 x 9.0 SHS	37.7	1510	1580	4800
6.0 SHS	26.2	1050	1100	3330
5.0 SHS	22.1	886	926	2810
125 x 125 x 9.0 SHS	30.6	1230	1280	3900
6.0 SHS	21.4	861	899	2730
5.0 SHS	18.2	729	761	2310
4.0 SHS	14.8	593	619	1880
100 x 100 x 9.0 SHS	23.5	944	986	3000
6.0 SHS	16.7	672	701	2130
5.0 SHS	14.2	571	597	1810
4.0 SHS	11.6	467	487	1480
3.0 SHS	8.96	359	375	1140
89 x 89 x 6.0 SHS	14.6	588	614	1870
5.0 SHS	12.5	502	524	1590
3.5 SHS	9.06	363	379	1150
75 x 75 x 6.0 SHS	12.0	483	504	1530
5.0 SHS	10.3	414	432	1310
4.0 SHS	8.49	341	356	1080
3.5 SHS	7.53	302	315	959
3.0 SHS	6.60	265	277	841
2.5 SHS	5.56	223	233	709
65 x 65 x 6.0 SHS	10.1	407	425	1290
5.0 SHS	8.75	351	367	1110
4.0 SHS	7.23	290	303	921
3.0 SHS	5.66	227	237	721
2.5 SHS	4.78	192	200	609
2.0 SHS	3.88	156	162	494
50 x 50 x 5.0 SHS	6.39	256	268	814
4.0 SHS	5.35	215	224	681
3.0 SHS	4.25	170	178	541
2.5 SHS	3.60	145	151	459
2.0 SHS	2.93	118	123	374
1.6 SHS	2.38	95.5	99.7	303
40 x 40 x 4.0 SHS	4.09	164	171	521
3.0 SHS	3.30	133	138	421
2.5 SHS	2.82	113	118	359
2.0 SHS	2.31	92.5	96.6	294
1.6 SHS	1.88	75.3	78.7	239
35 x 35 x 3.0 SHS	2.83	114	119	361
2.5 SHS	2.42	97.3	102	309
2.0 SHS	1.99	79.9	83.5	254
1.6 SHS	1.63	65.3	68.1	207
30 x 30 x 3.0 SHS	2.36	94.8	99.0	301
2.5 SHS	2.03	81.6	85.2	259
2.0 SHS	1.68	67.3	70.3	214
1.6 SHS	1.38	55.2	57.6	175
25 x 25 x 3.0 SHS	1.89	75.9	79.2	241
2.5 SHS	1.64	65.8	68.7	209
2.0 SHS	1.36	54.7	57.1	174
1.6 SHS	1.12	45.1	47.1	143

Notes: 1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85 A_g f_u$ (Clause 7.2 of AS 4100)

TABLE 6.1–6

DESIGN CAPACITIES FOR MEMBERS SUBJECT TO AXIAL TENSION SQUARE HOLLOW SECTIONS GRADE C450

Designation d b t	Mass per m	Axial Tension ϕN_t $\phi N_t(1)$	$\phi N_t(2)$	Gross Section Area A_g
mm mm mm	kg/m	kN	kN	mm^2
100 x 100 x 3.8 SHS	11.1	572	540	1410
3.3 SHS	9.73	502	474	1240
2.8 SHS	8.39	433	409	1070
2.3 SHS	6.95	359	339	885
75 x 75 x 3.3 SHS	7.14	368	348	909
2.8 SHS	6.19	319	302	788
2.3 SHS	5.14	265	251	655
65 x 65 x 2.8 SHS	5.31	274	259	676
2.3 SHS	4.42	228	215	563
50 x 50 x 2.8 SHS	3.99	206	194	508
2.3 SHS	3.34	172	163	425
40 x 40 x 2.8 SHS	3.11	161	152	396
2.3 SHS	2.62	135	127	333
35 x 35 x 2.8 SHS	2.67	138	130	340
2.3 SHS	2.25	116	110	287
30 x 30 x 2.8 SHS	2.23	115	109	284
2.3 SHS	1.89	97.7	92.3	241
25 x 25 x 2.3 SHS	1.53	79.1	74.7	195

Notes: 1. $\phi = 0.9$ (Table 3.4 of AS 4100)
2. $\phi N_t(1) = \phi A_g f_y$ (Clause 7.2 of AS 4100)
3. $\phi N_t(2) = \phi 0.85 A_g f_u$ (Clause 7.2 of AS 4100)

PART 7 MEMBERS SUBJECT TO COMBINED ACTIONS

PAGE

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES

PART 7 MEMBERS SUBJECT TO COMBINED ACTIONS

7.1 Scope

This part of the Tables contains the interaction formulae which must be used to design members subject to combined actions in accordance with Section 8 of AS 4100.

Tables 7.3.2–1 to 7.3.2–6 give values of elastic buckling load (N_{om}) for various effective lengths (L_e) determined in accordance with Clause 4.6.3 of AS 4100.

7.2 Method

Section 7.3 describes the use and determination of moment amplification factors and the determination of the elastic buckling load for braced or sway members. The elastic buckling load is required for combined bending and axial compression when the moment is amplified by the moment amplification factors δ_b and δ_s.

Sections 7.4 and 7.5 give the interaction formulae for combined bending and axial compression and combined bending and axial tension respectively. Each section describes the method for uniaxial bending about the major principal x–axis, for uniaxial bending about the minor principal y–axis, and for biaxial bending. Section 7.6 gives the interaction formulae for biaxial bending without axial forces. In every case both the section capacity and the member capacity must be checked.

7.3 Moment Amplification

For a member subjected to combined bending and axial compression force, irrespective of whether that member is an isolated statically determinate member or part of a statically indeterminate frame, the bending moments will be amplified by the presence of axial compression force. Such amplification can be accounted for by a variety of means and these are now considered in relation to braced and sway members.

Braced Member – the member is braced such that its ends cannot move relative to one another.

If a first order elastic analysis is conducted then δ_b (Clause 4.4.2.2 of AS 4100) must be used to amplify the design action effects between the ends of the member. However, when the moment amplification factor is greater than 1.4, a second order elastic analysis must be carried out (see Appendix E of AS 4100).

If an appropriate second order elastic analysis is carried out such that the design action effects at a sufficient number of locations between the ends of the member are determined then there is no need to modify the design action effects in the member using δ_b.

The moment amplification factor (δ_b) must be calculated using the procedure shown in Figure 7.3(1)

Sway Member – the ends of the member are permitted to move relative to one another.

If a first order elastic analysis is carried out then the design action effects must be modified using the moment amplification factor (δ_m), which is the greater of δ_b and δ_s (see Clause 4.4.2.3 of AS 4100). However, when the moment amplification factor is greater than 1.4, a second order elastic analysis must be carried out (see Appendix E of AS 4100).

If an appropriate second order elastic analysis is carried out such that the design action effects at a sufficient number of locations along the length of the member are determined then there is no need to modify the design action effects using δ_m. If this is not the situation, then the design action effects obtained from the second order elastic analysis may need to be modified using δ_b as described in Appendix E of AS 4100.

The moment amplification factors (δ_b and δ_s) must be calculated using the procedure shown in Figures 7.3(1) and 7.3(2).

7.3.1 Values of c_m

The value of c_m is specified in Clause 4.4.2.2 of AS 4100 as:

$$c_m = 0.6 - 0.4\,\beta_m$$

where β_m is the ratio of the smaller to the larger bending moments at the ends of the member, taken as positive when the member is bent in reverse curvature. Where the member is subjected to transverse loading, β_m may be taken as described in Clauses 4.4.2.2(a), (b), and (c) of AS 4100. Table 7.3.1 gives values of c_m for a range of β_m values for single and reverse curvature bending.

7.3.2 Elastic Buckling Load

Values of elastic buckling load (N_{om}) for various effective lengths (L_e) are given in Tables 7.3.2–1 to 7.3.2–6. N_{om} values are determined in accordance with Clause 4.6.2 of AS 4100 as:

$$N_{om} = \frac{\pi^2 EI}{(k_e L)^2}$$

where E = 200×10^3 MPa
I = second moment of area
$k_e L$ = effective length (Section 5.4 of these Tables)

"N_{om} x–axis" indicates N_{om} for the member buckling about the x–axis. "N_{om} y–axis" indicates N_{om} for the member buckling about the y–axis.

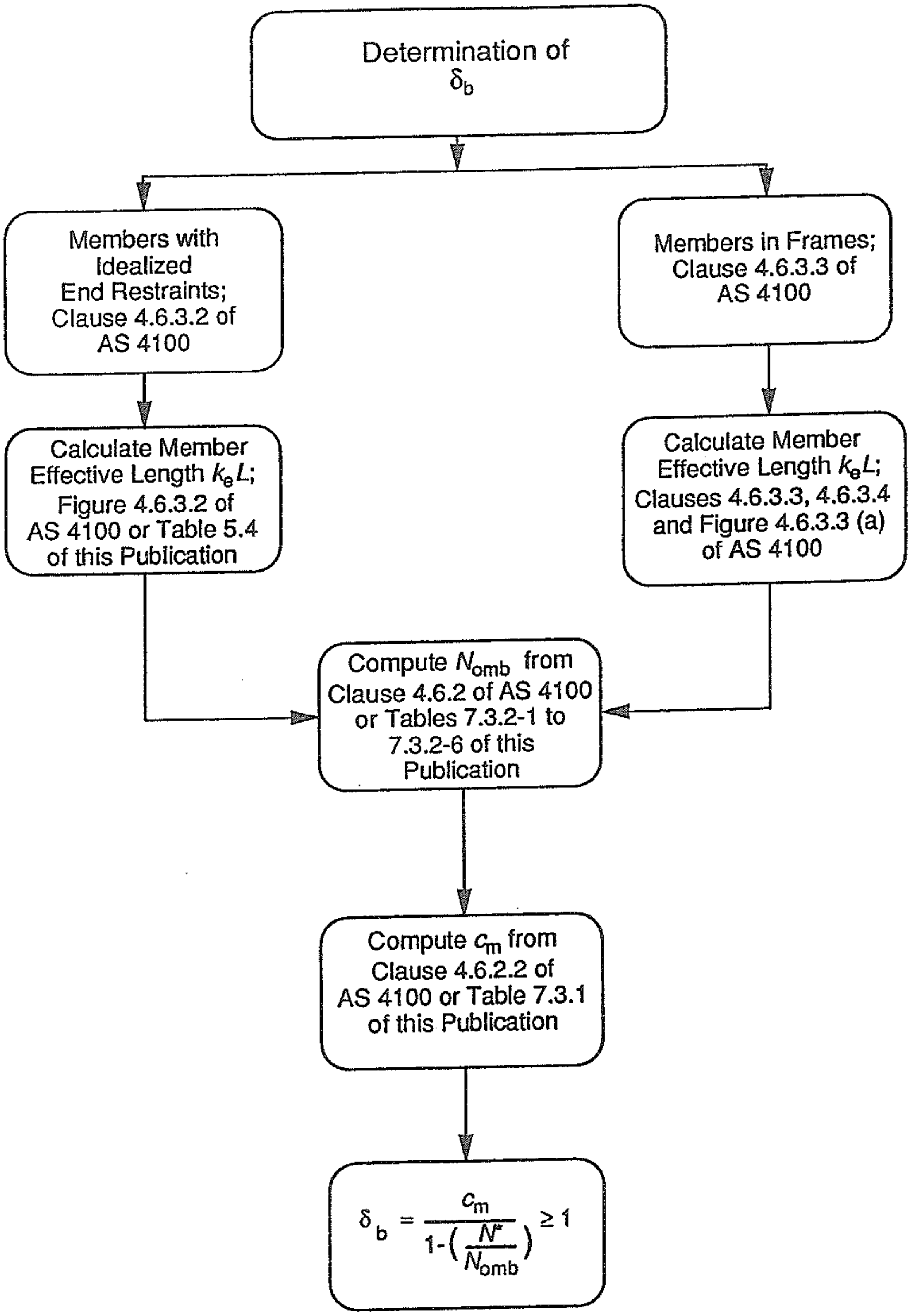


Figure 7.3(1): Flow Chart for Determination of δ_b

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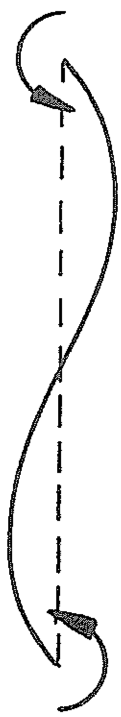
Table 7.3.1: Values of c_m for braced members

β_m	c_m	β_m	c_m	β_m	c_m	β_m	c_m
−1.00	1.00	−0.50	0.80	+0.05	0.58	+0.55	0.38
−0.95	0.98	−0.45	0.78	+0.10	0.56	+0.60	0.36
−0.90	0.96	−0.40	0.76	+0.15	0.54	+0.65	0.34
−0.85	0.94	−0.35	0.74	+0.20	0.52	+0.70	0.32
−0.80	0.92	−0.30	0.72	+0.25	0.50	+0.75	0.30
−0.75	0.90	−0.25	0.70	+0.30	0.48	+0.80	0.28
−0.70	0.88	−0.20	0.68	+0.35	0.46	+0.85	0.26
−0.65	0.86	−0.15	0.66	+0.40	0.42	+0.95	0.22
−0.55	0.82	−0.05	0.62	+0.50	0.40	+1.00	0.20
		0.00	0.60				

β_m is negative for single curvature bending:

β_m is positive for reverse curvature bending:



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7.4.1.2 Member Capacity

This section only applies to members analysed using an elastic method of analysis. Where there is sufficient restraint to prevent lateral buckling, only the in-plane requirements of Sections 7.4.1.1 and 7.4.1.2 need to be satisfied. If there is insufficient restraint to prevent lateral buckling, then both the in-plane and out-of-plane requirements of Sections 7.4.1.1 and 7.4.1.2 need to be satisfied.

a) In-plane capacity

$$\phi M_{ix} = \phi M_{sx}\left(1 - \frac{N^*}{\phi N_{cx}}\right) \qquad \text{(Clause 8.4.2.2 of AS 4100)}$$

Note: $N^* \leq \phi N_{cx}$

b) Out-of-plane capacity

$$\phi M_{ox} = \phi M_{bx}\left(1 - \frac{N^*}{\phi N_{cy}}\right) \qquad \text{(Clause 8.4.4.1 of AS 4100)}$$

where ϕM_{bx} = design member moment capacity for bending about the major principal x–axis (see Section 4.1.2 and Tables 4.1–1 to 4.1–4)

Note: $N^* \leq \phi N_{cy}$

7.4.2 Uniaxial Bending – about the minor principal y-axis

For a member subject to uniaxial bending about the minor principal y-axis and axial compression, the following condition must be satisfied:

$$M_y^* \leq \min.[\phi M_{ry} ; \phi M_{iy}]$$

where M_y^* = design bending moment about the minor principal y–axis
ϕ = 0.9 (Table 3.4 of AS 4100)
ϕM_{ry} = design section moment capacity (ϕM_s) about the minor principal y–axis reduced by axial force (see section 7.4.2.1)
ϕM_{iy} = nominal in-plane member moment capacity (ϕM_i) about the minor principal y–axis (see section 7.4.2.2)

7.4.2.1 Section Capacity

The value of ϕM_{ry} must be determined at all points along the member and the minimum value is used to satisfy Section 7.4.2.

$$\phi M_{ry} = \phi M_{sy}\left(1 - \frac{N^*}{\phi N_s}\right) \qquad \text{(Clause 8.3.3 of AS 4100)}$$

Note: $N^* \leq \phi N_s$

7.5 Combined Bending and Axial Tension

In this section:

ϕ = 0.9 (Table 3.4 of AS 4100)

ϕM_{sx} = design section moment capacity for bending about the major principal x–axis (see Section 3.2.3 and Tables 3.1–1 to 3.1–6)

ϕM_{sy} = design section moment capacity for bending about the minor principal y–axis (see Section 3.2.3 and Tables 3.1–1 to 3.1–6)

N^* = design axial compressive force

7.5.1 Uniaxial Bending - about the major principal x–axis

For a member subject to uniaxial bending about the major principal x–axis and axial tension, the following condition must be satisfied:

$$M_x^* \leq \min.[\phi M_{rx} \,;\, \phi M_{ox}]$$

where M_x^* = design bending moment about the major principal x-axis

ϕM_{rx} = design section moment capacity (ϕM_s) for bending about the major principal x–axis reduced by axial force (see section 7.5.1.1)

ϕM_{ox} = design out-of-plane member moment capacity (ϕM_o) for bending about the major principal x–axis (see section 7.5.1.2)

7.5.1.1 Section Capacity

The value of ϕM_{rx} must be determined at all points along the member and the minimum value is used to satisfy Section 7.5.1.

$$\phi M_{rx} = \phi M_{sx}\left(1 - \frac{N^*}{\phi N_t}\right) \qquad \text{(Clause 8.3.2 of AS 4100)}$$

where ϕN_t = design section capacity in tension (see Section 3.2.1 and Tables 3.1–1 to 3.1–6)

Note: $N^* \leq \phi N_t$

7.5.3.2 Member Capacity

$$\left(\frac{M_x^*}{\phi M_{tx}}\right)^{1.4} + \left(\frac{M_y^*}{\phi M_{ry}}\right)^{1.4} \leq 1 \qquad \text{(Clause 8.4.5.2 of AS 4100)}$$

where M_x^* = design bending moment about the major principal x–axis

ϕM_{tx} = *lesser* of the design section moment capacity (ϕM_{rx}) reduced by axial tension and the design out-of-plane member moment capacity (ϕM_{ox}) for bending about the major principal x–axis, determined in accordance with Sections 7.5.1.1 and 7.5.1.2 respectively

M_y^* = design bending moment about the minor principal y–axis

ϕM_{ry} = design section moment capacity reduced by axial tension, determined in accordance with Section 7.5.2

Note: $M_x^* \leq \phi M_{tx}$

$M_y^* \leq \phi M_{ry}$

7.6 Biaxial Bending

For a member subject to biaxial bending without any axial force, both the conditions defined in Sections 7.6.1 and 7.6.2 must be satisfied.

7.6.1 Section Capacity

$$\frac{M_x^*}{\phi M_{sx}} + \frac{M_y^*}{\phi M_{sy}} \leq 1 \qquad \text{(Clause 8.3.4 of AS 4100)}$$

where M_x^* = design bending moment about the major principal x–axis

ϕ = 0.9 (Table 3.4 of AS 4100)

ϕM_{sx} = design section moment capacity for bending about the major principal x–axis (see Section 3.2.3 and Tables 3.1–1 to 3.1–6)

M_y^* = design bending moment about the minor principal y–axis

ϕM_{sy} = design section moment capacity for bending about the minor principal y–axis (see Section 3.2.3 and Tables 3.1–1 to 3.1–6)

Note: $M_x^* \leq \phi M_{sx}$

$M_y^* \leq \phi M_{sy}$

7.6.2 Member Capacity

$$\left(\frac{M_x^*}{\phi M_{bx}}\right)^{1.4} + \left(\frac{M_y^*}{\phi M_{sy}}\right)^{1.4} \leq 1 \qquad \text{(Clause 8.4.5 of AS 4100)}$$

where M_x^* = design bending moment about the major principal x–axis

ϕ = 0.9 (Table 3.4 of AS 4100)

ϕM_{bx} = design member moment capacity for bending about the major principal x–axis (see Section 4.1.2 and Tables 4.1–1 to 4.1–4)

M_y^* = design bending moment about the minor principal y–axis

ϕM_{sy} = design section moment capacity for bending about the minor principal y–axis (see Section 3.2.3 and Tables 3.1–1 to 3.1–6)

Note: $M_x^* \leq \phi M_{bx}$

$M_y^* \leq \phi M_{by}$

From Figure 7.3(2) the moment amplification factor (δ_b) is given by:

$$\delta_b = \frac{c_m}{1 - \left(\dfrac{N^*}{N_{omb}}\right)}$$

	Considering flexural buckling about x–axis:	δ_{bx} = 0.614	(< 1)
∴	Maximum moment occurs at the ends, ie. at End A	M_x^* = 50 kNm	
	Considering flexural buckling about y–axis:	δ_{by} = 1.05	(> 1 and < 1.1)
∴	Maximum moment occurs between the ends, ie. in the span	M_y^* = 1.05 x 5.0 = 5.25 kNm	

2. Considering further Example 1 (Section 7.7), the adequacy of the member under the calculated design action effects is now checked as required by Clauses 8.3 and 8.4 of AS 4100.

<u>Design Data:</u>

Section: 250 x 150 x 6.0 RHS – Grade C350 steel

Effective lengths:
- Flexural buckling (x–axis) = 4.0 m
- Flexural buckling (y–axis) = 4.0 m
- Lateral buckling = 6.0 m

Design action effects:

$$N^* = 105 \text{ kN}$$
$$M_x^* = 50 \text{ kNm}$$
$$M_y^* = 5.25 \text{ kNm}$$

<u>Solution:</u> The example involes biaxial bending and axial compression as defined in Section 7.4.3 of these Tables.

(i) Section Capacity Check (Section 7.4.3.1)

From Table 3.1–3 we obtain:

$$\phi N_s = 1290 \text{ kN}$$
$$\phi M_{sx} = 118 \text{ kNm}$$
$$\phi M_{sx} = 65.6 \text{ kNm}$$

Thus,

$$\frac{N^*}{\phi N_s} + \frac{M_x^*}{\phi M_{sx}} + \frac{M_y^*}{\phi M_{sy}} = \frac{105}{1290} + \frac{50}{118} + \frac{5.25}{65.6}$$

$$= 0.585 \quad (\le 1.0 \ \therefore \text{O.K.})$$

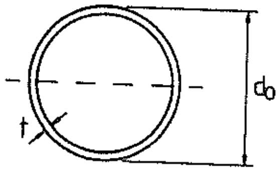
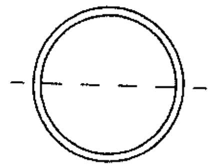


TABLE 7.3.2 – 1 (1)

ELASTIC BUCKLING LOADS
CIRCULAR HOLLOW SECTIONS: GRADE C250
buckling about any axis



Designation d_o (mm)	t (mm)	Mass per m (kg/m)	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
			Elastic Buckling Loads N_{om} (MN) — Effective Length (L_e) in metres													
610.0 x	12.7 CHS	187	∞	2100	525	233	131	84.0	58.3	42.8	32.8	25.9	21.0	14.6	10.7	8.20
	9.5 CHS	141	∞	1600	399	177	99.7	63.8	44.3	32.6	24.9	19.7	16.0	11.1	8.14	6.23
	6.4 CHS	95.3	∞	1090	273	121	68.2	43.6	30.3	22.3	17.0	13.5	10.9	7.58	5.57	4.26
508.0 x	12.7 CHS	155	∞	1200	299	133	74.8	47.9	33.2	24.4	18.7	14.8	12.0	8.31	6.11	4.68
	9.5 CHS	117	∞	913	228	101	57.0	36.5	25.3	18.6	14.3	11.3	9.13	6.34	4.66	3.56
	6.4 CHS	79.2	∞	626	157	69.6	39.1	25.0	17.4	12.8	9.78	7.73	6.26	4.35	3.19	2.45

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

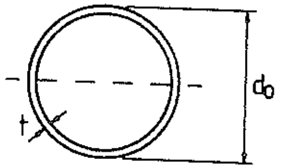
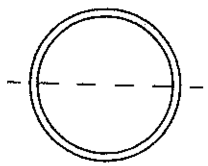


TABLE 7.3.2 – 1 (2)

ELASTIC BUCKLING LOADS
CIRCULAR HOLLOW SECTIONS: GRADE C250
buckling about any axis



Designation d_o (mm)	t (mm)	Mass per m (kg/m)	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0
			Elastic Buckling Loads N_{om} (kN) — Effective Length (L_e) in metres													
165.1 x	5.4 CHS	21.3	∞	68300	17100	7590	4270	2730	1900	1390	1070	683	474	348	267	211
	5.0 CHS	19.7	∞	63700	15900	7080	3980	2550	1770	1300	995	637	442	325	249	197
139.7 x	5.4 CHS	17.9	∞	40600	10200	4510	2540	1620	1130	829	635	406	282	207	159	125
	5.0 CHS	16.6	∞	37900	9490	4220	2370	1520	1050	774	593	379	263	194	148	117
114.3 x	5.4 CHS	14.5	∞	21700	5420	2410	1350	867	602	442	339	217	151	111	84.7	66.9
	4.5 CHS	12.2	∞	18500	4630	2060	1160	740	514	378	289	185	128	94.4	72.3	57.1
101.6 x	5.0 CHS	11.9	∞	14000	3500	1560	876	560	389	286	219	140	97.3	71.5	54.7	43.2
	4.0 CHS	9.63	∞	11600	2890	1280	722	462	321	236	180	116	80.2	58.9	45.1	35.6
88.9 x	5.9 CHS	12.1	∞	10500	2630	1170	657	421	292	215	164	105	73.0	53.6	41.1	32.4
	5.0 CHS	10.3	∞	9190	2300	1020	574	368	255	188	144	91.9	63.8	46.9	35.9	28.4
	4.0 CHS	8.38	∞	7610	1900	845	475	304	211	155	119	76.1	52.8	38.8	29.7	23.5
76.1 x	5.9 CHS	10.2	∞	6370	1590	708	398	255	177	130	99.6	63.7	44.3	32.5	24.9	19.7
	4.5 CHS	7.95	∞	5140	1290	571	321	206	143	105	80.3	51.4	35.7	26.2	20.1	15.9
	3.6 CHS	6.44	∞	4260	1070	474	267	171	118	87.0	66.6	42.6	29.6	21.8	16.7	13.2

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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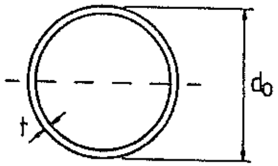
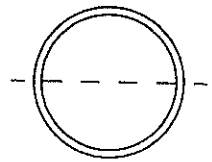


TABLE 7.3.2 – 2 (1)

ELASTIC BUCKLING LOADS
CIRCULAR HOLLOW SECTIONS: GRADE C350
buckling about any axis



Designation d_o (mm)	t (mm)	Mass per m (kg/m)	Elastic Buckling Loads N_{om} (MN), Effective Length (L_e) in metres: 0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
457.0 x	12.7 CHS	139	∞	864	216	96.0	54.0	34.6	24.0	17.6	13.5	10.7	8.64	6.00	4.41	3.38
	9.5 CHS	105	∞	660	165	73.4	41.3	26.4	18.3	13.5	10.3	8.15	6.60	4.58	3.37	2.58
	6.4 CHS	71.1	∞	454	113	50.4	28.4	18.2	12.6	9.26	7.09	5.60	4.54	3.15	2.32	1.77
406.4 x	12.7 CHS	123	∞	601	150	66.8	37.6	24.1	16.7	12.3	9.40	7.42	6.01	4.18	3.07	2.35
	9.5 CHS	93.0	∞	461	115	51.2	28.8	18.4	12.8	9.40	7.20	5.69	4.61	3.20	2.35	1.80
	6.4 CHS	63.1	∞	318	79.4	35.3	19.8	12.7	8.82	6.48	4.96	3.92	3.18	2.21	1.62	1.24
355.6 x	12.7 CHS	107	∞	397	99.4	44.2	24.8	15.9	11.0	8.11	6.21	4.91	3.97	2.76	2.03	1.55
	9.5 CHS	81.1	∞	306	76.4	33.9	19.1	12.2	8.49	6.24	4.77	3.77	3.06	2.12	1.56	1.19
	6.4 CHS	55.1	∞	211	52.8	23.5	13.2	8.45	5.87	4.31	3.30	2.61	2.11	1.47	1.08	0.825
323.9 x	12.7 CHS	97.5	∞	297	74.3	33.0	18.6	11.9	8.26	6.07	4.64	3.67	2.97	2.06	1.52	1.16
	9.5 CHS	73.7	∞	229	57.3	25.5	14.3	9.16	6.36	4.67	3.58	2.83	2.29	1.59	1.17	0.895
	6.4 CHS	50.1	∞	159	39.7	17.6	9.93	6.35	4.41	3.24	2.48	1.96	1.59	1.10	0.810	0.620
273.1 x	9.3 CHS	60.5	∞	133	33.1	14.7	8.28	5.30	3.68	2.70	2.07	1.64	1.33	0.920	0.676	0.518
	6.4 CHS	42.1	∞	94.2	23.5	10.5	5.89	3.77	2.62	1.92	1.47	1.16	0.942	0.654	0.480	0.368
	4.8 CHS	31.8	∞	71.9	18.0	7.99	4.49	2.88	2.00	1.47	1.12	0.887	0.719	0.499	0.367	0.281
219.1 x	8.2 CHS	42.6	∞	59.7	14.9	6.64	3.73	2.39	1.66	1.22	0.933	0.737	0.597	0.415	0.305	0.233
	6.4 CHS	33.6	∞	47.8	11.9	5.31	2.99	1.91	1.33	0.975	0.747	0.590	0.478	0.332	0.244	0.187
	4.8 CHS	25.4	∞	36.6	9.16	4.07	2.29	1.47	1.02	0.748	0.572	0.452	0.366	0.254	0.187	0.143
168.3 x	7.1 CHS	28.2	∞	23.1	5.77	2.57	1.44	0.924	0.642	0.471	0.361	0.285	0.231	0.160	0.118	0.0902
	6.4 CHS	25.6	∞	21.1	5.27	2.34	1.32	0.843	0.586	0.430	0.329	0.260	0.211	0.146	0.108	0.0824
	4.8 CHS	19.4	∞	16.3	4.07	1.81	1.02	0.651	0.452	0.332	0.254	0.201	0.163	0.113	0.0830	0.0636

