Design Capacity Tables

Profiles

Structural steel angles, channels and flats

DuraGal Ultra™

AustubeMills
SHAPING POSSIBILITIES

Effective from: March 2015

Important note

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Contents

Preface

This publication provides design capacity tables for a range of DuraGalUltra™ Profiles. These sections are produced by cold-forming and in-line galvanizing. The use of cold-formed members in structural design is not new. Structural steel hollow sections are produced universally in Australia by the cold-forming process. In addition, in Europe, cold-formed open Profiles like angles and channels have been available in a range of tensile strengths for many years. DuraGalUltra Profiles combine the dimensional accuracy and high tensile strength of the cold-forming process with the latest generation of steel production by Austube Mills to produce a product with more than adequate structural ductility for general structural applications.

The patented DuraGalUltra process combines cold-forming technology with a corrosion protection process that can be used either stand alone, or in conjunction with top coat systems to cover the majority of corrosion environments included in AS/NZS 2312:2002 'Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings'.

The Design Capacity Tables have been prepared for DuraGalUltra angles, channels and flats in accordance with AS/NZS 4600:2005 Cold-formed steel structures. For ease of use, a similar but slightly modified format to the ASI Design Capacity Tables has been adopted. The design basis of the tables is contained in Appendix A.

For connections where the thickness of all the connected parts is greater than or equal to 3 mm (2.5 mm for fillet welds), AS/NZS 4600 requires that the connection be designed in accordance with AS 4100 or NZS 3404. The majority of DuraGalUltra sizes are in this thickness range.

This manual will be updated as the benefits of research become available.

Originally printed July 1997.

This February 2015 edition includes:

October 1998 amendments to Section 8 - web bearing capacity, adopted from the research[17] carried out by The University of Sydney.

December 1999 amendments - changes in mechanical properties for angles, $t \leq 2.5$ mm. The sectional properties tables have been amended to reflect this change.

February 2015 - the tables have been updated to reflect changes in AS/NZS 4600 introduced in 2005. An exception is the web bearing capacity tables in Section 8. The University of Sydney research mentioned above is used for this edition. Further research in this area is under way and the results of this will be reflected in future editions.

Acknowledgements

Austube Mills wishes to acknowledge the contribution of the Centre for Advanced Structural Engineering at The University of Sydney.

The Centre for Advanced Structural Engineering provided assistance with interpretation of the limit states Cold-Formed Steel Structures Standard AS/NZS 4600 and research into the structural behaviour of the DuraGalUltra angles. Funding by the Australian Research Council for a Collaborative Grant Project between Austube Mills and The University of Sydney has provided additional data on the behaviour of DuraGalUltra angles.

Notation

A_e	effective area of a cross-section
A, A_f	full area of a cross-section
A_n	net area of a cross-section
b	flat width of element excluding radii
b_c	total width (including radii) of a channel compression flange
b_e	effective width of a plate element (strength calculations)
b_{ed}	effective width of a plate element (deflection calculations)
b_{eL}	effective width of the flat portion of the longer leg of an angle
b_{eS}	effective width of the flat portion of the shorter leg of an angle
b_{e1}, b_{e2}	effective width of a stiffened element with stress gradient
b_f	total flange width (including corner radius) of a channel
b_L	flat width of the longer leg of an angle
b_S	flat width of the shorter leg of an angle
b_t	total width (including radius) of a channel tension flange
b_1	longer leg length of an angle, *or* flange projection beyond the web (shear lag calculations)
b_2	shorter leg length of an angle
C_b	bending coefficient dependent on moment
C_m	coefficient for unequal end moment
C_s	coefficient for moment causing compression or tension on the shear centre side of the centroid
C_1 to C_4	coefficient
C_θ	coefficient
c	distance from the end of a beam to the edge of the load or reaction
d	overall depth of a channel
d_{e1}, d_{e2}	effective width of a stiffened element with stress gradient
d_1	depth of the flat portion of a web measured along the plane of the web
E	Young's modulus of elasticity
E_d	design action effect
e	distance from the edge of a load or reaction to the edge of the opposite load or reaction
FLR	the maximum segment length for full lateral restraint
f_n	critical stress
f_{oc}	elastic flexural, torsional and flexural-torsional buckling stress
f_{ox}	elastic buckling stress in an axially loaded compression member for flexural buckling about the x-axis
f_{oy}	elastic buckling stress in an axially loaded compression member for flexural buckling about the y-axis

f_{oz}	elastic buckling stress in an axially loaded compression member for torsional buckling
f_u	minimum tensile strength used in design
f_y	minimum yield stress used in design
f^*	design stress in the compression element calculated on the basis of the full section
f^*_d	design compressive stress in the element being considered based on the effective section at the load for which deflections are determined
f^*_1, f^*_2	stresses calculated on the basis of the full section specified in Clause 2.2.3.2 of AS/NZS 4600
G	shear modulus of elasticity (80 x 10^3 MPa)
I_b	second moment of area of the full, unreduced cross-section about the bending axis
I_e	effective second moment of area
I_f	second moment of area of the full section
I_n, I_p	second moment of area of the cross-section about the n- and p-axes
I_{np}	product of second moment of area of the full section about its n- and p-axes
I_{serv}	second moment of area required for serviceability design
I_w	warping constant for a cross-section
I_x, I_y	second moment of area of the cross-section about the major principal x- and y-axes
I_{xy}	product of second moment of area of the full section about its major and minor principal axes
J	torsion constant for a cross-section
k	plate buckling coefficient; *or* non-dimensional yield stress
k_e	effective length factor
k_{sm}	exposed surface area to mass ratio
k_t	correction factor for distribution of forces in a tension member
k_v	shear buckling coefficient
l	actual length of a compression member; *or* full span for simple beams; *or* distance between inflection points for continuous beams; *or* twice the length of cantilever beams; *or* unbraced length of a member
l_b	actual length of bearing
l_e	effective length of the member
l_{eb}	effective length in the plane of bending
l_{ex}, l_{ey}, l_{ez}	effective lengths for bending about the x- and y-axes, and for twisting, respectively
l_x, l_y, l_z	unbraced length of a member about the x-, y- and z-axes respectively
M_b	nominal member moment capacity
M_{bx}, M_{by}	nominal member capacities about the x- and y-axes, respectively
M_c	critical moment
M_f	maximum moment for serviceability loads at which the section is fully effective
M_{max}	absolute value of the maximum moment in the unbraced segment

M_o	elastic buckling moment
M_s	nominal section moment capacity
M_{serv}	design serviceability moment
M_{sxf}, M_{syf}	section yield capacity of the full section about the x- and y-axes, respectively
M_y	moment causing initial yield at the extreme compression fibre of a full section
M_1	smaller bending moment at the ends of the unbraced length
M_2	larger bending moment at the ends of the unbraced length
M_3	absolute value of the moment at quarter point of the unbraced segment
M_4	absolute value of the moment at centre-line of the unbraced segment
M_5	absolute value of the moment at three-quarter point of the unbraced segment
M^*	design bending moment
M^*_x, M^*_y	design bending moment about the x- and y-axes, respectively
N_c	nominal member capacity of a member in compression
N_e	elastic buckling load
N_s	nominal section capacity of a member in compression
N_t	nominal section capacity of a member in tension
N^*	design axial force, tensile or compressive
n, p	non-principal axes of the cross section parallel to the shorter and longer leg of angles respectively
R_b	nominal capacity for concentrated load or reaction for one solid web connecting top and bottom flanges
R_d	design capacity
R	nominal capacity
R^*	design concentrated load or reaction in the presence of bending moment
R^*_b	design concentrated load or reaction
r	radius of gyration of the full, unreduced cross-section
r_i	inside corner radius
r_o	outside corner radius
r_{o1}	polar radius of gyration of the cross-section about the shear centre
r_x, r_y	radius of gyration of the cross-section about the x- and y-axes, respectively
S	plastic section modulus
S_o	cross-sectional area of the tensile test specimen
S_x, S_y	plastic section modulus about the x- and y-axes, respectively
S^*	design action effect [design action]
t	nominal base steel thickness of any element or section exclusive of coating
t_w	thickness of a web
V_v	nominal shear capacity of the web
V^*	design shear force
W	applied load

W^*	design action
W^*_{L}	strength limit state design load
W^*_{Lmax}	strength limit state maximum design load
W^*_{L1max}	strength limit state maximum design load based on the design section moment capacity and combined bending and shear capacity of a beam
W^*_{L2max}	strength limit state maximum design load based on the design shear capacity of a beam
W^*_{S}	serviceability limit state design load
W^*_{Smax}	serviceability limit state maximum design load
w	width of flat bar
x, y	principal axes of the cross-section
x_o, y_o	coordinates of the shear centre of the cross-section
Z	elastic section modulus
Z_c	effective section modulus calculated at a stress M_c / Z_f in the extreme compression fibre
Z_e	effective section modulus calculated with the extreme compression or tension fibre at f_y
Z_f	full unreduced section modulus for the extreme compression fibre
Z_{ft}	section modulus of the full unreduced section for the extreme tension fibre about the appropriate axis
Z_x, Z_y	elastic section modulus about x- and y-axes, respectively
α_{nx}, α_{ny}	moment amplification factor
β_x, β_y	monosymmetry section constant about the x- and y-axes, respectively
θ	angle between the plane of the web and the plane of the bearing surface equal to 90° for DuraGalUltra channels
λ, λ_1, λ_2	slenderness ratio
λ_b	non-dimensional slenderness used to determine M_c for members subjected to lateral buckling
λ_c	non-dimensional slenderness used to determine f_n
ρ	effective width factor
ϕ	capacity [strength reduction] factor
ϕ_b	capacity [strength reduction] factor for bending
ϕ_c	capacity [strength reduction] factor for members in compression
ϕ_t	capacity [strength reduction] factor for members in tension
ϕ_v	capacity [strength reduction] factor for shear
ϕ_w	capacity [strength reduction] factor for bearing
Ψ	stress ratio f^*_1 / f^*_2

Properties of steel

The properties of steel adopted in these tables are listed below:

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

References

[1] HERA (1987), "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.

[2] Zhao, X.L. and Hancock, G.J. (1994), "Tests and Design of Butt Welds and Fillet Welds in DuraGal RHS Members", *Research Report No. R702*, Centre for Advanced Structural Engineering, The University of Sydney. Also in, Zhao, X.L and Hancock, G.J., "Welded Connections in Thin Cold-Formed Rectangular Hollow Sections", Connections in Steel Structures III, (Eds. Bjorhovde, Colson & Zandonini), Pergamon, 1996.

[3] Popovic, D., Hancock, G.J. and Rasmussen, K.J.R. (1996), "Axial compression Tests of Duragal Angles", *Research Report No. R730*, Centre for Advanced Structural Engineering, The University of Sydney. Also in, Popovic, D., Hancock, G.J. and Rasmussen, K.J.R., "Axial compression Tests of Cold-Formed Angles", J. Struct.Eng., ASCE, 125(5), 515- 523.

[4] SA/SNZ (2005), *Cold-Formed Steel Structures*, Australian / New Zealand Standard AS/NZS 4600, Standards Australia / Standards New Zealand.

[5] SA (1998), *Steel Structures*, Australian Standard AS 4100, Standards Australia.

[6] SA/SNZ (2002) Structural Design Actions, Part 0: General principles, Australian/New Zealand Standard AS/NZS 1170.0:2002 and SA/SNZ (2002) Structural Design Actions, Part 1: Permanent, imposed and other actions, Australian/New Zealnd Standard AS/NZS 1170.1:2002. (These Standards are part of what is known as the "Loading Code").

[7] SA/SNZ (1998), *Cold-Formed Steel Structures Commentary*, AS/NZS 4600 Supplement 1 to AS/NZS 4600:1996, Standards Australia / Standards New Zealand.

[8] Talja, A. and Salmi, P. (1994), "Simplified Design Expressions for Cold-Formed Channel Sections", *VTT Publications 201*, Technical Research Centre of Finland.

[9] Syam, A.A. (1992), "Beam Formulae", *Steel Construction*, Vol. 20, No. 1, Australian Steel Institute.

[10] Proe, D.J., Bennetts, I.D., Thomas, I.R.andSzeto, W.T.(1990), *Handbook for Fire Protection Materials for Structural Steel*, Australian Steel Institute.

[11] Austube Mills (2013), *Technical Information — DuraGal Profiles*, TS100, Austube Mills.

[12] Leigh, J.M. and Lay, M.G (1970), "Laterally Unsupported Angles with Equal and Unequal Legs", Project 22/2 Properties of Steel Angles, BHP Melbourne Research Laboratories.

[13] Madungula, M.K.S and Kennedy, J.B (1995), SIngle and Compound Angle Members — Structural Analysis and Design, Elsevier Applied Science Publishers Ltd.

[14] Centre for Advanced Structural Engineering (1996) "An Executable Module for the Design of DuraGal Angles and Channels to the Australian / New Zealand standard for Cold- Formed Steel Structures AS/NZS 4600:1996", Investigation Report No S1063, The University of Sydney.

[15] Hogan, T.J and Thomas, I.R (1994), Design of Structural Connections, 4th Edition, Australian Steel Institute, (ASI).

[16] Woolcock, S.T and Kitipornchai, S. (1986), " Design of Single Angle Web Struts in Trusses", Journal of Structural Engineering, ASCE, Vol 112, No 6, pp. 1327 – 1345.

[17] Young, B., Hancock, G.J. (1999), "Design of Cold-Formed Unlipped Channels Subjected to Web Crippling", *Research Report No. R794*, Centre for Advanced Structural Engineering, The University of Sydney. Also in, Young, B and Hancock G.J "Tests and Design of Cold- Formed Unlipped Channels subjected to Web Crippling" 15th International Specialty Conference on Cold-Formed Steel Structures, St Louis, MO 2000, pp 43-70.

[18] Young, B., Hancock, G.J. (2000), "Experimental Investigation of Cold-Formed Channels subjected to Combined Bending and Web Crippling", 15th International Specialty Conference on Cold-Formed Steel Structures, St Louis, MO 2000, pp 71 – 90.

[19] Young, B., Hancock, G.J. (2000), "Web Crippling Behaviour of Channels with Flanges Restrained", 15th International Specialty Conference on Cold-Formed Steel Structures, St Louis, MO 2000, pp 91 – 104.

[20] Popovic, D. and Hancock, G.J and Ramussen, K.J.R., "Compression Tests of Cold-Formed Angles Loaded Parallel with a Leg", J. Struct.Eng., ASCE, 127(6), pp 600 – 607.

Product specifications

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Contents page

1.1 Grade

DuraGalUltra angles, channels and flats are manufactured by a cold forming process which ensures that it complies with the requirements shown below:

Section	Actual thickness t mm	Grade	Minimum yield stress MPa	Minimum tensile strength MPa	Minimum elongation as a proportion of gauge length of $5.65\sqrt{S_o}$ %
Flats	$t \le 6.0$ $t > 6.0$	C400L0 C350L0	400 350	450 400	20 20
Angles	$t \le 2.5$ $2.5 < t \le 6.0$ $t > 6.0$	C350L0 C450L0 C400L0	350 450 400	400 500 450	20 16 16
Channels	$t \le 6.0$ $t > 6.0$	C450L0 C400L0	450 400	500 450	16 16

DuraGalUltra Profiles comply with the requirements of steel types 5 and 7B in Table 10.4.4 of AS 4100.

L0 indicates that DuraGalUltra Profiles have Charpy V-notch impact properties as specified in TS100[11]. Table 10.4.1 of AS 4100 Steel Structures permits L0 grades to have the following minimum service temperature:

Actual thickness mm	Lowest one day mean ambient temperature °C
$t \le 6$	-30
$6 < t \le 12$	-20

1.2 Surface finish

DuraGalUltra sections have a coating of zinc aluminium (11 to 12 per cent aluminium, with the balance zinc) applied by an in-line, hot-dip galvanizing process to a shot blasted and chemically cleaned bright metal surface equivalent to AS 1627.4 Class Sa3. A surface conversion coating is applied over the zinc aluminium coating to protect against white rust and enhance adhesion of paint and powder coatings. Sections coated with DuraGalUltra have a minimum average zinc aluminium coating mass of 75g/m^2 and Lintels for masonry construction have a minimum average zinc aluminium coating of 250g/m^2.

1.3 Size range

Equal angles	Unequal angles	Channels	Flats
30 x 30 to 150 x 150	75 x 50 to 150 x 100	75 x 40 to 300 x 90	50 to 300

1.4 Designation

Typical designations are: 300 x 90 x 6.0 CC DuraGalUltra
150 x 150 x 8.0 CA DuraGalUltra
150 x 100 x 8.0 CA DuraGalUltra
150 x 8.0 CF DuraGalUltra

where: CC = cold-formed channel
CA = cold-formed angle
CF = cold-formed flat

1.5 Length range

DuraGalUltra is generally stocked by distributors in the following lengths.

Section	Size	Standard lengths m	Non-std lengths* m
Equal angles	30 x 30 *to* 50 x 50 50 x 50 *to* 90 x 90 100 x 100 *to* 150 x 150	6.0 9.0 12.0	5.5 to 13.5 5.5 to 13.5 5.5 to 13.5
Unequal angles	75 x 50 100 x 75 *to* 150 x 100	9.0 12.0	5.5 to 13.5 5.5 to 13.5
Channels	75 x 40 *to* 125 x 65 150 x 75 *to* 300 x 90	9.0 12.0	5.5 to 13.5 5.5 to 13.5
Flats	50 *to* 300	6.0	5.5 to 13.5

* Non-standard Lengths — Subject to mill acceptance.
— Minimum order quantities and/or price extras may apply.

1.6 Chemistry

Chemical composition (cast or product) % max						
C	Si	Mn	P	S	Al	CE
0.20	0.05	1.60	0.03	0.03	0.10	0.39

Note:

1. The carbon equivalent (CE) in the above is calculated for an actual composition using the following equation:

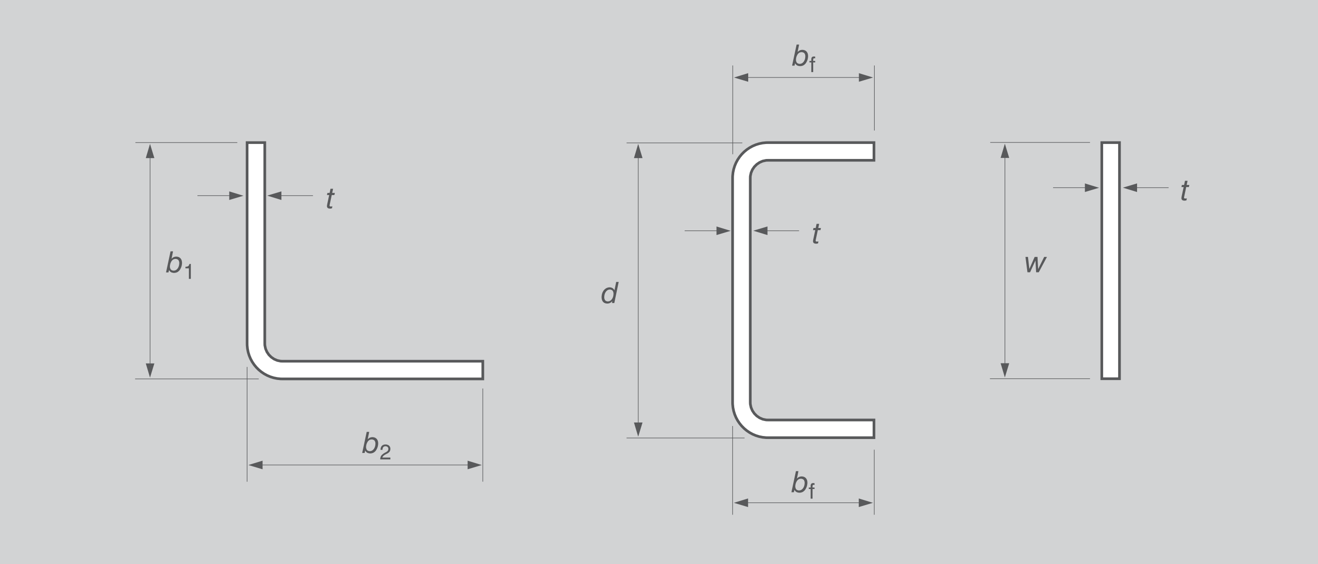
$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

This value is used in AS/NZS 1554.1:2004 Welding of Steel Structures, to determine the welding preheat required. Steels with CE of less than 0.40 usually do not require preheat.

2. Micro-alloying elements of niobium plus vanadium plus titanium can be addedd to a maximum content of 0.15 per cent, with vanadium not exceeding 0.10 per cent.

1.7 Tolerances

1.7.1 Cross section



The permissible variation on dimension b_u is shown below:

Designated dimension b_u mm	Permissible variation on dimension b_u mm		
	Actual Thickness, t (mm)		
	$1.5 < t \le 3$	$3 < t \le 6$	$6 < t \le 8$
$b_u \le 40$	± 0.80	± 1.00	± 1.25
$40 < b_u \le 100$	± 1.00	± 1.25	± 1.50
$100 < b_u \le 150$	± 1.25	± 1.50	± 1.75
$150 < b_u \le 200$	± 1.50	± 1.75	± 2.00

Note: 1. In the above table b_u applies to b_1, b_2 or b_f.
2. Actual thickness is the 'actual thickness' tabulated in Section 3.

The permissible variation on dimension *d* is shown below:

Designated dimension *d* mm	Permissible variation on dimension *d* mm		
	Actual thickness, *t* (mm)		
	$1.5 < t \leq 3$	$3 < t \leq 6$	$6 < t \leq 8$
$40 < d \leq 100$	± 0.75	± 1.00	± 1.25
$100 < d \leq 200$	± 1.00	± 1.25	± 1.50
$200 < d \leq 400$	± 1.50	± 1.75	± 2.00

The permissible variation on dimension *w* is shown below:

Designated dimension *w* mm	Permissible variation on dimension *w* mm
$40 < w \leq 100$	± 0.75
$100 < w \leq 200$	± 1.00
$200 < w \leq 400$	± 1.50

1.7.2 Thickness

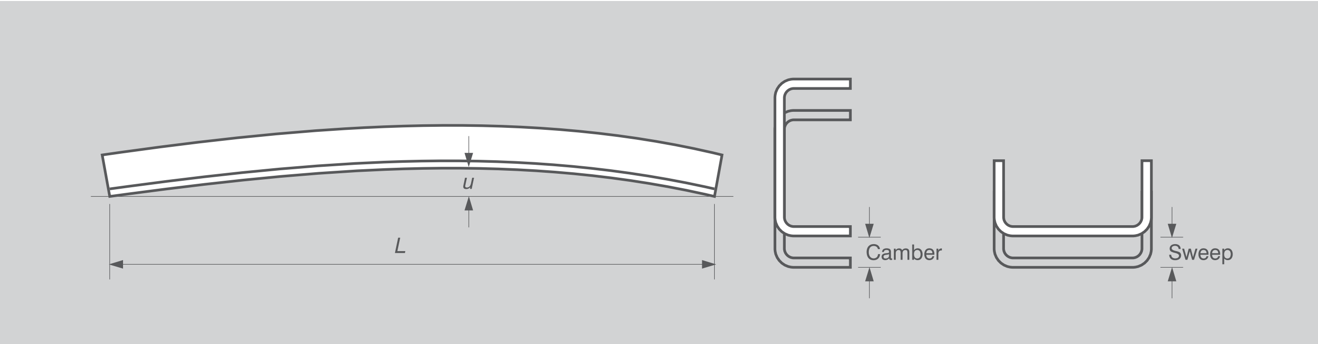
The permissible variation on the actual uncoated thickness is +10 per cent to -5 per cent. The relationship of the nominal thickness to the actual thickness is shown below:

Nominal thickness mm	Actual thickness *t* mm
2.5	2.4
4.0	3.8
5.0	4.7
6.0	6.0
8.0	8.0

1.7.3 Mass

The mass of a section should not be less than 0.95 times the nominal mass.

1.7.4 Straightness

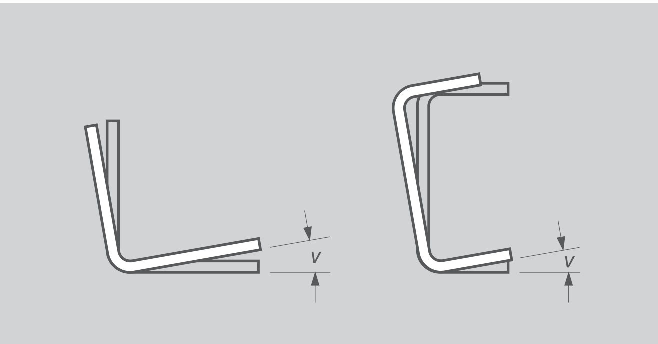


For the **total length**, the maximum out of straightness *(u)* is limited to:

$$u \leq \frac{L}{500}$$

The maximum out of straightness *(u)* applies to camber and sweep for angles and channels, and to camber for flats.

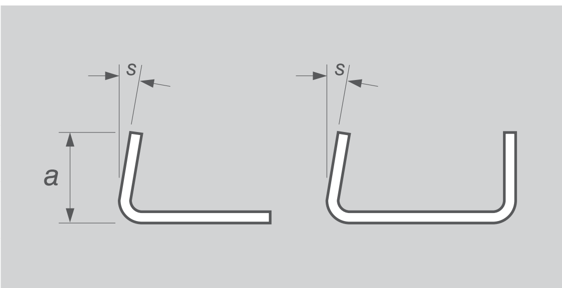
1.7.5 Twist



Maximum angle of twist *(v)* permitted is one degree per metre of length.

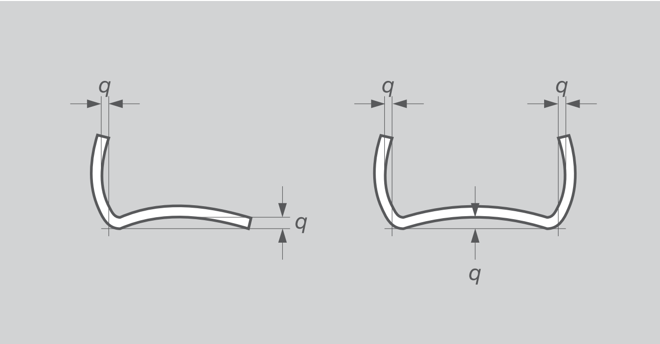
1.7.6 Squareness

The maximum out of squareness (s) of a corner angle is shown below:



Shorter designated leg length *a* mm	Angular tolerance *s* degrees
$a \leq 50$	± 2.0
$50 < a \leq 80$	± 1.5
$a > 80$	± 1.0

1.7.7 Flatness of sides



The flatness of any side *(q)* is limited to less than one per cent of the width of that side or 0.5mm, whichever is the larger.

1.7.8 Corner radii tolerance

The inside corner radius tolerance is shown below:

Inside corner radius r_i mm	Tolerance
< 2.5	± 0.5 mm
≥ 2.5	± 20% of r_i

1.7.9 Length

The variation in standard and non-standard lengths is -0 mm to +25 mm.

1.8 Corner radii

The corner radii for angles and channels are as follows:

Nominal thickness mm	Inside corner radius r_i mm
2.5	2.5
4.0	4.0
5.0	4.0
6.0	8.0
8.0	8.0

1.9 Welding

DuraGalUltra is readily welded. Its thin, evenly applied galvanized coating ensures minimal welding fumes. However, the ventilation recommendations given in Table 17.2 of Technical Note 7 published by WTIA (Welding Technology Institute of Australia), July 1994 should be observed. Mechanical dilution ventilation is advised for open work space and mechanical ventilation by local exhaust system for limited work space and confined space.

DuraGalUltra's carbon equivalent of not greater than 0.39 typically allows it to be welded in accordance with AS/NZS 1554.1:2011 Welding of Steel Structures, without preheat. The following are recommended consumables.

Process	Recommended consumables
Manual Metal-Arc (AS/NZ 4855)	B-E49X6 U / B-E49X8 U - Basic coated electrodes
Submerged Arc (AS 1858.1)	W502Y
Flux-Cored Arc (AS/NZS ISO 17632)	B-T492U
Gas Metal-Arc (AS/NZS 2717.1 ISO 14341)	W502 ES4/ES6 / B-G49 2U S4/S6

For more advise reference should be made to the DuraGal Easy Welding Guide available from our website at www.austubemills.com.

Further research [1], [2] has shown that the mechanical properties of cold-formed hollow sections are not reduced by a wide range of welding operations. DuraGalUltra angles, channels and flats are produced using the same materials and processes as used for the cold-formed hollow sections.

1.10 Painting

DuraGal's unique surface preparation and protective coating means painting and powder coating are easy and economical, and the result is a smooth, attractive surface. Refer to the DuraGal Easy Painting and Corrosion Protection Guide available from our website at www.austubemills.com.

1.11 White rust

If white rust is present, this should be removed before painting. For information on how to prevent and treat white rust, download our White Rust brochure at www.austubemills.com.

1.12 Protection of weld affected areas

Advice is given in the 'Addendum to the DuraGal Easy Painting and Corrosion Protection Guide' on the corrosion protection of the heat affected weld zone.

Analysis and design

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2.1 Structural analysis

2.1.1 General

AS/NZS 4600 together with AS/NZS 1170.0 require two types of limit states to be considered for the design of structures and its components:

- The ultimate (strength and stability) limit state, and
- The serviceability limit state.

While the above mentioned Standards allow alternative methods for establishing a suitable design, it is typically assumed in this publication that:

- Elastic structural analyses are used to determine strength [ultimate] design actions and serviceability results, and
- The design capacity is determined in accordance with Sections 2 to 7 together with the capacity reduction factor ϕ given in Table 1.6 of AS/NZS 4600.

Where alternative methods are used, this is described in the design method section preceding the tables.

The design loads and load combinations should be determined in accordance with AS/NZS 1170 for both strength and serviceability limit states. AS/NZS 4600 does not apply to the design of structures subject to fire and brittle fracture (Clause 1.1). For advice on fire and cold temperature applications of Profiles, it is suggested that reference be made to AS 4100 Steel Structures. For Profiles subject to significant cyclic loading, the design should take into account the fatigue provisions of AS/NZS 4600 Section 6.

2.1.2 Elastic analysis

The elastic structural analysis carried out to find the design action effect should normally be a first order analysis since second order effects are accounted for within the design equations (Clause 3.5.1 Combined axial compressive load and bending) in AS/NZS 4600.

Clause 3.5.1 of AS/NZS 4600 allows for second order effects for members subjected to combined axial compression and bending. When a first order analysis is carried out, the moment amplification factor (α_n) is calculated in accordance with clause 3.5.1 of AS/NZS 4600, and is included in the combined compression and bending interaction equation:

$$\frac{N^*}{\phi_c N_c} + \frac{C_{mx} M_x^*}{\phi_b M_{bx} \alpha_{nx}} + \frac{C_{my} M_y^*}{\phi_b M_{by} \alpha_{ny}} \leq 1.0$$

If a second order analysis is used to determine the design action effects, it is suggested that the moment amplification factors (α_{nx} and α_{ny}) and the coefficients for unequal end moments (C_{mx} and C_{my}) used in this interaction equation are taken as unity.

2.2 Limit states design

Limit states design for strength requires structural members and connections to be proportioned such that the **design capacity** (R_d) is greater than or equal to the **design action effect** (E_d).

$R_d \geq E_d$

(For the stability limit state, some modifications to the above inequality are made - refer AS/NZS 1170.0 Section 7.)

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/NZS 1170. These design actions/loads are identified by a superscript (*) after the appropriate action/load (e.g. W^*_L describes the strength limit state design transverse load on a beam).

Design action effects (E_d) 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 ($R_d = \phi R$) is the product of the nominal capacity (R) and the appropriate capacity factor (ϕ) given in Table 1.6 of AS/NZS 4600. R is determined from Sections 3 and 5 of AS/NZS 4600 for members and connections respectively.

Generally the tables provide values of the design capacity. For example, consider the strength limit state design of a simply supported beam subject to a total transverse design load (W^*) distributed uniformly along the beam with full lateral restraint. For bending, the design action effect (E_d) is the design bending moment (M^*) which is determined by:

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

where l = span of the beam

In this case the design capacity (ϕR) is equal to the design section moment capacity ($\phi_b M_s$), which is given by:

$\phi_b M_s = \phi_b f_y Z_e$

where ϕ_b = the capacity factor
f_y = yield stress used in design
Z_e = effective section modulus

To satisfy the requirement for strength limit state design the following relationship must be satisfied:

$M^* \leq \phi_b M_s$

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. Other criteria may include shear capacity, bearing capacity and combined bending and shear.

In Sections 14 to 17 the strength limit state **maximum design load** ($W^*_{L\,max}$) and the serviceability limit state **maximum design load** ($W^*_{S\,max}$) are tabulated. These are the maximum design actions or design loads which may be applied to a beam for the specified limit states.

Section properties

3

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Tables

Page

3.1 Scope

The section property tables include all relevant section dimensions and properties necessary for drawing, and for designing DuraGalUltra open profile steel structures in accordance with AS/NZS 4600.

For each open profile section, tables are provided for:

> Dimensions and full section properties

> Effective section properties

3.2 Dimensions and full section properties

The dimensions and full section properties tables give the standard dimensions and full section properties for angles, channels and flats. For angles, the dimensions and section properties are provided for both the principal x- and y-axes and for the non-principal n- and p-axes (parallel to the angle legs).

Full section properties of angles and channels are calculated using the accurate method of dividing the section into simple elements including bends (AS/NZS 4600 Clause 2.1.1) for all section properties except for I_w, J, x_o, y_o, β_x, β_y and r_{o1}. These are calculated in accordance with Appendix E of AS/NZS 4600 except for r_{o1} which is calculated in accordance with AS/NZS 4600 Equation 3.3.3.2(10). A detailed procedure to calculate the full section properties of DuraGalUltra angles and channels is presented in Appendix A1.

The full section properties assume that the sections are fully effective and may also be used for determining section or member capacities and deflection when the compression stresses in the elements of the cross section are sufficiently low so that local buckling of these elements will not occur.

3.3 Effective section properties

The section capacities presented in Section 6 have been calculated in accordance with AS/NZS 4600 using the effective section properties for angles and channels. For angles the effective section properties are provided for bending about the principal x- and y-axes, and for bending about the non-principal n- and p-axes (parallel to the angle legs). The effective section properties of DuraGalUltra angles and channels are calculated on the basis of the predicted reduction in capacity due to local buckling behaviour when subject to axial compression or bending. The method for determining these properties is given in Appendix A2.

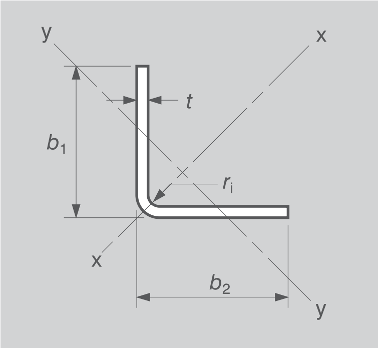


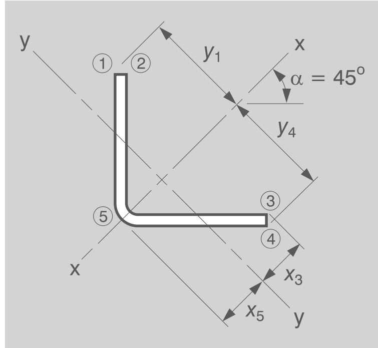
Table 3.1–1(A)

Dimensions and full section properties

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions									Section properties									
Designation			Mass per metre	Actual thick-ness	Inside corner radius	Coordinates of centroid			Full area of section	About x-axis				About y-axis				
Leg size b_1	b_2	Nominal thickness t		t	r_i	$y_1 = y_4$	$x_2 = x_3$	x_5	A_f	I_x	$Z_{x1} = Z_{x4}$	S_x	r_x	I_y	$Z_{y2} = Z_{y3}$	Z_{y5}	S_y	r_y
mm	mm	mm	kg/m	mm	mm	mm	mm	mm	mm^2	10^6mm^4	10^3mm^3	10^3mm^3	mm	10^6mm^4	10^3mm^3	10^3mm^3	10^3mm^3	mm
150 x	150 x	8.0 CA	18.0	8.0	8.0	106	53.5	51.6	2290	8.30	78.3	120	60.2	1.96	36.7	38.1	58.2	29.3
		6.0 CA	13.6	6.0	8.0	106	53.2	51.3	1740	6.36	59.9	91.6	60.5	1.51	28.3	29.4	44.3	29.5
		5.0 CA	10.8	4.7	4.0	106	53.4	52.4	1380	5.04	47.6	72.4	60.6	1.23	23.0	23.4	35.6	29.9
125 x	125 x	8.0 CA	14.9	8.0	8.0	88.4	44.6	42.8	1890	4.73	53.5	82.7	50.0	1.11	24.7	25.8	39.6	24.1
		5.0 CA	8.95	4.7	4.0	88.4	44.5	43.6	1140	2.89	32.7	50.0	50.4	0.699	15.7	16.0	24.4	24.8
		4.0 CA	7.27	3.8	4.0	88.4	44.4	43.4	926	2.36	26.7	40.7	50.5	0.572	12.9	13.2	19.9	24.9
100 x	100 x	8.0 CA#	11.7	8.0	8.0	70.7	35.8	33.9	1490	2.36	33.4	52.0	39.8	0.542	15.1	16.0	24.7	19.0
		6.0 CA#	8.92	6.0	8.0	70.7	35.5	33.6	1140	1.83	25.8	39.8	40.1	0.421	11.9	12.5	19.0	19.3
90 x	90 x	8.0 CA#	10.5	8.0	8.0	63.6	32.3	30.4	1330	1.70	26.7	41.7	35.7	0.386	12.0	12.7	19.7	17.0
		5.0 CA	6.37	4.7	4.0	63.6	32.2	31.2	811	1.06	16.6	25.5	36.1	0.252	7.83	8.06	12.4	17.6
75 x	75 x	8.0 CA#	8.59	8.0	8.0	53.0	26.9	25.1	1090	0.957	18.0	28.4	29.6	0.213	7.89	8.46	13.2	13.9
		6.0 CA#	6.56	6.0	8.0	53.0	26.7	24.8	836	0.747	14.1	21.9	29.9	0.167	6.26	6.73	10.2	14.1
		5.0 CA	5.26	4.7	4.0	53.0	26.8	25.9	670	0.601	11.3	17.5	30.0	0.142	5.29	5.48	8.44	14.6
		4.0 CA	4.29	3.8	4.0	53.0	26.7	25.8	546	0.495	9.34	14.3	30.1	0.117	4.39	4.55	6.93	14.7

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm < $t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.
3. # sizes are also available in Lintels.

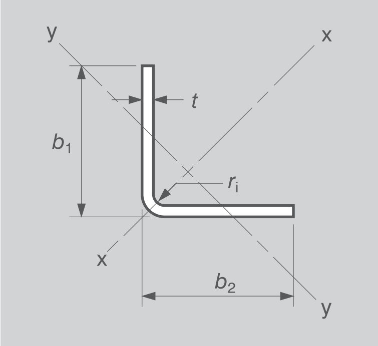


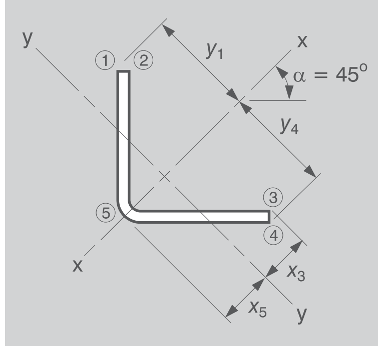
Table 3.1–1(B)

Dimensions and full section properties

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions									Section properties									
Designation			Mass per metre	Actual thick-ness	Inside corner radius	Coordinates of centroid			Full area of section	About x-axis				About y-axis				
Leg size		Nominal thickness																
b_1	b_2	t		t	r_i	$y_1 = y_4$	$x_2 = x_3$	x_5	A_f	I_x	$Z_{x1} = Z_{x4}$	S_x	r_x	I_y	$Z_{y2} = Z_{y3}$	Z_{y5}	S_y	r_y
mm	mm	mm	kg/m	mm	mm	mm	mm	mm	mm²	10⁶mm⁴	10³mm³	10³mm³	mm	10⁶mm⁴	10³mm³	10³mm³	10³mm³	mm
65 x	65 x	6.0 CA	5.62	6.0	8.0	46.0	23.1	21.3	716	0.477	10.4	16.2	25.8	0.104	4.52	4.91	7.5	12.1
		5.0 CA	4.52	4.7	4.0	46.0	23.3	22.4	576	0.386	8.39	13.0	25.9	0.0902	3.87	4.03	6.24	12.5
		4.0 CA	3.69	3.8	4.0	46.0	23.2	22.2	470	0.318	6.93	10.7	26.0	0.0747	3.22	3.36	5.13	12.6
50 x	50 x	6.0 CA	4.21	6.0	8.0	35.4	17.8	16.0	536	0.208	5.89	9.29	19.7	0.0434	2.44	2.71	4.18	9.00
		5.0 CA	3.42	4.7	4.0	35.4	18.0	17.1	435	0.170	4.80	7.53	19.8	0.0389	2.16	2.28	3.56	9.45
		4.0 CA	2.79	3.8	4.0	35.4	17.9	16.9	356	0.141	3.99	6.20	19.9	0.0324	1.81	1.91	2.94	9.54
		2.5 CA	1.81	2.4	2.5	35.4	17.8	17.2	230	0.093	2.63	4.04	20.1	0.0221	1.24	1.28	1.95	9.79
45 x	45 x	4.0 CA	2.50	3.8	4.0	31.8	16.1	15.2	318	0.102	3.19	4.98	17.9	0.0231	1.43	1.52	2.35	8.52
		2.5 CA	1.62	2.4	2.5	31.8	16.0	15.4	206	0.0673	2.11	3.25	18.1	0.0159	0.99	1.03	1.57	8.77
40 x	40 x	4.0 CA	2.20	3.8	4.0	28.3	14.3	13.4	280	0.0702	2.48	3.89	15.8	0.0157	1.10	1.17	1.82	7.50
		2.5 CA	1.43	2.4	2.5	28.3	14.3	13.7	182	0.0468	1.65	2.55	16.0	0.011	0.768	0.801	1.22	7.75
30 x	30 x	2.5 CA	1.06	2.4	2.5	21.2	10.7	10.2	134	0.0191	0.902	1.40	11.9	0.00438	0.408	0.431	0.664	5.71

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.

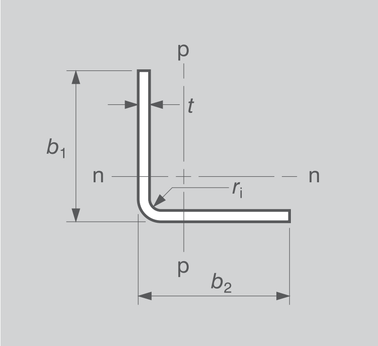


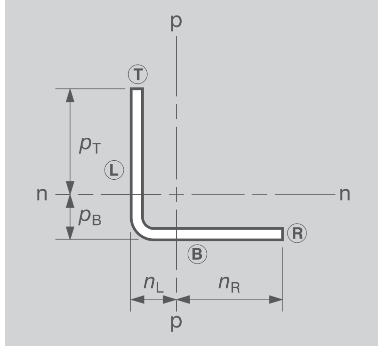
Table 3.1–2(A)

Dimensions and full section properties

About non-principal n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions								Section properties						
Designation			Mass per metre	Actual thickness	Inside corner radius	Co-ordinates of centroid		Full area of section	About n- and p-axes					Product 2nd moment of area
Leg size		Nominal thickness												
b_1	b_2	t		t	r_i	$p_B = n_L$	$p_T = n_R$	A_f	$I_n = I_p$	$Z_{nB} = Z_{pL}$	$Z_{nT} = Z_{pR}$	$S_n = S_p$	$m = r_p$	I_{np}
mm	mm	mm	kg/m	mm	mm	mm	mm	mm^2	10^6mm^4	10^3mm^3	10^3mm^3	10^3mm^3	mm	10^6mm^4
150 x	150 x	8.0 CA	18.0	8.0	8.0	41.2	109	2290	5.13	125	47.2	85.2	47.3	-3.17
		6.0 CA	13.6	6.0	8.0	40.4	110	1740	3.93	97.4	35.9	64.8	47.6	-2.42
		5.0 CA	10.8	4.7	4.0	39.6	110	1380	3.14	79.1	28.4	51.2	47.7	-1.91
125 x	125 x	8.0 CA	14.9	8.0	8.0	34.9	90.1	1890	2.92	83.5	32.4	58.5	39.2	-1.81
		5.0 CA	8.95	4.7	4.0	33.4	91.6	1140	1.80	53.8	19.6	35.3	39.7	-1.10
		4.0 CA	7.27	3.8	4.0	33.0	92.0	926	1.47	44.5	16.0	28.8	39.8	-0.896
100 x	100 x	8.0 CA#	11.7	8.0	8.0	28.7	71.3	1490	1.45	50.6	20.4	36.8	31.2	-0.91
		6.0 CA#	8.92	6.0	8.0	27.9	72.1	1140	1.12	40.3	15.6	28.2	31.5	-0.703
90 x	90 x	8.0 CA#	10.5	8.0	8.0	26.2	63.8	1330	1.04	39.8	16.3	29.5	27.9	-0.657
		5.0 CA	6.37	4.7	4.0	24.6	65.4	811	0.654	26.6	10.0	18.0	28.4	-0.402
75 x	75 x	8.0 CA#	8.59	8.0	8.0	22.5	52.5	1090	0.585	26.0	11.1	20.1	23.1	-0.372
		6.0 CA#	6.56	6.0	8.0	21.7	53.3	836	0.457	21.1	8.57	15.5	23.4	-0.29
		5.0 CA	5.26	4.7	4.0	20.9	54.1	670	0.372	17.8	6.86	12.4	23.5	-0.23
		4.0 CA	4.29	3.8	4.0	20.5	54.5	546	0.306	14.9	5.62	10.1	23.7	-0.189

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.
3. # sizes are also available in Lintels.

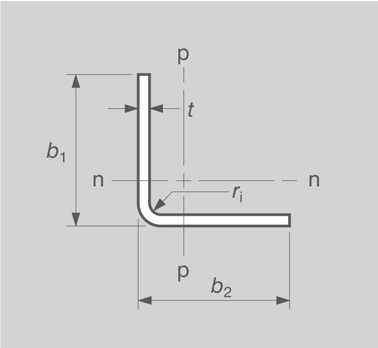


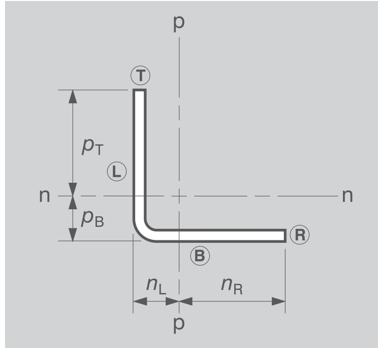
Table 3.1–2(B)

Dimensions and full section properties

About non-principal n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions								Section properties						
Designation: Leg size		Designation: Nominal thickness	Mass per metre	Actual thickness	Inside corner radius	Co-ordinates of centroid		Full area of section	About n- and p-axes					Product 2nd moment of area
b_1	b_2	t		t	r_i	$p_B = n_L$	$p_T = n_R$	A_f	$I_n = I_p$	$Z_{nB} = Z_{pL}$	$Z_{nT} = Z_{pR}$	$S_n = S_p$	$m = r_p$	I_{np}
mm	mm	mm	kg/m	mm	mm	mm	mm	mm²	10⁶mm⁴	10³mm³	10³mm³	10³mm³	mm	10⁶mm⁴
65 x	65 x	6.0 CA	5.62	6.0	8.0	19.2	45.8	716	0.291	15.2	6.35	11.5	20.2	-0.186
		5.0 CA	4.52	4.7	4.0	18.4	46.6	576	0.238	13.0	5.10	9.22	20.3	-0.148
		4.0 CA	3.69	3.8	4.0	18.0	47.0	470	0.197	10.9	4.18	7.56	20.5	-0.122
50 x	50 x	6.0 CA	4.21	6.0	8.0	15.4	34.6	536	0.126	8.15	3.64	6.59	15.3	-0.0823
		5.0 CA	3.42	4.7	4.0	14.6	35.4	435	0.104	7.14	2.95	5.33	15.5	-0.0655
		4.0 CA	2.79	3.8	4.0	14.3	35.7	356	0.0868	6.08	2.43	4.39	15.6	-0.0544
		2.5 CA	1.81	2.4	2.5	13.6	36.4	230	0.0576	4.23	1.58	2.86	15.8	-0.0355
45 x	45 x	4.0 CA	2.50	3.8	4.0	13.0	32.0	318	0.0623	4.79	1.95	3.52	14.0	-0.0392
		2.5 CA	1.62	2.4	2.5	12.4	32.6	206	0.0416	3.36	1.27	2.30	14.2	-0.0257
40 x	40 x	4.0 CA	2.20	3.8	4.0	11.8	28.2	280	0.043	3.65	1.52	2.75	12.4	-0.0272
		2.5 CA	1.43	2.4	2.5	11.1	28.9	182	0.0289	2.60	0.999	1.81	12.6	-0.0179
30 x	30 x	2.5 CA	1.06	2.4	2.5	8.61	21.4	134	0.0118	1.37	0.55	0.994	9.35	-0.00738

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.

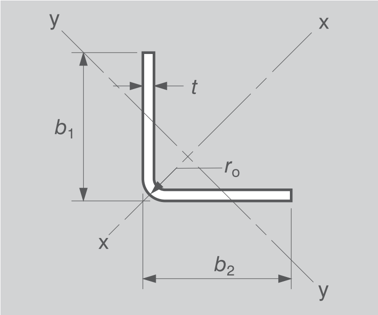


Table 3.1–3(A)

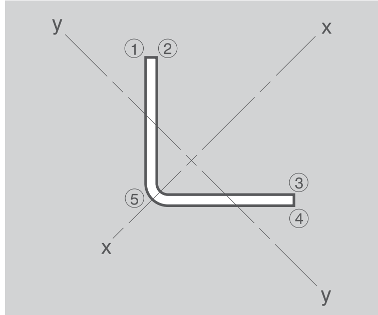
Limit state design

Effective section properties

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions						Ratios		Grade	Effective section properties							
Designation: Leg size		Nominal thickness	Mass per metre	Actual thickness	Outside corner radius			Yield stress	Effective area of Section		About x-axis		About y-axis			
b_1	b_2	t		t	r_o	$\frac{b_1 - r_o}{t}$	$\frac{b_2 - r_o}{t}$	f_y	A_e	$\frac{A_e}{A_f}$	$I_{ex1} = I_{ex4}$	$Z_{ex1} = Z_{ex4}$	$I_{ey2,3}$	$Z_{ey2,3}$	I_{ey5}	Z_{ey5}
mm	mm	mm	kg/m	mm	mm			MPa	mm^2		10^6mm^4	10^3mm^3	10^6mm^4	10^3mm^3	10^6mm^4	10^3mm^3
150 x	150 x	8.0 CA	18.0	8.0	16.0	16.8	16.8	400	1610	0.701	5.74	60.8	1.96	36.7	1.96	36.7
		6.0 CA	13.6	6.0	14.0	22.7	22.7	450	929	0.535	3.22	37.6	1.51	28.3	1.51	28.3
		5.0 CA	10.8	4.7	8.7	30.1	30.1	450	572	0.416	1.99	25.3	0.818	17.5	1.23	23.0
125 x	125 x	8.0 CA	14.9	8.0	16.0	13.6	13.6	400	1530	0.809	3.90	46.9	1.11	24.7	1.11	24.7
		5.0 CA	8.95	4.7	8.7	24.7	24.7	450	560	0.491	1.34	19.4	0.644	14.8	0.699	15.7
		4.0 CA	7.27	3.8	7.8	30.8	30.8	450	379	0.409	0.917	14.0	0.360	9.42	0.572	12.9
100 x	100 x	8.0 CA#	11.7	8.0	16.0	10.5	10.5	400	1410	0.946	2.36	33.4	0.542	15.1	0.542	15.1
		6.0 CA#	8.92	6.0	14.0	14.3	14.3	450	859	0.756	1.38	21.3	0.421	11.9	0.421	11.9
90 x	90 x	8.0 CA#	10.5	8.0	16.0	9.25	9.25	400	1330	1.00	1.70	26.7	0.386	12.0	0.386	12.0
		5.0 CA	6.37	4.7	8.7	17.3	17.3	450	530	0.654	0.672	12.2	0.252	7.83	0.252	7.83
75 x	75 x	8.0 CA#	8.59	8.0	16.0	7.38	7.38	400	1090	1.00	0.957	18.0	0.213	7.89	0.213	7.89
		6.0 CA#	6.56	6.0	14.0	10.2	10.2	450	781	0.934	0.735	13.9	0.167	6.26	0.167	6.26
		5.0 CA	5.26	4.7	8.7	14.1	14.1	450	508	0.759	0.458	9.41	0.142	5.29	0.142	5.29
		4.0 CA	4.29	3.8	7.8	17.7	17.7	450	353	0.646	0.310	6.78	0.117	4.39	0.117	4.39

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{ex1} and Z_{ex1} are for compression at point '1'; I_{ex4} and Z_{ex4} are for compression at point '4'; $I_{ey2,3}$ and $Z_{ey2,3}$ are for compression at points '2' and '3'; I_{ey5} and Z_{ey5} are for compression at point '5'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.
6. # sizes are also available in Lintels.

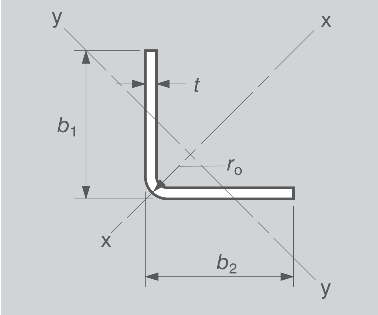


Table 3.1–3(B)

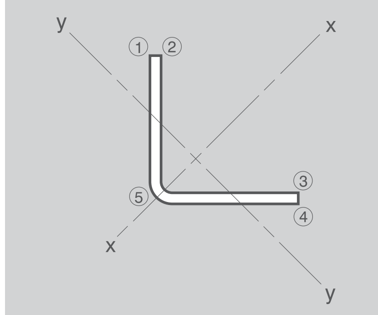
Limit state design

Effective section properties

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions						Ratios		Grade	Effective section properties							
Designation: Leg size b_1	Leg size b_2	Nominal thickness t	Mass per metre	Actual thickness t	Outside corner radius r_o	$\frac{b_1 - r_o}{t}$	$\frac{b_2 - r_o}{t}$	Yield stress f_y	Effective area of Section A_e	$\frac{A_e}{A_f}$	About x-axis $I_{ex1} = I_{ex4}$	About x-axis $Z_{ex1} = Z_{ex4}$	About y-axis $I_{ey2,3}$	About y-axis $Z_{ey2,3}$	About y-axis I_{ey5}	About y-axis Z_{ey5}
mm	mm	mm	kg/m	mm	mm			MPa	mm²		10⁶mm⁴	10³mm³	10⁶mm⁴	10³mm³	10⁶mm⁴	10³mm³
65 x	65 x	6.0 CA	5.62	6.0	14.0	8.50	8.50	450	716	1.00	0.477	10.4	0.104	4.52	0.104	4.52
		5.0 CA	4.52	4.7	8.7	12.0	12.00	450	487	0.846	0.337	7.65	0.0902	3.87	0.0902	3.87
		4.0 CA	3.69	3.8	7.8	15.1	15.1	450	342	0.727	0.230	5.54	0.0747	3.22	0.0747	3.22
50 x	50 x	6.0 CA	4.21	6.0	14.0	6.00	6.00	450	536	1.00	0.208	5.89	0.0434	2.44	0.0434	2.44
		5.0 CA	3.42	4.7	8.7	8.79	8.79	450	435	1.00	0.170	4.80	0.0389	2.16	0.0389	2.16
		4.0 CA	2.79	3.8	7.8	11.1	11.1	450	316	0.888	0.131	3.78	0.0324	1.81	0.0324	1.81
		2.5 CA	1.81	2.4	4.9	18.8	18.8	350	156	0.676	0.0615	1.98	0.0221	1.24	0.0221	1.24
45 x	45 x	4.0 CA	2.50	3.8	7.8	9.79	9.79	450	303	0.952	0.102	3.19	0.0231	1.43	0.0231	1.43
		2.5 CA	1.62	2.4	4.9	16.7	16.7	350	152	0.736	0.0494	1.71	0.0159	0.99	0.0159	0.99
40 x	40 x	4.0 CA	2.20	3.8	7.8	8.47	8.47	450	280	1.00	0.0702	2.48	0.0157	1.10	0.0157	1.10
		2.5 CA	1.43	2.4	4.9	14.6	14.6	350	147	0.806	0.0385	1.45	0.011	0.768	0.011	0.768
30 x	30 x	2.5 CA	1.06	2.4	4.9	10.5	10.5	350	132	0.980	0.0191	0.902	0.00438	0.408	0.00438	0.408

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{ex1} and Z_{ex1} are for compression at point '1'; I_{ex4} and Z_{ex4} are for compression at point '4'; $I_{ey2,3}$ and $Z_{ey2,3}$ are for compression at points '2' and '3'; I_{ey5} and Z_{ey5} are for compression at point '5'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.

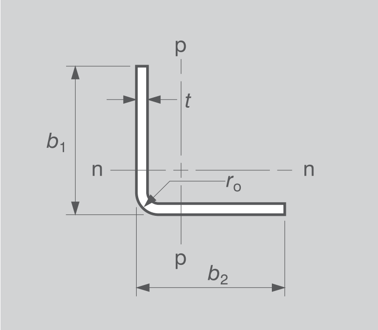


Table 3.1–4(A)

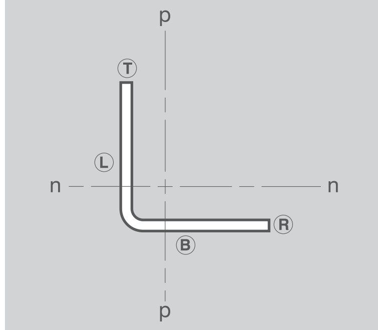
Limit state design

Effective section properties

About non-principal n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions: Designation: Leg size b_1 (mm)	Dimensions: Designation: Leg size b_2 (mm)	Dimensions: Designation: Nominal thickness t (mm)	Dimensions: Mass per metre (kg/m)	Dimensions: Actual thickness t (mm)	Dimensions: Outside corner radius r_o (mm)	Ratios: $\frac{b_1 - r_o}{t}$	Ratios: $\frac{b_2 - r_o}{t}$	Grade: Yield stress f_y (MPa)	Effective section properties: Effective area of section A_e (mm²)	Effective section properties: $\frac{A_e}{A_f}$	About n- and p-axes: $I_{enT} = I_{epR}$ (10⁶mm⁴)	About n- and p-axes: $Z_{enT} = Z_{epR}$ (10³mm³)	About n- and p-axes: $I_{enB} = I_{epL}$ (10⁶mm⁴)	About n- and p-axes: $Z_{enB} = Z_{epL}$ (10³mm³)
150 x	150 x	8.0 CA	18.0	8.0	16.0	16.8	16.8	400	1610	0.701	3.94	39.3	5.04	46.8
		6.0 CA	13.6	6.0	14.0	22.7	22.7	450	929	0.535	1.64	19.6	3.53	34.1
		5.0 CA	10.8	4.7	8.7	30.1	30.1	450	572	0.416	0.767	10.7	2.57	25.9
125 x	125 x	8.0 CA	14.9	8.0	16.0	13.6	13.6	400	1530	0.809	2.91	32.3	2.92	32.4
		5.0 CA	8.95	4.7	8.7	24.7	24.7	450	560	0.491	0.648	9.69	1.57	18.4
		4.0 CA	7.27	3.8	7.8	30.8	30.8	450	379	0.409	0.339	5.80	1.20	14.5
100 x	100 x	8.0 CA#	11.7	8.0	16.0	10.5	10.5	400	1410	0.946	1.45	20.4	1.45	20.4
		6.0 CA#	8.92	6.0	14.0	14.3	14.3	450	859	0.756	0.947	13.8	1.12	15.6
90 x	90 x	8.0 CA#	10.5	8.0	16.0	9.25	9.25	400	1330	1.00	1.04	16.3	1.04	16.3
		5.0 CA	6.37	4.7	8.7	17.3	17.3	450	530	0.654	0.441	7.61	0.629	9.83
75 x	75 x	8.0 CA#	8.59	8.0	16.0	7.38	7.38	400	1090	1.00	0.585	11.1	0.585	11.1
		6.0 CA#	6.56	6.0	14.0	10.2	10.2	450	781	0.934	0.457	8.57	0.457	8.57
		5.0 CA	5.26	4.7	8.7	14.1	14.1	450	508	0.759	0.334	6.38	0.372	6.86
		4.0 CA	4.29	3.8	7.8	17.7	17.7	450	353	0.646	0.196	4.13	0.293	5.51

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{enT} and Z_{enT} are for compression at point 'T'; I_{enB} and Z_{enB} are for compression at point 'B'; I_{epR} and Z_{epR} are for compression at point 'R'; I_{epL} and Z_{epL} are for compression at point 'L'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.
6. # sizes are also available in Lintels.

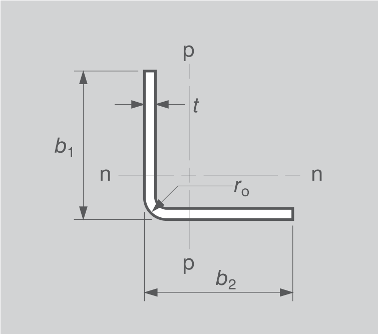
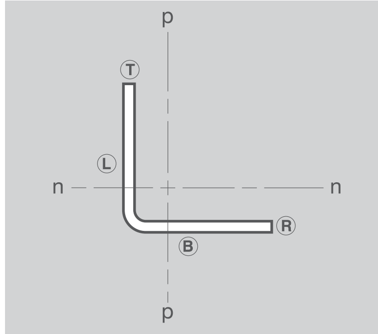


Table 3.1–4(B)

Limit state design
Effective section properties
About non-principal n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Dimensions						Ratios		Grade	Effective section properties					
Designation			Mass per metre	Actual thickness	Outside corner radius			Yield stress	Effective area of section		About n- and p-axes			
Leg size		Nominal thickness												
b_1	b_2	t		t	r_o	$\frac{b_1 - r_o}{t}$	$\frac{b_2 - r_o}{t}$	f_y	A_e	$\frac{A_e}{A_f}$	$I_{enT} = I_{epR}$	$Z_{enT} = Z_{epR}$	$I_{enB} = I_{epL}$	$Z_{enB} = Z_{epL}$
mm	mm	mm	kg/m	mm	mm			MPa	mm²		10^6mm⁴	10^3mm³	10^6mm⁴	10^3mm³
65 x	65 x	6.0 CA	5.62	6.0	14.0	8.50	8.50	450	716	1.00	0.291	6.35	0.291	6.35
		5.0 CA	4.52	4.7	8.7	12.0	12.0	450	487	0.846	0.238	5.10	0.238	5.10
		4.0 CA	3.69	3.8	7.8	15.1	15.1	450	342	0.727	0.159	3.62	0.195	4.17
50 x	50 x	6.0 CA	4.21	6.0	14.0	6.00	6.00	450	536	1.00	0.126	3.64	0.126	3.64
		5.0 CA	3.42	4.7	8.7	8.79	8.79	450	435	1.00	0.104	2.95	0.104	2.95
		4.0 CA	2.79	3.8	7.8	11.1	11.1	450	316	0.888	0.0868	2.43	0.0868	2.43
		2.5 CA	1.81	2.4	4.9	18.8	18.8	350	156	0.676	0.0414	1.26	0.0560	1.56
45 x	45 x	4.0 CA	2.50	3.8	7.8	9.79	9.79	450	303	0.952	0.0623	1.95	0.0623	1.95
		2.5 CA	1.62	2.4	4.9	16.7	16.7	350	152	0.736	0.0353	1.14	0.0414	1.27
40 x	40 x	4.0 CA	2.20	3.8	7.8	8.47	8.47	450	280	1.00	0.0430	1.52	0.0430	1.52
		2.5 CA	1.43	2.4	4.9	14.6	14.6	350	147	0.806	0.0288	0.998	0.0289	0.999
30 x	30 x	2.5 CA	1.06	2.4	4.9	10.5	10.5	350	132	0.98	0.0118	0.550	0.0118	0.550

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{enT} and Z_{enT} are for compression at point 'T'; I_{enB} and Z_{enB} are for compression at point 'B'; I_{epR} and Z_{epR} are for compression at point 'R'; I_{epL} and Z_{epL} are for compression at point 'L'.

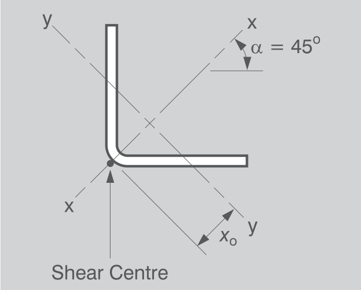
Table 3.1–5

Section properties to calculate member stability

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation			Mass per metre	Torsion constant	Coordinate of shear centre		Polar radius of gyration about the shear centre	Monosymmetry section constant	
Leg size		Nominal thickness							
b_1	b_2	t		J	x_o	y_o	r_{o1}	β_x	β_y
mm	mm	mm	kg/m	10^3mm^4	mm	mm	mm	mm	mm
150 x	150 x	8.0 CA	18.0	49.0	51.6	-	84.3	-	206
		6.0 CA	13.6	20.8	52.0	-	84.9	-	208
		5.0 CA	10.8	10.1	52.2	-	85.2	-	209
125 x	125 x	8.0 CA	14.9	40.4	42.8	-	69.9	-	171
		5.0 CA	8.95	8.39	43.4	-	70.8	-	173
		4.0 CA	7.27	4.46	43.5	-	71.1	-	174
100 x	100 x	8.0 CA	11.7	31.9	33.9	-	55.4	-	136
		6.0 CA	8.92	13.6	34.3	-	56.0	-	137
90 x	90 x	8.0 CA	10.5	28.5	30.4	-	49.7	-	122
		5.0 CA	6.37	5.97	31.0	-	50.6	-	124
75 x	75 x	8.0 CA	8.59	23.4	25.1	-	41.0	-	100
		6.0 CA	6.56	10.0	25.5	-	41.6	-	102
		5.0 CA	5.26	4.93	25.7	-	41.9	-	103
		4.0 CA	4.29	2.63	25.8	-	42.2	-	103
65 x	65 x	6.0 CA	5.62	8.59	21.9	-	35.8	-	87.7
		5.0 CA	4.52	4.24	22.2	-	36.2	-	88.6
		4.0 CA	3.69	2.26	22.3	-	36.4	-	89.2
50 x	50 x	6.0 CA	4.21	6.43	16.6	-	27.1	-	66.5
		5.0 CA	3.42	3.20	16.8	-	27.5	-	67.4
		4.0 CA	2.79	1.71	17.0	-	27.8	-	68.0
		2.5 CA	1.81	0.442	17.3	-	28.2	-	69.0
45 x	45 x	4.0 CA	2.50	1.53	15.2	-	24.9	-	61.0
		2.5 CA	1.62	0.396	15.5	-	25.3	-	61.9
40 x	40 x	4.0 CA	2.20	1.35	13.5	-	22.0	-	53.9
		2.5 CA	1.43	0.350	13.7	-	22.4	-	54.9
30 x	30 x	2.5 CA	1.06	0.258	10.2	-	16.6	-	40.7

Notes:
1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. With the exception of J, properties are calculated assuming a simplified shape where the bends are eliminated and the section is represented by straight mid-lines in accordance with Clause 2.1.2.1 of AS/NZS 4600.
3. β_x is zero for equal angles.
4. I_w is equal to zero for angles.
5. The shear centre is assumed to be located at the intersection of the centre lines of the angle legs.