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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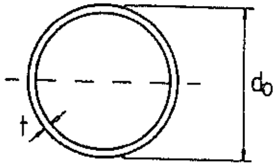
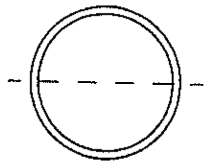


TABLE 7.3.2 – 2 (3)

ELASTIC BUCKLING LOADS
CIRCULAR HOLLOW SECTIONS: GRADE C350
buckling about any axis



Designation d_o mm	t mm	Mass per m kg/m	Elastic Buckling Loads N_{om} (kN) — Effective Length (L_e) in metres: 0.0	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0
76.1 x	3.2 CHS	5.75	∞	15400	3850	1710	963	616	428	314	241	154	107	78.6	60.2	38.5
	2.3 CHS	4.19	∞	11500	2870	1280	717	459	319	234	179	115	79.7	58.6	44.8	28.7
60.3 x	2.9 CHS	4.11	∞	6820	1700	758	426	273	189	139	107	68.2	47.4	34.8	26.6	17.0
	2.3 CHS	3.29	∞	5570	1390	619	348	223	155	114	87.1	55.7	38.7	28.4	21.8	13.9
48.3 x	2.9 CHS	3.25	∞	3380	845	375	211	135	93.9	69.0	52.8	33.8	23.5	17.2	13.2	8.45
	2.3 CHS	2.61	∞	2780	696	309	174	111	77.3	56.8	43.5	27.8	19.3	14.2	10.9	6.96
42.4 x	2.6 CHS	2.55	∞	2040	510	227	128	81.7	56.7	41.7	31.9	20.4	14.2	10.4	7.98	5.10
	2.0 CHS	1.99	∞	1640	410	182	102	65.6	45.5	33.5	25.6	16.4	11.4	8.37	6.40	4.10
33.7 x	2.6 CHS	1.99	∞	977	244	109	61.0	39.1	27.1	19.9	15.3	9.77	6.78	4.98	3.82	2.44
	2.0 CHS	1.56	∞	793	198	88.1	49.6	31.7	22.0	16.2	12.4	7.93	5.51	4.05	3.10	1.98
26.9 x	2.3 CHS	1.40	∞	428	107	47.6	26.8	17.1	11.9	8.74	6.69	4.28	2.97	2.19	1.67	1.07
	2.0 CHS	1.23	∞	385	96.4	42.8	24.1	15.4	10.7	7.87	6.02	3.85	2.68	1.97	1.51	0.964
21.3 x	2.0 CHS	0.952	∞	180	45.1	20.0	11.3	7.21	5.01	3.68	2.82	1.80	1.25	0.920	0.704	0.451

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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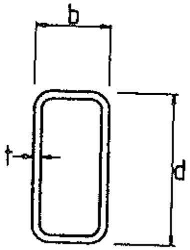
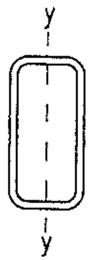


TABLE 7.3.2 – 3 (1)(B)

ELASTIC BUCKLING LOADS
RECTANGULAR HOLLOW SECTIONS: GRADE C350
buckling about y–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (MN)													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10.0
250 x 150 x 9.0 RHS	51.8	∞	192	48.0	21.3	12.0	7.68	5.34	3.92	3.00	1.92	1.33	0.980	0.750	0.480
6.0 RHS	35.6	∞	138	34.6	15.4	8.64	5.53	3.84	2.82	2.16	1.38	0.960	0.705	0.540	0.346
5.0 RHS	29.9	∞	118	29.5	13.1	7.38	4.72	3.28	2.41	1.85	1.18	0.820	0.603	0.461	0.295
200 x 100 x 9.0 RHS	37.7	∞	60.4	15.1	6.71	3.77	2.41	1.68	1.23	0.943	0.604	0.419	0.308	0.236	0.151
6.0 RHS	26.2	∞	44.9	11.2	4.99	2.81	1.80	1.25	0.917	0.702	0.449	0.312	0.229	0.176	0.112
5.0 RHS	22.1	∞	38.8	9.70	4.31	2.43	1.55	1.08	0.792	0.606	0.388	0.270	0.198	0.152	0.0970
4.0 RHS	17.9	∞	32.2	8.04	3.57	2.01	1.29	0.893	0.656	0.503	0.322	0.223	0.164	0.126	0.0804
150 x 100 x 6.0 RHS	21.4	∞	34.5	8.61	3.83	2.15	1.38	0.957	0.703	0.538	0.345	0.239	0.176	0.135	0.0861
5.0 RHS	18.2	∞	29.9	7.47	3.32	1.87	1.20	0.830	0.610	0.467	0.299	0.208	0.153	0.117	0.0747
4.0 RHS	14.8	∞	24.9	6.22	2.76	1.55	0.995	0.691	0.508	0.389	0.249	0.173	0.127	0.0972	0.0622
150 x 50 x 5.0 RHS	14.2	∞	6.04	1.51	0.671	0.378	0.242	0.168	0.123	0.0944	0.0604	0.0420	0.0308	0.0236	0.0151
4.0 RHS	11.6	∞	5.16	1.29	0.573	0.322	0.206	0.143	0.105	0.0806	0.0516	0.0358	0.0263	0.0201	0.0129
3.0 RHS	8.96	∞	4.16	1.04	0.462	0.260	0.166	0.115	0.0848	0.0650	0.0416	0.0289	0.0212	0.0162	0.0104
125 x 75 x 6.0 RHS	16.7	∞	14.8	3.70	1.64	0.925	0.592	0.411	0.302	0.231	0.148	0.103	0.0755	0.0578	0.0370
5.0 RHS	14.2	∞	13.0	3.25	1.44	0.812	0.520	0.361	0.265	0.203	0.130	0.0903	0.0663	0.0508	0.0325
4.0 RHS	11.6	∞	11.0	2.74	1.22	0.684	0.438	0.304	0.224	0.171	0.110	0.0761	0.0559	0.0428	0.0274
3.0 RHS	8.96	∞	8.73	2.18	0.970	0.545	0.349	0.242	0.178	0.136	0.0873	0.0606	0.0445	0.0341	0.0218
100 x 50 x 6.0 RHS	12.0	∞	4.48	1.12	0.498	0.280	0.179	0.124	0.0914	0.0700	0.0448	0.0311	0.0229	0.0175	0.0112
5.0 RHS	10.3	∞	4.04	1.01	0.448	0.252	0.161	0.112	0.0824	0.0631	0.0404	0.0280	0.0206	0.0158	0.0101
4.0 RHS	8.49	∞	3.48	0.870	0.387	0.218	0.139	0.0967	0.0710	0.0544	0.0348	0.0242	0.0178	0.0136	0.00870
3.5 RHS	7.53	∞	3.16	0.790	0.351	0.197	0.126	0.0878	0.0645	0.0494	0.0316	0.0219	0.0161	0.0123	0.00790
3.0 RHS	6.60	∞	2.85	0.712	0.316	0.178	0.114	0.0791	0.0581	0.0445	0.0285	0.0198	0.0145	0.0111	0.00712
2.5 RHS	5.56	∞	2.45	0.613	0.272	0.153	0.0981	0.0681	0.0500	0.0383	0.0245	0.0170	0.0125	0.00958	0.00613
2.0 RHS	4.50	∞	2.03	0.507	0.225	0.127	0.0811	0.0563	0.0414	0.0317	0.0203	0.0141	0.0103	0.00792	0.00507

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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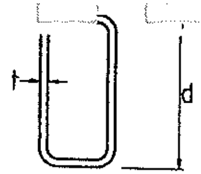

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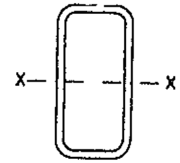
ELASTIC BUCKLING LOADS
RECTANGULAR HOLLOW SECTIONS: GRADE C450
buckling about x–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (kN)													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
125 x 75 x 3.8 RHS	11.1	∞	23100	5780	2570	1440	925	642	472	361	285	231	161	118	90.3
3.3 RHS	9.73	∞	20500	5140	2280	1280	822	571	419	321	254	205	143	105	80.3
2.8 RHS	8.39	∞	18000	4510	2000	1130	722	501	368	282	223	180	125	92.1	70.5
2.3 RHS	6.95	∞	15100	3780	1680	945	605	420	309	236	187	151	105	77.2	59.1
100 x 50 x 3.3 RHS	7.14	∞	8910	2230	990	557	356	247	182	139	110	89.1	61.8	45.4	34.8
2.8 RHS	6.19	∞	7930	1980	881	496	317	220	162	124	97.9	79.3	55.1	40.5	31.0
2.3 RHS	5.14	∞	6700	1670	744	419	268	186	137	105	82.7	67.0	46.5	34.2	26.2

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

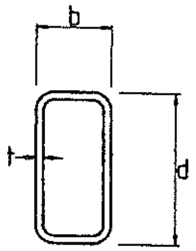
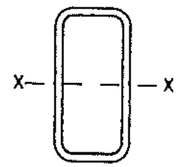


TABLE 7.3.2 – 4 (2)(A)

ELASTIC BUCKLING LOADS
RECTANGULAR HOLLOW SECTIONS: GRADE C450
buckling about x–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (kN													
		Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.50	1.75	2.0	2.5	3.0	3.5	4.0	5.0
100 x 50 x 3.3 RHS	7.14	∞	35600	8910	3960	2230	1420	990	727	557	356	247	182	139	89.1
2.8 RHS	6.19	∞	31700	7930	3530	1980	1270	881	648	496	317	220	162	124	79.3
2.3 RHS	5.14	∞	26800	6700	2980	1670	1070	744	547	419	268	186	137	105	67.0
75 x 50 x 2.8 RHS	5.09	∞	15600	3900	1730	974	623	433	318	244	156	108	79.5	60.9	39.0
2.3 RHS	4.24	∞	13200	3310	1470	827	529	368	270	207	132	91.9	67.5	51.7	33.1
65 x 35 x 2.8 RHS	3.99	∞	8430	2110	937	527	337	234	172	132	84.3	58.5	43.0	32.9	21.1
2.3 RHS	3.34	∞	7230	1810	803	452	289	201	147	113	72.3	50.2	36.9	28.2	18.1
50 x 25 x 2.8 RHS	2.89	∞	3370	844	375	211	135	93.7	68.9	52.7	33.7	23.4	17.2	13.2	8.44
2.3 RHS	2.44	∞	2940	735	327	184	118	81.7	60.0	46.0	29.4	20.4	15.0	11.5	7.35
50 x 20 x 2.8 RHS	2.67	∞	2880	720	320	180	115	80.0	58.8	45.0	28.8	20.0	14.7	11.3	7.20
2.3 RHS	2.25	∞	2530	632	281	158	101	70.2	51.6	39.5	25.3	17.6	12.9	9.87	6.32

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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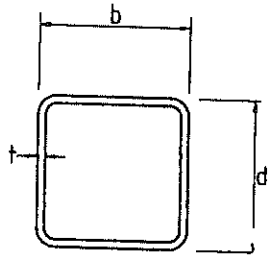
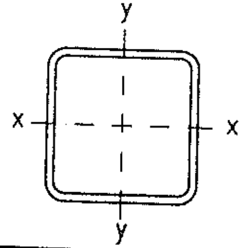


TABLE 7.3.2 – 5 (1)

ELASTIC BUCKLING LOADS
SQUARE HOLLOW SECTIONS: GRADE C350
buckling about x– and y–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (kN) (x10³) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	10.0	12.0
250 x 250 x 9.0 SHS	65.9	∞	158	70.0	39.4	25.2	17.5	12.9	9.85	6.30	4.38	3.22	2.46	1.58	1.09
6.0 SHS	45.0	∞	111	49.3	27.8	17.8	12.3	9.06	6.94	4.44	3.08	2.27	1.73	1.11	0.771
200 x 200 x 9.0 SHS	51.8	∞	77.3	34.4	19.3	12.4	8.59	6.31	4.83	3.09	2.15	1.58	1.21	0.773	0.537
6.0 SHS	35.6	∞	55.3	24.6	13.8	8.85	6.14	4.51	3.46	2.21	1.54	1.13	0.864	0.553	0.384
5.0 SHS	29.9	∞	47.1	21.0	11.8	7.54	5.24	3.85	2.95	1.89	1.31	0.962	0.737	0.471	0.327
150 x 150 x 9.0 SHS	37.7	∞	30.3	13.5	7.59	4.86	3.37	2.48	1.90	1.21	0.843	0.619	0.474	0.303	0.211
6.0 SHS	26.2	∞	22.3	9.90	5.57	3.56	2.47	1.82	1.39	0.891	0.619	0.455	0.348	0.223	0.155
5.0 SHS	22.1	∞	19.1	8.51	4.79	3.06	2.13	1.56	1.20	0.766	0.532	0.391	0.299	0.191	0.133
125 x 125 x 9.0 SHS	30.6	∞	16.5	7.35	4.13	2.65	1.84	1.35	1.03	0.662	0.459	0.338	0.258	0.165	0.115
6.0 SHS	21.4	∞	12.4	5.52	3.10	1.99	1.38	1.01	0.776	0.496	0.345	0.253	0.194	0.124	0.0862
5.0 SHS	18.2	∞	10.7	4.77	2.69	1.72	1.19	0.877	0.671	0.430	0.298	0.219	0.168	0.107	0.0746
4.0 SHS	14.8	∞	8.92	3.96	2.23	1.43	0.991	0.728	0.557	0.357	0.248	0.182	0.139	0.0892	0.0619
100 x 100 x 9.0 SHS	23.5	∞	7.71	3.43	1.93	1.23	0.857	0.629	0.482	0.308	0.214	0.157	0.120	0.0771	0.0535
6.0 SHS	16.7	∞	5.99	2.66	1.50	0.959	0.666	0.489	0.375	0.240	0.167	0.122	0.0937	0.0599	0.0416
5.0 SHS	14.2	∞	5.24	2.33	1.31	0.839	0.583	0.428	0.328	0.210	0.146	0.107	0.0819	0.0524	0.0364
4.0 SHS	11.6	∞	4.40	1.96	1.10	0.704	0.489	0.359	0.275	0.176	0.122	0.0898	0.0687	0.0440	0.0306
3.0 SHS	8.96	∞	3.49	1.55	0.874	0.559	0.388	0.285	0.218	0.140	0.0971	0.0713	0.0546	0.0349	0.0243
89 x 89 x 6.0 SHS	14.6	∞	4.06	1.80	1.01	0.649	0.451	0.331	0.254	0.162	0.113	0.0828	0.0634	0.0406	0.0282
5.0 SHS	12.5	∞	3.58	1.59	0.894	0.572	0.397	0.292	0.223	0.143	0.0993	0.0730	0.0559	0.0358	0.0248
3.5 SHS	9.06	∞	2.71	1.21	0.678	0.434	0.301	0.221	0.170	0.109	0.0754	0.0554	0.0424	0.0271	0.0188
75 x 75 x 6.0 SHS	12.0	∞	2.29	1.02	0.571	0.366	0.254	0.187	0.143	0.0914	0.0635	0.0466	0.0357	0.0229	0.0159
5.0 SHS	10.3	∞	2.04	0.906	0.510	0.326	0.227	0.166	0.127	0.0815	0.0566	0.0416	0.0319	0.0204	0.0142
4.0 SHS	8.49	∞	1.74	0.774	0.435	0.279	0.194	0.142	0.109	0.0697	0.0484	0.0355	0.0272	0.0174	0.0121
3.5 SHS	7.53	∞	1.57	0.699	0.393	0.252	0.175	0.128	0.0984	0.0629	0.0437	0.0321	0.0246	0.0157	0.0109
3.0 SHS	6.60	∞	1.41	0.628	0.353	0.226	0.157	0.115	0.0884	0.0565	0.0393	0.0289	0.0221	0.0141	0.00982
2.5 SHS	5.56	∞	1.21	0.539	0.303	0.194	0.135	0.0989	0.0757	0.0485	0.0337	0.0247	0.0189	0.0121	0.00841

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

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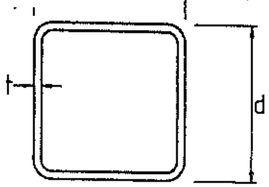
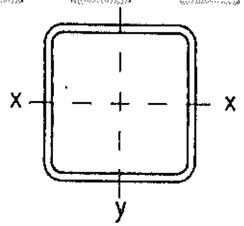
TABLE 7.3.2 – 6 (1)



ELASTIC BUCKLING LOADS
SQUARE HOLLOW SECTIONS: GRADE C450
buckling about x– and y–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
100 x 100 x 3.8 SHS	11.1	∞	16900	4220	1880	1050	675	469	344	264	208	169	117	86.1	65.9
3.3 SHS	9.73	∞	15000	3750	1670	937	600	417	306	234	185	150	104	76.5	58.6
2.8 SHS	8.39	∞	13200	3290	1460	822	526	365	268	206	162	132	91.4	67.1	51.4
2.3 SHS	6.95	∞	11000	2760	1230	690	441	306	225	172	136	110	76.6	56.3	43.1
75 x 75 x 3.3 SHS	7.14	∞	6010	1500	668	376	240	167	123	93.9	74.2	60.1	41.7	30.7	23.5
2.8 SHS	6.19	∞	5340	1330	593	334	214	148	109	83.4	65.9	53.4	37.1	27.2	20.9
2.3 SHS	5.14	∞	4510	1130	501	282	180	125	92.0	70.5	55.7	45.1	31.3	23.0	17.6

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

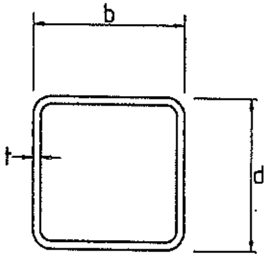
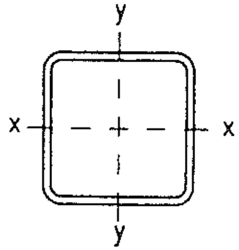


TABLE 7.3.2 – 6 (2)

ELASTIC BUCKLING LOADS
SQUARE HOLLOW SECTIONS: GRADE C450
buckling about x– and y–axis



Designation d b t	Mass per m	Elastic Buckling Loads N_{om} (kN) Effective Length (L_e) in metres													
mm mm mm	kg/m	0.0	0.25	0.5	0.75	1.0	1.25	1.50	1.75	2.0	2.5	3.0	3.5	4.0	5.0
75 x 75 x 3.3 SHS	7.14	∞	24000	6010	2670	1500	962	668	491	376	240	167	123	93.9	60.1
2.8 SHS	6.19	∞	21400	5340	2370	1330	854	593	436	334	214	148	109	83.4	53.4
2.3 SHS	5.14	∞	18000	4510	2000	1130	721	501	368	282	180	125	92.0	70.5	45.1
65 x 65 x 2.8 SHS	5.31	∞	13600	3390	1510	848	543	377	277	212	136	94.2	69.2	53.0	33.9
2.3 SHS	4.42	∞	11500	2880	1280	719	460	320	235	180	115	79.9	58.7	45.0	28.8
50 x 50 x 2.8 SHS	3.99	∞	5840	1460	649	365	234	162	119	91.2	58.4	40.6	29.8	22.8	14.6
2.3 SHS	3.34	∞	5010	1250	557	313	200	139	102	78.3	50.1	34.8	25.6	19.6	12.5
40 x 40 x 2.8 SHS	3.11	∞	2810	703	312	176	112	78.1	57.4	43.9	28.1	19.5	14.3	11.0	7.03
2.3 SHS	2.62	∞	2440	610	271	152	97.6	67.8	49.8	38.1	24.4	16.9	12.4	9.53	6.10
35 x 35 x 2.8 SHS	2.67	∞	1800	450	200	112	72.0	50.0	36.7	28.1	18.0	12.5	9.18	7.03	4.50
2.3 SHS	2.25	∞	1580	394	175	98.5	63.1	43.8	32.2	24.6	15.8	10.9	8.04	6.16	3.94
30 x 30 x 2.8 SHS	2.23	∞	1070	266	118	66.6	42.6	29.6	21.8	16.7	10.7	7.40	5.44	4.16	2.66
2.3 SHS	1.89	∞	945	236	105	59.1	37.8	26.3	19.3	14.8	9.45	6.56	4.82	3.69	2.36
25 x 25 x 2.3 SHS	1.53	∞	510	127	56.6	31.9	20.4	14.2	10.4	7.97	5.10	3.54	2.60	1.99	1.27

Note: 1. $N_{om} = \pi^2 EI / L_e^2$ (Clause 4.6.2 of AS 4100)

PART 8 MAXIMUM DESIGN LOADS FOR BEAMS

TABLES

NOTE: SEE PAGE (ix) FOR THE SPECIFIC MATERIAL STANDARD REFERRED TO BY THE SECTION TYPE AND STEEL GRADE IN THESE TABLES

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PART 8 MAXIMUM DESIGN LOADS FOR BEAMS

8.1 Scope

PART 8 gives values of maximum design loads distributed uniformly along the length of the beam with **full lateral restraint** for different beam support conditions.

Tables 8.1 for single span, simply supported beams

Tables 8.2 for continuous two span, simply supported beams

Tables 8.3 for single span, fixed end beams

Tables 8.4 for cantilever beams

Each group of tables is separated into two series:

- the (A) series (e.g. Table 8.1–1(A)) for the strength limit state
- the (B) series (e.g. Table 8.1–1(B)) for the serviceability limit state

For each group of tables, the (A) series tables are immediately followed by the (B) series tables. The design load (W^* = *total design load*) *is assumed to be uniformly distributed and applied through the shear centre in the direction of the principal y–axis.*

NOTE – BEAM SELF WEIGHT: For all tables, the self weight of the beam has NOT been deducted. The designer must include the self weight as part of the dead load when determining the maximum design load W_L^* or W_S^*.

8.2 Method

The maximum design load is the *lesser* of the strength limit state design load given in the (A) series tables determined in accordance with Section 8.2.1, and the serviceability limit state design load given in the (B) series tables determined and adjusted if necessary in accordance with Section 8.2.2.

8.2.1 Strength Limit State Design

The value of the maximum design load (W_L^*) given in the tables is the *lesser* of the maximum design load (W_{L1}^*) associated with the design section moment capacity (ϕM_{sx}) and the maximum design load (W_{L2}^*) associated with the design shear capacity (ϕV_{vx}).

$$W_L^* = \text{Min.}[W_{L1}^* \ ; \ W_{L2}^*]$$

The method is illustrated in Section 8.2.1.1 for the case of a simply supported beam.

Note: the interaction of shear and bending has not been included in the tables. If $V^* < 0.6\,\phi V_v$ or if $M^* < 0.75\,\phi M_b$ then no interaction check is necessary. Otherwise reference should be made to Section 8.4.

8.2.2 Serviceability Limit State Design

The value of serviceability load (W_S^*) given in the tables is the maximum design load which will achieve a **calculated total elastic deflection** of $L/250$ (where L is the span of the beam).

For deflection limits other than span / 250, the value of W_{S2}^* for the alternative deflection limit may be calculated from the tabulated value W_{S1}^* using the formula:

$$W_{S2}^* = \frac{250 W_{S1}^*}{D}$$

where D = the denominator value in the deflection limit incorporating the span term (e.g. D = 500 for the $L/500$ deflection limit)

For sections with a high shape factor (ratio of plastic moment to the yield moment of a beam) it may be possible for the maximum stresses in a member to reach the yield stress at serviceability loads without exceeding the strength limit state. This will invalidate the deflection calculations based on the assumption of elastic behaviour. However it has been found that for the hollow sections contained in these tables, using the load factors in AS 1170 and AS 4100, the strength limit state will always be exceeded before first yield occurs. Therefore values of the load at which first yield occurs have not been included in the tables.

The method is illustrated below for the case of a simply supported beam.

W_{S1}^* – based on a Deflection Limit of $L/250$ (simply supported beam)

For a simply supported beam subject to a uniformly distributed load, the maximum deflection (Δ_{max}) is given by:

$$\Delta_{max} = \frac{5WL^3}{384EI_x}$$

where W = total uniformly distributed load
L = length of span
E = 200×10^3 MPa
I_x = second moment of area about the major principal x–axis

Therefore, substituting $\Delta_{max} = L/250$ and rearranging the equation gives the serviceability limit state maximum design load (W_s^*):

$$W_s^* = \frac{384EI_x}{1250L^2}$$

8.5 Other Load Conditions

The values given in Tables 8.1–1 to 8.1–6 are for single span, simply supported beams subject to uniformly distributed loads. However, the information presented in these tables may be used for other loading situations, for beams with full lateral restraint and $\alpha_m = 1.0$, using the equivalent uniform design loads given in Table 8.5 and in conjunction with the following procedure:

(1) Calculate equivalent uniformly distributed maximum design load for moment (W^*_{EM}) using Table 8.5.

(2) Based on W^*_{EM} select a section with an adequate maximum design load (W^*_{L1}) associated with the design shear capacity from Tables 8.1–1(A) to 8.1–6(A).

(3) Calculate equivalent uniformly distributed maximum design load for shear (W^*_{EV}) using Table 8.5.

(4) Check that the section selected in (2) has an adequate maximum design load (W^*_{L2}) associated with the design shear capacity to resist W^*_{EV}. If not, select a new section size which can resist W^*_{EV}.

(5) Check shear and bending interaction in accordance with Section 4.2.3. A check is necessary if the design shear is less than 60% of the design shear capacity ($V^* < 0.6\,\phi V_v$) or if $M^* < 0.75\,\phi M_b$.

(6) Calculate equivalent uniformly distributed serviceability load (W^*_{ES}) using Table 8.5.

(7) Check that the section selected in (4) has an adequate maximum serviceability design load (W^*_{S1}) to resist W^*_{ES}. If not, select a new section size which can resist W^*_{ES}.

8.6 Examples

1. A simply supported beam of 4 metres is subjected to uniformly distributed loads of:

   G (Dead Load) = 50 kN (total load)

   Q (Live Load) = 64 kN (total load)

The beam is continuously laterally supported. The total deflection of the beam under serviceability load must not exceed $L / 250$.

<u>Solution:</u>

(a) Calculation of maximum design loads:

Strength limit state $W_L^* = 1.25G + 1.5Q$
$= 159$ kN

Serviceability limit state $W_S^* = G + 0.7Q$ (short term live load)
$= 94.8$ kN

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(b) Use of the Tables:

Strength Limit State – Select a section from the Tables such that the maximum design loads W^*_{L1} and W^*_{L2} are greater than or equal to W^*_L. It can be seen from Table 8.1–3(1)(A) that for a 250 x 150 x 5.0 RHS – Grade C350, the **maximum** design loads are:

$$W^*_{L1} = 189 \text{ kN}$$
$$W^*_{L2} = 873 \text{ kN}$$

$$\therefore \quad W^*_L = 189 \text{ kN} \qquad (> 159 \text{ kN})$$

Therefore, a 250 x 150 x 5.0 RHS has adequate strength.

Serviceability Limit State – From Table 8.1–3(1)(B) it can be seen that for a 250 x 150 x 5.0 RHS – Grade C350, the serviceability load is:

$$W^*_S = 126 \text{ kN} \qquad (> 94.8 \text{ kN})$$

The most efficient and practical hollow sections for this application are RHS and SHS. The alternative sections which satisfy the above strength and serviceability limit states are listed below:

250 x 150 x 5.0 RHS – Grade C350	29.9 kg/m
200 x 200 x 6.0 SHS – Grade C350	35.6 kg/m

Therefore, based on mass, select 250 x 150 x 5.0 RHS – Grade C350.

2. A beam which is simply supported has a span of 6.0 metres with full lateral restraint. The beam is subjected to nominal central dead and short term live loads of 10 kN and 25 kN respectively. Design a suitable RHS in Grade C350 steel with no limit on deflection of span / 250.

<u>Solution:</u>

(1) Calculate equivalent uniformly distributed maximum design load for moment (W^*_{EM})

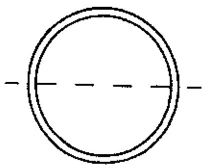
From Table 8.5 (W^*_{EM}) associated with the central dead and live loads is:

$$\begin{aligned} W^*_{EM} &= 2P \\ &= 2\,(1.25 \times 10 + 1.5 \times 25) \\ &= 100 \text{ kN} \end{aligned}$$

(2) Based on W^*_{EM} select a section with an adequate maximum design load (W^*_{L1}) based on design moment capacity

From Table 8.1–3(1)(A), a 250 x 150 x 5.0 RHS has adequate maximum design load (W^*_{L1} = 126 kN).