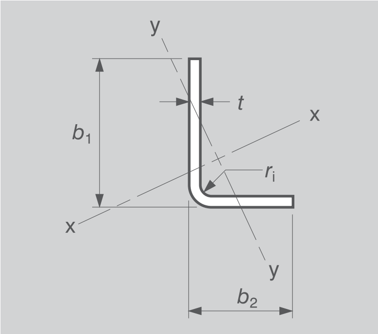


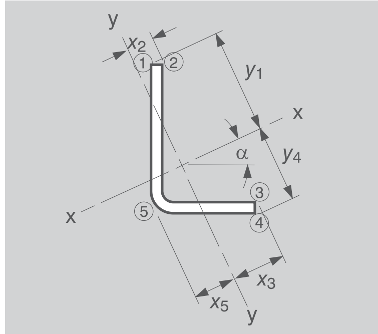
Table 3.2–1

Dimensions and full section properties

About principal x- and y-axes

Grade C450L0 / C400L0

Profile unequal angles



Dimensions

Designation Leg size b_1	b_2	Nominal thickness t	Mass per metre	Actual thickness t	Inside corner radius r_i	Coordinates of centroid y_1	y_4	x_2	x_3	x_5	Tan α
mm	mm	mm	kg/m	mm	mm	mm	mm	mm	mm	mm	
150 x	100 x	8.0 CA#	14.9	8.0	8.0	101	76.6	28.4	52.2	36.7	0.463
		6.0 CA#	11.3	6.0	8.0	102	76.3	27.8	52.3	36.3	0.465
125 x	75 x	8.0 CA#	11.7	8.0	8.0	82.6	61.0	20.6	40.9	27.2	0.386
		6.0 CA#	8.92	6.0	8.0	83.1	60.6	19.9	41.2	26.8	0.388
100 x	75 x	8.0 CA#	10.2	8.0	8.0	68.3	55.8	23.6	35.8	27.4	0.576
		6.0 CA#	7.74	6.0	8.0	68.6	55.5	23.1	35.8	27.0	0.578
75 x	50 x	6.0 CA	5.38	6.0	8.0	50.0	39.2	14.9	25.3	17.8	0.472
		5.0 CA	4.34	4.7	4.0	50.6	38.4	14.4	26.1	18.5	0.462
		4.0 CA	3.54	3.8	4.0	50.8	38.3	14.1	26.1	18.3	0.464

Section properties

Designation Leg size b_1	b_2	Nominal thickness t	Mass per metre	Actual thickness t	Full area of section A_f	About x-axis I_x	Z_{x1}=Z_{x4}	Z_{x4}	S_x	r_x	About y-axis I_y	Z_{y2}	Z_{y3}	Z_{y5}	S_y	r_y
mm	mm	mm	kg/m	mm	mm²	10^6mm⁴	10^3mm³	10^3mm³	10^3mm³	mm	10^6mm⁴	10^3mm³	10^3mm³	10^3mm³	10^3mm³	mm
150 x	100 x	8.0 CA#	14.9	8.0	1890	5.23	51.5	68.3	87.3	52.5	0.878	30.9	16.8	23.9	34.2	21.5
		6.0 CA#	11.3	6.0	1440	4.02	39.4	52.7	66.6	52.9	0.679	24.4	13.0	18.7	26.2	21.7
125 x	75 x	8.0 CA#	11.7	8.0	1490	2.74	33.1	44.8	56.2	42.8	0.381	18.5	9.30	14.0	19.8	16.0
		6.0 CA#	8.92	6.0	1140	2.11	25.4	34.9	43.0	43.1	0.297	14.9	7.21	11.1	15.2	16.2
100 x	75 x	8.0 CA#	10.2	8.0	1290	1.64	24.0	29.4	40.4	35.6	0.312	13.2	8.72	11.4	17.1	15.5
		6.0 CA#	7.74	6.0	986	1.27	18.6	22.9	31.1	36.0	0.244	10.6	6.81	9.03	13.2	15.7
75 x	50 x	6.0 CA	5.38	6.0	686	0.464	9.29	11.9	15.7	26.0	0.0731	4.89	2.89	4.10	5.97	10.3
		5.0 CA	4.34	4.7	553	0.378	7.47	9.83	12.7	26.2	0.0631	4.38	2.42	3.42	4.96	10.7
		4.0 CA	3.54	3.8	451	0.312	6.15	8.15	10.4	26.3	0.0524	3.71	2.01	2.87	4.08	10.8

Notes:
1. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.
3. # sizes are also available in Lintels.

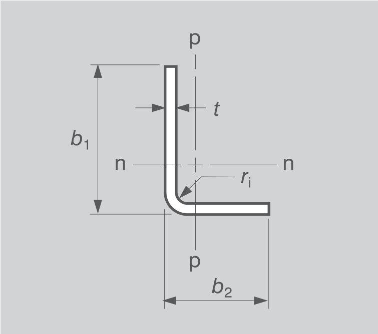


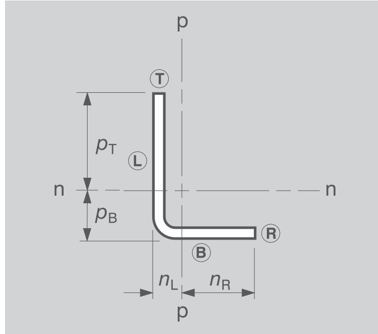
Table 3.2–2

Dimensions and full section properties

About non-principal n- and p-axes

Grade C450L0 / C400L0

Profile unequal angles



Dimensions								Section properties											
Designation: Leg size		Nominal thickness	Mass per metre	Co-ordinates of centroid				Full area of section	About n-axis					About p-axis					Product 2nd moment of area
b_1	b_2	t		p_B	p_T	n_L	n_R	A_f	I_n	Z_{nB}	Z_{nT}	S_n	m	I_p	Z_{pL}	Z_{pR}	S_p	r_p	I_{np}
mm	mm	mm	kg/m	mm	mm	mm	mm	mm²	10⁶mm⁴	10³mm³	10³mm³	10³mm³	mm	10⁶mm⁴	10³mm³	10³mm³	10³mm³	mm	10⁶mm⁴
150 x	100 x	8.0 CA#	14.9	49.0	101	23.5	76.5	1890	4.46	91.0	44.2	79.1	48.5	1.65	70.1	21.5	38.1	29.5	-1.66
		6.0 CA#	11.3	48.2	102	22.7	77.3	1440	3.42	71.1	33.6	60.3	48.8	1.27	56.1	16.4	28.9	29.8	-1.28
125 x	75 x	8.0 CA#	11.7	43.2	81.8	17.5	57.5	1490	2.43	56.2	29.7	52.4	40.3	0.687	39.2	11.9	21.4	21.4	-0.791
		6.0 CA#	8.92	42.3	82.7	16.7	58.3	1140	1.87	44.3	22.7	40.1	40.6	0.535	32.0	9.18	16.2	21.7	-0.613
100 x	75 x	8.0 CA#	10.2	32.5	67.5	19.6	55.4	1290	1.31	40.3	19.4	35.0	31.8	0.643	32.8	11.6	20.8	22.3	-0.575
		6.0 CA#	7.74	31.7	68.3	18.8	56.2	986	1.02	32.1	14.9	26.9	32.1	0.502	26.7	8.93	15.9	22.6	-0.446
75 x	50 x	6.0 CA	5.38	25.7	49.3	12.7	37.3	686	0.393	15.3	7.98	14.2	23.9	0.144	11.4	3.87	6.97	14.5	-0.151
		5.0 CA	4.34	24.8	50.2	12.0	38.0	553	0.323	13.0	6.43	11.5	24.2	0.119	9.86	3.12	5.56	14.6	-0.120
		4.0 CA	3.54	24.4	50.6	11.7	38.3	451	0.266	10.9	5.26	9.43	24.3	0.0983	8.44	2.57	4.54	14.8	-0.0991

Notes:
1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.
3. # sizes are also available in Lintels.

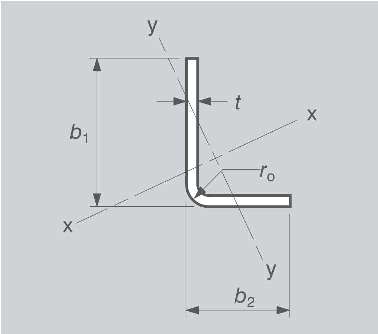
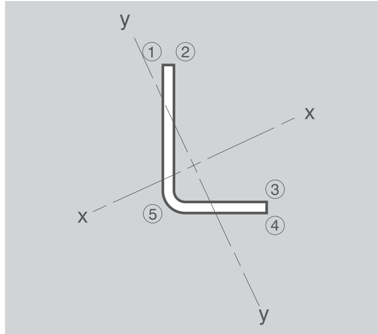


Table 3.2–3

Limit state design
Effective section properties

About principal x- and y-axes
Grade C450L0 / C400L0

Profile unequal angles



Dimensions						Ratios		Grade	Effective section properties									
Designation			Mass per metre	Actual thick-ness	Outside corner radius			Yield stress	Effective area of section		About x-axis				About y-axis			
Leg size		Nominal thickness																
b_1	b_2	t		t	r_o	$\frac{b_1 - r_o}{t}$	$\frac{b_2 - r_o}{t}$	f_y	A_e	$\frac{A_e}{A_f}$	I_{ex1}	Z_{ex1}	I_{ex4}	Z_{ex4}	$I_{ey2,3}$	$Z_{ey2,3}$	I_{ey5}	Z_{ey5}
mm	mm	mm	kg/m	mm	mm			MPa	mm²		10⁶mm⁴	10³mm³	10⁶mm⁴	10³mm³	10⁶mm⁴	10³mm³	10⁶mm⁴	10³mm³
150 x	100 x	8.0 CA#	14.9	8.0	16.0	16.8	10.5	400	1510	0.797	4.15	44.0	5.23	51.5	0.878	16.8	0.878	16.8
		6.0 CA#	11.3	6.0	14.0	22.7	14.3	450	894	0.623	1.96	24.2	3.59	36.8	0.679	13.0	0.679	13.0
125 x	75 x	8.0 CA#	11.7	8.0	16.0	13.6	7.38	400	1310	0.879	2.74	33.1	2.74	33.1	0.381	9.30	0.381	9.30
		6.0 CA#	8.92	6.0	14.0	18.5	10.2	450	841	0.741	1.42	19.4	2.11	25.4	0.297	7.21	0.297	7.21
100 x	75 x	8.0 CA#	10.2	8.0	16.0	10.5	7.38	400	1250	0.969	1.64	24.0	1.64	24.0	0.312	8.72	0.312	8.72
		6.0 CA#	7.74	6.0	14.0	14.3	10.2	450	820	0.832	1.02	15.9	1.27	18.6	0.244	6.81	0.244	6.81
75 x	50 x	6.0 CA	5.38	6.0	14.0	10.2	6.00	450	658	0.960	0.464	9.29	0.464	9.29	0.0731	2.89	0.0731	2.89
		5.0 CA	4.34	4.7	8.7	14.1	8.79	450	472	0.854	0.341	6.96	0.378	7.47	0.0631	2.42	0.0631	2.42
		4.0 CA	3.54	3.8	7.8	17.7	11.1	450	334	0.741	0.214	4.74	0.309	6.10	0.0524	2.01	0.0524	2.01

Notes:
1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{ex1} and Z_{ex1} are for compression at point '1'; I_{ex4} and Z_{ex4} are for compression at point '4'. $I_{ey2,3}$ and $Z_{ey2,3}$ are for compression at points '2' and '3'; I_{ey5} and Z_{ey5} are for compression at point '5'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.
6. # sizes are also available in Lintels.

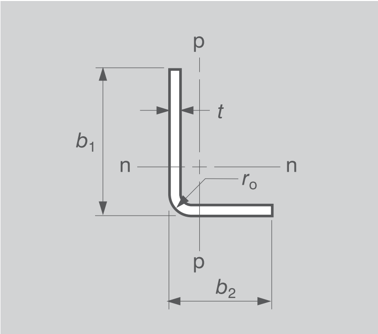


Table 3.2–4

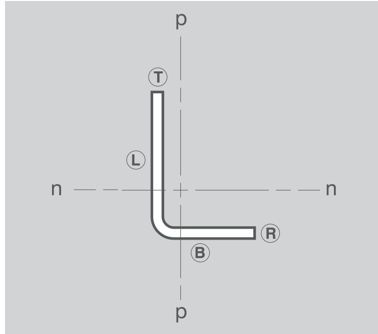
Limit state design

Effective section properties

About non-principal n- and p-axes

Grade C450LO / C400LO

Profile unequal angles



Dimensions						Ratios		Grade	Effective section properties									
Designation			Mass per metre	Actual thick-ness	Outside corner radius			Yield stress	Effective area of section		About n-axis				About p-axis			
Leg size		Nominal thickness																
b_1	b_2	t		t	r_o	$\frac{b_1 - r_o}{t}$	$\frac{b_2 - r_o}{t}$	f_y	A_e	$\frac{A_e}{A_f}$	I_{enT}	Z_{enT}	I_{enB}	Z_{enB}	I_{epR}	Z_{epR}	I_{epL}	Z_{epL}
mm	mm	mm	kg/m	mm	mm			MPa	mm²		10^6mm⁴	10^3mm³	10^6mm⁴	10^3mm³	10^6mm⁴	10^3mm³	10^6mm⁴	10^3mm³
150 x	100 x	8.0 CA#	14.9	8.0	16.0	16.8	10.5	400	1510	0.797	3.94	40.6	4.46	44.2	1.65	21.5	1.65	21.5
		6.0 CA#	11.3	6.0	14.0	22.7	14.3	450	894	0.623	1.70	20.8	3.35	33.3	0.941	13.4	1.19	16.0
125 x	75 x	8.0 CA#	11.7	8.0	16.0	13.6	7.38	400	1310	0.879	2.43	29.7	2.43	29.7	0.687	11.9	0.687	11.9
		6.0 CA#	8.92	6.0	14.0	18.5	10.2	450	841	0.741	1.34	18.0	1.87	22.7	0.535	9.18	0.525	9.11
100 x	75 x	8.0 CA#	10.2	8.0	16.0	10.5	7.38	400	1250	0.969	1.31	19.4	1.31	19.4	0.643	11.6	0.643	11.6
		6.0 CA#	7.74	6.0	14.0	14.3	10.2	450	820	0.832	0.939	14.1	1.02	14.9	0.502	8.93	0.502	8.93
75 x	50 x	6.0 CA	5.38	6.0	14.0	10.2	6.00	450	658	0.960	0.393	7.98	0.393	7.98	0.144	3.87	0.144	3.87
		5.0 CA	4.34	4.7	8.7	14.1	8.79	450	472	0.854	0.323	6.43	0.323	6.43	0.119	3.12	0.119	3.12
		4.0 CA	3.54	3.8	7.8	17.7	11.1	450	334	0.741	0.199	4.31	0.266	5.26	0.0983	2.57	0.0967	2.55

Notes:
1. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. A_e is calculated for sections with uniform axial compressive stress f_y.
3. I_e and Z_e are calculated with the extreme compression or tension fibres at f_y (first yield). Z_e is calculated at the extreme tension or compression fibre of the effective section.
4. I_{enT} and Z_{enT} are for compression at point 'T'; I_{enB} and Z_{enB} are for compression at point 'B'; I_{epR} and Z_{epR} are for compression at point 'R'; I_{epL} and Z_{epL} are for compression at point 'L'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.
6. # sizes are also available in Lintels.

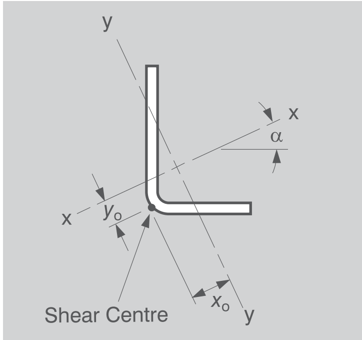
Table 3.2–5

Section properties to calculate member stability

About principal x- and y-axes

Grade C450L0 / C400L0

Profile unequal angles



Designation Leg size b_1	b_2	Nominal thickness t	Mass per metre	Torsion constant J	Coordinate of shear centre x_o	y_o	Polar radius of gyration about the shear centre r_{o1}	Monosymmetry section constant β_x	β_y
mm	mm	mm	kg/m	10^3mm^4	mm	mm	mm	mm	mm
150 x	100 x	8.0 CA	14.9	40.4	35.4	32.4	74.2	78.6	161
		6.0 CA	11.3	17.2	35.8	32.4	74.7	78.7	163
125 x	75 x	8.0 CA	11.7	31.9	25.5	31.2	60.8	74.7	126
		6.0 CA	8.92	13.6	25.9	31.3	61.3	74.9	127
100 x	75 x	8.0 CA	10.2	27.6	26.6	16.8	49.8	41.3	114
		6.0 CA	7.74	11.8	27.0	16.8	50.4	41.3	115
75 x	50 x	6.0 CA	5.38	8.23	17.3	16.2	36.6	39.2	79.2
		5.0 CA	4.34	4.07	17.6	16.2	36.9	39.2	80.2
		4.0 CA	3.54	2.17	17.7	16.2	37.2	39.3	80.8

Notes:
1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. With the exception of J, properties are calculated assuming a simplified shape where the bends are eliminated and the section is represented by straight mid-lines in accordance with Clause 2.1.2.1 of AS/NZS 4600.
3. I_w is equal to zero for angles.
4. The shear centre is assumed to be located at the intersection of the centre lines of the angle legs.

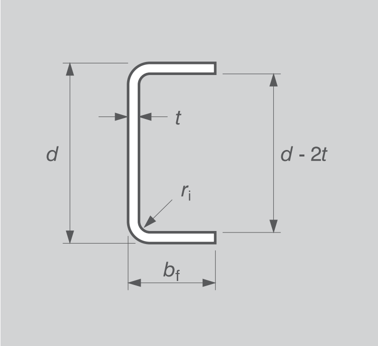


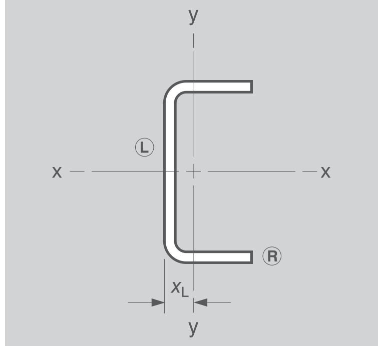
Table 3.3–1

Dimensions and full section properties

About principal x- and y-axes

Grade C450L0 / C400L0

Profile channels



Dimensions									Section properties								
Designation			Mass per metre	Actual thick-ness	Inside corner radius	Depth between flanges	Coord. of centroid	Full area of section	About x-axis				About y-axis				
Leg size		Nominal thickness															
d	b_f	t		t	r_i	$d - 2t$	x_L	A_f	I_x	Z_x	S_x	r_x	I_y	Z_{yR}	Z_{yL}	S_y	r_y
mm	mm	mm	kg/m	mm	mm	mm	mm	mm²	10^6mm⁴	10^3mm³	10^3mm³	mm	10^6mm⁴	10^3mm³	10^3mm³	10^3mm³	mm
300 x	90 x	8.0 CC	28.5	8.0	8.0	284	20.3	3630	44.2	294	359	110	2.44	35.0	120	62.1	25.9
		6.0 CC	21.6	6.0	8.0	288	19.5	2750	34.0	227	275	111	1.89	26.8	96.6	47.1	26.2
250 x	90 x	6.0 CC	19.2	6.0	8.0	238	21.6	2450	21.9	176	210	94.6	1.79	26.2	83.3	46.4	27.1
230 x	75 x	6.0 CC	16.9	6.0	8.0	218	17.5	2150	15.7	137	166	85.5	1.05	18.2	59.8	32.2	22.0
200 x	75 x	6.0 CC	15.5	6.0	8.0	188	18.8	1970	11.2	112	135	75.5	1.00	17.9	53.4	31.8	22.6
		5.0 CC	12.4	4.7	4.0	191	18.1	1580	9.18	91.8	109	76.4	0.812	14.3	44.9	25.3	22.7
180 x	75 x	5.0 CC	11.6	4.7	4.0	171	19.1	1480	7.16	79.5	93.7	69.5	0.787	14.1	41.2	25.1	23.1
150 x	75 x	5.0 CC	10.5	4.7	4.0	141	20.9	1340	4.67	62.3	72.5	59.0	0.743	13.7	35.6	24.8	23.5
125 x	65 x	4.0 CC	7.23	3.8	4.0	117	18.3	921	2.25	36.1	41.8	49.5	0.388	8.32	21.2	15.1	20.5
100 x	50 x	4.0 CC	5.59	3.8	4.0	92.4	14.3	712	1.08	21.7	25.4	39.0	0.174	4.86	12.2	8.78	15.6
75 x	40 x	4.0 CC	4.25	3.8	4.0	67.4	12.1	541	0.457	12.2	14.4	29.1	0.084	3.01	6.93	5.46	12.5

Notes:
1. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Full section properties are calculated in accordance with AS/NZS 4600.

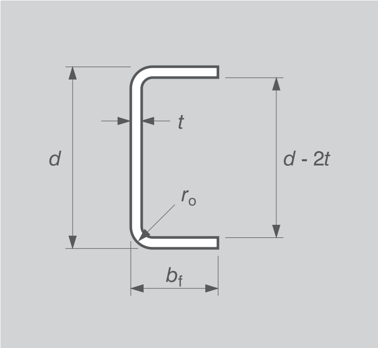
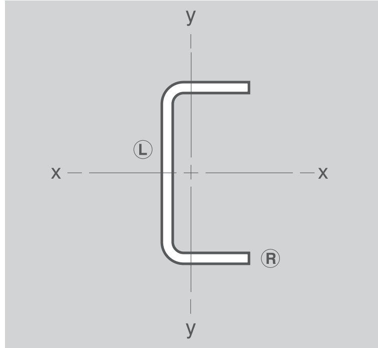


Table 3.3–2

Limit state design
Effective section properties

About principal x- and y-axes
Grade C450L0 / C400L0

Profile channels



Dimensions							Ratios					Grade	Effective section properties						
Designation: Leg size		Nominal thickness	Mass per metre	Actual thickness	Outside corner radius	Depth between flanges						Yield Stress	Effective Area of Section	About x-axis		About y-axis			
d	b_t	t		t	r_o	$d - 2t$	$\frac{(d-2r_o)}{t}$	$\frac{(b-r_o)}{t}$	$\frac{d_e}{(d-2r_o)}$	$\frac{b_e}{(b-r_o)}$	$\frac{A_e}{A_f}$	f_y	A_e	I_{ex}	Z_{ex}	I_{eyR}	Z_{eyR}	I_{eyL}	Z_{eyL}
mm	mm	mm	kg/m	mm	mm	mm						MPa	mm^2	10^6mm^4	10^3mm^3	10^6mm^4	10^3mm^3	10^6mm^4	10^3mm^3
300 x	90 x	8.0 CC	28.5	8.0	16.0	284	33.5	9.25	0.915	1.00	0.950	400	3450	44.2	294	2.44	35.0	2.44	35.0
		6.0 CC	21.6	6.0	14.0	288	45.3	12.7	0.712	0.801	0.763	450	2100	32.0	206	1.59	23.8	1.89	26.8
250 x	90 x	6.0 CC	19.2	6.0	14.0	238	37.0	12.7	0.825	0.801	0.831	450	2040	20.5	158	1.59	24.1	1.79	26.2
230 x	75 x	6.0 CC	16.9	6.0	14.0	218	33.7	10.2	0.879	0.925	0.906	450	1950	15.4	132	1.05	18.2	1.05	18.2
200 x	75 x	6.0 CC	15.5	6.0	14.0	188	28.7	10.2	0.968	0.925	0.955	450	1880	11.0	108	1.00	17.9	1.00	17.9
		5.0 CC	12.4	4.7	8.7	191	38.9	14.1	0.797	0.741	0.787	450	1240	8.37	79.5	0.667	12.5	0.812	14.3
180 x	75 x	5.0 CC	11.6	4.7	8.7	171	34.6	14.1	0.863	0.741	0.82	450	1220	6.50	68.4	0.668	12.6	0.787	14.1
150 x	75 x	5.0 CC	10.5	4.7	8.7	141	28.2	14.1	0.977	0.741	0.869	450	1160	4.22	52.9	0.668	12.8	0.743	13.7
125 x	65 x	4.0 CC	7.23	3.8	7.8	117	28.8	15.1	0.966	0.705	0.845	450	779	2.00	29.8	0.319	7.26	0.388	8.32
100 x	50 x	4.0 CC	5.59	3.8	7.8	92.4	22.2	11.1	1.00	0.875	0.944	450	672	1.04	20.1	0.174	4.86	0.174	4.86
75 x	40 x	4.0 CC	4.25	3.8	7.8	67.4	15.6	8.47	1.00	1.00	1.00	450	541	0.457	12.2	0.084	3.01	0.084	3.01

Notes:
1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. d_e and b_e are the effective widths of the web and flange respectively.
3. d_e, b_e and A_e are calculated for sections with uniform axial compressive stress f_y.
4. I_{eyL} and Z_{eyL} are for compression at point 'L'; I_{eyR} and Z_{eyR} are for compression at point 'R'.
5. Effective section properties are calculated in accordance with AS/NZS 4600.

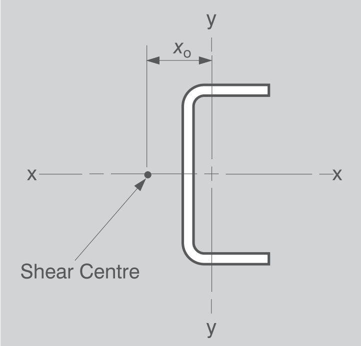
Table 3.3–3

Section properties to calculate member stability

About principal x- and y-axes

Grade C450L0 / C400L0

Profile channels



Designation: Leg size d	Leg size b_t	Nominal thickness t	Mass per metre	Torsion constant J	Warping constant I_w	Coordinate of shear centre x_o	Polar radius of gyration about the shear centre r_{o1}	Monosymmetry section constant β_y
mm	mm	mm	kg/m	10^3mm^4	10^9mm^6	mm	mm	mm
300 x	90 x	8.0 CC	28.5	77.4	37.7	43.4	122	338
		6.0 CC	21.6	33.0	29.6	44.0	123	340
250 x	90 x	6.0 CC	19.2	29.4	19.2	47.8	110	273
230 x	75 x	6.0 CC	16.9	25.8	9.48	37.8	96.7	254
200 x	75 x	6.0 CC	15.5	23.7	6.78	40.2	89.0	217
		5.0 CC	12.4	11.6	5.52	40.6	89.7	218
180 x	75 x	5.0 CC	11.6	10.9	4.29	42.4	84.9	197
150 x	75 x	5.0 CC	10.5	9.87	2.77	45.4	78.3	171
125 x	65 x	4.0 CC	7.23	4.43	1.01	40.0	67.0	145
100 x	50 x	4.0 CC	5.59	3.43	0.285	30.1	51.8	113
75 x	40 x	4.0 CC	4.25	2.60	0.0760	24.4	40.1	85.9

Notes:
1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. With the exception of J, properties are calculated assuming a simplified shape where the bends are eliminated and the section is represented by straight mid-lines in accordance with Clause 2.1.2.1 of AS/NZS 4600.
3. β_x is equal to zero for channels.

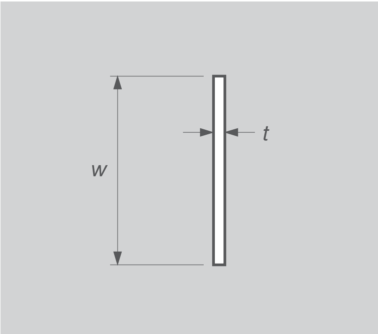


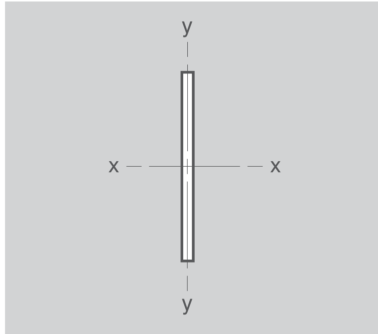
Table 3.4(A)

Dimensions and full section properties

About principal x- and y-axes

Grade C400LO / C350LO

Profile flats



Dimensions				Grade	Section properties									
Designation Width	Nominal thickness	Mass per metre	Actual thickness	Yield stress	Gross area of section	About x-axis				About y-axis				Torsion constant
w	t		t	f_y	A_g	I_x	Z_x	S_x	r_x	I_y	Z_y	S_y	r_y	J
mm	mm	kg/m	mm	MPa	mm²	10^6mm⁴	10^3mm³	10^3mm³	mm	10^6mm⁴	10^3mm³	10^3mm³	mm	10^3mm⁴
300 x	8.0 CF	18.8	8.0	350	2400	18.0	120	180	86.6	0.0128	3.20	4.80	2.31	51.2
	5.0 CF	11.1	4.7	400	1410	10.6	70.5	106	86.6	0.00260	1.10	1.66	1.36	10.4
250 x	8.0 CF	15.7	8.0	350	2000	10.4	83.3	125	72.2	0.0107	2.67	4.00	2.31	42.7
	5.0 CF	9.22	4.7	400	1180	6.12	49.0	73.4	72.2	0.00216	0.920	1.38	1.36	8.65
200 x	8.0 CF	12.6	8.0	350	1600	5.33	53.3	80.0	57.7	0.00853	2.13	3.20	2.31	34.1
	6.0 CF	9.42	6.0	400	1200	4.00	40.0	60.0	57.7	0.00360	1.20	1.80	1.73	14.4
	5.0 CF	7.38	4.7	400	940	3.13	31.3	47.0	57.7	0.00173	0.736	1.10	1.36	6.92
150 x	8.0 CF	9.42	8.0	350	1200	2.25	30.0	45.0	43.3	0.00640	1.60	2.40	2.31	25.6
	6.0 CF	7.07	6.0	400	900	1.69	22.5	33.8	43.3	0.00270	0.900	1.35	1.73	10.8
	5.0 CF	5.53	4.7	400	705	1.32	17.6	26.4	43.3	0.00130	0.552	0.828	1.36	5.19
130 x	5.0 CF	4.80	4.7	400	611	0.860	13.2	19.9	37.5	0.00112	0.479	0.718	1.36	4.50
100 x	8.0 CF	6.28	8.0	350	800	0.667	13.3	20.0	28.9	0.00427	1.07	1.60	2.31	17.1
	6.0 CF	4.71	6.0	400	600	0.500	10.0	15.0	28.9	0.00180	0.600	0.900	1.73	7.20
	5.0 CF	3.69	4.7	400	470	0.392	7.83	11.8	28.9	0.000865	0.368	0.552	1.36	3.46
	4.0 CF	2.98	3.8	400	380	0.317	6.33	9.50	28.9	0.000457	0.241	0.361	1.10	1.83

Notes:
1. Steel grade C400LO / C350LO (for $t \leq 6.0$ mm f_y = 400 MPa and f_u = 450 MPa, and for $t > 6.0$ mm f_y = 350 MPa and f_u = 400 MPa).
2. Section properties are calculated in accordance with AS/NZS 4600.

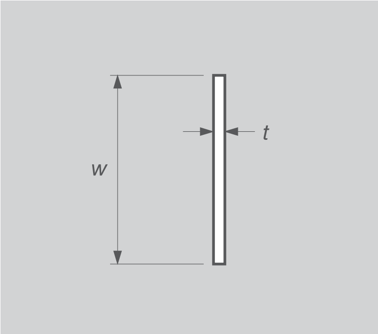


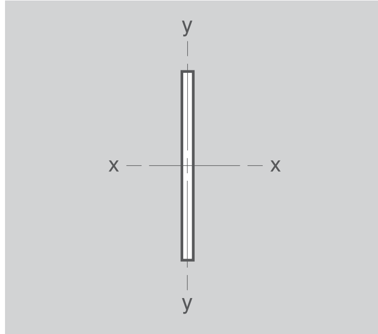
Table 3.4(B)

Dimensions and full section properties

About principal x- and y-axes

Grade C400L0 / C350L0

Profile flats



Dimensions				Grade	Section properties									
Designation Width	Nominal thickness	Mass per metre	Actual thickness	Yield stress	Gross area of section	About x-axis				About y-axis				Torsion constant
w	*t*		*t*	f_y	A_g	I_x	Z_x	S_x	r_x	I_y	Z_y	S_y	r_y	*J*
mm	mm	kg/m	mm	MPa	mm²	10^6mm⁴	10^3mm³	10^3mm³	mm	10^6mm⁴	10^3mm³	10^3mm³	mm	10^3mm⁴
90 x	6.0 CF	4.24	6.0	400	540	0.365	8.10	12.2	26.0	0.00162	0.54	0.81	1.73	6.48
75 x	5.0 CF	2.77	4.7	400	353	0.165	4.41	6.61	21.7	0.000649	0.276	0.414	1.36	2.60
	4.0 CF	2.24	3.8	400	285	0.134	3.56	5.34	21.7	0.000343	0.181	0.271	1.10	1.37
65 x	5.0 CF	2.40	4.7	400	306	0.108	3.31	4.96	18.8	0.000562	0.239	0.359	1.36	2.25
	4.0 CF	1.94	3.8	400	247	0.0870	2.68	4.01	18.8	0.000297	0.156	0.235	1.10	1.19
50 x	5.0 CF	1.84	4.7	400	235	0.0490	1.96	2.94	14.4	0.000433	0.184	0.276	1.36	1.73
	4.0 CF	1.49	3.8	400	190	0.0396	1.58	2.38	14.4	0.000229	0.120	0.181	1.10	0.915

Notes: 1. Steel grade C400L0 / C350L0 (for $t \leq 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa, and for $t > 6.0$ mm $f_y = 350$ MPa and $f_u = 400$ MPa).
2. Section properties are calculated in accordance with AS/NZS 4600.

Surface area

4

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Tables

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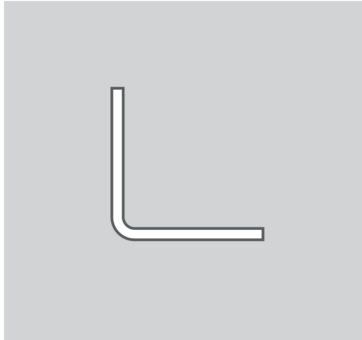
4.1 Scope

Surface area data may be used in estimating quantities of additional protective coatings. Tables 4.1 to 4.3 include values of external surface area per metre length and external surface area per tonne.

Table 4.1

Surface areas

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Profile distance	Profile surface area	Profile surface area
mm	mm	mm	kg/m	mm	m^2/m	$m^2/tonne$
150 x	150 x	8.0 CA	18.0	590	0.590	32.7
		6.0 CA	13.6	591	0.591	43.3
		5.0 CA	10.8	595	0.595	55.1
125 x	125 x	8.0 CA	14.9	490	0.490	32.9
		5.0 CA	8.95	495	0.495	55.3
		4.0 CA	7.27	495	0.495	68.1
100 x	100 x	8.0 CA	11.7	390	0.390	33.2
		6.0 CA	8.92	391	0.391	43.8
90 x	90 x	8.0 CA	10.5	350	0.350	33.4
		5.0 CA	6.37	355	0.355	55.7
75 x	75 x	8.0 CA	8.59	290	0.290	33.7
		6.0 CA	6.56	291	0.291	44.3
		5.0 CA	5.26	295	0.295	56.0
		4.0 CA	4.29	295	0.295	68.8
65 x	65 x	6.0 CA	5.62	251	0.251	44.6
		5.0 CA	4.52	255	0.255	56.3
		4.0 CA	3.69	255	0.255	69.1
50 x	50 x	6.0 CA	4.21	191	0.191	45.3
		5.0 CA	3.42	195	0.195	57.0
		4.0 CA	2.79	195	0.195	69.8
		2.5 CA	1.81	197	0.197	109
45 x	45 x	4.0 CA	2.50	175	0.175	70.1
		2.5 CA	1.62	177	0.177	109
40 x	40 x	4.0 CA	2.20	155	0.155	70.5
		2.5 CA	1.43	157	0.157	110
30 x	30 x	2.5 CA	1.06	117	0.117	111

Table 4.2

Surface areas

Profile unequal angles

Designation b_1 b_2 Nominal thickness	Mass per metre	Profile distance	Profile surface area	Profile surface area
mm mm mm	kg/m	mm	m^2/m	$m^2/tonne$
150 x 100 x 8.0 CA	14.9	490	0.490	32.9
6.0 CA	11.3	491	0.491	43.5
125 x 75 x 8.0 CA	11.7	390	0.390	33.2
6.0 CA	8.92	391	0.391	43.8
100 x 75 x 8.0 CA	10.2	340	0.340	33.4
6.0 CA	7.74	341	0.341	44.0
75 x 50 x 6.0 CA	5.38	241	0.241	44.7
5.0 CA	4.34	245	0.245	56.4
4.0 CA	3.54	245	0.245	69.2

Table 4.3

Surface areas

Profile channels

Designation d b_1 Nominal thickness	Mass per metre	Profile distance	Profile surface area	Profile surface area	Profile distance less 1 flange face	Profile surface area less 1 flange face	
mm mm mm	kg/m	mm	m^2/m	$m^2/tonne$	mm	m^2/m	$m^2/tonne$
300 x 90 x 8.0 CC	28.5	923	0.923	32.4	849	0.849	29.8
6.0 CC	21.6	929	0.929	43.0	853	0.853	39.5
250 x 90 x 6.0 CC	19.2	829	0.829	43.1	753	0.753	39.1
230 x 75 x 6.0 CC	16.9	729	0.729	43.2	668	0.668	39.6
200 x 75 x 6.0 CC	15.5	669	0.669	43.2	608	0.608	39.3
5.0 CC	12.4	680	0.680	55.0	613	0.613	49.6
180 x 75 x 5.0 CC	11.6	640	0.640	55.0	573	0.573	49.3
150 x 75 x 5.0 CC	10.5	580	0.580	55.1	513	0.513	48.8
125 x 65 x 4.0 CC	7.23	492	0.492	68.1	435	0.435	60.2
100 x 50 x 4.0 CC	5.59	382	0.382	68.4	340	0.340	60.9
75 x 40 x 4.0 CC	4.25	292	0.292	68.8	260	0.260	61.3

Fire engineering data

5

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Tables

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Exposed surface area to mass ratio (k_{sm})

5.1 Scope

To assist in the design of DuraGalUltra angles and channels for fire resistance, values of the exposed surface area to mass ratio (k_{sm}) are tabulated for various cases shown in Figure 5.1(1).

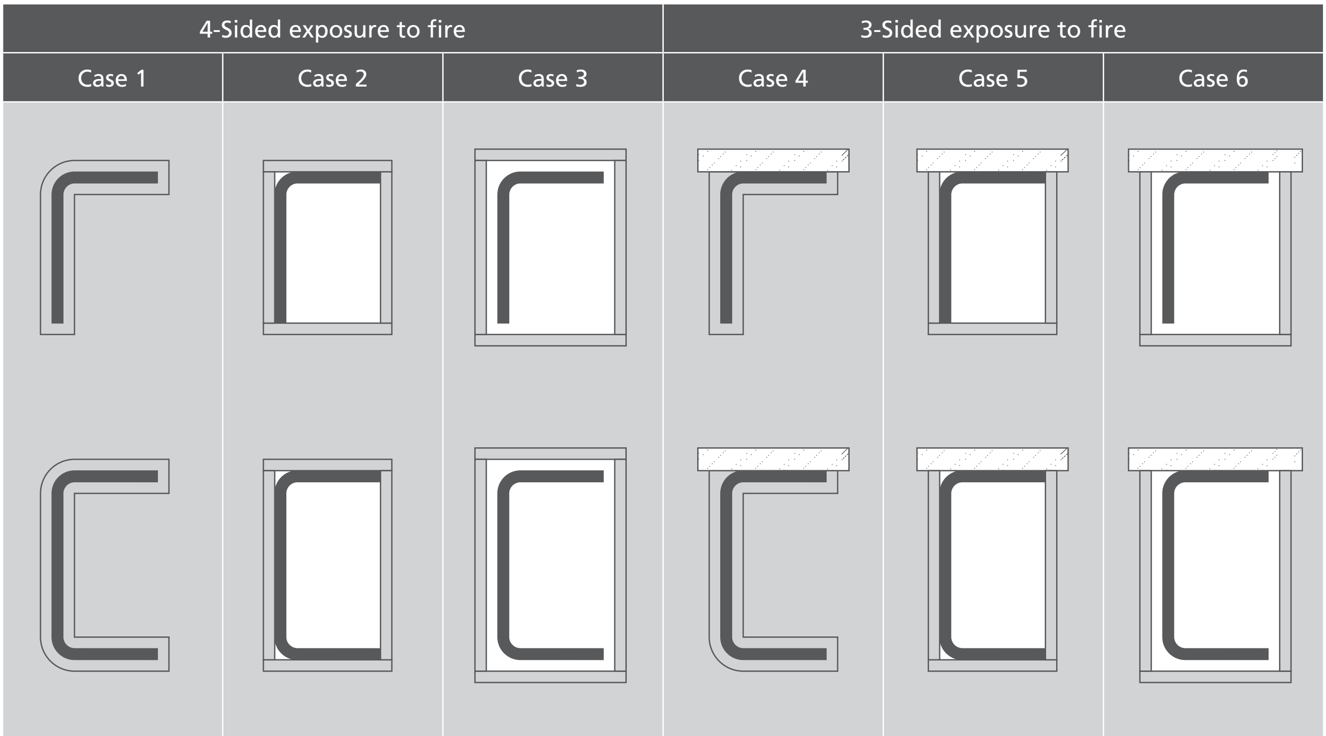
5.2 Dimensions method

In the absence of fire design rules in AS/NZS 4600, reference has been made to Section 12 of AS 4100.

For **unprotected structural sections** the value of k_{sm} corresponding to four- and three- sided exposure should be taken as those corresponding to cases one and four 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 ASI[10] may be consulted to determine the thickness of proprietary material required for given value of k_{sm} and fire-resistance level. In the ASI handbook, the exposed surface area to mass ratio (E) may be taken as equivalent to k_{sm}.

Figure 5.1(1) Cases for calculation of exposed surface area to mass ratio



Case 1 = Profile-protected
Case 2 = Total perimeter, box-protected, no gap
Case 3 = Total perimeter, box-protected, 25 mm gap
Case 4 = Top flange excluded, profile-protected
Case 5 = Top flange excluded, box-protected, no gap
Case 6 = Top flange excluded, box-protected, 25 mm gap

Table 5.1

Fire engineering data

Vertical leg down

Profile equal angles

Designation b_1 x b_2 x Nominal thickness	Mass per metre	Exposed surface area to mass ratio k_{sm} (m²/tonne)					
		Exposure type					
mm mm mm	kg/m	1	2	3	4	5	6
150 x 150 x 8.0 CA	18.0	32.7	33.3	44.4	25.3	25.0	30.5
6.0 CA	13.6	43.3	44.0	58.7	33.4	33.0	40.4
5.0 CA	10.8	55.1	55.6	74.1	42.0	41.7	51.0
125 x 125 x 8.0 CA	14.9	32.9	33.6	47.1	25.6	25.2	31.9
5.0 CA	8.95	55.3	55.9	78.2	42.3	41.9	53.1
4.0 CA	7.27	68.1	68.8	96.3	52.0	51.6	65.3
100 x 100 x 8.0 CA	11.7	33.2	34.1	51.1	26.1	25.6	34.1
6.0 CA	8.92	43.8	44.9	67.3	34.2	33.7	44.9
90 x 90 x 8.0 CA	10.5	33.4	34.4	53.4	26.3	25.8	35.3
5.0 CA	6.37	55.7	56.5	88.0	42.9	42.4	58.1
75 x 75 x 8.0 CA	8.59	33.7	34.9	58.2	26.8	26.2	37.8
6.0 CA	6.56	44.3	45.7	76.2	35.0	34.3	49.5
5.0 CA	5.26	56.0	57.0	95.1	43.4	42.8	61.8
4.0 CA	4.29	68.8	70.0	117	53.1	52.5	75.8
65 x 65 x 6.0 CA	5.62	44.6	46.3	81.9	35.5	34.7	52.5
5.0 CA	4.52	56.3	57.5	102	43.8	43.1	65.2
4.0 CA	3.69	69.1	70.5	125	53.6	52.9	80.0
50 x 50 x 6.0 CA	4.21	45.3	47.6	95.1	36.8	35.7	59.5
5.0 CA	3.42	57.0	58.6	117	44.9	43.9	73.2
4.0 CA	2.79	69.8	71.6	143	54.7	53.7	89.5
2.5 CA	1.81	109	111	221	83.9	82.9	138
45 x 45 x 4.0 CA	2.50	70.1	72.1	152	55.2	54.1	94.2
2.5 CA	1.62	109	111	235	84.4	83.3	145
40 x 40 x 4.0 CA	2.20	70.5	72.8	164	55.9	54.6	100
2.5 CA	1.43	110	112	251	85.0	83.8	154
30 x 30 x 2.5 CA	1.06	111	114	303	86.9	85.3	180

Exposure types:
1 = Total perimeter, profile protected
2 = Total perimeter, box protected, no gap
3 = Total perimeter, box protected, 25 mm gap
4 = Top horizontal leg excluded, profile protected
5 = Top horizontal leg excluded, box protected, no gap
6 = Top horizontal leg excluded, box protected, 25 mm gap

Table 5.2

Fire engineering data

Long Leg Down

Profile unequal angles

Designation b_1	b_2	Nominal thickness	Mass per metre	Exposed surface area to mass ratio k_{sm} (m²/tonne) Exposure type 1	2	3	4	5	6
mm	mm	mm	kg/m						
150	100	8.0 CA	14.9	32.9	33.6	47.1	25.1	26.9	33.6
		6.0 CA	11.3	43.5	44.4	62.1	33.4	35.5	44.4
125	75	8.0 CA	11.7	33.2	34.1	51.1	25.5	27.7	36.2
		6.0 CA	8.92	43.8	44.9	67.3	33.8	36.5	47.7
100	75	8.0 CA	10.2	33.4	34.4	54.1	24.5	27.1	36.9
		6.0 CA	7.74	44.0	45.2	71.1	32.5	35.5	48.5
75	50	6.0 CA	5.38	44.7	46.4	83.6	32.8	37.2	55.7
		5.0 CA	4.34	56.4	57.6	104	42.8	46.1	69.2
		4.0 CA	3.54	69.2	70.6	127	52.9	56.5	84.7

Exposure types:
1 = Total perimeter, profile protected
2 = Total perimeter, box protected, no gap
3 = Total perimeter, box protected, 25 mm gap
4 = Top horizontal leg excluded, profile protected
5 = Top horizontal leg excluded, box protected, no gap
6 = Top horizontal leg excluded, box protected, 25 mm gap

Table 5.3

Fire engineering data

Profile channels

Designation d b_1 Nominal thickness	Mass per metre	Exposed surface area to mass ratio k_{sm} (m²/tonne)					
		Exposure type					
mm mm mm	kg/m	1	2	3	4	5	6
300 x 90 x 8.0 CC	28.5	32.4	27.4	34.4	29.8	24.2	27.7
6.0 CC	21.6	43.0	36.1	45.4	39.5	31.9	36.6
250 x 90 x 6.0 CC	19.2	43.1	35.3	45.7	39.1	30.7	35.9
230 x 75 x 6.0 CC	16.9	43.2	36.1	48.0	39.6	31.7	37.6
200 x 75 x 6.0 CC	15.5	43.2	35.5	48.5	39.3	30.7	37.2
5.0 CC	12.4	55.0	44.5	60.7	49.6	38.4	46.5
180 x 75 x 5.0 CC	11.6	55.0	43.9	61.1	49.3	37.4	46.0
150 x 75 x 5.0 CC	10.5	55.1	42.8	61.8	48.8	35.6	45.1
125 x 65 x 4.0 CC	7.23	68.1	52.6	80.2	60.2	43.6	57.4
100 x 50 x 4.0 CC	5.59	68.4	53.7	89.5	60.9	44.7	62.6
75 x 40 x 4.0 CC	4.25	68.8	54.2	101	61.3	44.7	68.3

Exposure types:
1 = Total perimeter, profile protected
2 = Total perimeter, box protected, no gap
3 = Total perimeter, box protected, 25 mm gap
4 = Top horizontal leg excluded, profile protected
5 = Top horizontal leg excluded, box protected, no gap
6 = Top horizontal leg excluded, box protected, 25 mm gap

Section capacities

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6.1 Scope

The tables in this chapter provide design section capacities of DuraGalUltra angles and channels. The design action effects considered are:

> Axial tension

> Axial compression

> Bending moment

> Shear

Tables for web bearing capacity of DuraGalUltra channels are provided in Section 8.

6.2 Design method

6.2.1 General

Design section capacities are the maximum capacities, based on the effective section properties, which can be used for design. In such cases the members (channels and angles) are not subject to behaviour or influences which reduce its maximum load carrying capacity. For example:

> Members subject to axial tension do not have penetrations or holes and have full perimeter welded end connections.

> Members subject to axial compression are restrained so that flexural or flexural-torsional buckling will not occur.

> Beams are restrained and are not subject to flexural-torsional buckling.

Using the tables is simply a matter of selecting the value for a particular member size and design action effect. The tables assume that **axial loads are applied through the centroid** of the effective section and that **loads and reactions causing bending and shear are applied through the shear centre**. Refer to Section 3 of this manual for the location of the centroid and the shear centre of the sections. The method of derivation of the design section capacities in the tables is given in Appendix A3.

6.2.2 Angles in bending

Design section capacities are provided for bending about both the principal x- and y-axes and the non-principal n- and p-axes. The direction of the load causing bending has been taken into account. This determines which part of the angle is in compression and hence the design capacity.

6.2.3 Channels in bending

As well as design section capacities about the x-axis, two sets of design section capacities are provided for bending about the y-axis, one where compression occurs in the web of the channel, and one where tension occurs in the web.

Table 6.1–1

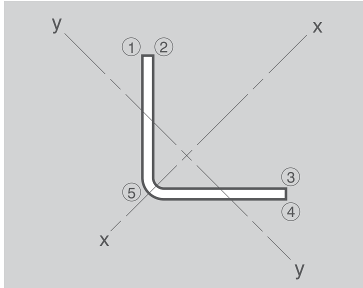
Limit states design

Section capacities

About principal x- and y-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



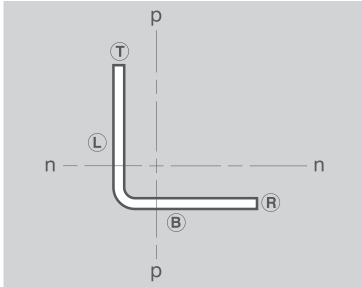
Designation b_1 b_2 Nominal thickness	Mass per metre	Axial tension[1] $\phi_t N_t$	Axial compression $\phi_c N_s$	Moment x-axis $\phi_b M_{sx1} = \phi_b M_{sx4}$	Moment y-axis $\phi_b M_{sy2,3}$	Moment y-axis $\phi_b M_{sy5}$	Shear x- and y-axes $\phi_v V_{vx} = \phi_v V_{vy}$
mm mm mm	kg/m	kN	kN	kNm	kNm	kNm	kN
150 x 150 x 8.0 CA	18.0	790	547	21.9	13.2	13.2	349
6.0 CA	13.6	664	355	15.2	11.5	11.5	299
5.0 CA	10.8	526	219	10.2	7.07	9.30	243
125 x 125 x 8.0 CA	14.9	652	521	16.9	8.91	8.91	284
5.0 CA	8.95	436	214	7.85	6.01	6.36	200
4.0 CA	7.27	354	145	5.69	3.82	5.22	163
100 x 100 x 8.0 CA	11.7	515	481	12.0	5.45	5.45	219
6.0 CA	8.92	434	329	8.63	4.80	4.80	189
90 x 90 x 8.0 CA	10.5	460	454	9.61	4.30	4.30	193
5.0 CA	6.37	310	203	4.93	3.17	3.17	140
75 x 75 x 8.0 CA	8.59	377	372	6.49	2.84	2.84	154
6.0 CA	6.56	320	299	5.64	2.54	2.54	134
5.0 CA	5.26	256	194	3.81	2.14	2.14	114
4.0 CA	4.29	209	135	2.74	1.78	1.78	93.6
65 x 65 x 6.0 CA	5.62	274	274	4.21	1.83	1.83	112
5.0 CA	4.52	220	186	3.10	1.57	1.57	97.0
4.0 CA	3.69	180	131	2.24	1.30	1.30	79.7
50 x 50 x 6.0 CA	4.21	205	205	2.38	0.989	0.989	79.2
5.0 CA	3.42	166	166	1.95	0.874	0.874	71.2
4.0 CA	2.79	136	121	1.53	0.734	0.734	58.8
2.5 CA	1.81	70.5	46.3	0.625	0.391	0.391	30.9
45 x 45 x 4.0 CA	2.50	122	116	1.29	0.581	0.581	51.8
2.5 CA	1.62	63.2	45.2	0.539	0.312	0.312	27.4
40 x 40 x 4.0 CA	2.20	107	107	1.01	0.445	0.445	44.9
2.5 CA	1.43	55.8	43.8	0.455	0.242	0.242	24.0
30 x 30 x 2.5 CA	1.06	41.1	39.2	0.284	0.128	0.128	17.2

Notes:
1. Tension capacities are for fully welded ends and are governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. $\phi_b M_{sx1}$ is for compression at point '1';
   $\phi_b M_{sx4}$ is for compression at point '4';
   $\phi_b M_{sy2,3}$ is for compression at points '2' and '3';
   $\phi_b M_{sy5}$ is for compression at point '5'.
3. $\phi_v V_{vx}$ is the design shear capacity perpendicular to the x- axis.
4. $\phi_v V_{vy}$ is the design shear capacity perpendicular to the y- axis.
5. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
6. Capacities are calculated in accordance with AS/NZS 4600.

Table 6.1–2

Limit states design
Section capacities

About non-principal n- and p-axes
Grade C450L0 / C400L0 / C350L0
Profile equal angles



Designation b_1 b_2 Nominal thickness	Mass per metre	Axial tension[(1)] $\phi_t N_t$	Axial compression $\phi_c N_s$	Moment n- and p-axes $\phi_b M_{snT} = \phi_b M_{spR}$	Moment n- and p-axes $\phi_b M_{snB} = \phi_b M_{spL}$	Shear n- and p-axes $\phi_v V_{vx} = \phi_v V_{vy}$
mm mm mm	kg/m	kN	kN	kNm	kNm	kN
150 x 150 x 8.0 CA	18.0	790	547	14.2	16.8	247
6.0 CA	13.6	664	355	7.93	13.8	212
5.0 CA	10.8	526	219	4.35	10.5	172
125 x 125 x 8.0 CA	14.9	652	521	11.6	11.7	201
5.0 CA	8.95	436	214	3.93	7.46	142
4.0 CA	7.27	354	145	2.35	5.87	115
100 x 100 x 8.0 CA	11.7	515	481	7.33	7.33	155
6.0 CA	8.92	434	329	5.61	6.31	134
90 x 90 x 8.0 CA	10.5	460	454	5.88	5.88	136
5.0 CA	6.37	310	203	3.08	3.98	99.0
75 x 75 x 8.0 CA	8.59	377	372	4.01	4.01	109
6.0 CA	6.56	320	229	3.47	3.47	94.9
5.0 CA	5.26	256	194	2.58	2.78	80.8
4.0 CA	4.29	209	135	1.67	2.23	66.2
65 x 65 x 6.0 CA	5.62	274	274	2.57	2.57	79.3
5.0 CA	4.52	220	186	2.07	2.07	68.6
4.0 CA	3.69	180	131	1.47	1.69	56.3
50 x 50 x 6.0 CA	4.21	205	205	1.47	1.47	56.0
5.0 CA	3.42	166	166	1.19	1.19	50.3
4.0 CA	2.79	136	121	0.983	0.983	41.6
2.5 CA	1.81	70.5	46.3	0.397	0.492	21.8
45 x 45 x 4.0 CA	2.50	122	116	0.789	0.789	36.6
2.5 CA	1.62	63.2	45.2	0.358	0.400	19.4
40 x 40 x 4.0 CA	2.20	107	107	0.616	0.616	31.7
2.5 CA	1.43	55.8	43.8	0.314	0.315	17.0
30 x 30 x 2.5 CA	1.06	41.1	39.2	0.173	0.173	12.1

Notes:
1. Tension capacities are for fully welded ends and are governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. $\phi_b M_{snT}$ is for compression at point 'T';
   $\phi_b M_{snB}$ is for compression at point 'B';
   $\phi_b M_{spR}$ is for compression at point 'R';
   $\phi_b M_{spL}$ is for compression at point 'L'.
3. $\phi_v V_{vn}$ is the design shear capacity prependicular to the n-axis.
4. $\phi_v V_{vp}$ is the design shear capacity prependicular to the p- axis.
5. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
6. Capacities are calculated in accordance with AS/NZS 4600.

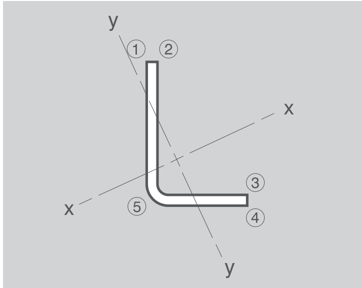
Table 6.2–1

Limit states design
Section capacities

About principal x- and y-axes

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1 x b_2 x Nominal thickness (mm)	Mass per metre (kg/m)	Axial tension[(1)] $\phi_t N_t$ (kN)	Axial compression $\phi_c N_s$ (kN)	Moment x-axis $\phi_b M_{sx1}$ (kNm)	Moment x-axis $\phi_b M_{sx4}$ (kNm)	Moment y-axis $\phi_b M_{sy2,3}$ (kNm)	Moment y-axis $\phi_b M_{sy5}$ (kNm)	Shear x-axis $\phi_v V_{vx}$ (kN)	Shear y-axis $\phi_v V_{vy}$ (kN)
150 x 100 x 8.0 CA	14.9	652	514	15.8	18.6	6.05	6.05	289	244
6.0 CA	11.3	549	342	9.78	14.9	5.25	5.25	248	210
125 x 75 x 8.0 CA	11.7	515	447	11.9	11.9	3.35	3.35	227	174
6.0 CA	8.92	434	322	7.84	10.3	2.92	2.92	195	151
100 x 75 x 8.0 CA	10.2	446	426	8.66	8.66	3.14	3.14	188	172
6.0 CA	7.74	377	314	6.45	7.53	2.76	2.76	163	149
75 x 50 x 6.0 CA	5.38	262	252	3.76	3.76	1.17	1.17	110	91.1
5.0 CA	4.34	211	180	2.82	3.02	0.981	0.981	94.4	79.6
4.0 CA	3.54	172	128	1.92	2.47	0.813	0.813	77.5	65.5

Notes:
1. Tension capacities are for fully welded ends and are governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. $\phi_b M_{sx1}$ is for compression at point '1';
   $\phi_b M_{sx4}$ is for compression at point '4';
   $\phi_b M_{sy2,3}$ is for compression at points '2' and '3';
   $\phi_b M_{sy5}$ is for compression at point '5'.
3. $\phi_v V_{vx}$ is the design shear capacity perpendicular to the x-axis.
4. $\phi_v V_{vy}$ is the design shear capacity perpendicular to the y-axis.
5. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
6. Capacities are calculated in accordance with AS/NZS 4600.

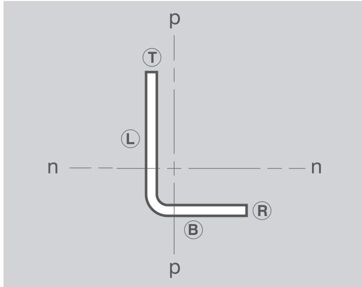
Table 6.2–2

Limit states design
Section capacities

About non-principal n- and p-axes

Grade C450L0 / C400L0

Profile unequal angles



Designation	Mass	Axial	Axial	Moment				Shear	
Nominal	per	tension[1]	compression	n-axis		p-axis		x-axis	y-axis
b_1 b_2 thickness	metre	$\phi_t N_t$	$\phi_c N_s$	$\phi_b M_{snT}$	$\phi_b M_{snB}$	$\phi_b M_{spR}$	$\phi_b M_{spL}$	$\phi_v V_{vn}$	$\phi_v V_{vp}$
mm mm mm	kg/m	kN	kN	kNm	kNm	kNm	kNm	kN	kN
150 x 100 x 8.0 CA	14.9	652	514	14.6	15.9	7.75	7.75	247	155
6.0 CA	11.3	549	342	8.42	13.5	5.41	6.47	212	134
125 x 75 x 8.0 CA	11.7	515	447	10.7	10.7	4.30	4.30	201	109
6.0 CA	8.92	434	322	7.29	9.19	3.72	3.69	173	94.9
100 x 75 x 8.0 CA	10.2	446	426	6.99	6.99	4.18	4.18	155	109
6.0 CA	7.74	377	314	5.70	6.02	3.62	3.62	134	94.9
75 x 50 x 6.0 CA	5.38	262	252	3.23	3.23	1.57	1.57	94.9	56.0
5.0 CA	4.34	211	180	2.60	2.60	1.26	1.26	80.8	50.3
4.0 CA	3.54	172	128	1.75	2.13	1.04	1.03	66.2	41.6

Notes:
1. Tension capacities are for fully welded ends and are governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. $\phi_b M_{snT}$ is for compression at point 'T';
   $\phi_b M_{snB}$ is for compression at point 'B';
   $\phi_b M_{spR}$ is for compression at point 'R';
   $\phi_b M_{spL}$ is for compression at point 'L'.
3. $\phi_v V_{vn}$ is the design shear capacity perpendicular to the n-axis.
4. $\phi_v V_{vp}$ is the design shear capacity perpendicular to the p-axis.
5. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
6. Capacities are calculated in accordance with AS/NZS 4600.

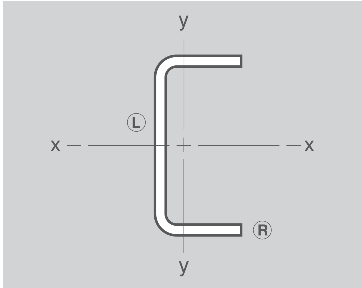
Table 6.3

Limit states design
Section capacities

About x- and y-axes

Grade C450L0 / C400L0

Profile channels



Designation d × b_f × Nominal thickness	Mass per metre	Axial tension[1]	Axial compression	Moment x-axis	Moment y-axis		Shear x-axis	Shear y-axis
		$\phi_t N_t$	$\phi_c N_s$	$\phi_b M_{sx}$	$\phi_b M_{syR}$	$\phi_b M_{syL}$	$\phi_v V_{vx}$	$\phi_v V_{vy}$
mm mm mm	kg/m	kN	kN	kNm	kNm	kNm	kN	kN
300 x 90 x 8.0 CC	28.5	1250	1170	106	12.6	12.6	494	273
6.0 CC	21.6	1050	803	83.6	9.65	10.8	423	236
250 x 90 x 6.0 CC	19.2	938	779	64.1	9.77	10.6	345	236
230 x 75 x 6.0 CC	16.9	823	746	53.5	7.36	7.36	314	190
200 x 75 x 6.0 CC	15.5	754	720	43.8	7.23	7.23	267	190
5.0 CC	12.4	603	474	32.2	5.05	5.78	222	162
180 x 75 x 5.0 CC	11.6	567	465	27.7	5.09	5.70	198	162
150 x 75 x 5.0 CC	10.5	513	445	21.4	5.16	5.56	162	162
125 x 65 x 4.0 CC	7.23	352	298	12.1	2.94	3.37	108	113
100 x 50 x 4.0 CC	5.59	272	257	8.16	1.97	1.97	83.1	83.1
75 x 40 x 4.0 CC	4.25	207	207	4.93	1.22	1.22	58.5	63.4

Notes:
1. Tension capacities are for fully welded ends and are governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. $\phi_b M_{syR}$ is for compression at point 'R';
   $\phi_b M_{syL}$ is for compression at point 'L';
3. $\phi_v V_{vx}$ is the design shear capacity perpendicular to the x-axis.
4. $\phi_v V_{vy}$ is the design shear capacity perpendicular to the y-axis.
5. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
6. Capacities are calculated in accordance with AS/NZS 4600.

Moment capacity

7

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Tables and graphs

Page

Design member moment capacity ($\phi_b M_b$) for beams ***without*** full lateral restraint

7.1 Scope

This section covers angles and channels **without full lateral restraint** bending about the principal x- and y-axes. The tables and graphs give the design member moment capacity ($\phi_b M_b$) for a range of effective lengths (l_e), and for the following range of moment distributions:

>	Equal angles:	bending about x-axis	C_b = 1.0
		bending about y-axis	C_{TF} = 1.0
>	Unequal angles:	bending about x-axis	C_{TF} = 1.0
		bending about y-axis	C_{TF} = 1.0
>	Channels:	bending about x-axis	C_b = 1.0
			C_b = 1.14
			C_b = 1.67
			C_b = 2.38
		bending about y-axis	C_{TF} = 1.0
			C_{TF} = 0.6

Values of the design section moment capacity ($\phi_b M_s$) and the shear capacity ($\phi_v V_v$) are also included in the tables for reference.

The values in the tables are based on the assumption that the **loads and reactions are applied through the shear centre** of the section.

7.2 Design method

7.2.1 General

To obtain the design member moment capacity ($\phi_b M_b$) from the tables for beams without full lateral restraint, the designer must first determine the effective length of the beam and the distribution of moment along the beam resulting from the loads applied.

A discussion on full lateral restraint and effective length is given in Sections 7.2.2 and 7.2.3 respectively.

The distribution of moment along a beam is represented by a bending coefficient (C_b) for bending about the principal x-axis of the equal angles and channels as discussed in Section 7.2.4. A coefficient for unequal end moment (C_{TF}) is used to allow for beam end moment for unequal angles and for equal angles and channels bending about the principal y-axis, as discussed in Section 7.2.5.

7.2.2 Full lateral restraint

The tables in this chapter assume that the angles and channels do not have full lateral restraint, and so may be subject to lateral buckling. A beam has full lateral restraint if the compression element is restrained against lateral movement and twisting, in which case the design moment capacity is equal to the design section moment capacity ($\phi_b M_s$).

7.2.3 Effective length

The elastic buckling moment of a beam, and hence the design member moment capacity ($\phi_b M_b$), is dependent on the effective length (l_e) for bending about the principal x- and y-axes (l_{ex} and l_{ey} respectively), and for twisting (l_{ez}) of the beam or the beam segment.

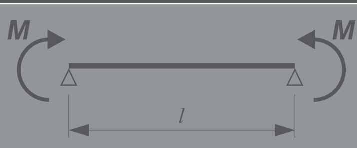
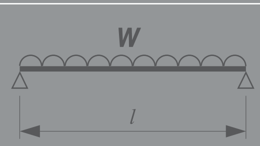
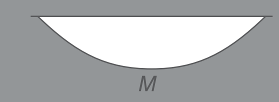
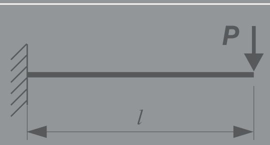
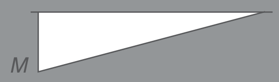
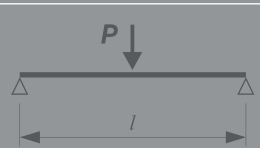
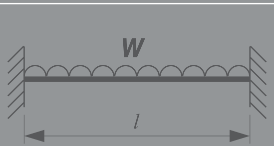
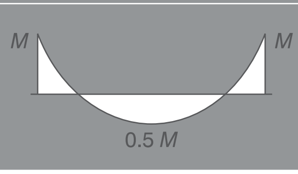
7.2.4 Bending coefficient

The bending coefficient (C_b) applies in the following cases:

- Equal Angles: bending about the principal x-axis
- Channels: bending about the principal x-axis

The bending coefficient (C_b) is dependent on the moment distribution along the member and is used to determine the elastic buckling moment (M_o) of a beam. Moment distributions and the corresponding values of C_b presented in the tables in this section are given in Figure 7.2(1). Higher values of C_b correspond to larger member moment capacities.