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT



CIRCULAR HOLLOW SECTIONS: GRADE C250

bending about any axis

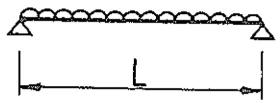


TABLE 8.1 – 1 (1)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	kN
610.0 x 12.7 CHS	187	8160	4080	2720	2040	1630	1360	1170	1020	906	816	680	583	510	3860
9.5 CHS	141	5880	2940	1960	1470	1180	980	840	735	654	588	490	420	368	2900
6.4 CHS	95.3	3590	1800	1200	898	718	599	513	449	399	359	299	257	224	1970
508.0 x 12.7 CHS	155	5610	2800	1870	1400	1120	935	801	701	623	561	467	401	351	3200
9.5 CHS	117	4200	2100	1400	1050	840	700	600	525	467	420	350	300	263	2410
6.4 CHS	79.2	2630	1310	875	656	525	438	375	328	292	263	219	188	164	1630

Notes: Refer to TABLE 8.1–1 (3)(A)

TABLE 8.1 – 1 (2)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
165.1 x 5.4 CHS	21.3	496	248	165	124	99.2	82.7	70.9	62.0	49.6	41.3	35.4	31.0	27.6	439
5.0 CHS	19.7	462	231	154	115	92.3	76.9	65.9	57.7	46.2	38.5	33.0	28.8	25.6	407
139.7 x 5.4 CHS	17.9	351	175	117	87.7	70.2	58.5	50.1	43.9	35.1	29.2	25.1	21.9	19.5	369
5.0 CHS	16.6	327	163	109	81.7	65.3	54.5	46.7	40.8	32.7	27.2	23.3	20.4	18.2	343
114.3 x 5.4 CHS	14.5	231	115	76.9	57.7	46.1	38.5	33.0	28.8	23.1	19.2	16.5	14.4	12.8	299
4.5 CHS	12.2	195	97.7	65.1	48.9	39.1	32.6	27.9	24.4	19.5	16.3	14.0	12.2	10.9	251
101.6 x 5.0 CHS	11.9	168	84.1	56.0	42.0	33.6	28.0	24.0	21.0	16.8	14.0	12.0	10.5	9.34	246
4.0 CHS	9.63	137	68.6	45.7	34.3	27.4	22.9	19.6	17.2	13.7	11.4	9.80	8.58	7.62	199
88.9 x 5.9 CHS	12.1	147	73.3	48.9	36.6	29.3	24.4	20.9	18.3	14.7	12.2	10.5	9.16	8.14	249
5.0 CHS	10.3	127	63.4	42.3	31.7	25.4	21.1	18.1	15.9	12.7	10.6	9.06	7.93	7.05	213
4.0 CHS	8.38	104	51.9	34.6	26.0	20.8	17.3	14.8	13.0	10.4	8.66	7.42	6.49	5.77	173
76.1 x 5.9 CHS	10.2	105	52.5	35.0	26.2	21.0	17.5	15.0	13.1	10.5	8.74	7.49	6.56	5.83	211
4.5 CHS	7.95	83.2	41.6	27.7	20.8	16.6	13.9	11.9	10.4	8.32	6.93	5.94	5.20	4.62	164
3.6 CHS	6.44	68.2	34.1	22.7	17.0	13.6	11.4	9.74	8.52	6.82	5.68	4.87	4.26	3.79	133

Notes: Refer to TABLE 8.1–1 (3)(A)

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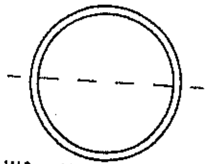
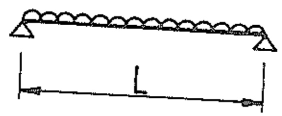
TABLE 8.1 – 1 (3)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT

CIRCULAR HOLLOW SECTIONS: GRADE C250

bending about any axis





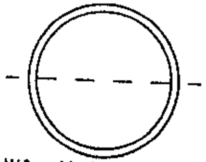
W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

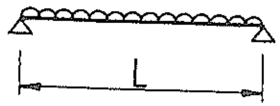
Designation d_o t	Mass per m	W^*_{L1} (kN)													W^*_{L2}
		Span of Beam (L) in metres													
mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	kN
76.1 x 5.9 CHS	10.2	210	105	69.9	52.5	42.0	35.0	30.0	26.2	21.0	17.5	15.0	13.1	10.5	211
4.5 CHS	7.95	166	83.2	55.4	41.6	33.3	27.7	23.8	20.8	16.6	13.9	11.9	10.4	8.32	164
3.6 CHS	6.44	136	68.2	45.5	34.1	27.3	22.7	19.5	17.0	13.6	11.4	9.74	8.52	6.82	133
60.3 x 5.4 CHS	7.31	118	58.8	39.2	29.4	23.5	19.6	16.8	14.7	11.8	9.80	8.40	7.35	5.88	151
4.5 CHS	6.19	101	50.6	33.7	25.3	20.2	16.9	14.4	12.6	10.1	8.43	7.22	6.32	5.06	128
3.6 CHS	5.03	83.4	41.7	27.8	20.9	16.7	13.9	11.9	10.4	8.34	6.95	5.96	5.22	4.17	104
48.3 x 5.4 CHS	5.71	71.9	36.0	24.0	18.0	14.4	12.0	10.3	8.99	7.19	5.99	5.14	4.50	3.60	118
4.0 CHS	4.37	56.7	28.3	18.9	14.2	11.3	9.45	8.10	7.08	5.67	4.72	4.05	3.54	2.83	90.2
3.2 CHS	3.56	46.9	23.5	15.6	11.7	9.39	7.82	6.71	5.87	4.69	3.91	3.35	2.93	2.35	73.4
42.4 x 4.9 CHS	4.53	49.9	24.9	16.6	12.5	9.98	8.32	7.13	6.24	4.99	4.16	3.56	3.12	2.49	93.5
4.0 CHS	3.79	42.6	21.3	14.2	10.7	8.52	7.10	6.09	5.33	4.26	3.55	3.04	2.66	2.13	78.2
3.2 CHS	3.09	35.5	17.7	11.8	8.87	7.10	5.91	5.07	4.44	3.55	2.96	2.53	2.22	1.77	63.8
33.7 x 4.5 CHS	3.24	27.8	13.9	9.28	6.96	5.57	4.64	3.98	3.48	2.78	2.32	1.99	1.74	1.39	66.9
4.0 CHS	2.93	25.6	12.8	8.52	6.39	5.11	4.26	3.65	3.19	2.56	2.13	1.83	1.60	1.28	60.5
3.2 CHS	2.41	21.5	10.8	7.17	5.38	4.30	3.59	3.07	2.69	2.15	1.79	1.54	1.34	1.08	49.7
26.9 x 4.0 CHS	2.26	15.3	7.63	5.09	3.81	3.05	2.54	2.18	1.91	1.53	1.27	1.09	0.954	0.763	46.6
3.2 CHS	1.87	13.0	6.51	4.34	3.25	2.60	2.17	1.86	1.63	1.30	1.08	0.930	0.814	0.651	38.6
2.6 CHS	1.56	11.1	5.55	3.70	2.77	2.22	1.85	1.59	1.39	1.11	0.925	0.793	0.694	0.555	32.2
21.3 x 3.6 CHS	1.57	8.23	4.12	2.74	2.06	1.65	1.37	1.18	1.03	0.823	0.686	0.588	0.515	0.412	32.4
3.2 CHS	1.43	7.63	3.81	2.54	1.91	1.53	1.27	1.09	0.953	0.763	0.636	0.545	0.477	0.381	29.5
2.6 CHS	1.20	6.59	3.29	2.20	1.65	1.32	1.10	0.941	0.824	0.659	0.549	0.471	0.412	0.329	24.7

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8\,\phi\,M_s\,/\,L$
5. $W^*_{L2} = 2\,\phi\,V_v$

TABLE 8.1 – 2 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis





W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t (mm × mm)	Mass per m (kg/m)	W^*_{L1} (kN), Span of Beam (L) in metres: 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	W^*_{L2} (kN)
457.0 x 12.7 CHS	139	6310	3160	2100	1580	1260	1050	902	789	701	631	526	451	394	4020
9.5 CHS	105	4520	2260	1510	1130	904	753	646	565	502	452	377	323	283	3030
6.4 CHS	71.1	2750	1370	916	687	550	458	393	343	305	275	229	196	172	2050
406.4 x 12.7 CHS	123	4960	2480	1650	1240	992	827	709	620	551	496	414	354	310	3560
9.5 CHS	93.0	3650	1820	1220	912	730	608	521	456	405	365	304	261	228	2690
6.4 CHS	63.1	2260	1130	752	564	451	376	322	282	251	226	188	161	141	1820
355.6 x 12.7 CHS	107	3760	1880	1250	941	753	627	538	471	418	376	314	269	235	3100
9.5 CHS	81.1	2850	1420	948	711	569	474	406	356	316	285	237	203	178	2340
6.4 CHS	55.1	1790	894	596	447	358	298	255	224	199	179	149	128	112	1590
323.9 x 12.7 CHS	97.5	3100	1550	1030	775	620	517	443	388	345	310	258	222	194	2820
9.5 CHS	73.7	2370	1180	789	592	473	395	338	296	263	237	197	169	148	2130
6.4 CHS	50.1	1510	757	505	379	303	252	216	189	168	151	126	108	94.7	1450
273.1 x 9.3 CHS	60.5	1630	816	544	408	326	272	233	204	181	163	136	117	102	1750
6.4 CHS	42.1	1110	555	370	278	222	185	159	139	123	111	92.5	79.3	69.4	1220
4.8 CHS	31.8	787	393	262	197	157	131	112	98.3	87.4	78.7	65.6	56.2	49.2	918
219.1 x 8.2 CHS	42.6	920	460	307	230	184	153	131	115	102	92.0	76.6	65.7	57.5	1230
6.4 CHS	33.6	730	365	243	182	146	122	104	91.2	81.1	73.0	60.8	52.1	45.6	970
4.8 CHS	25.4	530	265	177	133	106	88.3	75.7	66.3	58.9	53.0	44.2	37.9	33.1	733
168.3 x 7.1 CHS	28.2	465	233	155	116	93.0	77.5	66.5	58.2	51.7	46.5	38.8	33.2	29.1	815
6.4 CHS	25.6	423	211	141	106	84.6	70.5	60.4	52.9	47.0	42.3	35.2	30.2	26.4	738
4.8 CHS	19.4	323	162	108	80.9	64.7	53.9	46.2	40.4	35.9	32.3	27.0	23.1	20.2	559

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8\,\phi\,M_s / L$
5. $W^*_{L2} = 2\,\phi\,V_v$

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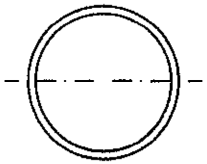
TABLE 8.1 – 2 (2)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS
FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

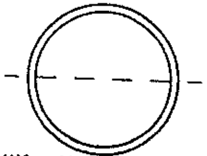
Designation d_o t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
168.3 x 7.1 CHS	28.2	930	465	310	233	186	155	133	116	93.0	77.5	66.5	58.2	51.7	815
6.4 CHS	25.6	846	423	282	211	169	141	121	106	84.6	70.5	60.4	52.9	47.0	738
4.8 CHS	19.4	647	323	216	162	129	108	92.4	80.9	64.7	53.9	46.2	40.4	35.9	559
165.1 x 3.5 CHS	13.9	436	218	145	109	87.3	72.7	62.3	54.5	43.6	36.4	31.2	27.3	24.2	403
3.0 CHS	12.0	362	181	121	90.6	72.4	60.4	51.7	45.3	36.2	30.2	25.9	22.6	20.1	346
139.7 x 3.5 CHS	11.8	321	160	107	80.2	64.2	53.5	45.8	40.1	32.1	26.7	22.9	20.1	17.8	340
3.0 CHS	10.1	268	134	89.5	67.1	53.7	44.7	38.3	33.6	26.8	22.4	19.2	16.8	14.9	292
114.3 x 6.0 CHS	16.0	355	178	118	88.8	71.0	59.2	50.7	44.4	35.5	29.6	25.4	22.2	19.7	463
4.8 CHS	13.0	290	145	96.8	72.6	58.1	48.4	41.5	36.3	29.0	24.2	20.7	18.1	16.1	374
3.6 CHS	9.83	222	111	74.1	55.6	44.5	37.1	31.8	27.8	22.2	18.5	15.9	13.9	12.4	284
3.2 CHS	8.77	199	99.6	66.4	49.8	39.8	33.2	28.4	24.9	19.9	16.6	14.2	12.4	11.1	253
101.6 x 3.2 CHS	7.77	156	78.1	52.1	39.1	31.2	26.0	22.3	19.5	15.6	13.0	11.2	9.76	8.68	224
2.6 CHS	6.35	126	63.2	42.1	31.6	25.3	21.1	18.1	15.8	12.6	10.5	9.03	7.90	7.02	183
88.9 x 5.5 CHS	11.3	193	96.5	64.4	48.3	38.6	32.2	27.6	24.1	19.3	16.1	13.8	12.1	10.7	327
4.8 CHS	9.96	171	85.6	57.1	42.8	34.3	28.5	24.5	21.4	17.1	14.3	12.2	10.7	9.52	288
3.2 CHS	6.76	119	59.3	39.5	29.6	23.7	19.8	16.9	14.8	11.9	9.88	8.46	7.41	6.58	195
2.6 CHS	5.53	97.6	48.8	32.5	24.4	19.5	16.3	13.9	12.2	9.76	8.14	6.97	6.10	5.42	160
76.1 x 3.2 CHS	5.75	85.8	42.9	28.6	21.4	17.2	14.3	12.3	10.7	8.58	7.15	6.13	5.36	4.76	166
2.3 CHS	4.19	63.2	31.6	21.1	15.8	12.6	10.5	9.02	7.89	6.32	5.26	4.51	3.95	3.51	121

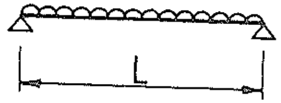
Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8 \phi M_s / L$
5. $W^*_{L2} = 2 \phi V_v$

@Seismicisolation

TABLE 8.1 – 2 (3)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis



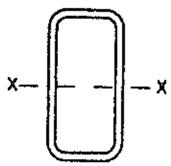


W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o (mm)	t (mm)	Mass per m (kg/m)	W^*_{L1} (kN), Span of Beam (L) in metres: 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	W^*_{L2} (kN)
76.1 x 3.2 CHS		5.75	172	85.8	57.2	42.9	34.3	28.6	24.5	21.4	17.2	14.3	12.3	10.7	8.58	166
	2.3 CHS	4.19	126	63.2	42.1	31.6	25.3	21.1	18.0	15.8	12.6	10.5	9.02	7.89	6.32	121
60.3 x 2.9 CHS		4.11	96.4	48.2	32.1	24.1	19.3	16.1	13.8	12.0	9.64	8.03	6.89	6.02	4.82	119
	2.3 CHS	3.29	78.0	39.0	26.0	19.5	15.6	13.0	11.1	9.75	7.80	6.50	5.57	4.88	3.90	95.0
48.3 x 2.9 CHS		3.25	60.3	30.2	20.1	15.1	12.1	10.1	8.62	7.54	6.03	5.03	4.31	3.77	3.02	93.8
	2.3 CHS	2.61	49.1	24.5	16.4	12.3	9.82	8.18	7.01	6.14	4.91	4.09	3.51	3.07	2.45	75.4
42.4 x 2.6 CHS		2.55	41.6	20.8	13.9	10.4	8.31	6.93	5.94	5.20	4.16	3.46	2.97	2.60	2.08	73.7
	2.0 CHS	1.99	32.9	16.5	11.0	8.23	6.59	5.49	4.70	4.12	3.29	2.74	2.35	2.06	1.65	57.6
33.7 x 2.6 CHS		1.99	25.4	12.7	8.47	6.35	5.08	4.23	3.63	3.18	2.54	2.12	1.81	1.59	1.27	57.6
	2.0 CHS	1.56	20.3	10.1	6.76	5.07	4.06	3.38	2.90	2.54	2.03	1.69	1.45	1.27	1.01	45.2
26.9 x 2.3 CHS		1.40	14.1	7.04	4.69	3.52	2.81	2.35	2.01	1.76	1.41	1.17	1.01	0.879	0.704	40.3
	2.0 CHS	1.23	12.5	6.26	4.18	3.13	2.51	2.09	1.79	1.57	1.25	1.04	0.895	0.783	0.626	35.5
21.3 x 2.0 CHS		0.952	7.54	3.77	2.51	1.88	1.51	1.26	1.08	0.942	0.754	0.628	0.538	0.471	0.377	27.5

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8 \phi M_s / L$
5. $W^*_{L2} = 2 \phi V_v$

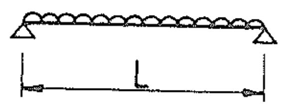
TABLE 8.1 – 3 (1)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x-axis

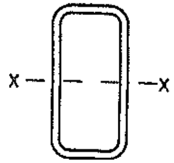


W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres														W_{L2}^*	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 150 x 9.0 RHS	51.8	1340	672	448	336	269	224	192	168	149	134	122	112	103	96.0	1520	15.6
6.0 RHS	35.6	943	471	314	236	189	157	135	118	105	94.3	85.7	78.6	72.5	67.4	1040	16.0
5.0 RHS	29.9	755	378	252	189	151	126	108	94.4	83.9	75.5	68.7	62.9	58.1	53.9	873	16.1
200 x 100 x 9.0 RHS	37.7	739	370	246	185	148	123	106	92.4	82.2	73.9	67.2	61.6	56.9	52.8	1180	8.55
6.0 RHS	26.2	530	265	177	132	106	88.3	75.7	66.2	58.8	53.0	48.1	44.1	40.7	37.8	812	8.86
5.0 RHS	22.1	452	226	151	113	90.3	75.3	64.5	56.5	50.2	45.2	41.1	37.6	34.7	32.3	684	8.96
4.0 RHS	17.9	370	185	123	92.4	73.9	61.6	52.8	46.2	41.1	37.0	33.6	30.8	28.4	26.4	553	9.06
150 x 100 x 6.0 RHS	21.4	339	169	113	84.6	67.7	56.4	48.4	42.3	37.6	33.9	30.8	28.2	26.0	24.2	606	11.4
5.0 RHS	18.2	290	145	96.7	72.5	58.0	48.3	41.4	36.3	32.2	29.0	26.4	24.2	22.3	20.7	512	11.6
4.0 RHS	14.8	238	119	79.5	59.6	47.7	39.7	34.1	29.8	26.5	23.8	21.7	19.9	18.3	17.0	416	11.7
150 x 50 x 5.0 RHS	14.2	199	99.4	66.2	49.7	39.7	33.1	28.4	24.8	22.1	19.9	18.1	16.6	15.3	14.2	492	2.93
4.0 RHS	11.6	165	82.4	55.0	41.2	33.0	27.5	23.6	20.6	18.3	16.5	15.0	13.7	12.7	11.8	399	3.00
3.0 RHS	8.96	130	64.8	43.2	32.4	25.9	21.6	18.5	16.2	14.4	13.0	11.8	10.8	9.97	9.26	304	3.07
125 x 75 x 6.0 RHS	16.7	212	106	70.7	53.1	42.4	35.4	30.3	26.5	23.6	21.2	19.3	17.7	16.3	15.2	493	7.62
5.0 RHS	14.2	183	91.7	61.1	45.8	36.7	30.6	26.2	22.9	20.4	18.3	16.7	15.3	14.1	13.1	418	7.75
4.0 RHS	11.6	152	75.9	50.6	38.0	30.4	25.3	21.7	19.0	16.9	15.2	13.8	12.7	11.7	10.8	340	7.87
3.0 RHS	8.96	119	59.5	39.7	29.8	23.8	19.8	17.0	14.9	13.2	11.9	10.8	9.92	9.16	8.51	260	8.00
100 x 50 x 6.0 RHS	12.0	114	57.1	38.1	28.6	22.9	19.0	16.3	14.3	12.7	11.4	10.4	9.52	8.79	8.16	380	4.12
5.0 RHS	10.3	100	50.1	33.4	25.0	20.0	16.7	14.3	12.5	11.1	10.0	9.11	8.35	7.71	7.16	324	4.23
4.0 RHS	8.49	84.2	42.1	28.1	21.0	16.8	14.0	12.0	10.5	9.35	8.42	7.65	7.02	6.48	6.01	265	4.33
3.5 RHS	7.53	75.4	37.7	25.1	18.9	15.1	12.6	10.8	9.43	8.38	7.54	6.86	6.29	5.80	5.39	234	4.38
3.0 RHS	6.60	67.2	33.6	22.4	16.8	13.4	11.2	9.60	8.40	7.46	6.72	6.11	5.60	5.17	4.80	203	4.44
2.5 RHS	5.56	57.1	28.6	19.0	14.3	11.4	9.52	8.16	7.14	6.35	5.71	5.19	4.76	4.39	4.08	171	4.49
2.0 RHS	4.50	46.6	23.3	15.5	11.7	9.33	7.77	6.66	5.83	5.18	4.66	4.24	3.89	3.59	3.33	138	4.53

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W_{L1}^* = 8 \phi M_s / L$
6. $W_{L2}^* = 2 \phi V_v$

TABLE 8.1 – 3 (2)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT

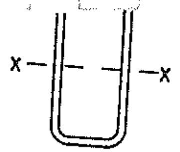
RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x–axis

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 6.0 RHS	12.0	229	152	114	91.4	76.2	65.3	57.1	45.7	38.1	32.6	28.6	25.4	22.9	19.0	380	4.12
5.0 RHS	10.3	200	134	100	80.2	66.8	57.3	50.1	40.1	33.4	28.6	25.0	22.3	20.0	16.7	324	4.23
4.0 RHS	8.49	168	112	84.2	67.4	56.1	48.1	42.1	33.7	28.1	24.1	21.0	18.7	16.8	14.0	265	4.33
3.5 RHS	7.53	151	101	75.4	60.4	50.3	43.1	37.7	30.2	25.1	21.6	18.9	16.8	15.1	12.6	234	4.38
3.0 RHS	6.60	134	89.6	67.2	53.7	44.8	38.4	33.6	26.9	22.4	19.2	16.8	14.9	13.4	11.2	203	4.44
2.5 RHS	5.56	114	76.2	57.1	45.7	38.1	32.6	28.6	22.9	19.0	16.3	14.3	12.7	11.4	9.52	171	4.49
2.0 RHS	4.50	93.3	62.2	46.6	37.3	31.1	26.6	23.3	18.7	15.5	13.3	11.7	10.4	9.33	7.77	138	4.53
75 x 50 x 6.0 RHS	9.67	141	94.3	70.7	56.6	47.1	40.4	35.4	28.3	23.6	20.2	17.7	15.7	14.1	11.8	277	5.28
5.0 RHS	8.35	125	83.6	62.7	50.2	41.8	35.8	31.4	25.1	20.9	17.9	15.7	13.9	12.5	10.5	238	5.43
4.0 RHS	6.92	107	71.0	53.3	42.6	35.5	30.4	26.6	21.3	17.8	15.2	13.3	11.8	10.7	8.88	196	5.57
3.0 RHS	5.42	86.1	57.4	43.1	34.4	28.7	24.6	21.5	17.2	14.4	12.3	10.8	9.57	8.61	7.18	151	5.73
2.5 RHS	4.58	73.5	49.0	36.8	29.4	24.5	21.0	18.4	14.7	12.3	10.5	9.19	8.17	7.35	6.13	128	5.79
2.0 RHS	3.72	60.3	40.2	30.1	24.1	20.1	17.2	15.1	12.1	10.0	8.61	7.53	6.70	6.03	5.02	104	5.86
75 x 25 x 2.5 RHS	3.60	50.7	33.8	25.4	20.3	16.9	14.5	12.7	10.1	8.45	7.24	6.34	5.63	5.07	4.23	123	1.47
2.0 RHS	2.93	41.9	27.9	20.9	16.8	14.0	12.0	10.5	8.38	6.98	5.98	5.23	4.65	4.19	3.49	99.9	1.50
1.6 RHS	2.38	34.3	22.9	17.2	13.7	11.4	9.81	8.59	6.87	5.72	4.91	4.29	3.82	3.43	2.86	80.8	1.53
65 x 35 x 3.0 RHS	4.25	55.4	36.9	27.7	22.2	18.5	15.8	13.8	11.1	9.23	7.91	6.92	6.16	5.54	4.62	128	3.23
2.5 RHS	3.60	47.6	31.8	23.8	19.1	15.9	13.6	11.9	9.53	7.94	6.81	5.96	5.29	4.76	3.97	108	3.28
2.0 RHS	2.93	39.3	26.2	19.7	15.7	13.1	11.2	9.83	7.86	6.55	5.62	4.91	4.37	3.93	3.28	88.2	3.33
50 x 25 x 3.0 RHS	3.07	29.5	19.7	14.8	11.8	9.85	8.44	7.39	5.91	4.92	4.22	3.69	3.28	2.95	2.46	95.0	2.08
2.5 RHS	2.62	25.7	17.2	12.9	10.3	8.58	7.35	6.43	5.15	4.29	3.68	3.22	2.86	2.57	2.14	81.0	2.12
2.0 RHS	2.15	21.5	14.3	10.7	8.59	7.16	6.14	5.37	4.30	3.58	3.07	2.69	2.39	2.15	1.79	66.2	2.17
1.6 RHS	1.75	17.8	11.8	8.88	7.11	5.92	5.08	4.44	3.55	2.96	2.54	2.22	1.97	1.78	1.48	53.9	2.21
50 x 20 x 3.0 RHS	2.83	26.0	17.3	13.0	10.4	8.66	7.43	6.50	5.20	4.33	3.71	3.25	2.89	2.60	2.17	93.8	1.31
2.5 RHS	2.42	22.7	15.2	11.4	9.10	7.58	6.50	5.68	4.55	3.79	3.25	2.84	2.53	2.27	1.89	80.0	1.35
2.0 RHS	1.99	19.1	12.7	9.53	7.63	6.35	5.45	4.77	3.81	3.18	2.72	2.38	2.12	1.91	1.59	65.4	1.39
1.6 RHS	1.63	15.8	10.5	7.91	6.33	5.27	4.52	3.95	3.16	2.64	2.26	1.98	1.76	1.58	1.32	53.2	1.42

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 8\,\phi\,M_s\,/\,L$
6. $W^*_{L2} = 2\,\phi\,V_v$



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR **SIMPLY SUPPORTED BEAMS** WITH FULL LATERAL RESTRAINT
RECTANGULAR HOLLOW SECTIONS: GRADE C450
bending about x-axis

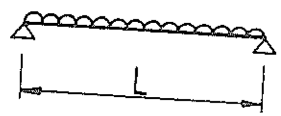


TABLE 8.1 – 4 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
125 x 75 x 3.8 RHS	11.1	187	93.4	62.3	46.7	37.4	31.1	26.7	23.3	20.8	18.7	17.0	15.6	14.4	13.3	417	6.14
3.3 RHS	9.73	165	82.5	55.0	41.3	33.0	27.5	23.6	20.6	18.3	16.5	15.0	13.8	12.7	11.8	365	6.19
2.8 RHS	8.39	136	67.8	45.2	33.9	27.1	22.6	19.4	16.9	15.1	13.6	12.3	11.3	10.4	9.68	313	6.24
2.3 RHS	6.95	98.0	49.0	32.7	24.5	19.6	16.3	14.0	12.3	10.9	9.80	8.91	8.17	7.54	7.00	259	6.29
100 x 50 x 3.3 RHS	7.14	92.3	46.2	30.8	23.1	18.5	15.4	13.2	11.5	10.3	9.23	8.39	7.69	7.10	6.59	285	3.42
2.8 RHS	6.19	81.3	40.6	27.1	20.3	16.3	13.5	11.6	10.2	9.03	8.13	7.39	6.77	6.25	5.81	245	3.47
2.3 RHS	5.14	68.1	34.1	22.7	17.0	13.6	11.4	9.73	8.52	7.57	6.81	6.19	5.68	5.24	4.87	203	3.50

Notes: Refer to TABLE 8.1–4 (2)(A)

TABLE 8.1 – 4 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 3.3 RHS	7.14	185	123	92.3	73.9	61.5	52.8	46.2	36.9	30.8	26.4	23.1	20.5	18.5	15.4	285	3.42
2.8 RHS	6.19	163	108	81.3	65.0	54.2	46.4	40.6	32.5	27.1	23.2	20.3	18.1	16.3	13.5	245	3.47
2.3 RHS	5.14	136	90.8	68.1	54.5	45.4	38.9	34.1	27.3	22.7	19.5	17.0	15.1	13.6	11.4	203	3.50
75 x 50 x 2.8 RHS	5.09	104	69.6	52.2	41.7	34.8	29.8	26.1	20.9	17.4	14.9	13.0	11.6	10.4	8.70	183	4.48
2.3 RHS	4.24	87.8	58.6	43.9	35.1	29.3	25.1	22.0	17.6	14.6	12.5	11.0	9.76	8.78	7.32	152	4.53
65 x 35 x 2.8 RHS	3.99	67.3	44.9	33.7	26.9	22.4	19.2	16.8	13.5	11.2	9.62	8.42	7.48	6.73	5.61	155	2.53
2.3 RHS	3.34	57.1	38.0	28.5	22.8	19.0	16.3	14.3	11.4	9.51	8.15	7.13	6.34	5.71	4.76	129	2.57
50 x 25 x 2.8 RHS	2.89	36.1	24.1	18.0	14.4	12.0	10.3	9.02	7.22	6.02	5.16	4.51	4.01	3.61	3.01	115	1.63
2.3 RHS	2.44	31.0	20.6	15.5	12.4	10.3	8.85	7.74	6.19	5.16	4.42	3.87	3.44	3.10	2.58	96.7	1.67
50 x 20 x 2.8 RHS	2.67	31.8	21.2	15.9	12.7	10.6	9.09	7.95	6.36	5.30	4.54	3.98	3.53	3.18	2.65	114	1.03
2.3 RHS	2.25	27.4	18.3	13.7	11.0	9.14	7.83	6.85	5.48	4.57	3.92	3.43	3.05	2.74	2.28	95.4	1.06

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W^*_{L1} = 8 \cdot \phi M_s / L$
6. $W^*_{L2} = 2 \phi V_v$

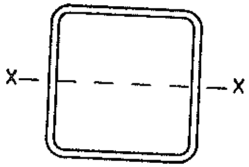
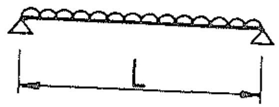


TABLE 8.1 – 5 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C350

bending about x–axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 250 x 9.0 SHS	65.9	1880	938	625	469	375	313	268	234	208	188	171	156	144	134	1560	41.8
6.0 SHS	45.0	1030	515	343	257	206	172	147	129	114	103	93.6	85.8	79.2	73.5	1070	42.4
200 x 200 x 9.0 SHS	51.8	1170	586	391	293	235	195	168	147	130	117	107	97.7	90.2	83.8	1220	33.0
6.0 SHS	35.6	740	370	247	185	148	123	106	92.5	82.2	74.0	67.3	61.7	56.9	52.9	842	33.7
5.0 SHS	29.9	561	280	187	140	112	93.4	80.1	70.1	62.3	56.1	51.0	46.7	43.1	40.0	709	33.9
150 x 150 x 9.0 SHS	37.7	625	313	208	156	125	104	89.4	78.2	69.5	62.5	56.9	52.1	48.1	44.7	887	24.3
6.0 SHS	26.2	447	224	149	112	89.5	74.6	63.9	55.9	49.7	44.7	40.7	37.3	34.4	32.0	618	24.9
5.0 SHS	22.1	364	182	121	91.0	72.8	60.7	52.0	45.5	40.5	36.4	33.1	30.3	28.0	26.0	523	25.2
125 x 125 x 9.0 SHS	30.6	416	208	139	104	83.1	69.3	59.4	52.0	46.2	41.6	37.8	34.6	32.0	29.7	719	19.9
6.0 SHS	21.4	302	151	101	75.6	60.4	50.4	43.2	37.8	33.6	30.2	27.5	25.2	23.2	21.6	506	20.6
5.0 SHS	18.2	259	129	86.3	64.7	51.8	43.2	37.0	32.4	28.8	25.9	23.5	21.6	19.9	18.5	429	20.8
4.0 SHS	14.8	199	99.4	66.2	49.7	39.7	33.1	28.4	24.8	22.1	19.9	18.1	16.6	15.3	14.2	349	21.0
100 x 100 x 9.0 SHS	23.5	248	124	82.8	62.1	49.7	41.4	35.5	31.0	27.6	24.8	22.6	20.7	19.1	17.7	551	15.5
6.0 SHS	16.7	185	92.7	61.8	46.3	37.1	30.9	26.5	23.2	20.6	18.5	16.8	15.4	14.3	13.2	394	16.2
5.0 SHS	14.2	160	80.0	53.3	40.0	32.0	26.7	22.9	20.0	17.8	16.0	14.5	13.3	12.3	11.4	336	16.4
4.0 SHS	11.6	133	66.3	44.2	33.1	26.5	22.1	18.9	16.6	14.7	13.3	12.1	11.0	10.2	9.47	275	16.6
3.0 SHS	8.96	93.5	46.8	31.2	23.4	18.7	15.6	13.4	11.7	10.4	9.35	8.50	7.79	7.19	6.68	211	16.9
89 x 89 x 6.0 SHS	14.6	143	71.3	47.5	35.6	28.5	23.8	20.4	17.8	15.8	14.3	13.0	11.9	11.0	10.2	345	14.2
5.0 SHS	12.5	124	61.9	41.2	30.9	24.7	20.6	17.7	15.5	13.7	12.4	11.2	10.3	9.52	8.84	295	14.5
3.5 SHS	9.06	91.9	45.9	30.6	23.0	18.4	15.3	13.1	11.5	10.2	9.19	8.35	7.66	7.07	6.56	214	14.8
75 x 75 x 6.0 SHS	12.0	96.8	48.4	32.3	24.2	19.4	16.1	13.8	12.1	10.8	9.68	8.80	8.07	7.45	6.91	282	11.8
5.0 SHS	10.3	84.8	42.4	28.3	21.2	17.0	14.1	12.1	10.6	9.42	8.48	7.71	7.07	6.52	6.06	243	12.0
4.0 SHS	8.49	71.2	35.6	23.7	17.8	14.2	11.9	10.2	8.90	7.91	7.12	6.47	5.93	5.48	5.08	200	12.2
3.5 SHS	7.53	63.8	31.9	21.3	15.9	12.8	10.6	9.11	7.97	7.08	6.38	5.80	5.31	4.90	4.55	178	12.4
3.0 SHS	6.60	56.7	28.3	18.9	14.2	11.3	9.44	8.09	7.08	6.30	5.67	5.15	4.72	4.36	4.05	155	12.5
2.5 SHS	5.56	46.0	23.0	15.3	11.5	9.20	7.67	6.57	5.75	5.11	4.60	4.18	3.83	3.54	3.29	131	12.6

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 8\,\phi\,M_s / L$
6. $W^*_{L2} = 2\,\phi\,V_v$

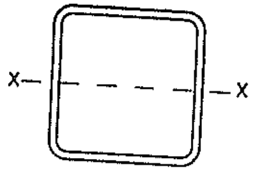
@Seismicisolation

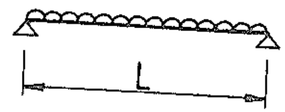
TABLE 8.1 – 5 (2)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C350

bending about x–axis



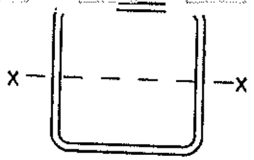


W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN)														W_{L2}^*	FLR
		Span of Beam (L) in metres															
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 6.0 SHS	12.0	194	129	96.8	77.4	64.5	55.3	48.4	38.7	32.3	27.7	24.2	21.5	19.4	16.1	282	11.8
5.0 SHS	10.3	170	113	84.8	67.8	56.5	48.4	42.4	33.9	28.3	24.2	21.2	18.8	17.0	14.1	243	12.0
4.0 SHS	8.49	142	94.9	71.2	56.9	47.5	40.7	35.6	28.5	23.7	20.3	17.8	15.8	14.2	11.9	200	12.2
3.5 SHS	7.53	128	85.0	63.8	51.0	42.5	36.4	31.9	25.5	21.3	18.2	15.9	14.2	12.8	10.6	178	12.4
3.0 SHS	6.60	113	75.6	56.7	45.3	37.8	32.4	28.3	22.7	18.9	16.2	14.2	12.6	11.3	9.44	155	12.5
2.5 SHS	5.56	92.0	61.4	46.0	36.8	30.7	26.3	23.0	18.4	15.3	13.1	11.5	10.2	9.20	7.67	131	12.6
65 x 65 x 6.0 SHS	10.1	139	92.4	69.3	55.5	46.2	39.6	34.7	27.7	23.1	19.8	17.3	15.4	13.9	11.6	237	10.0
5.0 SHS	8.75	123	81.7	61.3	49.0	40.9	35.0	30.6	24.5	20.4	17.5	15.3	13.6	12.3	10.2	205	10.3
4.0 SHS	7.23	104	69.2	51.9	41.5	34.6	29.7	26.0	20.8	17.3	14.8	13.0	11.5	10.4	8.65	170	10.5
3.0 SHS	5.66	83.5	55.7	41.8	33.4	27.8	23.9	20.9	16.7	13.9	11.9	10.4	9.28	8.35	6.96	132	10.8
2.5 SHS	4.78	71.3	47.5	35.6	28.5	23.8	20.4	17.8	14.3	11.9	10.2	8.91	7.92	7.13	5.94	112	10.9
2.0 SHS	3.88	53.3	35.6	26.7	21.3	17.8	15.2	13.3	10.7	8.89	7.62	6.67	5.93	5.33	4.44	91.1	11.0
50 x 50 x 5.0 SHS	6.39	66.3	44.2	33.2	26.5	22.1	18.9	16.6	13.3	11.1	9.47	8.29	7.37	6.63	5.53	149	7.61
4.0 SHS	5.35	57.4	38.2	28.7	22.9	19.1	16.4	14.3	11.5	9.56	8.19	7.17	6.37	5.74	4.78	125	7.85
3.0 SHS	4.25	47.3	31.5	23.7	18.9	15.8	13.5	11.8	9.46	7.89	6.76	5.91	5.26	4.73	3.94	98.6	8.13
2.5 SHS	3.60	40.7	27.1	20.3	16.3	13.6	11.6	10.2	8.14	6.78	5.81	5.09	4.52	4.07	3.39	84.0	8.24
2.0 SHS	2.93	33.6	22.4	16.8	13.4	11.2	9.59	8.39	6.72	5.60	4.80	4.20	3.73	3.36	2.80	68.7	8.34
1.6 SHS	2.38	25.7	17.1	12.9	10.3	8.57	7.35	6.43	5.14	4.29	3.67	3.21	2.86	2.57	2.14	55.9	8.42
40 x 40 x 4.0 SHS	4.09	33.9	22.6	17.0	13.6	11.3	9.70	8.49	6.79	5.66	4.85	4.24	3.77	3.39	2.83	95.6	6.09
3.0 SHS	3.30	28.8	19.2	14.4	11.5	9.62	8.24	7.21	5.77	4.81	4.12	3.61	3.21	2.88	2.40	76.2	6.38
2.5 SHS	2.82	25.0	16.7	12.5	10.0	8.34	7.15	6.26	5.01	4.17	3.58	3.13	2.78	2.50	2.09	65.3	6.48
2.0 SHS	2.31	20.8	13.9	10.4	8.33	6.94	5.95	5.21	4.17	3.47	2.98	2.60	2.31	2.08	1.74	53.8	6.59
1.6 SHS	1.88	17.2	11.5	8.60	6.88	5.73	4.91	4.30	3.44	2.87	2.46	2.15	1.91	1.72	1.43	44.0	6.67
35 x 35 x 3.0 SHS	2.83	21.3	14.2	10.7	8.53	7.10	6.09	5.33	4.26	3.55	3.04	2.66	2.37	2.13	1.78	65.0	5.50
2.5 SHS	2.42	18.6	12.4	9.31	7.45	6.21	5.32	4.66	3.72	3.10	2.66	2.33	2.07	1.86	1.55	56.0	5.61
2.0 SHS	1.99	15.6	10.4	7.80	6.24	5.20	4.46	3.90	3.12	2.60	2.23	1.95	1.73	1.56	1.30	46.3	5.71
1.6 SHS	1.63	12.9	8.62	6.47	5.17	4.31	3.70	3.23	2.59	2.16	1.85	1.62	1.44	1.29	1.08	38.0	5.80
30 x 30 x 3.0 SHS	2.36	14.9	9.94	7.46	5.97	4.97	4.26	3.73	2.98	2.49	2.13	1.86	1.66	1.49	1.24	53.8	4.63
2.5 SHS	2.03	13.2	8.77	6.58	5.26	4.38	3.76	3.29	2.63	2.19	1.88	1.64	1.46	1.32	1.10	46.7	4.73
2.0 SHS	1.68	11.1	7.41	5.56	4.45	3.70	3.18	2.78	2.22	1.85	1.59	1.39	1.23	1.11	0.926	38.8	4.84
1.6 SHS	1.38	9.28	6.19	4.64	3.71	3.09	2.65	2.32	1.86	1.55	1.33	1.16	1.03	0.928	0.773	32.0	4.92
25 x 25 x 3.0 SHS	1.89	9.65	6.43	4.83	3.86	3.22	2.76	2.41	1.93	1.61	1.38	1.21	1.07	0.965	0.804	42.6	3.75
2.5 SHS	1.64	8.63	5.75	4.32	3.45	2.88	2.47	2.16	1.73	1.44	1.23	1.08	0.959	0.863	0.719	37.3	3.85
2.0 SHS	1.36	7.39	4.93	3.69	2.96	2.46	2.11	1.85	1.48	1.23	1.06	0.924	0.821	0.739	0.616	31.4	3.96
1.6 SHS	1.12	6.23	4.15	3.11	2.49	2.08	1.78	1.56	1.25	1.04	0.890	0.779	0.692	0.623	0.519	26.0	4.04
20 x 20 x 1.6 SHS	0.873	3.78	2.52	1.89	1.51	1.26	1.08	0.946	0.757	0.631	0.540	0.473	0.420	0.378	0.315	20.1	3.17

Note: Refer to TABLE 8.1–5 (1)(A)

@Seismicisolation



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS
FOR SIMPLY SUPPORTED BEAMS WITH FULL LATERAL RESTRAINT
SQUARE HOLLOW SECTIONS: GRADE C450
bending about x-axis

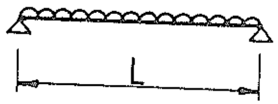


TABLE 8.1 – 6 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
100 x 100 x 3.8 SHS	11.1	157	78.3	52.2	39.2	31.3	26.1	22.4	19.6	17.4	15.7	14.2	13.1	12.0	11.2	337	13.0
3.3 SHS	9.73	127	63.7	42.4	31.8	25.5	21.2	18.2	15.9	14.1	12.7	11.6	10.6	9.80	9.10	296	13.1
2.8 SHS	8.39	100	50.1	33.4	25.1	20.1	16.7	14.3	12.5	11.1	10.0	9.12	8.36	7.71	7.16	254	13.2
2.3 SHS	6.95	74.8	37.4	24.9	18.7	15.0	12.5	10.7	9.34	8.31	7.48	6.80	6.23	5.75	5.34	211	13.2
75 x 75 x 3.3 SHS	7.14	78.0	39.0	26.0	19.5	15.6	13.0	11.1	9.75	8.67	7.80	7.09	6.50	6.00	5.57	217	9.65
2.8 SHS	6.19	65.3	32.6	21.8	16.3	13.1	10.9	9.32	8.16	7.25	6.53	5.93	5.44	5.02	4.66	187	9.76
2.3 SHS	5.14	52.5	26.3	17.5	13.1	10.5	8.75	7.50	6.56	5.83	5.25	4.77	4.38	4.04	3.75	155	9.84

Notes: Refer to TABLE 8.1–5 (1)(A)

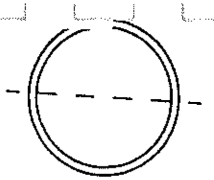
TABLE 8.1 – 6 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 3.3 SHS	7.14	156	104	78.0	62.4	52.0	44.6	39.0	31.2	26.0	22.3	19.5	17.3	15.6	13.0	217	9.65
2.8 SHS	6.19	131	87.0	65.3	52.2	43.5	37.3	32.6	26.1	21.8	18.6	16.3	14.5	13.1	10.9	187	9.76
2.3 SHS	5.14	97.1	64.7	48.6	38.8	32.4	27.7	24.3	19.4	16.2	13.9	12.1	10.8	9.71	8.09	155	9.84
65 x 65 x 2.8 SHS	5.31	101	67.5	50.6	40.5	33.7	28.9	25.3	20.2	16.9	14.5	12.6	11.2	10.1	8.43	160	8.40
2.3 SHS	4.42	78.6	52.4	39.3	31.4	26.2	22.5	19.6	15.7	13.1	11.2	9.82	8.73	7.86	6.55	133	8.48
50 x 50 x 2.8 SHS	3.99	57.5	38.3	28.8	23.0	19.2	16.4	14.4	11.5	9.58	8.21	7.19	6.39	5.75	4.79	119	6.36
2.3 SHS	3.34	48.7	32.5	24.4	19.5	16.2	13.9	12.2	9.75	8.12	6.96	6.09	5.42	4.87	4.06	100	6.44
40 x 40 x 2.8 SHS	3.11	35.2	23.5	17.6	14.1	11.7	10.1	8.80	7.04	5.86	5.03	4.40	3.91	3.52	2.93	92.5	4.99
2.3 SHS	2.62	30.1	20.1	15.0	12.0	10.0	8.60	7.52	6.02	5.01	4.30	3.76	3.34	3.01	2.51	78.2	5.08
35 x 35 x 2.8 SHS	2.67	26.1	17.4	13.0	10.4	8.69	7.45	6.52	5.21	4.34	3.72	3.26	2.90	2.61	2.17	79.0	4.31
2.3 SHS	2.25	22.4	15.0	11.2	8.98	7.48	6.41	5.61	4.49	3.74	3.21	2.80	2.49	2.24	1.87	67.1	4.39
30 x 30 x 2.8 SHS	2.23	18.3	12.2	9.16	7.33	6.10	5.23	4.58	3.66	3.05	2.62	2.29	2.03	1.83	1.53	65.6	3.63
2.3 SHS	1.89	15.9	10.6	7.95	6.36	5.30	4.54	3.98	3.18	2.65	2.27	1.99	1.77	1.59	1.33	56.1	3.71
25 x 25 x 2.3 SHS	1.53	10.5	7.00	5.25	4.20	3.50	3.00	2.62	2.10	1.75	1.50	1.31	1.17	1.05	0.87	45.0	3.03

Notes: Refer to TABLE 8.1–5 (1)(A)

@Seismicisolation



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT

CIRCULAR HOLLOW SECTIONS: GRADE C250

bending about any axis

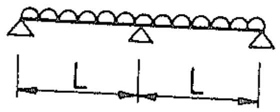


TABLE 8.2 – 1 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t (mm × mm)	Mass per m (kg/m)	W^*_{L1} (kN), Span of Beam (L) in metres: 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	W^*_{L2} (kN)
610.0 x 12.7 CHS	187	8160	4080	2720	2040	1630	1360	1170	1020	906	816	680	583	510	3090
9.5 CHS	141	5880	2940	1960	1470	1180	980	840	735	654	588	490	420	368	2320
6.4 CHS	95.3	3590	1800	1200	898	718	599	513	449	399	359	299	257	224	1570
508.0 x 12.7 CHS	155	5610	2800	1870	1400	1120	935	801	701	623	561	467	401	351	2560
9.5 CHS	117	4200	2100	1400	1050	840	700	600	525	467	420	350	300	263	1930
6.4 CHS	79.2	2630	1310	875	656	525	438	375	328	292	263	219	188	164	1310

Notes: Refer to TABLE 8.2–1 (3)(A)

TABLE 8.2 – 1 (2)(A)

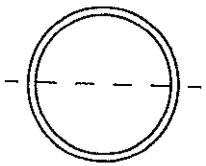
W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t (mm × mm)	Mass per m (kg/m)	W^*_{L1} (kN), Span of Beam (L) in metres: 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	W^*_{L2} (kN)
165.1 x 5.4 CHS	21.3	496	248	165	124	99.2	82.7	70.9	62.0	49.6	41.3	35.4	31.0	27.6	351
5.0 CHS	19.7	462	231	154	115	92.3	76.9	65.9	57.7	46.2	38.5	33.0	28.8	25.6	326
139.7 x 5.4 CHS	17.9	351	175	117	87.7	70.2	58.5	50.1	43.9	35.1	29.2	25.1	21.9	19.5	295
5.0 CHS	16.6	327	163	109	81.7	65.3	54.5	46.7	40.8	32.7	27.2	23.3	20.4	18.2	274
114.3 x 5.4 CHS	14.5	231	115	76.9	57.7	46.1	38.5	33.0	28.8	23.1	19.2	16.5	14.4	12.8	239
4.5 CHS	12.2	195	97.7	65.1	48.9	39.1	32.6	27.9	24.4	19.5	16.3	14.0	12.2	10.9	201
101.6 x 5.0 CHS	11.9	168	84.1	56.0	42.0	33.6	28.0	24.0	21.0	16.8	14.0	12.0	10.5	9.34	197
4.0 CHS	9.63	137	68.6	45.7	34.3	27.4	22.9	19.6	17.2	13.7	11.4	9.80	8.58	7.62	159
88.9 x 5.9 CHS	12.1	147	73.3	48.9	36.6	29.3	24.4	20.9	18.3	14.7	12.2	10.5	9.16	8.14	199
5.0 CHS	10.3	127	63.4	42.3	31.7	25.4	21.1	18.1	15.9	12.7	10.6	9.06	7.93	7.05	171
4.0 CHS	8.38	104	51.9	34.6	26.0	20.8	17.3	14.8	13.0	10.4	8.66	7.42	6.49	5.77	138
76.1 x 5.9 CHS	10.2	105	52.5	35.0	26.2	21.0	17.5	15.0	13.1	10.5	8.74	7.49	6.56	5.83	169
4.5 CHS	7.95	83.2	41.6	27.7	20.8	16.6	13.9	11.9	10.4	8.32	6.93	5.94	5.20	4.62	131
3.6 CHS	6.44	68.2	34.1	22.7	17.0	13.6	11.4	9.74	8.52	6.82	5.68	4.87	4.26	3.79	106

Notes: Refer to TABLE 8.2–1 (3)(A)

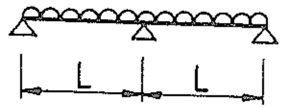
@Seismicisolation

TABLE 8.2 – 1 (3)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT CIRCULAR HOLLOW SECTIONS: GRADE C250

bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t (mm × mm)	Mass per m (kg/m)	W^*_{L1} (kN), Span of Beam (L) in metres: 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	W^*_{L2} (kN)
76.1 x 5.9 CHS	10.2	210	105	69.9	52.5	42.0	35.0	30.0	26.2	21.0	17.5	15.0	13.1	10.5	169
4.5 CHS	7.95	166	83.2	55.4	41.6	33.3	27.7	23.8	20.8	16.6	13.9	11.9	10.4	8.32	131
3.6 CHS	6.44	136	68.2	45.5	34.1	27.3	22.7	19.5	17.0	13.6	11.4	9.74	8.52	6.82	106
60.3 x 5.4 CHS	7.31	118	58.8	39.2	29.4	23.5	19.6	16.8	14.7	11.8	9.80	8.40	7.35	5.88	121
4.5 CHS	6.19	101	50.6	33.7	25.3	20.2	16.9	14.4	12.6	10.1	8.43	7.22	6.32	5.06	102
3.6 CHS	5.03	83.4	41.7	27.8	20.9	16.7	13.9	11.9	10.4	8.34	6.95	5.96	5.22	4.17	83.1
48.3 x 5.4 CHS	5.71	71.9	36.0	24.0	18.0	14.4	12.0	10.3	8.99	7.19	5.99	5.14	4.50	3.60	94.3
4.0 CHS	4.37	56.7	28.3	18.9	14.2	11.3	9.45	8.10	7.08	5.67	4.72	4.05	3.54	2.83	72.1
3.2 CHS	3.56	46.9	23.5	15.6	11.7	9.39	7.82	6.71	5.87	4.69	3.91	3.35	2.93	2.35	58.8
42.4 x 4.9 CHS	4.53	49.9	24.9	16.6	12.5	9.98	8.32	7.13	6.24	4.99	4.16	3.56	3.12	2.49	74.8
4.0 CHS	3.79	42.6	21.3	14.2	10.7	8.52	7.10	6.09	5.33	4.26	3.55	3.04	2.66	2.13	62.5
3.2 CHS	3.09	35.5	17.7	11.8	8.87	7.10	5.91	5.07	4.44	3.55	2.96	2.53	2.22	1.77	51.1
33.7 x 4.5 CHS	3.24	27.8	13.9	9.28	6.96	5.57	4.64	3.98	3.48	2.78	2.32	1.99	1.74	1.39	53.5
4.0 CHS	2.93	25.6	12.8	8.52	6.39	5.11	4.26	3.65	3.19	2.56	2.13	1.83	1.60	1.28	48.4
3.2 CHS	2.41	21.5	10.8	7.17	5.38	4.30	3.59	3.07	2.69	2.15	1.79	1.54	1.34	1.08	39.7
26.9 x 4.0 CHS	2.26	15.3	7.63	5.09	3.81	3.05	2.54	2.18	1.91	1.53	1.27	1.09	0.954	0.763	37.3
3.2 CHS	1.87	13.0	6.51	4.34	3.25	2.60	2.17	1.86	1.63	1.30	1.08	0.930	0.814	0.651	30.9
2.6 CHS	1.56	11.1	5.55	3.70	2.77	2.22	1.85	1.59	1.39	1.11	0.925	0.793	0.694	0.555	25.7
21.3 x 3.6 CHS	1.57	8.23	4.12	2.74	2.06	1.65	1.37	1.18	1.03	0.823	0.686	0.588	0.515	0.412	25.9
3.2 CHS	1.43	7.63	3.81	2.54	1.91	1.53	1.27	1.09	0.953	0.763	0.636	0.545	0.477	0.381	23.6

Notes:
1. ϕ = 0.9
2. α_m = 1.0
3. α_s = 1.0
4. $W^*_{L1} = 8 \phi M_s / L$
5. $W^*_{L2} = 1.6 \phi V_v$

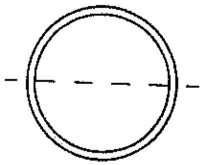
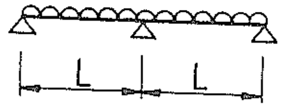


TABLE 8.2 – 2 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

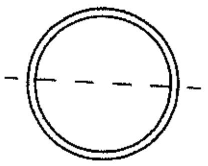
Designation d_o mm	t mm	Mass per m kg/m	W^*_{L1} (kN), Span of Beam (L) in metres: 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	W^*_{L2} kN
457.0 x	12.7 CHS	139	6310	3160	2100	1580	1260	1050	902	789	701	631	526	451	394	3220
	9.5 CHS	105	4520	2260	1510	1130	904	753	646	565	502	452	377	323	283	2420
	6.4 CHS	71.1	2750	1370	916	687	550	458	393	343	305	275	229	196	172	1640
406.4 x	12.7 CHS	123	4960	2480	1650	1240	992	827	709	620	551	496	414	354	310	2850
	9.5 CHS	93.0	3650	1820	1220	912	730	608	521	456	405	365	304	261	228	2150
	6.4 CHS	63.1	2260	1130	752	564	451	376	322	282	251	226	188	161	141	1460
355.6 x	12.7 CHS	107	3760	1880	1250	941	753	627	538	471	418	376	314	269	235	2480
	9.5 CHS	81.1	2850	1420	948	711	569	474	406	356	316	285	237	203	178	1870
	6.4 CHS	55.1	1790	894	596	447	358	298	255	224	199	179	149	128	112	1270
323.9 x	12.7 CHS	97.5	3100	1550	1030	775	620	517	443	388	345	310	258	222	194	2250
	9.5 CHS	73.7	2370	1180	789	592	473	395	338	296	263	237	197	169	148	1700
	6.4 CHS	50.1	1510	757	505	379	303	252	216	189	168	151	126	108	94.7	1160
273.1 x	9.3 CHS	60.5	1630	816	544	408	326	272	233	204	181	163	136	117	102	1400
	6.4 CHS	42.1	1110	555	370	278	222	185	159	139	123	111	92.5	79.3	69.4	973
	4.8 CHS	31.8	787	393	262	197	157	131	112	98.3	87.4	78.7	65.6	56.2	49.2	734
219.1 x	8.2 CHS	42.6	920	460	307	230	184	153	131	115	102	92.0	76.6	65.7	57.5	986
	6.4 CHS	33.6	730	365	243	182	146	122	104	91.2	81.1	73.0	60.8	52.1	45.6	776
	4.8 CHS	25.4	530	265	177	133	106	88.3	75.7	66.3	58.9	53.0	44.2	37.9	33.1	586
168.3 x	7.1 CHS	28.2	465	233	155	116	93.0	77.5	66.5	58.2	51.7	46.5	38.8	33.2	29.1	652
	6.4 CHS	25.6	423	211	141	106	84.6	70.5	60.4	52.9	47.0	42.3	35.2	30.2	26.4	591
	4.8 CHS	19.4	323	162	108	80.9	64.7	53.9	46.2	40.4	35.9	32.3	27.0	23.1	20.2	447

Notes:
1. ϕ = 0.9
2. α_m = 1.0
3. α_s = 1.0
4. $W^*_{L1} = 8 \phi M_s / L$
5. $W^*_{L2} = 1.6 \phi V_v$