Figure7.2(1) Examples of bending coefficients (C_b) used in the tables

Load type	Moment distribution	Bending coefficient C_b
		1.0
		1.14
		1.67 (braced at load point)
		1.67 (braced at load point)
		2.38

Note: All supports are assumed to provide full or partial restraint

Clause 3.3.3.2.1(a) of AS/NZS 4600 specifies that a value of C_b = 1.0 should be used for the following case: Cantilevers or overhangs where the free end is unbraced.

For information on calculating values of bending coefficient for other cases, refer to Appendix A4. Alternatively, AS/NZS 4600 permits the use of C_b = 1.0 for all cases.

7.2.5 Coefficient for unequal end moments

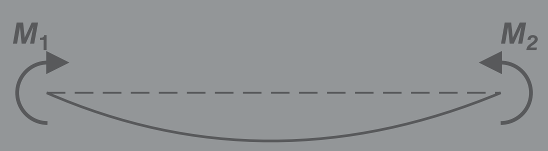
The coefficient for unequal end moments (C_{TF}) applies in the following cases:

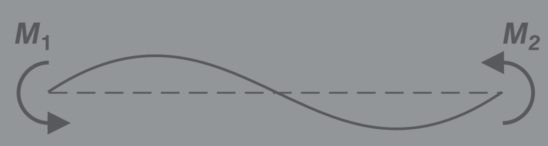
- Equal angles: bending about the principal y-axis
- Unequal angles: bending about the principal x- and y-axes
- Channels: bending about the principal y-axis

The coefficient for unequal end moment (C_{TF}) is dependent on the member end moments and is used to determine the elastic buckling moment (M_o) of a beam. End moment ratios and the corresponding values of C_{TF} are given in Figure 7.2(2). M_1 is the smaller of the two end moments.

Figure 7.2(2) Examples of coefficients for unequal end moments (C_{TF})

Single curvature bending				Double curvature bending			
M_1/M_2	C_{TF}	M_1/M_2	C_{TF}	M_1/M_2	C_{TF}	M_1/M_2	C_{TF}
-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	0.44	+0.90	0.24
-0.60	0.84	-0.10	0.64	+0.45	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				





Clause 3.3.3.2.1(a) of AS/NZS 4600 specifies that a value of C_{TF} = 1.0 should be used for the following case: If the bending moment at any point within an unbraced length is larger than that at both ends of this length.

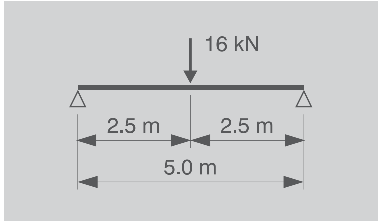
A value of C_{TF} = 1.0 may conservatively be used.

7.2.6 Shear lag

The shear lag effect is usually applicable to short span beams supporting concentrated loads. This effect is not considered in the tables provided in this manual. Where relevant, the designer should check the shear lag effect in accordance with Appendix A4.

7.3 Example

A single span simply supported beam of 5.0 m span is required to support a design central point load of 16 kN. At the location of the load and at the supports, the loads are applied through the shear centre and lateral restraint is provided.

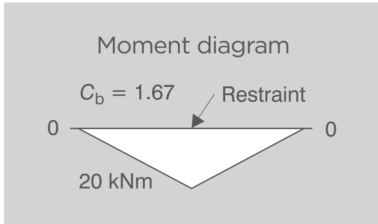


The effective length of the member $l_{ey} = l_{ez} = 2.5$ m.

What size DuraGalUltra channel bending about the x-axis is required to support this load?

Solution:

Moment capacity



Design bending moment $\quad M_x^* = \dfrac{Pl}{4} = \dfrac{16 \times 5.0}{4}$

$= 20.0$ kNm

Effective length $\quad l_{ey} = l_{ez} = 2.5$ m

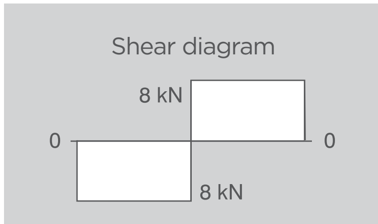
Bending coefficient $\quad C_b = 1.67$ (Fig. 7.2(1))

The member moment capacity ($\phi_b M_{bx}$) for channels bending about the x-axis with $C_b = 1.67$ is obtained from Table 7.3–3.

For a 180 x 75 x 5.0 CC DuraGalUltra

$\phi_b M_{bx} = 23.7 \text{ kNm} > 20.0 \text{ kNm}$

Shear capacity



Design shear force $\quad V^* = 8.0$ kN

The shear capacity ($\phi_v V_v$) for channels bending about the x-axis is obtained from either Table 7.3–3 or Table 6.3.

For a 180 x 75 x 5.0 CC DuraGalUltra

$\phi_v V_v = 198 \text{ kN} > 8.0 \text{ kN}$

The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

Note: If an allowance has not been made for the self-weight of the beam in the design load, this should be included in the design load now to ensure that the moment capacity and shear capacity of the channel is still greater than the design moment and design shear.

Additional design checks which should be performed include:

- Interaction of shear and bending (Section 9)
- Bearing (Section 8 if applicable)
- Deflection (Section 10)

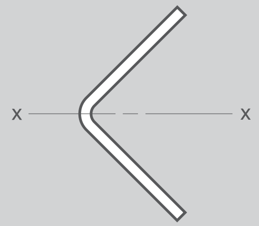


Table 7.1–1(A)

Limit state design
Member moment capacity

C_b = 1.0
Beams *without* full lateral restraint
Bending about principal x-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Typical moment distribution

for C_b = 1.0

Designation b_1	b_2	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) Effective length, l_e (m)														Design shear capacity $\phi_v V_{vx}$
mm	mm	mm	kg/m	kNm	0.25	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	kN
150 x	150 x	8.0 CA	18.0	21.9	21.9	21.9	21.9	21.8	21.2	20.5	19.9	19.3	18.6	18.0	17.3	16.0	14.5	13.2	349
		6.0 CA	13.6	15.2	15.2	15.2	15.1	14.5	13.8	13.2	12.5	11.8	11.1	10.3	9.63	8.47	7.60	6.91	299
		5.0 CA	10.8	10.2	10.2	10.2	9.93	9.36	8.79	8.20	7.59	6.98	6.37	5.86	5.45	4.80	4.31	3.93	243
125 x	125 x	8.0 CA	14.9	16.9	16.9	16.9	16.9	16.8	16.3	15.8	15.3	14.8	14.3	13.8	13.2	12.1	10.80	9.45	284
		5.0 CA	8.95	7.85	7.85	7.85	7.63	7.20	6.77	6.32	5.86	5.39	4.93	4.54	4.22	3.72	3.34	3.04	200
		4.0 CA	7.27	5.69	5.69	5.69	5.37	4.97	4.57	4.15	3.72	3.33	3.04	2.80	2.60	2.29	2.06	1.87	163
100 x	100 x	8.0 CA	11.7	12.0	12.0	12.0	12.0	11.9	11.5	11.0	10.5	10.0	9.56	9.08	8.61	7.66	6.72	5.88	219
		6.0 CA	8.92	8.63	8.63	8.63	8.57	8.20	7.82	7.43	7.03	6.62	6.20	5.76	5.33	4.52	3.87	3.39	189
90 x	90 x	8.0 CA	10.5	9.61	9.61	9.61	9.61	9.53	9.15	8.77	8.39	8.01	7.63	7.25	6.87	6.11	5.35	4.69	193
		5.0 CA	6.37	4.93	4.93	4.93	4.80	4.53	4.26	3.98	3.69	3.39	3.10	2.84	2.63	2.30	1.98	1.73	140
75 x	75 x	8.0 CA	8.59	6.49	6.49	6.49	6.49	6.43	6.18	5.92	5.66	5.40	5.14	4.89	4.63	4.11	3.60	3.15	154
		6.0 CA	6.56	5.64	5.64	5.64	5.60	5.31	4.96	4.62	4.28	3.93	3.59	3.25	2.93	2.44	2.09	1.83	134
		5.0 CA	5.26	3.81	3.81	3.81	3.70	3.50	3.28	3.06	2.83	2.59	2.35	2.10	1.89	1.58	1.35	1.18	114
		4.0 CA	4.29	2.74	2.74	2.74	2.60	2.41	2.22	2.02	1.81	1.62	1.47	1.35	1.25	1.05	0.897	0.784	93.6

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. Values are not listed below 0.100 kNm.

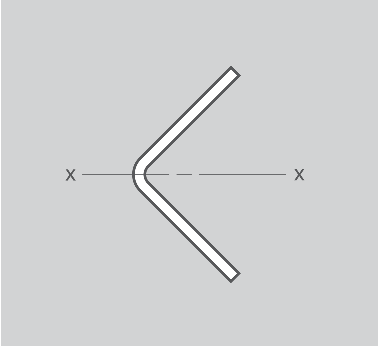


Table 7.1–1(B)

Limit state design

Member moment capacity

C_b = 1.0
Beams *without* full lateral restraint
Bending about principal x-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Typical moment distribution

for C_b = 1.0

Designation b_1	b_2	Nominal thickness		Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) — Effective length, l_e (m)														Design shear capacity $\phi_v V_{vx}$
mm	mm	mm		kg/m	kNm	0.25	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	kN
65	65	6.0	CA	5.62	4.21	4.21	4.21	4.16	3.91	3.65	3.40	3.14	2.89	2.63	2.38	2.14	1.79	1.53	1.34	112
		5.0	CA	4.52	3.10	3.10	3.10	3.01	2.83	2.65	2.47	2.25	1.99	1.75	1.55	1.40	1.17	0.999	0.874	97.0
		4.0	CA	3.69	2.24	2.24	2.24	2.12	1.97	1.81	1.64	1.47	1.31	1.16	1.03	0.93	0.775	0.664	0.581	79.7
50	50	6.0	CA	4.21	2.38	2.38	2.38	2.35	2.21	2.06	1.91	1.77	1.62	1.47	1.33	1.19	0.995	0.853	0.747	79.2
		5.0	CA	3.42	1.95	1.95	1.95	1.87	1.72	1.57	1.43	1.28	1.14	0.998	0.887	0.798	0.665	0.57	0.499	71.2
		4.0	CA	2.79	1.53	1.53	1.53	1.44	1.33	1.19	1.04	0.888	0.761	0.666	0.592	0.533	0.444	0.381	0.333	58.8
		2.5	CA	1.81	0.625	0.625	0.623	0.572	0.519	0.463	0.404	0.354	0.316	0.280	0.248	0.224	0.186	0.160	0.140	30.9
45	45	4.0	CA	2.50	1.29	1.29	1.29	1.19	1.07	0.95	0.829	0.708	0.607	0.531	0.472	0.425	0.354	0.304	0.266	51.8
		2.5	CA	1.62	0.539	0.539	0.537	0.493	0.446	0.397	0.346	0.299	0.256	0.224	0.199	0.179	0.150	0.128	0.112	27.4
40	40	4.0	CA	2.20	1.01	1.01	1.01	0.926	0.832	0.737	0.643	0.549	0.471	0.412	0.366	0.329	0.274	0.235	0.206	44.9
		2.5	CA	1.43	0.456	0.456	0.454	0.416	0.376	0.333	0.280	0.234	0.200	0.175	0.156	0.140	0.117	0.100	-	24.0
30	30	2.5	CA	1.06	0.284	0.284	0.283	0.25	0.217	0.184	0.152	0.127	0.109	-	-	-	-	-	-	17.2

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. Values are not listed below 0.100 kNm.

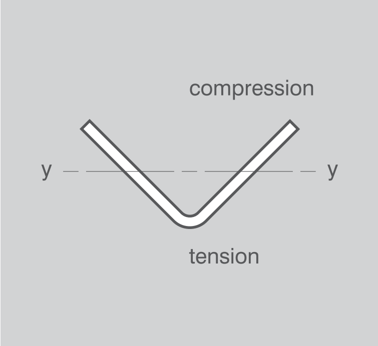


Table 7.1–2(A)

Limit state design

Member moment capacity

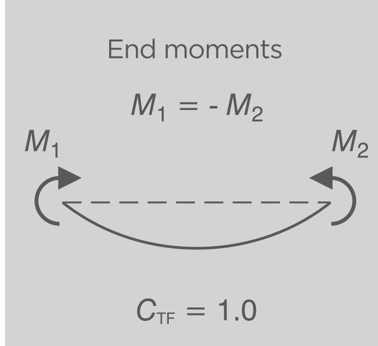
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about principal y-axis (tips in compression)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 x b_2 x Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m)														Design shear capacity $\phi_v V_{vy}$
mm mm mm	kg/m	kNm	0.25	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	kN
150 x 150 x 8.0 CA	18.0	13.2	11.5	11.5	11.5	11.5	11.4	11.4	11.4	11.3	11.3	11.2	11.1	11.00	10.8	10.6	349
6.0 CA	13.6	11.5	7.11	7.11	7.09	7.07	7.04	7.00	6.96	6.91	6.85	6.78	6.71	6.54	6.37	6.17	299
5.0 CA	10.8	7.07	3.49	3.49	3.48	3.48	3.47	3.45	3.43	3.41	3.39	3.37	3.34	3.28	3.22	3.15	243
125 x 125 x 8.0 CA	14.9	8.91	8.45	8.45	8.43	8.41	8.39	8.35	8.31	8.27	8.22	8.16	8.11	7.99	7.86	7.73	284
5.0 CA	8.95	6.01	3.48	3.48	3.47	3.45	3.43	3.40	3.37	3.33	3.29	3.25	3.20	3.10	2.99	2.89	200
4.0 CA	7.27	3.82	1.84	1.84	1.84	1.83	1.83	1.82	1.80	1.79	1.77	1.76	1.74	1.70	1.66	1.61	163
100 x 100 x 8.0 CA	11.7	5.45	5.45	5.45	5.45	5.45	5.45	5.42	5.39	5.36	5.32	5.28	5.24	5.16	5.07	4.99	219
6.0 CA	8.92	4.80	4.34	4.33	4.32	4.30	4.28	4.24	4.21	4.17	4.13	4.08	4.03	3.93	3.82	3.71	189
90 x 90 x 8.0 CA	10.5	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.27	4.24	4.21	4.14	4.07	4.00	193
5.0 CA	6.37	3.17	2.62	2.62	2.61	2.60	2.57	2.55	2.52	2.48	2.45	2.41	2.37	2.28	2.19	2.09	140
75 x 75 x 8.0 CA	8.59	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.83	2.79	2.74	2.70	154
6.0 CA	6.56	2.54	2.54	2.53	2.52	2.51	2.49	2.46	2.44	2.41	2.38	2.36	2.33	2.27	2.21	2.14	134
5.0 CA	5.26	2.14	1.97	1.96	1.96	1.94	1.92	1.90	1.87	1.85	1.82	1.79	1.76	1.69	1.62	1.56	114
4.0 CA	4.29	1.78	1.44	1.44	1.43	1.42	1.40	1.38	1.36	1.33	1.3	1.27	1.24	1.18	1.11	1.05	93.6

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

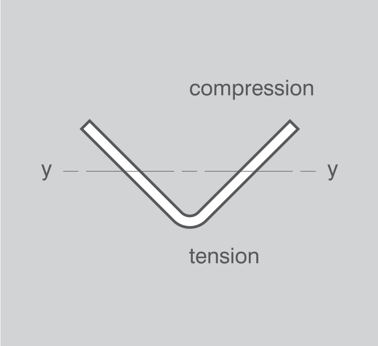


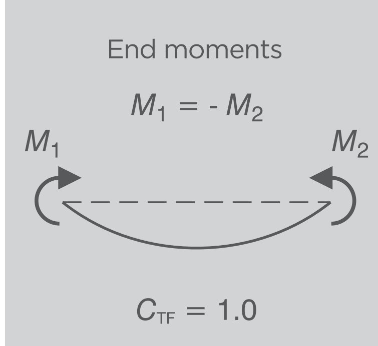
Table 7.1–2(B)

Limit state design
Member moment capacity

C_{TF} = 1.0
Beams *without* full lateral restraint
Bending about principal y-axis (tips in compression)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m)														Design shear capacity $\phi_v V_{vy}$
mm	mm	mm	kg/m	kNm	0.25	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	kN
65 x	65 x	6.0 CA	5.62	1.83	1.83	1.83	1.83	1.83	1.83	1.82	1.81	1.79	1.76	1.74	1.72	1.68	1.64	1.59	112
		5.0 CA	4.52	1.57	1.52	1.52	1.51	1.49	1.48	1.46	1.44	1.42	1.39	1.37	1.35	1.30	1.25	1.20	97.0
		4.0 CA	3.69	1.30	1.16	1.16	1.15	1.14	1.12	1.11	1.09	1.07	1.04	1.02	0.996	0.946	0.896	0.844	79.7
50 x	50 x	6.0 CA	4.21	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.981	0.970	0.959	0.936	0.913	0.890	79.2
		5.0 CA	3.42	0.874	0.874	0.874	0.874	0.874	0.870	0.858	0.845	0.832	0.818	0.804	0.791	0.763	0.735	0.708	71.2
		4.0 CA	2.79	0.734	0.723	0.721	0.715	0.705	0.694	0.682	0.669	0.655	0.641	0.627	0.613	0.584	0.555	0.526	58.8
		2.5 CA	1.81	0.391	0.331	0.331	0.328	0.323	0.317	0.310	0.303	0.295	0.286	0.277	0.268	0.249	0.230	0.211	30.9
45 x	45 x	4.0 CA	2.50	0.581	0.581	0.581	0.579	0.570	0.561	0.551	0.540	0.529	0.518	0.507	0.496	0.473	0.450	0.427	51.8
		2.5 CA	1.62	0.312	0.281	0.280	0.277	0.273	0.268	0.262	0.255	0.248	0.241	0.234	0.226	0.211	0.195	0.180	27.4
40 x	40 x	4.0 CA	2.20	0.445	0.445	0.445	0.445	0.445	0.438	0.430	0.422	0.413	0.405	0.396	0.387	0.370	0.353	0.335	44.9
		2.5 CA	1.43	0.242	0.229	0.228	0.226	0.222	0.217	0.212	0.207	0.201	0.195	0.189	0.184	0.172	0.159	0.147	24.0
30 x	30 x	2.5 CA	1.06	0.128	0.128	0.128	0.128	0.126	0.123	0.120	0.117	0.114	0.111	0.108	0.105	-	-	-	17.2

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. Values are not listed below 0.100 kNm.

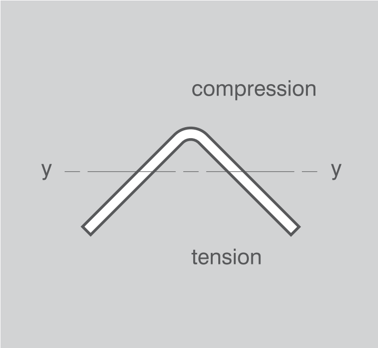


Table 7.1-3(A)

Limit state design

Member moment capacity

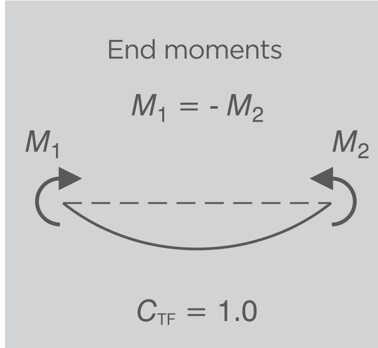
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about principal y-axis (corner in compression)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness		Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m)														Design shear capacity $\phi_v V_{vy}$
mm	mm	mm		kg/m	kNm	0.25	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	kN
150 x	150 x	8.0	CA	18.0	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	349
		6.0	CA	13.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	299
		5.0	CA	10.8	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	243
125 x	125 x	8.0	CA	14.9	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	284
		5.0	CA	8.95	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	200
		4.0	CA	7.27	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	5.22	163
100 x	100 x	8.0	CA	11.7	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	219
		6.0	CA	8.92	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	189
90 x	90 x	8.0	CA	10.5	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	193
		5.0	CA	6.37	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.16	3.06	140
75 x	75 x	8.0	CA	8.59	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	2.84	154
		6.0	CA	6.56	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	134
		5.0	CA	5.26	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.09	2.02	114
		4.0	CA	4.29	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.77	1.69	1.62	93.6

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

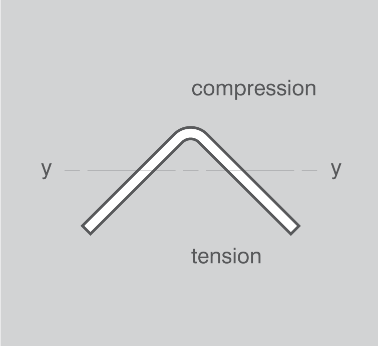


Table 7.1–3(B)

Limit state design

Member moment capacity

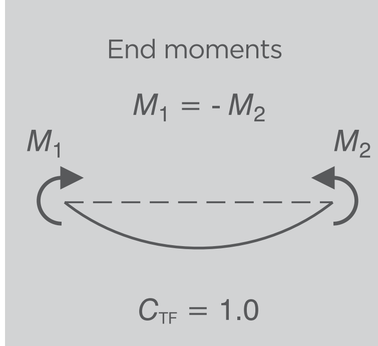
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about principal y-axis (corner in compression)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 × b_2 × Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m)														Design shear capacity $\phi_v V_{vy}$
mm mm mm	kg/m	kNm	0.25	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	kN
65 x 65 x 6.0 CA	5.62	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	112
5.0 CA	4.52	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.52	1.46	97.0
4.0 CA	3.69	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.28	1.22	1.17	79.7
50 x 50 x 6.0 CA	4.21	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.989	79.2
5.0 CA	3.42	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.874	0.869	0.838	0.807	71.2
4.0 CA	2.79	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.734	0.705	0.673	0.64	58.8
2.5 CA	1.81	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.390	0.381	0.361	0.340	0.319	30.9
45 x 45 x 4.0 CA	2.50	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.581	0.555	0.530	0.504	51.8
2.5 CA	1.62	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.312	0.308	0.300	0.284	0.267	0.250	27.4
40 x 40 x 4.0 CA	2.20	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.445	0.425	0.405	0.385	44.9
2.5 CA	1.43	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.237	0.230	0.217	0.204	0.191	24.0
30 x 30 x 2.5 CA	1.06	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.124	0.121	0.114	0.107	-	17.2

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. Values are not listed below 0.100 kNm.

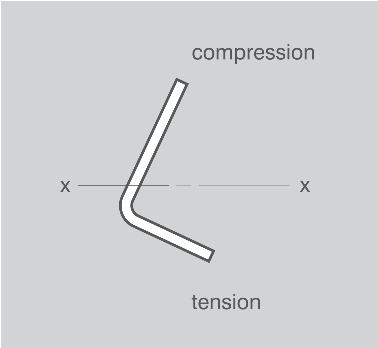


Table 7.2–1

Limit state design

Member moment capacity

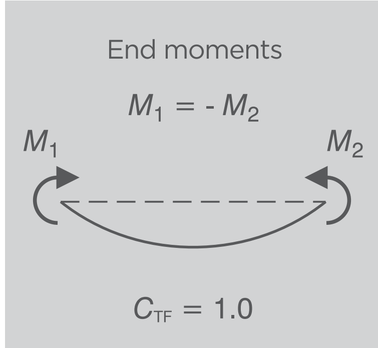
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about principal x-axis (long leg tip in compression)

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness		Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) Effective length, l_e (m)														Design shear capacity $\phi_v V_{vx}$
mm	mm	mm		kg/m	kNm	0.25	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	kN
150 x	100 x	8.0	CA	14.9	15.8	15.4	15.3	15.1	14.7	14.4	14.0	13.5	13.1	12.6	11.9	11.2	9.65	8.45	7.52	289
		6.0	CA	11.3	9.78	8.68	8.63	8.44	8.17	7.84	7.47	7.07	6.69	6.34	6.03	5.75	5.26	4.64	4.15	248
125 x	75 x	8.0	CA	11.7	11.9	11.8	11.6	11.2	10.7	10.2	9.65	9.11	8.56	8.02	7.47	6.92	5.90	5.14	4.55	227
		6.0	CA	8.92	7.84	7.25	7.19	6.98	6.70	6.38	6.01	5.62	5.08	4.59	4.17	3.83	3.28	2.87	2.55	195
100 x	75 x	8.0	CA	10.2	8.66	8.66	8.66	8.63	8.30	7.96	7.61	7.27	6.92	6.58	6.23	5.88	5.19	4.52	3.98	188
		6.0	CA	7.74	6.45	6.41	6.34	6.13	5.89	5.63	5.36	5.07	4.72	4.27	3.85	3.50	2.96	2.57	2.27	163
75 x	50 x	6.0	CA	5.38	3.76	3.76	3.74	3.51	3.27	3.03	2.78	2.53	2.28	2.04	1.83	1.66	1.39	1.20	1.06	110
		5.0	CA	4.34	2.82	2.77	2.72	2.59	2.41	2.17	1.92	1.68	1.47	1.30	1.17	1.06	0.896	0.775	0.683	94.4
		4.0	CA	3.54	1.92	1.82	1.78	1.69	1.57	1.49	1.26	1.08	0.951	0.846	0.762	0.693	0.587	0.509	0.449	77.5

NOTES: 1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

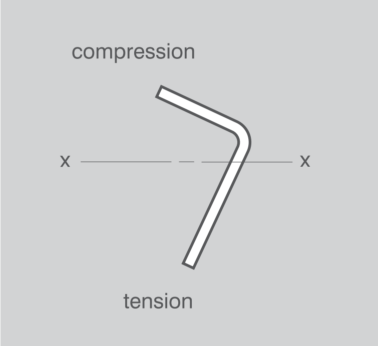


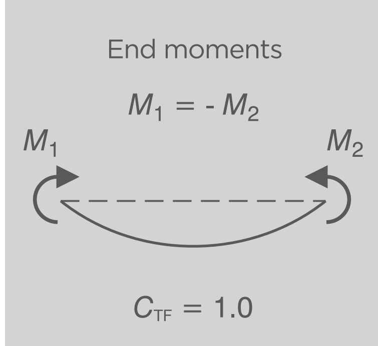
Table 7.2–2

Limit state design
Member moment capacity

C_{TF} = 1.0
Beams *without* full lateral restraint
Bending about principal x-axis (short leg tip in compression)

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) Effective length, l_e (m)														Design shear capacity $\phi_v V_{vx}$
mm	mm	mm	kg/m	kNm	0.25	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	kN
150	100	8.0 CA	14.9	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.5	17.1	15.7	13.1	11.0	9.43	289
		6.0 CA	11.3	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	13.6	12.2	10.9	9.74	7.90	6.58	5.63	248
125	75	8.0 CA	11.7	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.0	9.96	8.96	7.31	6.17	5.34	227
		6.0 CA	8.92	10.3	10.3	10.3	10.3	10.3	10.3	10.3	9.58	8.28	7.05	6.12	5.41	4.38	3.68	3.17	195
100	75	8.0 CA	10.2	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.45	7.93	7.41	6.89	5.86	4.98	4.33	188
		6.0 CA	7.74	7.53	7.53	7.53	7.53	7.53	7.53	7.44	6.75	6.07	5.38	4.73	4.22	3.46	2.93	2.55	163
75	50	6.0 CA	5.38	3.76	3.76	3.76	3.76	3.76	3.76	3.52	3.12	2.72	2.36	2.08	1.86	1.53	1.31	1.14	110
		5.0 CA	4.34	3.02	3.02	3.02	3.02	3.02	3.01	2.59	2.17	1.83	1.58	1.39	1.24	1.02	0.865	0.752	94.4
		4.0 CA	3.54	2.47	2.47	2.47	2.47	2.47	2.28	1.85	1.49	1.25	1.07	0.943	0.84	0.689	0.584	0.506	77.5

Notes: 1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

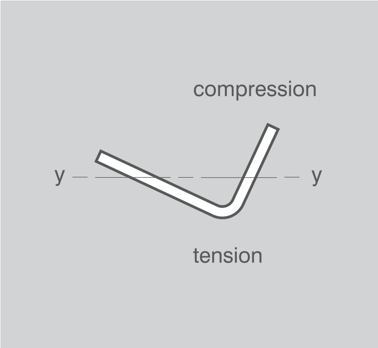


Table 7.2-3

Limit state design

Member moment capacity

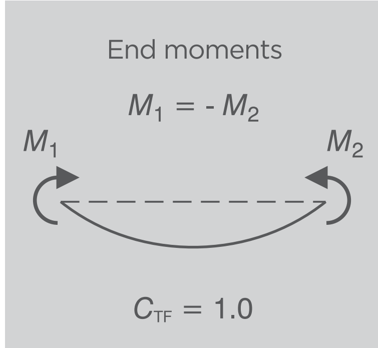
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about principal y-axis (tips in compression)

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) Effective length, l_e (m)														Design shear capacity $\phi_v V_{vy}$
mm	mm	mm	kg/m	kNm	0.25	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	kN
150 x	100 x	8.0 CA	14.9	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.03	6.01	5.99	5.97	5.94	5.89	5.83	5.77	244
		6.0 CA	11.3	5.25	4.71	4.71	4.71	4.70	4.68	4.67	4.65	4.63	4.61	4.58	4.55	4.49	4.43	4.36	210
125 x	75 x	8.0 CA	11.7	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.34	174
		6.0 CA	8.92	2.92	2.90	2.90	2.90	2.89	2.88	2.87	2.86	2.84	2.83	2.81	2.80	2.76	2.72	2.69	151
100 x	75 x	8.0 CA	10.2	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.11	3.07	172
		6.0 CA	7.74	2.76	2.74	2.74	2.74	2.73	2.71	2.70	2.68	2.66	2.64	2.62	2.59	2.55	2.50	2.45	149
75 x	50 x	6.0 CA	5.38	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.15	1.13	1.12	91.1
		5.0 CA	4.34	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.973	0.964	0.955	0.945	0.935	0.915	0.895	0.875	79.6
		4.0 CA	3.54	0.813	0.797	0.796	0.793	0.788	0.781	0.774	0.766	0.757	0.748	0.738	0.728	0.708	0.688	0.667	65.5

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

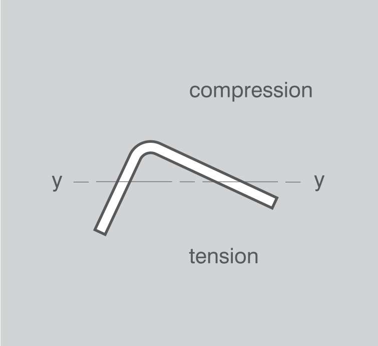


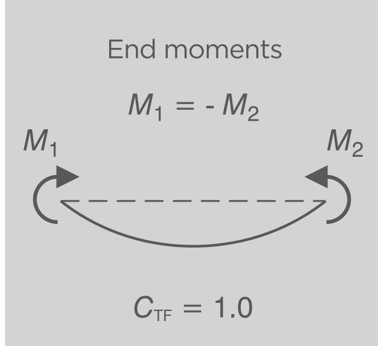
Table 7.2–4

Limit state design
Member moment capacity

C_{TF} = 1.0
Beams *without* full lateral restraint
Bending about principal y-axis (corner in compression)

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m) 0.25	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	Design shear capacity $\phi_v V_{vy}$
mm	mm	mm	kg/m	kNm															kN
150	x 100	x 8.0 CA	14.9	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	6.05	244
		6.0 CA	11.3	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	210
125	x 75	x 8.0 CA	11.7	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	174
		6.0 CA	8.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	151
100	x 75	x 8.0 CA	10.2	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	172
		6.0 CA	7.74	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	2.76	149
75	x 50	x 6.0 CA	5.38	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	91.1
		5.0 CA	4.34	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	79.6
		4.0 CA	3.54	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	65.5

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

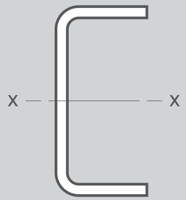


Table 7.3–1

Limit state design
Member moment capacity

C_b = 1.0
Beams *without* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

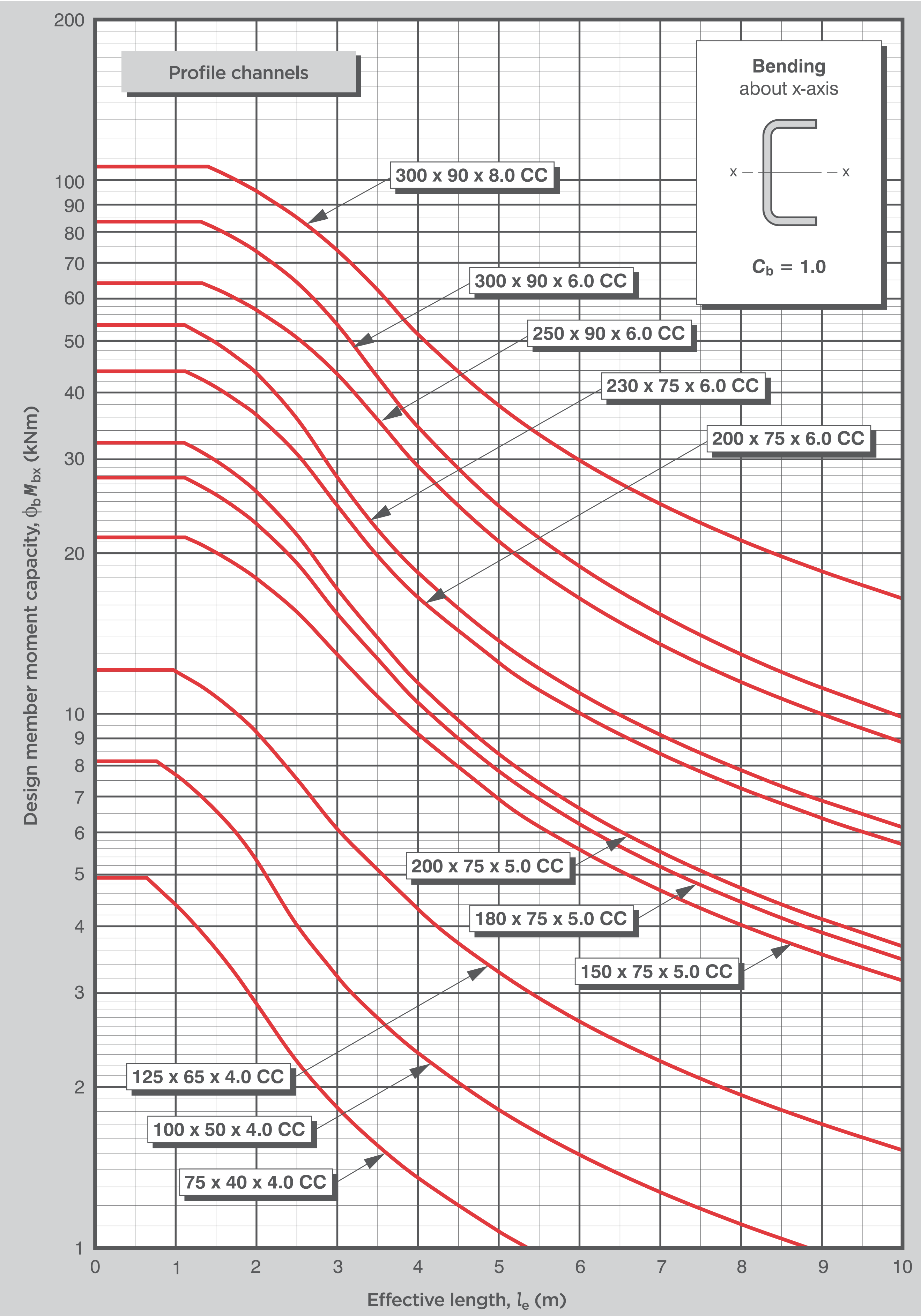
Profile channels

Typical moment distribution

for C_b = 1.0

Designation d	b_f	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) — Effective length, l_e (m)															Design shear capacity $\phi_v V_{vx}$
mm	mm	mm	kg/m	kNm	1	1.25	1.5	1.75	2	2.5	3	3.5	4	5	6	7	8	9	10	kN
300 x	90 x	8.0 CC	28.5	106	106	106	104	100	95.4	85.0	73.9	62.2	51.4	37.8	29.9	24.8	21.2	18.5	16.4	494
		6.0 CC	21.6	83.6	83.6	83.6	81.1	77.5	73.5	64.3	53.6	42.7	34.5	24.5	18.9	15.4	12.9	11.2	9.87	423
250 x	90 x	6.0 CC	19.2	64.1	64.1	64.1	62.5	59.9	57.1	50.7	43.3	35.6	29.1	21.1	16.5	13.5	11.5	10.0	8.85	345
230 x	75 x	6.0 CC	16.9	53.5	53.5	52.1	49.6	46.6	43.5	35.8	27.7	22.1	18.4	13.7	11.0	9.14	7.85	6.88	6.14	314
200 x	75 x	6.0 CC	15.5	43.8	43.8	42.9	40.9	38.7	36.3	30.7	24.5	19.8	16.5	12.5	10.0	8.42	7.26	6.38	5.70	267
		5.0 CC	12.4	32.2	32.2	31.4	29.8	28.0	26.1	21.7	17.1	13.9	11.4	8.42	6.66	5.52	4.72	4.13	3.67	222
180 x	75 x	5.0 CC	11.6	27.7	27.7	27.0	25.7	24.3	22.7	19.2	15.4	12.7	10.5	7.81	6.22	5.18	4.45	3.90	3.47	198
150 x	75 x	5.0 CC	10.5	21.4	21.4	21.0	20.1	19.0	17.9	15.5	12.9	10.8	9.17	6.92	5.57	4.67	4.03	3.55	3.17	162
125 x	65 x	4.0 CC	7.23	12.1	12.0	11.4	10.8	10.0	9.25	7.54	6.08	5.11	4.31	3.28	2.66	2.24	1.93	1.70	1.52	108
100 x	50 x	4.0 CC	5.59	8.16	7.70	7.16	6.58	5.98	5.31	4.02	3.22	2.69	2.32	1.81	1.49	1.27	1.11	0.981	0.881	83.1
75 x	40 x	4.0 CC	4.25	4.93	4.39	4.01	3.62	3.24	2.86	2.23	1.83	1.55	1.35	1.07	0.890	0.761	0.665	0.590	0.531	58.5

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.


Profile channels
Bending
about x-axis
x
x
$C_b = 1.0$
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
Design member moment capacity, $\phi_b M_{bx}$ (kNm)
Effective length, l_e (m)

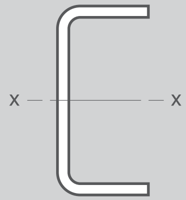


Table 7.3–2

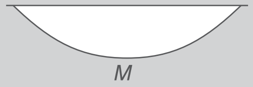
Limit state design
Member moment capacity

C_b = 1.14
Beams *without* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

Profile channels

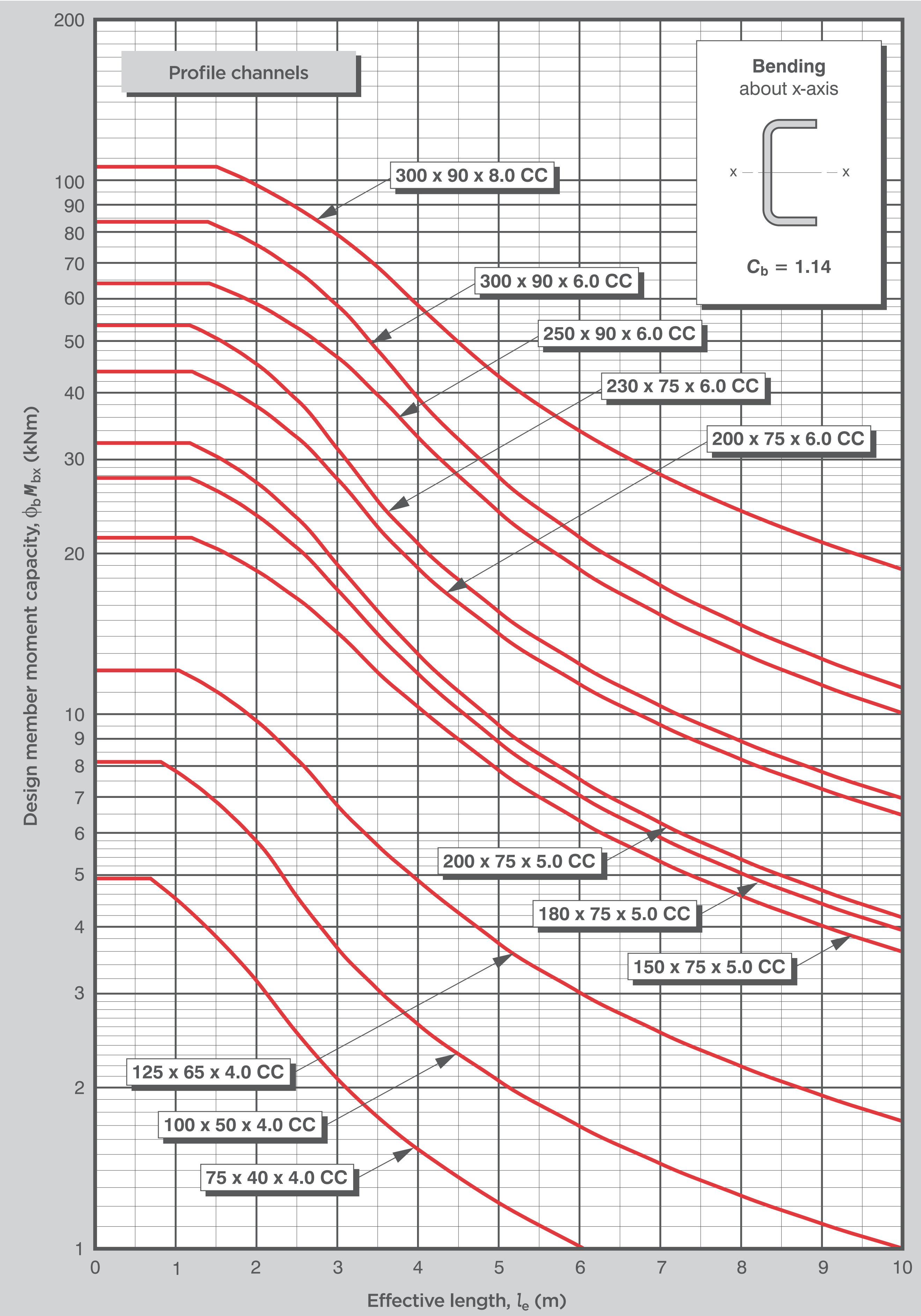
Typical moment distribution



for C_b = 1.14

Designation d × b_f × Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) — Effective length, l_e (m)															Design shear capacity $\phi_v V_{vx}$
mm mm mm	kg/m	kNm	1	1.25	1.5	1.75	2	2.5	3	3.5	4	5	6	7	8	9	10	kN
300 x 90 x 8.0 CC	28.5	106	106	106	106	102	98.0	88.9	79.1	68.8	58.4	43.0	34.0	28.1	24.0	21.0	18.7	494
6.0 CC	21.6	83.6	83.6	83.6	82.3	79.2	75.7	67.7	58.4	48.1	39.1	27.9	21.5	17.5	14.7	12.7	11.2	423
250 x 90 x 6.0 CC	19.2	64.1	64.1	64.1	63.4	61.2	58.7	53.0	46.7	39.7	33.0	23.9	18.7	15.4	13.1	11.4	10.1	345
230 x 75 x 6.0 CC	16.9	53.5	53.5	52.9	50.7	48.1	45.3	38.9	31.5	25.2	20.9	15.6	12.4	10.4	8.91	7.82	6.97	314
200 x 75 x 6.0 CC	15.5	43.8	43.8	43.5	41.8	39.8	37.7	33.0	27.6	22.5	18.8	14.2	11.4	9.57	8.25	7.25	6.48	267
5.0 CC	12.4	32.2	32.2	31.8	30.5	28.9	27.2	23.4	19.1	15.6	13.0	9.56	7.57	6.27	5.36	4.69	4.17	222
180 x 75 x 5.0 CC	11.6	27.7	27.7	27.4	26.3	25.0	23.6	20.5	17.1	14.1	11.9	8.87	7.07	5.89	5.05	4.43	3.94	198
150 x 75 x 5.0 CC	10.5	21.4	21.4	21.3	20.5	19.6	18.6	16.5	14.2	12.0	10.3	7.87	6.33	5.31	4.58	4.03	3.60	162
125 x 65 x 4.0 CC	7.23	12.1	12.1	11.6	11.1	10.4	9.73	8.26	6.76	5.69	4.90	3.73	3.02	2.54	2.20	1.94	1.73	108
100 x 50 x 4.0 CC	5.59	8.16	7.84	7.37	6.87	6.35	5.80	4.57	3.66	3.06	2.63	2.06	1.70	1.44	1.26	1.11	1.00	83.1
75 x 40 x 4.0 CC	4.25	4.93	4.52	4.18	3.84	3.51	3.18	2.54	2.08	1.77	1.54	1.22	1.01	0.865	0.755	0.670	0.603	58.5

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.



Profile channels
Bending
about x-axis
x
x
C_b = 1.14
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC
Design member moment capacity, $\phi_b M_{bx}$ (kNm)
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
Effective length, l_e (m)

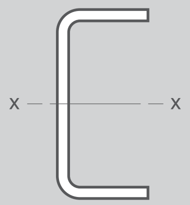


Table 7.3-3

Limit state design

Member moment capacity

C_b = 1.67
Beams *without* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

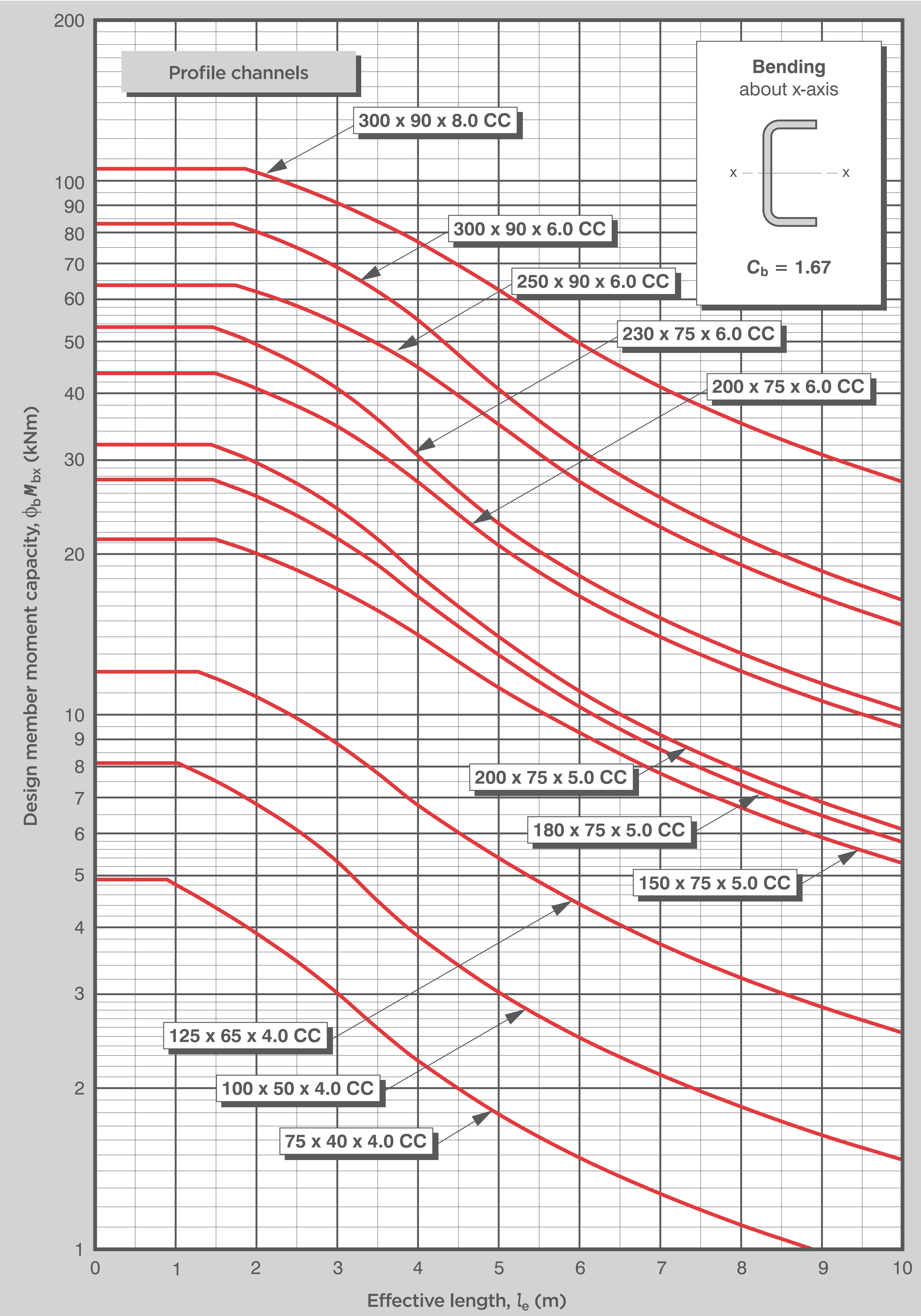
Profile channels

Typical moment distribution

for C_b = 1.67

Designation d	b_f	Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) Effective length, l_e (m)															Design shear capacity $\phi_v V_{vx}$
mm	mm	mm	kg/m	kNm	1	1.25	1.5	1.75	2	2.5	3	3.5	4	5	6	7	8	9	10	kN
300 x	90 x	8.0 CC	28.5	106	106	106	106	106	104	98.1	91.4	84.4	77.3	62.8	49.9	41.4	35.3	30.9	27.5	494
		6.0 CC	21.6	83.6	83.6	83.6	83.6	83.2	80.8	75.4	69.2	62.4	55.1	40.9	31.6	25.7	21.6	18.7	16.5	423
250 x	90 x	6.0 CC	19.2	64.1	64.1	64.1	64.1	64.0	62.4	58.6	54.4	49.8	45.0	35.1	27.5	22.6	19.2	16.7	14.8	345
230 x	75 x	6.0 CC	16.9	53.5	53.5	53.5	53.2	51.5	49.6	45.6	41.1	35.9	30.7	22.9	18.3	15.3	13.1	11.5	10.2	314
200 x	75 x	6.0 CC	15.5	43.8	43.8	43.8	43.8	42.5	41.1	38.1	34.9	31.2	27.4	20.8	16.8	14.1	12.1	10.7	9.52	267
		5.0 CC	12.4	32.2	32.2	32.2	32.0	30.9	29.8	27.2	24.4	21.4	18.4	14.1	11.1	9.22	7.88	6.89	6.13	222
180 x	75 x	5.0 CC	11.6	27.7	27.7	27.7	27.5	26.7	25.8	23.7	21.5	19.1	16.7	13.0	10.4	8.65	7.42	6.51	5.80	198
150 x	75 x	5.0 CC	10.5	21.4	21.4	21.4	21.4	20.8	20.1	18.8	17.3	15.7	14.2	11.3	9.31	7.81	6.73	5.92	5.29	162
125 x	65 x	4.0 CC	7.23	12.1	12.1	12.1	11.7	11.3	10.9	9.89	8.86	7.80	6.79	5.41	4.44	3.74	3.23	2.85	2.55	108
100 x	50 x	4.0 CC	5.59	8.16	8.16	7.87	7.53	7.19	6.83	6.10	5.33	4.50	3.87	3.03	2.50	2.12	1.85	1.64	1.47	83.1
75 x	40 x	4.0 CC	4.25	4.93	4.83	4.60	4.37	4.14	3.91	3.46	3.02	2.60	2.26	1.79	1.49	1.27	1.11	0.986	0.886	58.5

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq$ 6.0 mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.



Profile channels
Bending
about x-axis
x
x
C_b = 1.67
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC
Design member moment capacity, $\phi_b M_{bx}$ (kNm)
Effective length, l_e (m)
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10

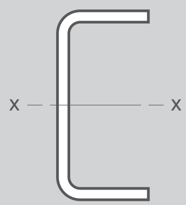


Table 7.3–4

Limit state design

Member moment capacity

C_b = 2.38

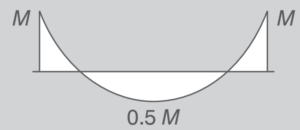
Beams *without* full lateral restraint

Bending about x-axis

Grade C450L0 / C400L0

Profile channels

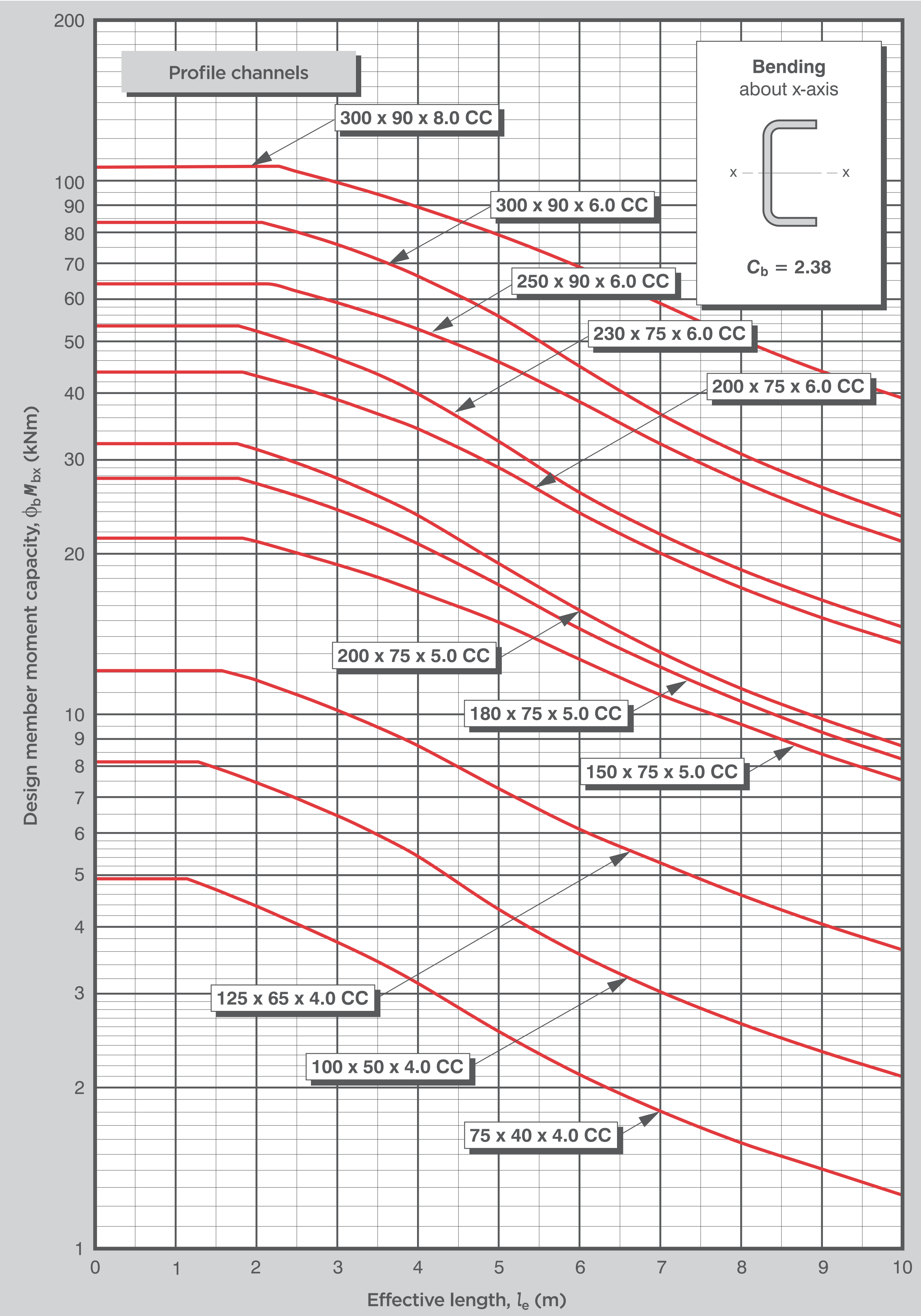
Typical moment distribution



for C_b = 2.38

Designation d × b_f × Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sx}$	Design member moment capacity $\phi_b M_{bx}$ (kNm) — Effective length, l_e (m)															Design shear capacity $\phi_v V_{vx}$
mm mm mm	kg/m	kNm	1	1.25	1.5	1.75	2	2.5	3	3.5	4	5	6	7	8	9	10	kN
300 x 90 x 8.0 CC	28.5	106	106	106	106	106	106	104	99.3	94.4	89.3	79.2	69.0	59.0	50.4	44.0	39.2	494
6.0 CC	21.6	83.6	83.6	83.6	83.6	83.6	83.6	80.2	76.0	71.3	66.3	55.7	45.0	36.6	30.8	26.7	23.5	423
250 x 90 x 6.0 CC	19.2	64.1	64.1	64.1	64.1	64.1	64.1	62.1	59.1	56.0	52.7	45.8	38.6	32.2	27.4	23.8	21.1	345
230 x 75 x 6.0 CC	16.9	53.5	53.5	53.5	53.5	53.5	52.3	49.5	46.5	43.4	39.9	32.5	26.1	21.8	18.7	16.4	14.6	314
200 x 75 x 6.0 CC	15.5	43.8	43.8	43.8	43.8	43.8	43.1	41.1	38.9	36.6	34.3	29.0	23.9	20.1	17.3	15.2	13.6	267
5.0 CC	12.4	32.2	32.2	32.2	32.2	32.2	31.4	29.6	27.7	25.7	23.6	19.2	15.7	13.1	11.2	9.83	8.74	222
180 x 75 x 5.0 CC	11.6	27.7	27.7	27.7	27.7	27.7	27.1	25.7	24.2	22.6	20.9	17.5	14.5	12.3	10.6	9.28	8.26	198
150 x 75 x 5.0 CC	10.5	21.4	21.4	21.4	21.4	21.4	21.1	20.1	19.1	18.1	17.0	14.9	12.7	10.9	9.60	8.44	7.54	162
125 x 65 x 4.0 CC	7.23	12.1	12.1	12.1	12.1	11.9	11.6	10.9	10.2	9.48	8.75	7.27	6.11	5.28	4.60	4.06	3.63	108
100 x 50 x 4.0 CC	5.59	8.16	8.16	8.16	7.95	7.71	7.46	6.97	6.47	5.96	5.43	4.32	3.56	3.03	2.64	2.34	2.10	83.1
75 x 40 x 4.0 CC	4.25	4.93	4.93	4.86	4.70	4.54	4.38	4.06	3.75	3.45	3.14	2.55	2.12	1.81	1.58	1.41	1.26	58.5

Notes:
1. The values in the table are based on $l_e = l_{ey} = l_{ez}$.
2. The moment distribution considered is for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.


Profile channels
Bending
about x-axis
x
x
C_b = 2.38
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC
Design member moment capacity, $\phi_b M_{bx}$ (kNm)
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
Effective length, l_e (m)

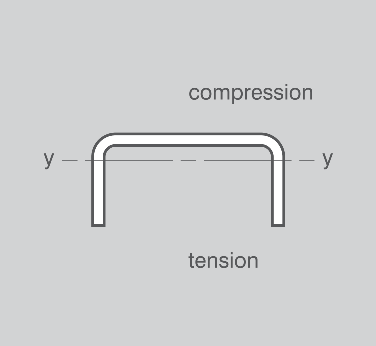


Table 7.3-5

Limit state design

Member moment capacity

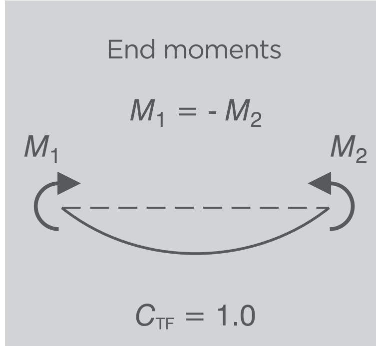
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about y-axis (web in compression)

Grade C450L0 / C400L0

Profile channels



Designation d b_f Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) Effective length, l_e (m)													Design shear capacity $\phi_v V_{vy}$
mm mm mm	kg/m	kNm	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	kN
300 x 90 x 8.0 CC	28.5	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	273
6.0 CC	21.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	236
250 x 90 x 6.0 CC	19.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	236
230 x 75 x 6.0 CC	16.9	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	190
200 x 75 x 6.0 CC	15.5	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	190
5.0 CC	12.4	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	162
180 x 75 x 5.0 CC	11.6	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	162
150 x 75 x 5.0 CC	10.5	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	162
125 x 65 x 4.0 CC	7.23	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	113
100 x 50 x 4.0 CC	5.59	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	83.1
75 x 40 x 4.0 CC	4.25	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	63.4

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

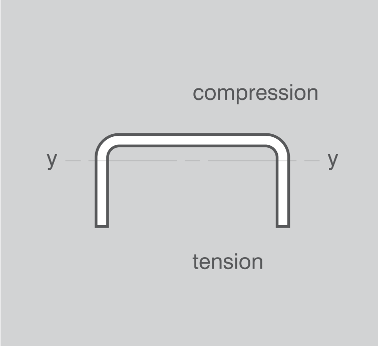


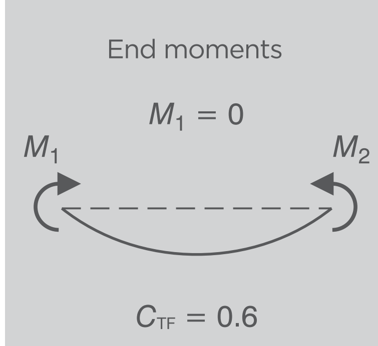
Table 7.3–6

Limit state design
Member moment capacity

C_{TF} = 0.6
Beams *without* full lateral restraint
Bending about y-axis (web in compression)

Grade C450L0 / C400L0

Profile channels



Designation d × b_f × Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}$ (kNm) — Effective length, l_e (m)													Design shear capacity $\phi_v V_{vy}$
mm × mm × mm	kg/m	kNm	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	kN
300 x 90 x 8.0 CC	28.5	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	273
6.0 CC	21.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	236
250 x 90 x 6.0 CC	19.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	236
230 x 75 x 6.0 CC	16.9	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	190
200 x 75 x 6.0 CC	15.5	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	190
5.0 CC	12.4	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	6.10	162
180 x 75 x 5.0 CC	11.6	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02	162
150 x 75 x 5.0 CC	10.5	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87	162
125 x 65 x 4.0 CC	7.23	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	113
100 x 50 x 4.0 CC	5.59	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	83.1
75 x 40 x 4.0 CC	4.25	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	63.4

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

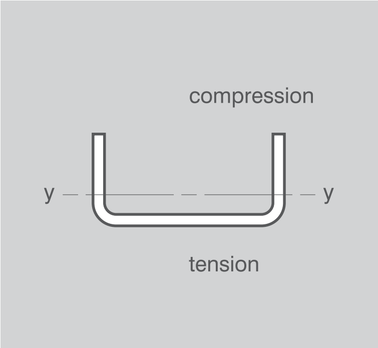


Table 7.3-7

Limit state design

Member moment capacity

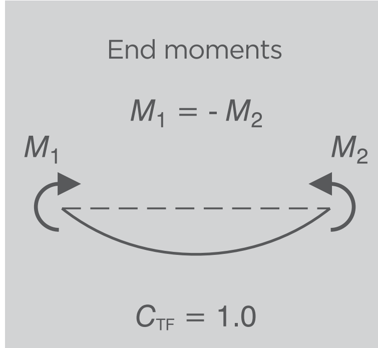
C_{TF} = 1.0

Beams *without* full lateral restraint

Bending about y- axis (flange tips in compression)

Grade C450L0 / C400L0

Profile channels



Designation d b Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by} R$ (kNm) — Effective length, l_e (m)													Design shear capacity $\phi_v V_{vy}$
mm mm mm	kg/m	kNm	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	kN
300 x 90 x 8.0 CC	28.5	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.5	12.3	11.9	11.7	273
6.0 CC	21.6	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.5	9.33	9.17	8.86	8.61	236
250 x 90 x 6.0 CC	19.2	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.72	9.54	9.37	9.2	8.91	8.58	236
230 x 75 x 6.0 CC	16.9	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.23	7.01	6.83	6.68	6.44	6.27	190
200 x 75 x 6.0 CC	15.5	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.04	6.85	6.68	6.55	6.34	6.19	190
5.0 CC	12.4	5.05	5.05	5.05	5.05	5.05	5.05	5.05	5.02	4.91	4.8	4.7	4.6	4.44	4.29	162
180 x 75 x 5.0 CC	11.6	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.04	4.92	4.8	4.7	4.61	4.42	4.21	162
150 x 75 x 5.0 CC	10.5	5.16	5.16	5.16	5.16	5.16	5.16	5.11	5.04	4.9	4.78	4.63	4.47	4.22	4.03	162
125 x 65 x 4.0 CC	7.23	2.94	2.94	2.94	2.94	2.94	2.9	2.85	2.8	2.71	2.63	2.56	2.48	2.31	2.18	113
100 x 50 x 4.0 CC	5.59	1.97	1.97	1.97	1.97	1.94	1.89	1.84	1.8	1.74	1.69	1.66	1.62	1.57	1.51	83.1
75 x 40 x 4.0 CC	4.25	1.22	1.22	1.22	1.22	1.2	1.18	1.17	1.15	1.13	1.11	1.09	1.08	1.04	1.01	63.4

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

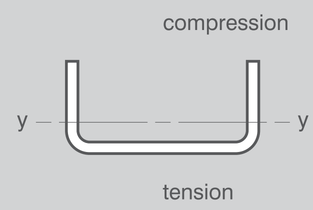


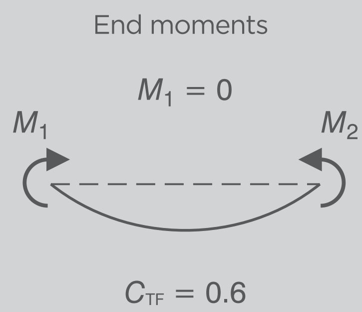
Table 7.3–8

Limit state design
Member moment capacity

C_{TF} = 0.6
Beams *without* full lateral restraint
Bending about y-axis (flange tips in compression)

Grade C450L0 / C400L0

Profile channels



Designation d b Nominal thickness	Mass per metre	Design section moment capacity $\phi_b M_{sy}$	Design member moment capacity $\phi_b M_{by}R$ (kNm)													Design shear capacity $\phi_v V_{vy}$
			Effective length, l_e (m)													
mm mm mm	kg/m	kNm	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	kN
300 x 90 x 8.0 CC	28.5	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	273
6.0 CC	21.6	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.65	9.59	9.42	9.28	236
250 x 90 x 6.0 CC	19.2	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.77	9.67	9.52	9.39	236
230 x 75 x 6.0 CC	16.9	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.36	7.28	7.13	7.03	190
200 x 75 x 6.0 CC	15.5	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.22	7.14	7.02	6.93	190
5.0 CC	12.4	5.05	5.05	5.05	5.05	5.05	5.05	5.05	5.05	5.05	5.01	4.96	4.91	4.82	4.76	162
180 x 75 x 5.0 CC	11.6	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.04	4.98	4.93	4.85	4.79	162
150 x 75 x 5.0 CC	10.5	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.16	5.13	5.07	5.01	4.96	4.88	4.82	162
125 x 65 x 4.0 CC	7.23	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.92	2.87	2.83	2.79	2.76	2.71	2.67	113
100 x 50 x 4.0 CC	5.59	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.95	1.92	1.89	1.87	1.85	1.81	1.78	83.1
75 x 40 x 4.0 CC	4.25	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.21	1.2	1.19	1.17	1.15	63.4

Notes:
1. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
2. The end moments considered are for the unbraced length.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

Web bearing capacity 8

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Tables

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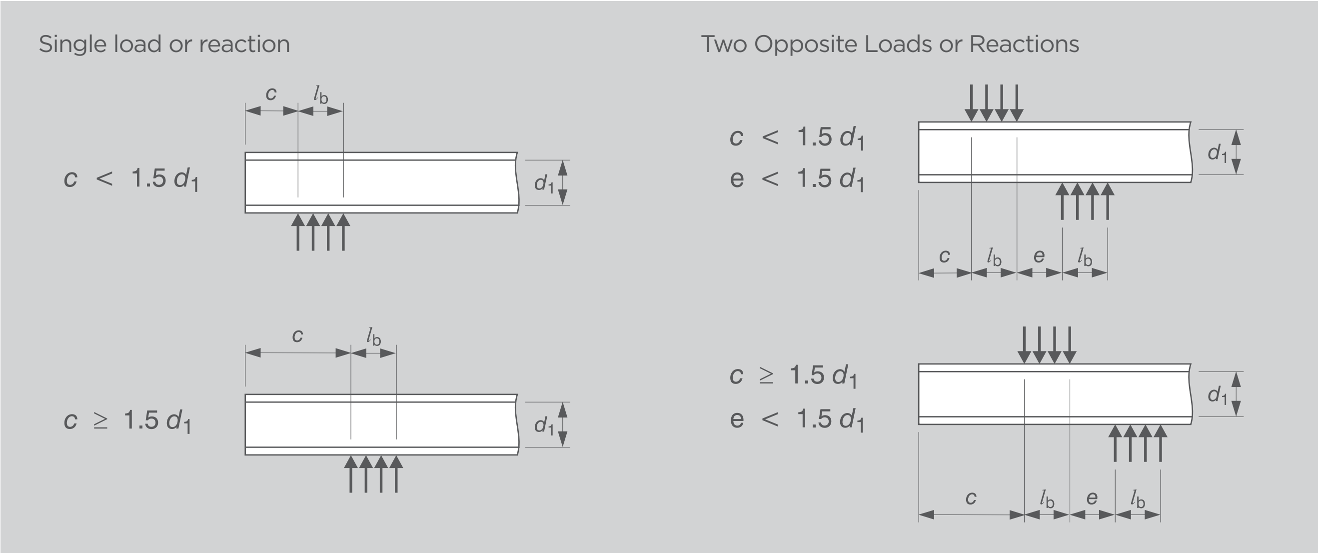
Design web bearing capacity ($\phi_w \boldsymbol{R}_b$)

8.1 Scope

The tables in this section provide the design web bearing capacity ($\phi_w R_b$) perpendicular to the x-axis for channels for the four load types and positions shown below.