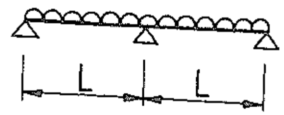
@Seismicisolation

@Seismicisolation

TABLE 8.2 – 2 (2)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis

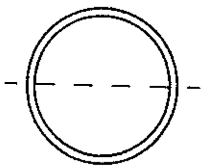


W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

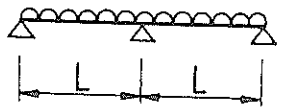
Designation d_o t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
168.3 x 7.1 CHS	28.2	930	465	310	233	186	155	133	116	93.0	77.5	66.5	58.2	51.7	652
6.4 CHS	25.6	846	423	282	211	169	141	121	106	84.6	70.5	60.4	52.9	47.0	591
4.8 CHS	19.4	647	323	216	162	129	108	92.4	80.9	64.7	53.9	46.2	40.4	35.9	447
165.1 x 3.5 CHS	13.9	436	218	145	109	87.3	72.7	62.3	54.5	43.6	36.4	31.2	27.3	24.2	322
3.0 CHS	12.0	362	181	121	90.6	72.4	60.4	51.7	45.3	36.2	30.2	25.9	22.6	20.1	277
139.7 x 3.5 CHS	11.8	321	160	107	80.2	64.2	53.5	45.8	40.1	32.1	26.7	22.9	20.1	17.8	272
3.0 CHS	10.1	268	134	89.5	67.1	53.7	44.7	38.3	33.6	26.8	22.4	19.2	16.8	14.9	234
114.3 x 6.0 CHS	16.0	355	178	118	88.8	71.0	59.2	50.7	44.4	35.5	29.6	25.4	22.2	19.7	370
4.8 CHS	13.0	290	145	96.8	72.6	58.1	48.4	41.5	36.3	29.0	24.2	20.7	18.1	16.1	300
3.6 CHS	9.83	222	111	74.1	55.6	44.5	37.1	31.8	27.8	22.2	18.5	15.9	13.9	12.4	227
3.2 CHS	8.77	199	99.6	66.4	49.8	39.8	33.2	28.4	24.9	19.9	16.6	14.2	12.4	11.1	203
101.6 x 3.2 CHS	7.77	156	78.1	52.1	39.1	31.2	26.0	22.3	19.5	15.6	13.0	11.2	9.76	8.68	179
2.6 CHS	6.35	126	63.2	42.1	31.6	25.3	21.1	18.1	15.8	12.6	10.5	9.03	7.90	7.02	147
88.9 x 5.5 CHS	11.3	193	96.5	64.4	48.3	38.6	32.2	27.6	24.1	19.3	16.1	13.8	12.1	10.7	261
4.8 CHS	9.96	171	85.6	57.1	42.8	34.3	28.5	24.5	21.4	17.1	14.3	12.2	10.7	9.52	230
3.2 CHS	6.76	119	59.3	39.5	29.6	23.7	19.8	16.9	14.8	11.9	9.88	8.46	7.41	6.58	156
2.6 CHS	5.53	97.6	48.8	32.5	24.4	19.5	16.3	13.9	12.2	9.76	8.14	6.97	6.10	5.42	128
76.1 x 3.2 CHS	5.75	85.8	42.9	28.6	21.4	17.2	14.3	12.3	10.7	8.58	7.15	6.13	5.36	4.76	133
2.3 CHS	4.19	63.2	31.6	21.1	15.8	12.6	10.5	9.02	7.89	6.32	5.26	4.51	3.95	3.51	96.8

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8\,\phi\,M_s / L$
5. $W^*_{L2} = 1.6\,\phi\,V_v$

TABLE 8.2 – 2 (3)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR **CONTINUOUS BEAMS** WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

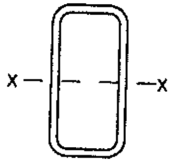
Designation d_o t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	kN
76.1 x 3.2 CHS	5.75	172	85.8	57.2	42.9	34.3	28.6	24.5	21.4	17.2	14.3	12.3	10.7	8.58	133
2.3 CHS	4.19	126	63.2	42.1	31.6	25.3	21.1	18.0	15.8	12.6	10.5	9.02	7.89	6.32	96.8
60.3 x 2.9 CHS	4.11	96.4	48.2	32.1	24.1	19.3	16.1	13.8	12.0	9.64	8.03	6.89	6.02	4.82	94.9
2.3 CHS	3.29	78.0	39.0	26.0	19.5	15.6	13.0	11.1	9.75	7.80	6.50	5.57	4.88	3.90	76.0
48.3 x 2.9 CHS	3.25	60.3	30.2	20.1	15.1	12.1	10.1	8.62	7.54	6.03	5.03	4.31	3.77	3.02	75.0
2.3 CHS	2.61	49.1	24.5	16.4	12.3	9.82	8.18	7.01	6.14	4.91	4.09	3.51	3.07	2.45	60.3
42.4 x 2.6 CHS	2.55	41.6	20.8	13.9	10.4	8.31	6.93	5.94	5.20	4.16	3.46	2.97	2.60	2.08	59.0
2.0 CHS	1.99	32.9	16.5	11.0	8.23	6.59	5.49	4.70	4.12	3.29	2.74	2.35	2.06	1.65	46.1
33.7 x 2.6 CHS	1.99	25.4	12.7	8.47	6.35	5.08	4.23	3.63	3.18	2.54	2.12	1.81	1.59	1.27	46.1
2.0 CHS	1.56	20.3	10.1	6.76	5.07	4.06	3.38	2.90	2.54	2.03	1.69	1.45	1.27	1.01	36.1
26.9 x 2.3 CHS	1.40	14.1	7.04	4.69	3.52	2.81	2.35	2.01	1.76	1.41	1.17	1.01	0.879	0.704	32.3
2.0 CHS	1.23	12.5	6.26	4.18	3.13	2.51	2.09	1.79	1.57	1.25	1.04	0.895	0.783	0.626	28.4
21.3 x 2.0 CHS	0.952	7.54	3.77	2.51	1.88	1.51	1.26	1.08	0.942	0.754	0.628	0.538	0.471	0.377	22.0

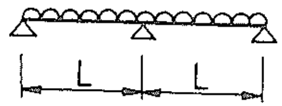
Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 8 \phi M_s / L$
5. $W^*_{L2} = 1.6 \phi V_v$

TABLE 8.2 – 3 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350 bending about x–axis





W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
		1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0		
mm mm mm	kg/m															kN	m
250 x 150 x 9.0 RHS	51.8	1340	672	448	336	269	224	192	168	149	134	122	112	103	96.0	1220	15.6
6.0 RHS	35.6	943	471	314	236	189	157	135	118	105	94.3	85.7	78.6	72.5	67.4	831	16.0
5.0 RHS	29.9	755	378	252	189	151	126	108	94.4	83.9	75.5	68.7	62.9	58.1	53.9	698	16.1
200 x 100 x 9.0 RHS	37.7	739	370	246	185	148	123	106	92.4	82.2	73.9	67.2	61.6	56.9	52.8	943	8.55
6.0 RHS	26.2	530	265	177	132	106	88.3	75.7	66.2	58.8	53.0	48.1	44.1	40.7	37.8	650	8.86
5.0 RHS	22.1	452	226	151	113	90.3	75.3	64.5	56.5	50.2	45.2	41.1	37.6	34.7	32.3	547	8.96
4.0 RHS	17.9	370	185	123	92.4	73.9	61.6	52.8	46.2	41.1	37.0	33.6	30.8	28.4	26.4	442	9.06
150 x 100 x 6.0 RHS	21.4	339	169	113	84.6	67.7	56.4	48.4	42.3	37.6	33.9	30.8	28.2	26.0	24.2	485	11.4
5.0 RHS	18.2	290	145	96.7	72.5	58.0	48.3	41.4	36.3	32.2	29.0	26.4	24.2	22.3	20.7	410	11.6
4.0 RHS	14.8	238	119	79.5	59.6	47.7	39.7	34.1	29.8	26.5	23.8	21.7	19.9	18.3	17.0	332	11.7
150 x 50 x 5.0 RHS	14.2	199	99.4	66.2	49.7	39.7	33.1	28.4	24.8	22.1	19.9	18.1	16.6	15.3	14.2	394	2.93
4.0 RHS	11.6	165	82.4	55.0	41.2	33.0	27.5	23.6	20.6	18.3	16.5	15.0	13.7	12.7	11.8	320	3.00
3.0 RHS	8.96	130	64.8	43.2	32.4	25.9	21.6	18.5	16.2	14.4	13.0	11.8	10.8	9.97	9.26	243	3.07
125 x 75 x 6.0 RHS	16.7	212	106	70.7	53.1	42.4	35.4	30.3	26.5	23.6	21.2	19.3	17.7	16.3	15.2	395	7.62
5.0 RHS	14.2	183	91.7	61.1	45.8	36.7	30.6	26.2	22.9	20.4	18.3	16.7	15.3	14.1	13.1	335	7.75
4.0 RHS	11.6	152	75.9	50.6	38.0	30.4	25.3	21.7	19.0	16.9	15.2	13.8	12.7	11.7	10.8	272	7.87
3.0 RHS	8.96	119	59.5	39.7	29.8	23.8	19.8	17.0	14.9	13.2	11.9	10.8	9.92	9.16	8.51	208	8.00
100 x 50 x 6.0 RHS	12.0	114	57.1	38.1	28.6	22.9	19.0	16.3	14.3	12.7	11.4	10.4	9.52	8.79	8.16	304	4.12
5.0 RHS	10.3	100	50.1	33.4	25.0	20.0	16.7	14.3	12.5	11.1	10.0	9.11	8.35	7.71	7.16	259	4.23
4.0 RHS	8.49	84.2	42.1	28.1	21.0	16.8	14.0	12.0	10.5	9.35	8.42	7.65	7.02	6.48	6.01	212	4.33
3.5 RHS	7.53	75.4	37.7	25.1	18.9	15.1	12.6	10.8	9.43	8.38	7.54	6.86	6.29	5.80	5.39	187	4.38
3.0 RHS	6.60	67.2	33.6	22.4	16.8	13.4	11.2	9.60	8.40	7.46	6.72	6.11	5.60	5.17	4.80	162	4.44
2.5 RHS	5.56	57.1	28.6	19.0	14.3	11.4	9.52	8.16	7.14	6.35	5.71	5.19	4.76	4.39	4.08	137	4.49
2.0 RHS	4.50	46.6	23.3	15.5	11.7	9.33	7.77	6.66	5.83	5.18	4.66	4.24	3.89	3.59	3.33	111	4.53

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 8\,\phi\,M_s / L$
6. $W^*_{L2} = 1.6\,\phi\,V_v$

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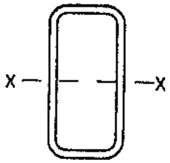
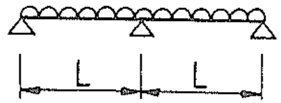
TABLE 8.2 – 3 (2)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x–axis





W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 6.0 RHS	12.0	229	152	114	91.4	76.2	65.3	57.1	45.7	38.1	32.6	28.6	25.4	22.9	19.0	304	4.12
5.0 RHS	10.3	200	134	100	80.2	66.8	57.3	50.1	40.1	33.4	28.6	25.0	22.3	20.0	16.7	259	4.23
4.0 RHS	8.49	168	112	84.2	67.4	56.1	48.1	42.1	33.7	28.1	24.1	21.0	18.7	16.8	14.0	212	4.33
3.5 RHS	7.53	151	101	75.4	60.4	50.3	43.1	37.7	30.2	25.1	21.6	18.9	16.8	15.1	12.6	187	4.38
3.0 RHS	6.60	134	89.6	67.2	53.7	44.8	38.4	33.6	26.9	22.4	19.2	16.8	14.9	13.4	11.2	162	4.44
2.5 RHS	5.56	114	76.2	57.1	45.7	38.1	32.6	28.6	22.9	19.0	16.3	14.3	12.7	11.4	9.52	137	4.49
2.0 RHS	4.50	93.3	62.2	46.6	37.3	31.1	26.6	23.3	18.7	15.5	13.3	11.7	10.4	9.33	7.77	111	4.53
75 x 50 x 6.0 RHS	9.67	141	94.3	70.7	56.6	47.1	40.4	35.4	28.3	23.6	20.2	17.7	15.7	14.1	11.8	221	5.28
5.0 RHS	8.35	125	83.6	62.7	50.2	41.8	35.8	31.4	25.1	20.9	17.9	15.7	13.9	12.5	10.5	190	5.43
4.0 RHS	6.92	107	71.0	53.3	42.6	35.5	30.4	26.6	21.3	17.8	15.2	13.3	11.8	10.7	8.88	157	5.57
3.0 RHS	5.42	86.1	57.4	43.1	34.4	28.7	24.6	21.5	17.2	14.4	12.3	10.8	9.57	8.61	7.18	121	5.73
2.5 RHS	4.58	73.5	49.0	36.8	29.4	24.5	21.0	18.4	14.7	12.3	10.5	9.19	8.17	7.35	6.13	102	5.79
2.0 RHS	3.72	60.3	40.2	30.1	24.1	20.1	17.2	15.1	12.1	10.0	8.61	7.53	6.70	6.03	5.02	83.1	5.86
75 x 25 x 2.5 RHS	3.60	50.7	33.8	25.4	20.3	16.9	14.5	12.7	10.1	8.45	7.24	6.34	5.63	5.07	4.23	98.5	1.47
2.0 RHS	2.93	41.9	27.9	20.9	16.8	14.0	12.0	10.5	8.38	6.98	5.98	5.23	4.65	4.19	3.49	79.9	1.50
1.6 RHS	2.38	34.3	22.9	17.2	13.7	11.4	9.81	8.59	6.87	5.72	4.91	4.29	3.82	3.43	2.86	64.6	1.53
65 x 35 x 3.0 RHS	4.25	55.4	36.9	27.7	22.2	18.5	15.8	13.8	11.1	9.23	7.91	6.92	6.16	5.54	4.62	102	3.23
2.5 RHS	3.60	47.6	31.8	23.8	19.1	15.9	13.6	11.9	9.53	7.94	6.81	5.96	5.29	4.76	3.97	86.8	3.28
2.0 RHS	2.93	39.3	26.2	19.7	15.7	13.1	11.2	9.83	7.86	6.55	5.62	4.91	4.37	3.93	3.28	70.6	3.33
50 x 25 x 3.0 RHS	3.07	29.5	19.7	14.8	11.8	9.85	8.44	7.39	5.91	4.92	4.22	3.69	3.28	2.95	2.46	76.0	2.08
2.5 RHS	2.62	25.7	17.2	12.9	10.3	8.58	7.35	6.43	5.15	4.29	3.68	3.22	2.86	2.57	2.14	64.8	2.12
2.0 RHS	2.15	21.5	14.3	10.7	8.59	7.16	6.14	5.37	4.30	3.58	3.07	2.69	2.39	2.15	1.79	53.0	2.17
1.6 RHS	1.75	17.8	11.8	8.88	7.11	5.92	5.08	4.44	3.55	2.96	2.54	2.22	1.97	1.78	1.48	43.1	2.21
50 x 20 x 3.0 RHS	2.83	26.0	17.3	13.0	10.4	8.66	7.43	6.50	5.20	4.33	3.71	3.25	2.89	2.60	2.17	75.1	1.31
2.5 RHS	2.42	22.7	15.2	11.4	9.10	7.58	6.50	5.68	4.55	3.79	3.25	2.84	2.53	2.27	1.89	64.0	1.35
2.0 RHS	1.99	19.1	12.7	9.53	7.63	6.35	5.45	4.77	3.81	3.18	2.72	2.38	2.12	1.91	1.59	52.3	1.39
1.6 RHS	1.63	15.8	10.5	7.91	6.33	5.27	4.52	3.95	3.16	2.64	2.26	1.98	1.76	1.58	1.32	42.6	1.42

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W^*_{L1} = 8\,\phi\,M_s / L$
6. $W^*_{L2} = 1.6\,\phi\,V_v$

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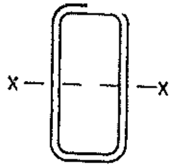

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C450

bending about x-axis

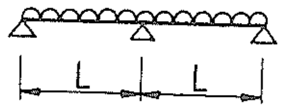

TABLE 8.2 – 4 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
125 x 75 x 3.8 RHS	11.1	187	93.4	62.3	46.7	37.4	31.1	26.7	23.3	20.8	18.7	17.0	15.6	14.4	13.3	334	6.14
3.3 RHS	9.73	165	82.5	55.0	41.3	33.0	27.5	23.6	20.6	18.3	16.5	15.0	13.8	12.7	11.8	292	6.19
2.8 RHS	8.39	136	67.8	45.2	33.9	27.1	22.6	19.4	16.9	15.1	13.6	12.3	11.3	10.4	9.68	250	6.24
2.3 RHS	6.95	98.0	49.0	32.7	24.5	19.6	16.3	14.0	12.3	10.9	9.80	8.91	8.17	7.54	7.00	207	6.29
100 x 50 x 3.3 RHS	7.14	92.3	46.2	30.8	23.1	18.5	15.4	13.2	11.5	10.3	9.23	8.39	7.69	7.10	6.59	228	3.42
2.8 RHS	6.19	81.3	40.6	27.1	20.3	16.3	13.5	11.6	10.2	9.03	8.13	7.39	6.77	6.25	5.81	196	3.47
2.3 RHS	5.14	68.1	34.1	22.7	17.0	13.6	11.4	9.73	8.52	7.57	6.81	6.19	5.68	5.24	4.87	162	3.50

• Notes: Refer to TABLE 8.2–4 (2)(A)

TABLE 8.2 – 4 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 5.0 x 3.3 RHS	7.14	185	123	92.3	73.9	61.5	52.8	46.2	36.9	30.8	26.4	23.1	20.5	18.5	15.4	228	3.42
2.8 RHS	6.19	163	108	81.3	65.0	54.2	46.4	40.6	32.5	27.1	23.2	20.3	18.1	16.3	13.5	196	3.47
2.3 RHS	5.14	136	90.8	68.1	54.5	45.4	38.9	34.1	27.3	22.7	19.5	17.0	15.1	13.6	11.4	162	3.50
75 x 50 x 2.8 RHS	5.09	104	69.6	52.2	41.7	34.8	29.8	26.1	20.9	17.4	14.9	13.0	11.6	10.4	8.70	146	4.48
2.3 RHS	4.24	87.8	58.6	43.9	35.1	29.3	25.1	22.0	17.6	14.6	12.5	11.0	9.76	8.78	7.32	122	4.53
65 x 35 x 2.8 RHS	3.99	67.3	44.9	33.7	26.9	22.4	19.2	16.8	13.5	11.2	9.62	8.42	7.48	6.73	5.61	124	2.53
2.3 RHS	3.34	57.1	38.0	28.5	22.8	19.0	16.3	14.3	11.4	9.51	8.15	7.13	6.34	5.71	4.76	103	2.57
50 x 25 x 2.8 RHS	2.89	36.1	24.1	18.0	14.4	12.0	10.3	9.02	7.22	6.02	5.16	4.51	4.01	3.61	3.01	92.1	1.63
2.3 RHS	2.44	31.0	20.6	15.5	12.4	10.3	8.85	7.74	6.19	5.16	4.42	3.87	3.44	3.10	2.58	77.3	1.67
50 x 20 x 2.8 RHS	2.67	31.8	21.2	15.9	12.7	10.6	9.09	7.95	6.36	5.30	4.54	3.98	3.53	3.18	2.65	90.9	1.03
2.3 RHS	2.25	27.4	18.3	13.7	11.0	9.14	7.83	6.85	5.48	4.57	3.92	3.43	3.05	2.74	2.28	76.3	1.06

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 8\,\phi\,M_s / L$
6. $W^*_{L2} = 1.6\,\phi\,V_v$

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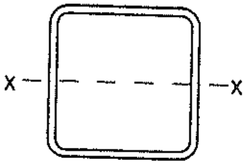
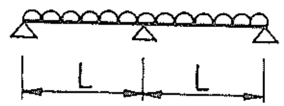
TABLE 8.2 – 5 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT
SQUARE HOLLOW SECTIONS: GRADE C350
bending about x–axis





W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 250 x 9.0 SHS	65.9	1880	938	625	469	375	313	268	234	208	188	171	156	144	134	1250	41.8
6.0 SHS	45.0	1030	515	343	257	206	172	147	129	114	103	93.6	85.8	79.2	73.5	853	42.4
200 x 200 x 9.0 SHS	51.8	1170	586	391	293	235	195	168	147	130	117	107	97.7	90.2	83.8	978	33.0
6.0 SHS	35.6	740	370	247	185	148	123	106	92.5	82.2	74.0	67.3	61.7	56.9	52.9	674	33.7
5.0 SHS	29.9	561	280	187	140	112	93.4	80.1	70.1	62.3	56.1	51.0	46.7	43.1	40.0	567	33.9
150 x 150 x 9.0 SHS	37.7	625	313	208	156	125	104	89.4	78.2	69.5	62.5	56.9	52.1	48.1	44.7	710	24.3
6.0 SHS	26.2	447	224	149	112	89.5	74.6	63.9	55.9	49.7	44.7	40.7	37.3	34.4	32.0	495	24.9
5.0 SHS	22.1	364	182	121	91.0	72.8	60.7	52.0	45.5	40.5	36.4	33.1	30.3	28.0	26.0	418	25.2
125 x 125 x 9.0 SHS	30.6	416	208	139	104	83.1	69.3	59.4	52.0	46.2	41.6	37.8	34.6	32.0	29.7	575	19.9
6.0 SHS	21.4	302	151	101	75.6	60.4	50.4	43.2	37.8	33.6	30.2	27.5	25.2	23.2	21.6	405	20.6
5.0 SHS	18.2	259	129	86.3	64.7	51.8	43.2	37.0	32.4	28.8	25.9	23.5	21.6	19.9	18.5	343	20.8
4.0 SHS	14.8	199	99.4	66.2	49.7	39.7	33.1	28.4	24.8	22.1	19.9	18.1	16.6	15.3	14.2	280	21.0
100 x 100 x 9.0 SHS	23.5	248	124	82.8	62.1	49.7	41.4	35.5	31.0	27.6	24.8	22.6	20.7	19.1	17.7	441	15.5
6.0 SHS	16.7	185	92.7	61.8	46.3	37.1	30.9	26.5	23.2	20.6	18.5	16.8	15.4	14.3	13.2	315	16.2
5.0 SHS	14.2	160	80.0	53.3	40.0	32.0	26.7	22.9	20.0	17.8	16.0	14.5	13.3	12.3	11.4	269	16.4
4.0 SHS	11.6	133	66.3	44.2	33.1	26.5	22.1	18.9	16.6	14.7	13.3	12.1	11.0	10.2	9.47	220	16.6
3.0 SHS	8.96	93.5	46.8	31.2	23.4	18.7	15.6	13.4	11.7	10.4	9.35	8.50	7.79	7.19	6.68	168	16.9
89 x 89 x 6.0 SHS	14.6	143	71.3	47.5	35.6	28.5	23.8	20.4	17.8	15.8	14.3	13.0	11.9	11.0	10.2	276	14.2
5.0 SHS	12.5	124	61.9	41.2	30.9	24.7	20.6	17.7	15.5	13.7	12.4	11.2	10.3	9.52	8.84	236	14.5
3.5 SHS	9.06	91.9	45.9	30.6	23.0	18.4	15.3	13.1	11.5	10.2	9.19	8.35	7.66	7.07	6.56	171	14.8
75 x 75 x 6.0 SHS	12.0	96.8	48.4	32.3	24.2	19.4	16.1	13.8	12.1	10.8	9.68	8.80	8.07	7.45	6.91	226	11.8
5.0 SHS	10.3	84.8	42.4	28.3	21.2	17.0	14.1	12.1	10.6	9.42	8.48	7.71	7.07	6.52	6.06	194	12.0
4.0 SHS	8.49	71.2	35.6	23.7	17.8	14.2	11.9	10.2	8.90	7.91	7.12	6.47	5.93	5.48	5.08	160	12.2
3.5 SHS	7.53	63.8	31.9	21.3	15.9	12.8	10.6	9.11	7.97	7.08	6.38	5.80	5.31	4.90	4.55	142	12.4
3.0 SHS	6.60	56.7	28.3	18.9	14.2	11.3	9.44	8.09	7.08	6.30	5.67	5.15	4.72	4.36	4.05	124	12.5
2.5 SHS	5.56	46.0	23.0	15.3	11.5	9.20	7.67	6.57	5.75	5.11	4.60	4.18	3.83	3.54	3.29	105	12.6

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 8\,\phi\,M_s / L$
6. $W^*_{L2} = 2\,\phi\,V_v$

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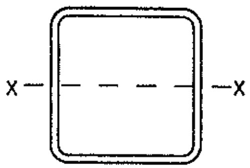
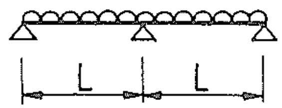


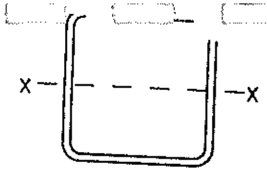
STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS
FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT
SQUARE HOLLOW SECTIONS: GRADE C350
bending about x–axis



W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres														W_{L2}^*	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 6.0 SHS	12.0	194	129	96.8	77.4	64.5	55.3	48.4	38.7	32.3	27.7	24.2	21.5	19.4	16.1	226	11.8
5.0 SHS	10.3	170	113	84.8	67.8	56.5	48.4	42.4	33.9	28.3	24.2	21.2	18.8	17.0	14.1	194	12.0
4.0 SHS	8.49	142	94.9	71.2	56.9	47.5	40.7	35.6	28.5	23.7	20.3	17.8	15.8	14.2	11.9	160	12.2
3.5 SHS	7.53	128	85.0	63.8	51.0	42.5	36.4	31.9	25.5	21.3	18.2	15.9	14.2	12.8	10.6	142	12.4
3.0 SHS	6.60	113	75.6	56.7	45.3	37.8	32.4	28.3	22.7	18.9	16.2	14.2	12.6	11.3	9.44	124	12.5
2.5 SHS	5.56	92.0	61.4	46.0	36.8	30.7	26.3	23.0	18.4	15.3	13.1	11.5	10.2	9.20	7.67	105	12.6
65 x 65 x 6.0 SHS	10.1	139	92.4	69.3	55.5	46.2	39.6	34.7	27.7	23.1	19.8	17.3	15.4	13.9	11.6	190	10.0
5.0 SHS	8.75	123	81.7	61.3	49.0	40.9	35.0	30.6	24.5	20.4	17.5	15.3	13.6	12.3	10.2	164	10.3
4.0 SHS	7.23	104	69.2	51.9	41.5	34.6	29.7	26.0	20.8	17.3	14.8	13.0	11.5	10.4	8.65	136	10.5
3.0 SHS	5.66	83.5	55.7	41.8	33.4	27.8	23.9	20.9	16.7	13.9	11.9	10.4	9.28	8.35	6.96	106	10.8
2.5 SHS	4.78	71.3	47.5	35.6	28.5	23.8	20.4	17.8	14.3	11.9	10.2	8.91	7.92	7.13	5.94	89.6	10.9
2.0 SHS	3.88	53.3	35.6	26.7	21.3	17.8	15.2	13.3	10.7	8.89	7.62	6.67	5.93	5.33	4.44	72.9	11.0
50 x 50 x 5.0 SHS	6.39	66.3	44.2	33.2	26.5	22.1	18.9	16.6	13.3	11.1	9.47	8.29	7.37	6.63	5.53	119	7.61
4.0 SHS	5.35	57.4	38.2	28.7	22.9	19.1	16.4	14.3	11.5	9.56	8.19	7.17	6.37	5.74	4.78	100	7.85
3.0 SHS	4.25	47.3	31.5	23.7	18.9	15.8	13.5	11.8	9.46	7.89	6.76	5.91	5.26	4.73	3.94	78.8	8.13
2.5 SHS	3.60	40.7	27.1	20.3	16.3	13.6	11.6	10.2	8.14	6.78	5.81	5.09	4.52	4.07	3.39	67.2	8.24
2.0 SHS	2.93	33.6	22.4	16.8	13.4	11.2	9.59	8.39	6.72	5.60	4.80	4.20	3.73	3.36	2.80	55.0	8.34
1.6 SHS	2.38	25.7	17.1	12.9	10.3	8.57	7.35	6.43	5.14	4.29	3.67	3.21	2.86	2.57	2.14	44.7	8.42
40 x 40 x 4.0 SHS	4.09	33.9	22.6	17.0	13.6	11.3	9.70	8.49	6.79	5.66	4.85	4.24	3.77	3.39	2.83	76.5	6.09
3.0 SHS	3.30	28.8	19.2	14.4	11.5	9.62	8.24	7.21	5.77	4.81	4.12	3.61	3.21	2.88	2.40	60.9	6.38
2.5 SHS	2.82	25.0	16.7	12.5	10.0	8.34	7.15	6.26	5.01	4.17	3.58	3.13	2.78	2.50	2.09	52.3	6.48
2.0 SHS	2.31	20.8	13.9	10.4	8.33	6.94	5.95	5.21	4.17	3.47	2.98	2.60	2.31	2.08	1.74	43.0	6.59
1.6 SHS	1.88	17.2	11.5	8.60	6.88	5.73	4.91	4.30	3.44	2.87	2.46	2.15	1.91	1.72	1.43	35.2	6.67
35 x 35 x 3.0 SHS	2.83	21.3	14.2	10.7	8.53	7.10	6.09	5.33	4.26	3.55	3.04	2.66	2.37	2.13	1.78	52.0	5.50
2.5 SHS	2.42	18.6	12.4	9.31	7.45	6.21	5.32	4.66	3.72	3.10	2.66	2.33	2.07	1.86	1.55	44.8	5.61
2.0 SHS	1.99	15.6	10.4	7.80	6.24	5.20	4.46	3.90	3.12	2.60	2.23	1.95	1.73	1.56	1.30	37.0	5.71
1.6 SHS	1.63	12.9	8.62	6.47	5.17	4.31	3.70	3.23	2.59	2.16	1.85	1.62	1.44	1.29	1.08	30.4	5.80
30 x 30 x 3.0 SHS	2.36	14.9	9.94	7.46	5.97	4.97	4.26	3.73	2.98	2.49	2.13	1.86	1.66	1.49	1.24	43.0	4.63
2.5 SHS	2.03	13.2	8.77	6.58	5.26	4.38	3.76	3.29	2.63	2.19	1.88	1.64	1.46	1.32	1.10	37.3	4.73
2.0 SHS	1.68	11.1	7.41	5.56	4.45	3.70	3.18	2.78	2.22	1.85	1.59	1.39	1.23	1.11	0.926	31.1	4.84
1.6 SHS	1.38	9.28	6.19	4.64	3.71	3.09	2.65	2.32	1.86	1.55	1.33	1.16	1.03	0.928	0.773	25.6	4.92
25 x 25 x 3.0 SHS	1.89	9.65	6.43	4.83	3.86	3.22	2.76	2.41	1.93	1.61	1.38	1.21	1.07	0.965	0.804	34.0	3.75
2.5 SHS	1.64	8.63	5.75	4.32	3.45	2.88	2.47	2.16	1.73	1.44	1.23	1.08	0.959	0.863	0.719	29.9	3.85
2.0 SHS	1.36	7.39	4.93	3.69	2.96	2.46	2.11	1.85	1.48	1.23	1.06	0.924	0.821	0.739	0.616	25.1	3.96
1.6 SHS	1.12	6.23	4.15	3.11	2.49	2.08	1.78	1.56	1.25	1.04	0.890	0.779	0.692	0.623	0.519	20.8	4.04
20 x 20 x 1.6 SHS	0.873	3.78	2.52	1.89	1.51	1.26	1.08	0.946	0.757	0.631	0.540	0.473	0.420	0.378	0.315	16.1	3.17