Figure 8.1(1) Type and position of loads or reactions for determining design web bearing capacity.



In accordance with Clause 3.3.6.2 of AS/NZS 4600, these tables are only applicable to channels with:

$$\frac{d_1}{t} \leq 200$$

and no holes are present in the channel web (other than bolt holes)

where: l_b = the actual length of bearing
d_1 = the depth of the flat portion of the web
t = the thickness of the web

8.2 Design method

8.2.1 Web bearing capacity

The web bearing capacity ($\phi_w R_b$) of a channel is determined in accordance with Clause 3.3.6 of AS/NZS 4600 and research carried out at The University of Sydney[17],[18],[19] and is discussed in more detail in Appendix A4 of this manual. The tables are provided for the four load arrangements described in Section 8.1.

Once the appropriate table has been selected based on the load arrangement given in Figure 8.1(1), the design web bearing capacity can be read from the tables for a range of bearing lengths.

8.2.2 Bending and bearing interaction

Bending and bearing interaction may need to be checked when bending moment and bearing forces occur at the same location. The design equation for beams without transverse web stiffeners from Clause 3.3.7 of AS/NZS 4600 is provided in this section.

The design bearing capacity ($\phi_w R_b$) determined from the tables may be significantly reduced when the section is subject to a large bending moment at the same location. According to Clause 3.3.7 of AS/NZS 4600, channels **with single unstiffened webs** subject to a concentrated load or reaction (R^*) and a bending moment (M^*), must satisfy:

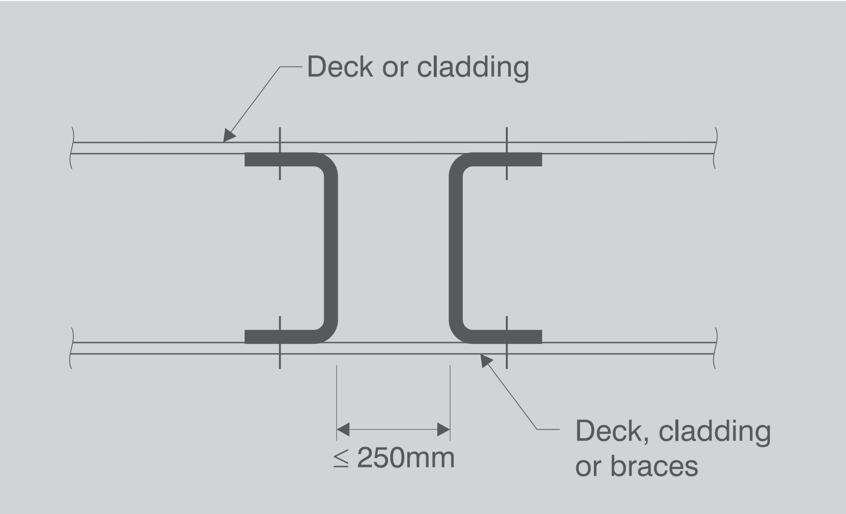
$$1.07\left(\frac{R^*}{\phi_w R_b}\right) + \left(\frac{M^*}{\phi_b M_s}\right) \leq 1.42$$

where $\phi_b M_s$ = design section moment capacity given in Table 6.3

$\phi_w R_b$ = design web bearing capacity given in Tables 8.1 to 8.4

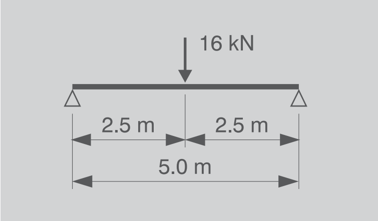
However, Clause 3.3.7 of AS/NZS 4600 and AS/NZS 4600 Supplement 1[7] state that the above interaction of combined bending and bearing need not be checked for the interior support of a continuous span beam, arranged as shown in Figure 8.2(1).

Figure 8.2(1) Exception to clause 3.3.7 of AS/NZS 4600



8.3 Example

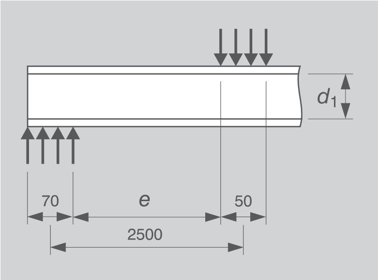
A simply supported 180 x 75 x 5.0 CC DuraGalUltra with a single span of 5.0 m is required to support a design central point load of 16 kN.The load is applied over the full width of the flange for a length of 50 mm along the channel. The bearing length at the support is 70 mm.



Check the bearing capacity of the DuraGalUltra channel.

Solution:

At the applied load



Design bearing force $R^* = 16.0$ kN

Bearing length $l_b = 50$ mm

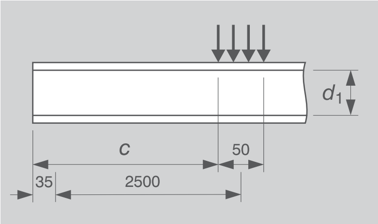
For a 180 x 75 x 5.0 CC DuraGalUltra,

$1.5\ d_1 = 244$ mm (Table 8.1)

$e = 2500 - 25 - 35$

$= 2440 \quad > 1.5\ d_1$

Therefore a table for a Single load or reaction must be used.



$c = 2500 - 25 + 35$

$= 2510 \quad > 1.5\ d_1$

In this case the web bearing capacity ($\phi_w R_b$) for channels bending about the x-axis is obtained from Table 8.2.

For a 180 x 75 x 5.0 CC DuraGalUltra with a bearing length $l_b = 50$ mm

$\phi_w R_b = 81.7$ kN $\quad > 16.0$ kN

The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

Check for combined bending and bearing:

Design bending moment $M_x^* = \dfrac{Pl}{4} = \dfrac{16 \times 5.0}{4}$

$= 20.0$ kNm

Section moment capacity $\phi_b M_{sx} = 27.7$ kNm (Table 6.3 or Table 8.2)

$$1.07\left(\frac{R^*}{\phi_w R_b}\right) + \left(\frac{M^*}{\phi_b M_s}\right) = 1.07\left(\frac{16.0}{81.7}\right) + \left(\frac{20.0}{27.7}\right)$$

$= 0.932 < 1.42$

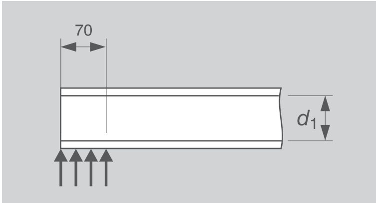
The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

At the support

Design bearing force R^* = 8.0 kN

Bearing length l_b = 70 mm

A table for a Single load or reaction must be used.



c = 0.0 > 1.5 d_1

In this case the web bearing capacity ($\phi_w R_b$) for channels bending about the x-axis is obtained from Table 8.1.

For a 180 x 75 x 5.0 CC DuraGalUltra with a bearing length l_b = 70 mm

$\phi_w R_b$ = 46.0 kN > 8.0 kN

The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

There is no need to check for combined bending and bearing at the support because the bending moment is zero.

Note: These calculations must be repeated to include the self-weight of the beam in the design bending moment and the design bearing force at the support.

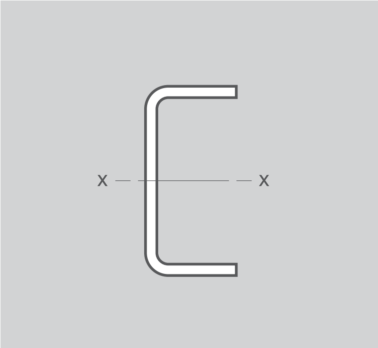


Table 8.1

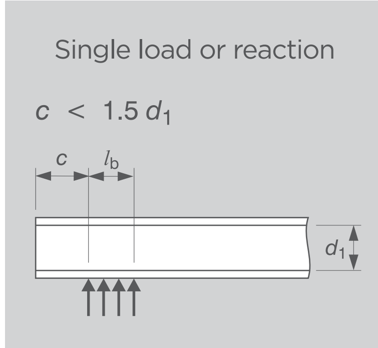
Limit state design
Web bearing capacity

Single load or reaction
Perpendicular to the x-axis

***c* < 1.5 *d*₁**

Grade C450L0 / C400L0

Profile channels



Designation d	b_f	Nominal thickness	Mass per metre	$1.5\,d_1$	Design web bearing capacity $\phi_w R_{bx}$ (kN) — Bearing length, l_b (mm)															Section moment capacity $\phi_b M_{sx}$
mm	mm	mm	kg/m	mm	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	kNm
300	90	8.0 CC	28.5	402	67.6	71.6	75.6	79.6	83.5	87.5	91.5	95.5	99.4	109	119	129	–	–	–	106
		6.0 CC	21.6	408	39.3	41.3	43.9	46.2	48.5	50.9	53.2	55.5	57.8	63.6	69.3	75.1	–	–	–	86.3
250	90	6.0 CC	19.2	333	38.0	40.6	43.2	45.8	48.4	51.0	53.7	56.3	58.9	65.4	72.0	78.5	–	–	–	64.1
230	75	6.0 CC	16.9	303	37.0	39.7	42.5	45.2	47.9	50.7	53.4	56.2	58.9	65.8	72.6	–	–	–	–	53.5
200	75	6.0 CC	15.5	258	35.1	38.0	40.9	43.9	46.8	49.7	52.6	55.5	58.5	65.8	73.1	–	–	–	–	43.8
		5.0 CC	12.4	274	32.5	35.2	37.9	40.7	43.4	46.1	48.8	51.5	54.2	61.0	67.8	–	–	–	–	32.2
180	75	5.0 CC	11.6	244	31.6	34.5	37.4	40.3	43.1	46.0	48.9	51.8	54.6	61.8	69.0	–	–	–	–	27.7
150	75	5.0 CC	10.5	199	29.7	32.8	35.9	39.1	42.2	45.3	48.4	51.6	54.7	62.5	70.3	–	–	–	–	21.4
125	65	4.0 CC	7.23	164	18.0	20.2	22.4	24.6	26.7	28.9	31.1	33.3	35.5	40.9	–	–	–	–	–	12.1
100	50	4.0 CC	5.59	127	16.5	18.9	21.3	23.6	26.0	28.4	30.7	33.1	35.5	–	–	–	–	–	–	8.16
75	40	4.0 CC	4.25	89.1	14.6	17.2	19.7	22.3	24.8	27.4	29.9	–	–	–	–	–	–	–	–	4.93

Notes:
1. d_1 is the depth of the flat portion of the web.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Capacities are calculated in accordance with AS/NZS 4600 and research conducted at The University of Sydney.[17],[18],[19]
4. Values to the left of the solid line were verified during testing at The University of Sydney[17],[18],[19]. Values to the right of the solid line have been extrapolated from the test results.

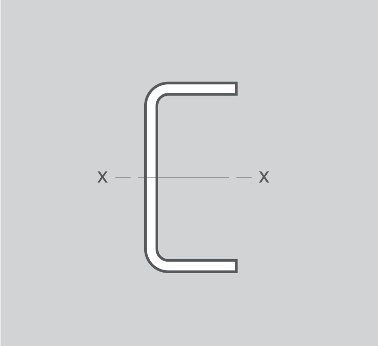


Table 8.2

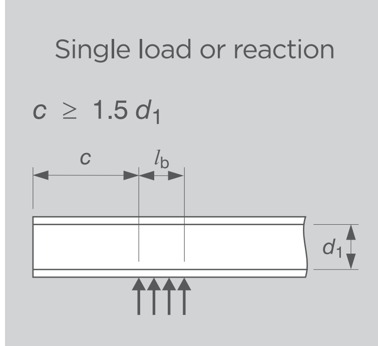
Limit state design
Web bearing capacity

Single load or reaction
Perpendicular to the x-axis

$c \geq 1.5\ d_1$

Grade C450L0 / C400L0

Profile channels



Designation d	b_f	Nominal thickness	Mass per metre	$1.5\ d_1$	Design web bearing capacity $\phi_w R_{bx}$ (kN) — Bearing length, l_b (mm)															Section moment capacity $\phi_b M_{sx}$
mm	mm	mm	kg/m	mm	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	kNm
300 x	90 x	8.0 CC	28.5	402	163	167	171	175	179	183	187	191	195	205	215	225	–	–	–	106
		6.0 CC	21.6	408	94.8	97.1	99.4	102	104	106	109	111	113	119	125	131	–	–	–	86.3
250 x	90 x	6.0 CC	19.2	333	90.3	92.9	95.5	98.2	101	103	106	109	111	118	124	131	–	–	–	64.1
230 x	75 x	6.0 CC	16.9	303	87.4	90.1	92.9	95.6	98.4	101	104	107	109	116	123	–	–	–	–	53.5
200 x	75 x	6.0 CC	15.5	258	81.9	84.8	87.7	90.6	93.6	96.5	99.4	102	105	113	120	–	–	–	–	43.8
		5.0 CC	12.4	274	75.9	78.6	81.3	84.0	86.7	89.4	92.1	94.9	97.6	104	111	–	–	–	–	32.2
180 x	75 x	5.0 CC	11.6	244	73.1	75.9	78.8	81.7	84.6	87.4	90.3	93.2	96.1	103	110	–	–	–	–	27.7
150 x	75 x	5.0 CC	10.5	199	67.2	70.3	73.4	76.6	79.7	82.8	85.9	89.1	92.2	100	108	–	–	–	–	21.4
125 x	65 x	4.0 CC	7.23	164	39.8	42.0	44.2	46.4	48.6	50.8	52.9	55.1	57.3	62.8	–	–	–	–	–	12.1
100 x	50 x	4.0 CC	5.59	127	35.5	37.8	40.2	42.5	44.9	47.3	49.6	52.0	54.4	–	–	–	–	–	–	8.16
75 x	40 x	4.0 CC	4.25	89.1	29.9	32.4	35.0	37.5	40.1	42.6	45.2	–	–	–	–	–	–	–	–	4.93

Notes:
1. d_1 is the depth of the flat portion of the web.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Capacities are calculated in accordance with AS/NZS 4600 and research conducted at The University of Sydney.[17],[18],[19]
4. Values to the left of the solid line were verified during testing at The University of Sydney[17],[18],[19]. Values to the right of the solid line have been extrapolated from the test results.

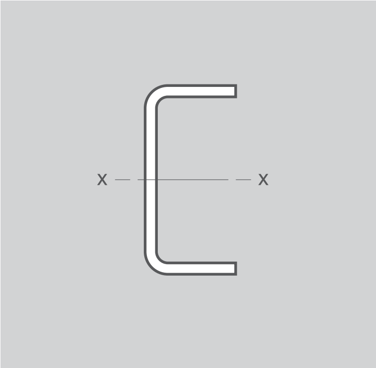


Table 8.3

Limit state design

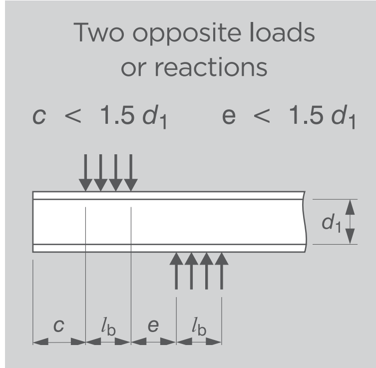
Web bearing capacity

Two opposite loads or reactions
Perpendicular to the x-axis

***c* < 1.5 d_1 and *e* < 1.5 d_1**

Grade C450L0 / C400L0

Profile channels



Designation d × b_f × Nominal thickness	Mass per metre	1.5 d_1	Design web bearing capacity $\phi_w R_{bx}$ (kN) — Bearing length, l_b (mm)															Section moment capacity $\phi_b M_{sx}$
mm mm mm	kg/m	mm	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	kNm
300 x 90 x 8.0 CC	28.5	402	43.8	47.7	51.7	55.7	59.7	63.6	67.6	71.6	75.6	85.5	95.5	105	–	–	–	106
6.0 CC	21.6	408	25.4	27.7	30.0	32.4	34.7	37.0	39.3	41.6	43.9	49.7	55.5	61.3	–	–	–	86.3
250 x 90 x 6.0 CC	19.2	333	24.9	27.5	30.1	32.7	35.3	38.0	40.6	43.2	45.8	52.3	58.9	65.4	–	–	–	64.1
230 x 75 x 6.0 CC	16.9	303	24.4	27.1	29.9	32.6	35.3	38.1	40.8	43.6	46.3	53.2	60.0	–	–	–	–	53.5
200 x 75 x 6.0 CC	15.5	258	23.4	26.3	29.2	32.2	35.1	38.0	40.9	43.9	46.8	54.1	61.4	–	–	–	–	43.8
5.0 CC	12.4	274	21.7	24.4	27.1	29.8	32.5	35.2	37.9	40.7	43.4	50.1	56.9	–	–	–	–	32.2
180 x 75 x 5.0 CC	11.6	244	21.3	24.2	27.0	29.9	32.8	35.7	38.5	41.4	44.3	51.5	58.7	–	–	–	–	27.7
150 x 75 x 5.0 CC	10.5	199	20.3	23.4	26.6	29.7	32.8	35.9	39.1	42.2	45.3	53.1	60.9	–	–	–	–	21.4
125 x 65 x 4.0 CC	7.23	164	12.6	14.7	16.9	19.1	21.3	23.5	25.6	27.8	30.0	35.5	–	–	–	–	–	12.1
100 x 50 x 4.0 CC	5.59	127	11.8	14.2	16.5	18.9	21.3	23.6	26.0	28.4	30.7	–	–	–	–	–	–	8.16
75 x 40 x 4.0 CC	4.25	89.1	10.8	13.4	15.9	18.4	21.0	23.5	26.1	–	–	–	–	–	–	–	–	4.93

Notes:
1. d_1 is the depth of the flat portion of the web.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Capacities are calculated in accordance with AS/NZS 4600 and research conducted at The University of Sydney.[17],[18],[19]
4. Values to the left of the solid line were verified during testing at The University of Sydney[17],[18],[19]. Values to the right of the solid line have been extrapolated from the test results.

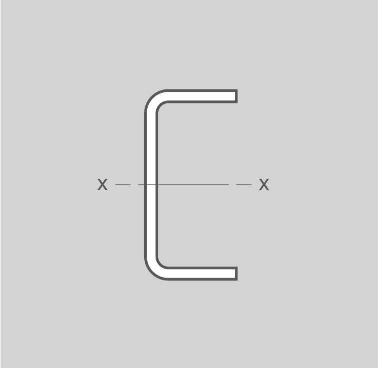


Table 8.4

Limit state design

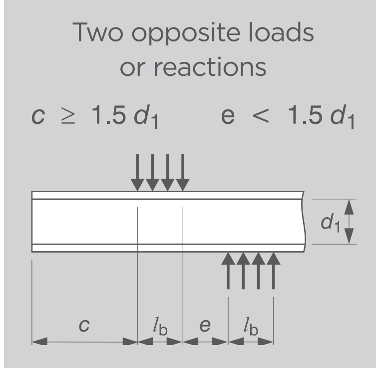
Web bearing capacity

Two opposite loads or reactions
Perpendicular to the x-axis

$\boldsymbol{c} \geq 1.5\ \boldsymbol{d_1}$ **and** $\boldsymbol{e} < 1.5\ \boldsymbol{d_1}$

Grade C450L0 / C400L0

Profile channels



Designation d × b_f × Nominal thickness (mm × mm × mm)	Mass per metre (kg/m)	$1.5\ d_1$ (mm)	Design web bearing capacity $\phi_w R_{bx}$ (kN) — Bearing length, l_b (mm): 20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	Section moment capacity $\phi_b M_{sx}$ (kNm)
300 x 90 x 8.0 CC	28.5	402	175	179	183	187	191	195	199	203	207	217	227	237	–	–	–	106
6.0 CC	21.6	408	102	104	106	109	111	113	116	118	120	126	132	138	–	–	–	86.3
250 x 90 x 6.0 CC	19.2	333	96.8	99.5	102	105	107	110	113	115	118	124	131	137	–	–	–	64.1
230 x 75 x 6.0 CC	16.9	303	93.7	96.4	99.2	102	105	107	110	113	116	122	129	–	–	–	–	53.5
200 x 75 x 6.0 CC	15.5	258	87.7	90.6	93.6	96.5	99.4	102	105	108	111	118	126	–	–	–	–	43.8
5.0 CC	12.4	274	81.3	84.0	86.7	89.4	92.1	94.9	97.6	100	103	110	117	–	–	–	–	32.2
180 x 75 x 5.0 CC	11.6	244	78.2	81.1	84.0	86.9	89.7	92.6	95.5	98.4	101	108	116	–	–	–	–	27.7
150 x 75 x 5.0 CC	10.5	199	71.9	75.0	78.1	81.3	84.4	87.5	90.6	93.8	96.9	105	113	–	–	–	–	21.4
125 x 65 x 4.0 CC	7.23	164	42.6	44.8	46.9	49.1	51.3	53.5	55.7	57.8	60.0	65.5	–	–	–	–	–	12.1
100 x 50 x 4.0 CC	5.59	127	37.8	40.2	42.5	44.9	47.3	49.6	52.0	54.4	56.7	–	–	–	–	–	–	8.16
75 x 40 x 4.0 CC	4.25	89.1	31.8	34.3	36.9	39.4	42.0	44.5	47.1	–	–	–	–	–	–	–	–	4.93

Notes:
1. d_1 is the depth of the flat portion of the web.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
3. Capacities are calculated in accordance with AS/NZS 4600 and research conducted at The University of Sydney.[17],[18],[19]
4. Values to the left of the solid line were verified during testing at The University of Sydney[17],[18],[19]. Values to the right of the solid line have been extrapolated from the test results.

Combined bending and shear

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9.1 Scope

A graph is provided to show the interaction of bending moment and shear for channels bending about the x-axis.

9.2 Design method

The design web shear capacity given in the tables in Sections 6 and 7 may be significantly reduced when the section is subjected to a large bending moment at the same location. For beams without transverse stiffeners, Clause 3.3.5 of AS/NZS 4600 requires that the design bending moment (M^*) and the design shear force (V^*) shall satisfy:

$$\left(\frac{M^*}{\phi_b M_s}\right)^2 + \left(\frac{V^*}{\phi_v V_v}\right)^2 \leq 1.0$$

where $\phi_b M_s$ = design section moment capacity given in Table 6.3
$\phi_v V_v$ = design web shear capacity given in Table 6.3

The graph allows any combination of bending moment and shear to be checked for all DuraGalUltra channels.

Designers are directed to Clause 3.3.5 of AS/NZS 4600 for combined bending and shear in channels with transverse web stiffeners.

9.3 Example

What size DuraGalUltra channel is required to resist the following design moment and shear force at the same location on a beam?

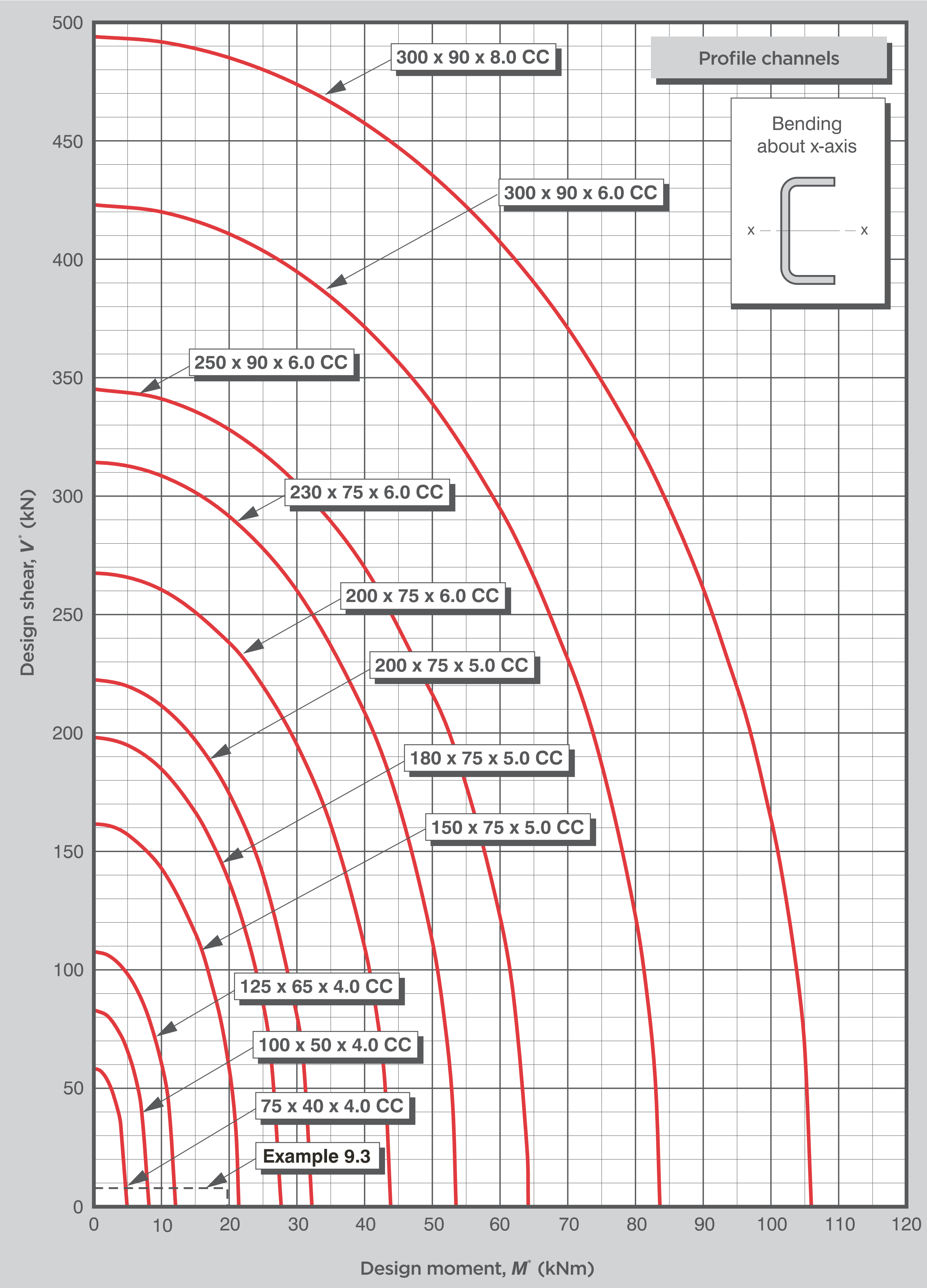
Design bending moment M_x^* = 20.0 kNm

Design shear force V^* = 8.0 kN

Solution

From Figure 9.1 it can be seen that the moment-shear interaction line for the 150 x 75 x 5.0 CC DuraGalUltra is above the intersection of the values for design bending moment and design shear, so the 150 x 75 x 5.0 CC DuraGalUltra is satisfactory.

Figure 9.1 Combined bending and shear for channels



Deflection

10

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Tables

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Maximum moment for sections to be fully effective (M_f)

10.1 Scope

This section provides a list of common methods which may be used to calculate elastic beam deflections. It also provides tables of the maximum moment for which the full second moment of area may be used in the deflection calculations for DuraGalUltra angles and channels.

For some of the common beam and load configurations, the tables in Sections 14 to 17 provide the maximum design loads for angles and channels limited by a maximum deflection of span / 250.

10.2 Deflection calculations

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

(1) Integration of M / EI diagram

(2) Moment area

(3) Slope deflection

(4) Published solutions for particular cases

(5) Approximate or numerical methods (e.g. finite elements)

A comprehensive set of beam deflection formulae is published in the ASI technical journal 'Steel Construction', Volume 26, No. 1, February 1992.

10.3 Second moment of area

A simplified approach presented in this section may be used to determine the second moment of area for beam deflection calculations. A detailed explanation of this method is given in Appendix A5. Tables 10.1 to 10.3 give values of the maximum moment (M_f) for which the sections are fully effective. If the design serviceability moment (M_{serv}) resulting from serviceability loads is less than or equal to the value of M_f, then the full second moment of area should be used for the deflection calculations.

For $M_{serv} \leq M_f$ use $I = I_f$ (full second moment of area tabulated in Section 3)

If the design serviceability moment (M_{serv}) is greater than the value of M_f, then the effective second moment of area should be used for the deflection calculations.

For $M_{serv} > M_f$ use $I = I_e$ (effective second moment of area tabulated in Section 3)

The value of effective second moment of area (I_e) tabulated in Section 3 may be used to calculate a conservative estimate of the deflection, or alternatively a more accurate value of I_e (intermediate between the tabulated values of I_f and I_e) computed at the actual serviceability stress level may be determined using the methods in Appendix A5.

For beams with positive and negative bending moments (reverse curvature such as in continuous beams and fixed ended beams), the stiffness of the beam at the support (negative moment) has an effect on the beam deflection. Effective second moment of area is calculated at the maximum positive as well as the maximum negative moment and the lower of the two values is used for the deflection calculations for the entire beam.

10.4 Examples

10.4.1 Simply supported beam

A single span simply supported beam has a calculated design moment for serviceability loads, M_{serv} = 15.0 kNm. The calculated minimum second moment of area required for deflection is I_{serv} = 5.0 x 10^6 mm^4. What size DuraGalUltra channel is required for bending about the x-axis?

Solution:

Select a channel with a full second moment of area equal to or greater than that required.

Choose a 180 x 75 x 5.0 CC DuraGalUltra from Table 3.3–1

$$I_x = 7.16 \times 10^6 \text{ mm}^4 \quad > \quad I_{serv} = 5.0 \times 10^6 \text{ mm}^4$$

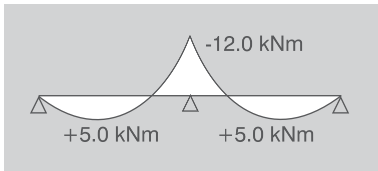
Check if the full second moment of area may be used by comparing the design serviceability moment with the maximum moment for the channel to be fully effective from Table 10.3.

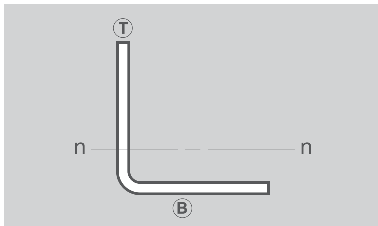
$$M_{fx} = 14.1 \text{ kNm} \quad < \quad M_{serv} = 15.0 \text{ kNm}$$

Therefore the full second moment of area I_x = 7.16 x 10^6 mm^4 (Table 3.3-1) **cannot** be used. The effective second moment of area I_{ex} = 6.50 x 10^6 mm^4 (Table 3.3-2) may be used to give a conservative estimate of the deflection. Alternatively a more accurate value of I_{ex} computed at the actual serviceability level may be determined using the methods given in Appendix A5.

Because $I_{ex} > I_{serv}$ = 5.0 x 10^6 mm^4, the 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for deflection.

10.4.2 Continuous beam





The calculated minimum second moment of area required for deflection of a continuous beam is I_{serv} = 2.0 x 10^6 mm^4, and the maximum design moments for serviceability loads are:

Maximum positive moment (between supports)

$$M_{serv} = 5.0 \text{ kNm}$$

Maximum negative moment (at a support)

$$M_{serv} = 12.0 \text{ kNm}$$

What size DuraGalUltra equal angle with the vertical leg up is required?

Solution:

Select an equal angle with a full second moment of area equal to or greater than that required.

Choose a 150 x 150 x 6.0 CA DuraGalUltra from Table 3.1–2(A)

$$I_n = 3.93 \times 10^6 \text{ mm}^4 \quad > \quad I_{serv} = 2.0 \times 10^6 \text{ mm}^4$$

Check if the full second moment of area may be used by comparing the design serviceability moment with the maximum moment for the equal angle to be fully effective from Table 10.1.

Positive moment (tips of vertical leg in compression)

$$M_{fnT} = 5.49 \text{ kNm} \quad > \quad M_{serv} = 5.0 \text{ kNm}$$

Negative moment (horizontal leg in compression)

$$M_{fnB} = 6.67 \text{ kNm} \quad < \quad M_{serv} = 12.0 \text{ kNm}$$

Therefore the full second moment of area I_n = 3.93 x 10^6 mm^4 **cannot** be used, and it is recommended that the minimum effective second moment of area for positive or negative moment be used to conservatively estimate the beam deflection.

The effective second moments of area of the 150 x 150 x 6.0 CA DuraGalUltra for positive and negative moments are obtained from Table 3.1–4(A) and are respectively:

I_{enT} = 1.64 x 10^6 mm^4 < I_{serv} = 2.0 x 10^6 mm^4

I_{enB} = 3.53 x 10^6 mm^4 > I_{serv} = 2.0 x 10^6 mm^4

Because I_{enT} is less than the calculated minimum second moment of area, a larger section is required.

Choose a 125 x 125 x 8.0 CA DuraGalUltra from Table 3.1–2(A)

I_n = 2.92 x 10^6 mm^4 > I_{serv} = 2.0 x 10^6 mm^4

Check if the full second moment of area may be used by comparing the design serviceability moment with the maximum moment for the equal angle to be fully effective from Table 10.1.

Positive moment (tips in compression)

M_{fnT} = 12.9 kNm > M_{serv} = 5.0 kNm

Negative moment (horizontal leg in compression)

M_{fnB} = 15.8 kNm < M_{serv} = 12.0 kNm

For the maximum positive and negative moments the section is fully effective and use of the full second moment of area for estimating the deflection is satisfactory. The second moment of area of the 125 x 125 x 8.0 CA DuraGalUltra for maximum negative moment is obtained from Table 3.1–2(A):

I_n = 2.92 x 10^6 mm^4 > I_{serv} = 2.0 x 10^6 mm^4

Therefore the 125 x 125 x 8.0 CA DuraGalUltra is satisfactory.

Another approach is to conservatively use the lower effective second moments of area considering positive and negative moments. From Table 3.1-4(A) these values are:

I_{enT} = 2.91 x 10^6 mm^4 > I_{serv} = 2.0 x 10^6 mm^4, and

I_{enB} = 2.92 x 10^6 mm^4 > I_{serv} = 2.0 x 10^6 mm^4

In this case there is minimal reduction compared to the full section property. The lower value exceeds the minimum requirement again demonstrating the adequacy of the 125 x 125 x 8.0 CA DuraGalUltra.

Table 10.1

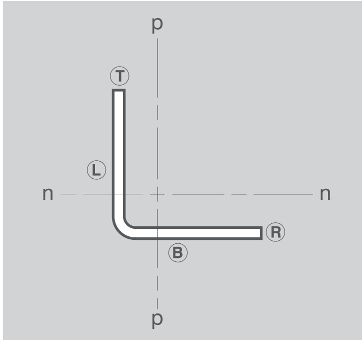
Limit state design

Maximum moment for sections to be fully effective

Bending about n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 mm	b_2 mm	Nominal thickness mm		Mass per metre kg/m	Maximum moment for sections to be fully effective, n- and p-axes: $M_{fnT} = M_{fpR}$ kNm	$M_{fnB} = M_{fpL}$ kNm
150 x	150 x	8.0	CA	18.0	13.0	15.6
		6.0	CA	13.6	5.49	6.67
		5.0	CA	10.8	2.67	3.08
125 x	125 x	8.0	CA	14.9	12.9	15.8
		5.0	CA	8.95	2.66	3.09
		4.0	CA	7.27	1.41	1.65
100 x	100 x	8.0	CA	11.7	8.15	16.2
		6.0	CA	8.92	5.41	6.91
90 x	90 x	8.0	CA	10.5	6.53	15.9
		5.0	CA	6.37	2.64	3.12
75 x	75 x	8.0	CA	8.59	4.45	10.4
		6.0	CA	6.56	3.86	7.19
		5.0	CA	5.26	2.63	3.15
		4.0	CA	4.29	1.39	1.68
65 x	65 x	6.0	CA	5.62	2.86	6.83
		5.0	CA	4.52	2.30	3.18
		4.0	CA	3.69	1.39	1.70
50 x	50 x	6.0	CA	4.21	1.64	3.67
		5.0	CA	3.42	1.33	3.21
		4.0	CA	2.79	1.09	1.74
		2.5	CA	1.81	0.351	0.422
45 x	45 x	4.0	CA	2.50	0.877	1.76
		2.5	CA	1.62	0.350	0.424
40 x	40 x	4.0	CA	2.20	0.685	1.64
		2.5	CA	1.43	0.349	0.428
30 x	30 x	2.5	CA	1.06	0.192	0.439

Notes:
1. Values of M_f are limited to the yield stress f_y in the extreme compression fibre.
2. M_{fnT} is for compression at point 'T';
   M_{fnB} is for compression at point 'B';
   M_{fpR} is for compression at point 'R';
   M_{fpL} is for compression at point 'L'.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
4. Moments are calculated in accordance with AS/NZS 4600.

Unequal Angles

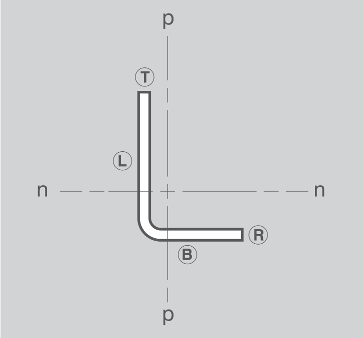
Table 10.2

Limit state design
Maximum moment for sections to be fully effective

Bending about n- and p-axes

Grade C450L0 / C400L0 / C350L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Maximum moment for sections to be fully effective: n-axis M_{fnT}	n-axis M_{fnB}	p-axis M_{fpR}	p-axis M_{fpL}
mm	mm	mm	kg/m	kNm	kNm	kNm	kNm
150	100	8.0 CA	14.9	14.7	29.1	8.61	22.4
		6.0 CA	11.3	6.20	12.2	5.42	9.60
125	75	8.0 CA	11.7	11.9	22.5	4.78	15.7
		6.0 CA	8.92	6.36	15.1	4.13	10.9
100	75	8.0 CA	10.2	7.77	16.1	4.64	13.1
		6.0 CA	7.74	5.91	10.9	4.02	9.08
75	50	6.0 CA	5.38	3.59	6.88	1.74	5.11
		5.0 CA	4.34	2.89	5.85	1.40	4.44
		4.0 CA	3.54	1.57	3.11	1.15	2.41

Notes:
1. Values of M_f are limited to the yield stress f_y in the extreme compression fibre.
2. M_{fnT} is for compression at point 'T';
   M_{fnB} is for compression at point 'B';
   M_{fpR} is for compression at point 'R';
   M_{fpL} is for compression at point 'L'.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Moments are calculated in accordance with AS/NZS 4600.

Table 10.3

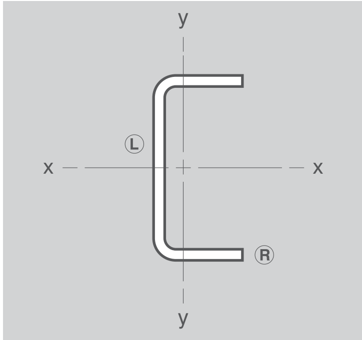
Limit state design

Maximum moment for sections to be fully effective

Bending about x- and y-axes

Grade C450L0 / C400L0

Profile channels



Designation d x b_f x Nominal thickness (mm mm mm)	Mass per metre (kg/m)	Maximum moment for sections to be fully effective: x-axis M_{fx} (kNm)	y-axis M_{fyL} (kNm)	y-axis M_{fyR} (kNm)
300 x 90 x 8.0 CC	28.5	118	35.0	14.0
6.0 CC	21.6	49.8	15.4	10.9
250 x 90 x 6.0 CC	19.2	38.5	19.9	11.8
230 x 75 x 6.0 CC	16.9	46.6	17.3	8.18
200 x 75 x 6.0 CC	15.5	38.3	21.3	8.04
5.0 CC	12.4	16.2	9.73	6.42
180 x 75 x 5.0 CC	11.6	14.1	11.3	6.34
150 x 75 x 5.0 CC	10.5	11.0	14.7	6.18
125 x 65 x 4.0 CC	7.23	5.60	8.36	3.74
100 x 50 x 4.0 CC	5.59	6.18	5.48	2.19
75 x 40 x 4.0 CC	4.25	5.48	3.12	1.36

Notes:
1. Values of M_f are limited to the yield stress f_y in the extreme compression fibre.
2. M_{fyR} is for compression at point 'R';
   M_{fyL} is for compression at point 'L'.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Moments are calculated in accordance with AS/NZS 4600.

Axial compression force

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Tables and graphs

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Design axial compression force (N_c^*)

11.1 Scope

This section contains tables and graphs which give the maximum design member force (N^*_c) for angles and channels subject to axial compression for the following cases:

- Equal angles: flexural buckling about the y-axis (based on l_{ey}) or flexural-torsional buckling about the x- and z-axes (based on l_{ex} = l_{ez})
- Unequal angles: flexural-torsional buckling about x-, y- and z-axes (based on l_{ex} = l_{ey} = l_{ez})
- Channels: flexural-torsional buckling about x- and z-axes (based on l_{ex} = l_{ez})
  flexural buckling about y-axis (based on l_{ey})

The tables assume the angles and channels are **concentrically loaded** – all loads act through the **centroid of the effective section** as per Clause 3.4 of AS/NZS 4600. However, research[3] shows that for the purpose of the design of angles using Clause 3.4 of AS/NZS 4600, the axial loads can be assumed to be applied through the **centroid of the full section**.

11.2 Design method

11.2.1 Design axial compression force

The maximum design member force (N^*_c) is calculated in accordance with Clause 3.4 of AS/NZS 4600, and can be read directly from the tables or graphs for a range of effective lengths. The design compression capacity for angles and channels is based on the least of the elastic stresses resulting from:

- Equal angles and channels: flexural buckling about the y-axis
  flexural-torsional buckling about the x- and z-axes
- Unequal angles: flexural-torsional buckling about the x-, y- and z-axes

The effective length must be determined for each axis about which buckling may occur. Guidance on the selection of the appropriate effective length to use for design is given in Section 11.2.2.

Local buckling is included by the use of effective area (A_e) in computing the section capacity ($\phi_c N_s$) and the member capacity ($\phi_c N_c$).

For **angles**, all possible buckling modes are taken into account in a single table, assuming that the effective lengths l_{ex}, l_{ey} and l_{ez} for buckling about each of the x-, y- and z-axes respectively, are equal. However, if the actual effective lengths are not equal, then the larger of l_{ex}, l_{ey} and l_{ez} should be used as the effective length (l_e) in the tables.

Clauses 3.4.1 and 3.5.1 of AS/NZS 4600 require slender angles and unequal angles to be designed for the design axial force (N^*) acting simultaneously with moment about the y-axis equal to the design bending moment, or that moment plus $N^* l/1000$ where l is the unbraced length of the member in compression. As such, the tables in Section 11 have been produced with the moment $N^* l/1000$ applied to slender angles and to unequal angles. The additional moment is assumed to cause commression in the angle tips. Slender angles are those for which $A_e/A_f < 1.0$ – refer to the tables in Section 3. For all sections, where the design bending moment about the x-axis (M^*_x) is not zero, that moment needs to be included in the combined axial compression and bending check.

For **channels**, two tables are provided. Table 11.3–1 takes into account the flexural-torsional buckling modes about the x- and z-axes assuming that the effective lengths (l_{ex} and l_{ez}) about these axes are equal. Table 11.3–2 takes into account the flexural buckling mode about the y- axis.

Channels are designed for axial compression by checking the flexural-torsional buckling about the x- and z-axes (N^*_{cxz} in Table 11.3–1) and the flexural buckling about the y-axis (N^*_{cy} in Table 11.3–2). The effective length (l_e) used in Table 11.3–1 is equal to the larger of l_{ex} and l_{ez}. For Table 11.3–2 the effective length (l_e) used is equal to l_{ey}. The maximum design member force (N^*_c) is the minimum of N^*_{cxz} and N^*_{cy} obtained from Tables 11.3–1 and 11.3–2 respectively.

A detailed discussion of the axial compression capacity calculations is included in Appendix A6.

11.2.2 Effective length

The effective length of a compression member for flexural buckling about the principal x- and y-axes (l_{ex} and l_{ey} respectively) and for twisting (l_{ez}) depends on the translational and the rotational restraints at the ends of the member, and may be either smaller or larger than the actual length. Guidance on determining the effective length for flexural buckling is provided in Notes 1 and 2 in Clause 3.4.2 of AS/NZS 4600.

For **members braced against sidesway** and for **truss members** the effective length is equal to the unbraced length. However, a rational analysis may be used to justify smaller effective lengths with the exception of truss members for which the effective length is always equal to the unbraced length.

For **unbraced members** the effective length is calculated using a rational method but should not be less than the unbraced length.

Since AS/NZS 4600 allows the use of a rational analysis to justify a smaller effective length it is recommended that to determine the effective length for members with idealised end restraints, the method in Clause 4.6.3 of AS 4100 (Figure 11.1(1)) be adopted. However, for truss members the effective length is always equal to the unbraced length.

For flexural buckling about the principal x- and y-axes the effective lengths (l_{ex} and l_{ey}) are determined using the following formula:

$$l_e = k_e \, l$$

where: k_e = effective length factor

l = unbraced length of the compression member

The member effective length factor (k_e) can be determined using Clause 4.6.3 of AS 4100 or by a rational frame buckling analysis. Alternatively, for idealised end restraints, values of k_e may be taken from Figure 11.1(1).

The torsional effective length (l_{ez}) is usually assumed to be the distance between points of torsional restraint. More detailed guidance to calculate the torsional effective length (l_{ez}) is given in Figure 11.1(2) for channels, adapted from Talja and Salmi[8].

Figure 11.1(1) Flexural effective length factor (k_e) for members with idealised end restraints

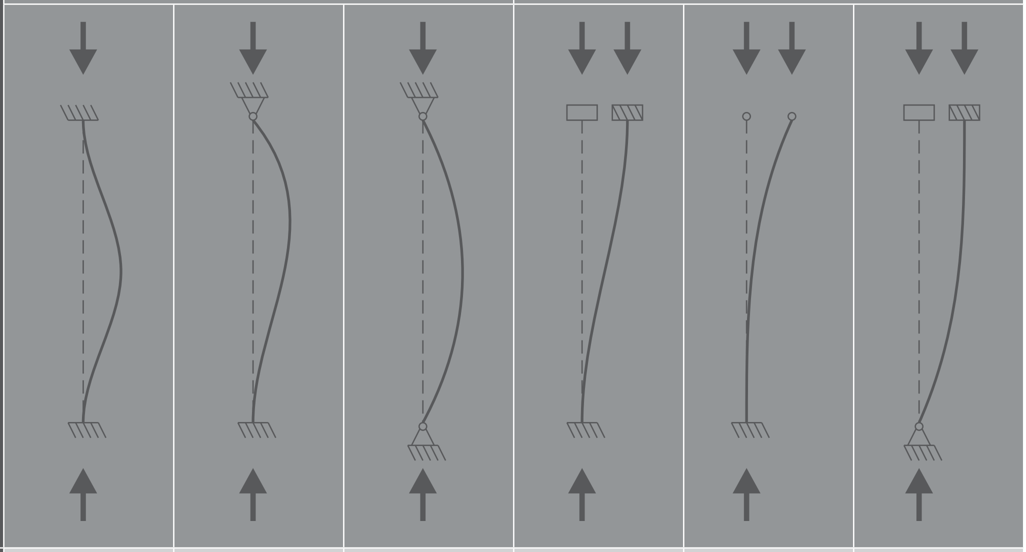
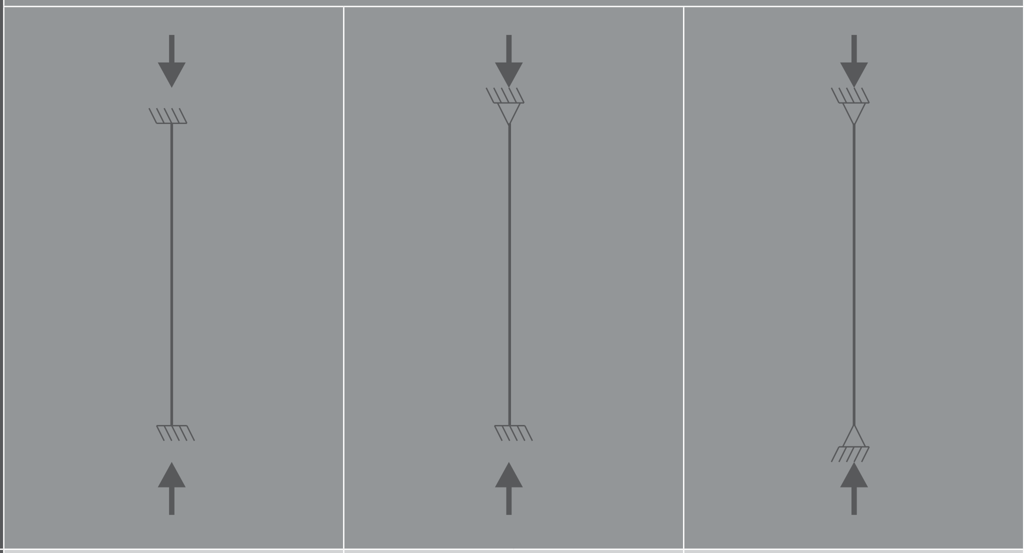
	Braced member			Sway member		
Flexural buckling						
Effective length factor (k_e)	0.7	0.85	1.0	1.2	2.2	2.2
Symbols for end restraint conditions	= Rotation fixed, translation fixed = Rotation free, translation fixed			= Rotation fixed, translation free = Rotation free, translation free		

Figure 11.1(2) Torsional effective length factor (k_e) for channels with idealised end restraints

	Braced member		
Torsional buckling			
Effective length factor (k_e)	0.7	0.85	1.0
Symbols for end restraint conditions	= Twisting fixed, warping fixed	= Twisting fixed, warping free	

11.3 Examples

11.3.1 Equal angle

What size DuraGalUltra equal angle with an unbraced length of 1.5 m is required to resist a design axial compression force of 80 kN? The member is pin ended and is unrestrained against torsional buckling along its length. The member is concentrically loaded (the load passes through the centroid of the effective section). The member is fully braced against sidesway.

Solution:

Design axial compression force $N^* = 80.0$ kN

Unbraced length $l_x = l_y = l_z = 1.5$ m

Restraint conditions
- Pin ended with torsional restraints (about z-axis) at the ends
- Unrestrained against torsional buckling along its length
- Braced against sidesway

Effective length calculations

For flexural buckling ($l_{ex} = l_{ey}$)

Effective length factor $k_e = 1.0$ (Figure 11.1(1))

Effective length $l_{ex} = l_{ey} = 1.0 \times 1.5$

$= 1.5$ m

For torsional buckling

Effective length factor $k_e = 1.0$ (Figure 11.1(2))

Effective length $l_{ez} = 1.0 \times 1.5$

$= 1.5$ m

Maximum design axial compression force (N^*_c)

Using $l_e = 1.5$ m

75 x 75 x 6.0 CA DuraGalUltra (6.56 kg/m)

$N^*_c = 92.7$ kN (Table 11.1-1(A))

$> N^* = 80.0$ kN

90 x 90 x 5.0 CA DuraGalUltra (6.37 kg/m)

$N^*_c = 101$ kN (Table 11.1-1(A))

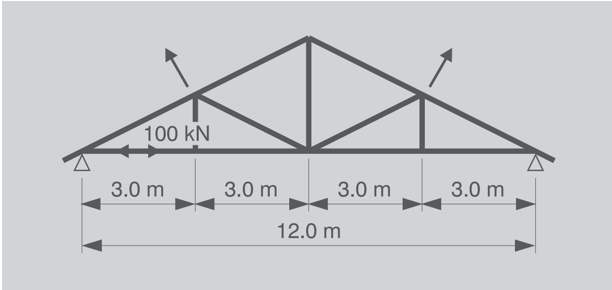
$> N^* = 80.0$ kN

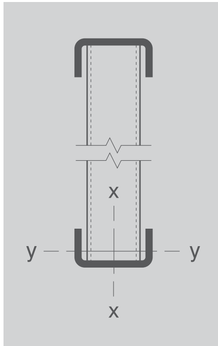
Both angles are satisfactory for this load case.

Select 90 x 90 x 5.0 CA DuraGalUltra because of the lower mass.

11.3.2 Channel

What size DuraGalUltra channel is required for the bottom chord of the truss shown with lateral restraints at the quarter (node) points and without restraints at the quarter points? The total length of the bottom chord is 12.0 m and the maximum design axial compression in the chord under wind uplift is 100 kN. The truss web members are assumed to provide torsional restraint to the chords. The load can be assumed to be compression only (no moment) applied through the centroid of the effective section.





Solution:

(a) Lateral and torsional restraints at quarter points

Design axial compression force $N^* = 100$ kN

Unbraced length $l_x = l_y = l_z = 3.0$ m

Effective length = unbraced length (AS/NZS 4600 Clause 3.4.2 Note 1 - truss member)

Effective length $l_{ex} = l_{ey} = l_{ez} = 3.0$ m

For flexural-torsional buckling about the x- and z-axes, use Table 11.3-1 with $l_e = 3.0$ m.

Select a 150 x 75 x 5.0 CC DuraGalUltra $\phi_c N_{cxz} = 156$ kN > $N^* = 100$ kN

For flexural buckling about the y-axis, use Table 11.3-2 with $l_e = 3.0$ m.

Check the 150 x 75 x 5.0 CC DuraGalUltra $\phi_c N_{cy} = 122$ kN > $N^* = 100$ kN

The 150 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

(b) Torsional restraints but no lateral restraints at quarter points

Design axial compression force $N^* = 100$ kN

Unbraced lengths $l_y = l_z = 3.0$ m
$l_x = 12.0$ m

Effective length = unbraced length (AS/NZS 4600 Clause 3.4.2 Note 1 - truss members)

Effective length $l_{ey} = l_{ez} = 3.0$ m
$l_{ex} = 12.0$ m

For flexural-torsional buckling about the x- and z-axes, use Table 11.3-1 with $l_e = 12.0$ m.

Select a 230 x 75 x 6.0 CC DuraGalUltra $\phi_c N_{cxz} = 120$ kN > $N^* = 100$ kN

For flexural buckling about the y-axis, use Table 11.3-2 with $l_e = 3.0$ m.

Check the 230 x 75 x 6.0 CC DuraGalUltra $\phi_c N_{cy} = 171$ kN > $N^* = 100$ kN

The 230 x 75 x 6.0 CC DuraGalUltra is satisfactory for this load case.

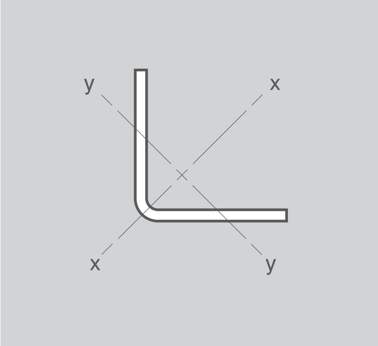


Table 11.1(A)

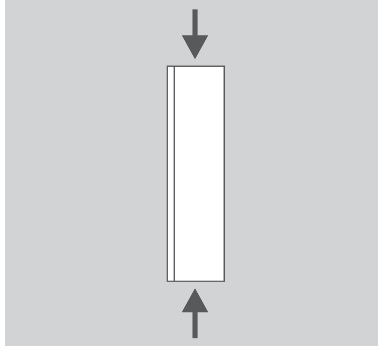
Limit state design

Axial compression force

Lesser of flexural buckling about y-axis and Flexural-torsional buckling about the x- and z-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 x b_2 x Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Maximum design axial compression force N_c^* (kN) — Effective length, l_e (m)													
mm x mm x mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150 x 150 x 8.0 CA	18.0	547	340	337	334	330	325	320	314	307	299	289	251	198	154	123
6.0 CA	13.6	355	148	147	146	145	143	142	140	139	137	134	129	122	108	90.6
5.0 CA	10.8	219	69.4	69.0	68.6	68.1	67.7	67.2	66.6	66.0	65.3	64.6	63.0	61.1	58.9	56.2
125 x 125 x 8.0 CA	14.9	521	368	363	358	351	342	332	318	293	256	216	153	115	89.0	71.1
5.0 CA	8.95	214	83.9	83.3	82.6	81.8	80.9	79.9	78.8	77.5	76.1	74.4	70.4	63.5	52.1	42.7
4.0 CA	7.27	145	44.1	43.8	43.5	43.1	42.7	42.3	41.8	41.3	40.8	40.2	38.8	37.0	35.0	31.0
100 x 100 x 8.0 CA	11.7	481	369	361	350	335	308	255	208	167	134	110	77.6	57.8	44.8	35.7
6.0 CA	8.92	329	211	208	204	198	191	180	159	130	104	85.3	60.3	44.9	34.8	27.7
90 x 90 x 8.0 CA	10.5	454	356	354	351	338	287	234	185	142	112	90.8	63.1	46.3	35.5	28.0
5.0 CA	6.37	203	117	115	113	110	106	101	92.6	75.9	62.2	51.0	36.0	26.8	20.8	16.5
75 x 75 x 8.0 CA	8.59	372	315	313	291	240	188	139	102	78.2	61.8	50.0	34.7	25.5	19.5	–
6.0 CA	6.56	299	222	214	202	171	127	92.7	69.3	53.8	43.0	35.1	24.7	18.4	14.2	–
5.0 CA	5.26	194	130	127	122	115	102	77.9	58.3	45.2	36.2	29.6	20.9	15.5	12.0	–
4.0 CA	4.29	135	74.7	73.2	71.2	68.6	64.9	59.0	46.8	36.8	29.5	24.1	17.0	12.7	9.78	–

Notes:
1. The effective length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. The values in the table are based on $l_e = l_{ex} = l_{ey} = l_{ez}$.
4. The force is assumed to be applied through the centroid of the effective section.
5. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
6. Maximum design axial compression forces are calculated in accordance with AS/NZS 4600.

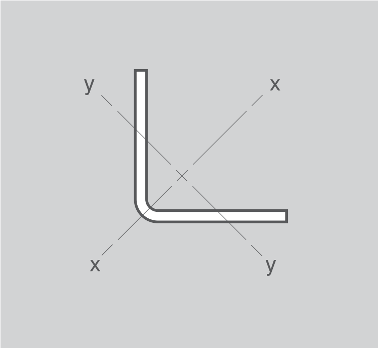


Table 11.1(B)

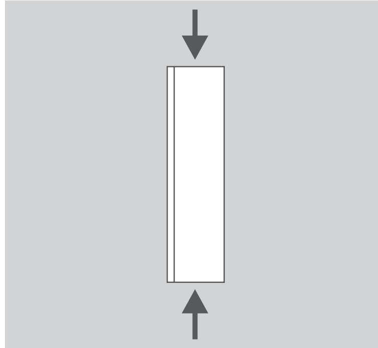
Limit state design

Axial compression force

Lesser of flexural buckling about y-axis and Flexural-torsional buckling about the x- and z-axes

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 × b_2 × Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Maximum design axial compression force N_c^* (kN) — Effective length, l_e (m)													
mm mm mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
65 x 65 x 6.0 CA	5.62	274	212	210	190	142	98.4	68.3	50.2	38.4	30.4	24.6	17.1	12.6	–	–
5.0 CA	4.52	186	135	130	122	101	71.4	50.6	37.8	29.3	23.4	19.1	13.4	9.98	–	–
4.0 CA	3.69	131	82.3	80.0	76.4	71.0	57.3	41.5	31.0	24.1	19.2	15.7	11.1	8.21	–	–
50 x 50 x 6.0 CA	4.21	205	176	153	106	63.8	40.9	28.4	20.8	16.0	12.6	10.2	–	–	–	–
5.0 CA	3.42	166	130	127	91.2	57.2	36.6	25.4	18.7	14.3	11.3	9.15	–	–	–	–
4.0 CA	2.79	121	88.2	82.4	64.0	40.4	26.5	18.7	13.9	10.8	8.59	7.01	–	–	–	–
2.5 CA	1.81	46.3	27.3	26.4	24.9	22.7	17.0	12.2	9.14	7.09	5.66	4.63	–	–	–	–
45 x 45 x 4.0 CA	2.50	116	85.5	77.0	48.8	29.2	19.1	13.5	10.0	7.75	6.17	5.03	–	–	–	–
2.5 CA	1.62	45.2	29.0	27.6	25.2	19.0	12.6	8.95	6.68	5.18	4.13	3.37	–	–	–	–
40 x 40 x 4.0 CA	2.20	107	83.7	70.0	41.2	23.2	14.8	10.3	7.56	5.79	–	–	–	–	–	–
2.5 CA	1.43	43.8	30.0	27.9	22.1	13.5	8.89	6.28	4.68	3.62	2.89	–	–	–	–	–
30 x 30 x 2.5 CA	1.06	39.2	28.2	18.9	9.69	5.63	3.68	2.59	–	–	–	–	–	–	–	–

Notes:
1. The effective length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. The values in the table are based on $l_e = l_{ex} = l_{ey} = l_{ez}$.
4. The force is assumed to be applied through the centroid of the effective section.
5. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
6. Maximum design axial compression forces are calculated in accordance with AS/NZS 4600.

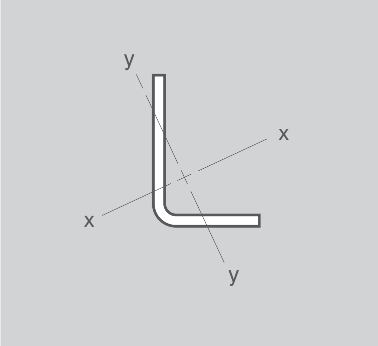


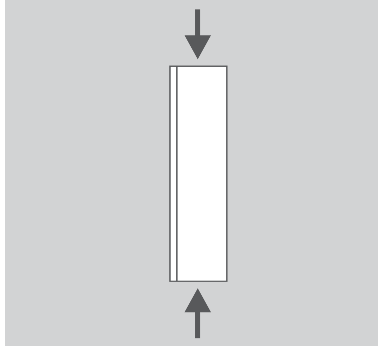
Table 11.2

Limit state design
Axial compression force

Flexural-torsional buckling about the x-, y- and z-axes

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1 x b_2 x Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Maximum design axial compression force N_c^* (kN) — Effective length, l_e (m)													
mm mm mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150 x 100 x 8.0 CA	14.9	514	491	326	317	305	288	267	241	211	182	155	114	86.7	68.0	54.7
6.0 CA	11.3	342	159	157	154	150	144	138	130	121	111	100	80.8	64.0	50.9	41.3
125 x 75 x 8.0 CA	11.7	447	422	308	287	256	217	175	137	109	88.5	73.3	52.5	39.5	30.7	24.6
6.0 CA	8.92	322	179	173	164	151	134	114	96.4	80.2	66.4	55.6	40.3	30.5	23.8	19.1
100 x 75 x 8.0 CA	10.2	426	334	319	294	252	203	158	121	94.6	76.1	62.6	44.4	33.2	25.7	20.5
6.0 CA	7.74	314	209	202	191	175	150	120	93.0	73.5	59.4	48.9	34.8	26.0	20.2	16.1
75 x 50 x 6.0 CA	5.38	252	190	166	124	83.3	56.0	40.1	30.1	23.5	18.8	15.4	10.9	–	–	–
5.0 CA	4.34	180	121	111	92.2	67.8	46.8	33.9	25.6	20.0	16.1	13.2	9.31	–	–	–
4.0 CA	3.54	128	75.3	70.4	61.9	49.0	36.9	27.3	20.8	16.3	13.1	10.8	7.66	–	–	–

Notes:
1. The effective length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. The values in the table are based on $l_e = l_{ex} = l_{ey} = l_{ez}$.
4. The force is assumed to be applied through the centroid of the effective section.
5. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
6. Maximum design axial compression forces are calculated in accordance with AS/NZS 4600.

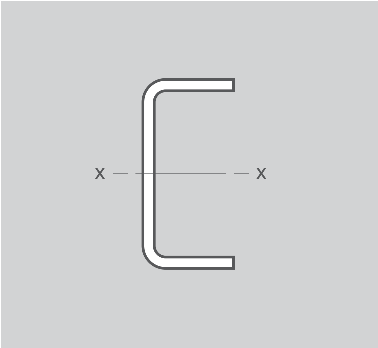


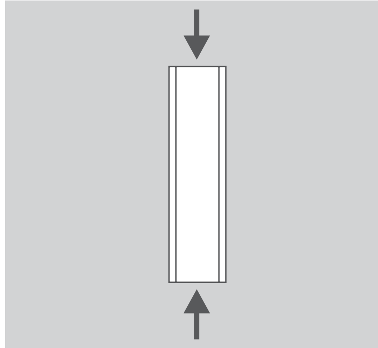
Table 11.3–1

Limit state design
Axial compression force

Flexural-torsional buckling about the x- and z-axes

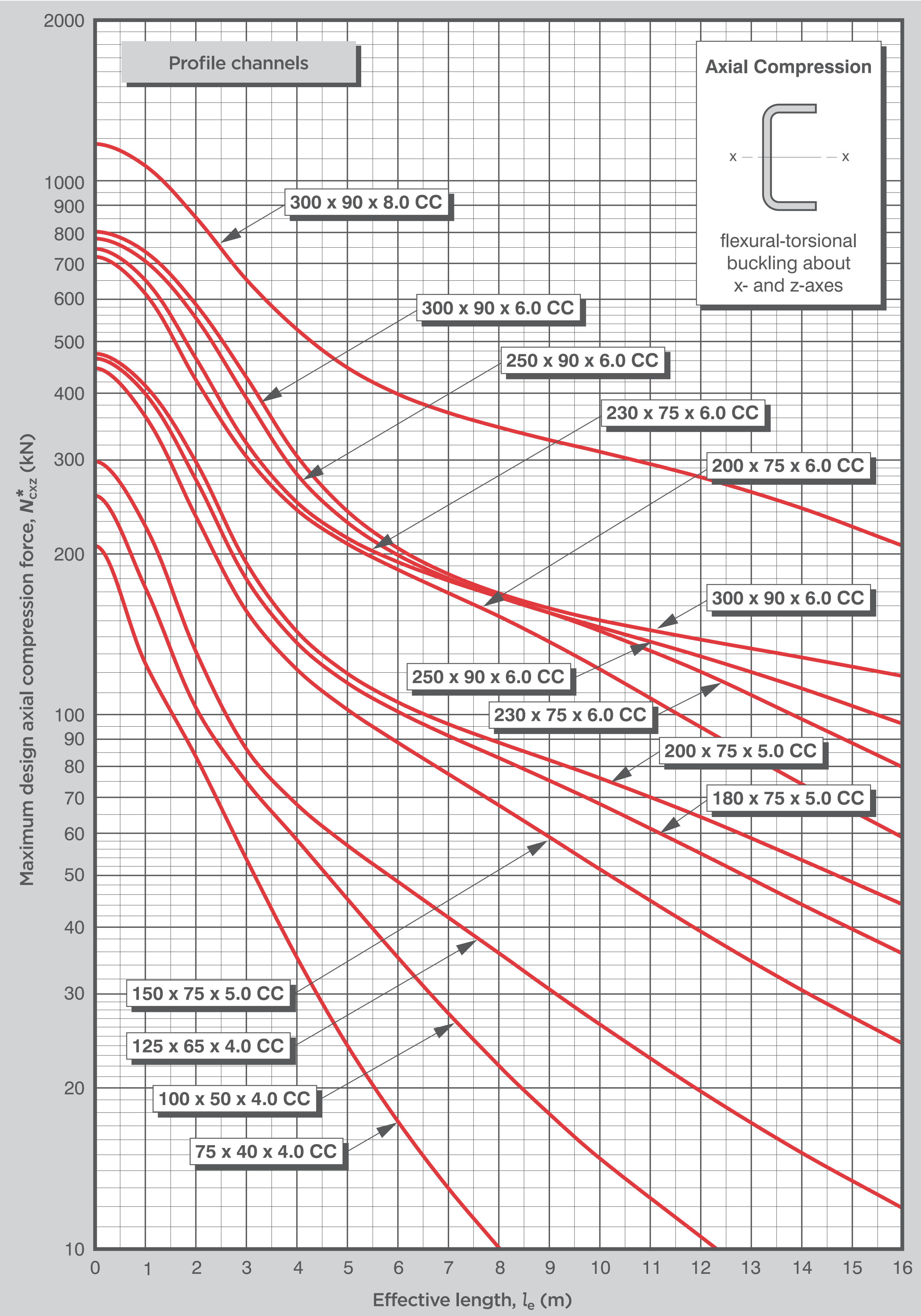
Grade C450L0 / C400L0

Profile channels



Designation d (mm)	b_f (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Design section capacity $\phi_c N_s$ (kN)	Maximum design axial compression force N^*_{cxz} (kN) — Effective length, l_e (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
300	90	8.0 CC	28.5	1170	1070	853	654	526	447	399	368	345	327	311	279	243	207
		6.0 CC	21.6	803	736	586	429	305	240	205	183	169	158	150	138	128	118
250	90	6.0 CC	19.2	779	706	553	392	282	229	199	180	166	155	146	129	112	96.1
230	75	6.0 CC	16.9	746	652	465	323	250	214	193	178	166	155	144	120	98.2	79.7
200	75	6.0 CC	15.5	720	615	424	305	242	209	187	169	153	137	122	94.9	74.2	58.9
		5.0 CC	12.4	474	413	298	192	143	119	106	96.1	88.6	82.1	76.0	64.3	53.4	44.1
180	75	5.0 CC	11.6	465	399	276	180	136	115	101	91.4	83.0	75.3	68.1	55.0	44.1	35.7
150	75	5.0 CC	10.5	445	362	235	156	122	102	88.7	77.5	67.7	59.0	51.4	39.3	30.5	24.2
125	65	4.0 CC	7.23	298	226	131	86.2	67.8	56.9	48.7	41.7	35.7	30.6	26.3	19.7	15.1	–
100	50	4.0 CC	5.59	257	173	103	74.9	58.2	45.2	35.1	27.6	22.0	17.9	14.8	–	–	–
75	40	4.0 CC	4.25	207	125	83.3	53.7	35.1	24.0	17.3	13.0	10.1	–	–	–	–	–

Notes:
1. The effective length exceeds $200r_x$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_x$.
3. The values in the table are based on $l_e = l_{ex} = l_{ez}$.
4. The force is assumed to be applied through the centroid of the effective section.
5. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
6. Maximum design axial compression forces are calculated in accordance with AS/NZS 4600.


Profile channels
Axial Compression
x
x
flexural-torsional buckling about x- and z-axes
2000
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Maximum design axial compression force, N^*_{cxz} (kN)
Effective length, l_e (m)
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC

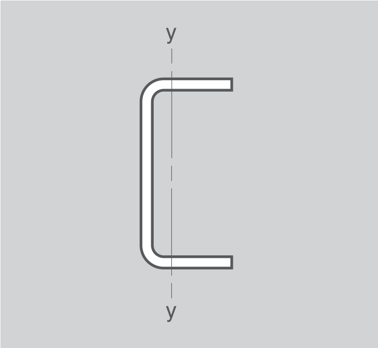


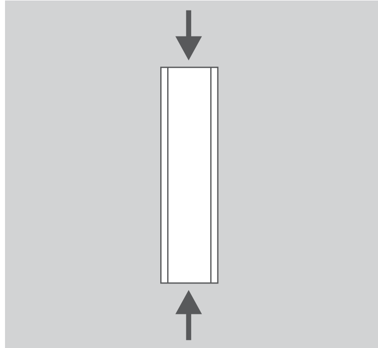
Table 11.3–2

Limit state design
Axial compression force

Flexural buckling about the y-axis

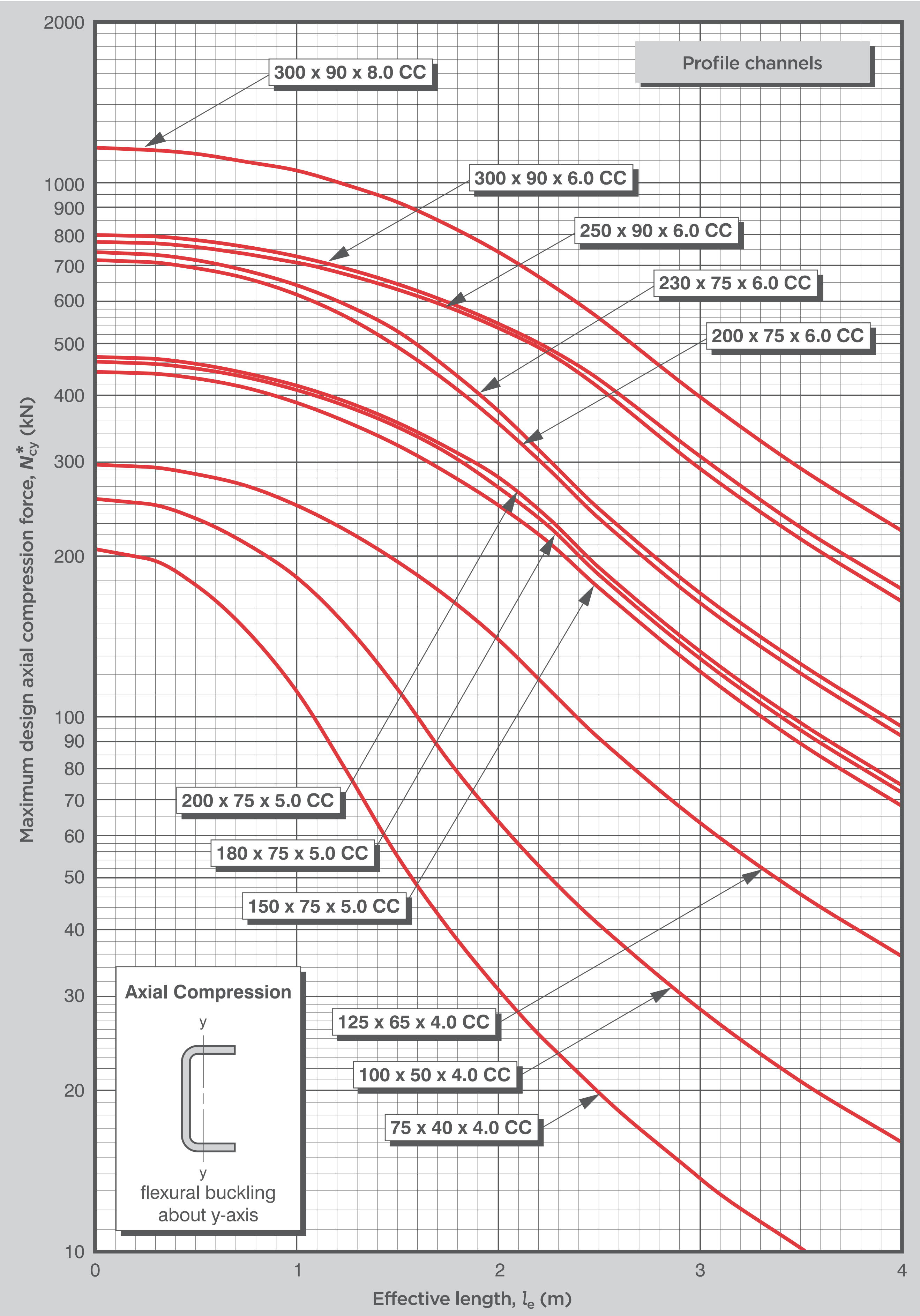
Grade C450LO / C400LO

Profile channels



Designation d × b_f × Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Maximum design axial compression force N^*_{cy} (kN) — Effective length, l_e (m)												
mm mm mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0
300 x 90 x 8.0 CC	28.5	1170	1160	1140	1100	1060	995	924	838	745	651	560	399	293	224
6.0 CC	21.6	803	799	785	762	731	694	649	600	547	492	430	309	227	174
250 x 90 x 6.0 CC	19.2	779	775	762	740	712	676	634	588	537	482	415	293	216	165
230 x 75 x 6.0 CC	16.9	746	739	720	688	646	593	529	451	375	304	246	171	126	96.2
200 x 75 x 6.0 CC	15.5	720	714	696	666	620	563	495	425	356	292	236	164	121	92.3
5.0 CC	12.4	474	471	460	442	419	390	357	320	282	236	191	133	97.6	74.7
180 x 75 x 5.0 CC	11.6	465	461	451	434	411	383	350	313	270	228	185	129	94.6	72.4
150 x 75 x 5.0 CC	10.5	445	442	432	415	389	358	324	287	250	213	175	122	89.3	68.3
125 x 65 x 4.0 CC	7.23	298	295	286	272	250	224	196	168	140	113	91.4	63.5	46.6	35.7
100 x 50 x 4.0 CC	5.59	257	252	236	212	183	148	113	83.4	63.8	50.4	40.9	28.4	21.0	16.0
75 x 40 x 4.0 CC	4.25	207	199	177	146	112	79.1	54.9	40.4	30.9	24.4	20.0	13.7	10.1	–

Notes:
1. The effective length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. The values in the table are based on $l_e = l_{ey}$.
4. The force is assumed to be applied through the centroid of the effective section.
5. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
6. Maximum design axial compression forces are calculated in accordance with AS/NZS 4600.



Profile channels
300 x 90 x 8.0 CC
300 x 90 x 6.0 CC
250 x 90 x 6.0 CC
230 x 75 x 6.0 CC
200 x 75 x 6.0 CC
200 x 75 x 5.0 CC
180 x 75 x 5.0 CC
150 x 75 x 5.0 CC
125 x 65 x 4.0 CC
100 x 50 x 4.0 CC
75 x 40 x 4.0 CC
Axial Compression
y
y
flexural buckling about y-axis
Maximum design axial compression force, N^*_{cy} (kN)
Effective length, l_e (m)
2000
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4

Axial tension capacity

12

Contents

Page

Tables

Page

12.1 Scope

This section contains tables which give the design capacity for angles and channels subject to axial tension. These tables provide axial tension capacities for the following end connection configurations:

> Angles: – fully welded ends
– bolted or welded connection to one leg only

> Channels: – fully welded ends
– bolted or welded connection to the web only
– bolted or welded connection to both flanges

12.2 Design method

The design axial tension capacity ($\phi_t N_t$) is calculated in accordance with Clause 3.2 of AS/NZS 4600, and can be read directly from the tables for the end connection configurations listed in Section 12.1.

The design axial tension capacities given in the tables for bolted angles and channels assume a bolt hole diameter of 14mm, 18 mm or 22 mm. If the member end connection has a bolt hole diameter smaller than the diameter specified in the table, the design axial tension capacity given in the table can be used conservatively. Alternatively, the design axial tension capacity may be calculated accurately using the method given in Appendix A7.

12.3 Examples

12.3.1 Angle connected through one leg only

Design a DuraGalUltra equal angle tension member connected at the ends with a single row of M12 bolts (14 mm hole size) through one leg only, with a design tension force of 100 kN.

Solution:

Design axial tension force N^* = 100 kN

Bolt hole diameter = 14 mm

Using Table 12.1 for a single row of M12 bolts in one leg, the required angle size is:

50 x 50 x 5.0 CA DuraGalUltra $\phi_t N_t$ = 120 kN
> N^* = 100 kN

The 50 x 50 x 5.0 CA DuraGalUltra is satisfactory for this load case.

For the angle selected, block shear rupture needs to be checked in accordance with Clause 5.6.3 of AS/NZS 4600 as outlined in Appendix A7.

12.3.2 Channel connected through web only

Design a DuraGalUltra channel tension member connected at the ends with two rows of M20 bolts (22 mm hole size) through the web only, with a design tension force of 400 kN.

Solution:

Design axial tension force N^* = 400 kN

Bolt hole diameter = 22 mm

Using Table 12.3 for two rows of M20 bolts in the web, the required channel size is:

180 x 75 x 5.0 CC DuraGalUltra $\phi_t N_t$ = 414 kN
> N^* = 400 kN

The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

For the channel selected, block shear rupture needs to be checked in accordance with Clause 5.6.3 of AS/NZS 4600 as outlined in Appendix A7.

Table 12.1

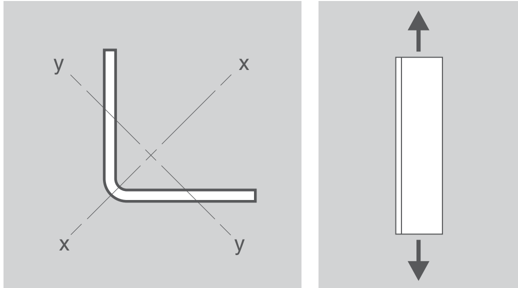
Limit state design

Axial tension capacity

Fully welded / One leg connected

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Fully welded $\phi_t N_t$	One leg connected: Welded, no holes $\phi_t N_t$	One leg connected: Bolted, Hole diameter	Bolted $\phi_t N_t$ (kN), No. of bolts: 1	2
mm	mm	mm	kg/m	kN	kN	mm	1	2
150	x 150	x 8.0 CA	18.0	790	671	22.0	620	568
		6.0 CA	13.6	664	564	22.0	521	478
		5.0 CA	10.8	526	447	22.0	413	380
125	x 125	x 8.0 CA	14.9	652	554	18.0	512	470
		5.0 CA	8.95	436	371	18.0	343	316
		4.0 CA	7.27	354	301	18.0	279	257
100	x 100	x 8.0 CA	11.7	515	437	18.0	395	–
		6.0 CA	8.92	434	369	18.0	334	–
90	x 90	x 8.0 CA	10.5	460	391	18.0	348	–
		5.0 CA	6.37	310	264	18.0	236	–
75	x 75	x 8.0 CA	8.59	377	320	18.0	278	–
		6.0 CA	6.56	320	272	18.0	237	–
		5.0 CA	5.26	256	218	18.0	190	–
		4.0 CA	4.29	209	177	18.0	155	–
65	x 65	x 6.0 CA	5.62	274	233	18.0	198	–
		5.0 CA	4.52	220	187	18.0	160	–
		4.0 CA	3.69	180	153	18.0	131	–
50	x 50	x 6.0 CA	4.21	205	174	14.0	147	–
		5.0 CA	3.42	166	141	14.0	120	–
		4.0 CA	2.79	136	116	14.0	98.4	–
		2.5 CA	1.81	70.5	59.9	14.0	51.2	–
45	x 45	x 4.0 CA	2.50	122	103	14.0	86.1	–
		2.5 CA	1.62	63.2	53.7	14.0	45.0	–
40	x 40	x 4.0 CA	2.20	107	91.0	14.0	–	–
		2.5 CA	1.43	55.8	47.4	14.0	38.7	–
30	x 30	x 2.5 CA	1.06	41.1	35.0	14.0	–	–

Notes:
1. Tension capacity is governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. Block shear rupture may need to be checked in accordance with Clause 5.6.3 of AS/NZS 4600.
3. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. 'F' indicates failure by tensile fracture. 'Y' indicates failure by tensile yielding.

Table 12.2

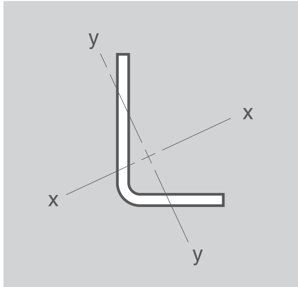
Limit state design

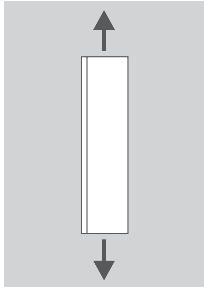
Axial tension capacity

Fully welded / One leg connected

Grade C450L0 / C400L0

Profile unequal angles





Designation			Mass per metre	Fully welded	Long leg connected				Short leg connected		
					Welded	Bolted			Welded	Bolted	
		Nominal			no holes	Hole	$\phi_t N_t$ (kN)		no holes	Hole	$\phi_t N_t$ (kN)
b_1	b_2	thickness		$\phi_t N_t$	$\phi_t N_t$	diameter	No. of bolts		$\phi_t N_t$	diameter	No. of bolts
mm	mm	mm	kg/m	kN	kN	mm	1	2	kN	mm	1
150	100	8.0 CA	14.9	652	554	18.0	512	470	489 F	18.0	512
		6.0 CA	11.3	549	467	18.0	432	397	412 F	18.0	432
125	75	8.0 CA	11.7	515	437	18.0	395	353	386 F	18.0	395
		6.0 CA	8.92	434	369	18.0	334	299	326 F	18.0	334
100	75	8.0 CA	10.2	446	379	18.0	337	–	334 F	18.0	337
		6.0 CA	7.74	377	320	18.0	285	–	283 F	18.0	285
75	50	6.0 CA	5.38	262	223	18.0	188	–	197 F	14.0	188
		5.0 CA	4.34	211	180	18.0	152	–	159 F	14.0	152
		4.0 CA	3.54	172	147	18.0	124	–	129 F	14.0	124

Notes:
1. Tension capacity is governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. Block shear rupture may need to be checked in accordance with Clause 5.6.3 of AS/NZS 4600.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.
5. 'F' indicates failure by tensile fracture. 'Y' indicates failure by tensile yielding.

Table 12.3

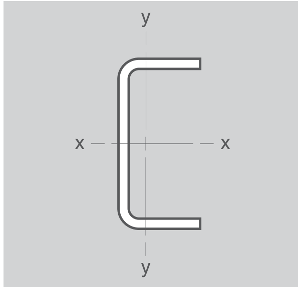
Limit state design

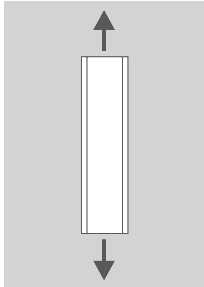
Axial tension capacity

Fully welded / Web connected / Flange connected

Grade C450L0 / C400L0

Profile channels





Designation d x b_f x Nominal thickness	Mass per metre	Fully welded $\phi_t N_t$	Web connected: Welded no holes $\phi_t N_t$	Web connected: Bolted Hole Diameter	Web connected: Bolted $\phi_t N_t$ (kN) No. of bolt rows 1	2	3	Flange connected: Welded no holes $\phi_t N_t$	Flange connected: Bolted Hole diameter	Flange connected: Bolted $\phi_t N_t$ (kN) Bolt rows 1
mm mm mm	kg/m	kN	kN	mm				kN	mm	
300 x 90 x 8.0 CC	28.5	1250	1060	22.0	1010	959	908	1060	22.0	959
6.0 CC	21.6	1050	895	22.0	852	809	766	895	22.0	809
250 x 90 x 6.0 CC	19.2	938	797	22.0	754	711	668	797	22.0	711
230 x 75 x 6.0 CC	16.9	823	699	22.0	657	614	–	699	22.0	614
200 x 75 x 6.0 CC	15.5	754	641	22.0	598	555	–	641	22.0	555
5.0 CC	12.4	603	512	22.0	479	445	–	512	22.0	445
180 x 75 x 5.0 CC	11.6	567	482	22.0	448	414	–	482	22.0	414
150 x 75 x 5.0 CC	10.5	513	436	18.0	408	381	–	436	18.0	381
125 x 65 x 4.0 CC	7.23	352	299	18.0	277	–	–	299	18.0	255
100 x 50 x 4.0 CC	5.59	272	231	18.0	209	–	–	231	18.0	–
75 x 40 x 4.0 CC	4.25	207	176	18.0	154	–	–	176	18.0	–

Notes:
1. Tension capacity is governed by tension fracture in accordance with Clause 3.2 of AS/NZS 4600 unless noted.
2. Block shear rupture may need to be checked in accordance with Clause 5.6.3 of AS/NZS 4600.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Capacities are calculated in accordance with AS/NZS 4600.

Channels

Combined actions

13

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13.1 Scope

This section contains the interaction formulae which are used to calculate the design capacity of a member subject to combined axial force and bending. Tables are provided for the elastic buckling loads for angles and channels buckling about the principal x- and y-axes. The elastic buckling loads are used to determine the moment amplification factors in the combined axial compression and bending interaction equations.

Additional tables are provided in Section 18 for the special case of eccentrically loaded single angles used as web members in trusses.

13.2 Combined axial compression and bending

For a member subject to combined axial compression and bending, the design axial compression force (N^*), and the design bending moment (M_x^* and M_y^*) about the x- and y-axes must satisfy the following interaction equations from Clause 3.5.1 of AS/NZS 4600:

(a) $$\frac{N^*}{\phi_c N_c} + \frac{C_{mx} M_x^*}{\phi_b M_{bx} \alpha_{nx}} + \frac{C_{my} M_y^*}{\phi_b M_{by} \alpha_{ny}} \leq 1.0$$

(b) $$\frac{N^*}{\phi_c N_s} + \frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} \leq 1.0$$

If $\frac{N^*}{\phi_c N_c} \leq 0.15$, the following interaction may be used in lieu of items (a) and (b):

$$\frac{N^*}{\phi_c N_c} + \frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} \leq 1.0$$

where: N^* = design axial compression force

$\phi_c N_c$ = design member axial compression capacity (Section 11)

$\phi_c N_s$ = design section axial compression capacity (Section 6)

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

M_y^* = design bending moment about the y-axis

Clauses 3.4.1 and 3.5.1 of AS/NZS 4600 require slender angles and unequal angles to be designed for the design axial force (N^*) acting simultaneously with moment about the y-axis equal to the design bending moment, or that moment plus $N^* l/1000$ where l is the unbraced length of the member in compression. The additional moment is assumed to cause compression in the angle tips. Slender angles are those for which $A_e/A_f < 1.0$ – refer to the tables in Section 3. For all sections, where the design bending moment about the x-axis (M^*_x) is not zero, that moment needs to be included in the combined axial compression and bending check.

$\phi_b M_{bx}$ = design member moment capacity about the x-axis calculated using C_b or C_{TF} = 1.0 (Section 7)

$\phi_b M_{by}$ = design member moment capacity about the y-axis calculated using C_{TF} = 1.0 (Section 7)

ϕ_c = 0.85 (AS/NZS 4600 Table 1.6)

ϕ_b = 0.95 for channels bending about the y-axis with the web in compression

= 0.9 for angles bending about the x- or y-axis, and for channels bending about the x-axis or about the y-axis with the flange tips in compression (AS/NZS 4600 Table 1.6)

C_{mx} = coefficient for unequal end moment about the x-axis

C_{my} = coefficient for unequal end moment about the y-axis

Values of C_m are calculated in accordance with Clause 3.5.1 of AS/NZS 4600 as follows:

(i) For compression members in frames subject to joint translation (side-sway):

$C_m = 0.85$

(ii) For restrained compression members in frames braced against joint translation and not subject to transverse loading between their supports in the plane of bending:

$C_m = 0.6 - 0.4(M_1 / M_2)$

M_1 / M_2 is the ratio of the smaller to the larger moment at the ends of that portion of the member under consideration which is unbraced in the plane of bending. M_1 / M_2 is positive if the member is bent in reverse curvature and negative if it is bent in single curvature.

(iii) For compression members in frames braced against joint translation in the plane of loading and subject to transverse loading between their supports, the value of C_m may be determined by rational analysis. However, in lieu of such analysis, the following values may be used:

(A) For members whose ends are restrained:

$C_m = 0.85$

(B) For members whose ends are unrestrained:

$C_m = 1.0$

α_{nx}, α_{ny} = moment amplification factors

$$= 1 - \left(\frac{N^*}{N_e}\right)$$

N_e = elastic buckling load (given in the tables in this section)

$$= \frac{\pi^2 E I_b}{l_{eb}^2}$$

I_b = second moment of area of the full section about the bending axis

l_{eb} = effective length in the plane of bending

13.3 Combined axial tension and bending

For members subject to axial tension and bending, the following interaction equations from Clause 3.5.2 of AS/NZS 4600 must be satisfied:

$$\frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} - \frac{N^*}{\phi_t N_t} \leq 1.0$$

$$\frac{N^*}{\phi_t N_t} + \frac{M_x^*}{\phi_b M_{sxf}} + \frac{M_y^*}{\phi_b M_{syf}} \leq 1.0$$

where N^* = design axial tensile force

ϕ_t = 0.9 (AS/NZS 4600 Table 1.6)

$\phi_t N_t$ = design section capacity of the member in tension (Section 12)

ϕ_b = 0.95 for channels bending about the y-axis with the web in compression

= 0.9 for angles bending about the x- or y-axis, and for channels bending about the x-axis or about the y-axis with the flange tips in compression (AS/NZS 4600 Table 1.6)

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

M_y^* = design bending moment about the y-axis

$\phi_b M_{bx}$ = design member moment capacity about the x-axis calculated using C_b or C_{TF} = 1.0 (Section 7)

$\phi_b M_{by}$ = design member moment capacity about the y-axis calculated using C_{TF} = 1.0 (Section 7)

M_{sxf} = section yield capacity of the full section about the x-axis

= $\phi_b Z_{ftx} f_y$

M_{syf} = section yield capacity of the full section about the x-axis

= $\phi_b Z_{fty} f_y$

Z_{ft} = section modulus of the full unreduced section for the extreme tension fibres about the appropriate axis (Section 3)

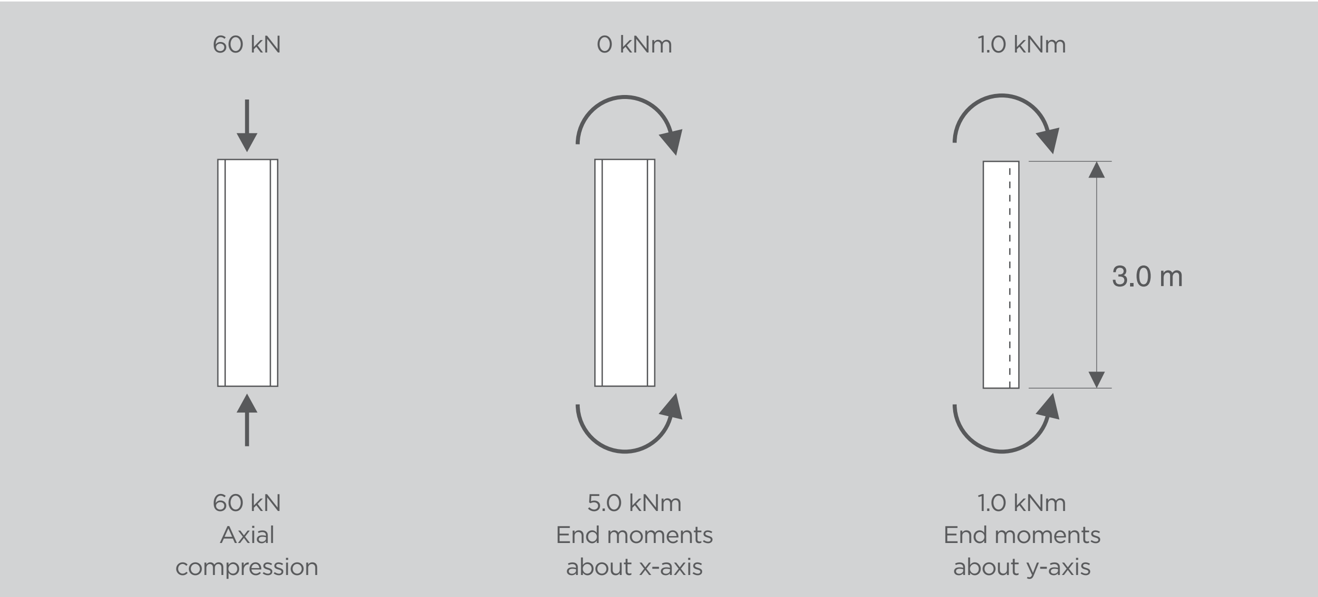
13.4 Examples

13.4.1 Channel subject to combined axial compression and bending

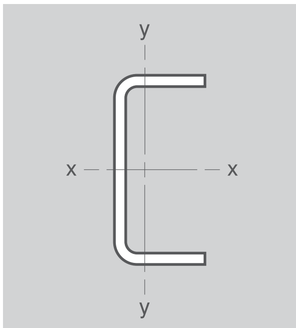
Check the ability of a 3.0 m long 180 x 75 x 5.0 CC DuraGalUltra to resist the combined design axial compression force and the design biaxial bending moments shown. The member is braced against sidesway and is not subjected to any transverse loading between supports. For bending about the y-axis, the channel web is in compression. The axial compression force is assumed to act through the centroid of the effective section. The loads or reactions causing the moments are assumed to act through the shear centre.

The effective lengths are given as:

Axial compression	$l_{ex} = l_{ey} = l_{ez}$	= 3.0 m
Bending about x-axis	$l_{ey} = l_{ez}$	= 3.0 m
Bending about y-axis	$l_{ex} = l_{ez}$	= 3.0 m



Solution:



Design action effects:

Axial compression force	N^*	=	60.0 kN
Bending moment about x-axis	M_x^*	=	5.0 kNm
Bending moment about y-axis	M_y^*	=	1.0 kNm

Axial compression

For 180 x 75 x 5.0 CC DuraGalUltra:

Design section axial compression capacity

$$\phi_c N_s = 465 \text{ kN (Table 6.3)}$$

Design member axial compression capacity:

for flexural-torsional buckling about the x- and z-axes

$$\phi_c N_{cxz} = N^*_{cxz} \quad = \quad 180 \text{ kN (Table 11.3–1)}$$

for flexural buckling about the y-axes

$$\phi_c N_{cy} = N^*_{cy} \quad = \quad 129 \text{ kN (Table 11.3–2)}$$

Use the smaller value $\qquad \phi_c N_c \quad = \quad 129$ kN

$$\frac{N^*}{\phi N_c} = \frac{60.0}{129} = 0.465 > 0.15$$

Therefore the interaction equations to be used are:

$$\frac{N^*}{\phi_c N_c} + \frac{C_{mx} M^*_x}{\phi_b M_{bx} \alpha_{nx}} + \frac{C_{my} M^*_y}{\phi_b M_{by} \alpha_{ny}} \leq 1.0$$

and

$$\frac{N^*}{\phi_c N_s} + \frac{M^*_x}{\phi_b M_{bx}} + \frac{M^*_y}{\phi_b M_{by}} \leq 1.0$$

Bending about x-axis

For 180 x 75 x 5.0 CC DuraGalUltra:

Design member moment capacity $\quad \phi_b M_{bx} \quad = \quad 15.4$ kNm (Table 7.3–1)

(using bending coefficient C_b = 1.0 - a conservative option in accordance with Clause 3.3.3.2.1(a)(i) of AS/NZS 4600)

End moment ratio $M_1 / M_2 = 0$

The coefficient for unequal end moments to be used in the interaction equations is:

$$C_{mx} = 0.6$$

Moment amplification factor $\qquad \alpha_{nx} = 1 - \left(\frac{N^*}{N_{ex}}\right)$

where: $\qquad N_{ex} = 1570$ kN (Table 13.3–1)

$$\alpha_{nx} = 1 - \left(\frac{60.0}{1570}\right) = 0.962$$

Bending about y-axis

For 180 x 75 x 5.0 CC DuraGalUltra:

Design member moment capacity $\quad \phi_b M_{by} \quad = \quad 6.02$ kNm (Table 7.3–5)

(using coefficient for unequal end moments C_{TF} = 1.0 in accordance with Clause 3.3.3.2.1(a)(i) of AS/NZS 4600)

End moment ratio $M_1 / M_2 = -1.0$

The coefficient for unequal end moments to be used in the interaction equations is:

$$C_{my} = 0.6 - 0.4\,(-1.0)$$

$$= 1.0 \text{ (AS/NZS 4600 Clause 3.5.1)}$$

Moment amplification factor $\alpha_{ny} = 1 - \left(\dfrac{N^*}{N_{ey}}\right)$

where $N_{ey} = 173$ kN (Table 13.3–2)

$$\alpha_{ny} = 1 - \left(\frac{60.0}{173}\right) = 0.653$$

Axial compression and bending interaction

$$\frac{N^*}{\phi_c N_c} + \frac{C_{mx} M_x^*}{\phi_b M_{bx} \alpha_{nx}} + \frac{C_{my} M_y^*}{\phi_b M_{by} \alpha_{ny}} = \frac{60.0}{129} + \frac{0.6 \times 0.5}{15.4 \times 0.962} + \frac{1.0 \times 1.0}{6.02 \times 0.653}$$

$$= 0.922 < 1.0$$

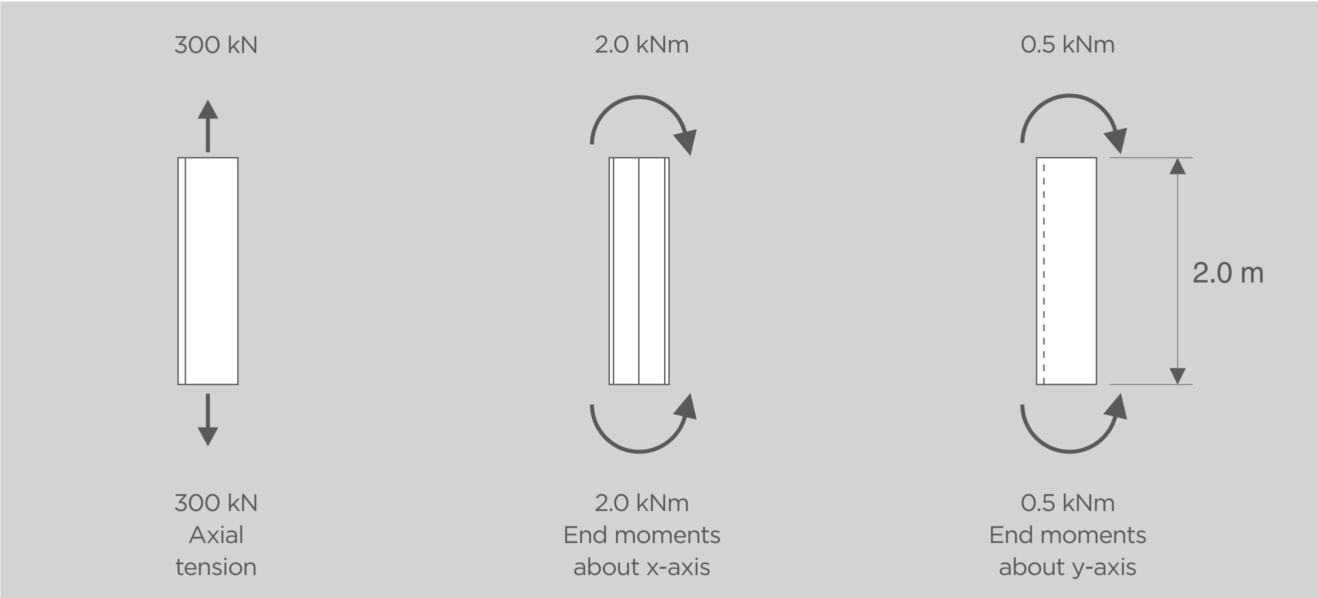
$$\frac{N^*}{\phi_c N_s} + \frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} = \frac{60.0}{465} + \frac{5.0}{15.4} + \frac{1.0}{6.02}$$

$$= 0.620 < 1.0$$

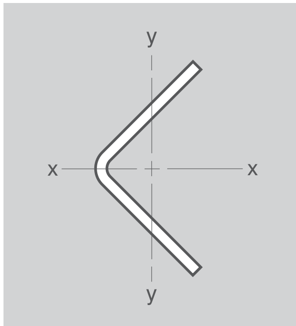
The 180 x 75 x 5.0 CC DuraGalUltra is satisfactory for this load case.

13.4.2 Angle subject to combined axial tension and bending

Design a DuraGalUltra equal angle to resist a design axial tension force combined with the design bending moments about the x- and y-axes as shown. Bending about the minor principal y-axis results in compression at the tips of the angle. The effective length of the member in bending about the x- and y-axes (l_{ex} and l_{ey}) and twisting (l_{ez}) is 2.0 m. Both legs are welded at each end connection. The loads or reactions causing the moments are assumed to act through the shear centre.



Solution:



Design action effects:

Axial tension force $N^* = 300$ kN

Bending moment about x-axis $M_x^* = 2.0$ kNm

Bending moment about y-axis $M_y^* = 0.5$ kNm

Interaction equations:

$$\frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} - \frac{N^*}{\phi_t N_t} \leq 1.0$$

and

$$\frac{N^*}{\phi_t N_t} + \frac{M_x^*}{\phi_b M_{sxf}} + \frac{M_y^*}{\phi_b M_{syf}} \leq 1.0$$

Try a 90 x 90 x 8.0 CA DuraGalUltra:

Axial tension

Design axial tension capacity $\phi_t N_t = 460$ kN (Table 12.1 or Table 6.1–1)

Bending about x-axis

Design member moment capacity $\phi_b M_{bx}$ = 9.15 kNm (Table 7.1-1(A))

(using bending coefficient C_b = 1.0 in accordance with Clause 3.3.3.2.1(a)(i) of AS/NZS 4600)

Section yield capacity $M_{sxf} = Z_{ft} f_y$

where $Z_{ft} = Z_{x1} = 26.7 \times 10^3$ mm^3 (Table 3.1-1(A))

f_y = 400 MPa

Capacity (strength reduction) factor for bending ϕ_b = 0.9 (AS/NZS 4600, Table 1.6)

$\phi_b M_{sxf}$ = 9.61 kNm

Bending about y-axis

Design member moment capacity $\phi_b M_{by}$ = 4.30 kNm (Table 7.1-2(A))

(using coefficient for unequal end moments C_{TF} = 1.0 in accordance with Clause 3.3.3.2.1(a)(ii) of AS/NZS 4600)

Section yield capacity $M_{syf} = Z_{ft} f_y$

where $Z_{ft} = Z_{y5} = 12.7 \times 10^3$ mm^3 (Table 3.1-1(A))

f_y = 400 MPa

Capacity (strength reduction) factor for bending ϕ_b = 0.9 (AS/NZS 4600, Table 1.6)

$\phi_b M_{syf}$ = 4.57 kNm

Axial tension and bending interaction

$$\frac{M_x^*}{\phi_b M_{bx}} + \frac{M_y^*}{\phi_b M_{by}} - \frac{N^*}{\phi_t N_t} = \frac{2.0}{9.15} + \frac{0.5}{4.30} - \frac{300}{460}$$

$$= -0.317 < 1.0$$

$$\frac{N^*}{\phi_t N_t} + \frac{M_x^*}{\phi_b M_{sxf}} + \frac{M_y^*}{\phi_b M_{syf}} = \frac{300}{460} + \frac{2.0}{9.61} - \frac{0.5}{4.57}$$

$$= -0.970 < 1.0$$

The 90 x 90 x 8.0 CA DuraGalUltra is satisfactory for this load case.

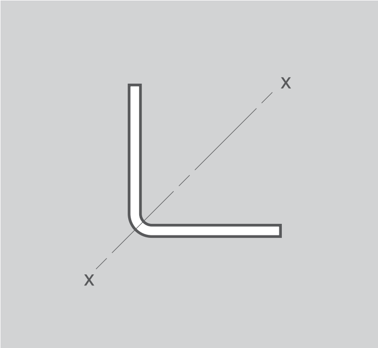


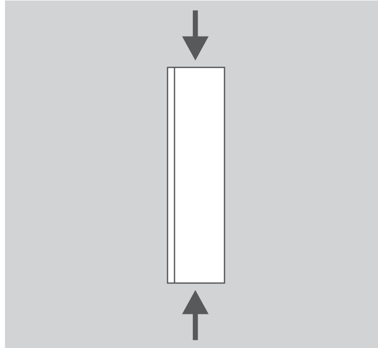
Table 13.1-1(A)

Limit state design
Elastic buckling load

Buckling about x-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Elastic buckling load N_{ex} (kN) — Effective length, l_{ex} (m)														
mm	mm	mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	x 150	x 8.0 CA	18.0	65600	16400	7290	4100	2620	1820	1340	1020	810	656	542	455	388	335	256
		6.0 CA	13.6	50200	12500	5580	3140	2010	1390	1020	784	619	502	415	348	297	256	196
		5.0 CA	10.8	39800	9960	4430	2490	1590	1110	813	622	492	398	329	277	236	203	156
125	x 125	x 8.0 CA	14.9	37300	9330	4150	2330	1490	1040	762	583	461	373	309	259	221	190	146
		5.0 CA	8.95	22800	5710	2540	1430	913	634	466	357	282	228	189	159	135	116	89.2
		4.0 CA	7.27	18700	4670	2070	1170	746	518	381	292	230	187	154	130	110	95.2	72.9
100	x 100	x 8.0 CA	11.7	18700	4660	2070	1170	746	518	381	291	230	187	154	130	110	95.2	72.9
		6.0 CA	8.92	14400	3610	1600	901	577	401	294	225	178	144	119	100	85.3	73.6	56.3
90	x 90	x 8.0 CA	10.5	13400	3350	1490	838	537	373	274	210	166	134	111	93.2	79.4	68.4	52.4
		5.0 CA	6.37	8340	2080	926	521	333	232	170	130	103	83.4	68.9	57.9	49.3	42.5	32.6

Notes: 1. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

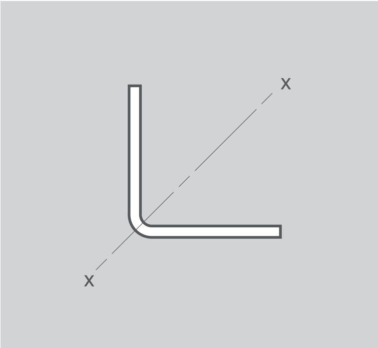


Table 13.1–1(B)

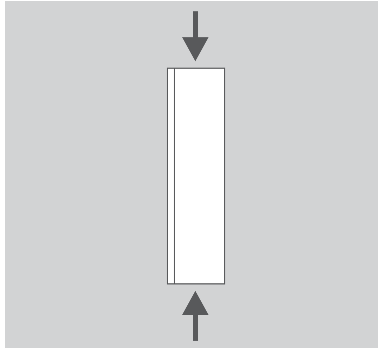
Limit state design

Elastic buckling load

Buckling about x-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Elastic buckling load N_{ex} (kN), Effective length, l_{ex} (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	4.5	5.0	6.0
75	75	8.0 CA	8.59	30200	7550	3360	1890	1210	839	617	472	302	210	154	118	93.3	75.5	52.5
		6.0 CA	6.56	23600	5900	2620	1480	944	656	482	369	236	164	120	92.2	72.9	59.0	41.0
		5.0 CA	5.26	19000	4750	2110	1190	760	528	388	297	190	132	96.9	74.2	58.6	47.5	33.0
		4.0 CA	4.29	15600	3910	1740	977	625	434	319	244	156	109	79.8	61.1	48.3	39.1	27.1
65	65	6.0 CA	5.62	15100	3770	1680	942	603	419	308	236	151	105	76.9	58.9	46.5	37.7	26.2
		5.0 CA	4.52	12200	3050	1350	761	487	338	249	190	122	84.6	62.2	47.6	37.6	30.5	21.1
		4.0 CA	3.69	10100	2510	1120	629	402	279	205	157	101	69.9	51.3	39.3	31.0	25.1	17.5
50	50	6.0 CA	4.21	6570	1640	730	411	263	183	134	103	65.7	45.6	33.5	25.7	20.3	16.4	11.4
		5.0 CA	3.42	5360	1340	596	335	215	149	109	83.8	53.6	37.3	27.4	21.0	16.6	13.4	9.31
		4.0 CA	2.79	4460	1110	495	279	178	124	91.0	69.6	44.6	31.0	22.7	17.4	13.8	11.1	7.74
		2.5 CA	1.81	2940	734	326	184	118	81.6	60.0	45.9	29.4	20.4	15.0	11.5	9.07	7.34	5.10
45	45	4.0 CA	2.50	3210	802	356	200	128	89.1	65.5	50.1	32.1	22.3	16.4	12.5	9.90	8.02	5.57
		2.5 CA	1.62	2120	531	236	133	85.0	59.0	43.4	33.2	21.2	14.8	10.8	8.30	6.56	5.31	3.69
40	40	4.0 CA	2.20	2220	554	246	139	88.7	61.6	45.2	34.6	22.2	15.4	11.3	8.66	6.84	5.54	3.85
		2.5 CA	1.43	1480	369	164	92.3	59.1	41.0	30.1	23.1	14.8	10.3	7.54	5.77	4.56	3.69	2.56
30	30	2.5 CA	1.06	604	151	67.2	37.8	24.2	16.8	12.3	9.44	6.04	4.20	3.08	2.36	1.87	1.51	1.05

Notes: 1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm $< t \le 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

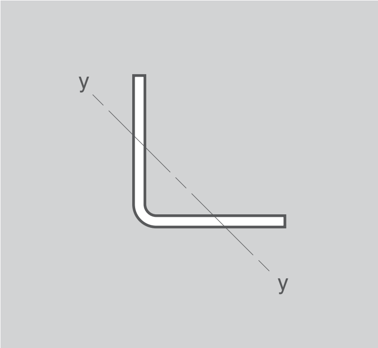


Table 13.1–2(A)

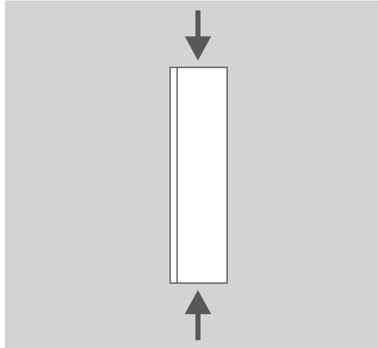
Limit state design

Elastic buckling load

Buckling about y-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Elastic buckling load N_{ey} (kN) — Effective length, l_{ey} (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150	x 150	x 8.0 CA	18.0	62000	15500	6890	3880	2480	1720	1270	969	766	620	431	316	242	191	155
		6.0 CA	13.6	47600	11900	5290	2980	1910	1320	972	745	588	476	331	243	186	147	119
		5.0 CA	10.8	38700	9680	4300	2420	1550	1080	790	605	478	387	269	198	151	120	96.8
125	x 125	x 8.0 CA	14.9	34900	8730	3880	2180	1400	969	712	545	431	349	242	178	136	108	87.3
		5.0 CA	8.95	22100	5520	2450	1380	883	613	450	345	272	221	153	113	86.2	68.1	55.2
		4.0 CA	7.27	18100	4520	2010	1130	723	502	369	282	223	181	126	92.2	70.6	55.8	45.2
100	x 100	x 8.0 CA	11.7	17100	4280	1900	1070	685	476	349	267	211	171	119	87.3	66.9	52.8	42.8
		6.0 CA	8.92	13300	3330	1480	831	532	369	271	208	164	133	92.4	67.9	52.0	41.1	33.3
90	x 90	x 8.0 CA	10.5	12200	3050	1350	761	487	338	249	190	150	122	84.6	62.1	47.6	37.6	30.5
		5.0 CA	6.37	7950	1990	883	497	318	221	162	124	98.1	79.5	55.2	40.5	31.0	24.5	19.9

Notes: 1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

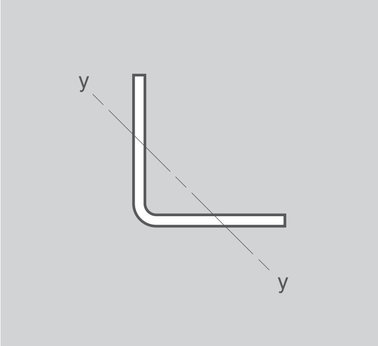


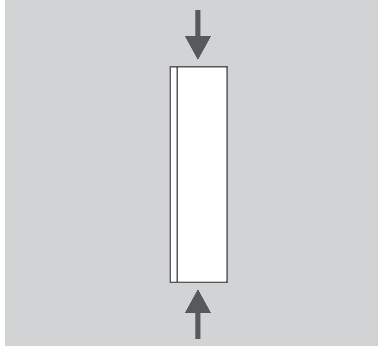
Table 13.1–2(B)

Limit state design
Elastic buckling load

Buckling about y-axis

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1 x b_2 x Nominal thickness	Mass per metre	Elastic buckling load N_{ey} (kN) — Effective length, l_{ey} (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	4.0
75 x 75 x 8.0 CA	8.59	6710	1680	746	420	269	186	137	105	82.9	67.1	55.5	46.6	39.7	34.2	26.2
6.0 CA	6.56	5270	1320	586	330	211	146	108	82.4	65.1	52.7	43.6	36.6	31.2	26.9	20.6
5.0 CA	5.26	4480	1120	498	280	179	124	91.5	70.0	55.3	44.8	37.0	31.1	26.5	22.9	17.5
4.0 CA	4.29	3700	925	411	231	148	103	75.5	57.8	45.7	37.0	30.6	25.7	21.9	18.9	14.5
65 x 65 x 6.0 CA	5.62	3300	825	367	206	132	91.7	67.4	51.6	40.7	33.0	27.3	22.9	19.5	16.8	12.9
5.0 CA	4.52	2850	712	316	178	114	79.1	58.1	44.5	35.2	28.5	23.5	19.8	16.9	14.5	11.1
4.0 CA	3.69	2360	590	262	147	94.4	65.5	48.1	36.9	29.1	23.6	19.5	16.4	14.0	12.0	9.22
50 x 50 x 6.0 CA	4.21	1370	343	152	85.6	54.8	38.1	28.0	21.4	16.9	13.7	11.3	9.52	8.11	6.99	5.35
5.0 CA	3.42	1230	307	136	76.7	49.1	34.1	25.0	19.2	15.2	12.3	10.1	8.52	7.26	6.26	4.79
4.0 CA	2.79	1020	256	114	64.0	40.9	28.4	20.9	16.0	12.6	10.2	8.46	7.11	6.06	5.22	4.00
2.5 CA	1.81	698	174	77.5	43.6	27.9	19.4	14.2	10.9	8.61	6.98	5.77	4.85	4.13	3.56	2.73
45 x 45 x 4.0 CA	2.50	729	182	81.0	45.6	29.2	20.2	14.9	11.4	9.00	7.29	6.02	5.06	4.31	3.72	2.85
2.5 CA	1.62	502	125	55.7	31.3	20.1	13.9	10.2	7.84	6.19	5.02	4.14	3.48	2.97	2.56	1.96
40 x 40 x 4.0 CA	2.20	497	124	55.2	31.1	19.9	13.8	10.1	7.76	6.14	4.97	4.11	3.45	2.94	2.54	1.94
2.5 CA	1.43	346	86.5	38.4	21.6	13.8	9.61	7.06	5.41	4.27	3.46	2.86	2.40	2.05	1.77	1.35
30 x 30 x 2.5 CA	1.06	138	34.6	15.4	8.64	5.53	3.84	2.82	2.16	1.71	1.38	1.14	0.960	0.818	0.705	0.540

Notes: 1. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

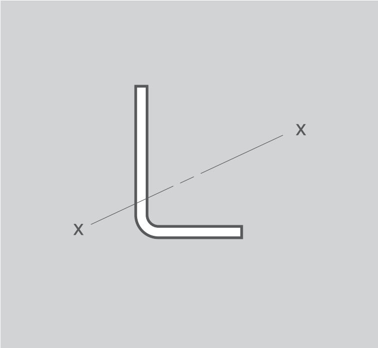


Table 13.2–1

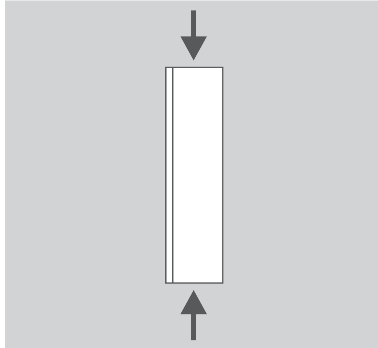
Limit state design

Elastic buckling load

Buckling about x-axis

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Elastic buckling load N_{ex} (kN) Effective length, l_{ex} (m)														
mm	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	4.5	5.0	6.0
150 x	100 x	8.0 CA	14.9	165000	41300	18400	10300	6610	4590	3370	2580	1650	1150	843	645	510	413	287
		6.0 CA	11.3	127000	31700	14100	7930	5080	3520	2590	1980	1270	881	647	496	392	317	220
125 x	75 x	8.0 CA	11.7	86400	21600	9600	5400	3460	2400	1760	1350	864	600	441	337	267	216	150
		6.0 CA	8.92	66700	16700	7410	4170	2670	1850	1360	1040	667	463	340	261	206	167	116
100 x	75 x	8.0 CA	10.2	51900	13000	5760	3240	2070	1440	1060	810	519	360	265	203	160	130	90.0
		6.0 CA	7.74	40200	10100	4470	2520	1610	1120	821	629	402	280	205	157	124	101	69.9
75 x	50 x	6.0 CA	5.38	14700	3670	1630	917	587	407	299	229	147	102	74.8	57.3	45.3	36.7	25.5
		5.0 CA	4.34	11900	2980	1330	746	477	332	244	186	119	82.9	60.9	46.6	36.8	29.8	20.7
		4.0 CA	3.54	9860	2460	1100	616	394	274	201	154	98.6	68.5	50.3	38.5	30.4	24.6	17.1

Notes: 1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

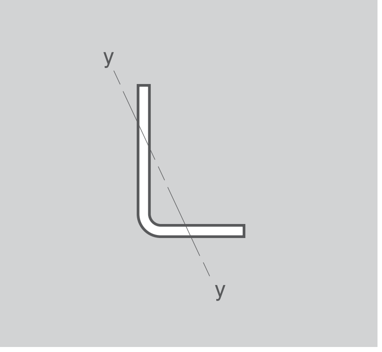


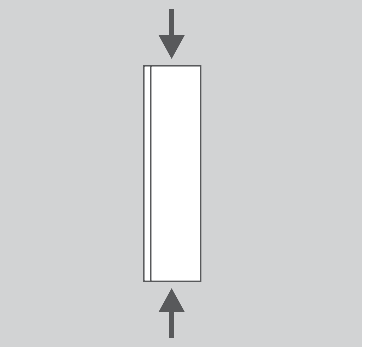
Table 13.2–2

Limit state design
Elastic buckling load

Buckling about y-axis

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Elastic buckling load N_{ey} (kN) Effective length, l_{ey} (m)														
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	4.0
150 x	100 x	8.0 CA	14.9	27700	6930	3080	1730	1110	770	566	433	342	277	229	192	164	141	108
		6.0 CA	11.3	21400	5360	2380	1340	857	595	437	335	265	214	177	149	127	109	83.7
125 x	75 x	8.0 CA	11.7	12000	3010	1340	752	481	334	245	188	149	120	99.4	83.5	71.2	61.4	47.0
		6.0 CA	8.92	9380	2340	1040	586	375	260	191	147	116	93.8	77.5	65.1	55.5	47.8	36.6
100 x	75 x	8.0 CA	10.2	9860	2460	1100	616	394	274	201	154	122	98.6	81.5	68.4	58.3	50.3	38.5
		6.0 CA	7.74	7700	1930	856	481	308	214	157	120	95.1	77.0	63.7	53.5	45.6	39.3	30.1
75 x	50 x	6.0 CA	5.38	2310	577	257	144	92.4	64.1	47.1	36.1	28.5	23.1	19.1	16.0	13.7	11.8	9.02
		5.0 CA	4.34	1990	498	222	125	79.7	55.4	40.7	31.2	24.6	19.9	16.5	13.8	11.8	10.2	7.79
		4.0 CA	3.54	1660	414	184	103	66.2	46.0	33.8	25.9	20.4	16.6	13.7	11.5	9.80	8.45	6.47

Notes: 1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

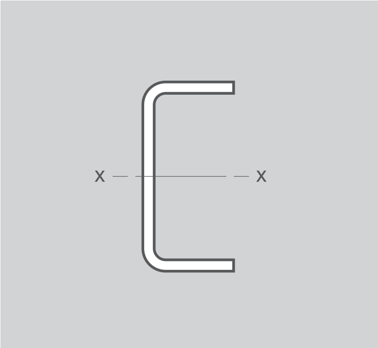


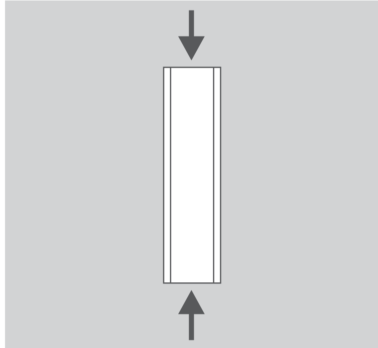
Table 13.3–1

Limit state design
Elastic buckling load

Buckling about x-axis

Grade C450LO / C400LO

Profile channels



Designation d × b_f × Nominal thickness (mm)	Mass per metre (kg/m)	Elastic buckling load N_{ex} (kN) — Effective length, l_{ex} (m): 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
300 x 90 x 8.0 CC	28.5	87200	55800	38700	28500	21800	13900	9680	7120	5450	3490	2420	1780	1360	1080	872
6.0 CC	21.6	67200	43000	29900	21900	16800	10700	7460	5480	4200	2690	1870	1370	1050	829	672
250 x 90 x 6.0 CC	19.2	43300	27700	19300	14100	10800	6930	4810	3540	2710	1730	1200	884	677	535	433
230 x 75 x 6.0 CC	16.9	31100	19900	13800	10100	7760	4970	3450	2540	1940	1240	863	634	485	383	311
200 x 75 x 6.0 CC	15.5	22200	14200	9860	7240	5550	3550	2460	1810	1390	887	616	453	347	274	222
5.0 CC	12.4	18100	11600	8060	5920	4530	2900	2010	1480	1130	725	504	370	283	224	181
180 x 75 x 5.0 CC	11.6	14100	9040	6280	4610	3530	2260	1570	1150	883	565	393	288	221	174	141
150 x 75 x 5.0 CC	10.5	9920	5900	4100	3010	2300	1480	1020	753	576	369	256	188	144	114	92.2
125 x 65 x 4.0 CC	7.23	4450	2850	1980	1450	1110	712	494	363	278	178	124	90.8	69.5	54.9	44.5
100 x 50 x 4.0 CC	5.59	2140	1370	950	698	534	342	237	174	134	85.5	59.4	43.6	33.4	26.4	21.4
75 x 40 x 4.0 CC	4.25	901	577	401	294	225	144	100	73.6	56.3	36.0	25.0	18.4	14.1	11.1	9.01

Notes: 1. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

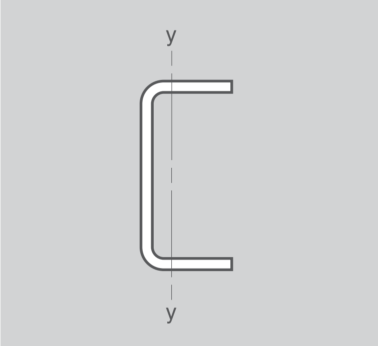
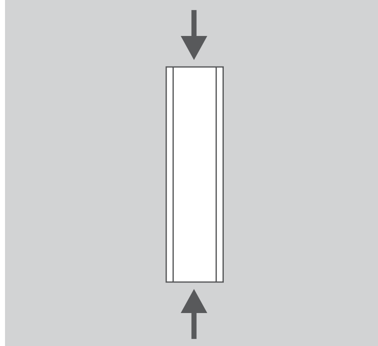


Table 13.3–2

Limit state design
Elastic buckling load
Buckling about y-axis

Grade C450L0 / C400L0

Profile channels



Designation d × b_f × Nominal thickness (mm mm mm)	Mass per metre (kg/m)	Elastic buckling load N_{ey} (kN) — Effective length, l_{ey} (m) 0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0
300 x 90 x 8.0 CC	28.5	19200	8550	4810	3080	2140	1570	1200	770	535	393	301	192	134	98.2	75.2
6.0 CC	21.6	14900	6620	3730	2380	1660	1220	931	596	414	304	233	149	103	76.0	58.2
250 x 90 x 6.0 CC	19.2	14200	6300	3540	2270	1570	1160	886	567	394	289	221	142	98.4	72.3	55.4
230 x 75 x 6.0 CC	16.9	8250	3670	2060	1320	917	674	516	330	229	168	129	82.5	57.3	42.1	32.2
200 x 75 x 6.0 CC	15.5	7930	3520	1980	1270	881	647	495	317	220	162	124	79.3	55.0	40.4	31.0
5.0 CC	12.4	6410	2850	1600	1030	713	523	401	257	178	131	100	64.1	44.	32.7	25.0
180 x 75 x 5.0 CC	11.6	6220	2760	1550	994	691	507	388	249	173	127	97.1	62.2	43.2	31.7	24.3
150 x 75 x 5.0 CC	10.5	5870	2610	1470	939	652	479	367	235	163	120	91.7	58.7	40.8	29.9	22.9
125 x 65 x 4.0 CC	7.23	3060	1360	766	490	340	250	192	123	85.1	62.5	47.9	30.6	21.3	15.6	12.0
100 x 50 x 4.0 CC	5.59	1370	609	343	219	152	112	85.6	54.8	38.1	28.0	21.4	13.7	9.52	6.99	5.35
75 x 40 x 4.0 CC	4.25	663	295	166	106	73.7	54.1	41.4	26.5	18.4	13.5	10.4	6.63	4.60	3.38	2.59

Notes: 1. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
2. Elastic buckling loads are calculated in accordance with AS/NZS 4600.

Simply supported beams

14

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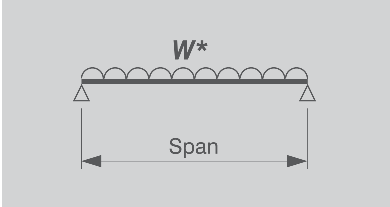
Equal angle beams with full lateral restraint

Unequal angle beams with full lateral restraint

Channel beams with full lateral restraint

14.1 Scope

The tables in this section apply to **single span simply supported beams** with **full lateral restraint** and with a **uniformly distributed load**. Separate tables are provided for the strength limit state and the serviceability limit state (deflection limit = span / 250). Tables are provided for the following cases:



- Angles bending about the n- and p-axes with:
  - long leg down
  - long leg up
  - short leg down
  - short leg up
- Channels bending about the x-axis

14.2 Design assumptions

14.2.1 Full lateral restraint

The beam span tables in this section assume that the beam has full lateral restraint. Full lateral restraint means that the beam is restrained continuously or at such close spacing that flexural-torsional buckling of the beam will not occur, and the design section moment capacity may be used to calculate the maximum design load.

Full lateral restraint is automatically provided for channels when the **compression flange** is firmly connected to floor decking, roof sheeting, floor joists or roof trusses or rafters, provided the connections are spaced at sufficiently close centres. An estimate of this spacing may be obtained from Section 7. Beams for which the design member moment capacity is equal to the design section moment capacity may be assumed to have full lateral restraint.

14.2.2 Loading through the shear centre

The tables assume loads and reactions are applied through the shear centre of the beam. In practice this does not always occur with angles and channels, but if the beam has full lateral restraint as assumed in these tables, twisting due to the load being eccentric to the shear centre may be prevented. In such cases these tables may be used, but caution should be taken to ensure that the lateral restraints are capable of preventing twisting of the beam.

14.3 Maximum design load

14.3.1 General

The strength limit state design load (W^*_L) and the serviceability limit state design load (W^*_S) are determined from the load combinations given in AS/NZS 1170 Structural Design Actions[6]. These design loads must not exceed the strength limit state **maximum design load** ($W^*_{L\,max}$) and the serviceability limit state **maximum design load** ($W^*_{S\,max}$), which are provided in the tables.

For strength: W^*_L (calculated) $\leq$ $W^*_{L\,max}$ (tabulated)

For serviceability: W^*_S (calculated) $\leq$ $W^*_{S\,max}$ (tabulated)

Beam self-weight: For all tables, the self-weight of the beam has not been deducted. The designer must include the self-weight of the beam as part of the dead load when calculating the design load W^*_L or W^*_S.

14.3.2 Strength limit state

The strength limit state maximum design load ($W^*_{L\,max}$) is the **lesser** of:

> The maximum design load (W^*_{L1max}) based on the design section moment capacity ($\phi_b M_s$) and the combined moment and shear capacity of the beam, and

> The maximum design load (W^*_{L2max}) based on the design section shear capacity ($\phi_v V_v$) of the beam.

$$W^*_{L\,max} = \min.\ [W^*_{L1max}\ ;\ W^*_{L2max}\ ]$$

Values of W^*_{L1max} and W^*_{L2max} are given in the strength limit state design tables.

14.3.3 Serviceability limit state

The serviceability limit state maximum design load ($W^*_{S\,max}$) given in the tables is the load that will cause an elastic deflection of span / 250 in the beam. In the tables provided, the maximum compressive stress under service load used to calculate the maximum design load ($W^*_{S\,max}$) is limited to the yield stress (f_y).

For beams with **deflection limits smaller than span / 250**, e.g. span / 500, these tables **can be used** conservatively to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For beams with **deflection limits larger than span / 250**, e.g. span / 125, these tables **can not be used** to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For such cases refer to Section 10 for deflection calculations of the beam.

14.4 Additional design checks

The following design action effects have not been taken into account in the tables, and should also be checked if appropriate:

> Web bearing (Section 8)

> Combined bending and bearing (Section 13)

> Shear lag effects - short spans (Appendix A4)

14.5 Other load configurations

14.5.1 Equivalent uniformly distributed loads for strength limit state

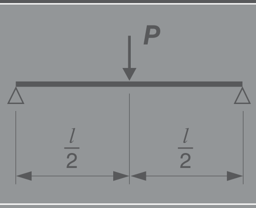
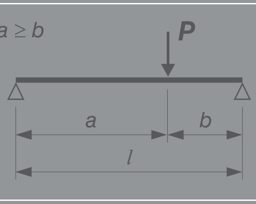
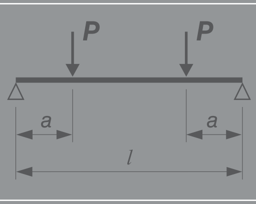
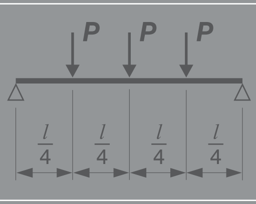
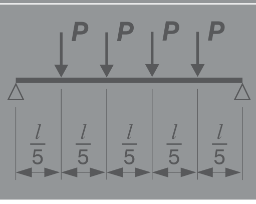
The tables in this section may also be used for single span simply supported beams with other load configurations by converting the loads to equivalent uniformly distributed loads, provided the beams have full lateral restraint. Figure 14.5(1) provides equivalent uniformly distributed loads (W^*_{EM}) for the strength limit state for several point load configurations for single span simply supported beams.