Notes: ... to TAB... 2-5 (1)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CONTINUOUS BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C450

bending about x-axis

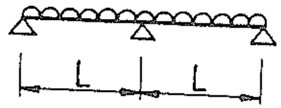


TABLE 8.2 – 6 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t (mm mm mm)	Mass per m (kg/m)	W^*_{L1} (kN) Span of Beam (L) in metres 1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	W^*_{L2} (kN)	FLR (m)
100 x 100 x 3.8 SHS	11.1	157	78.3	52.2	39.2	31.3	26.1	22.4	19.6	17.4	15.7	14.2	13.1	12.0	11.2	270	13.0
3.3 SHS	9.73	127	63.7	42.4	31.8	25.5	21.2	18.2	15.9	14.1	12.7	11.6	10.6	9.80	9.10	237	13.1
2.8 SHS	8.39	100	50.1	33.4	25.1	20.1	16.7	14.3	12.5	11.1	10.0	9.12	8.36	7.71	7.16	203	13.2
2.3 SHS	6.95	74.8	37.4	24.9	18.7	15.0	12.5	10.7	9.34	8.31	7.48	6.80	6.23	5.75	5.34	169	13.2
75 x 75 x 3.3 SHS	7.14	78.0	39.0	26.0	19.5	15.6	13.0	11.1	9.75	8.67	7.80	7.09	6.50	6.00	5.57	173	9.65
2.8 SHS	6.19	65.3	32.6	21.8	16.3	13.1	10.9	9.32	8.16	7.25	6.53	5.93	5.44	5.02	4.66	149	9.76
2.3 SHS	5.14	48.6	24.3	16.2	12.1	9.71	8.09	6.94	6.07	5.39	4.86	4.41	4.05	3.73	3.47	124	9.84

Notes: Refer to TABLE 8.2–5 (1)(A)

TABLE 8.2 – 6 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t (mm mm mm)	Mass per m (kg/m)	W^*_{L1} (kN) Span of Beam (L) in metres 0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	W^*_{L2} (kN)	FLR (m)
75 x 75 x 3.3 SHS	7.14	156	104	78.0	62.4	52.0	44.6	39.0	31.2	26.0	22.3	19.5	17.3	15.6	13.0	173	9.65
2.8 SHS	6.19	131	87.0	65.3	52.2	43.5	37.3	32.6	26.1	21.8	18.6	16.3	14.5	13.1	10.9	149	9.76
2.3 SHS	5.14	97.1	64.7	48.6	38.8	32.4	27.7	24.3	19.4	16.2	13.9	12.1	10.8	9.71	8.09	124	9.84
65 x 65 x 2.8 SHS	5.31	101	67.5	50.6	40.5	33.7	28.9	25.3	20.2	16.9	14.5	12.6	11.2	10.1	8.43	128	8.40
2.3 SHS	4.42	78.6	52.4	39.3	31.4	26.2	22.5	19.6	15.7	13.1	11.2	9.82	8.73	7.86	6.55	107	8.48
50 x 50 x 2.8 SHS	3.99	57.5	38.3	28.8	23.0	19.2	16.4	14.4	11.5	9.58	8.21	7.19	6.39	5.75	4.79	95.5	6.36
2.3 SHS	3.34	48.7	32.5	24.4	19.5	16.2	13.9	12.2	9.75	8.12	6.96	6.09	5.42	4.87	4.06	80.2	6.44
40 x 40 x 2.8 SHS	3.11	35.2	23.5	17.6	14.1	11.7	10.1	8.80	7.04	5.86	5.03	4.40	3.91	3.52	2.93	74.0	4.99
2.3 SHS	2.62	30.1	20.1	15.0	12.0	10.0	8.60	7.52	6.02	5.01	4.30	3.76	3.34	3.01	2.51	62.5	5.08
35 x 35 x 2.8 SHS	2.67	26.1	17.4	13.0	10.4	8.69	7.45	6.52	5.21	4.34	3.72	3.26	2.90	2.61	2.17	63.2	4.31
2.3 SHS	2.25	22.4	15.0	11.2	8.98	7.48	6.41	5.61	4.49	3.74	3.21	2.80	2.49	2.24	1.87	53.7	4.39
30 x 30 x 2.8 SHS	2.23	18.3	12.2	9.16	7.33	6.10	5.23	4.58	3.66	3.05	2.62	2.29	2.03	1.83	1.53	52.5	3.63
2.3 SHS	1.89	15.9	10.6	7.95	6.36	5.30	4.54	3.98	3.18	2.65	2.27	1.99	1.77	1.59	1.33	44.9	3.71
25 x 25 x 2.3 SHS	1.53	10.5	7.00	5.25	4.20	3.50	3.00	2.62	2.10	1.75	1.50	1.31	1.17	1.05	0.874	36.0	3.03

Notes: Refer to TABLE 8.2–5 (1)(A)

@Seismicisolation

…IM… DE…N LOADS

FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C250
bending about any axis

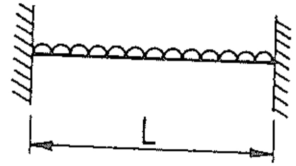


TABLE 8.3 – 1 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	kN
610.0 x 12.7 CHS	187	12200	6120	4080	3060	2450	2040	1750	1530	1360	1220	1020	874	765	3860
9.5 CHS	141	8820	4410	2940	2210	1760	1470	1260	1100	980	882	735	630	552	2900
6.4 CHS	95.3	5390	2690	1800	1350	1080	898	770	673	599	539	449	385	337	1970
508.0 x 12.7 CHS	155	8410	4210	2800	2100	1680	1400	1200	1050	935	841	701	601	526	3200
9.5 CHS	117	6300	3150	2100	1580	1260	1050	900	788	700	630	525	450	394	2410
6.4 CHS	79.2	3940	1970	1310	985	788	656	563	492	438	394	328	281	246	1630

Notes: Refer to TABLE 8.3–1 (3)(A)

TABLE 8.3 – 1 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
165.1 x 5.4 CHS	21.3	744	372	248	186	149	124	106	93.0	74.4	62.0	53.1	46.5	41.3	439
5.0 CHS	19.7	692	346	231	173	138	115	98.9	86.5	69.2	57.7	49.4	43.3	38.5	407
139.7 x 5.4 CHS	17.9	526	263	175	132	105	87.7	75.2	65.8	52.6	43.9	37.6	32.9	29.2	369
5.0 CHS	16.6	490	245	163	123	98.0	81.7	70.0	61.3	49.0	40.8	35.0	30.6	27.2	343
114.3 x 5.4 CHS	14.5	346	173	115	86.5	69.2	57.7	49.4	43.3	34.6	28.8	24.7	21.6	19.2	299
4.5 CHS	12.2	293	147	97.7	73.3	58.6	48.9	41.9	36.6	29.3	24.4	20.9	18.3	16.3	251
101.6 x 5.0 CHS	11.9	252	126	84.1	63.0	50.4	42.0	36.0	31.5	25.2	21.0	18.0	15.8	14.0	246
4.0 CHS	9.63	206	103	68.6	51.5	41.2	34.3	29.4	25.7	20.6	17.2	14.7	12.9	11.4	199
88.9 x 5.9 CHS	12.1	220	110	73.3	55.0	44.0	36.6	31.4	27.5	22.0	18.3	15.7	13.7	12.2	249
5.0 CHS	10.3	190	95.1	63.4	47.6	38.1	31.7	27.2	23.8	19.0	15.9	13.6	11.9	10.6	213
4.0 CHS	8.38	156	77.9	51.9	39.0	31.2	26.0	22.3	19.5	15.6	13.0	11.1	9.74	8.66	173
76.1 x 5.9 CHS	10.2	157	78.7	52.5	39.3	31.5	26.2	22.5	19.7	15.7	13.1	11.2	9.84	8.74	211
4.5 CHS	7.95	125	62.4	41.6	31.2	24.9	20.8	17.8	15.6	12.5	10.4	8.91	7.80	6.93	164
3.6 CHS	6.44	102	51.1	34.1	25.6	20.5	17.0	14.6	12.8	10.2	8.52	7.30	6.39	5.68	133

Notes: Refer to TABLE 8.3–1 (3)(A)

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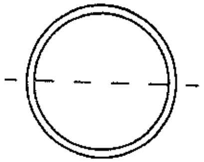
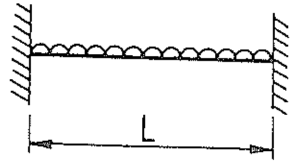
TABLE 8.3 – 1 (3)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR **FIXED END BEAMS** WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C250
bending about any axis



W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	kN
76.1 x 5.9 CHS	10.2	315	157	105	78.7	63.0	52.5	45.0	39.3	31.5	26.2	22.5	19.7	15.7	211
4.5 CHS	7.95	249	125	83.2	62.4	49.9	41.6	35.6	31.2	24.9	20.8	17.8	15.6	12.5	164
3.6 CHS	6.44	205	102	68.2	51.1	40.9	34.1	29.2	25.6	20.5	17.0	14.6	12.8	10.2	133
60.3 x 5.4 CHS	7.31	176	88.2	58.8	44.1	35.3	29.4	25.2	22.0	17.6	14.7	12.6	11.0	8.82	151
4.5 CHS	6.19	152	75.8	50.6	37.9	30.3	25.3	21.7	19.0	15.2	12.6	10.8	9.48	7.58	128
3.6 CHS	5.03	125	62.6	41.7	31.3	25.0	20.9	17.9	15.6	12.5	10.4	8.94	7.82	6.26	104
48.3 x 5.4 CHS	5.71	108	53.9	36.0	27.0	21.6	18.0	15.4	13.5	10.8	8.99	7.71	6.74	5.39	118
4.0 CHS	4.37	85.0	42.5	28.3	21.3	17.0	14.2	12.1	10.6	8.50	7.08	6.07	5.31	4.25	90.2
3.2 CHS	3.56	70.4	35.2	23.5	17.6	14.1	11.7	10.1	8.80	7.04	5.87	5.03	4.40	3.52	73.4
42.4 x 4.9 CHS	4.53	74.8	37.4	24.9	18.7	15.0	12.5	10.7	9.36	7.48	6.24	5.35	4.68	3.74	93.5
4.0 CHS	3.79	63.9	32.0	21.3	16.0	12.8	10.7	9.13	7.99	6.39	5.33	4.57	4.00	3.20	78.2
3.2 CHS	3.09	53.2	26.6	17.7	13.3	10.6	8.87	7.60	6.65	5.32	4.44	3.80	3.33	2.66	63.8
33.7 x 4.5 CHS	3.24	41.8	20.9	13.9	10.4	8.35	6.96	5.97	5.22	4.18	3.48	2.98	2.61	2.09	66.9
4.0 CHS	2.93	38.3	19.2	12.8	9.58	7.67	6.39	5.48	4.79	3.83	3.19	2.74	2.40	1.92	60.5
3.2 CHS	2.41	32.3	16.1	10.8	8.07	6.45	5.38	4.61	4.03	3.23	2.69	2.30	2.02	1.61	49.7
26.9 x 4.0 CHS	2.26	22.9	11.4	7.63	5.72	4.58	3.81	3.27	2.86	2.29	1.91	1.63	1.43	1.14	46.6
3.2 CHS	1.87	19.5	9.76	6.51	4.88	3.91	3.25	2.79	2.44	1.95	1.63	1.39	1.22	0.976	38.6
2.6 CHS	1.56	16.6	8.32	5.55	4.16	3.33	2.77	2.38	2.08	1.66	1.39	1.19	1.04	0.832	32.2
21.3 x 3.6 CHS	1.57	12.3	6.17	4.12	3.09	2.47	2.06	1.76	1.54	1.23	1.03	0.882	0.772	0.617	32.4
3.2 CHS	1.43	11.4	5.72	3.81	2.86	2.29	1.91	1.63	1.43	1.14	0.953	0.817	0.715	0.572	29.5
2.6 CHS	1.20	9.88	4.94	3.29	2.47	1.98	1.65	1.41	1.24	0.988	0.824	0.706	0.618	0.494	24.7

Notes:
1. ϕ = 0.9
2. α_m = 1.0
3. α_s = 1.0
4. $W_{L1}^* = 12 \phi M_s / L$
5. $W_{L2}^* = 2 \phi V_v$

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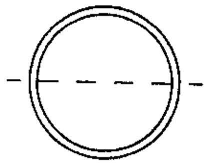
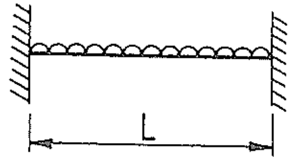
TABLE 8.3 – 2 (1)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT CIRCULAR HOLLOW SECTIONS: GRADE C350

bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	kN
457.0 x 12.7 CHS	139	9470	4730	3160	2370	1890	1580	1350	1180	1050	947	789	676	592	4020
9.5 CHS	105	6780	3390	2260	1700	1360	1130	969	848	753	678	565	484	424	3030
6.4 CHS	71.1	4120	2060	1370	1030	824	687	589	515	458	412	343	294	258	2050
406.4 x 12.7 CHS	123	7440	3720	2480	1860	1490	1240	1060	930	827	744	620	532	465	3560
9.5 CHS	93.0	5470	2740	1820	1370	1090	912	782	684	608	547	456	391	342	2690
6.4 CHS	63.1	3380	1690	1130	846	677	564	483	423	376	338	282	242	211	1820
355.6 x 12.7 CHS	107	5650	2820	1880	1410	1130	941	807	706	627	565	471	403	353	3100
9.5 CHS	81.1	4270	2130	1420	1070	854	711	610	533	474	427	356	305	267	2340
6.4 CHS	55.1	2680	1340	894	671	537	447	383	335	298	268	224	192	168	1590
323.9 x 12.7 CHS	97.5	4650	2330	1550	1160	930	775	665	581	517	465	388	332	291	2820
9.5 CHS	73.7	3550	1780	1180	888	710	592	507	444	395	355	296	254	222	2130
6.4 CHS	50.1	2270	1140	757	568	454	379	325	284	252	227	189	162	142	1450
273.1 x 9.3 CHS	60.5	2450	1220	816	612	489	408	350	306	272	245	204	175	153	1750
6.4 CHS	42.1	1670	833	555	416	333	278	238	208	185	167	139	119	104	1220
4.8 CHS	31.8	1180	590	393	295	236	197	169	147	131	118	98.3	84.3	73.7	918
219.1 x 8.2 CHS	42.6	1380	690	460	345	276	230	197	172	153	138	115	98.5	86.2	1230
6.4 CHS	33.6	1090	547	365	274	219	182	156	137	122	109	91.2	78.2	68.4	970
4.8 CHS	25.4	795	398	265	199	159	133	114	99.4	88.3	79.5	66.3	56.8	49.7	733
168.3 x 7.1 CHS	28.2	698	349	233	174	140	116	99.7	87.2	77.5	69.8	58.2	49.8	43.6	815
6.4 CHS	25.6	634	317	211	159	127	106	90.6	79.3	70.5	63.4	52.9	45.3	39.7	738
4.8 CHS	19.4	485	243	162	121	97.0	80.9	69.3	60.6	53.9	48.5	40.4	34.7	30.3	559

Notes:
1. ϕ = 0.9
2. α_m = 1.0
3. α_s = 1.0
4. $W^*_{L1} = 12 \phi M_s / L$
5. $W^*_{L2} = 2 \phi V_v$

@Seismicisolation

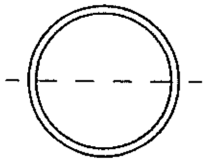
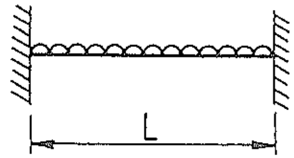


TABLE 8.3 – 2 (2)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT CIRCULAR HOLLOW SECTIONS: GRADE C350

bending about any axis



W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
168.3 x 7.1 CHS	28.2	1400	698	465	349	279	233	199	174	140	116	99.7	87.2	77.5	815
6.4 CHS	25.6	1270	634	423	317	254	211	181	159	127	106	90.6	79.3	70.5	738
4.8 CHS	19.4	970	485	323	243	194	162	139	121	97.0	80.9	69.3	60.6	53.9	559
165.1 x 3.5 CHS	13.9	655	327	218	164	131	109	93.5	81.8	65.5	54.5	46.8	40.9	36.4	403
3.0 CHS	12.0	543	272	181	136	109	90.6	77.6	67.9	54.3	45.3	38.8	34.0	30.2	346
139.7 x 3.5 CHS	11.8	481	241	160	120	96.3	80.2	68.8	60.2	48.1	40.1	34.4	30.1	26.7	340
3.0 CHS	10.1	403	201	134	101	80.5	67.1	57.5	50.3	40.3	33.6	28.8	25.2	22.4	292
114.3 x 6.0 CHS	16.0	533	266	178	133	107	88.8	76.1	66.6	53.3	44.4	38.0	33.3	29.6	463
4.8 CHS	13.0	435	218	145	109	87.1	72.6	62.2	54.4	43.5	36.3	31.1	27.2	24.2	374
3.6 CHS	9.83	334	167	111	83.4	66.7	55.6	47.7	41.7	33.4	27.8	23.8	20.9	18.5	284
3.2 CHS	8.77	299	149	99.6	74.7	59.7	49.8	42.7	37.3	29.9	24.9	21.3	18.7	16.6	253
101.6 x 3.2 CHS	7.77	234	117	78.1	58.6	46.9	39.1	33.5	29.3	23.4	19.5	16.7	14.6	13.0	224
2.6 CHS	6.35	190	94.8	63.2	47.4	37.9	31.6	27.1	23.7	19.0	15.8	13.5	11.9	10.5	183
88.9 x 5.5 CHS	11.3	290	145	96.5	72.4	57.9	48.3	41.4	36.2	29.0	24.1	20.7	18.1	16.1	327
4.8 CHS	9.96	257	128	85.6	64.2	51.4	42.8	36.7	32.1	25.7	21.4	18.4	16.1	14.3	288
3.2 CHS	6.76	178	88.9	59.3	44.4	35.6	29.6	25.4	22.2	17.8	14.8	12.7	11.1	9.88	195
2.6 CHS	5.53	146	73.2	48.8	36.6	29.3	24.4	20.9	18.3	14.6	12.2	10.5	9.15	8.14	160
76.1 x 3.2 CHS	5.75	129	64.3	42.9	32.2	25.7	21.4	18.4	16.1	12.9	10.7	9.19	8.04	7.15	166
2.3 CHS	4.19	94.7	47.4	31.6	23.7	18.9	15.8	13.5	11.8	9.47	7.89	6.77	5.92	5.26	121

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W_{L1}^* = 12 \phi M_s / L$
5. $W_{L2}^* = 2 \phi V_v$

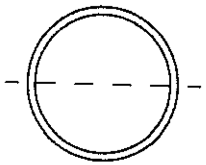
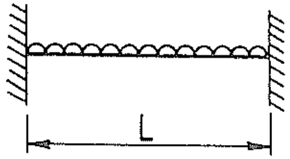


TABLE 8.3 – 2 (3)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis



W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	kN
76.1 x 3.2 CHS	5.75	257	129	85.8	64.3	51.5	42.9	36.8	32.2	25.7	21.4	18.4	16.1	12.9	166
2.3 CHS	4.19	189	94.7	63.2	47.4	37.9	31.6	27.1	23.7	18.9	15.8	13.5	11.8	9.47	121
60.3 x 2.9 CHS	4.11	145	72.3	48.2	36.1	28.9	24.1	20.7	18.1	14.5	12.0	10.3	9.04	7.23	119
2.3 CHS	3.29	117	58.5	39.0	29.3	23.4	19.5	16.7	14.6	11.7	9.75	8.36	7.32	5.85	95.0
48.3 x 2.9 CHS	3.25	90.5	45.3	30.2	22.6	18.1	15.1	12.9	11.3	9.05	7.54	6.46	5.66	4.53	93.8
2.3 CHS	2.61	73.6	36.8	24.5	18.4	14.7	12.3	10.5	9.21	7.36	6.14	5.26	4.60	3.68	75.4
42.4 x 2.6 CHS	2.55	62.4	31.2	20.8	15.6	12.5	10.4	8.91	7.80	6.24	5.20	4.45	3.90	3.12	73.7
2.0 CHS	1.99	49.4	24.7	16.5	12.3	9.88	8.23	7.06	6.17	4.94	4.12	3.53	3.09	2.47	57.6
33.7 x 2.6 CHS	1.99	38.1	19.1	12.7	9.53	7.62	6.35	5.44	4.76	3.81	3.18	2.72	2.38	1.91	57.6
2.0 CHS	1.56	30.4	15.2	10.1	7.61	6.09	5.07	4.35	3.80	3.04	2.54	2.17	1.90	1.52	45.2
26.9 x 2.3 CHS	1.40	21.1	10.6	7.04	5.28	4.22	3.52	3.02	2.64	2.11	1.76	1.51	1.32	1.06	40.3
2.0 CHS	1.23	18.8	9.39	6.26	4.70	3.76	3.13	2.68	2.35	1.88	1.57	1.34	1.17	0.939	35.5
21.3 x 2.0 CHS	0.952	11.3	5.65	3.77	2.83	2.26	1.88	1.61	1.41	1.13	0.942	0.807	0.707	0.565	27.5

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W_{L1}^* = 12\,\phi\,M_s / L$
5. $W_{L2}^* = 2\,\phi\,V_v$

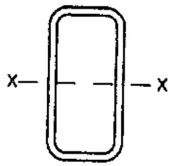
@Seismicisolation

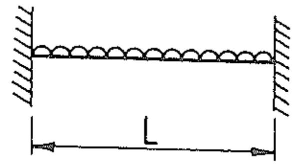
TABLE 8.3 – 3 (1)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x–axis





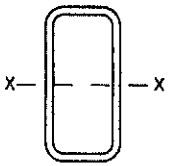
W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 150 x 9.0 RHS	51.8	2020	1010	672	504	403	336	288	252	224	202	183	168	155	144	1520	15.6
6.0 RHS	35.6	1410	707	471	354	283	236	202	177	157	141	129	118	109	101	1040	16.0
5.0 RHS	29.9	1130	566	378	283	227	189	162	142	126	113	103	94.4	87.1	80.9	873	16.1
200 x 100 x 9.0 RHS	37.7	1110	555	370	277	222	185	158	139	123	111	101	92.4	85.3	79.2	1180	8.55
6.0 RHS	28.2	794	397	265	199	159	132	113	99.3	88.3	79.4	72.2	66.2	61.1	56.7	812	8.86
5.0 RHS	22.1	677	339	226	169	135	113	96.8	84.7	75.3	67.7	61.6	56.5	52.1	48.4	684	8.96
4.0 RHS	17.9	554	277	185	139	111	92.4	79.2	69.3	61.6	55.4	50.4	46.2	42.6	39.6	553	9.06
150 x 100 x 6.0 RHS	21.4	508	254	169	127	102	84.6	72.5	63.5	56.4	50.8	46.2	42.3	39.1	36.3	606	11.4
5.0 RHS	18.2	435	218	145	109	87.0	72.5	62.2	54.4	48.3	43.5	39.6	36.3	33.5	31.1	512	11.6
4.0 RHS	14.8	358	179	119	89.4	71.5	59.6	51.1	44.7	39.7	35.8	32.5	29.8	27.5	25.6	416	11.7
150 x 50 x 5.0 RHS	14.2	298	149	99.4	74.5	59.6	49.7	42.6	37.3	33.1	29.8	27.1	24.8	22.9	21.3	492	2.93
4.0 RHS	11.6	247	124	82.4	61.8	49.5	41.2	35.3	30.9	27.5	24.7	22.5	20.6	19.0	17.7	399	3.00
3.0 RHS	8.96	194	97.2	64.8	48.6	38.9	32.4	27.8	24.3	21.6	19.4	17.7	16.2	15.0	13.9	304	3.07
125 x 75 x 6.0 RHS	16.7	318	159	106	79.6	63.7	53.1	45.5	39.8	35.4	31.8	28.9	26.5	24.5	22.7	493	7.62
5.0 RHS	14.2	275	137	91.7	68.7	55.0	45.8	39.3	34.4	30.6	27.5	25.0	22.9	21.2	19.6	418	7.75
4.0 RHS	11.6	228	114	75.9	57.0	45.6	38.0	32.5	28.5	25.3	22.8	20.7	19.0	17.5	16.3	340	7.87
3.0 RHS	8.96	179	89.3	59.5	44.7	35.7	29.8	25.5	22.3	19.8	17.9	16.2	14.9	13.7	12.8	260	8.00
100 x 50 x 6.0 RHS	12.0	171	85.7	57.1	42.8	34.3	28.6	24.5	21.4	19.0	17.1	15.6	14.3	13.2	12.2	380	4.12
5.0 RHS	10.3	150	75.1	50.1	37.6	30.1	25.0	21.5	18.8	16.7	15.0	13.7	12.5	11.6	10.7	324	4.23
4.0 RHS	8.49	126	63.1	42.1	31.6	25.3	21.0	18.0	15.8	14.0	12.6	11.5	10.5	9.71	9.02	265	4.33
3.5 RHS	7.53	113	56.6	37.7	28.3	22.6	18.9	16.2	14.1	12.6	11.3	10.3	9.43	8.71	8.08	234	4.38
3.0 RHS	6.60	101	50.4	33.6	25.2	20.2	16.8	14.4	12.6	11.2	10.1	9.16	8.40	7.75	7.20	203	4.44
2.5 RHS	5.56	85.7	42.8	28.6	21.4	17.1	14.3	12.2	10.7	9.52	8.57	7.79	7.14	6.59	6.12	171	4.49
2.0 RHS	4.50	69.9	35.0	23.3	17.5	14.0	11.7	9.99	8.74	7.77	6.99	6.36	5.83	5.38	5.00	138	4.53

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W^*_{L1} = 12 \phi M_s / L$
6. $W^*_{L2} = 2 \phi V_v$

@Seismicisolation

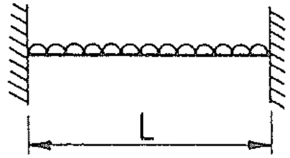
TABLE 8.3 – 3 (2)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