To use the tables in this section, the following design checks are required for the bending and shear strength limit states:

$$W^*_{L1} = W^*_{EM} \leq W^*_{L1max}$$

$$W^*_{L2} = W^*_{EV} \leq W^*_{L2max}$$

Figure 14.5(1) Equivalent uniformly distributed loads

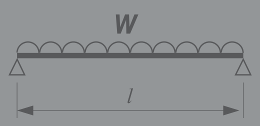
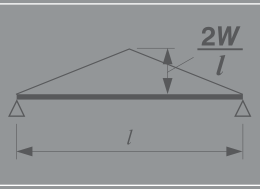
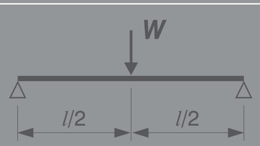
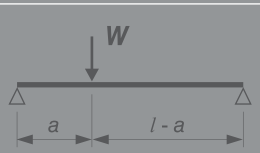
Loading	Equivalent strength maximum design load	
	Moment W^*_{EM}	Shear W^*_{EV}
	2P	P
For $a \geq b$ 	$\frac{8abP}{l^2}$	$\frac{2aP}{l}$
	$\frac{8aP}{l}$	$2P$
	$4P$	$3P$
	$\frac{24P}{5}$	$4P$

14.5.2 Beam deflection calculations

The deflection calculations of beams subject to load configurations not covered in this manual can be performed using standard deflection formulae. Some of the frequently used deflection formulae are given in Figure 14.5(2). A more comprehensive set of beam deflection formulae is published by the ASI[9].

The second moment of area (I) to be used in these deflection calculations can be determined using the method given in Section 10.3.

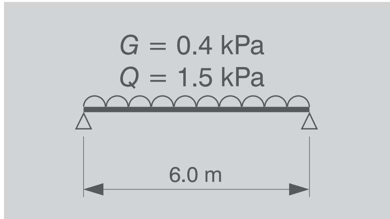
Figure 14.5(2) Deflection formulae

Simply supported beams	
	$\Delta = \frac{5}{384} \frac{W l^3}{EI}$
	$\Delta = \frac{1}{60} \frac{W l^3}{EI}$
	$\Delta = \frac{1}{48} \frac{W l^3}{EI}$
	$\Delta = \frac{W^3}{48EI} \left[\frac{3a}{l} - 4\left(\frac{a}{l}\right)^3 \right]$
	$\Delta = \frac{k}{192(n-1)} \frac{W l^3}{EI}$
n odd;	$k = \left(n - \frac{1}{n}\right)\left[3 - \frac{1}{2}\left(1 - \frac{1}{n^2}\right)\right]$
n even;	$k = n \left[3 - \frac{1}{2}\left(1 + \frac{4}{n^2}\right)\right]$

Note: Δ is the elastic deflection

14.6 Example

Design a DuraGalUltra channel floor joist spaced at 600 mm centres and a single span of 6.0 m to support a timber floor in a domestic house where the floor loads are:



Dead load G = 0.4 kPa
Live load Q = 1.5 kPa

The desired deflection limit for serviceability loads is span / 250.

Solution:

Design loads and load combinations:

Strength: $1.2G + 1.5Q = 1.2 \times 0.4 + 1.5 \times 1.5$
$= 2.73$ kPa

Design load $W^*_L = 2.73 \times 6.0 \times 0.6$
$= 9.83$ kN

Serviceability: $G + 0.7Q = 0.4 + 0.7 \times 1.5$
$= 1.45$ kPa

Design load $W^*_S = 1.45 \times 6.0 \times 0.6$
$= 5.22$ kN

Select a channel size:

Strength: (Table 14.3–1)

Select 100 x 50 x 4.0 CC DuraGalUltra

$W^*_{L1max} = 10.9$ kN $> W^*_L = 9.83$ kN

$W^*_{L2max} = 166$ kN $> W^*_L = 9.83$ kN

Serviceability: (Table 14.3–2)

Check 100 x 50 x 4.0 CC DuraGalUltra

$W^*_{Smax} = 1.85$ kN $< W^*_S = 5.22$ kN

Select 150 x 75 x 5.0 CC DuraGalUltra

$W^*_{Smax} = 7.97$ kN $> W^*_S = 5.22$ kN

Strength: (Table 14.3–1)

Check 150 x 75 x 5.0 CC DuraGalUltra

$W^*_{L1max} = 28.6$ kN $> W^*_L = 9.83$ kN

$W^*_{L2max} = 323$ kN $> W^*_L = 9.83$ kN

The 150 x 75 x 5.0 CC DuraGalUltra is satisfactory for these strength and serviceability limit states.

Additional checks may be required as listed in Section 14.4 and to include the self-weight of the beam.

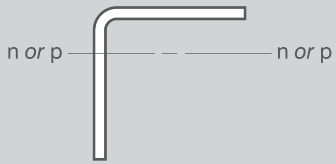


Table 14.1–1(A)

Strength limit state

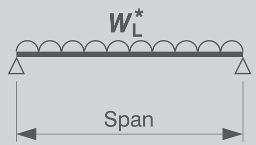
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
simply supported



Designation Leg size b_1 (mm)	Designation Leg size b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	W^*_{L1max} (kN) Span, l (m) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	150	8.0 CA	18.0	270	135	89.9	67.4	53.9	44.9	38.5	33.7	30.0	27.0	24.5	22.5	20.7	19.3	16.8	494
		6.0 CA	13.6	221	111	73.7	55.3	44.2	36.9	31.6	27.7	24.6	22.1	20.1	18.4	17.0	15.8	13.8	423
		5.0 CA	10.8	168	83.9	55.9	41.9	33.5	28.0	24.0	21.0	18.6	16.8	15.2	14.0	12.9	12.0	10.5	344
125	125	8.0 CA	14.9	187	93.3	62.2	46.6	37.3	31.1	26.6	23.3	20.7	18.7	17.0	15.5	14.3	13.3	11.7	402
		5.0 CA	8.95	119	59.6	39.8	29.8	23.9	19.9	17.0	14.9	13.3	11.9	10.8	9.94	9.18	8.52	7.46	283
		4.0 CA	7.27	93.9	46.9	31.3	23.5	18.8	15.6	13.4	11.7	10.4	9.39	8.53	7.82	7.22	6.71	5.87	231
100	100	8.0 CA	11.7	117	58.7	39.1	29.3	23.5	19.6	16.8	14.7	13.0	11.7	10.7	9.78	9.02	8.38	7.33	310
		6.0 CA	8.92	101	50.5	33.6	25.2	20.2	16.8	14.4	12.6	11.2	10.1	9.18	8.41	7.76	7.21	6.31	267
90	90	8.0 CA	10.5	94.1	47.0	31.4	23.5	18.8	15.7	13.4	11.8	10.5	9.41	8.55	7.84	7.24	6.72	5.88	273
		5.0 CA	6.37	63.7	31.8	21.2	15.9	12.7	10.6	9.1	7.96	7.08	6.37	5.79	5.31	4.90	4.55	3.98	198

Notes:
1. Maximum design load $W^*_{L\,max}$ is the LESSER of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

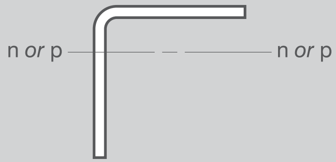


Table 14.1–1(B)

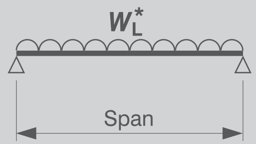
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
simply supported



Designation			Mass per metre	Maximum design loads															
Leg size		Nominal		W^*_{L1max} (kN)															W^*_{L2max} (kN)
b_1	b_2	thickness		Span, l (m)															
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
75	75	8.0 CA	8.59	128	64.1	42.7	32.0	25.6	21.4	18.3	16.0	14.2	12.8	10.7	9.16	8.01	7.12	6.41	217
		6.0 CA	6.56	111	55.5	37.0	27.8	22.2	18.5	15.9	13.9	12.3	11.1	9.25	7.93	6.94	6.17	5.55	190
		5.0 CA	5.26	89.0	44.5	29.7	22.2	17.8	14.8	12.7	11.1	9.88	8.9	7.41	6.35	5.56	4.94	4.45	162
		4.0 CA	4.29	71.4	35.7	23.8	17.9	14.3	11.9	10.2	8.93	7.93	7.14	5.95	5.10	4.46	3.97	3.57	132
65	65	6.0 CA	5.62	82.3	41.1	27.4	20.6	16.5	13.7	11.8	10.3	9.14	8.23	6.85	5.88	5.14	4.57	4.11	159
		5.0 CA	4.52	66.1	33.1	22.0	16.5	13.2	11.0	9.45	8.27	7.35	6.61	5.51	4.72	4.13	3.67	3.31	137
		4.0 CA	3.69	54.0	27.0	18.0	13.5	10.8	9.00	7.71	6.75	6.00	5.40	4.50	3.86	3.37	3.00	2.70	113
50	50	6.0 CA	4.21	47.1	23.6	15.7	11.8	9.43	7.86	6.73	5.89	5.24	4.71	3.93	3.37	2.95	2.62	2.36	112
		5.0 CA	3.42	38.2	19.1	12.7	9.56	7.65	6.37	5.46	4.78	4.25	3.82	3.19	2.73	2.39	2.12	1.91	101
		4.0 CA	2.79	31.5	15.7	10.5	7.87	6.29	5.24	4.50	3.93	3.5	3.15	2.62	2.25	1.97	1.75	1.57	83.1
		2.5 CA	1.81	15.7	7.87	5.25	3.94	3.15	2.62	2.25	1.97	1.75	1.57	1.31	1.12	0.984	0.875	0.787	43.6
45	45	4.0 CA	2.50	25.3	12.6	8.42	6.31	5.05	4.21	3.61	3.16	2.81	2.53	2.10	1.80	1.58	1.40	1.26	73.3
		2.5 CA	1.62	12.8	6.41	4.27	3.20	2.56	2.14	1.83	1.60	1.42	1.28	1.07	0.915	0.801	0.712	0.641	38.8
40	40	4.0 CA	2.20	19.7	9.86	6.57	4.93	3.94	3.29	2.82	2.47	2.19	1.97	1.64	1.41	1.23	1.10	0.986	63.4
		2.5 CA	1.43	10.1	5.03	3.36	2.52	2.01	1.68	1.44	1.26	1.12	1.01	0.839	0.719	0.629	0.559	0.503	34.0
30	30	2.5 CA	1.06	5.54	2.77	1.85	1.39	1.11	0.924	0.792	0.693	0.616	0.554	0.462	0.396	0.346	0.308	0.277	24.3

Notes:
1. Maximum design load $W^*_{L\,max}$ is the LESSER of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

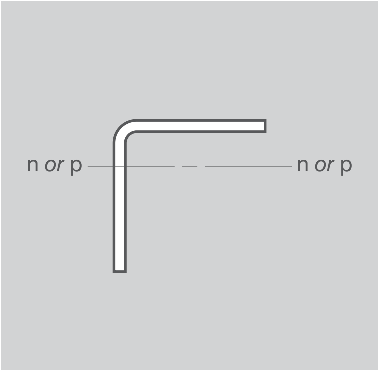


Table 14.1–2(A)

Serviceability limit state

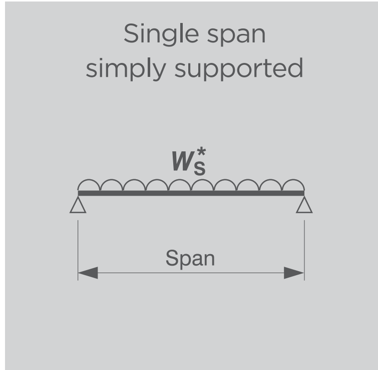
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)		Mass per metre (kg/m)	Maximum design loads $W^*_{S\max}$ (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	150	8.0	CA	18.0	1120	284	133	77.2	50.4	35.1	25.8	19.7	15.6	12.6	10.4	8.76	7.47	6.44	4.93
		6.0	CA	13.6	786	200	94.3	55.2	36.3	25.8	19.3	14.9	11.9	9.66	7.99	6.71	5.72	4.93	3.77
		5.0	CA	10.8	577	146	69.0	40.6	26.8	19.1	14.4	11.2	8.97	7.36	6.15	5.22	4.48	3.89	3.01
125	125	8.0	CA	14.9	670	173	79.6	44.8	28.7	19.9	14.6	11.2	8.85	7.17	5.92	4.98	4.24	3.66	2.80
		5.0	CA	8.95	349	91.2	43.1	25.2	16.6	11.8	8.80	6.83	5.45	4.41	3.65	3.06	2.61	2.25	1.72
		4.0	CA	7.27	268	69.7	33.0	19.4	12.8	9.13	6.84	5.33	4.27	3.50	2.92	2.48	2.12	1.84	1.41
100	100	8.0	CA	11.7	351	89.2	39.7	22.3	14.3	9.91	7.28	5.58	4.41	3.57	2.95	2.48	2.11	1.82	1.39
		6.0	CA	8.92	252	67.7	30.7	17.3	11.0	7.67	5.64	4.32	3.41	2.76	2.28	1.92	1.63	1.41	1.08
90	90	8.0	CA	10.5	256	64.0	28.5	16.0	10.2	7.12	5.23	4.00	3.16	2.56	2.12	1.78	1.52	1.31	1.00
		5.0	CA	6.37	140	38.3	17.7	10.0	6.43	4.46	3.28	2.51	1.98	1.61	1.33	1.12	0.951	0.820	0.627

Notes: 1. $W^*_{S\max}$ = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

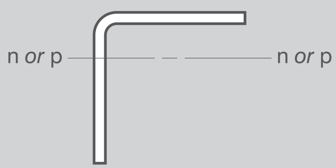


Table 14.1–2(B)

Serviceability limit state
Maximum design loads

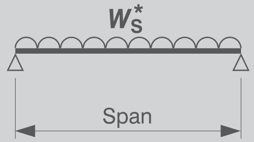
For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
simply supported



Designation Leg size b_1 × b_2, Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN), Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	575	144	63.9	35.9	23.0	16.0	11.7	8.98	7.10	5.75	3.99	2.93	2.24	1.77	1.44
6.0 CA	6.56	440	112	49.9	28.1	18.0	12.5	9.17	7.02	5.55	4.49	3.12	2.29	1.76	1.39	1.12
5.0 CA	5.26	334	85.9	39.9	22.8	14.6	10.1	7.46	5.71	4.51	3.65	2.54	1.86	1.43	1.13	0.913
4.0 CA	4.29	261	66.9	31.3	18.2	11.9	8.36	6.14	4.70	3.72	3.01	2.09	1.54	1.18	0.929	0.752
65 x 65 x 6.0 CA	5.62	286	71.5	31.8	17.9	11.4	7.94	5.84	4.47	3.53	2.86	1.99	1.46	1.12	0.883	0.715
5.0 CA	4.52	222	57.8	26.0	14.6	9.36	6.50	4.77	3.65	2.89	2.34	1.62	1.19	0.914	0.722	0.585
4.0 CA	3.69	174	45.6	21.1	12.1	7.73	5.37	3.94	3.02	2.39	1.93	1.34	0.986	0.755	0.596	0.483
50 x 50 x 6.0 CA	4.21	124	30.9	13.7	7.73	4.94	3.43	2.52	1.93	1.53	1.24	0.858	0.631	0.483	0.381	0.309
5.0 CA	3.42	103	25.6	11.4	6.41	4.10	2.85	2.09	1.60	1.27	1.03	0.712	0.523	0.401	0.317	0.256
4.0 CA	2.79	82.1	21.3	9.48	5.33	3.41	2.37	1.74	1.33	1.05	0.853	0.592	0.435	0.333	0.263	0.213
2.5 CA	1.81	49.8	13.1	6.09	3.52	2.26	1.57	1.15	0.884	0.699	0.566	0.393	0.289	0.221	0.175	0.141
45 x 45 x 4.0 CA	2.50	60.8	15.3	6.81	3.83	2.45	1.70	1.25	0.957	0.756	0.613	0.425	0.313	0.239	0.189	0.153
2.5 CA	1.62	37.0	9.82	4.54	2.55	1.63	1.14	0.834	0.639	0.505	0.409	0.284	0.209	0.160	0.126	0.102
40 x 40 x 4.0 CA	2.20	42.2	10.6	4.69	2.64	1.69	1.17	0.862	0.660	0.521	0.422	0.293	0.215	0.165	0.130	0.106
2.5 CA	1.43	26.5	7.07	3.15	1.77	1.13	0.788	0.579	0.443	0.350	0.284	0.197	0.145	0.111	0.0876	0.0709
30 x 30 x 2.5 CA	1.06	11.6	2.89	1.28	0.722	0.462	0.321	0.236	0.181	0.143	0.116	0.0803	0.0590	0.0451	0.0357	0.0289

Notes:
1. W^*_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

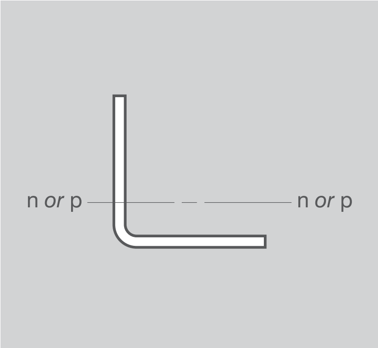


Table 14.1–3(A)

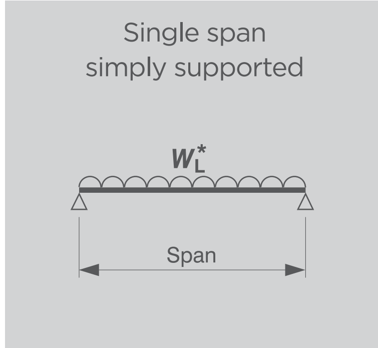
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads: W^*_{L1max} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	150	8.0 CA	18.0	226	113	75.5	56.6	45.3	37.7	32.3	28.3	25.2	22.6	20.6	18.9	17.4	16.2	14.2	494
		6.0 CA	13.6	127	63.4	42.3	31.7	25.4	21.1	18.1	15.9	14.1	12.7	11.5	10.6	9.76	9.06	7.93	423
		5.0 CA	10.8	69.6	34.8	23.2	17.4	13.9	11.6	9.94	8.70	7.73	6.96	6.33	5.80	5.35	4.97	4.35	344
125	125	8.0 CA	14.9	186	93.1	62.1	46.6	37.3	31.0	26.6	23.3	20.7	18.6	16.9	15.5	14.3	13.3	11.6	402
		5.0 CA	8.95	62.8	31.4	20.9	15.7	12.6	10.5	8.97	7.85	6.98	6.28	5.71	5.23	4.83	4.49	3.93	283
		4.0 CA	7.27	37.6	18.8	12.5	9.40	7.52	6.27	5.37	4.70	4.18	3.76	3.42	3.13	2.89	2.69	2.35	231
100	100	8.0 CA	11.7	117	58.7	39.1	29.3	23.5	19.6	16.8	14.7	13.0	11.7	10.7	9.78	9.02	8.38	7.33	310
		6.0 CA	8.92	89.7	44.9	29.9	22.4	17.9	15.0	12.8	11.2	9.97	8.97	8.16	7.48	6.90	6.41	5.61	267
90	90	8.0 CA	10.5	94.1	47.0	31.4	23.5	18.8	15.7	13.4	11.8	10.5	9.41	8.55	7.84	7.24	6.72	5.88	273
		5.0 CA	6.37	49.3	24.7	16.4	12.3	9.87	8.22	7.05	6.17	5.48	4.93	4.49	4.11	3.80	3.52	3.08	198

Notes:
1. Maximum design load $W^*_{L max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

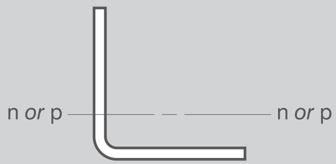


Table 14.1–3(B)

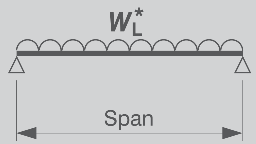
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
simply supported



Designation Leg size b_1 x b_2 x Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
75 x 75 x 8.0 CA	8.59	128	64.1	42.7	32.0	25.6	21.4	18.3	16.0	14.2	12.8	10.7	9.16	8.01	7.12	6.41	217
6.0 CA	6.56	111	55.5	37.0	27.8	22.2	18.5	15.9	13.9	12.3	11.1	9.25	7.93	6.94	6.17	5.55	190
5.0 CA	5.26	82.6	41.3	27.5	20.7	16.5	13.8	11.8	10.3	9.18	8.26	6.89	5.90	5.16	4.59	4.13	162
4.0 CA	4.29	53.6	26.8	17.9	13.4	10.7	8.93	7.65	6.70	5.95	5.36	4.47	3.83	3.35	2.98	2.68	132
65 x 65 x 6.0 CA	5.62	82.3	41.1	27.4	20.6	16.5	13.7	11.8	10.3	9.14	8.23	6.85	5.88	5.14	4.57	4.11	159
5.0 CA	4.52	66.1	33.1	22.0	16.5	13.2	11.0	9.45	8.27	7.35	6.61	5.51	4.72	4.13	3.67	3.31	137
4.0 CA	3.69	46.9	23.4	15.6	11.7	9.38	7.82	6.70	5.86	5.21	4.69	3.91	3.35	2.93	2.61	2.34	113
50 x 50 x 6.0 CA	4.21	47.1	23.6	15.7	11.8	9.43	7.86	6.73	5.89	5.24	4.71	3.93	3.37	2.95	2.62	2.36	112
5.0 CA	3.42	38.2	19.1	12.7	9.56	7.65	6.37	5.46	4.78	4.25	3.82	3.19	2.73	2.39	2.12	1.91	101
4.0 CA	2.79	31.5	15.7	10.5	7.87	6.29	5.24	4.50	3.93	3.50	3.15	2.62	2.25	1.97	1.75	1.57	83.1
2.5 CA	1.81	12.7	6.35	4.23	3.17	2.54	2.12	1.81	1.59	1.41	1.27	1.06	0.907	0.793	0.705	0.635	43.6
45 x 45 x 4.0 CA	2.50	25.3	12.6	8.42	6.31	5.05	4.21	3.61	3.16	2.81	2.53	2.10	1.80	1.58	1.40	1.26	73.3
2.5 CA	1.62	11.5	5.73	3.82	2.87	2.29	1.91	1.64	1.43	1.27	1.15	0.955	0.819	0.716	0.637	0.573	38.8
40 x 40 x 4.0 CA	2.20	19.7	9.86	6.57	4.93	3.94	3.29	2.82	2.47	2.19	1.97	1.64	1.41	1.23	1.10	0.986	63.4
2.5 CA	1.43	10.1	5.03	3.35	2.52	2.01	1.68	1.44	1.26	1.12	1.01	0.839	0.719	0.629	0.559	0.503	34.0
30 x 30 x 2.5 CA	1.06	5.54	2.77	1.85	1.39	1.11	0.924	0.792	0.693	0.616	0.554	0.462	0.396	0.346	0.308	0.277	24.3

Notes:
1. Maximum design load $W^*_{L\,max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

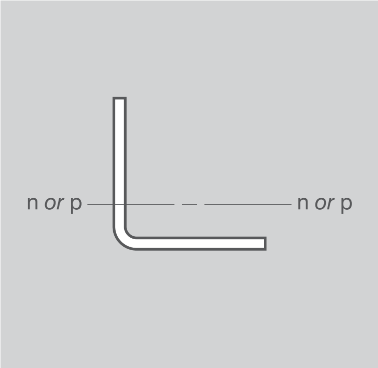


Table 14.1–4(A)

Serviceability limit state

Maximum design loads

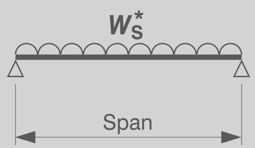
For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
simply supported



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W_{Smax} (kN), Span, l (m) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	x 150	x 8.0 CA	18.0	969	242	108	66.6	46.7	34.9	25.8	19.7	15.6	12.6	10.4	8.76	7.47	6.44	4.93
		6.0 CA	13.6	402	113	61.0	39.2	27.7	20.9	16.4	13.3	11.0	9.31	7.99	6.71	5.72	4.93	3.77
		5.0 CA	10.8	205	69.7	37.9	24.5	17.5	13.2	10.4	8.49	7.07	6.01	5.18	4.52	3.98	3.55	2.87
125	x 125	x 8.0 CA	14.9	715	179	79.5	44.8	28.7	19.9	14.6	11.2	8.85	7.17	5.92	4.98	4.24	3.66	2.80
		5.0 CA	8.95	159	52.7	28.4	18.3	12.9	9.75	7.66	6.21	5.15	4.35	3.65	3.06	2.61	2.25	1.72
		4.0 CA	7.27	116	34.8	18.8	12.2	8.66	6.55	5.16	4.20	3.50	2.97	2.55	2.23	1.96	1.74	1.41
100	x 100	x 8.0 CA	11.7	357	89.2	39.7	22.3	14.3	9.91	7.28	5.58	4.41	3.57	2.95	2.48	2.11	1.82	1.39
		6.0 CA	8.92	233	58.2	30.0	17.3	11.0	7.67	5.64	4.32	3.41	2.76	2.28	1.92	1.63	1.41	1.08
90	x 90	x 8.0 CA	10.5	256	64.0	28.5	16.0	10.2	7.12	5.23	4.00	3.16	2.56	2.12	1.78	1.52	1.31	1.00
		5.0 CA	6.37	108	30.7	16.2	10.00	6.43	4.46	3.28	2.51	1.98	1.61	1.33	1.12	0.951	0.820	0.627

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

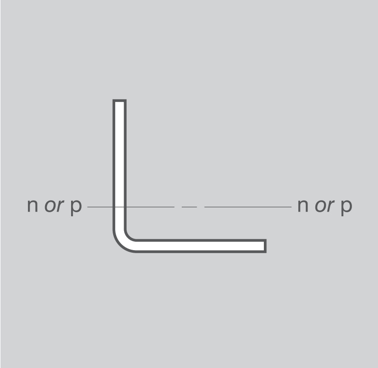


Table 14.1–4(B)

Serviceability limit state

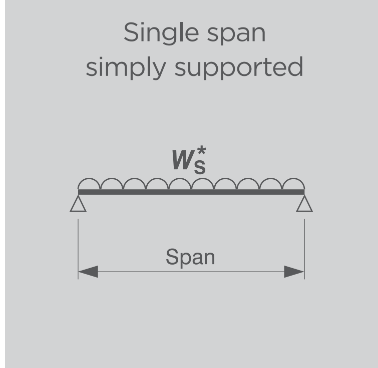
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1	b_2	Nominal thickness		Mass per metre	Maximum design loads W_{Smax} (kN), Span, l (m)														
mm	mm	mm		kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75	75	8.0	CA	8.59	575	144	63.9	35.9	23.0	16.0	11.7	8.98	7.10	5.75	3.99	2.93	2.24	1.77	1.44
		6.0	CA	6.56	449	112	49.9	28.1	18.0	12.5	9.17	7.02	5.55	4.49	3.12	2.29	1.76	1.39	1.12
		5.0	CA	5.26	328	82.1	36.5	22.1	14.6	10.1	7.46	5.71	4.51	3.65	2.54	1.86	1.43	1.13	0.913
		4.0	CA	4.29	193	48.3	23.8	15.2	10.7	7.98	6.14	4.70	3.72	3.01	2.09	1.54	1.18	0.929	0.752
65	65	6.0	CA	5.62	286	71.5	31.8	17.9	11.4	7.94	5.84	4.47	3.53	2.86	1.99	1.46	1.12	0.883	0.715
		5.0	CA	4.52	234	58.5	26.0	14.6	9.36	6.50	4.77	3.65	2.89	2.34	1.62	1.19	0.914	0.722	0.585
		4.0	CA	3.69	157	39.2	18.5	11.7	7.73	5.37	3.94	3.02	2.39	1.93	1.34	0.986	0.755	0.596	0.483
50	50	6.0	CA	4.21	124	30.9	13.7	7.73	4.94	3.43	2.52	1.93	1.53	1.24	0.858	0.631	0.483	0.381	0.309
		5.0	CA	3.42	103	25.6	11.4	6.41	4.10	2.85	2.09	1.60	1.27	1.03	0.712	0.523	0.401	0.317	0.256
		4.0	CA	2.79	85.3	21.3	9.48	5.33	3.41	2.37	1.74	1.33	1.05	0.853	0.592	0.435	0.333	0.263	0.213
		2.5	CA	1.81	40.7	10.2	5.08	3.23	2.26	1.57	1.15	0.884	0.699	0.566	0.393	0.289	0.221	0.175	0.141
45	45	4.0	CA	2.50	61.3	15.3	6.81	3.83	2.45	1.70	1.25	0.957	0.756	0.613	0.425	0.313	0.239	0.189	0.153
		2.5	CA	1.62	34.7	8.67	4.20	2.55	1.63	1.14	0.834	0.639	0.505	0.409	0.284	0.209	0.160	0.126	0.102
40	40	4.0	CA	2.20	42.2	10.6	4.69	2.64	1.69	1.17	0.862	0.660	0.521	0.422	0.293	0.215	0.165	0.130	0.106
		2.5	CA	1.43	28.3	7.09	3.15	1.77	1.13	0.788	0.579	0.443	0.350	0.284	0.197	0.145	0.111	0.0876	0.0709
30	30	2.5	CA	1.06	11.6	2.89	1.28	0.722	0.462	0.321	0.236	0.181	0.143	0.116	0.0803	0.0590	0.0451	0.0357	0.0289

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

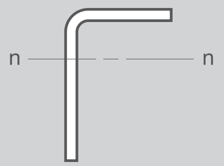


Table 14.2-1

Strength limit state

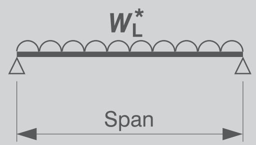
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation			Mass per metre	Maximum design loads															
Leg size		Nominal		W^*_{L1max} (kN)															W^*_{L2max} (kN)
b_1	b_2	thickness		Span, l (m)															
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
150	100	8.0 CA	14.9	509	255	170	127	102	84.9	72.7	63.6	56.6	50.9	42.4	36.4	31.8	28.3	25.5	494
		6.0 CA	11.3	431	216	144	108	86.3	71.9	61.6	53.9	47.9	43.1	35.9	30.8	27.0	24.0	21.6	423
125	75	8.0 CA	11.7	342	171	114	85.5	68.4	57.0	48.9	42.8	38.0	34.2	28.5	24.4	21.4	19.0	17.1	402
		6.0 CA	8.92	294	147	98.0	73.5	58.8	49.0	42.0	36.7	32.7	29.4	24.5	21.0	18.4	16.3	14.7	345
100	75	8.0 CA	10.2	224	112	74.6	55.9	44.7	37.3	32.0	28.0	24.9	22.4	18.6	16.0	14.0	12.4	11.2	310
		6.0 CA	7.74	193	96.4	64.3	48.2	38.6	32.1	27.5	24.1	21.4	19.3	16.1	13.8	12.0	10.7	9.64	267
75	50	6.0 CA	5.38	103	51.7	34.5	25.9	20.7	17.2	14.8	12.9	11.5	10.3	8.62	7.39	6.46	5.75	5.17	190
		5.0 CA	4.34	83.3	41.6	27.8	20.8	16.7	13.9	11.9	10.4	9.25	8.33	6.94	5.95	5.20	4.63	4.16	162
		4.0 CA	3.54	68.2	34.1	22.7	17.1	13.6	11.4	9.74	8.53	7.58	6.82	5.68	4.87	4.26	3.79	3.41	132

Notes:
1. Maximum design load $W^*_{L\,max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

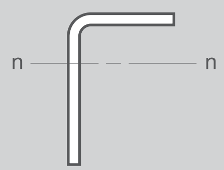


Table 14.2-2

Serviceability limit state

Maximum design loads

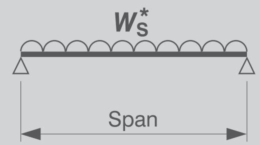
For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation Leg size b_1 mm	b_2 mm	Nominal thickness mm	Mass per metre kg/m	Maximum design loads W_{Smax} (kN) Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x	100 x	8.0 CA	14.9	4300	1080	478	270	175	122	89.5	68.5	54.2	43.9	30.5	22.4	17.1	13.5	11.0
		6.0 CA	11.3	3060	765	340	194	127	90.2	67.4	52.2	41.6	33.7	23.4	17.2	13.2	10.4	8.42
125 x	75 x	8.0 CA	11.7	2390	597	265	149	95.5	66.3	48.7	37.3	29.5	23.9	16.6	12.2	9.33	7.37	5.97
		6.0 CA	8.92	1800	450	200	115	73.7	51.2	37.6	28.8	22.8	18.4	12.8	9.40	7.20	5.69	4.61
100 x	75 x	8.0 CA	10.2	1290	322	143	80.5	51.5	35.8	26.3	20.1	15.9	12.9	8.95	6.57	5.03	3.98	3.22
		6.0 CA	7.74	976	244	111	62.4	40.0	27.8	20.4	15.6	12.3	9.99	6.94	5.10	3.90	3.08	2.50
75 x	50 x	6.0 CA	5.38	386	96.6	42.9	24.2	15.5	10.7	7.89	6.04	4.77	3.86	2.68	1.97	1.51	1.19	0.966
		5.0 CA	4.34	317	79.3	35.2	19.8	12.7	8.81	6.47	4.95	3.91	3.17	2.20	1.62	1.24	0.979	0.793
		4.0 CA	3.54	251	63.7	29.1	16.4	10.5	7.27	5.34	4.09	3.23	2.62	1.82	1.34	1.02	0.808	0.654

Notes:
1. W^*_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

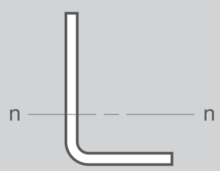


Table 14.2-3

Strength limit state

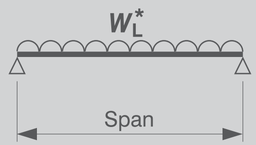
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation: Leg size b_1 (mm)	Designation: Leg size b_2 (mm)	Designation: Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads: W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	467	234	156	117	93.5	77.9	66.8	58.4	51.9	46.7	38.9	33.4	29.2	26.0	23.4	494
		6.0 CA	11.3	269	135	89.8	67.3	53.9	44.9	38.5	33.7	29.9	26.9	22.4	19.2	16.8	15.0	13.5	423
125	75	8.0 CA	11.7	342	171	114	85.5	68.4	57.0	48.9	42.8	38.0	34.2	28.5	24.4	21.4	19.0	17.1	402
		6.0 CA	8.92	233	117	77.8	58.4	46.7	38.9	33.3	29.2	25.9	23.3	19.5	16.7	14.6	13.0	11.7	345
100	75	8.0 CA	10.2	224	112	74.6	55.9	44.7	37.3	32.0	28.0	24.9	22.4	18.6	16.0	14.0	12.4	11.2	310
		6.0 CA	7.74	183	91.3	60.8	45.6	36.5	30.4	26.1	22.8	20.3	18.3	15.2	13.0	11.4	10.1	9.13	267
75	50	6.0 CA	5.38	103	51.7	34.5	25.9	20.7	17.2	14.8	12.9	11.5	10.3	8.62	7.39	6.46	5.75	5.17	190
		5.0 CA	4.34	83.3	41.6	27.8	20.8	16.7	13.9	11.9	10.4	9.25	8.33	6.94	5.95	5.20	4.63	4.16	162
		4.0 CA	3.54	55.9	27.9	18.6	14.0	11.2	9.31	7.98	6.98	6.21	5.59	4.66	3.99	3.49	3.10	2.79	132

Notes:
1. Maximum design load $W^*_{L\,max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

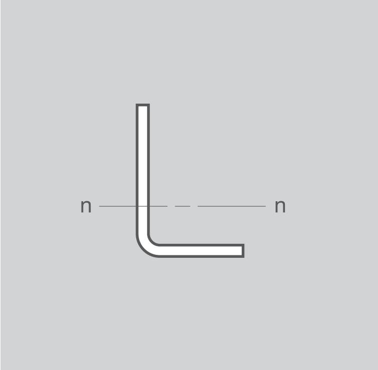


Table 14.2–4

Serviceability limit state
Maximum design loads

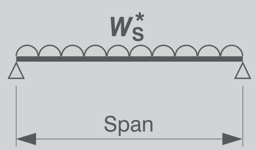
For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation Leg size b_1 b_2		Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN) Span, l (m)														
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x	100 x	8.0 CA	14.9	3880	969	431	242	155	108	79.8	64.5	53.4	43.9	30.5	22.4	17.1	13.5	11.0
		6.0 CA	11.3	2030	508	226	127	86.9	64.7	50.3	40.5	33.4	28.1	20.8	16.1	12.9	10.4	8.42
125 x	75 x	8.0 CA	11.7	2390	597	265	149	95.5	66.3	48.7	37.3	29.5	23.9	16.6	12.2	9.33	7.37	5.97
		6.0 CA	8.92	1440	361	160	90.1	60.3	44.6	34.6	27.7	22.7	18.4	12.8	9.40	7.20	5.69	4.61
100 x	75 x	8.0 CA	10.2	1290	322	143	80.5	51.5	35.8	26.3	20.1	15.9	12.9	8.95	6.57	5.03	3.98	3.22
		6.0 CA	7.74	938	235	104	58.7	39.2	27.8	20.4	15.6	12.3	9.99	6.94	5.10	3.90	3.08	2.50
75 x	50 x	6.0 CA	5.38	386	96.6	42.9	24.2	15.5	10.7	7.89	6.04	4.77	3.86	2.68	1.97	1.51	1.19	0.966
		5.0 CA	4.34	317	79.3	35.2	19.8	12.7	8.81	6.47	4.95	3.91	3.17	2.20	1.62	1.24	0.979	0.793
		4.0 CA	3.54	211	52.8	24.1	15.0	10.3	7.27	5.34	4.09	3.23	2.62	1.82	1.34	1.02	0.808	0.654

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

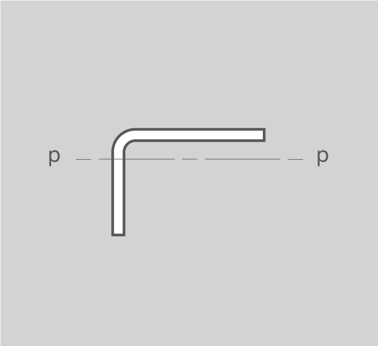


Table 14.2-5

Strength limit state

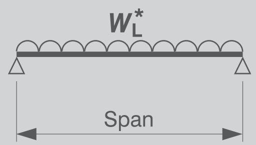
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	248	124	82.6	62.0	49.6	41.3	35.4	31.0	27.5	24.8	20.7	17.7	15.5	13.8	12.4	310
		6.0 CA	11.3	207	104	69.0	51.8	41.4	34.5	29.6	25.9	23.0	20.7	17.3	14.8	12.9	11.5	10.4	267
125	75	8.0 CA	11.7	138	68.8	45.9	34.4	27.5	22.9	19.7	17.2	15.3	13.8	11.5	9.83	8.60	7.64	6.88	217
		6.0 CA	8.92	118	59.0	39.3	29.5	23.6	19.7	16.9	14.8	13.1	11.8	9.83	8.43	7.38	6.56	5.90	190
100	75	8.0 CA	10.2	134	66.9	44.6	33.4	26.8	22.3	19.1	16.7	14.9	13.4	11.1	9.56	8.36	7.43	6.69	217
		6.0 CA	7.74	116	57.9	38.6	28.9	23.2	19.3	16.5	14.5	12.9	11.6	9.65	8.27	7.23	6.43	5.79	190
75	50	6.0 CA	5.38	50.2	25.1	16.7	12.5	10.0	8.36	7.17	6.27	5.57	5.02	4.18	3.58	3.13	2.79	2.51	112
		5.0 CA	4.34	40.4	20.2	13.5	10.1	8.09	6.74	5.78	5.05	4.49	4.04	3.37	2.89	2.53	2.25	2.02	101
		4.0 CA	3.54	33.0	16.5	11.0	8.25	6.60	5.50	4.72	4.13	3.67	3.30	2.75	2.36	2.06	1.83	1.65	83.1

Notes:
1. Maximum design load $W^*_{L\,max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on Ddesign shear capacity.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

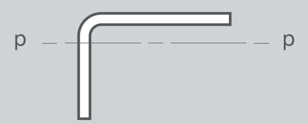


Table 14.2–6

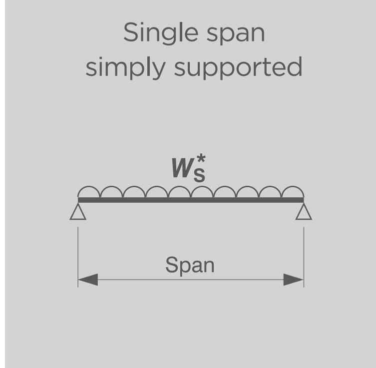
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 × b_2 (mm × mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN) — Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100	8.0 CA	14.9	1460	365	169	98.1	64.1	45.0	33.0	25.3	20.0	16.2	11.2	8.26	6.32	5.00	4.05
	6.0 CA	11.3	627	157	83.4	54.6	38.8	29.1	22.7	18.2	14.9	12.4	8.68	6.38	4.88	3.86	3.13
125 x 75	8.0 CA	11.7	637	164	75.0	42.2	27.0	18.7	13.8	10.5	8.33	6.75	4.69	3.44	2.64	2.08	1.69
	6.0 CA	8.92	460	120	55.9	32.3	21.0	14.6	10.7	8.22	6.49	5.26	3.65	2.68	2.05	1.62	1.31
100 x 75	8.0 CA	10.2	622	158	70.3	39.5	25.3	17.6	12.9	9.88	7.81	6.32	4.39	3.23	2.47	1.95	1.58
	6.0 CA	7.74	453	118	54.3	30.8	19.7	13.7	10.1	7.71	6.09	4.93	3.43	2.52	1.93	1.52	1.23
75 x 50	6.0 CA	5.38	140	35.5	15.8	8.87	5.67	3.94	2.89	2.22	1.75	1.42	0.985	0.724	0.554	0.438	0.355
	5.0 CA	4.34	109	29.0	12.9	7.28	4.66	3.24	2.38	1.82	1.44	1.16	0.809	0.594	0.455	0.360	0.291
	4.0 CA	3.54	85.3	23.2	10.7	6.04	3.87	2.69	1.97	1.51	1.19	0.967	0.671	0.493	0.378	0.298	0.242

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

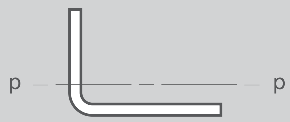


Table 14.2–7

Strength limit state

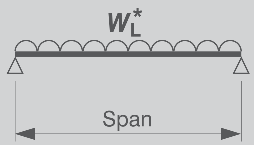
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation			Mass per metre	Maximum design loads															
Leg size		Nominal thickness		W^*_{L1max} (kN)															W^*_{L2max} (kN)
b_1	b_2			Span, l (m)															
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
150	100	8.0 CA	14.9	248	124	82.6	62.0	49.6	41.3	35.4	31.0	27.5	24.8	20.7	17.7	15.5	13.8	12.4	310
		6.0 CA	11.3	177	88.6	59.0	44.3	35.4	29.5	25.3	22.1	19.7	17.7	14.8	12.7	11.1	9.84	8.86	267
125	75	8.0 CA	11.7	138	68.8	45.9	34.4	27.5	22.9	19.7	17.2	15.3	13.8	11.5	9.83	8.60	7.64	6.88	217
		6.0 CA	8.92	119	59.5	39.6	29.7	23.8	19.8	17.0	14.9	13.2	11.9	9.91	8.50	7.43	6.61	5.95	190
100	75	8.0 CA	10.2	134	66.9	44.6	33.4	26.8	22.3	19.1	16.7	14.9	13.4	11.1	9.56	8.36	7.43	6.69	217
		6.0 CA	7.74	116	57.9	38.6	28.9	23.2	19.3	16.5	14.5	12.9	11.6	9.65	8.27	7.23	6.43	5.79	190
75	50	6.0 CA	5.38	50.2	25.1	16.7	12.5	10.0	8.36	7.17	6.27	5.57	5.02	4.18	3.58	3.13	2.79	2.51	112
		5.0 CA	4.34	40.4	20.2	13.5	10.1	8.09	6.74	5.78	5.05	4.49	4.04	3.37	2.89	2.53	2.25	2.02	101
		4.0 CA	3.54	33.2	16.6	11.1	8.31	6.65	5.54	4.75	4.16	3.69	3.32	2.77	2.37	2.08	1.85	1.66	83.1

Notes:
1. Maximum design load $W^*_{L max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

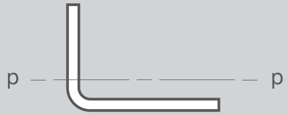


Table 14.2-8

Serviceability limit state
Maximum design loads

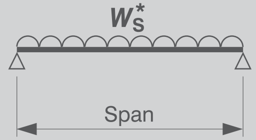
For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Single span
simply supported



Designation Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
mm	mm	mm	kg/m															
150	100	8.0 CA	14.9	1620	405	180	101	64.8	45.0	33.0	25.3	20.0	16.2	11.2	8.26	6.32	5.00	4.05
		6.0 CA	11.3	957	239	106	59.8	41.7	31.1	24.2	19.4	15.4	12.5	8.68	6.38	4.88	3.86	3.13
125	75	8.0 CA	11.7	675	169	75.0	42.2	27.0	18.7	13.8	10.5	8.33	6.75	4.69	3.44	2.64	2.08	1.69
		6.0 CA	8.92	526	131	58.4	32.9	21.0	14.6	10.7	8.22	6.49	5.26	3.65	2.68	2.05	1.62	1.31
100	75	8.0 CA	10.2	632	158	70.3	39.5	25.3	17.6	12.9	9.88	7.81	6.32	4.39	3.23	2.47	1.95	1.58
		6.0 CA	7.74	493	123	54.8	30.8	19.7	13.7	10.1	7.71	6.09	4.93	3.43	2.52	1.93	1.52	1.23
75	50	6.0 CA	5.38	142	35.5	15.8	8.87	5.67	3.94	2.89	2.22	1.75	1.42	0.985	0.724	0.554	0.438	0.355
		5.0 CA	4.34	116	29.1	12.9	7.28	4.66	3.24	2.38	1.82	1.44	1.16	0.809	0.594	0.455	0.360	0.291
		4.0 CA	3.54	96.7	24.2	10.7	6.04	3.87	2.69	1.97	1.51	1.19	0.967	0.671	0.493	0.378	0.298	0.242

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

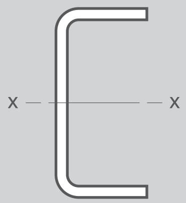


Table 14.3–1

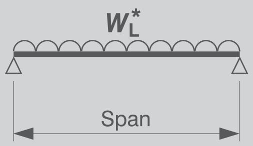
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

Profile channels

Single span
simply supported



Designation d × b_f × Nominal thickness (mm mm mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	W^*_{L2max} (kN)	FLR (m) C_b 1.0
300 x 90 x 8.0 CC	28.5	848	678	565	484	424	339	283	242	212	170	141	121	106	94.2	84.8	988	1.40
6.0 CC	21.6	669	535	446	382	334	267	223	191	167	134	111	95.5	83.6	74.3	66.9	846	1.31
250 x 90 x 6.0 CC	19.2	513	411	342	293	257	205	171	147	128	103	85.5	73.3	64.1	57.0	51.3	691	1.33
230 x 75 x 6.0 CC	16.9	428	342	285	245	214	171	143	122	107	85.6	71.3	61.2	53.5	47.6	42.8	628	1.11
200 x 75 x 6.0 CC	15.5	351	281	234	200	175	140	117	100	87.7	70.2	58.5	50.1	43.8	39.0	35.1	535	1.12
5.0 CC	12.4	258	206	172	147	129	103	85.9	73.6	64.4	51.5	42.9	36.8	32.2	28.6	25.8	445	1.10
180 x 75 x 5.0 CC	11.6	222	177	148	127	111	88.7	73.9	63.3	55.4	44.3	36.9	31.7	27.7	24.6	22.2	396	1.11
150 x 75 x 5.0 CC	10.5	171	137	114	98.0	85.7	68.6	57.2	49.0	42.9	34.3	28.6	24.5	21.4	19.1	17.1	323	1.12
125 x 65 x 4.0 CC	7.23	96.7	77.4	64.5	55.3	48.4	38.7	32.2	27.6	24.2	19.3	16.1	13.8	12.1	10.7	9.67	216	0.968
100 x 50 x 4.0 CC	5.59	65.3	52.2	43.5	37.3	32.6	26.1	21.8	18.6	16.3	13.1	10.9	9.32	8.16	7.25	6.53	166	0.762
75 x 40 x 4.0 CC	4.25	39.4	31.6	26.3	22.5	19.7	15.8	13.1	11.3	9.86	7.89	6.57	5.64	4.93	4.38	3.94	117	0.641

Notes:
1. Maximum design load $W^*_{L max}$ is the lesser of W^*_{L1max} and W^*_{L2max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity.
4. FLR is the maximum unbraced segment length for full lateral restraint.
5. Beam spans to the right of the solid line must be braced at intervals equal to or less than the FLR value to have full lateral restraint.
6. All supports are assumed to provide full lateral restraint.
7. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
8. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

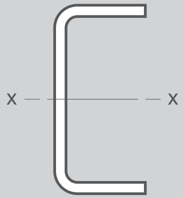


Table 14.3–2

Serviceability limit state
Maximum design loads

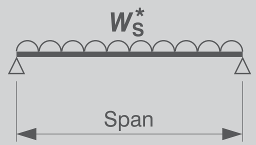
For beams *with* full lateral restraint
Bending about x-axis

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile channels

Single span
simply supported



Designation d × b_f × Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) — Span, l (m)														
mm mm mm	kg/m	1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
300 x 90 x 8.0 CC	28.5	2710	1740	1210	886	678	434	301	221	170	109	75.4	55.4	42.4	33.5	27.1
6.0 CC	21.6	1970	1260	874	642	491	315	221	165	128	83.3	58.1	42.7	32.7	25.8	20.9
250 x 90 x 6.0 CC	19.2	1260	808	561	412	316	205	145	108	83.6	53.9	37.5	27.5	21.1	16.6	13.5
230 x 75 x 6.0 CC	16.9	945	605	420	309	236	154	107	78.9	60.4	38.7	26.9	19.7	15.1	11.9	9.67
200 x 75 x 6.0 CC	15.5	674	432	300	220	171	110	76.7	56.4	43.1	27.6	19.2	14.1	10.8	8.52	6.90
5.0 CC	12.4	514	329	229	168	130	85.4	60.5	45.1	35.0	22.6	15.7	11.5	8.82	6.97	5.64
180 x 75 x 5.0 CC	11.6	399	256	178	132	102	67.2	47.6	35.5	27.5	17.6	12.2	8.98	6.87	5.43	4.40
150 x 75 x 5.0 CC	10.5	259	166	117	87.4	68.0	44.7	31.6	23.4	17.9	11.5	7.97	5.86	4.48	3.54	2.87
125 x 65 x 4.0 CC	7.23	123	79.6	56.6	42.4	33.0	21.7	15.3	11.3	8.65	5.54	3.85	2.83	2.16	1.71	1.38
100 x 50 x 4.0 CC	5.59	64.5	42.3	29.6	21.7	16.6	10.6	7.39	5.43	4.16	2.66	1.85	1.36	1.04	0.821	0.665
75 x 40 x 4.0 CC	4.25	28.1	18.0	12.5	9.16	7.01	4.49	3.12	2.29	1.75	1.12	0.779	0.572	0.438	0.346	0.281

Notes:
1. W^*_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Continuous beams

15

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Tables | Page

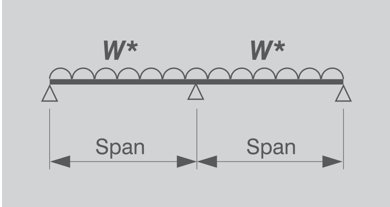
Equal angle beams with full lateral restraint

Unequal angle beams with full lateral restraint

Channel beams with full lateral restraint

15.1 Scope

The tables in this section apply to **two span continuous beams** with **full lateral restraint** and with a **uniformly distributed load**. Separate tables are provided for the strength limit state and the serviceability limit state (deflection limit = span / 250). Tables are provided for the following cases:



- Angles bending about the n- and p-axes with:
  - long leg down
  - long leg up
  - short leg down
  - short leg up
- Channels bending about the x-axis

15.2 Design assumptions

15.2.1 Full lateral restraint

The beam span tables in this section assume that the beam has full lateral restraint. Full lateral restraint means that the beam is restrained continuously or at such close spacing that flexural-torsional buckling of the beam will not occur, and the design section moment capacity may be used to calculate the maximum design load.

Full lateral restraint is automatically provided for channels when the **compression flange** is firmly connected to floor decking, roof sheeting, floor joists or roof trusses or rafters, provided the connections are spaced at sufficiently close centres. An estimate of this spacing may be obtained from Section 7. Beams for which the design member moment capacity is equal to the design section moment capacity may be assumed to have full lateral restraint.

15.2.2 Loading through the shear centre

The tables assume loads and reactions are applied through the shear centre of the beam. In practice this does not always occur with angles and channels, but if the beam has full lateral restraint as assumed in these tables, twisting due to the load being eccentric to the shear centre may be prevented. In such cases these tables may be used, but caution should be taken to ensure that the lateral restraints are capable of preventing twisting of the beam.

15.3 Maximum design load

15.3.1 General

The strength limit state design load (W^*_L) and the serviceability limit state design load (W^*_S) are determined from the load combinations given in AS/NZS 1170 Structural Design Actions[6]. These design loads must not exceed the strength limit state **maximum design load** ($W^*_{L\,max}$) and the serviceability limit state **maximum design load** ($W^*_{S\,max}$), which are provided in the tables.

For strength: W^*_L (calculated) $\leq$ $W^*_{L\,max}$ (tabulated)

For serviceability: W^*_S (calculated) $\leq$ $W^*_{S\,max}$ (tabulated)

Beam self-weight: For all tables, the self-weight of the beam has not been deducted. The designer must include the self-weight of the beam as part of the dead load when calculating the design load W^*_L or W^*_S.

15.3.2 Strength limit state

The strength limit state maximum design load ($W^*_{L\,max}$) is the **lesser** of:

> The maximum design load (W^*_{L1max}) based on the design section moment capacity ($\phi_b M_s$) and the combined moment and shear capacity of the beam, and

> The maximum design load (W^*_{L2max}) based on the design section shear capacity ($\phi_v V_v$) of the beam.

$$W^*_{L\,max} = \min.\,[W^*_{L1max}\,;\,W^*_{L2max}\,]$$

Values of W^*_{L1max} and W^*_{L2max} are given in the strength limit state design tables.

15.3.3 Serviceability limit state

The serviceability limit state maximum design load ($W^*_{S\,max}$) given in the tables is the load that will cause an elastic deflection in the beam of span / 250. In the tables provided, the maximum compressive stress under service load used to calculate the maximum design load ($W^*_{S\,max}$) is limited to the yield stress (f_y).

For beams with **deflection limits smaller than span / 250**, e.g. span / 500, these tables **can be used** conservatively to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For beams with **deflection limits larger than span / 250**, e.g. span / 125, these tables **can not be used** to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For such cases refer to Section 10 for deflection calculations of the beam.

15.4 Additional design checks

The following design action effects have not been taken into account in the tables, and should also be checked if appropriate:

> Web bearing (Section 8)

> Combined bending and bearing (Section 13)

> Shear lag effects - short spans (Appendix A4)

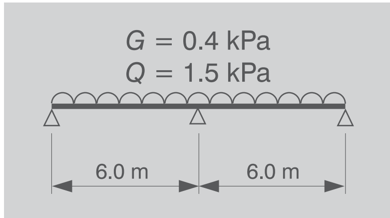
15.5 Beam deflection calculations

The deflection calculations of beams subject to load configurations not covered in this manual can be performed using standard deflection formulae. Some of the frequently used deflection formulae are given in Figure 14.5(2). A more comprehensive set of beam deflection formulae is published by the ASI[9].

The second moment of area (I) to be used in these deflection calculations can be determined using the method given in Section 10.3.

15.6 Example

Design a DuraGalUltra channel floor joist spaced at 600 mm centres and two equal continuous spans of 6.0 m to support a timber floor in a domestic house where the floor loads are:



Dead load G = 0.4 kPa
Live load Q = 1.5 kPa

The desired deflection limit for serviceability loads is span / 250.

Solution:

Design loads and load combinations:

Strength: $1.2G + 1.5Q = 1.2 \times 0.4 + 1.5 \times 1.5 = 2.73$ kPa

Design load $W^*_L = 2.73 \times 6.0 \times 0.6$
$= 9.83$ kN

Serviceability: $G + 0.7Q = 0.4 + 0.7 \times 1.5 = 1.45$ kPa

Design load $W^*_S = 1.45 \times 6.0 \times 0.6$
$= 5.22$ kN

Select a channel size:

Strength: (Table 15.3–1)

Select 100 x 50 x 4.0 CC DuraGalUltra

$W^*_{Lmax} = W^*_{L1max} = 10.8$ kN $> W^*_L = 9.83$ kN

Serviceability: (Table 15.3–2)

Check 100 x 50 x 4.0 CC DuraGalUltra

$W^*_{Smax} = 4.45$ kN $< W^*_S = 5.22$ kN

Select 125 x 65 x 4.0 CC DuraGalUltra

$W^*_{Smax} = 9.06$ kN $> W^*_S = 5.22$ kN

Strength: (Table 15.3–1)

Check 125 x 65 x 4.0 CC DuraGalUltra

$W^*_{Lmax} = W^*_{L1max} = 16.0$ kN $> W^*_L = 9.83$ kN

The 125 x 65 x 4.0 CC DuraGalUltra is satisfactory for these strength and serviceability limit states. Note that the size selected is smaller than that for the single span example in Section 14.6. Additional checks may be required as listed in Section 15.4 and to include the self-weight of the beam.

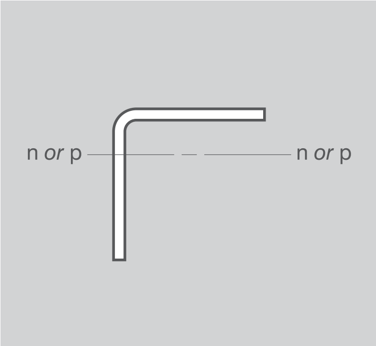


Table 15.1–1(A)

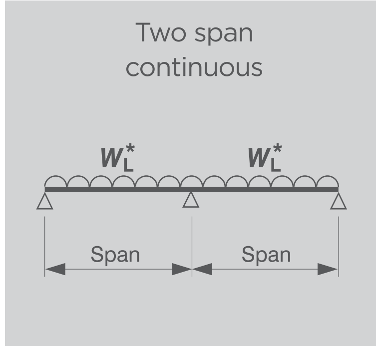
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 mm	b_2 mm	Nominal thickness mm		Mass per metre kg/m	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	150	8.0	CA	18.0	196	109	74.1	56.0	45.0	37.6	32.2	28.2	25.1	22.6	20.6	18.8	17.4	16.2	14.1	395
		6.0	CA	13.6	119	62.4	42.0	31.6	25.3	21.1	18.1	15.8	14.1	12.7	11.5	10.6	9.76	9.06	7.93	338
		5.0	CA	10.8	67.5	34.5	23.1	17.4	13.9	11.6	9.93	8.69	7.73	6.96	6.32	5.80	5.35	4.97	4.35	275
125	125	8.0	CA	14.9	161	89.5	61.0	46.1	37.0	30.9	26.5	23.2	20.7	18.6	16.9	15.5	14.3	13.3	11.6	321
		5.0	CA	8.95	60.5	31.1	20.9	15.7	12.5	10.5	8.97	7.85	6.98	6.28	5.71	5.23	4.83	4.49	3.93	227
		4.0	CA	7.27	36.8	18.7	12.5	9.39	7.51	6.26	5.37	4.70	4.18	3.76	3.42	3.13	2.89	2.69	2.35	185
100	100	8.0	CA	11.7	106	57.1	38.6	29.1	23.4	19.5	16.7	14.6	13.0	11.7	10.7	9.77	9.02	8.37	7.33	248
		6.0	CA	8.92	82.7	43.9	29.6	22.3	17.9	14.9	12.8	11.2	9.96	8.96	8.15	7.47	6.90	6.41	5.61	214
90	90	8.0	CA	10.5	86.4	46.0	31.0	23.4	18.8	15.6	13.4	11.7	10.4	9.40	8.55	7.84	7.23	6.72	5.88	218
		5.0	CA	6.37	47.1	24.4	16.4	12.3	9.85	8.21	7.04	6.16	5.48	4.93	4.48	4.11	3.79	3.52	3.08	158

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

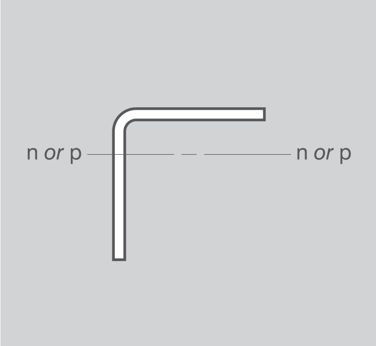


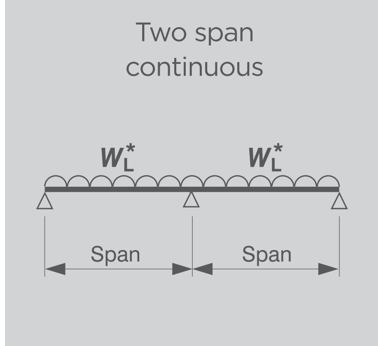
Table 15.1–1(B)

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	Leg size b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
75	75	8.0 CA	8.59	103	60.1	41.5	31.5	25.4	21.2	18.2	16.0	14.2	12.8	10.7	9.14	8.00	7.11	6.40	174
		6.0 CA	6.56	89.6	52.1	36.0	27.3	22.0	18.4	15.8	13.8	12.3	11.1	9.24	7.92	6.93	6.16	5.55	152
		5.0 CA	5.26	69.6	39.4	26.9	20.4	16.4	13.7	11.8	10.3	9.16	8.25	6.88	5.90	5.16	4.59	4.13	129
		4.0 CA	4.29	47.8	26.0	17.6	13.3	10.7	8.90	7.63	6.68	5.94	5.35	4.46	3.82	3.35	2.98	2.68	106
65	65	6.0 CA	5.62	69.0	39.1	26.8	20.3	16.3	13.6	11.7	10.2	9.12	8.21	6.84	5.87	5.14	4.57	4.11	127
		5.0 CA	4.52	56.6	31.7	21.6	16.3	13.1	11.0	9.41	8.24	7.33	6.60	5.50	4.72	4.13	3.67	3.31	110
		4.0 CA	3.69	41.6	22.7	15.4	11.6	9.33	7.79	6.68	5.85	5.20	4.68	3.90	3.35	2.93	2.60	2.34	90.1
50	50	6.0 CA	4.21	41.7	22.8	15.5	11.7	9.38	7.83	6.72	5.88	5.23	4.71	3.92	3.36	2.94	2.62	2.36	89.6
		5.0 CA	3.42	34.5	18.6	12.6	9.49	7.61	6.35	5.45	4.77	4.24	3.82	3.18	2.73	2.39	2.12	1.91	80.5
		4.0 CA	2.79	28.4	15.3	10.4	7.81	6.27	5.23	4.49	3.93	3.49	3.14	2.62	2.25	1.97	1.75	1.57	66.5
		2.5 CA	1.81	11.9	6.24	4.20	3.16	2.53	2.11	1.81	1.58	1.41	1.27	1.06	0.906	0.793	0.705	0.635	34.9
45	45	4.0 CA	2.50	23.2	12.3	8.33	6.28	5.03	4.20	3.60	3.15	2.80	2.52	2.10	1.80	1.58	1.40	1.26	58.6
		2.5 CA	1.62	10.8	5.64	3.79	2.85	2.29	1.91	1.64	1.43	1.27	1.15	0.955	0.818	0.716	0.637	0.573	31.0
40	40	4.0 CA	2.20	18.4	9.68	6.52	4.91	3.93	3.28	2.81	2.46	2.19	1.97	1.64	1.41	1.23	1.10	0.986	50.7
		2.5 CA	1.43	9.44	4.95	3.33	2.51	2.01	1.67	1.44	1.26	1.12	1.01	0.838	0.719	0.629	0.559	0.503	27.2
30	30	2.5 CA	1.06	5.33	2.74	1.84	1.38	1.11	0.922	0.791	0.692	0.615	0.554	0.462	0.396	0.346	0.308	0.277	19.4

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

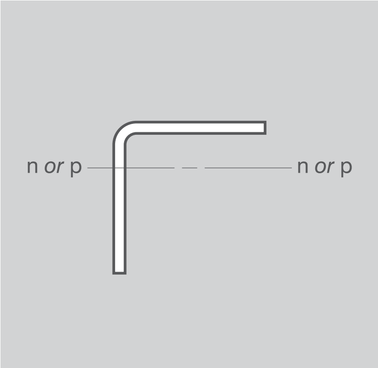


Table 15.1–2(A)

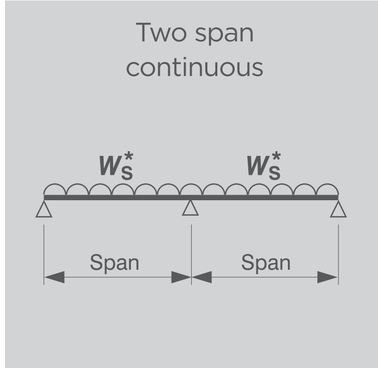
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 x b_2 x Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN), Span, l (m)														
mm x mm x mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150 x 150 x 8.0 CA	18.0	2330	583	259	146	93.3	64.8	47.6	37.0	30.8	26.1	22.4	19.5	17.2	15.2	11.9
6.0 CA	13.6	969	242	108	62.5	44.5	33.7	26.6	21.7	18.1	15.4	13.3	11.6	10.2	9.11	7.39
5.0 CA	10.8	454	113	68.8	51.4	27.4	20.8	16.5	13.5	11.3	9.62	8.32	7.29	6.45	5.76	4.69
125 x 125 x 8.0 CA	14.9	1610	404	188	108	68.9	47.9	35.2	26.9	21.3	17.3	14.3	12.0	10.2	8.81	6.75
5.0 CA	8.95	384	96.0	44.8	29.0	20.7	15.7	12.4	10.1	8.43	7.17	6.19	5.41	4.77	4.25	3.45
4.0 CA	7.27	201	57.8	38.6	19.1	13.6	10.4	8.21	6.71	5.61	4.78	4.13	3.62	3.20	2.85	2.32
100 x 100 x 8.0 CA	11.7	845	215	95.5	53.7	34.4	23.9	17.5	13.4	10.6	8.60	7.11	5.97	5.09	4.39	3.36
6.0 CA	8.92	561	140	62.3	35.0	22.4	16.8	13.1	10.4	8.21	6.65	5.50	4.62	3.94	3.39	2.60
90 x 90 x 8.0 CA	10.5	617	154	68.6	38.6	24.7	17.1	12.6	9.64	7.62	6.17	5.10	4.29	3.65	3.15	2.41
5.0 CA	6.37	261	65.2	29.0	17.0	12.0	9.05	7.09	5.73	4.75	3.87	3.20	2.69	2.29	1.97	1.51

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

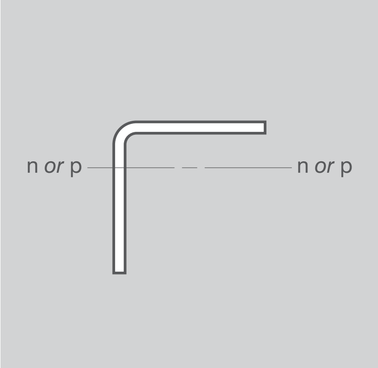


Table 15.1–2(B)

Serviceability limit state

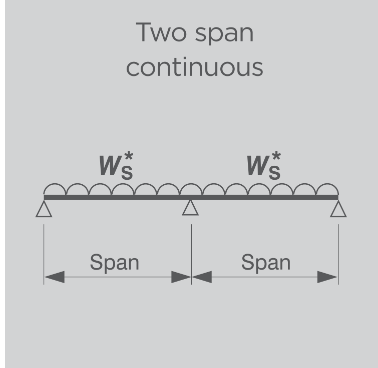
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 x b_2, Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN), Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	1380	346	154	86.5	55.4	38.5	28.3	21.6	17.1	13.8	9.61	7.06	5.41	4.27	3.46
6.0 CA	6.56	1060	265	120	67.7	43.3	30.1	22.1	16.9	13.4	10.8	7.52	5.52	4.23	3.34	2.71
5.0 CA	5.26	791	198	87.9	49.4	31.6	22.0	16.1	12.4	10.2	8.65	6.11	4.49	3.44	2.72	2.20
4.0 CA	4.29	465	116	51.7	29.1	18.6	13.2	10.4	8.42	7.01	5.94	4.45	3.49	2.81	2.24	1.81
65 x 65 x 6.0 CA	5.62	689	172	76.5	43.1	27.6	19.1	14.1	10.8	8.51	6.89	4.78	3.51	2.69	2.13	1.72
5.0 CA	4.52	534	135	62.4	35.2	22.5	15.7	11.5	8.80	6.96	5.63	3.91	2.87	2.20	1.74	1.41
4.0 CA	3.69	377	94.3	41.9	23.6	15.1	10.5	8.07	6.53	5.41	4.57	3.23	2.38	1.82	1.44	1.16
50 x 50 x 6.0 CA	4.21	298	74.4	33.1	18.6	11.9	8.27	6.08	4.65	3.68	2.98	2.07	1.52	1.16	0.919	0.744
5.0 CA	3.42	247	61.8	27.5	15.4	9.88	6.86	5.04	3.86	3.05	2.47	1.72	1.26	0.965	0.763	0.618
4.0 CA	2.79	198	51.2	22.8	12.8	8.22	5.71	4.19	3.21	2.54	2.05	1.43	1.05	0.803	0.634	0.514
2.5 CA	1.81	98.0	24.5	10.9	6.13	3.92	2.82	2.22	1.80	1.49	1.26	0.943	0.695	0.532	0.421	0.341
45 x 45 x 4.0 CA	2.50	145	36.9	16.4	9.22	5.90	4.10	3.01	2.31	1.82	1.48	1.02	0.753	0.576	0.455	0.369
2.5 CA	1.62	83.5	20.9	9.28	5.22	3.34	2.34	1.84	1.48	1.22	0.984	0.684	0.502	0.385	0.304	0.246
40 x 40 x 4.0 CA	2.20	102	25.4	11.3	6.36	4.07	2.83	2.08	1.59	1.26	1.02	0.706	0.519	0.397	0.314	0.254
2.5 CA	1.43	63.8	16.5	7.59	4.27	2.73	1.90	1.39	1.07	0.844	0.683	0.475	0.349	0.267	0.211	0.171
30 x 30 x 2.5 CA	1.06	27.7	6.96	3.09	1.74	1.11	0.773	0.568	0.435	0.344	0.278	0.193	0.142	0.109	0.0859	0.0696

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

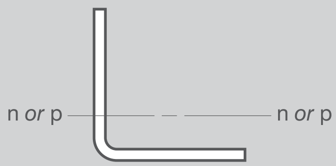


Table 15.1-3(A)

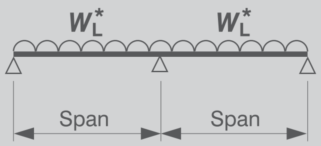
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Two span continuous



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	x 150	x 8.0 CA	18.0	223	128	87.6	66.4	53.4	44.6	38.3	33.6	29.9	26.9	24.5	22.4	20.7	19.2	16.8	395
		6.0 CA	13.6	185	105	72.1	54.6	43.9	36.7	31.5	27.6	24.5	22.1	20.1	18.4	17.0	15.8	13.8	338
		5.0 CA	10.8	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	7.73	275
125	x 125	x 8.0 CA	14.9	161	89.6	61.0	46.1	37.1	30.9	26.6	23.3	20.7	18.6	16.9	15.5	14.3	13.3	11.7	321
		5.0 CA	8.95	106	55.8	37.2	27.9	22.3	18.6	16.0	14.0	12.4	11.2	10.2	9.31	8.59	7.98	6.98	227
		4.0 CA	7.27	66.8	33.4	22.3	16.7	13.4	11.1	9.55	8.36	7.43	6.68	6.08	5.57	5.14	4.77	4.18	185
100	x 100	x 8.0 CA	11.7	106	57.1	38.6	29.1	23.4	19.5	16.7	14.6	13.0	11.7	10.7	9.77	9.02	8.37	7.33	248
		6.0 CA	8.92	91.3	49.1	33.2	25.1	20.1	16.8	14.4	12.6	11.2	10.1	9.17	8.40	7.76	7.21	6.31	214
90	x 90	x 8.0 CA	10.5	86.4	46.0	31.0	23.4	18.8	15.6	13.4	11.7	10.4	9.40	8.55	7.84	7.23	6.72	5.88	218
		5.0 CA	6.37	59.1	31.2	21.0	15.8	12.7	10.6	9.08	7.95	7.07	6.36	5.79	5.30	4.90	4.55	3.98	158

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

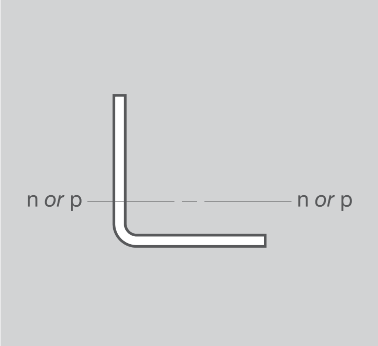


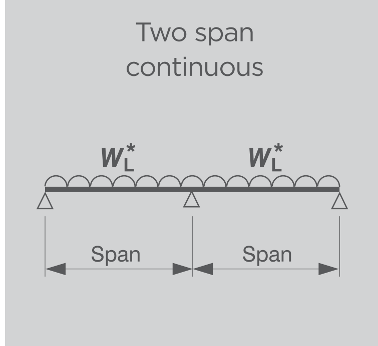
Table 15.1–3(B)

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation			Mass per metre	Maximum design loads															
Leg size b_1	b_2	Nominal thickness		W^*_{L1max} (kN)															W^*_{L2max} (kN)
				Span, l (m)															
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
75	75	8.0 CA	8.59	103	60.1	41.5	31.5	25.4	21.2	18.2	16.0	14.2	12.8	10.7	9.14	8.00	7.11	6.40	174
		6.0 CA	6.56	89.6	52.1	36.0	27.3	22.0	18.4	15.8	13.8	12.3	11.1	9.24	7.92	6.93	6.16	5.55	152
		5.0 CA	5.26	73.3	42.1	28.9	21.9	17.6	14.7	12.6	11.1	9.86	8.88	7.40	6.35	5.56	4.94	4.45	129
		4.0 CA	4.29	59.2	33.8	23.2	17.6	14.2	11.8	10.2	8.89	7.91	7.12	5.94	5.09	4.46	3.96	3.57	106
65	65	6.0 CA	5.62	69.0	39.1	26.8	20.3	16.3	13.6	11.7	10.2	9.12	8.21	6.84	5.87	5.14	4.57	4.11	127
		5.0 CA	4.52	56.6	31.7	21.6	16.3	13.1	11.0	9.41	8.24	7.33	6.60	5.50	4.72	4.13	3.67	3.31	110
		4.0 CA	3.69	46.3	25.9	17.6	13.3	10.7	8.95	7.68	6.73	5.99	5.39	4.49	3.85	3.37	3.00	2.70	90.1
50	50	6.0 CA	4.21	41.7	22.8	15.5	11.7	9.38	7.83	6.72	5.88	5.23	4.71	3.92	3.36	2.94	2.62	2.36	89.6
		5.0 CA	3.42	34.5	18.6	12.6	9.49	7.61	6.35	5.45	4.77	4.24	3.82	3.18	2.73	2.39	2.12	1.91	80.5
		4.0 CA	2.79	28.4	15.3	10.4	7.81	6.27	5.23	4.49	3.93	3.49	3.14	2.62	2.25	1.97	1.75	1.57	66.5
		2.5 CA	1.81	14.4	7.68	5.19	3.91	3.14	2.62	2.25	1.97	1.75	1.57	1.31	1.12	0.984	0.875	0.787	34.9
45	45	4.0 CA	2.50	23.2	12.3	8.33	6.28	5.03	4.20	3.60	3.15	2.80	2.52	2.10	1.80	1.58	1.40	1.26	58.6
		2.5 CA	1.62	11.8	6.27	4.23	3.19	2.55	2.13	1.83	1.60	1.42	1.28	1.07	0.915	0.801	0.712	0.64	31.0
40	40	4.0 CA	2.20	18.4	9.68	6.52	4.91	3.93	3.28	2.81	2.46	2.19	1.97	1.64	1.41	1.23	1.10	0.986	50.7
		2.5 CA	1.43	9.44	4.95	3.33	2.51	2.01	1.68	1.44	1.26	1.12	1.01	0.839	0.719	0.629	0.559	0.503	27.2
30	30	2.5 CA	1.06	5.33	2.74	1.84	1.38	1.11	0.922	0.791	0.692	0.615	0.554	0.462	0.396	0.346	0.308	0.277	19.4

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

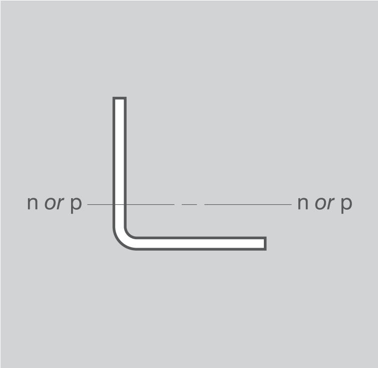


Table 15.1-4(A)

Serviceability limit state

Maximum design loads

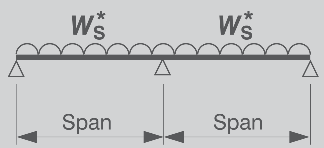
For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Two span continuous



Designation: Leg size b_1 (mm)	Leg size b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W_{Smax} (kN) — Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	150	8.0 CA	18.0	2330	583	259	146	99.2	74.4	58.2	45.6	36.5	29.9	24.9	21.1	18.0	15.5	11.9
		6.0 CA	13.6	969	242	127	82.1	58.2	43.9	34.6	28.1	23.4	19.8	17.0	14.8	13.0	11.4	8.83
		5.0 CA	10.8	454	113	78.5	50.9	36.3	27.6	21.8	17.8	14.8	12.6	10.9	9.52	8.40	7.49	6.08
125	125	8.0 CA	14.9	1610	403	179	102	67.1	47.4	35.2	27.0	21.3	17.3	14.3	12.0	10.2	8.81	6.75
		5.0 CA	8.95	384	110	59.3	38.2	27.2	20.5	16.1	13.1	10.9	9.25	7.96	6.93	5.97	5.19	4.04
		4.0 CA	7.27	204	50.2	39.1	25.3	18.1	13.7	10.8	8.81	7.34	6.24	5.38	4.70	4.15	3.70	3.00
100	100	8.0 CA	11.7	845	211	94.7	53.7	34.4	23.9	17.5	13.4	10.6	8.60	7.11	5.97	5.09	4.39	3.36
		6.0 CA	8.92	561	140	64.0	40.0	26.2	18.5	13.6	10.4	8.21	6.65	5.50	4.62	3.94	3.39	2.60
90	90	8.0 CA	10.5	617	154	68.6	38.6	24.7	17.1	12.6	9.64	7.62	6.17	5.10	4.29	3.65	3.15	2.41
		5.0 CA	6.37	261	65.2	34.4	21.9	14.8	10.5	7.83	6.05	4.78	3.87	3.20	2.69	2.29	1.97	1.51

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

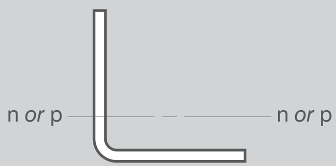


Table 15.1–4(B)

Serviceability limit state
Maximum design loads

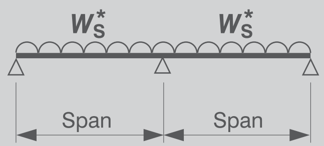
For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Two span continuous



Designation: Leg size b_1 x b_2 x Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN), Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	1380	346	154	86.5	55.4	38.5	28.3	21.6	17.1	13.8	9.61	7.06	5.41	4.27	3.46
6.0 CA	6.56	1060	265	118	66.7	43.3	30.1	22.1	16.9	13.4	10.8	7.52	5.52	4.23	3.34	2.71
5.0 CA	5.26	791	198	87.9	49.4	33.0	23.6	17.6	13.6	10.9	8.80	6.11	4.49	3.44	2.72	2.20
4.0 CA	4.29	465	116	51.7	32.0	22.6	17.0	13.3	10.7	8.60	7.05	4.98	3.70	2.83	2.24	1.81
65 x 65 x 6.0 CA	5.62	689	172	76.5	43.1	27.6	19.1	14.1	10.8	8.51	6.89	4.78	3.51	2.69	2.13	1.72
5.0 CA	4.52	534	134	59.3	34.2	22.3	15.7	11.5	8.80	6.96	5.63	3.91	2.87	2.20	1.74	1.41
4.0 CA	3.69	377	94.3	41.9	24.9	17.4	12.5	9.33	7.23	5.75	4.66	3.23	2.38	1.82	1.44	1.16
50 x 50 x 6.0 CA	4.21	298	74.4	33.1	18.6	11.9	8.27	6.08	4.65	3.68	2.98	2.07	1.52	1.16	0.919	0.744
5.0 CA	3.42	247	61.8	27.5	15.4	9.88	6.86	5.04	3.86	3.05	2.47	1.72	1.26	0.965	0.763	0.618
4.0 CA	2.79	198	49.4	22.4	12.8	8.22	5.71	4.19	3.21	2.54	2.05	1.43	1.05	0.803	0.634	0.514
2.5 CA	1.81	98.0	24.5	10.9	6.84	4.81	3.59	2.68	2.08	1.67	1.36	0.947	0.695	0.532	0.421	0.341
45 x 45 x 4.0 CA	2.50	145	36.3	16.4	9.22	5.90	4.10	3.01	2.31	1.82	1.48	1.02	0.753	0.576	0.455	0.369
2.5 CA	1.62	83.5	20.9	9.28	5.66	3.80	2.69	2.00	1.54	1.22	0.984	0.684	0.502	0.385	0.304	0.246
40 x 40 x 4.0 CA	2.20	102	25.4	11.3	6.36	4.07	2.83	2.08	1.59	1.26	1.02	0.706	0.519	0.397	0.314	0.254
2.5 CA	1.43	63.8	15.9	7.22	4.19	2.73	1.90	1.39	1.07	0.844	0.683	0.475	0.349	0.267	0.211	0.171
30 x 30 x 2.5 CA	1.06	27.7	6.96	3.09	1.74	1.11	0.773	0.568	0.435	0.344	0.278	0.193	0.142	0.109	0.0859	0.0696

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

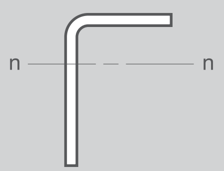


Table 15.2–1

Strength limit state

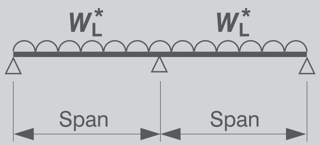
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	304	204	148	114	92.8	78.0	67.2	59.0	52.6	47.4	39.6	34.0	29.8	26.5	23.8	395
		6.0 CA	11.3	228	140	98.2	75.0	60.6	50.7	43.6	38.2	34.0	30.7	25.6	21.9	19.2	17.1	15.4	338
125	75	8.0 CA	11.7	234	151	107	82.7	66.9	56.2	48.3	42.4	37.8	34.0	28.4	24.4	21.3	19.0	17.1	321
		6.0 CA	8.92	185	113	79.3	60.6	48.9	40.9	35.2	30.8	27.4	24.7	20.6	17.7	15.5	13.8	12.4	276
100	75	8.0 CA	10.2	166	102	71.4	54.5	44.0	36.9	31.7	27.8	24.7	22.3	18.6	15.9	14.0	12.4	11.2	248
		6.0 CA	7.74	140	84.8	59.1	45.1	36.4	30.5	26.2	22.9	20.4	18.4	15.3	13.2	11.5	10.2	9.22	214
75	50	6.0 CA	5.38	85.5	48.9	33.6	25.5	20.5	17.1	14.7	12.9	11.5	10.3	8.6	7.38	6.46	5.74	5.17	152
		5.0 CA	4.34	70.0	39.6	27.1	20.6	16.5	13.8	11.8	10.4	9.23	8.31	6.93	5.94	5.20	4.62	4.16	129
		4.0 CA	3.54	51.4	28.3	19.3	14.6	11.7	9.76	8.38	7.34	6.52	5.87	4.90	4.20	3.67	3.27	2.94	106

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and dhear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

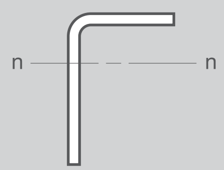


Table 15.2–2

Serviceability limit state
Maximum design loads

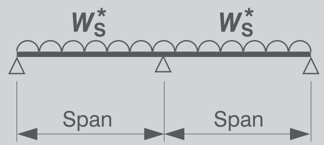
For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation Leg size b_1 b_2	Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN) Span, l (m)														
mm mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x	8.0 CA	14.9	9370	2340	1040	586	375	260	191	146	116	93.7	65.1	47.8	36.6	29.9	25.2
	6.0 CA	11.3	4040	1010	449	252	161	112	82.4	63.1	51.7	44.0	33.2	26.2	21.3	17.7	15.1
125 x 75 x	8.0 CA	11.7	5750	1440	639	360	230	160	117	89.9	71.0	57.5	40.0	29.4	22.5	17.8	14.4
	6.0 CA	8.92	3180	794	353	198	127	88.2	64.8	49.6	39.2	32.2	24.2	18.9	15.3	12.7	10.7
100 x 75 x	8.0 CA	10.2	3100	776	345	194	124	86.2	63.3	48.5	38.3	31.0	21.6	15.8	12.1	9.58	7.76
	6.0 CA	7.74	2220	556	247	139	89.0	61.8	45.4	34.7	27.5	22.2	16.3	12.3	9.40	7.43	6.02
75 x 50 x	6.0 CA	5.38	931	233	103	58.2	37.2	25.9	19.0	14.5	11.5	9.31	6.46	4.75	3.64	2.87	2.33
	5.0 CA	4.34	764	191	84.9	47.7	30.5	21.2	15.6	11.9	9.43	7.64	5.30	3.90	2.98	2.36	1.91
	4.0 CA	3.54	472	118	52.4	29.5	18.9	13.1	10.1	8.21	6.82	5.77	4.31	3.22	2.46	1.95	1.58

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

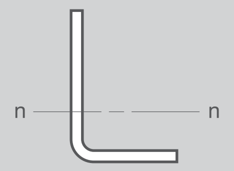


Table 15.2-3

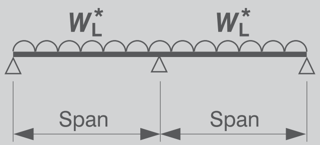
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation: Leg size b_1 (mm)	Designation: Leg size b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	312	214	156	121	98.6	83.0	71.5	62.8	56.0	50.5	42.2	36.2	31.7	28.2	25.4	395
		6.0 CA	11.3	266	182	132	103	83.6	70.3	60.6	53.2	47.5	42.8	35.7	30.7	26.9	23.9	21.5	338
125	75	8.0 CA	11.7	234	151	107	82.7	66.9	56.2	48.3	42.4	37.8	34.0	28.4	24.4	21.3	19.0	17.1	321
		6.0 CA	8.92	201	130	92.4	71.0	57.5	48.2	41.5	36.4	32.4	29.2	24.4	20.9	18.3	16.3	14.7	276
100	75	8.0 CA	10.2	166	102	71.4	54.5	44.0	36.9	31.7	27.8	24.7	22.3	18.6	15.9	14.0	12.4	11.2	248
		6.0 CA	7.74	143	87.9	61.5	47.0	37.9	31.8	27.3	23.9	21.3	19.2	16.0	13.7	12.0	10.7	9.63	214
75	50	6.0 CA	5.38	85.5	48.9	33.6	25.5	20.5	17.1	14.7	12.9	11.5	10.3	8.60	7.38	6.46	5.74	5.17	152
		5.0 CA	4.34	70.0	39.6	27.1	20.6	16.5	13.8	11.8	10.4	9.23	8.31	6.93	5.94	5.20	4.62	4.16	129
		4.0 CA	3.54	57.3	32.5	22.2	16.8	13.5	11.3	9.70	8.50	7.56	6.81	5.68	4.87	4.26	3.79	3.41	106

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

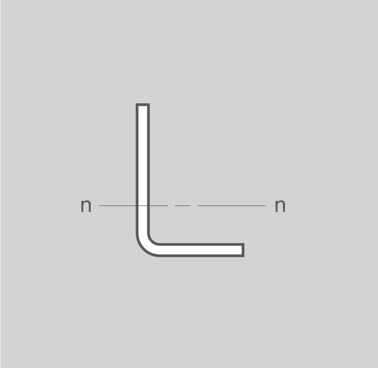


Table 15.2-4

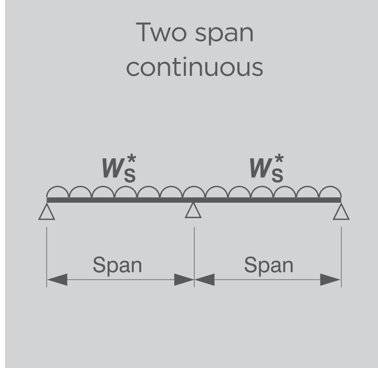
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation Leg size b_1 b_2 Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN) Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x 8.0 CA	14.9	9330	2330	1040	583	373	259	191	146	115	96.2	71.9	53.9	41.3	32.6	26.4
6.0 CA	11.3	4900	1220	544	306	196	139	108	87.1	71.9	60.6	45.0	34.9	28.0	23.1	19.4
125 x 75 x 8.0 CA	11.7	5750	1440	639	360	230	160	117	89.9	71.0	57.5	40.0	29.4	22.5	17.8	14.4
6.0 CA	8.92	3470	868	386	217	139	96.6	75.0	60.2	49.5	41.5	30.6	22.7	17.3	13.7	11.1
100 x 75 x 8.0 CA	10.2	3100	776	345	194	124	86.2	63.3	48.5	38.3	31.0	21.6	15.8	12.1	9.58	7.76
6.0 CA	7.74	2260	565	251	141	90.4	63.0	48.8	37.6	29.7	24.1	16.7	12.3	9.40	7.43	6.02
75 x 50 x 6.0 CA	5.38	931	233	103	58.2	37.2	25.9	19.0	14.5	11.5	9.31	6.46	4.75	3.64	2.87	2.33
5.0 CA	4.34	764	191	84.9	47.7	30.5	21.2	15.6	11.9	9.43	7.64	5.30	3.90	2.98	2.36	1.91
4.0 CA	3.54	508	127	56.5	32.5	22.5	16.6	12.8	9.85	7.78	6.30	4.38	3.22	2.46	1.95	1.58

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

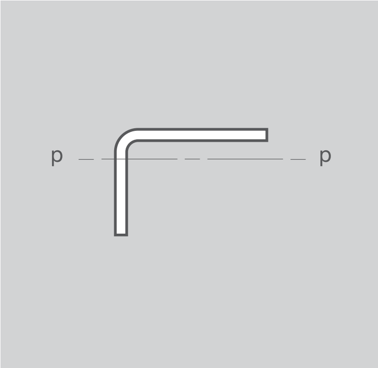


Table 15.2-5

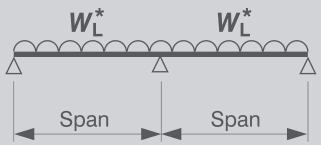
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	175	111	78.4	60.1	48.6	40.8	35.1	30.7	27.4	24.7	20.6	17.7	15.5	13.8	12.4	248
		6.0 CA	11.3	135	80.3	55.8	42.5	34.2	28.6	24.6	21.5	19.2	17.3	14.4	12.4	10.8	9.62	8.66	214
125	75	8.0 CA	11.7	108	64.0	44.3	33.7	27.2	22.7	19.5	17.1	15.2	13.7	11.4	9.81	8.59	7.64	6.87	174
		6.0 CA	8.92	93.6	55.4	38.4	29.2	23.5	19.7	16.9	14.8	13.2	11.9	9.89	8.48	7.43	6.60	5.94	152
100	75	8.0 CA	10.2	106	62.4	43.2	32.8	26.4	22.1	19.0	16.6	14.8	13.3	11.1	9.54	8.35	7.43	6.68	174
		6.0 CA	7.74	92.0	54.1	37.4	28.4	22.9	19.1	16.4	14.4	12.8	11.5	9.63	8.26	7.23	6.43	5.78	152
75	50	6.0 CA	5.38	43.8	24.1	16.4	12.4	9.97	8.32	7.14	6.25	5.56	5.01	4.18	3.58	3.13	2.79	2.51	89.6
		5.0 CA	4.34	36.1	19.6	13.3	10.0	8.05	6.72	5.76	5.04	4.49	4.04	3.37	2.89	2.53	2.25	2.02	80.5
		4.0 CA	3.54	29.7	16.1	10.9	8.25	6.62	5.52	4.74	4.15	3.69	3.32	2.77	2.37	2.08	1.85	1.66	66.5

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

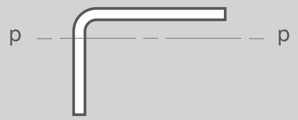


Table 15.2–6

Serviceability limit state

Maximum design loads

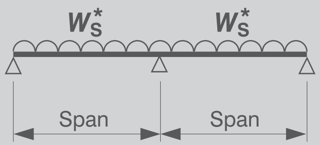
For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation Leg size b_1 b_2	Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN) Span, l (m)														
mm mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100	x 8.0 CA	14.9	3520	880	393	229	150	106	78.9	60.9	48.1	39.0	27.1	19.9	15.2	12.0	9.75
	6.0 CA	11.3	1510	378	168	112	80.8	61.4	45.5	34.8	27.5	22.9	17.2	13.5	10.9	9.01	7.53
125 x 75	x 8.0 CA	11.7	1530	384	177	102	65.0	45.2	33.2	25.4	20.1	16.3	11.3	8.29	6.35	5.02	4.06
	6.0 CA	8.92	1110	278	130	75.6	49.4	34.9	25.8	19.8	15.6	12.7	8.80	6.46	4.95	3.91	3.17
100 x 75	x 8.0 CA	10.2	1500	375	169	95.2	60.9	42.3	31.1	23.8	18.8	15.2	10.6	7.77	5.95	4.70	3.81
	6.0 CA	7.74	1090	273	127	73.5	47.5	33.0	24.3	18.6	14.7	11.9	8.25	6.06	4.64	3.67	2.97
75 x 50	x 6.0 CA	5.38	335	85.4	38.0	21.4	13.7	9.49	6.97	5.34	4.22	3.42	2.37	1.74	1.33	1.05	0.854
	5.0 CA	4.34	259	68.1	31.2	17.5	11.2	7.80	5.73	4.38	3.46	2.81	1.95	1.43	1.10	0.866	0.702
	4.0 CA	3.54	205	54.0	25.1	14.5	9.32	6.47	4.75	3.64	2.88	2.33	1.62	1.19	0.910	0.719	0.582

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

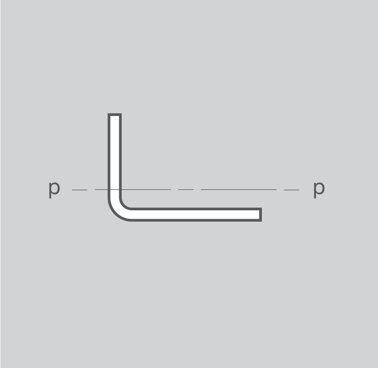


Table 15.2–7

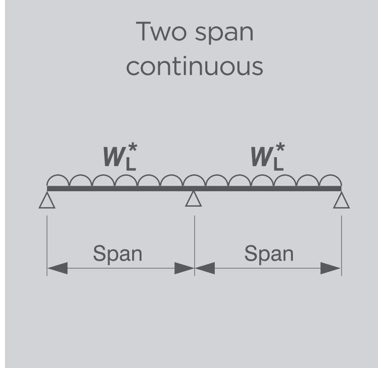
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2} (kN)
150	100	8.0 CA	14.9	175	111	78.4	60.1	48.6	40.8	35.1	30.7	27.4	24.7	20.6	17.7	15.5	13.8	12.4	248
		6.0 CA	11.3	149	93.2	65.7	50.3	40.7	34.1	29.3	25.7	22.9	20.6	17.2	14.8	12.9	11.5	10.3	214
125	75	8.0 CA	11.7	108	64.0	44.3	33.7	27.2	22.7	19.5	17.1	15.2	13.7	11.4	9.81	8.59	7.64	6.87	174
		6.0 CA	8.92	93.2	55.0	38.1	29.0	23.3	19.5	16.8	14.7	13.1	11.8	9.81	8.42	7.37	6.55	5.90	152
100	75	8.0 CA	10.2	106	62.4	43.2	32.8	26.4	22.1	19.0	16.6	14.8	13.3	11.1	9.54	8.35	7.43	6.68	174
		6.0 CA	7.74	92.0	54.1	37.4	28.4	22.9	19.1	16.4	14.4	12.8	11.5	9.63	8.26	7.23	6.43	5.78	152
75	50	6.0 CA	5.38	43.8	24.1	16.4	12.4	9.97	8.32	7.14	6.25	5.56	5.01	4.18	3.58	3.13	2.79	2.51	89.6
		5.0 CA	4.34	36.1	19.6	13.3	10.0	8.05	6.72	5.76	5.04	4.49	4.04	3.37	2.89	2.53	2.25	2.02	80.5
		4.0 CA	3.54	29.6	16.0	10.9	8.19	6.57	5.48	4.70	4.12	3.66	3.30	2.75	2.36	2.06	1.83	1.65	66.5

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

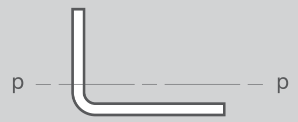


Table 15.2-8

Serviceability limit state

Maximum design loads

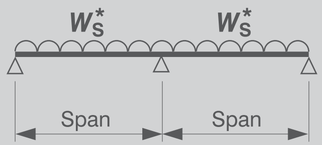
For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Two span continuous



Designation Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W_{Smax} (kN) Span, l (m)														
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x	100 x	8.0 CA	14.9	3590	897	399	224	145	102	75.8	58.6	46.7	38.1	26.8	19.9	15.2	12.0	9.75
		6.0 CA	11.3	2300	576	256	144	92.2	66.4	51.9	41.7	33.5	27.5	19.5	14.6	11.3	9.06	7.41
125 x	75 x	8.0 CA	11.7	1530	384	170	97.0	63.4	44.7	33.2	25.4	20.1	16.3	11.3	8.29	6.35	5.02	4.06
		6.0 CA	8.92	1110	277	123	70.7	46.5	33.0	24.7	19.1	15.3	12.5	8.79	6.46	4.95	3.91	3.17
100 x	75 x	8.0 CA	10.2	1500	375	167	94.3	60.9	42.3	31.1	23.8	18.8	15.2	10.6	7.77	5.95	4.70	3.81
		6.0 CA	7.74	1090	273	121	69.3	45.5	32.2	24.0	18.5	14.7	11.9	8.25	6.06	4.64	3.67	2.97
75 x	50 x	6.0 CA	5.38	335	83.8	38.0	21.4	13.7	9.49	6.97	5.34	4.22	3.42	2.37	1.74	1.33	1.05	0.854
		5.0 CA	4.34	259	64.8	29.8	17.2	11.2	7.80	5.73	4.38	3.46	2.81	1.95	1.43	1.10	0.866	0.702
		4.0 CA	3.54	205	51.2	23.5	13.7	8.97	6.34	4.72	3.64	2.88	2.33	1.62	1.19	0.910	0.719	0.582

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

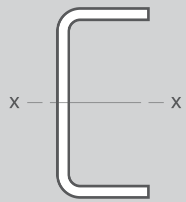


Table 15.3–1

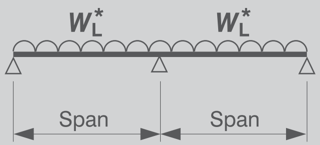
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

Profile channels

Two span continuous



Designation d x b_f x Nominal thickness (mm x mm x mm)	Mass per metre (kg/m)	Maximum design loads W_{L1max}^* (kN), Span, l (m): 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	W_{L2max}^* (kN)	FLR (m) C_b 1.0
300 x 90 x 8.0 CC	28.5	578	515	460	413	374	312	266	232	205	166	139	120	105	93.5	84.3	790	1.40
6.0 CC	21.6	476	420	372	333	300	249	212	184	162	131	110	94.6	83.0	73.9	66.5	677	1.31
250 x 90 x 6.0 CC	19.2	376	329	291	259	233	192	163	142	125	101	84.5	72.7	63.7	56.7	51.1	552	1.33
230 x 75 x 6.0 CC	16.9	326	283	248	220	197	162	137	119	105	84.4	70.6	60.7	53.2	47.4	42.7	503	1.11
200 x 75 x 6.0 CC	15.5	271	235	205	182	162	133	113	97.6	85.9	69.2	57.9	49.8	43.6	38.8	35.0	428	1.12
5.0 CC	12.4	209	178	155	136	121	99.0	83.5	72.1	63.4	51.0	42.6	36.6	32.1	28.5	25.7	356	1.10
180 x 75 x 5.0 CC	11.6	182	155	134	118	105	85.4	71.9	62.1	54.6	43.9	36.7	31.5	27.6	24.6	22.1	317	1.11
150 x 75 x 5.0 CC	10.5	143	121	105	91.6	81.4	66.3	55.8	48.1	42.3	34.0	28.4	24.4	21.4	19.0	17.1	258	1.12
125 x 65 x 4.0 CC	7.23	84.3	70.6	60.4	52.6	46.6	37.7	31.7	27.3	23.9	19.2	16.0	13.8	12.1	10.7	9.66	172	0.968
100 x 50 x 4.0 CC	5.59	58.6	48.6	41.3	35.9	31.7	25.6	21.5	18.5	16.2	13.0	10.8	9.30	8.14	7.24	6.52	133	0.762
75 x 40 x 4.0 CC	4.25	36.4	29.9	25.3	21.9	19.3	15.6	13.0	11.2	9.81	7.86	6.56	5.62	4.92	4.38	3.94	93.6	0.641

Notes:
1. Maximum design load $W_{L\,max}^*$ is equal to W_{L1max}^*.
2. W_{L1max}^* = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W_{L2max}^* = Maximum design load based on design shear capacity only.
4. FLR is the maximum unbraced segment length for full lateral restraint.
5. Beam spans to the right of the solid line must be braced at intervals equal to or less than the FLR value to have full lateral restraint.
6. All supports are assumed to provide full lateral restraint.
7. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
8. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

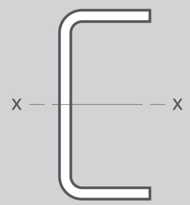


Table 15.3–2

Serviceability limit state

Maximum design loads

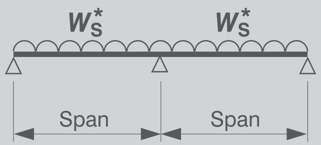
For beams *with* full lateral restraint
Bending about x-axis

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile channels

Two span continuous



Designation d	b_f	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) — Span, l (m) 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
mm	mm	mm	kg/m															
300	x 90	x 8.0 CC	28.5	6540	4180	2900	2130	1630	1050	726	533	408	261	182	133	102	80.7	65.4
		6.0 CC	21.6	4740	3030	2100	1550	1180	758	526	387	296	189	132	97.5	75.6	60.4	49.4
250	x 90	x 6.0 CC	19.2	3040	1950	1350	993	760	486	338	248	190	122	85.5	63.8	49.5	39.5	32.3
230	x 75	x 6.0 CC	16.9	2280	1460	1010	744	569	364	253	186	142	91.4	64.5	47.5	36.4	28.7	23.3
200	x 75	x 6.0 CC	15.5	1620	1040	722	530	406	260	180	133	102	66.1	46.2	33.9	26.0	20.5	16.6
		5.0 CC	12.4	1240	793	551	405	310	198	138	101	77.4	50.4	35.7	26.7	20.7	16.6	13.5
180	x 75	x 5.0 CC	11.6	962	616	428	314	241	154	107	78.6	60.3	39.6	28.1	21.0	16.3	13.0	10.6
150	x 75	x 5.0 CC	10.5	624	399	277	204	156	99.8	69.3	51.4	40.0	26.3	18.7	13.9	10.8	8.53	6.91
125	x 65	x 4.0 CC	7.23	296	190	132	96.7	74.0	47.4	33.3	24.9	19.4	12.8	9.06	6.77	5.21	4.12	3.34
100	x 50	x 4.0 CC	5.59	153	98.0	68.1	50.0	38.3	25.0	17.7	13.1	10.0	6.41	4.45	3.27	2.50	1.98	1.60
75	x 40	x 4.0 CC	4.25	67.6	43.2	30.0	22.1	16.9	10.8	7.51	5.52	4.22	2.70	1.88	1.38	1.06	0.834	0.676

Notes:
1. W^*_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Fixed ended beams

16

Contents

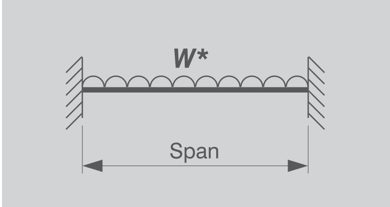
Page

Tables

Page

16.1 Scope

The tables in this section apply to **fixed ended beams** with **full lateral restraint** and with a **uniformly distributed load**. Separate tables are provided for the strength limit state and the serviceability limit state (deflection limit = span / 250). Tables are provided for the following cases:



- Angles bending about the n- and p-axes with:
  - long leg down
  - long leg up
  - short leg down
  - short leg up
- Channels bending about the x-axis

16.2 Design assumptions

16.2.1 Full lateral restraint

The beam span tables in this section assume that the beam has full lateral restraint. Full lateral restraint means that the beam is restrained continuously or at such close spacing that flexural-torsional buckling of the beam will not occur, and the design section moment capacity may be used to calculate the maximum design load.

Full lateral restraint is automatically provided for channels when the **compression flange** is firmly connected to floor decking, roof sheeting, floor joists or roof trusses or rafters, provided the connections are spaced at sufficiently close centres. An estimate of this spacing may be obtained from Section 7. Beams for which the design member moment capacity is equal to the design section moment capacity may be assumed to have full lateral restraint.

16.2.2 Loading through the shear centre

The tables assume loads and reactions are applied through the shear centre of the beam. In practice this does not always occur with angles and channels, but if the beam has full lateral restraint as assumed in these tables, twisting due to the load being eccentric to the shear centre may be prevented. In such cases these tables may be used, but caution should be taken to ensure that the lateral restraints are capable of preventing twisting of the beam.

16.3 Maximum design load

16.3.1 General

The strength limit state design load (W^*_L) and the serviceability limit state design load (W^*_S) are determined from the load combinations given in AS/NZS 1170 Structural Design Actions[6]. These design loads must not exceed the strength limit state **maximum design load** ($W^*_{L\,max}$) and the serviceability limit state **maximum design load** ($W^*_{S\,max}$), which are provided in the tables.

For strength: W^*_L (calculated) $\leq$ $W^*_{L\,max}$ (tabulated)

For serviceability: W^*_S (calculated) $\leq$ $W^*_{S\,max}$ (tabulated)

Beam self-weight: For all tables, the self-weight of the beam has not been deducted. The designer must include the self-weight of the beam as part of the dead load when calculating the design load W^*_L or W^*_S.

16.3.2 Strength limit state

The strength limit state maximum design load ($W^*_{L\,max}$) is the **lesser** of:

> The maximum design load (W^*_{L1max}) based on the design section moment capacity ($\phi_b M_s$) and the combined moment and shear capacity of the beam, and

> The maximum design load (W^*_{L2max}) based on the design section shear capacity ($\phi_v V_v$) of the beam.

$$W^*_{L\,max} = \min.\,[W^*_{L1max}\,;\,W^*_{L2max}\,]$$

Values of W^*_{L1max} and W^*_{L2max} are given in the strength limit state design tables.

16.3.3 Serviceability limit atate

The serviceability limit state maximum design load ($W^*_{S\,max}$) given in the tables is the load that will cause an elastic deflection in the beam of span / 250. In the tables provided, the maximum compressive stress under service load used to calculate the maximum design load ($W^*_{S\,max}$) is limited to the yield stress (f_y).

For beams with **deflection limits smaller than span / 250**, e.g. span / 500, these tables **can be used** conservatively to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For beams with **deflection limits larger than span / 250**, e.g. span / 125, these tables **can not be used** to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For such cases refer to Section 10 for deflection calculations of the beam.

16.4 Additional design checks

The following design action effects have not been taken into account in the tables, and should also be checked if appropriate:

> Web bearing (Section 8)

> Combined bending and bearing (Section 13)

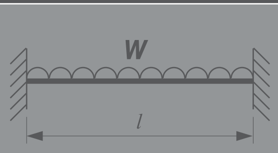
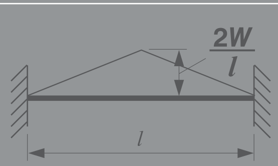
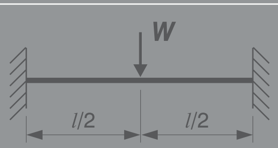
> Shear lag effects - short spans (Appendix A4)

16.5 Beam deflection calculations

The deflection calculations of beams subject to load configurations not covered in this manual can be performed using standard deflection formulae. Some of the frequently used deflection formulae are given in Figure 16.5(1). A more comprehensive set of beam deflection formulae is published by the ASI[9].

The second moment of area (I) to be used in these deflection calculations can be determined using the method given in Section 10.3.

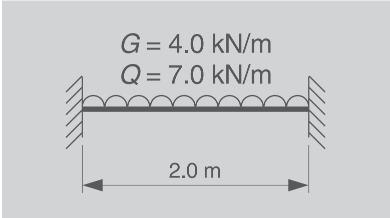
Figure 16.5(1) Deflection formulae

Fixed ended beams	
	$\Delta = \frac{1}{384}\frac{Wl^3}{EI}$
	$\Delta = \frac{1.4}{384}\frac{Wl^3}{EI}$
	$\Delta = \frac{1}{192}\frac{Wl^3}{EI}$
each force **W/(n-1)** 	$\Delta = \frac{k}{192(n-1)}\frac{Wl^3}{EI}$
n odd;	$k = \left(n - \frac{1}{n}\right)\left[1 - \frac{1}{2}\left(1 - \frac{1}{n^2}\right)\right]$
n even;	$k = n\left[3 - \frac{1}{2}\left(1 + \frac{4}{n^2}\right)\right] - 2\left(n - \frac{1}{n}\right)$

Note: Δ is the elastic deflection

16.6 Example

A fixed ended beam of 2.0 m span with full lateral restraint is required to support the following loads:



Dead load G = 4.0 kN/m
Live load Q = 7.0 kN/m

What size DuraGalUltra equal angle with leg up is required for a desired deflection limit of span / 250?

Solution:

Design loads and load combinations:

Strength: $1.2G + 1.5Q = 1.2 \times 4.0 + 1.5 \times 7.0$
$= 15.3$ kN/m

Design load $W^*_L = 15.3 \times 2.0$
$= 30.6$ kN

Serviceability: $G + 0.7Q = 4.0 + 0.7 \times 7.0$
$= 8.9$ kN/m

Design load $W^*_S = 8.9 \times 2.0$
$= 17.8$ kN

Select an angle size:

Strength: (Table 16.1–3(A))

Select 100 x 100 x 6.0 CA DuraGalUltra

$$W^*_{Lmax} = W^*_{L1max} = 37.5 \text{ kN} \quad > W^*_L = 30.6 \text{ kN}$$

Serviceability: (Table 16.1–4(A))

Check 100 x 100 x 6.0 CA DuraGalUltra

$$W^*_{Smax} = 77.2 \text{ kN} \quad > W^*_S = 17.8 \text{ kN}$$

The 100 x 100 x 6.0 CA DuraGalUltra is satisfactory for these strength and serviceability limit states.

Additional checks may be required as listed in Section 16.4 and to include the self-weight of the beam.

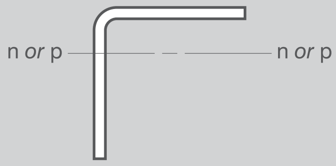


Table 16.1–1(A)

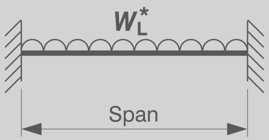
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
fixed ends



Designation			Mass per metre	Maximum design loads															
Leg size b_1	b_2	Nominal thickness		W^*_{L1max} (kN) Span, l (m)															W^*_{L2max} (kN)
mm	mm	mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	
150	150	8.0 CA	18.0	280	161	110	83.7	67.3	56.2	48.3	42.3	37.6	33.9	30.8	28.3	26.1	24.2	21.2	494
		6.0 CA	13.6	174	92.8	62.7	47.3	37.9	31.6	27.1	23.8	21.1	19.0	17.3	15.8	14.6	13.6	11.9	423
		5.0 CA	10.8	99.9	51.6	34.6	26.0	20.8	17.4	14.9	13.0	11.6	10.4	9.49	8.70	8.03	7.45	6.52	344
125	125	8.0 CA	14.9	229	132	90.7	68.8	55.4	46.3	39.7	34.8	31.0	27.9	25.4	23.2	21.5	19.9	17.4	402
		5.0 CA	8.95	89.4	46.5	31.2	23.5	18.8	15.7	13.4	11.8	10.5	9.42	8.56	7.85	7.25	6.73	5.89	283
		4.0 CA	7.27	54.8	28	18.7	14.1	11.3	9.39	8.05	7.05	6.26	5.64	5.13	4.7	4.34	4.03	3.52	231
100	100	8.0 CA	11.7	153	84.6	57.6	43.6	35.0	29.2	25.1	21.9	19.5	17.6	16.0	14.6	13.5	12.6	11.0	310
		6.0 CA	8.92	120	65.3	44.2	33.4	26.8	22.3	19.2	16.8	14.9	13.4	12.2	11.2	10.3	9.61	8.41	267
90	90	8.0 CA	10.5	125	68.3	46.4	35.0	28.1	23.4	20.1	17.6	15.7	14.1	12.8	11.8	10.8	10.1	8.82	273
		5.0 CA	6.37	69.3	36.4	24.5	18.4	14.8	12.3	10.6	9.24	8.22	7.40	6.72	6.16	5.69	5.28	4.62	198

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

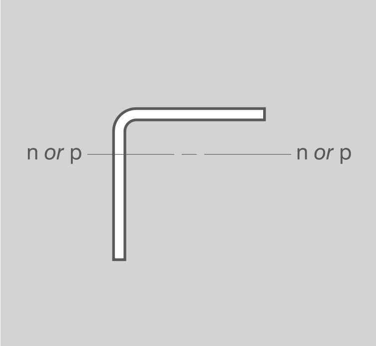


Table 16.1–1(B)

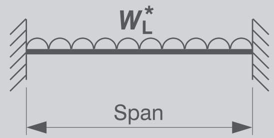
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
fixed ends



Designation: Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads: W^*_{L1max} (kN), Span, l (m)															W^*_{L2max} (kN)
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
75	75	8.0 CA	8.59	144	87.9	61.5	46.9	37.9	31.7	27.2	23.9	21.3	19.2	16.0	13.7	12.0	10.7	9.60	217
		6.0 CA	6.56	125	76.3	53.3	40.7	32.8	27.5	23.6	20.7	18.4	16.6	13.8	11.9	10.4	9.24	8.32	190
		5.0 CA	5.26	98.3	57.9	40.0	30.4	24.5	20.5	17.6	15.4	13.7	12.4	10.3	8.84	7.74	6.88	6.19	162
		4.0 CA	4.29	68.7	38.5	26.3	19.9	16.0	13.3	11.4	10.0	8.91	8.02	6.69	5.74	5.02	4.46	4.02	132
65	65	6.0 CA	5.62	97.4	57.5	39.8	30.3	24.4	20.4	17.5	15.3	13.7	12.3	10.3	8.80	7.70	6.85	6.16	159
		5.0 CA	4.52	80.4	46.6	32.1	24.4	19.6	16.4	14.1	12.3	11.0	9.89	8.25	7.08	6.19	5.51	4.96	137
		4.0 CA	3.69	59.7	33.6	23.0	17.4	14.0	11.7	10.0	8.77	7.80	7.02	5.85	5.02	4.39	3.91	3.52	113
50	50	6.0 CA	4.21	59.8	33.7	23.1	17.5	14.0	11.7	10.1	8.81	7.84	7.06	5.88	5.05	4.42	3.93	3.53	112
		5.0 CA	3.42	49.8	27.6	18.8	14.2	11.4	9.51	8.17	7.15	6.36	5.73	4.77	4.09	3.58	3.18	2.87	101
		4.0 CA	2.79	41	22.7	15.5	11.7	9.38	7.83	6.72	5.89	5.23	4.71	3.93	3.37	2.95	2.62	2.36	83.1
		2.5 CA	1.81	17.5	9.30	6.28	4.73	3.79	3.16	2.71	2.38	2.11	1.90	1.59	1.36	1.19	1.06	0.952	43.6
45	45	4.0 CA	2.50	33.7	18.3	12.4	9.39	7.54	6.29	5.40	4.73	4.20	3.78	3.15	2.70	2.37	2.10	1.89	73.3
		2.5 CA	1.62	15.7	8.39	5.67	4.27	3.43	2.86	2.45	2.15	1.91	1.72	1.43	1.23	1.07	0.955	0.859	38.8
40	40	4.0 CA	2.20	26.8	14.4	9.74	7.35	5.89	4.92	4.22	3.69	3.28	2.96	2.46	2.11	1.85	1.64	1.48	63.4
		2.5 CA	1.43	13.8	7.37	4.98	3.75	3.01	2.51	2.15	1.88	1.68	1.51	1.26	1.08	0.943	0.838	0.755	34.0
30	30	2.5 CA	1.06	7.86	4.10	2.75	2.07	1.66	1.38	1.19	1.04	0.923	0.831	0.692	0.594	0.519	0.462	0.416	24.3

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

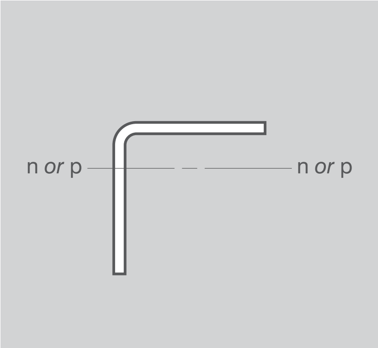


Table 16.1–2(A)

Serviceability limit state

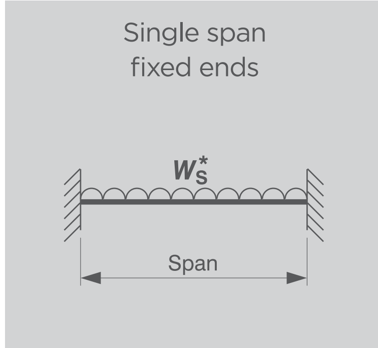
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN), Span, l (m)														
mm	mm	mm	kg/m	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	x 150	x 8.0 CA	18.0	4840	1210	538	303	194	135	98.9	75.7	59.8	48.4	40.5	35.4	31.2	27.7	22.4
		6.0 CA	13.6	2010	503	224	126	80.5	59.9	47.4	38.6	32.3	27.5	23.7	20.7	18.3	16.4	13.3
		5.0 CA	10.8	942	235	105	77.4	61.9	51.2	29.2	23.9	20.0	17.0	14.8	12.9	11.5	10.2	8.36
125	x 125	x 8.0 CA	14.9	3350	837	381	221	143	99.4	73.0	55.9	44.2	35.8	29.6	24.9	21.2	18.3	14.0
		5.0 CA	8.95	797	199	88.5	51.3.	36.7	27.8	22.0	18.0	15.0	12.8	11.1	9.67	8.55	7.63	6.21
		4.0 CA	7.27	417	104	57.9	43.5	34.5	18.3	14.5	11.9	9.95	8.48	7.34	6.43	5.69	5.09	4.15
100	x 100	x 8.0 CA	11.7	1750	441	198	112	71.4	49.6	36.4	27.9	22.0	17.8	14.7	12.4	10.6	9.11	6.97
		6.0 CA	8.92	1160	291	129	72.7	46.5	32.3	23.9	19.3	16.0	13.5	11.4	9.59	8.17	7.05	5.39
90	x 90	x 8.0 CA	10.5	1280	320	142	80.1	51.2	35.6	26.1	20.0	15.8	12.8	10.6	8.90	7.58	6.54	5.00
		5.0 CA	6.37	542	135	60.2	33.8	21.7	16.3	12.8	10.4	8.63	7.31	6.28	5.46	4.75	4.10	3.14

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

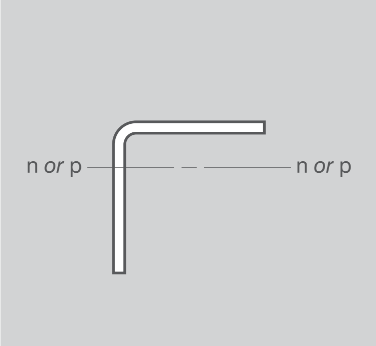


Table 16.1–2(B)

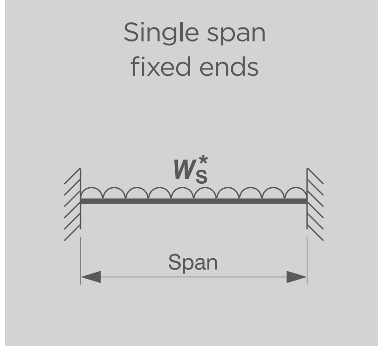
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 x b_2 x Nominal thickness (mm x mm x mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	2870	718	319	180	115	79.8	58.6	44.9	35.5	28.7	20.0	14.7	11.2	8.87	7.18
6.0 CA	6.56	2200	550	248	140	89.9	62.4	45.9	35.1	27.7	22.5	15.6	11.5	8.78	6.94	5.62
5.0 CA	5.26	1640	410	182	103	65.7	45.6	33.5	25.6	20.3	16.4	11.8	9.20	7.13	5.64	4.57
4.0 CA	4.29	965	241	107	60.3	38.6	26.8	19.7	15.1	12.6	10.7	8.05	6.32	5.12	4.25	3.59
65 x 65 x 6.0 CA	5.62	1430	357	159	89.4	57.2	39.7	29.2	22.3	17.7	14.3	9.93	7.30	5.59	4.41	3.57
5.0 CA	4.52	1110	277	127	73.1	46.8	32.5	23.9	18.3	14.4	11.7	8.12	5.97	4.57	3.61	2.92
4.0 CA	3.69	783	196	87.0	48.9	31.3	21.8	16.0	12.2	9.82	8.32	6.22	4.86	3.77	2.98	2.42
50 x 50 x 6.0 CA	4.21	618	155	68.7	38.6	24.7	17.2	12.6	9.66	7.63	6.18	4.29	3.15	2.41	1.91	1.55
5.0 CA	3.42	513	128	57.0	32.1	20.5	14.2	10.5	8.01	6.33	5.13	3.56	2.62	2.00	1.58	1.28
4.0 CA	2.79	410	104	47.4	26.7	17.1	11.8	8.70	6.66	5.27	4.27	2.96	2.18	1.67	1.32	1.07
2.5 CA	1.81	203	50.9	22.6	12.7	8.14	5.65	4.15	3.24	2.70	2.29	1.72	1.34	1.09	0.873	0.707
45 x 45 x 4.0 CA	2.50	302	76.6	34.0	19.1	12.3	8.51	6.25	4.79	3.78	3.06	2.13	1.56	1.20	0.945	0.766
2.5 CA	1.62	173	43.4	19.3	10.8	6.94	4.82	3.54	2.71	2.24	1.89	1.41	1.04	0.798	0.631	0.511
40 x 40 x 4.0 CA	2.20	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	0.652	0.528
2.5 CA	1.43	132	33.6	15.6	8.86	5.67	3.94	2.89	2.21	1.75	1.42	0.985	0.724	0.554	0.438	0.355
30 x 30 x 2.5 CA	1.06	57.4	14.4	6.42	3.61	2.31	1.61	1.18	0.903	0.713	0.578	0.401	0.295	0.226	0.178	0.144

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

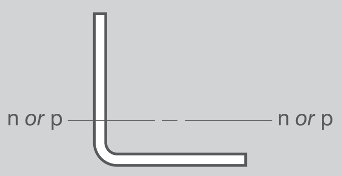


Table 16.1–3(A)

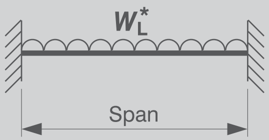
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
fixed ends



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W_{L1max}^* (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W_{L2max}^* (kN)
150	150	8.0 CA	18.0	313	187	130	99.0	79.8	66.8	57.4	50.3	44.7	40.3	36.7	33.6	31.0	28.8	25.2	494
		6.0 CA	13.6	261	154	107	81.4	65.6	54.8	47.1	41.3	36.7	33.1	30.1	27.6	25.5	23.7	20.7	423
		5.0 CA	10.8	203	104	69.6	52.2	41.8	34.8	29.8	26.1	23.2	20.9	19.0	17.4	16.1	14.9	13.0	344
125	125	8.0 CA	14.9	230	132	90.8	68.9	55.4	46.3	39.8	34.8	31.0	27.9	25.4	23.3	21.5	20.0	17.5	402
		5.0 CA	8.95	151	85.3	58.4	44.2	35.5	29.7	25.5	22.3	19.8	17.9	16.2	14.9	13.7	12.8	11.2	283
		4.0 CA	7.27	113	56.4	37.6	28.2	22.6	18.8	16.1	14.1	12.5	11.3	10.3	9.40	8.68	8.06	7.05	231
100	100	8.0 CA	11.7	153	84.6	57.6	43.6	35.0	29.2	25.1	21.9	19.5	17.6	16.0	14.6	13.5	12.6	11.0	310
		6.0 CA	8.92	132	72.8	49.6	37.5	30.1	25.1	21.6	18.9	16.8	15.1	13.7	12.6	11.6	10.8	9.46	267
90	90	8.0 CA	10.5	125	68.3	46.4	35.0	28.1	23.4	20.1	17.6	15.7	14.1	12.8	11.8	10.8	10.1	8.82	273
		5.0 CA	6.37	86.0	46.4	31.4	23.7	19.0	15.9	13.6	11.9	10.6	9.54	8.68	7.95	7.34	6.82	5.97	198

Notes:
1. Maximum design load $W_{L\,max}^*$ is equal to W_{L1max}^*.
2. W_{L1max}^* = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W_{L2max}^* = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

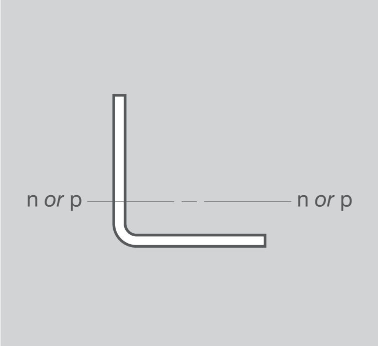


Table 16.1–3(B)

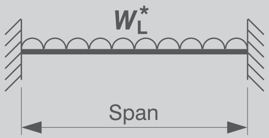
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
fixed ends



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
75	75	8.0 CA	8.59	144	87.9	61.5	46.9	37.9	31.7	27.2	23.9	21.3	19.2	16.0	13.7	12.0	10.7	9.6	217
		6.0 CA	6.56	125	76.3	53.3	40.7	32.8	27.5	23.6	20.7	18.4	16.6	13.8	11.9	10.4	9.24	8.32	190
		5.0 CA	5.26	103	61.7	42.9	32.7	26.3	22.0	18.9	16.6	14.8	13.3	11.1	9.52	8.33	7.41	6.67	162
		4.0 CA	4.29	83.3	49.6	34.5	26.2	21.1	17.7	15.2	13.3	11.9	10.7	8.91	7.64	6.69	5.94	5.35	132
65	65	6.0 CA	5.62	97.4	57.5	39.8	30.3	24.4	20.4	17.5	15.3	13.7	12.3	10.3	8.80	7.70	6.85	6.16	159
		5.0 CA	4.52	80.4	46.6	32.1	24.4	19.6	16.4	14.1	12.3	11.0	9.89	8.25	7.08	6.19	5.51	4.96	137
		4.0 CA	3.69	65.8	38.1	26.3	19.9	16.0	13.4	11.5	10.1	8.97	8.08	6.74	5.78	5.06	4.50	4.05	113
50	50	6.0 CA	4.21	59.8	33.7	23.1	17.5	14.0	11.7	10.1	8.81	7.84	7.06	5.88	5.05	4.42	3.93	3.53	112
		5.0 CA	3.42	49.8	27.6	18.8	14.2	11.4	9.51	8.17	7.15	6.36	5.73	4.77	4.09	3.58	3.18	2.87	101
		4.0 CA	2.79	41.0	22.7	15.5	11.7	9.38	7.83	6.72	5.89	5.23	4.71	3.93	3.37	2.95	2.62	2.36	83.1
		2.5 CA	1.81	20.8	11.4	7.75	5.85	4.70	3.92	3.36	2.95	2.62	2.36	1.97	1.69	1.48	1.31	1.18	43.6
45	45	4.0 CA	2.50	33.7	18.3	12.4	9.39	7.54	6.29	5.40	4.73	4.20	3.78	3.15	2.70	2.37	2.10	1.89	73.3
		2.5 CA	1.62	17.2	9.33	6.32	4.77	3.82	3.19	2.74	2.40	2.13	1.92	1.60	1.37	1.20	1.07	0.961	38.8
40	40	4.0 CA	2.20	26.8	14.4	9.74	7.35	5.89	4.92	4.22	3.69	3.28	2.96	2.46	2.11	1.85	1.64	1.48	63.4
		2.5 CA	1.43	13.8	7.37	4.98	3.75	3.01	2.51	2.15	1.89	1.68	1.51	1.26	1.08	0.944	0.839	0.755	34.0
30	30	2.5 CA	1.06	7.86	4.10	2.75	2.07	1.66	1.38	1.19	1.04	0.923	0.831	0.692	0.594	0.519	0.462	0.416	24.3

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

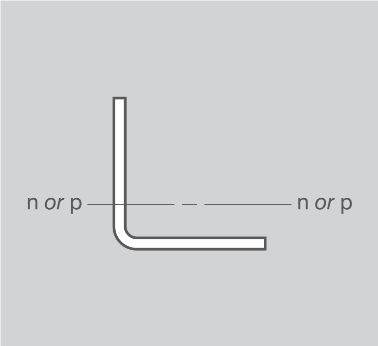


Table 16.1-4(A)

Serviceability limit state

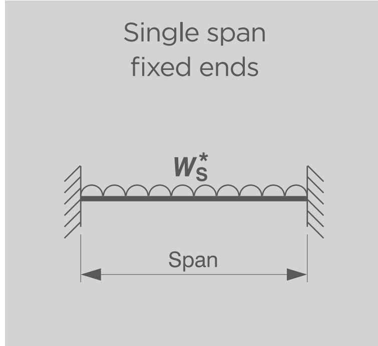
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 mm	b_2 mm	Nominal thickness mm	Mass per metre kg/m	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	150	8.0 CA	18.0	4840	1210	538	303	194	141	111	89.8	65.2	59.9	50.0	42.4	36.5	31.7	24.5
		6.0 CA	13.6	2010	503	240	155	110	83.0	65.4	53.2	44.3	37.6	32.4	28.2	24.9	22.1	17.7
		5.0 CA	10.8	942	310	205	95.5	68.2	51.8	41.0	33.4	27.9	23.8	20.5	18.0	15.9	14.2	11.5
125	125	8.0 CA	14.9	3350	837	372	209	134	95.3	71.1	55.2	44.1	35.8	29.6	24.9	21.2	18.3	14.0
		5.0 CA	8.95	797	205	111	71.9	51.2	38.7	30.5	24.8	20.7	17.6	15.1	13.2	11.6	10.3	8.07
		4.0 CA	7.27	417	174	73.3	47.5	33.9	25.7	20.3	16.6	13.9	11.8	10.2	8.90	7.86	7.01	5.69
100	100	8.0 CA	11.7	1750	438	195	110	71.4	49.6	36.4	27.9	22.0	17.8	14.7	12.4	10.6	9.11	6.97
		6.0 CA	8.92	1160	291	129	77.2	52.5	37.2	27.8	21.5	17.1	13.8	11.4	9.59	8.17	7.05	5.39
90	90	8.0 CA	10.5	1280	320	142	80.1	51.2	35.6	26.1	20.0	15.8	12.8	10.6	8.90	7.58	6.54	5.00
		5.0 CA	6.37	542	135	65.2	41.6	29.2	21.0	15.7	12.2	9.76	7.98	6.64	5.58	4.75	4.10	3.14

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

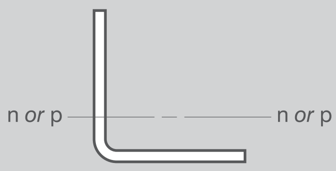


Table 16.1–4(B)

Serviceability limit state
Maximum design loads

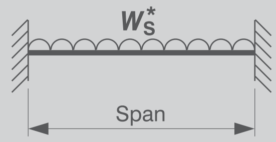
For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles

Single span
fixed ends



Designation Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) Span, l (m)														
mm	mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75	x 75	x 8.0 CA	8.59	2870	718	319	180	115	79.8	58.6	44.9	35.5	28.7	20.0	14.7	11.2	8.87	7.18
		6.0 CA	6.56	2200	550	244	137	87.9	62.0	45.9	35.1	27.7	22.5	15.6	11.5	8.78	6.94	5.62
		5.0 CA	5.26	1640	410	182	103	65.7	47.1	35.3	27.4	21.9	18.0	12.7	9.32	7.13	5.64	4.57
		4.0 CA	4.29	965	241	107	60.5	42.8	32.2	25.3	20.5	17.0	14.1	10.00	7.47	5.80	4.63	3.76
65	x 65	x 6.0 CA	5.62	1430	357	159	89.4	57.2	39.7	29.2	22.3	17.7	14.3	9.93	7.30	5.59	4.41	3.57
		5.0 CA	4.52	1110	277	123	69.3	44.9	31.8	23.7	18.3	14.4	11.7	8.12	5.97	4.57	3.61	2.92
		4.0 CA	3.69	783	196	87.0	48.9	33.3	24.9	18.7	14.5	11.6	9.52	6.71	4.93	3.77	2.98	2.42
50	x 50	x 6.0 CA	4.21	618	155	68.7	38.6	24.7	17.2	12.6	9.66	7.63	6.18	4.29	3.15	2.41	1.91	1.55
		5.0 CA	3.42	513	128	57.0	32.1	20.5	14.2	10.5	8.01	6.33	5.13	3.56	2.62	2.00	1.58	1.28
		4.0 CA	2.79	410	103	45.6	26.1	17.0	11.8	8.70	6.66	5.27	4.27	2.96	2.18	1.67	1.32	1.07
		2.5 CA	1.81	203	50.9	22.6	13.0	9.15	6.86	5.36	4.17	3.34	2.74	1.94	1.44	1.11	0.873	0.707
45	x 45	x 4.0 CA	2.50	302	75.4	33.5	19.1	12.3	8.51	6.25	4.79	3.78	3.06	2.13	1.56	1.20	0.945	0.766
		2.5 CA	1.62	173	43.4	19.3	10.8	7.57	5.39	4.03	3.13	2.50	2.04	1.42	1.04	0.798	0.631	0.511
40	x 40	x 4.0 CA	2.20	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	0.652	0.528
		2.5 CA	1.43	132	33.1	14.7	8.39	5.50	3.89	2.90	2.22	1.75	1.42	0.985	0.724	0.554	0.438	0.355
30	x 30	x 2.5 CA	1.06	57.4	14.4	6.42	3.61	2.31	1.61	1.18	0.903	0.713	0.578	0.401	0.295	0.226	0.178	0.144