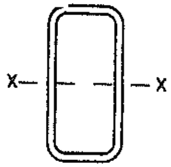
bending about x–axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 6.0 RHS	12.0	343	229	171	137	114	97.9	85.7	68.6	57.1	49.0	42.8	38.1	34.3	28.6	380	4.12
5.0 RHS	10.3	301	200	150	120	100	85.9	75.1	60.1	50.1	42.9	37.6	33.4	30.1	25.0	324	4.23
4.0 RHS	8.49	253	168	126	101	84.2	72.2	63.1	50.5	42.1	36.1	31.6	28.1	25.3	21.0	265	4.33
3.5 RHS	7.53	226	151	113	90.5	75.4	64.7	56.6	45.3	37.7	32.3	28.3	25.1	22.6	18.9	234	4.38
3.0 RHS	6.60	202	134	101	80.6	67.2	57.6	50.4	40.3	33.6	28.8	25.2	22.4	20.2	16.8	203	4.44
2.5 RHS	5.56	171	114	85.7	68.6	57.1	49.0	42.8	34.3	28.6	24.5	21.4	19.0	17.1	14.3	171	4.49
2.0 RHS	4.50	140	93.3	69.9	56.0	46.6	40.0	35.0	28.0	23.3	20.0	17.5	15.5	14.0	11.7	138	4.53
75 x 50 x 6.0 RHS	9.67	212	141	106	84.9	70.7	60.6	53.0	42.4	35.4	30.3	26.5	23.6	21.2	17.7	277	5.28
5.0 RHS	8.35	188	125	94.1	75.3	62.7	53.8	47.1	37.6	31.4	26.9	23.5	20.9	18.8	15.7	238	5.43
4.0 RHS	6.92	160	107	79.9	63.9	53.3	45.7	40.0	32.0	26.6	22.8	20.0	17.8	16.0	13.3	196	5.57
3.0 RHS	5.42	129	86.1	64.6	51.7	43.1	36.9	32.3	25.8	21.5	18.5	16.1	14.4	12.9	10.8	151	5.73
2.5 RHS	4.58	110	73.5	55.2	44.1	36.8	31.5	27.6	22.1	18.4	15.8	13.8	12.3	11.0	9.19	128	5.79
2.0 RHS	3.72	90.4	60.3	45.2	36.2	30.1	25.8	22.6	18.1	15.1	12.9	11.3	10.0	9.04	7.53	104	5.86
75 x 25 x 2.5 RHS	3.60	76.1	50.7	38.0	30.4	25.4	21.7	19.0	15.2	12.7	10.9	9.51	8.45	7.61	6.34	123	1.47
2.0 RHS	2.93	62.8	41.9	31.4	25.1	20.9	17.9	15.7	12.6	10.5	8.97	7.85	6.98	6.28	5.23	99.9	1.50
1.6 RHS	2.38	51.5	34.3	25.8	20.6	17.2	14.7	12.9	10.3	8.59	7.36	6.44	5.72	5.15	4.29	80.8	1.53
65 x 35 x 3.0 RHS	4.25	83.1	55.4	41.5	33.2	27.7	23.7	20.8	16.6	13.8	11.9	10.4	9.23	8.31	6.92	128	3.23
2.5 RHS	3.60	71.5	47.6	35.7	28.6	23.8	20.4	17.9	14.3	11.9	10.2	8.93	7.94	7.15	5.96	108	3.28
2.0 RHS	2.93	59.0	39.3	29.5	23.6	19.7	16.8	14.7	11.8	9.83	8.42	7.37	6.55	5.90	4.91	88.2	3.33
50 x 25 x 3.0 RHS	3.07	44.3	29.5	22.2	17.7	14.8	12.7	11.1	8.86	7.39	6.33	5.54	4.92	4.43	3.69	95.0	2.08
2.5 RHS	2.62	38.6	25.7	19.3	15.4	12.9	11.0	9.65	7.72	6.43	5.51	4.82	4.29	3.86	3.22	81.0	2.12
2.0 RHS	2.15	32.2	21.5	16.1	12.9	10.7	9.21	8.06	6.44	5.37	4.60	4.03	3.58	3.22	2.69	66.2	2.17
1.6 RHS	1.75	26.7	17.8	13.3	10.7	8.88	7.61	6.66	5.33	4.44	3.81	3.33	2.96	2.67	2.22	53.9	2.21
50 x 20 x 3.0 RHS	2.83	39.0	26.0	19.5	15.6	13.0	11.1	9.75	7.80	6.50	5.57	4.87	4.33	3.90	3.25	93.8	1.31
2.5 RHS	2.42	34.1	22.7	17.1	13.6	11.4	9.74	8.53	6.82	5.68	4.87	4.26	3.79	3.41	2.84	80.0	1.35
2.0 RHS	1.99	28.6	19.1	14.3	11.4	9.53	8.17	7.15	5.72	4.77	4.08	3.57	3.18	2.86	2.38	65.4	1.39
1.6 RHS	1.63	23.7	15.8	11.9	9.49	7.91	6.78	5.93	4.74	3.95	3.39	2.97	2.64	2.37	1.98	53.2	1.42

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W^*_{L1} = 12\,\phi\,M_s / L$
6. $W^*_{L2} = 2\,\phi\,V_v$



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C450

bending about x-axis

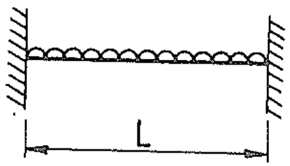


TABLE 8.3 – 4 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
125 x 75 x 3.8 RHS	11.1	280	140	93.4	70.0	56.0	46.7	40.0	35.0	31.1	28.0	25.5	23.3	21.6	20.0	417	6.14
3.3 RHS	9.73	248	124	82.5	61.9	49.5	41.3	35.4	30.9	27.5	24.8	22.5	20.6	19.0	17.7	365	6.19
2.8 RHS	8.39	203	102	67.8	50.8	40.7	33.9	29.0	25.4	22.6	20.3	18.5	16.9	15.6	14.5	313	6.24
2.3 RHS	6.95	147	73.5	49.0	36.8	29.4	24.5	21.0	18.4	16.3	14.7	13.4	12.3	11.3	10.5	259	6.29
100 x 50 x 3.3 RHS	7.14	138	69.2	46.2	34.6	27.7	23.1	19.8	17.3	15.4	13.8	12.6	11.5	10.7	9.89	285	3.42
2.8 RHS	6.19	122	61.0	40.6	30.5	24.4	20.3	17.4	15.2	13.5	12.2	11.1	10.2	9.38	8.71	245	3.47
2.3 RHS	5.14	102	51.1	34.1	25.5	20.4	17.0	14.6	12.8	11.4	10.2	9.29	8.52	7.86	7.30	203	3.50

Notes: Refer to 8.3–4 (2)(A)

TABLE 8.3 – 4 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

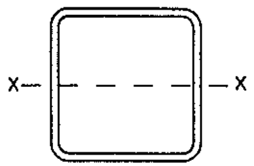
Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 3.3 RHS	7.14	277	185	138	111	92.3	79.1	69.2	55.4	46.2	39.6	34.6	30.8	27.7	23.1	285	3.42
2.8 RHS	6.19	244	163	122	97.5	81.3	69.7	61.0	48.8	40.6	34.8	30.5	27.1	24.4	20.3	245	3.47
2.3 RHS	5.14	204	136	102	81.8	68.1	58.4	51.1	40.9	34.1	29.2	25.5	22.7	20.4	17.0	203	3.50
75 x 50 x 2.8 RHS	5.09	157	104	78.3	62.6	52.2	44.7	39.1	31.3	26.1	22.4	19.6	17.4	15.7	13.0	183	4.48
2.3 RHS	4.24	132	87.8	65.9	52.7	43.9	37.6	32.9	26.4	22.0	18.8	16.5	14.6	13.2	11.0	152	4.53
65 x 35 x 2.8 RHS	3.99	101	67.3	50.5	40.4	33.7	28.9	25.2	20.2	16.8	14.4	12.6	11.2	10.1	8.42	155	2.53
2.3 RHS	3.34	85.6	57.1	42.8	34.2	28.5	24.5	21.4	17.1	14.3	12.2	10.7	9.51	8.56	7.13	129	2.57
50 x 25 x 2.8 RHS	2.89	54.1	36.1	27.1	21.7	18.0	15.5	13.5	10.8	9.02	7.73	6.77	6.02	5.41	4.51	115	1.63
2.3 RHS	2.44	46.4	31.0	23.2	18.6	15.5	13.3	11.6	9.29	7.74	6.64	5.81	5.16	4.64	3.87	96.7	1.67
50 x 20 x 2.8 RHS	2.67	47.7	31.8	23.9	19.1	15.9	13.6	11.9	9.54	7.95	6.82	5.96	5.30	4.77	3.98	114	1.03
2.3 RHS	2.25	41.1	27.4	20.6	16.4	13.7	11.7	10.3	8.22	6.85	5.87	5.14	4.57	4.11	3.43	95.4	1.06

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 12 \phi M_s / L$
6. $W^*_{L2} = 2 \phi V_v$

@Seismicisolation

@Seismicisolation

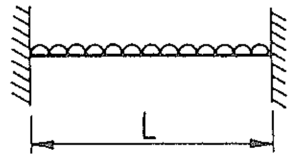
TABLE 8.3 – 5 (1)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C350

bending about x–axis

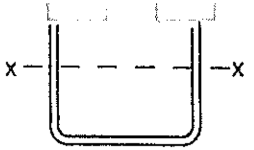


W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

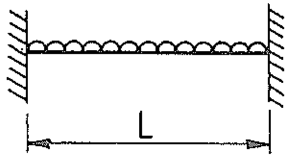
Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 250 x 9.0 SHS	65.9	2810	1410	938	703	563	469	402	352	313	281	256	234	216	201	1560	41.8
6.0 SHS	45.0	1540	772	515	386	309	257	221	193	172	154	140	129	119	110	1070	42.4
200 x 200 x 9.0 SHS	51.8	1760	880	586	440	352	293	251	220	195	176	160	147	135	126	1220	33.0
6.0 SHS	35.6	1110	555	370	278	222	185	159	139	123	111	101	92.5	85.4	79.3	842	33.7
5.0 SHS	29.9	841	420	280	210	168	140	120	105	93.4	84.1	76.4	70.1	64.7	60.1	709	33.9
150 x 150 x 9.0 SHS	37.7	938	469	313	235	188	156	134	117	104	93.8	85.3	78.2	72.2	67.0	887	24.3
6.0 SHS	26.2	671	336	224	168	134	112	95.9	83.9	74.6	67.1	61.0	55.9	51.6	47.9	618	24.9
5.0 SHS	22.1	546	273	182	137	109	91.0	78.0	68.3	60.7	54.6	49.6	45.5	42.0	39.0	523	25.2
125 x 125 x 9.0 SHS	30.6	623	312	208	156	125	104	89.1	77.9	69.3	62.3	56.7	52.0	48.0	44.5	719	19.9
6.0 SHS	21.4	453	227	151	113	90.7	75.6	64.8	56.7	50.4	45.3	41.2	37.8	34.9	32.4	506	20.6
5.0 SHS	18.2	388	194	129	97.1	77.7	64.7	55.5	48.5	43.2	38.8	35.3	32.4	29.9	27.7	429	20.8
4.0 SHS	14.8	298	149	99.4	74.5	59.6	49.7	42.6	37.3	33.1	29.8	27.1	24.8	22.9	21.3	349	21.0
100 x 100 x 9.0 SHS	23.5	373	186	124	93.1	74.5	62.1	53.2	46.6	41.4	37.3	33.9	31.0	28.7	26.6	551	15.5
6.0 SHS	16.7	278	139	92.7	69.5	55.6	46.3	39.7	34.7	30.9	27.8	25.3	23.2	21.4	19.9	394	16.2
5.0 SHS	14.2	240	120	80.0	60.0	48.0	40.0	34.3	30.0	26.7	24.0	21.8	20.0	18.5	17.1	336	16.4
4.0 SHS	11.6	199	99.4	66.3	49.7	39.8	33.1	28.4	24.9	22.1	19.9	18.1	16.6	15.3	14.2	275	16.6
3.0 SHS	8.96	140	70.1	46.8	35.1	28.1	23.4	20.0	17.5	15.6	14.0	12.8	11.7	10.8	10.0	211	16.9
89 x 89 x 6.0 SHS	14.6	214	107	71.3	53.4	42.8	35.6	30.5	26.7	23.8	21.4	19.4	17.8	16.4	15.3	345	14.2
5.0 SHS	12.5	186	92.8	61.9	46.4	37.1	30.9	26.5	23.2	20.6	18.6	16.9	15.5	14.3	13.3	295	14.5
3.5 SHS	9.06	138	68.9	45.9	34.5	27.6	23.0	19.7	17.2	15.3	13.8	12.5	11.5	10.6	9.84	214	14.8
75 x 75 x 6.0 SHS	12.0	145	72.6	48.4	36.3	29.0	24.2	20.7	18.1	16.1	14.5	13.2	12.1	11.2	10.4	282	11.8
5.0 SHS	10.3	127	63.6	42.4	31.8	25.4	21.2	18.2	15.9	14.1	12.7	11.6	10.6	9.78	9.08	243	12.0
4.0 SHS	8.49	107	53.4	35.6	26.7	21.4	17.8	15.3	13.3	11.9	10.7	9.71	8.90	8.21	7.63	200	12.2
3.5 SHS	7.53	95.6	47.8	31.9	23.9	19.1	15.9	13.7	12.0	10.6	9.56	8.69	7.97	7.36	6.83	178	12.4
3.0 SHS	6.60	85.0	42.5	28.3	21.2	17.0	14.2	12.1	10.6	9.44	8.50	7.73	7.08	6.54	6.07	155	12.5
2.5 SHS	5.56	69.0	34.5	23.0	17.3	13.8	11.5	9.86	8.63	7.67	6.90	6.28	5.75	5.31	4.93	131	12.6

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. ϕ = 0.9
3. α_m = 1.0
4. α_s = 1.0
5. $W^*_{L1} = 12\,\phi\,M_s / L$
6. $W^*_{L2} = 2\,\phi\,V_v$

@Seismicisolation
@Seismicisolation



FOR FIXED END BEAMS WITH FULL LATERAL RESTRAINT
SQUARE HOLLOW SECTIONS: GRADE C350
bending about x–axis

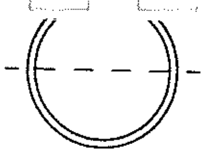


W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 6.0 SHS	12.0	290	194	145	116	96.8	83.0	72.6	58.1	48.4	41.5	36.3	32.3	29.0	24.2	282	11.8
5.0 SHS	10.3	254	170	127	102	84.8	72.7	63.6	50.9	42.4	36.3	31.8	28.3	25.4	21.2	243	12.0
4.0 SHS	8.49	214	142	107	85.4	71.2	61.0	53.4	42.7	35.6	30.5	26.7	23.7	21.4	17.8	200	12.2
3.5 SHS	7.53	191	128	95.6	76.5	63.8	54.7	47.8	38.3	31.9	27.3	23.9	21.3	19.1	15.9	178	12.4
3.0 SHS	6.60	170	113	85.0	68.0	56.7	48.6	42.5	34.0	28.3	24.3	21.2	18.9	17.0	14.2	155	12.5
2.5 SHS	5.56	138	92.0	69.0	55.2	46.0	39.4	34.5	27.6	23.0	19.7	17.3	15.3	13.8	11.5	131	12.6
65 x 65 x 6.0 SHS	10.1	208	139	104	83.2	69.3	59.4	52.0	41.6	34.7	29.7	26.0	23.1	20.8	17.3	237	10.0
5.0 SHS	8.75	184	123	91.9	73.6	61.3	52.5	46.0	36.8	30.6	26.3	23.0	20.4	18.4	15.3	205	10.3
4.0 SHS	7.23	156	104	77.9	62.3	51.9	44.5	38.9	31.1	26.0	22.2	19.5	17.3	15.6	13.0	170	10.5
3.0 SHS	5.66	125	83.5	62.6	50.1	41.8	35.8	31.3	25.1	20.9	17.9	15.7	13.9	12.5	10.4	132	10.8
2.5 SHS	4.78	107	71.3	53.5	42.8	35.6	30.5	26.7	21.4	17.8	15.3	13.4	11.9	10.7	8.91	112	10.9
2.0 SHS	3.88	80.0	53.3	40.0	32.0	26.7	22.9	20.0	16.0	13.3	11.4	10.0	8.89	8.00	6.67	91.1	11.0
50 x 50 x 5.0 SHS	6.39	99.5	66.3	49.7	39.8	33.2	28.4	24.9	19.9	16.6	14.2	12.4	11.1	9.95	8.29	149	7.61
4.0 SHS	5.35	86.0	57.4	43.0	34.4	28.7	24.6	21.5	17.2	14.3	12.3	10.8	9.56	8.60	7.17	125	7.85
3.0 SHS	4.25	71.0	47.3	35.5	28.4	23.7	20.3	17.7	14.2	11.8	10.1	8.87	7.89	7.10	5.91	98.6	8.13
2.5 SHS	3.60	61.0	40.7	30.5	24.4	20.3	17.4	15.3	12.2	10.2	8.72	7.63	6.78	6.10	5.09	84.0	8.24
2.0 SHS	2.93	50.4	33.6	25.2	20.1	16.8	14.4	12.6	10.1	8.39	7.20	6.30	5.60	5.04	4.20	68.7	8.34
1.6 SHS	2.38	38.6	25.7	19.3	15.4	12.9	11.0	9.64	7.71	6.43	5.51	4.82	4.29	3.86	3.21	55.9	8.42
40 x 40 x 4.0 SHS	4.09	50.9	33.9	25.5	20.4	17.0	14.5	12.7	10.2	8.49	7.27	6.37	5.66	5.09	4.24	95.6	6.09
3.0 SHS	3.30	43.3	28.8	21.6	17.3	14.4	12.4	10.8	8.65	7.21	6.18	5.41	4.81	4.33	3.61	76.2	6.38
2.5 SHS	2.82	37.5	25.0	18.8	15.0	12.5	10.7	9.39	7.51	6.26	5.36	4.69	4.17	3.75	3.13	65.3	6.48
2.0 SHS	2.31	31.3	20.8	15.6	12.5	10.4	8.93	7.81	6.25	5.21	4.46	3.91	3.47	3.13	2.60	53.8	6.59
1.6 SHS	1.88	25.8	17.2	12.9	10.3	8.60	7.37	6.45	5.16	4.30	3.68	3.22	2.87	2.58	2.15	44.0	6.67
35 x 35 x 3.0 SHS	2.83	32.0	21.3	16.0	12.8	10.7	9.13	7.99	6.39	5.33	4.57	4.00	3.55	3.20	2.66	65.0	5.50
2.5 SHS	2.42	27.9	18.6	14.0	11.2	9.31	7.98	6.98	5.59	4.66	3.99	3.49	3.10	2.79	2.33	56.0	5.61
2.0 SHS	1.99	23.4	15.6	11.7	9.36	7.80	6.68	5.85	4.68	3.90	3.34	2.92	2.60	2.34	1.95	46.3	5.71
1.6 SHS	1.63	19.4	12.9	9.70	7.76	6.47	5.54	4.85	3.88	3.23	2.77	2.42	2.16	1.94	1.62	38.0	5.80
30 x 30 x 3.0 SHS	2.36	22.4	14.9	11.2	8.95	7.46	6.39	5.59	4.47	3.73	3.20	2.80	2.49	2.24	1.86	53.8	4.63
2.5 SHS	2.03	19.7	13.2	9.87	7.89	6.58	5.64	4.93	3.95	3.29	2.82	2.47	2.19	1.97	1.64	46.7	4.73
2.0 SHS	1.68	16.7	11.1	8.34	6.67	5.56	4.76	4.17	3.33	2.78	2.38	2.08	1.85	1.67	1.39	38.8	4.84
1.6 SHS	1.38	13.9	9.28	6.96	5.57	4.64	3.98	3.48	2.78	2.32	1.99	1.74	1.55	1.39	1.16	32.0	4.92
25 x 25 x 3.0 SHS	1.89	14.5	9.65	7.24	5.79	4.83	4.14	3.62	2.90	2.41	2.07	1.81	1.61	1.45	1.21	42.6	3.75
2.5 SHS	1.64	12.9	8.63	6.47	5.18	4.32	3.70	3.24	2.59	2.16	1.85	1.62	1.44	1.29	1.08	37.3	3.85
2.0 SHS	1.36	11.1	7.39	5.54	4.43	3.69	3.17	2.77	2.22	1.85	1.58	1.39	1.23	1.11	0.924	31.4	3.96
1.6 SHS	1.12	9.34	6.23	4.67	3.74	3.11	2.67	2.34	1.87	1.56	1.33	1.17	1.04	0.934	0.779	26.0	4.04
20 x 20 x 1.6 SHS	0.873	5.67	3.78	2.84	2.27	1.89	1.62	1.42	1.13	0.946	0.811	0.709	0.631	0.567	0.473	20.1	3.17

Notes: Refer to TABLE 8.3–5 (1)(A)

@Seismicisolation



FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C250
bending about any axis

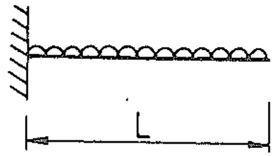


TABLE 8.4 – 1 (1)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	kN
610.0 x 12.7 CHS	187	2040	1020	680	510	408	340	291	255	227	204	170	146	127	1930
9.5 CHS	141	1470	735	490	368	294	245	210	184	163	147	123	105	91.9	1450
6.4 CHS	95.3	898	449	299	224	180	150	128	112	99.8	89.8	74.8	64.1	56.1	983
508.0 x 12.7 CHS	155	1400	701	467	351	280	234	200	175	156	140	117	100	87.6	1600
9.5 CHS	117	1050	525	350	263	210	175	150	131	117	105	87.5	75.0	65.6	1210
6.4 CHS	79.2	656	328	219	164	131	109	93.8	82.1	72.9	65.6	54.7	46.9	41.0	817

Notes: Refer to TABLE 8.4–1 (3)(A)

TABLE 8.4 – 1 (2)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d_o × t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres													W_{L2}^*
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
165.1 x 5.4 CHS	21.3	124	62.0	41.3	31.0	24.8	20.7	17.7	15.5	12.4	10.3	8.86	7.75	6.89	219
5.0 CHS	19.7	115	57.7	38.5	28.8	23.1	19.2	16.5	14.4	11.5	9.62	8.24	7.21	6.41	204
139.7 x 5.4 CHS	17.9	87.7	43.9	29.2	21.9	17.5	14.6	12.5	11.0	8.77	7.31	6.26	5.48	4.87	185
5.0 CHS	16.6	81.7	40.8	27.2	20.4	16.3	13.6	11.7	10.2	8.17	6.81	5.83	5.11	4.54	171
114.3 x 5.4 CHS	14.5	57.7	28.8	19.2	14.4	11.5	9.61	8.24	7.21	5.77	4.81	4.12	3.61	3.20	150
4.5 CHS	12.2	48.9	24.4	16.3	12.2	9.77	8.14	6.98	6.11	4.89	4.07	3.49	3.05	2.71	126
101.6 x 5.0 CHS	11.9	42.0	21.0	14.0	10.5	8.41	7.00	6.00	5.25	4.20	3.50	3.00	2.63	2.33	123
4.0 CHS	9.63	34.3	17.2	11.4	8.58	6.86	5.72	4.90	4.29	3.43	2.86	2.45	2.14	1.91	99.3
88.9 x 5.9 CHS	12.1	36.6	18.3	12.2	9.16	7.33	6.11	5.23	4.58	3.66	3.05	2.62	2.29	2.04	125
5.0 CHS	10.3	31.7	15.9	10.6	7.93	6.34	5.29	4.53	3.96	3.17	2.64	2.27	1.98	1.76	107
4.0 CHS	8.38	26.0	13.0	8.66	6.49	5.19	4.33	3.71	3.25	2.60	2.16	1.85	1.62	1.44	86.4
76.1 x 5.9 CHS	10.2	26.2	13.1	8.74	6.56	5.25	4.37	3.75	3.28	2.62	2.19	1.87	1.64	1.46	105
4.5 CHS	7.95	20.8	10.4	6.93	5.20	4.16	3.46	2.97	2.60	2.08	1.73	1.48	1.30	1.15	82.0
3.6 CHS	6.44	17.0	8.52	5.68	4.26	3.41	2.84	2.43	2.13	1.70	1.42	1.22	1.07	0.947	66.4

Notes: Refer to TABLE 8.4–1 (3)(A)

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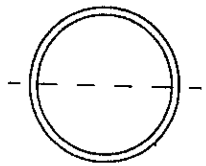
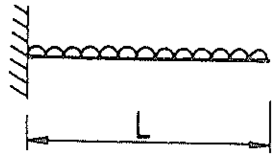
TABLE 8.4 – 2 (2)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT CIRCULAR HOLLOW SECTIONS: GRADE C350

bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o × t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	kN
168.3 x 7.1 CHS	28.2	233	116	77.5	58.2	46.5	38.8	33.2	29.1	23.3	19.4	16.6	14.5	12.9	408
6.4 CHS	25.6	211	106	70.5	52.9	42.3	35.2	30.2	26.4	21.1	17.6	15.1	13.2	11.7	369
4.8 CHS	19.4	162	80.9	53.9	40.4	32.3	27.0	23.1	20.2	16.2	13.5	11.6	10.1	8.98	280
165.1 x 3.5 CHS	13.9	109	54.5	36.4	27.3	21.8	18.2	15.6	13.6	10.9	9.09	7.79	6.82	6.06	201
3.0 CHS	12.0	90.6	45.3	30.2	22.6	18.1	15.1	12.9	11.3	9.06	7.55	6.47	5.66	5.03	173
139.7 x 3.5 CHS	11.8	80.2	40.1	26.7	20.1	16.0	13.4	11.5	10.0	8.02	6.68	5.73	5.01	4.46	170
3.0 CHS	10.1	67.1	33.6	22.4	16.8	13.4	11.2	9.59	8.39	6.71	5.59	4.79	4.19	3.73	146
114.3 x 6.0 CHS	16.0	88.8	44.4	29.6	22.2	17.8	14.8	12.7	11.1	8.88	7.40	6.34	5.55	4.93	231
4.8 CHS	13.0	72.6	36.3	24.2	18.1	14.5	12.1	10.4	9.07	7.26	6.05	5.18	4.54	4.03	187
3.6 CHS	9.83	55.6	27.8	18.5	13.9	11.1	9.27	7.94	6.95	5.56	4.63	3.97	3.48	3.09	142
3.2 CHS	8.77	49.8	24.9	16.6	12.4	9.96	8.30	7.11	6.22	4.98	4.15	3.56	3.11	2.77	127
101.6 x 3.2 CHS	7.77	39.1	19.5	13.0	9.76	7.81	6.51	5.58	4.88	3.91	3.25	2.79	2.44	2.17	112
2.6 CHS	6.35	31.6	15.8	10.5	7.90	6.32	5.27	4.52	3.95	3.16	2.63	2.26	1.98	1.76	91.7
88.9 x 5.5 CHS	11.3	48.3	24.1	16.1	12.1	9.65	8.05	6.90	6.03	4.83	4.02	3.45	3.02	2.68	163
4.8 CHS	9.96	42.8	21.4	14.3	10.7	8.56	7.14	6.12	5.35	4.28	3.57	3.06	2.68	2.38	144
3.2 CHS	6.76	29.6	14.8	9.88	7.41	5.93	4.94	4.23	3.70	2.96	2.47	2.12	1.85	1.65	97.7
2.6 CHS	5.53	24.4	12.2	8.14	6.10	4.88	4.07	3.49	3.05	2.44	2.03	1.74	1.53	1.36	79.9
76.1 x 3.2 CHS	5.75	21.4	10.7	7.15	5.36	4.29	3.57	3.06	2.68	2.14	1.79	1.53	1.34	1.19	83.1
2.3 CHS	4.19	15.8	7.89	5.26	3.95	3.16	2.63	2.26	1.97	1.58	1.32	1.13	0.987	0.877	60.5

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 2\phi M_s / L$
5. $W^*_{L2} = \phi V_v$

@Seismicisolation

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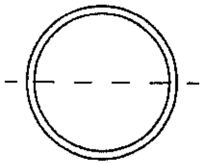
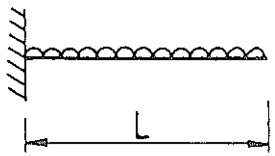


TABLE 8.4 – 2 (3)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS
FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT
CIRCULAR HOLLOW SECTIONS: GRADE C350
bending about any axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d_o t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres													W^*_{L2}
mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	kN
76.1 x 3.2 CHS	5.75	42.9	21.4	14.3	10.7	8.58	7.15	6.13	5.36	4.29	3.57	3.06	2.68	2.14	83.1
2.3 CHS	4.19	31.6	15.8	10.5	7.89	6.32	5.26	4.51	3.95	3.16	2.63	2.26	1.97	1.58	60.5
60.3 x 2.9 CHS	4.11	24.1	12.0	8.03	6.02	4.82	4.02	3.44	3.01	2.41	2.01	1.72	1.51	1.20	59.3
2.3 CHS	3.29	19.5	9.75	6.50	4.88	3.90	3.25	2.79	2.44	1.95	1.63	1.39	1.22	0.975	47.5
48.3 x 2.9 CHS	3.25	15.1	7.54	5.03	3.77	3.02	2.51	2.15	1.89	1.51	1.26	1.08	0.943	0.754	46.9
2.3 CHS	2.61	12.3	6.14	4.09	3.07	2.45	2.05	1.75	1.53	1.23	1.02	0.877	0.767	0.614	37.7
42.4 x 2.6 CHS	2.55	10.4	5.20	3.46	2.60	2.08	1.73	1.48	1.30	1.04	0.866	0.742	0.650	0.520	36.9
2.0 CHS	1.99	8.23	4.12	2.74	2.06	1.65	1.37	1.18	1.03	0.823	0.686	0.588	0.515	0.412	28.8
33.7 x 2.6 CHS	1.99	6.35	3.18	2.12	1.59	1.27	1.06	0.907	0.794	0.635	0.529	0.454	0.397	0.318	28.8
2.0 CHS	1.56	5.07	2.54	1.69	1.27	1.01	0.845	0.724	0.634	0.507	0.423	0.362	0.317	0.254	22.6
26.9 x 2.3 CHS	1.40	3.52	1.76	1.17	0.879	0.704	0.586	0.503	0.440	0.352	0.293	0.251	0.220	0.176	20.2
2.0 CHS	1.23	3.13	1.57	1.04	0.783	0.626	0.522	0.447	0.391	0.313	0.261	0.224	0.196	0.157	17.7
21.3 x 2.0 CHS	0.952	1.88	0.942	0.628	0.471	0.377	0.314	0.269	0.236	0.188	0.157	0.135	0.118	0.0942	13.8

Notes:
1. $\phi = 0.9$
2. $\alpha_m = 1.0$
3. $\alpha_s = 1.0$
4. $W^*_{L1} = 2\phi M_s / L$
5. $W^*_{L2} = \phi V_v$

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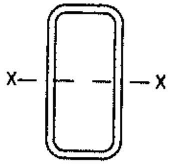
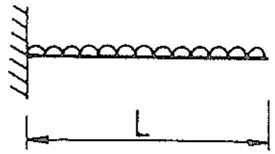
TABLE 8.4 – 3 (1)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR **CANTILEVER BEAMS** WITH FULL LATERAL RESTRAINT
RECTANGULAR HOLLOW SECTIONS: GRADE C350
bending about x–axis



W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
250 x 150 x 9.0 RHS	51.8	336	168	112	84.0	67.2	56.0	48.0	42.0	37.3	33.6	30.5	28.0	25.8	24.0	759	15.6
6.0 RHS	35.6	236	118	78.6	58.9	47.1	39.3	33.7	29.5	26.2	23.6	21.4	19.6	18.1	16.8	519	16.0
5.0 RHS	29.9	189	94.4	62.9	47.2	37.8	31.5	27.0	23.6	21.0	18.9	17.2	15.7	14.5	13.5	436	16.1
200 x 100 x 9.0 RHS	37.7	185	92.4	61.6	46.2	37.0	30.8	26.4	23.1	20.5	18.5	16.8	15.4	14.2	13.2	590	8.55
6.0 RHS	26.2	132	66.2	44.1	33.1	26.5	22.1	18.9	16.6	14.7	13.2	12.0	11.0	10.2	9.46	406	8.86
5.0 RHS	22.1	113	56.5	37.6	28.2	22.6	18.8	16.1	14.1	12.5	11.3	10.3	9.41	8.69	8.06	342	8.96
4.0 RHS	17.9	92.4	46.2	30.8	23.1	18.5	15.4	13.2	11.5	10.3	9.24	8.40	7.70	7.11	6.60	276	9.06
150 x 100 x 6.0 RHS	21.4	84.6	42.3	28.2	21.2	16.9	14.1	12.1	10.6	9.40	8.46	7.69	7.05	6.51	6.05	303	11.4
5.0 RHS	18.2	72.5	36.3	24.2	18.1	14.5	12.1	10.4	9.07	8.06	7.25	6.59	6.04	5.58	5.18	256	11.6
4.0 RHS	14.8	59.6	29.8	19.9	14.9	11.9	9.94	8.52	7.45	6.62	5.96	5.42	4.97	4.59	4.26	208	11.7
150 x 50 x 5.0 RHS	14.2	49.7	24.8	16.6	12.4	9.94	8.28	7.10	6.21	5.52	4.97	4.52	4.14	3.82	3.55	246	2.93
4.0 RHS	11.6	41.2	20.6	13.7	10.3	8.24	6.87	5.89	5.15	4.58	4.12	3.75	3.44	3.17	2.94	200	3.00
3.0 RHS	8.96	32.4	16.2	10.8	8.10	6.48	5.40	4.63	4.05	3.60	3.24	2.95	2.70	2.49	2.31	152	3.07
125 x 75 x 6.0 RHS	16.7	53.1	26.5	17.7	13.3	10.6	8.84	7.58	6.63	5.90	5.31	4.82	4.42	4.08	3.79	247	7.62
5.0 RHS	14.2	45.8	22.9	15.3	11.5	9.17	7.64	6.55	5.73	5.09	4.58	4.17	3.82	3.53	3.27	209	7.75
4.0 RHS	11.6	38.0	19.0	12.7	9.49	7.59	6.33	5.42	4.75	4.22	3.80	3.45	3.16	2.92	2.71	170	7.87
3.0 RHS	8.96	29.8	14.9	9.92	7.44	5.95	4.96	4.25	3.72	3.31	2.98	2.71	2.48	2.29	2.13	130	8.00
100 x 50 x 6.0 RHS	12.0	28.6	14.3	9.52	7.14	5.71	4.76	4.08	3.57	3.17	2.86	2.60	2.38	2.20	2.04	190	4.12
5.0 RHS	10.3	25.0	12.5	8.35	6.26	5.01	4.17	3.58	3.13	2.78	2.50	2.28	2.09	1.93	1.79	162	4.23
4.0 RHS	8.49	21.0	10.5	7.02	5.26	4.21	3.51	3.01	2.63	2.34	2.10	1.91	1.75	1.62	1.50	132	4.33
3.5 RHS	7.53	18.9	9.43	6.29	4.72	3.77	3.14	2.69	2.36	2.10	1.89	1.71	1.57	1.45	1.35	117	4.38
3.0 RHS	6.60	16.8	8.40	5.60	4.20	3.36	2.80	2.40	2.10	1.87	1.68	1.53	1.40	1.29	1.20	102	4.44
2.5 RHS	5.56	14.3	7.14	4.76	3.57	2.86	2.38	2.04	1.79	1.59	1.43	1.30	1.19	1.10	1.02	85.5	4.49
2.0 RHS	4.50	11.7	5.83	3.89	2.91	2.33	1.94	1.67	1.46	1.30	1.17	1.06	0.972	0.897	0.833	69.1	4.53

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W^*_{L1} = 2\,\phi M_s / L$
6. $W^*_{L2} = \phi V_v$

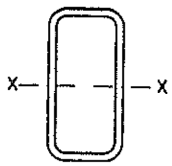


TABLE 8.4 – 3 (2)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT

RECTANGULAR HOLLOW SECTIONS: GRADE C350

bending about x-axis

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres														W_{L2}^*	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 6.0 RHS	12.0	57.1	38.1	28.6	22.9	19.0	16.3	14.3	11.4	9.52	8.16	7.14	6.35	5.71	4.76	190	4.12
5.0 RHS	10.3	50.1	33.4	25.0	20.0	16.7	14.3	12.5	10.0	8.35	7.16	6.26	5.57	5.01	4.17	162	4.23
4.0 RHS	8.49	42.1	28.1	21.0	16.8	14.0	12.0	10.5	8.42	7.02	6.01	5.26	4.68	4.21	3.51	132	4.33
3.5 RHS	7.53	37.7	25.1	18.9	15.1	12.6	10.8	9.43	7.54	6.29	5.39	4.72	4.19	3.77	3.14	117	4.38
3.0 RHS	6.60	33.6	22.4	16.8	13.4	11.2	9.60	8.40	6.72	5.60	4.80	4.20	3.73	3.36	2.80	102	4.44
2.5 RHS	5.56	28.6	19.0	14.3	11.4	9.52	8.16	7.14	5.71	4.76	4.08	3.57	3.17	2.86	2.38	85.5	4.49
2.0 RHS	4.50	23.3	15.5	11.7	9.33	7.77	6.66	5.83	4.66	3.89	3.33	2.91	2.59	2.33	1.94	69.1	4.53
75 x 50 x 6.0 RHS	9.67	35.4	23.6	17.7	14.1	11.8	10.1	8.84	7.07	5.89	5.05	4.42	3.93	3.54	2.95	138	5.28
5.0 RHS	8.35	31.4	20.9	15.7	12.5	10.5	8.96	7.84	6.27	5.23	4.48	3.92	3.49	3.14	2.61	119	5.43
4.0 RHS	6.92	26.6	17.8	13.3	10.7	8.88	7.61	6.66	5.33	4.44	3.81	3.33	2.96	2.66	2.22	98.0	5.57
3.0 RHS	5.42	21.5	14.4	10.8	8.61	7.18	6.15	5.38	4.31	3.59	3.08	2.69	2.39	2.15	1.79	75.7	5.73
2.5 RHS	4.58	18.4	12.3	9.19	7.35	6.13	5.25	4.60	3.68	3.06	2.63	2.30	2.04	1.84	1.53	64.0	5.79
2.0 RHS	3.72	15.1	10.0	7.53	6.03	5.02	4.31	3.77	3.01	2.51	2.15	1.88	1.67	1.51	1.26	51.9	5.86
75 x 25 x 2.5 RHS	3.60	12.7	8.45	6.34	5.07	4.23	3.62	3.17	2.54	2.11	1.81	1.58	1.41	1.27	1.06	61.5	1.47
2.0 RHS	2.93	10.5	6.98	5.23	4.19	3.49	2.99	2.62	2.09	1.74	1.50	1.31	1.16	1.05	0.872	49.9	1.50
1.6 RHS	2.38	8.59	5.72	4.29	3.43	2.86	2.45	2.15	1.72	1.43	1.23	1.07	0.954	0.859	0.716	40.4	1.53
65 x 35 x 3.0 RHS	4.25	13.8	9.23	6.92	5.54	4.62	3.96	3.46	2.77	2.31	1.98	1.73	1.54	1.38	1.15	64.0	3.23
2.5 RHS	3.60	11.9	7.94	5.96	4.76	3.97	3.40	2.98	2.38	1.99	1.70	1.49	1.32	1.19	0.993	54.2	3.28
2.0 RHS	2.93	9.83	6.55	4.91	3.93	3.28	2.81	2.46	1.97	1.64	1.40	1.23	1.09	0.983	0.819	44.1	3.33
50 x 25 x 3.0 RHS	3.07	7.39	4.92	3.69	2.95	2.46	2.11	1.85	1.48	1.23	1.06	0.923	0.821	0.739	0.616	47.5	2.08
2.5 RHS	2.62	6.43	4.29	3.22	2.57	2.14	1.84	1.61	1.29	1.07	0.919	0.804	0.715	0.643	0.536	40.5	2.12
2.0 RHS	2.15	5.37	3.58	2.69	2.15	1.79	1.53	1.34	1.07	0.895	0.767	0.671	0.597	0.537	0.448	33.1	2.17
1.6 RHS	1.75	4.44	2.96	2.22	1.78	1.48	1.27	1.11	0.888	0.740	0.635	0.555	0.494	0.444	0.370	27.0	2.21
50 x 20 x 3.0 RHS	2.83	6.50	4.33	3.25	2.60	2.17	1.86	1.62	1.30	1.08	0.928	0.812	0.722	0.650	0.542	46.9	1.31
2.5 RHS	2.42	5.68	3.79	2.84	2.27	1.89	1.62	1.42	1.14	0.947	0.812	0.711	0.632	0.568	0.474	40.0	1.35
2.0 RHS	1.99	4.77	3.18	2.38	1.91	1.59	1.36	1.19	0.953	0.794	0.681	0.596	0.530	0.477	0.397	32.7	1.39
1.6 RHS	1.63	3.95	2.64	1.98	1.58	1.32	1.13	0.989	0.791	0.659	0.565	0.494	0.439	0.395	0.330	26.6	1.42

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W_{L1}^* = 2\,\phi M_s / L$
6. $W_{L2}^* = \phi V_v$

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RECTANGULAR HOLLOW SECTIONS: GRADE C450
bending about x–axis

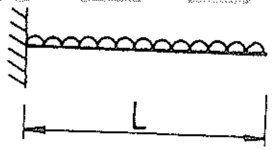

TABLE 8.4 – 4 (1)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres														W_{L2}^*	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
125 x 75 x 3.8 RHS	11.1	46.7	23.3	15.6	11.7	9.34	7.78	6.67	5.84	5.19	4.67	4.25	3.89	3.59	3.34	209	6.14
3.3 RHS	9.73	41.3	20.6	13.8	10.3	8.25	6.88	5.89	5.16	4.58	4.13	3.75	3.44	3.17	2.95	183	6.19
2.8 RHS	8.39	33.9	16.9	11.3	8.47	6.78	5.65	4.84	4.24	3.76	3.39	3.08	2.82	2.61	2.42	156	6.24
2.3 RHS	6.95	24.3	12.3	8.17	6.13	4.90	4.08	3.50	3.06	2.72	2.45	2.23	2.04	1.88	1.75	129	6.29
100 x 50 x 3.3 RHS	7.14	23.1	11.5	7.69	5.77	4.62	3.85	3.30	2.89	2.56	2.31	2.10	1.92	1.78	1.65	143	3.42
2.8 RHS	6.19	20.3	10.2	6.77	5.08	4.06	3.39	2.90	2.54	2.26	2.03	1.85	1.69	1.56	1.45	122	3.47
2.3 RHS	5.14	17.0	8.52	5.68	4.26	3.41	2.84	2.43	2.13	1.89	1.70	1.55	1.42	1.31	1.22	102	3.50

Notes: Refer to TABLE 8.4–4 (2)(A)

TABLE 8.4 – 4 (2)(A)

W_{L1}^* = Maximum Design Load based on Design Moment Capacity
W_{L2}^* = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W_L^* is LESSER of W_{L1}^* and W_{L2}^*

Designation d b t	Mass per m	W_{L1}^* (kN) Span of Beam (L) in metres														W_{L2}^*	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
100 x 50 x 3.3 RHS	7.14	46.2	30.8	23.1	18.5	15.4	13.2	11.5	9.23	7.69	6.59	5.77	5.13	4.62	3.85	143	3.42
2.8 RHS	6.19	40.6	27.1	20.3	16.3	13.5	11.6	10.2	8.13	6.77	5.81	5.08	4.52	4.06	3.39	122	3.47
2.3 RHS	5.14	34.1	22.7	17.0	13.6	11.4	9.73	8.52	6.81	5.68	4.87	4.26	3.78	3.41	2.84	102	3.50
75 x 50 x 2.8 RHS	5.09	26.1	17.4	13.0	10.4	8.70	7.45	6.52	5.22	4.35	3.73	3.26	2.90	2.61	2.17	91.4	4.48
2.3 RHS	4.24	22.0	14.6	11.0	8.78	7.32	6.27	5.49	4.39	3.66	3.14	2.74	2.44	2.20	1.83	76.2	4.53
65 x 35 x 2.8 RHS	3.99	16.8	11.2	8.42	6.73	5.61	4.81	4.21	3.37	2.81	2.40	2.10	1.87	1.68	1.40	77.3	2.53
2.3 RHS	3.34	14.3	9.51	7.13	5.71	4.76	4.08	3.57	2.85	2.38	2.04	1.78	1.59	1.43	1.19	64.6	2.57
50 x 25 x 2.8 RHS	2.89	9.02	6.02	4.51	3.61	3.01	2.58	2.26	1.80	1.50	1.29	1.13	1.00	0.902	0.752	57.5	1.63
2.3 RHS	2.44	7.74	5.16	3.87	3.10	2.58	2.21	1.94	1.55	1.29	1.11	0.968	0.860	0.774	0.645	48.3	1.67
50 x 20 x 2.8 RHS	2.67	7.95	5.30	3.98	3.18	2.65	2.27	1.99	1.59	1.33	1.14	0.994	0.884	0.795	0.663	56.8	1.03
2.3 RHS	2.25	6.85	4.57	3.43	2.74	2.28	1.96	1.71	1.37	1.14	0.979	0.857	0.761	0.685	0.571	47.7	1.06

Notes:
1. FLR – segment length for Full Lateral Restraint (Clause 5.3.2.4 of AS 4100) with $\beta_m = -0.8$
2. $\phi = 0.9$
3. $\alpha_m = 1.0$
4. $\alpha_s = 1.0$
5. $W_{L1}^* = 2\,\phi M_s / L$
6. $W_{L2}^* = \phi V_v$

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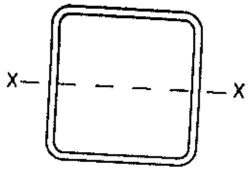
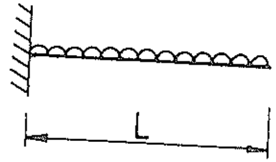
TABLE 8.4 – 5 (2)(A)

STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C350

bending about x–axis

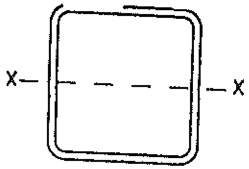




W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.50	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 6.0 SHS	12.0	48.4	32.3	24.2	19.4	16.1	13.8	12.1	9.68	8.07	6.91	6.05	5.38	4.84	4.03	141	11.8
5.0 SHS	10.3	42.4	28.3	21.2	17.0	14.1	12.1	10.6	8.48	7.07	6.06	5.30	4.71	4.24	3.53	121	12.0
4.0 SHS	8.49	35.6	23.7	17.8	14.2	11.9	10.2	8.90	7.12	5.93	5.08	4.45	3.95	3.56	2.97	100	12.2
3.5 SHS	7.53	31.9	21.3	15.9	12.8	10.6	9.11	7.97	6.38	5.31	4.55	3.98	3.54	3.19	2.66	88.9	12.4
3.0 SHS	6.60	28.3	18.9	14.2	11.3	9.44	8.09	7.08	5.67	4.72	4.05	3.54	3.15	2.83	2.36	77.3	12.5
2.5 SHS	5.56	23.0	15.3	11.5	9.20	7.67	6.57	5.75	4.60	3.83	3.29	2.88	2.56	2.30	1.92	65.3	12.6
65 x 65 x 6.0 SHS	10.1	34.7	23.1	17.3	13.9	11.6	9.90	8.67	6.93	5.78	4.95	4.33	3.85	3.47	2.89	119	10.0
5.0 SHS	8.75	30.6	20.4	15.3	12.3	10.2	8.76	7.66	6.13	5.11	4.38	3.83	3.41	3.06	2.55	103	10.3
4.0 SHS	7.23	26.0	17.3	13.0	10.4	8.65	7.42	6.49	5.19	4.33	3.71	3.24	2.88	2.60	2.16	85.1	10.5
3.0 SHS	5.66	20.9	13.9	10.4	8.35	6.96	5.97	5.22	4.18	3.48	2.98	2.61	2.32	2.09	1.74	66.1	10.8
2.5 SHS	4.78	17.8	11.9	8.91	7.13	5.94	5.09	4.45	3.56	2.97	2.55	2.23	1.98	1.78	1.48	56.0	10.9
2.0 SHS	3.88	13.3	8.89	6.67	5.33	4.44	3.81	3.33	2.67	2.22	1.90	1.67	1.48	1.33	1.11	45.5	11.0
50 x 50 x 5.0 SHS	6.39	16.6	11.1	8.29	6.63	5.53	4.74	4.14	3.32	2.76	2.37	2.07	1.84	1.66	1.38	74.7	7.61
4.0 SHS	5.35	14.3	9.56	7.17	5.74	4.78	4.10	3.59	2.87	2.39	2.05	1.79	1.59	1.43	1.20	62.7	7.85
3.0 SHS	4.25	11.8	7.89	5.91	4.73	3.94	3.38	2.96	2.37	1.97	1.69	1.48	1.31	1.18	0.986	49.3	8.13
2.5 SHS	3.60	10.2	6.78	5.09	4.07	3.39	2.91	2.54	2.03	1.70	1.45	1.27	1.13	1.02	0.848	42.0	8.24
2.0 SHS	2.93	8.39	5.60	4.20	3.36	2.80	2.40	2.10	1.68	1.40	1.20	1.05	0.933	0.839	0.700	34.3	8.34
1.6 SHS	2.38	6.43	4.29	3.21	2.57	2.14	1.84	1.61	1.29	1.07	0.918	0.804	0.714	0.643	0.536	28.0	8.42
40 x 40 x 4.0 SHS	4.09	8.49	5.66	4.24	3.39	2.83	2.42	2.12	1.70	1.41	1.21	1.06	0.943	0.849	0.707	47.8	6.09
3.0 SHS	3.30	7.21	4.81	3.61	2.88	2.40	2.06	1.80	1.44	1.20	1.03	0.901	0.801	0.721	0.601	38.1	6.38
2.5 SHS	2.82	6.26	4.17	3.13	2.50	2.09	1.79	1.56	1.25	1.04	0.894	0.782	0.695	0.626	0.522	32.7	6.48
2.0 SHS	2.31	5.21	3.47	2.60	2.08	1.74	1.49	1.30	1.04	0.868	0.744	0.651	0.579	0.521	0.434	26.9	6.59
1.6 SHS	1.88	4.30	2.87	2.15	1.72	1.43	1.23	1.07	0.860	0.716	0.614	0.537	0.478	0.430	0.358	22.0	6.67
35 x 35 x 3.0 SHS	2.83	5.33	3.55	2.66	2.13	1.78	1.52	1.33	1.07	0.888	0.761	0.666	0.592	0.533	0.444	32.5	5.50
2.5 SHS	2.42	4.66	3.10	2.33	1.86	1.55	1.33	1.16	0.931	0.776	0.665	0.582	0.517	0.466	0.388	28.0	5.61
2.0 SHS	1.99	3.90	2.60	1.95	1.56	1.30	1.11	0.975	0.780	0.650	0.557	0.487	0.433	0.390	0.325	23.1	5.71
1.6 SHS	1.63	3.23	2.16	1.62	1.29	1.08	0.924	0.808	0.647	0.539	0.462	0.404	0.359	0.323	0.269	19.0	5.80
30 x 30 x 3.0 SHS	2.36	3.73	2.49	1.86	1.49	1.24	1.07	0.932	0.746	0.621	0.533	0.466	0.414	0.373	0.311	26.9	4.63
2.5 SHS	2.03	3.29	2.19	1.64	1.32	1.10	0.940	0.822	0.658	0.548	0.470	0.411	0.365	0.329	0.274	23.3	4.73
2.0 SHS	1.68	2.78	1.85	1.39	1.11	0.926	0.794	0.695	0.556	0.463	0.397	0.347	0.309	0.278	0.232	19.4	4.84
1.6 SHS	1.38	2.32	1.55	1.16	0.928	0.773	0.663	0.580	0.464	0.387	0.331	0.290	0.258	0.232	0.193	16.0	4.92
25 x 25 x 3.0 SHS	1.89	2.41	1.61	1.21	0.965	0.804	0.689	0.603	0.483	0.402	0.345	0.302	0.268	0.241	0.201	21.3	3.75
2.5 SHS	1.64	2.16	1.44	1.08	0.863	0.719	0.617	0.539	0.432	0.360	0.308	0.270	0.240	0.216	0.180	18.7	3.85
2.0 SHS	1.36	1.85	1.23	0.924	0.739	0.616	0.528	0.462	0.369	0.308	0.264	0.231	0.205	0.185	0.154	15.7	3.96
1.6 SHS	1.12	1.56	1.04	0.779	0.623	0.519	0.445	0.389	0.311	0.260	0.222	0.195	0.173	0.156	0.1301	13.0	4.04
20 x 20 x 1.6 SHS	0.873	0.946	0.631	0.473	0.378	0.315	0.270	0.236	0.189	0.158	0.135	0.118	0.105	0.0946	0.0788	10.0	3.17

Note: Refer to TABLE 8.1–5 (1)(A)



STRENGTH LIMIT STATE MAXIMUM DESIGN LOADS FOR CANTILEVER BEAMS WITH FULL LATERAL RESTRAINT

SQUARE HOLLOW SECTIONS: GRADE C450

bending about x-axis

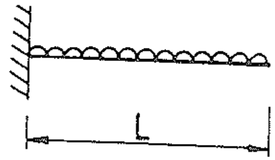


TABLE 8.4 – 6 (1)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	kN	m
100 x 100 x 3.8 SHS	11.1	39.2	19.6	13.1	9.79	7.83	6.53	5.59	4.89	4.35	3.92	3.56	3.26	3.01	2.80	169	13.0
3.3 SHS	9.73	31.8	15.9	10.6	7.96	6.37	5.31	4.55	3.98	3.54	3.18	2.89	2.65	2.45	2.27	148	13.1
2.8 SHS	8.39	25.1	12.5	8.36	6.27	5.01	4.18	3.58	3.13	2.79	2.51	2.28	2.09	1.93	1.79	127	13.2
2.3 SHS	6.95	18.7	9.34	6.23	4.67	3.74	3.11	2.67	2.34	2.08	1.87	1.70	1.56	1.44	1.33	105	13.2
75 x 75 x 3.3 SHS	7.14	19.5	9.75	6.50	4.88	3.90	3.25	2.79	2.44	2.17	1.95	1.77	1.63	1.50	1.39	108	9.65
2.8 SHS	6.19	16.3	8.16	5.44	4.08	3.26	2.72	2.33	2.04	1.81	1.63	1.48	1.36	1.25	1.17	93.3	9.76
2.3 SHS	5.14	12.1	6.07	4.05	3.03	2.43	2.02	1.73	1.52	1.35	1.21	1.10	1.01	0.934	0.867	77.7	9.84

Notes: Refer to TABLE 8.4–5 (1)(A)

TABLE 8.4 – 6 (2)(A)

W^*_{L1} = Maximum Design Load based on Design Moment Capacity
W^*_{L2} = Maximum Design Load based on Design Shear Capacity
Maximum Design Load W^*_L is LESSER of W^*_{L1} and W^*_{L2}

Designation d b t	Mass per m	W^*_{L1} (kN) Span of Beam (L) in metres														W^*_{L2}	FLR
mm mm mm	kg/m	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	kN	m
75 x 75 x 3.3 SHS	7.14	39.0	26.0	19.5	15.6	13.0	11.1	9.75	7.80	6.50	5.57	4.88	4.33	3.90	3.25	108	9.65
2.8 SHS	6.19	32.6	21.8	16.3	13.1	10.9	9.32	8.16	6.53	5.44	4.66	4.08	3.63	3.26	2.72	93.3	9.76
2.3 SHS	5.14	24.3	16.2	12.1	9.71	8.09	6.94	6.07	4.86	4.05	3.47	3.03	2.70	2.43	2.02	77.7	9.84
65 x 65 x 2.8 SHS	5.31	25.3	16.9	12.6	10.1	8.43	7.23	6.32	5.06	4.22	3.61	3.16	2.81	2.53	2.11	79.8	8.40
2.3 SHS	4.42	19.6	13.1	9.82	7.86	6.55	5.61	4.91	3.93	3.27	2.81	2.46	2.18	1.96	1.64	66.7	8.48
50 x 50 x 2.8 SHS	3.99	14.4	9.58	7.19	5.75	4.79	4.11	3.59	2.88	2.40	2.05	1.80	1.60	1.44	1.20	59.7	6.36
2.3 SHS	3.34	12.2	8.12	6.09	4.87	4.06	3.48	3.05	2.44	2.03	1.74	1.52	1.35	1.22	1.02	50.1	6.44
40 x 40 x 2.8 SHS	3.11	8.80	5.86	4.40	3.52	2.93	2.51	2.20	1.76	1.47	1.26	1.10	0.977	0.880	0.733	46.2	4.99
2.3 SHS	2.62	7.52	5.01	3.76	3.01	2.51	2.15	1.88	1.50	1.25	1.07	0.940	0.836	0.752	0.627	39.1	5.08
35 x 35 x 2.8 SHS	2.67	6.52	4.34	3.26	2.61	2.17	1.86	1.63	1.30	1.09	0.931	0.815	0.724	0.652	0.543	39.5	4.31
2.3 SHS	2.25	5.61	3.74	2.80	2.24	1.87	1.60	1.40	1.12	0.935	0.801	0.701	0.623	0.561	0.467	33.6	4.39
30 x 30 x 2.8 SHS	2.23	4.58	3.05	2.29	1.83	1.53	1.31	1.14	0.916	0.763	0.654	0.572	0.509	0.458	0.382	32.8	3.63
2.3 SHS	1.89	3.98	2.65	1.99	1.59	1.33	1.14	0.994	0.795	0.663	0.568	0.497	0.442	0.398	0.331	28.0	3.71
25 x 25 x 2.3 SHS	1.53	2.62	1.75	1.31	1.05	0.874	0.750	0.656	0.525	0.437	0.375	0.328	0.291	0.262	0.219	22.5	3.03

Notes: Refer to TABLE 8.4–5 (1)(A)

@Seismicisolation

@Seismicisolation

NOTES