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

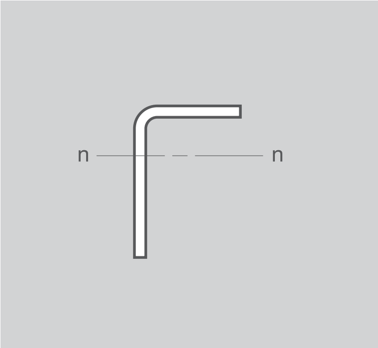


Table 16.2–1

Strength limit state

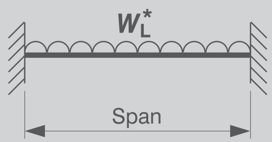
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Grade C450L0 / C400L0

Profile unequal angles

Single span
fixed ends



Designation Leg size b_1 × b_2 × Nominal thickness (mm × mm × mm)	Mass per metre (kg/m)	Maximum design loads $W^*_{\ell 1max}$ (kN) Sapn, ℓ (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	$W^*_{\ell 2max}$ (kN)
150 x 100 x 8.0 CA	14.9	404	286	211	165	135	114	98.2	86.3	76.9	69.4	58.0	49.8	43.6	38.8	35.0	494
6.0 CA	11.3	292	182	128	98.2	79.4	66.5	57.2	50.1	44.6	40.2	33.6	28.8	25.2	22.4	20.2	423
125 x 75 x 8.0 CA	11.7	316	216	157	122	99.5	83.7	72.1	63.4	56.5	50.9	42.5	36.5	32.0	28.4	25.6	402
6.0 CA	8.92	246	156	111	84.8	68.6	57.5	49.5	43.4	38.7	34.8	29.1	24.9	21.8	19.4	17.5	345
100 x 75 x 8.0 CA	10.2	228	147	105	81.0	65.6	55.0	47.4	41.6	37.0	33.4	27.8	23.9	20.9	18.6	16.8	310
6.0 CA	7.74	191	122	86.4	66.3	53.7	45.0	38.7	34.0	30.2	27.2	22.7	19.5	17.1	15.2	13.7	267
75 x 50 x 6.0 CA	5.38	120	71.8	49.9	38.0	30.6	25.6	22.0	19.3	17.2	15.5	12.9	11.1	9.68	8.61	7.75	190
5.0 CA	4.34	98.8	58.3	40.3	30.7	24.7	20.6	17.7	15.5	13.8	12.5	10.4	8.91	7.80	6.93	6.24	162
4.0 CA	3.54	70.8	39.9	27.3	20.7	16.6	13.9	11.9	10.4	9.29	8.36	6.97	5.98	5.23	4.65	4.19	132

Notes:
1. Maximum design load $W^*_{\ell\,max}$ is equal to $W^*_{\ell 1max}$.
2. $W^*_{\ell 1max}$ = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. $W^*_{\ell 2max}$ = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

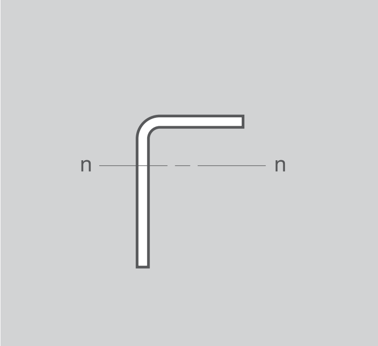


Table 16.2–2

Serviceability limit state

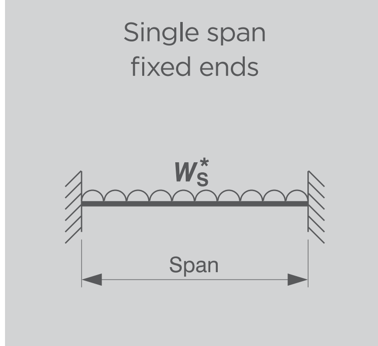
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation Leg size b_1 b_2 (mm mm) Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN) — Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x 8.0 CA	14.9	19400	4860	2160	1220	778	540	397	304	240	194	135	99.2	76.0	60.0	48.6
6.0 CA	11.3	8380	2090	931	524	335	233	171	131	103	83.8	59.3	46.8	38.1	31.8	27.0
125 x 75 x 8.0 CA	11.7	11900	2990	1330	746	478	332	244	187	147	119	82.9	60.9	46.6	36.9	29.9
6.0 CA	8.92	6590	1650	732	412	264	183	135	103	81.4	65.9	45.8	34.2	27.8	23.1	19.5
100 x 75 x 8.0 CA	10.2	6440	1610	716	403	258	179	131	101	79.5	64.4	44.7	32.9	25.2	19.9	16.1
6.0 CA	7.74	4620	1150	513	288	185	128	94.2	72.1	57.0	46.2	32.1	23.6	18.8	15.4	12.5
75 x 50 x 6.0 CA	5.38	1930	483	215	121	77.3	53.7	39.4	30.2	23.9	19.3	13.4	9.86	7.55	5.96	4.83
5.0 CA	4.34	1590	396	176	99.1	63.4	44.0	32.4	24.8	19.6	15.9	11.0	8.09	6.19	4.89	3.96
4.0 CA	3.54	980	245	109	61.2	39.2	27.2	20.0	15.3	12.3	10.4	7.84	6.13	4.95	4.04	3.27

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

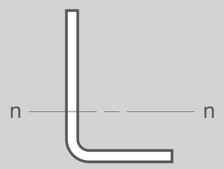


Table 16.2-3

Strength limit state

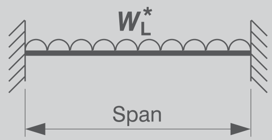
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Grade C450L0 / C400L0

Profile unequal angles

Single span
fixed ends



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	415	302	226	178	146	123	107	93.7	83.6	75.5	63.1	54.2	47.5	42.3	38.1	494
		6.0 CA	11.3	354	257	192	151	124	104	90.3	79.4	70.9	64.0	53.5	45.9	40.3	35.8	32.3	423
125	75	8.0 CA	11.7	316	216	157	122	99.5	83.7	72.1	63.4	56.5	50.9	42.5	36.5	32.0	28.4	25.6	402
		6.0 CA	8.92	272	186	135	105	85.4	71.9	62.0	54.4	48.5	43.7	36.5	31.4	27.5	24.4	22.0	345
100	75	8.0 CA	10.2	228	147	105	81.0	65.6	55.0	47.4	41.6	37.0	33.4	27.8	23.9	20.9	18.6	16.8	310
		6.0 CA	7.74	196	127	90.7	69.8	56.5	47.4	40.8	35.8	31.9	28.8	24.0	20.6	18.0	16.0	14.4	267
75	50	6.0 CA	5.38	120	71.8	49.9	38.0	30.6	25.6	22.0	19.3	17.2	15.5	12.9	11.1	9.68	8.61	7.75	190
		5.0 CA	4.34	98.8	58.3	40.3	30.7	24.7	20.6	17.7	15.5	13.8	12.5	10.4	8.91	7.80	6.93	6.24	162
		4.0 CA	3.54	81.0	47.7	33.0	25.1	20.2	16.9	14.5	12.7	11.3	10.2	8.51	7.30	6.39	5.68	5.11	132

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

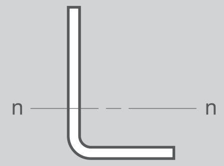


Table 16.2–4

Serviceability limit state

Maximum design loads

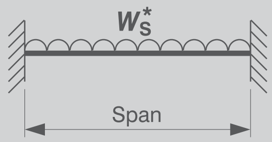
For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Single span
fixed ends



Designation: Leg size b_1 x b_2, Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) — Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x 8.0 CA	14.9	19400	4840	2150	1210	775	538	395	303	239	194	137	107	85.7	67.7	54.8
6.0 CA	11.3	10200	2540	1130	635	407	282	208	167	138	116	86.5	67.3	54.1	44.6	37.5
125 x 75 x 8.0 CA	11.7	11900	2990	1330	746	478	332	244	187	147	119	82.9	60.9	46.6	36.9	29.9
6.0 CA	8.92	7210	1800	801	451	288	200	147	116	95.6	80.4	59.4	45.9	36.0	28.4	23.0
100 x 75 x 8.0 CA	10.2	6440	1610	716	403	258	179	131	101	79.5	64.4	44.7	32.9	25.2	19.9	16.1
6.0 CA	7.74	4690	1170	521	293	188	130	95.8	75.6	61.4	50.0	34.7	25.5	19.5	15.4	12.5
75 x 50 x 6.0 CA	5.38	1930	483	215	121	77.3	53.7	39.4	30.2	23.9	19.3	13.4	9.86	7.55	5.96	4.83
5.0 CA	4.34	1590	396	176	99.1	63.4	44.0	32.4	24.8	19.6	15.9	11.0	8.09	6.19	4.89	3.96
4.0 CA	3.54	1060	264	117	66.0	43.4	32.1	24.9	19.9	16.2	13.1	9.09	6.68	5.11	4.04	3.27

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

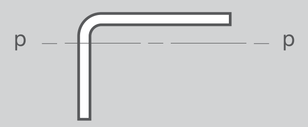


Table 16.2-5

Strength limit state

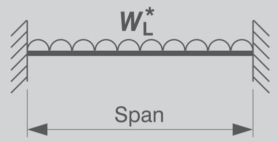
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Grade C450L0 / C400L0

Profile unequal angles

Single span
fixed ends



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	238	159	115	89.0	72.3	60.8	52.4	46.0	41.0	36.9	30.8	26.5	23.2	20.6	18.6	310
		6.0 CA	11.3	186	117	82.4	63.1	51.0	42.8	36.8	32.2	28.7	25.9	21.6	18.5	16.2	14.4	13.0	267
125	75	8.0 CA	11.7	150	93.2	65.6	50.2	40.6	34.0	29.2	25.6	22.8	20.5	17.1	14.7	12.9	11.4	10.3	217
		6.0 CA	8.92	130	80.7	56.8	43.4	35.1	29.4	25.3	22.2	19.7	17.8	14.8	12.7	11.1	9.90	8.91	190
100	75	8.0 CA	10.2	147	91.1	63.9	48.9	39.5	33.1	28.4	24.9	22.2	20.0	16.7	14.3	12.5	11.1	10.0	217
		6.0 CA	7.74	128	78.9	55.4	42.3	34.2	28.6	24.6	21.6	19.2	17.3	14.4	12.4	10.8	9.63	8.67	190
75	50	6.0 CA	5.38	62.4	35.7	24.5	18.5	14.9	12.5	10.7	9.37	8.34	7.51	6.26	5.37	4.70	4.18	3.76	112
		5.0 CA	4.34	51.9	29.0	19.8	15.0	12.0	10.1	8.63	7.56	6.72	6.05	5.05	4.33	3.79	3.37	3.03	101
		4.0 CA	3.54	42.8	23.9	16.3	12.3	9.90	8.27	7.10	6.22	5.53	4.98	4.15	3.56	3.11	2.77	2.49	83.1

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

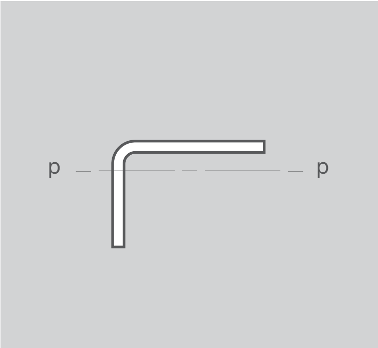


Table 16.2–6

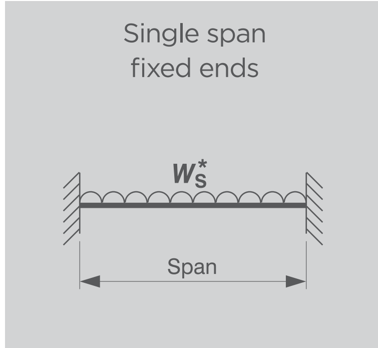
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Deflection LIMIT = SPAN / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
mm	mm	mm	kg/m															
150 x	100 x	8.0 CA	14.9	7300	1830	812	463	304	216	161	125	99.4	80.9	56.2	41.3	31.6	25.0	20.2
		6.0 CA	11.3	3140	784	348	206	150	115	91.3	72.3	57.1	46.3	32.1	24.4	19.7	16.4	13.9
125 x	75 x	8.0 CA	11.7	3190	796	361	208	135	93.7	68.9	52.7	41.7	33.7	23.4	17.2	13.2	10.4	8.44
		6.0 CA	8.92	2300	576	264	153	101	71.1	53.0	41.0	32.5	26.3	18.3	13.4	10.3	8.11	6.57
100 x	75 x	8.0 CA	10.2	3110	778	350	198	126	87.8	64.5	49.4	39.0	31.6	22.0	16.1	12.4	9.76	7.90
		6.0 CA	7.74	2270	567	258	150	97.8	68.5	50.3	38.5	30.5	24.7	17.1	12.6	9.64	7.61	6.17
75 x	50 x	6.0 CA	5.38	696	177	78.8	44.3	28.4	19.7	14.5	11.1	8.76	7.09	4.93	3.62	2.77	2.19	1.77
		5.0 CA	4.34	538	138	64.0	36.4	23.3	16.2	11.9	9.10	7.19	5.82	4.05	2.97	2.28	1.80	1.46
		4.0 CA	3.54	425	109	51.0	29.5	19.3	13.4	9.87	7.55	5.97	4.83	3.36	2.47	1.89	1.49	1.21

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

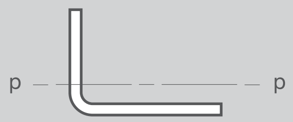


Table 16.2–7

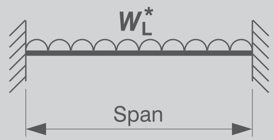
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Grade C450L0 / C400L0

Profile unequal angles

Single span
fixed ends



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	238	159	115	89.0	72.3	60.8	52.4	46.0	41.0	36.9	30.8	26.5	23.2	20.6	18.6	310
		6.0 CA	11.3	203	134	96.6	74.6	60.5	50.8	43.8	38.4	34.2	30.9	25.8	22.1	19.4	17.2	15.5	267
125	75	8.0 CA	11.7	150	93.2	65.6	50.2	40.6	34.0	29.2	25.6	22.8	20.5	17.1	14.7	12.9	11.4	10.3	217
		6.0 CA	8.92	129	80.2	56.3	43.1	34.8	29.2	25.1	22.0	19.6	17.6	14.7	12.6	11.0	9.82	8.84	190
100	75	8.0 CA	10.2	147	91.1	63.9	48.9	39.5	33.1	28.4	24.9	22.2	20.0	16.7	14.3	12.5	11.1	10.0	217
		6.0 CA	7.74	128	78.9	55.4	42.3	34.2	28.6	24.6	21.6	19.2	17.3	14.4	12.4	10.8	9.63	8.67	190
75	50	6.0 CA	5.38	62.4	35.7	24.5	18.5	14.9	12.5	10.7	9.37	8.34	7.51	6.26	5.37	4.70	4.18	3.76	112
		5.0 CA	4.34	51.9	29.0	19.8	15.0	12.0	10.1	8.63	7.56	6.72	6.05	5.05	4.33	3.79	3.37	3.03	101
		4.0 CA	3.54	42.5	23.7	16.2	12.2	9.83	8.21	7.05	6.17	5.49	4.94	4.12	3.53	3.09	2.75	2.47	83.1

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

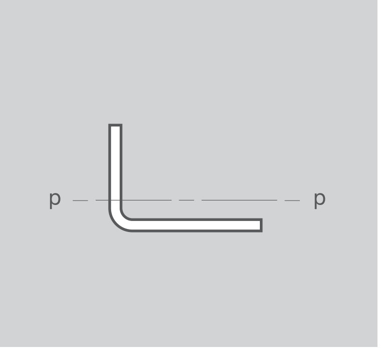


Table 16.2–8

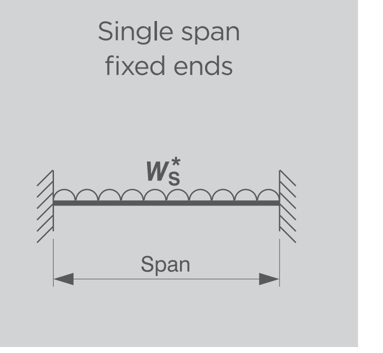
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 b_2, Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) — Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x 8.0 CA	14.9	7450	1860	827	465	298	207	154	119	94.7	77.3	54.4	40.4	31.2	24.9	20.2
6.0 CA	11.3	4780	1200	532	299	191	133	99.2	80.1	66.3	54.6	38.9	29.1	22.7	18.2	14.9
125 x 75 x 8.0 CA	11.7	3190	796	354	199	128	90.2	67.2	52.1	41.5	33.7	23.4	17.2	13.2	10.4	8.44
6.0 CA	8.92	2300	576	256	144	92.7	65.9	49.3	38.4	30.7	25.2	17.8	13.2	10.2	8.11	6.57
100 x 75 x 8.0 CA	10.2	3110	778	346	194	124	87.5	64.5	49.4	39.0	31.6	22.0	16.1	12.4	9.76	7.90
6.0 CA	7.74	2270	567	252	142	91.0	64.5	48.2	37.4	29.9	24.4	17.1	12.6	9.64	7.61	6.17
75 x 50 x 6.0 CA	5.38	696	174	77.3	44.3	28.4	19.7	14.5	11.1	8.76	7.09	4.93	3.62	2.77	2.19	1.77
5.0 CA	4.34	538	135	59.8	34.6	22.7	16.0	11.9	9.10	7.19	5.82	4.05	2.97	2.28	1.80	1.46
4.0 CA	3.54	425	106	47.3	27.3	18.0	12.7	9.51	7.38	5.89	4.81	3.36	2.47	1.89	1.49	1.21

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

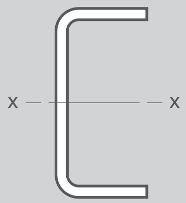


Table 16.3–1

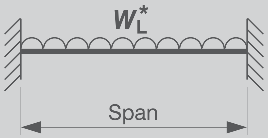
Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

Profile channels

Single span
fixed ends



Designation Nominal d (mm)	b_f (mm)	thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	W^*_{L2max} (kN)	FLR (m) C_b 1.0
300	90	8.0 CC	28.5	780	709	643	585	535	452	390	341	303	246	207	179	157	140	126	988	1.40
		6.0 CC	21.6	647	582	525	475	431	363	311	271	240	195	164	141	124	110	99.6	846	1.31
250	90	6.0 CC	19.2	514	460	412	371	336	281	240	210	185	150	126	109	95.3	84.9	76.5	691	1.33
230	75	6.0 CC	16.9	449	398	354	317	286	238	203	176	156	126	106	90.8	79.6	70.9	63.9	628	1.11
200	75	6.0 CC	15.5	375	331	293	262	236	196	167	145	128	103	86.5	74.4	65.3	58.1	52.4	535	1.12
		5.0 CC	12.4	292	254	223	198	177	146	124	107	94.4	76.2	63.7	54.8	48.0	42.7	38.5	445	1.10
180	75	5.0 CC	11.6	255	221	193	171	153	126	107	92.4	81.3	65.6	54.9	47.2	41.3	36.8	33.1	396	1.11
150	75	5.0 CC	10.5	201	174	151	134	119	98.0	82.9	71.7	63.1	50.8	42.5	36.5	32.0	28.5	25.6	323	1.12
125	65	4.0 CC	7.23	120	102	88.2	77.4	68.7	56.0	47.2	40.7	35.8	28.8	24.0	20.6	18.1	16.1	14.5	216	0.968
100	50	4.0 CC	5.59	84.4	70.8	60.7	53.0	46.9	38.1	32.0	27.6	24.2	19.4	16.2	13.9	12.2	10.9	9.77	166	0.762
75	40	4.0 CC	4.25	52.8	43.9	37.4	32.5	28.7	23.2	19.4	16.7	14.7	11.8	9.83	8.43	7.38	6.56	5.91	117	0.641

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. FLR is the maximum unbraced segment length for full lateral restraint.
5. Beam spans to the right of the solid line must be braced at intervals equal to or less than the FLR value to have full lateral restraint.
6. All supports are assumed to provide full lateral restraint.
7. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
8. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

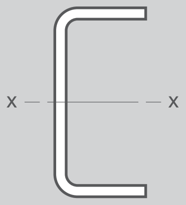


Table 16.3–2

Serviceability limit state
Maximum design loads

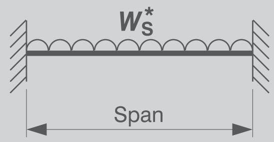
For beams *with* full lateral restraint
Bending about x-axis

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile channels

Single span
fixed ends



Designation Nominal d × b_f × thickness (mm × mm × mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN) — Span, l (m): 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
300 x 90 x 8.0 CC	28.5	13600	8680	6030	4430	3390	2170	1510	1110	848	543	377	277	212	167	136
6.0 CC	21.6	9830	6290	4370	3210	2460	1570	1090	802	614	393	273	201	154	122	99.5
250 x 90 x 6.0 CC	19.2	6310	4040	2800	2060	1580	1010	701	515	394	252	175	129	99.4	79.5	65.1
230 x 75 x 6.0 CC	16.9	4730	3020	2100	1540	1180	756	525	386	295	189	131	96.9	75.1	59.7	48.3
200 x 75 x 6.0 CC	15.5	3370	2160	1500	1100	843	539	375	275	211	135	94.0	70.0	53.9	42.6	34.5
5.0 CC	12.4	2570	1650	1140	840	643	412	286	210	161	103	71.5	53.4	41.5	33.2	27.2
180 x 75 x 5.0 CC	11.6	2000	1280	888	652	499	320	222	163	125	79.9	56.2	42.0	32.7	26.2	21.4
150 x 75 x 5.0 CC	10.5	1300	829	576	423	324	207	144	106	81.0	52.5	37.3	27.9	21.7	17.4	14.2
125 x 65 x 4.0 CC	7.23	615	393	273	201	154	98.3	68.3	50.2	38.7	25.5	18.1	13.6	10.5	8.43	6.90
100 x 50 x 4.0 CC	5.59	318	203	141	104	79.5	50.9	35.4	26.5	20.6	13.3	9.24	6.79	5.20	4.11	3.33
75 x 40 x 4.0 CC	4.25	140	89.8	62.3	45.8	35.1	22.4	15.6	11.4	8.77	5.61	3.90	2.86	2.19	1.73	1.40

Notes: 1. W^*_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Cantilever beams

17

Contents

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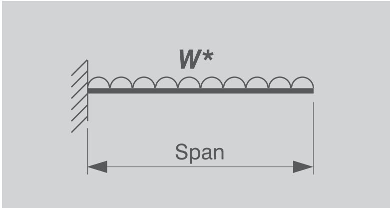
Tables

Page

17.1 Scope

The tables in this section apply to **cantilever beams** with **full lateral restraint** and with a **uniformly distributed load**. Separate tables are provided for the strength limit state and the serviceability limit state (deflection limit = span / 250). Tables are provided for the following cases:



- Angles bending about the n- and p-axes with:
  - long leg down
  - long leg up
  - short leg down
  - short leg up
- Channels bending about the x-axis

17.2 Design assumptions

17.2.1 Full lateral restraint

The beam span tables in this section assume that the beam has full lateral restraint. Full lateral restraint means that the beam is restrained continuously or at such close spacing that flexural-torsional buckling of the beam will not occur, and the design section moment capacity may be used to calculate the maximum design load.

Full lateral restraint is automatically provided for channels when the **compression flange** is firmly connected to floor decking, roof sheeting, floor joists or roof trusses or rafters, provided the connections are spaced at sufficiently close centres. An estimate of this spacing may be obtained from Section 7. Beams for which the design member moment capacity is equal to the design section moment capacity may be assumed to have full lateral restraint.

17.2.2 Loading through the shear centre

The tables assume loads and reactions are applied through the shear centre of the beam. In practice this does not always occur with angles and channels, but if the beam has full lateral restraint as assumed in these tables, twisting due to the load being eccentric to the shear centre may be prevented. In such cases these tables may be used, but caution should be taken to ensure that the lateral restraints are capable of preventing twisting of the beam.

17.3 Maximum design load

17.3.1 General

The strength limit state design load (W^*_L) and the serviceability limit state design load (W^*_S) are determined from the load combinations given in AS/NZS 1170 Structural Design Actions[6]. These design loads must not exceed the strength limit state **maximum design load** ($W^*_{L\,max}$) and the serviceability limit state **maximum design load** ($W^*_{S\,max}$), which are provided in the tables.

For strength: W^*_L (calculated) $\leq$ $W^*_{L\,max}$ (tabulated)

For serviceability: W^*_S (calculated) $\leq$ $W^*_{S\,max}$ (tabulated)

Beam self-weight: For all tables, the self-weight of the beam has not been deducted. The designer must include the self-weight of the beam as part of the dead load when calculating the design load W^*_L or W^*_S.

17.3.2 Strength limit state

The strength limit state maximum design load ($W^*_{L\,max}$) is the **lesser** of:

> The maximum design load (W^*_{L1max}) based on the design section moment capacity ($\phi_b M_s$) and the combined moment and shear capacity of the beam, and

> The maximum design load (W^*_{L2max}) based on the design section shear capacity ($\phi_v V_v$) of the beam.

$$W^*_{L\,max} = \min.\,[W^*_{L1max}\,;\,W^*_{L2max}\,]$$

Values of W^*_{L1max} and W^*_{L2max} are given in the strength limit state design tables.

17.3.3 Serviceability limit state

The serviceability limit state maximum design load ($W^*_{S\,max}$) given in the tables is the load that will cause an elastic deflection in the beam of span / 250. In the tables provided, the maximum compressive stress under service load used to calculate the maximum design load ($W^*_{S\,max}$) is limited to the yield stress (f_y).

For beams with **deflection limits smaller than span / 250**, e.g. span / 500, these tables **can be used** conservatively to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For beams with **deflection limits larger than span / 250**, e.g. span / 125, these tables **can not be used** to pro rata the maximum serviceability design load ($W^*_{S\,max}$). For such cases refer to Section 10 for deflection calculations of the beam.

17.4 Additional design checks

the following design action effects have not been taken into account in the tables, and should also be checked if appropriate:

> Web bearing (Section 8)

> Combined bending and bearing (Section 13)

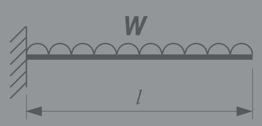
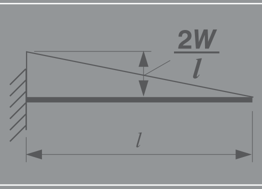
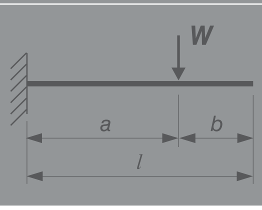
> Shear lag effects - short spans (Appendix A4)

17.5 Beam deflection calculations

The deflection calculations of beams subject to load configurations not covered in this manual can be performed using standard deflection formulae. Some of the frequently used deflection formulae are given in Figure 17.5(1). A more comprehensive set of beam deflection formulae is published by the ASI[9].

The second moment of area (I) to be used in these deflection calculations can be determined using the method given in Section 10.3.

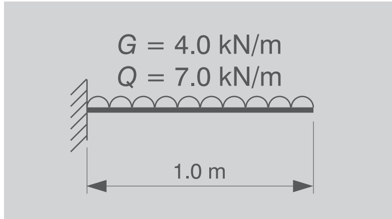
Figure 17.5(1) Deflection formulae

Cantilever beams	
	$\Delta = \frac{1}{8}\frac{Wl^3}{EI}$
	$\Delta = \frac{1}{15}\frac{Wl^3}{EI}$
	$\Delta = \frac{Wa^3}{3EI}\left(1 + \frac{3b}{2a}\right)$

Note: Δ is the elastic deflection

17.6 Example

A cantilever beam 1.0 m long with full lateral restraint is required to support the following loads:



Dead load G = 4.0 kN/m
Live load Q = 7.0 kN/m

What size DuraGalUltra equal angle with leg up is required for a desired deflection limit of span / 250?

Solution:

Design loads and load combinations:

Strength:		$1.2G + 1.5Q$	= 1.2 x 4.0 + 1.5 x 7.0
			= 15.3 kN/m
	Design load	W^*_L	= 15.3 x 1.0
			= 15.3 kN
Serviceability:		$G + 0.7Q$	= 4.0 + 0.7 x 7.0
			= 8.9 kN/m
	Design load	W^*_S	= 8.9 x 1.0
			= 8.9 kN

Select an angle size:

Strength: (Table 17.1–3(A))

Select 150 x 150 x 5.0 CA DuraGalUltra

$W^*_{Lmax} = W^*_{L1max}$ = 20.8 kN > W^*_L = 15.3 kN

Serviceability: (Table 17.1–4(A))

Check 150 x 150 x 5.0 CA DuraGalUltra

W^*_{Smax} = 17.4 kN > W^*_S = 8.9 kN

The 150 x 150 x 5.0 CA DuraGalUltra is satisfactory for these strength and serviceability limit states.

Additional checks may be required as listed in Section 16.4 and to include the self-weight of the beam.

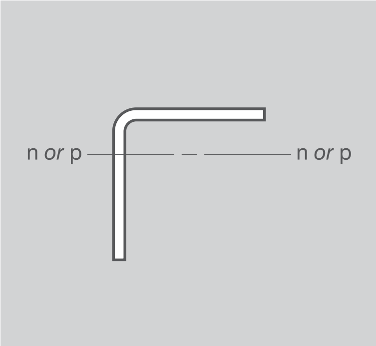


Table 17.1–1(A)

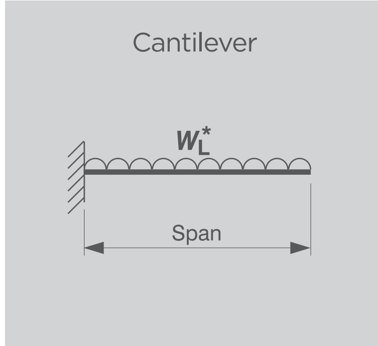
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	150	8.0 CA	18.0	55.2	28.1	18.8	14.1	11.3	9.43	8.08	7.07	6.29	5.66	5.14	4.72	4.35	4.04	3.54	247
		6.0 CA	13.6	31.4	15.8	10.6	7.92	6.34	5.29	4.53	3.96	3.52	3.17	2.88	2.64	2.44	2.27	1.98	212
		5.0 CA	10.8	17.3	8.69	5.80	4.35	3.48	2.90	2.48	2.17	1.93	1.74	1.58	1.45	1.34	1.24	1.09	172
125	125	8.0 CA	14.9	45.4	23.1	15.5	11.6	9.30	7.76	6.65	5.82	5.17	4.66	4.23	3.88	3.58	3.33	2.91	201
		5.0 CA	8.95	15.6	7.84	5.23	3.92	3.14	2.62	2.24	1.96	1.74	1.57	1.43	1.31	1.21	1.12	0.982	142
		4.0 CA	7.27	9.37	4.70	3.13	2.35	1.88	1.57	1.34	1.17	1.04	0.94	0.855	0.783	0.723	0.671	0.588	115
100	100	8.0 CA	11.7	28.8	14.6	9.76	7.32	5.86	4.89	4.19	3.66	3.26	2.93	2.67	2.44	2.26	2.09	1.83	155
		6.0 CA	8.92	22.1	11.2	7.46	5.60	4.48	3.74	3.20	2.80	2.49	2.24	2.04	1.87	1.73	1.60	1.40	134
90	90	8.0 CA	10.5	23.2	11.7	7.83	5.88	4.70	3.92	3.36	2.94	2.61	2.35	2.14	1.96	1.81	1.68	1.47	136
		5.0 CA	6.37	12.2	6.16	4.11	3.08	2.47	2.06	1.76	1.54	1.37	1.23	1.12	1.03	0.949	0.881	0.771	99.0

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

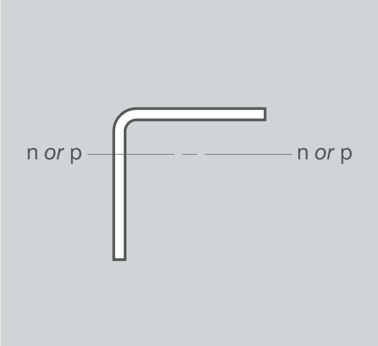


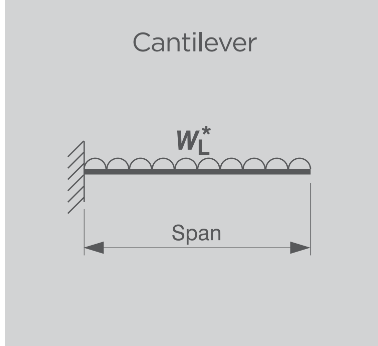
Table 17.1–1(B)

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1	b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
mm	mm	mm	kg/m																
75	75	8.0 CA	8.59	30.7	15.9	10.6	7.99	6.40	5.33	4.57	4.00	3.56	3.20	2.67	2.29	2.00	1.78	1.60	109
		6.0 CA	6.56	26.6	13.7	9.21	6.92	5.54	4.62	3.96	3.47	3.08	2.78	2.31	1.98	1.74	1.54	1.39	94.9
		5.0 CA	5.26	20.0	10.2	6.86	5.15	4.13	3.44	2.95	2.58	2.29	2.07	1.72	1.48	1.29	1.15	1.03	80.8
		4.0 CA	4.29	13.1	6.66	4.46	3.34	2.68	2.23	1.91	1.67	1.49	1.34	1.12	0.957	0.837	0.744	0.67	66.2
65	65	6.0 CA	5.62	19.9	10.2	6.83	5.13	4.11	3.42	2.94	2.57	2.28	2.06	1.71	1.47	1.29	1.14	1.03	79.3
		5.0 CA	4.52	16.1	8.21	5.49	4.13	3.30	2.75	2.36	2.07	1.84	1.65	1.38	1.18	1.03	0.918	0.827	68.6
		4.0 CA	3.69	11.5	5.83	3.90	2.93	2.34	1.95	1.67	1.46	1.30	1.17	0.977	0.837	0.733	0.651	0.586	56.3
50	50	6.0 CA	4.21	11.5	5.86	3.92	2.94	2.35	1.96	1.68	1.47	1.31	1.18	0.982	0.842	0.737	0.655	0.589	56.0
		5.0 CA	3.42	9.39	4.76	3.18	2.39	1.91	1.59	1.36	1.19	1.06	0.956	0.796	0.683	0.597	0.531	0.478	50.3
		4.0 CA	2.79	7.73	3.92	2.62	1.96	1.57	1.31	1.12	0.983	0.874	0.787	0.656	0.562	0.492	0.437	0.393	41.6
		2.5 CA	1.81	3.14	1.58	1.06	0.793	0.634	0.529	0.453	0.397	0.353	0.317	0.264	0.227	0.198	0.176	0.159	21.8
45	45	4.0 CA	2.50	6.22	3.15	2.10	1.58	1.26	1.05	0.902	0.789	0.701	0.631	0.526	0.451	0.395	0.351	0.316	36.6
		2.5 CA	1.62	2.83	1.43	0.954	0.716	0.573	0.477	0.409	0.358	0.318	0.287	0.239	0.205	0.179	0.159	0.143	19.4
40	40	4.0 CA	2.20	4.87	2.46	1.64	1.23	0.986	0.822	0.704	0.616	0.548	0.493	0.411	0.352	0.308	0.274	0.247	31.7
		2.5 CA	1.43	2.49	1.25	0.838	0.629	0.503	0.419	0.359	0.314	0.279	0.252	0.210	0.180	0.157	0.140	0.126	17.0
30	30	2.5 CA	1.06	1.38	0.692	0.461	0.346	0.277	0.231	0.198	0.173	0.154	0.139	0.115	-	-	-	-	12.1

Notes: 1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm $f_y = 350$ MPa and $f_u = 400$ MPa, for 2.5 mm < $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.
6. Values are not listed below 0.100 kN.

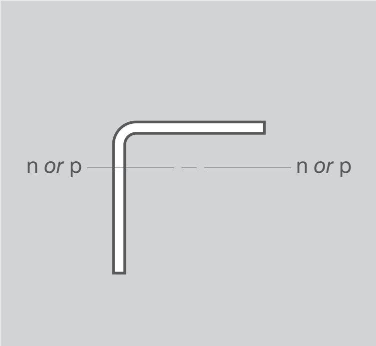


Table 17.1–2(A)

Serviceability limit state

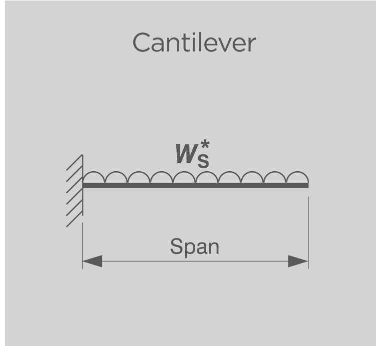
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	150	8.0 CA	18.0	101	29.9	14.6	8.21	5.26	3.65	2.68	2.05	1.62	1.31	1.09	0.913	0.778	0.671	0.513
		6.0 CA	13.6	51.5	17.7	9.41	5.96	4.03	2.80	2.05	1.57	1.24	1.01	0.832	0.699	0.596	0.514	0.393
		5.0 CA	10.8	31.8	11.1	5.99	3.84	2.71	2.03	1.59	1.25	0.991	0.803	0.663	0.557	0.475	0.409	0.314
125	125	8.0 CA	14.9	74.5	18.7	8.30	4.67	2.99	2.07	1.52	1.17	0.922	0.747	0.617	0.519	0.442	0.381	0.292
		5.0 CA	8.95	24.0	8.28	4.40	2.79	1.84	1.28	0.938	0.718	0.567	0.460	0.380	0.319	0.272	0.234	0.180
		4.0 CA	7.27	15.8	5.53	2.97	1.90	1.34	1.00	0.767	0.587	0.464	0.376	0.311	0.261	0.222	0.192	0.147
100	100	8.0 CA	11.7	37.2	9.29	4.13	2.32	1.49	1.03	0.759	0.581	0.459	0.372	0.307	0.258	0.220	0.190	0.145
		6.0 CA	8.92	25.7	7.19	3.20	1.80	1.15	0.799	0.587	0.450	0.355	0.288	0.238	0.200	0.170	0.147	0.112
90	90	8.0 CA	10.5	26.7	6.67	2.97	1.67	1.07	0.741	0.545	0.417	0.329	0.267	0.221	0.185	0.158	0.136	0.104
		5.0 CA	6.37	13.9	4.18	1.86	1.05	0.669	0.465	0.341	0.261	0.207	0.167	0.138	0.116	0.0990	0.0854	0.0654

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \le 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

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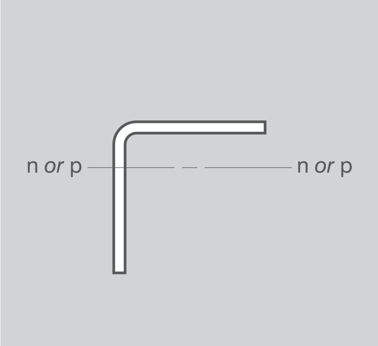


Table 17.1–2(B)

Serviceability limit state

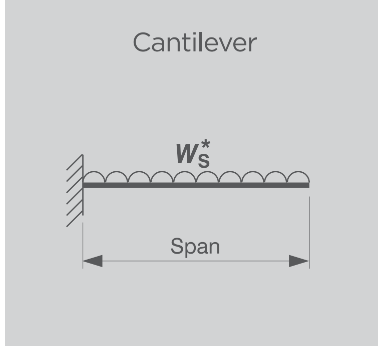
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 x b_2 x Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN)														
		Span, l (m)														
mm x mm x mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	59.9	15.0	6.65	3.74	2.39	1.66	1.22	0.935	0.739	0.599	0.416	0.305	0.234	0.185	0.150
6.0 CA	6.56	46.8	11.7	5.20	2.93	1.87	1.30	0.955	0.731	0.578	0.468	0.325	0.239	0.183	0.144	0.117
5.0 CA	5.26	34.2	9.51	4.23	2.38	1.52	1.06	0.777	0.595	0.470	0.381	0.264	0.194	0.149	0.117	0.0951
4.0 CA	4.29	20.2	6.83	3.48	1.96	1.25	0.871	0.640	0.490	0.387	0.313	0.218	0.160	0.122	0.0968	0.0784
65 x 65 x 6.0 CA	5.62	29.8	7.45	3.31	1.86	1.19	0.828	0.608	0.465	0.368	0.298	0.207	0.152	0.116	0.0919	0.0745
5.0 CA	4.52	24.4	6.09	2.71	1.52	0.975	0.677	0.497	0.381	0.301	0.244	0.169	0.124	0.0952	0.0752	0.0609
4.0 CA	3.69	16.3	5.03	2.24	1.26	0.805	0.559	0.411	0.315	0.249	0.201	0.140	0.103	0.0786	0.0621	0.0503
50 x 50 x 6.0 CA	4.21	12.9	3.22	1.43	0.805	0.515	0.358	0.263	0.201	0.159	0.129	0.0894	0.0657	0.0503	0.0397	0.0322
5.0 CA	3.42	10.7	2.67	1.19	0.668	0.427	0.297	0.218	0.167	0.132	0.107	0.0742	0.0545	0.0417	0.0330	0.0267
4.0 CA	2.79	8.89	2.22	0.987	0.555	0.355	0.247	0.181	0.139	0.110	0.0889	0.0617	0.0453	0.0347	0.0274	0.0222
2.5 CA	1.81	4.32	1.45	0.655	0.368	0.236	0.164	0.120	0.0921	0.0728	0.0589	0.0409	0.0301	0.0230	0.0182	0.0147
45 x 45 x 4.0 CA	2.50	6.38	1.60	0.709	0.399	0.255	0.177	0.130	0.0997	0.0788	0.0638	0.0443	0.0326	0.0249	0.0197	0.0160
2.5 CA	1.62	3.61	1.06	0.473	0.266	0.170	0.118	0.0869	0.0665	0.0526	0.0426	0.0296	0.0217	0.0166	0.0131	0.0106
40 x 40 x 4.0 CA	2.20	4.40	1.10	0.489	0.275	0.176	0.122	0.0898	0.0687	0.0543	0.0440	0.0306	0.0224	0.0172	0.0136	0.0110
2.5 CA	1.43	2.95	0.739	0.328	0.185	0.118	0.0821	0.0603	0.0462	0.0365	0.0296	0.0205	0.0151	0.0115	0.00912	0.00739
30 x 30 x 2.5 CA	1.06	1.20	0.301	0.134	0.0752	0.0482	0.0334	0.0246	0.0188	0.0149	0.0120	0.00836	0.00614	0.00470	0.00372	0.00301

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

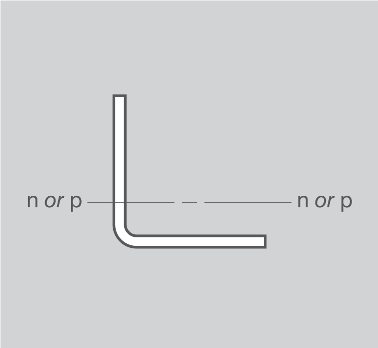


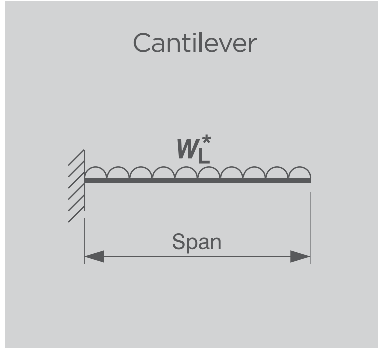
Table 17.1–3(A)

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0	W^*_{L2max} (kN)
150	150	8.0 CA	18.0	65.0	33.4	22.4	16.8	13.5	11.2	9.62	8.42	7.48	6.74	6.12	5.61	5.18	4.81	4.21	247
		6.0 CA	13.6	53.5	27.4	18.4	13.8	11.0	9.21	7.90	6.91	6.14	5.53	5.03	4.61	4.25	3.95	3.46	212
		5.0 CA	10.8	40.7	20.8	13.9	10.5	8.38	6.98	5.99	5.24	4.66	4.19	3.81	3.49	3.23	2.99	2.62	172
125	125	8.0 CA	14.9	45.4	23.2	15.5	11.6	9.32	7.77	6.66	5.83	5.18	4.66	4.24	3.89	3.59	3.33	2.91	201
		5.0 CA	8.95	29.2	14.8	9.92	7.45	5.96	4.97	4.26	3.73	3.31	2.98	2.71	2.48	2.29	2.13	1.86	142
		4.0 CA	7.27	23.0	11.7	7.81	5.86	4.69	3.91	3.35	2.93	2.61	2.35	2.13	1.96	1.81	1.68	1.47	115
100	100	8.0 CA	11.7	28.8	14.6	9.76	7.32	5.86	4.89	4.19	3.66	3.26	2.93	2.67	2.44	2.26	2.09	1.83	155
		6.0 CA	8.92	24.8	12.6	8.39	6.30	5.04	4.20	3.60	3.15	2.80	2.52	2.29	2.10	1.94	1.80	1.58	134
90	90	8.0 CA	10.5	23.2	11.7	7.83	5.88	4.70	3.92	3.36	2.94	2.61	2.35	2.14	1.96	1.81	1.68	1.47	136
		5.0 CA	6.37	15.7	7.93	5.30	3.98	3.18	2.65	2.27	1.99	1.77	1.59	1.45	1.33	1.22	1.14	0.995	99.0

Notes: 1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

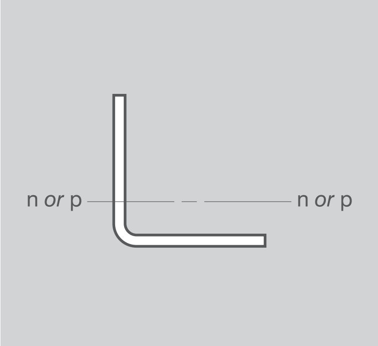


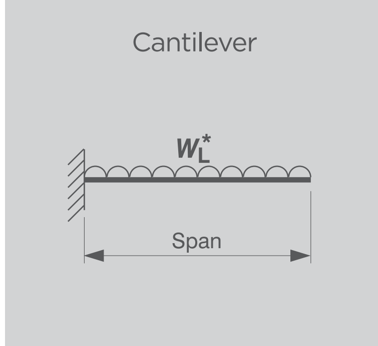
Table 17.1–3(B)

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation Leg size b_1 b_2, Nominal thickness	Mass per metre	Maximum design loads															
		W^*_{L1max} (kN)															W^*_{L2max} (kN)
		Span, l (m)															
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	
75 x 75 x 8.0 CA	8.59	30.7	15.9	10.6	7.99	6.40	5.33	4.57	4.00	3.56	3.20	2.67	2.29	2.00	1.78	1.60	109
6.0 CA	6.56	26.6	13.7	9.21	6.92	5.54	4.62	3.96	3.47	3.08	2.78	2.31	1.98	1.74	1.54	1.39	94.9
5.0 CA	5.26	21.4	11.0	7.38	5.55	4.44	3.70	3.17	2.78	2.47	2.22	1.85	1.59	1.39	1.24	1.11	80.8
4.0 CA	4.29	17.2	8.85	5.93	4.45	3.57	2.97	2.55	2.23	1.98	1.78	1.49	1.27	1.12	0.992	0.893	66.2
65 x 65 x 6.0 CA	5.62	19.9	10.2	6.83	5.13	4.11	3.42	2.94	2.57	2.28	2.06	1.71	1.47	1.29	1.14	1.03	79.3
5.0 CA	4.52	16.1	8.21	5.49	4.13	3.30	2.75	2.36	2.07	1.84	1.65	1.38	1.18	1.03	0.918	0.827	68.6
4.0 CA	3.69	13.1	6.70	4.48	3.37	2.70	2.25	1.93	1.69	1.50	1.35	1.12	0.964	0.843	0.75	0.675	56.3
50 x 50 x 6.0 CA	4.21	11.5	5.86	3.92	2.94	2.35	1.96	1.68	1.47	1.31	1.18	0.982	0.842	0.737	0.655	0.589	56.0
5.0 CA	3.42	9.39	4.76	3.18	2.39	1.91	1.59	1.36	1.19	1.06	0.956	0.796	0.683	0.597	0.531	0.478	50.3
4.0 CA	2.79	7.73	3.92	2.62	1.96	1.57	1.31	1.12	0.983	0.874	0.787	0.656	0.562	0.492	0.437	0.393	41.6
2.5 CA	1.81	3.87	1.96	1.31	0.983	0.787	0.656	0.562	0.492	0.437	0.394	0.328	0.281	0.246	0.219	0.197	21.8
45 x 45 x 4.0 CA	2.50	6.22	3.15	2.10	1.58	1.26	1.05	0.902	0.789	0.701	0.631	0.526	0.451	0.395	0.351	0.316	36.6
2.5 CA	1.62	3.16	1.60	1.07	0.800	0.640	0.534	0.457	0.400	0.356	0.320	0.267	0.229	0.200	0.178	0.160	19.4
40 x 40 x 4.0 CA	2.20	4.87	2.46	1.64	1.23	0.986	0.822	0.704	0.616	0.548	0.493	0.411	0.352	0.308	0.274	0.247	31.7
2.5 CA	1.43	2.49	1.26	0.838	0.629	0.503	0.419	0.360	0.315	0.28	0.252	0.210	0.180	0.157	0.14	0.126	17.0
30 x 30 x 2.5 CA	1.06	1.38	0.692	0.461	0.346	0.277	0.231	0.198	0.173	0.154	0.139	0.115	-	-	-	-	12.1

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.
6. Values are not listed below 0.100 kN.

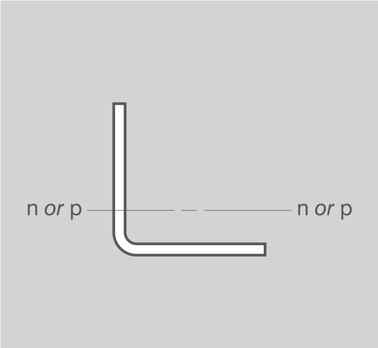


Table 17.1–4(A)

Serviceability limit state

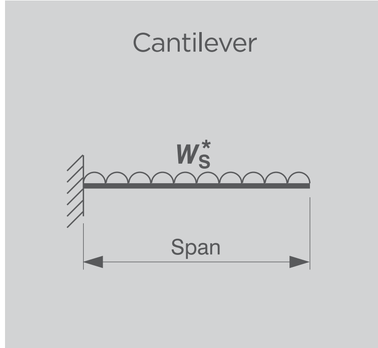
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation: Leg size b_1 (mm)	x b_2 (mm)	x Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	8.0
150	150	8.0 CA	18.0	121	32.7	14.6	8.21	5.26	3.65	2.68	2.05	1.62	1.31	1.09	0.913	0.778	0.671	0.513
		6.0 CA	13.6	85.7	23.5	11.0	6.29	4.03	2.80	2.05	1.57	1.24	1.01	0.832	0.699	0.596	0.514	0.393
		5.0 CA	10.8	62.4	17.4	8.18	4.77	3.13	2.21	1.64	1.25	0.991	0.803	0.663	0.557	0.475	0.409	0.314
125	125	8.0 CA	14.9	73.6	18.7	8.30	4.67	2.99	2.07	1.52	1.17	0.922	0.747	0.617	0.519	0.442	0.381	0.292
		5.0 CA	8.95	39.1	10.8	5.01	2.87	1.84	1.28	0.938	0.718	0.567	0.460	0.380	0.319	0.272	0.234	0.180
		4.0 CA	7.27	29.9	8.29	3.89	2.27	1.49	1.04	0.767	0.587	0.464	0.376	0.311	0.261	0.222	0.192	0.147
100	100	8.0 CA	11.7	37.2	9.29	4.13	2.32	1.49	1.03	0.759	0.581	0.459	0.372	0.307	0.258	0.220	0.190	0.145
		6.0 CA	8.92	28.7	7.19	3.20	1.80	1.15	0.799	0.587	0.450	0.355	0.288	0.238	0.200	0.170	0.147	0.112
90	90	8.0 CA	10.5	26.7	6.67	2.97	1.67	1.07	0.741	0.545	0.417	0.329	0.267	0.221	0.185	0.158	0.136	0.104
		5.0 CA	6.37	16.3	4.18	1.86	1.05	0.669	0.465	0.341	0.261	0.207	0.167	0.138	0.116	0.0990	0.0854	0.0654

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

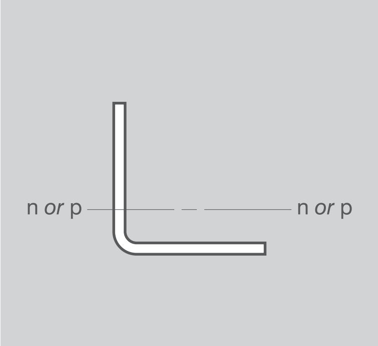


Table 17.1–4(B)

Serviceability limit state

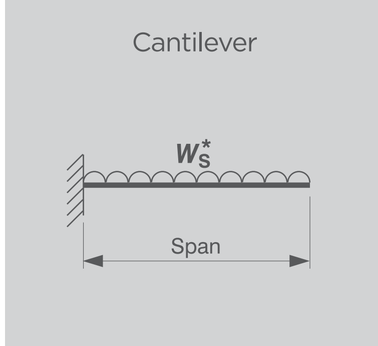
Maximum design loads

For beams *with* full lateral restraint
Bending about n- or p-axis (leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation Leg size b_1 b_2 Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) Span, l (m)														
mm mm mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
75 x 75 x 8.0 CA	8.59	59.9	15.0	6.65	3.74	2.39	1.66	1.22	0.935	0.739	0.599	0.416	0.305	0.234	0.185	0.150
6.0 CA	6.56	46.8	11.7	5.20	2.93	1.87	1.30	0.955	0.731	0.578	0.468	0.325	0.239	0.183	0.144	0.117
5.0 CA	5.26	36.6	9.51	4.23	2.38	1.52	1.06	0.777	0.595	0.470	0.381	0.264	0.194	0.149	0.117	0.0951
4.0 CA	4.29	28.6	7.73	3.48	1.96	1.25	0.871	0.640	0.490	0.387	0.313	0.218	0.160	0.122	0.0968	0.0784
65 x 65 x 6.0 CA	5.62	29.8	7.45	3.31	1.86	1.19	0.828	0.608	0.465	0.368	0.298	0.207	0.152	0.116	0.0919	0.0745
5.0 CA	4.52	24.4	6.09	2.71	1.52	0.975	0.677	0.497	0.381	0.301	0.244	0.169	0.124	0.0952	0.0752	0.0609
4.0 CA	3.69	19.4	5.03	2.24	1.26	0.805	0.559	0.411	0.315	0.249	0.201	0.140	0.103	0.0786	0.0621	0.0503
50 x 50 x 6.0 CA	4.21	12.9	3.22	1.43	0.805	0.515	0.358	0.263	0.201	0.159	0.129	0.0894	0.0657	0.0503	0.0397	0.0322
5.0 CA	3.42	10.7	2.67	1.19	0.668	0.427	0.297	0.218	0.167	0.132	0.107	0.0742	0.0545	0.0417	0.0330	0.0267
4.0 CA	2.79	8.89	2.22	0.987	0.555	0.355	0.247	0.181	0.139	0.110	0.0889	0.0617	0.0453	0.0347	0.0274	0.0222
2.5 CA	1.81	5.56	1.47	0.655	0.368	0.236	0.164	0.120	0.0921	0.0728	0.0589	0.0409	0.0301	0.0230	0.0182	0.0147
45 x 45 x 4.0 CA	2.50	6.38	1.60	0.709	0.399	0.255	0.177	0.130	0.0997	0.0788	0.0638	0.0443	0.0326	0.0249	0.0197	0.0160
2.5 CA	1.62	4.17	1.06	0.473	0.266	0.170	0.118	0.0869	0.0665	0.0526	0.0426	0.0296	0.0217	0.0166	0.0131	0.0106
40 x 40 x 4.0 CA	2.20	4.40	1.10	0.489	0.275	0.176	0.122	0.0898	0.0687	0.0543	0.0440	0.0306	0.0224	0.0172	0.0136	0.0110
2.5 CA	1.43	2.96	0.739	0.328	0.185	0.118	0.0821	0.0603	0.0462	0.0365	0.0296	0.0205	0.0151	0.0115	0.00912	0.00739
30 x 30 x 2.5 CA	1.06	1.20	0.301	0.134	0.0752	0.0482	0.0334	0.0246	0.0188	0.0149	0.0120	0.00836	0.00614	0.00470	0.00372	0.00301

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 / C350L0 (for $t \leq 2.5$ mm f_y = 350 MPa and f_u = 400 MPa, for 2.5 mm < $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

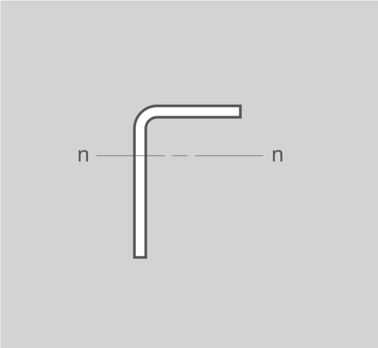


Table 17.2–1

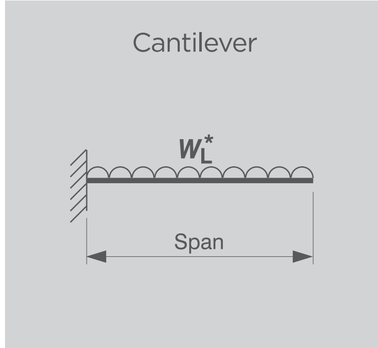
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Grade C450L0 / C400L0

Profile unequal angles



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN) Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150 x	100 x	8.0 CA	14.9	106	56.9	38.5	29.0	23.3	19.4	16.7	14.6	13.0	11.7	9.73	8.34	7.30	6.49	5.84	247
		6.0 CA	11.3	64.2	33.2	22.3	16.8	13.4	11.2	9.61	8.41	7.48	6.73	5.61	4.81	4.21	3.74	3.37	212
125 x	75 x	8.0 CA	11.7	78.7	41.8	28.2	21.3	17.0	14.2	12.2	10.7	9.49	8.55	7.12	6.11	5.34	4.75	4.28	201
		6.0 CA	8.92	55.3	28.8	19.3	14.5	11.6	9.71	8.33	7.29	6.48	5.83	4.86	4.17	3.65	3.24	2.92	173
100 x	75 x	8.0 CA	10.2	52.6	27.5	18.5	13.9	11.2	9.30	7.98	6.98	6.21	5.59	4.66	3.99	3.49	3.11	2.80	155
		6.0 CA	7.74	43.2	22.5	15.1	11.4	9.11	7.59	6.51	5.70	5.07	4.56	3.80	3.26	2.85	2.53	2.28	134
75 x	50 x	6.0 CA	5.38	24.9	12.8	8.58	6.45	5.16	4.3	3.69	3.23	2.87	2.58	2.15	1.85	1.62	1.44	1.29	94.9
		5.0 CA	4.34	20.2	10.3	6.91	5.19	4.16	3.47	2.97	2.60	2.31	2.08	1.73	1.49	1.30	1.16	1.04	80.8
		4.0 CA	3.54	13.7	6.95	4.64	3.49	2.79	2.33	1.99	1.75	1.55	1.40	1.16	0.998	0.873	0.776	0.698	66.2

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

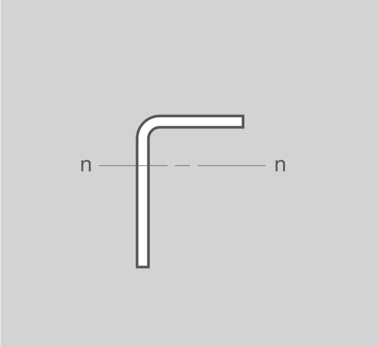


Table 17.2–2

Serviceability limit state

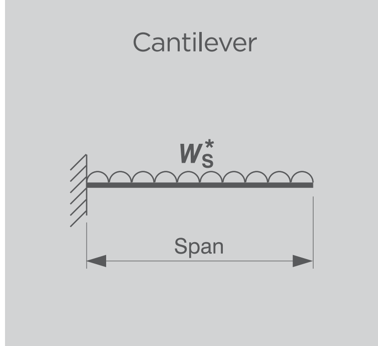
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x	100 x	8.0 CA	14.9	405	101	45.8	28.6	18.3	12.7	9.33	7.14	5.64	4.57	3.17	2.33	1.79	1.41	1.14
		6.0 CA	11.3	175	50.8	27.2	17.3	12.2	9.13	7.13	5.48	4.33	3.51	2.44	1.79	1.37	1.08	0.877
125 x	75 x	8.0 CA	11.7	249	62.2	27.6	15.5	9.95	6.91	5.08	3.89	3.07	2.49	1.73	1.27	0.972	0.768	0.622
		6.0 CA	8.92	137	37.0	19.5	12.0	7.68	5.33	3.92	3.00	2.37	1.92	1.33	0.979	0.750	0.593	0.480
100 x	75 x	8.0 CA	10.2	134	33.5	14.9	8.39	5.37	3.73	2.74	2.10	1.66	1.34	0.932	0.685	0.524	0.414	0.335
		6.0 CA	7.74	96.2	25.1	11.6	6.51	4.16	2.89	2.12	1.63	1.28	1.04	0.723	0.531	0.407	0.321	0.260
75 x	50 x	6.0 CA	5.38	40.3	10.1	4.47	2.52	1.61	1.12	0.822	0.629	0.497	0.403	0.280	0.205	0.157	0.124	0.101
		5.0 CA	4.34	33.0	8.26	3.67	2.06	1.32	0.917	0.674	0.516	0.408	0.330	0.229	0.169	0.129	0.102	0.0826
		4.0 CA	3.54	20.4	6.61	3.03	1.70	1.09	0.757	0.556	0.426	0.337	0.273	0.189	0.139	0.106	0.0841	0.0681

Notes: 1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Unequal Angles

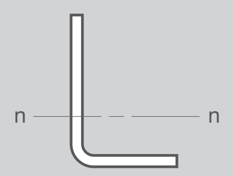


Table 17.2–3

Strength limit state

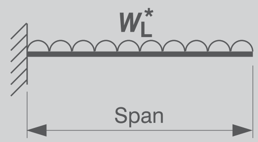
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Grade C450L0 / C400L0

Profile unequal angles

Cantilever



Designation Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN) Span, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150 x	100 x	8.0 CA	14.9	113	61.6	41.8	31.6	25.3	21.1	18.1	15.9	14.1	12.7	10.6	9.09	7.95	7.07	6.36	247
		6.0 CA	11.3	96.1	52.2	35.4	26.7	21.5	17.9	15.4	13.5	12.0	10.8	8.98	7.70	6.74	5.99	5.39	212
125 x	75 x	8.0 CA	11.7	78.7	41.8	28.2	21.3	17.0	14.2	12.2	10.7	9.49	8.55	7.12	6.11	5.34	4.75	4.28	201
		6.0 CA	8.92	67.6	35.9	24.3	18.3	14.6	12.2	10.5	9.17	8.16	7.34	6.12	5.25	4.59	4.08	3.67	173
100 x	75 x	8.0 CA	10.2	52.6	27.5	18.5	13.9	11.2	9.30	7.98	6.98	6.21	5.59	4.66	3.99	3.49	3.11	2.80	155
		6.0 CA	7.74	45.3	23.7	16.0	12.0	9.61	8.02	6.88	6.02	5.35	4.82	4.01	3.44	3.01	2.68	2.41	134
75 x	50 x	6.0 CA	5.38	24.9	12.8	8.58	6.45	5.16	4.30	3.69	3.23	2.87	2.58	2.15	1.85	1.62	1.44	1.29	94.9
		5.0 CA	4.34	20.2	10.3	6.91	5.19	4.16	3.47	2.97	2.60	2.31	2.08	1.73	1.49	1.30	1.16	1.04	80.8
		4.0 CA	3.54	16.5	8.46	5.66	4.25	3.41	2.84	2.43	2.13	1.89	1.70	1.42	1.22	1.07	0.947	0.853	66.2

Notes:
1. Maximum design load $W^*_{L\,max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

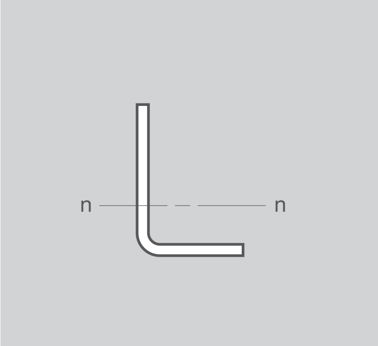


Table 17.2–4

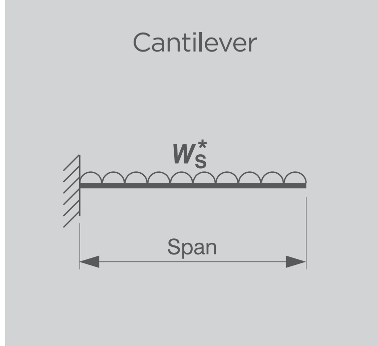
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about n-axis (long leg up)

Deflection limit = span / 250

Grade C450LO / C400LO

Profile unequal angles



Designation Leg size b_1 b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) Span, l (m)														
mm mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100	x 8.0 CA	14.9	449	114	50.8	28.6	18.3	12.7	9.33	7.14	5.64	4.57	3.17	2.33	1.79	1.41	1.14
	6.0 CA	11.3	319	82.5	38.3	21.9	14.0	9.74	7.16	5.48	4.33	3.51	2.44	1.79	1.37	1.08	0.877
125 x 75	x 8.0 CA	11.7	249	62.2	27.6	15.5	9.95	6.91	5.08	3.89	3.07	2.49	1.73	1.27	0.972	0.768	0.622
	6.0 CA	8.92	188	48.0	21.3	12.0	7.68	5.33	3.92	3.00	2.37	1.92	1.33	0.979	0.750	0.593	0.480
100 x 75	x 8.0 CA	10.2	134	33.5	14.9	8.39	5.37	3.73	2.74	2.10	1.66	1.34	0.932	0.685	0.524	0.414	0.335
	6.0 CA	7.74	102	26.0	11.6	6.51	4.16	2.89	2.12	1.63	1.28	1.04	0.723	0.531	0.407	0.321	0.260
75 x 50	x 6.0 CA	5.38	40.3	10.1	4.47	2.52	1.61	1.12	0.822	0.629	0.497	0.403	0.280	0.205	0.157	0.124	0.101
	5.0 CA	4.34	33.0	8.26	3.67	2.06	1.32	0.917	0.674	0.516	0.408	0.330	0.229	0.169	0.129	0.102	0.0826
	4.0 CA	3.54	27.0	6.81	3.03	1.70	1.09	0.757	0.556	0.426	0.337	0.273	0.189	0.139	0.106	0.0841	0.0681

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

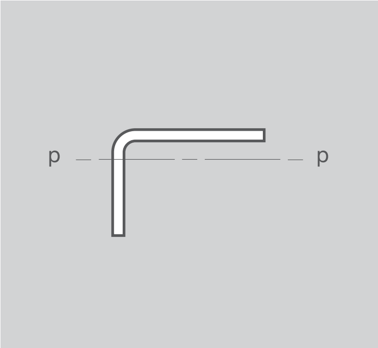


Table 17.2–5

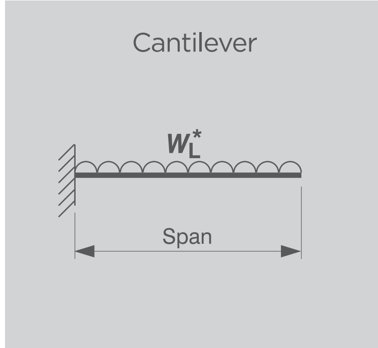
Strength limit state

Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 (mm)	Leg size b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads: W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	57.5	30.4	20.5	15.4	12.4	10.3	8.84	7.74	6.88	6.19	5.16	4.43	3.87	3.44	3.10	155
		6.0 CA	11.3	42.0	21.8	14.7	11.0	8.84	7.37	6.32	5.53	4.92	4.43	3.69	3.16	2.77	2.46	2.21	134
125	75	8.0 CA	11.7	32.8	17.0	11.4	8.57	6.87	5.72	4.91	4.30	3.82	3.44	2.87	2.46	2.15	1.91	1.72	109
		6.0 CA	8.92	28.4	14.7	9.86	7.41	5.94	4.95	4.24	3.71	3.30	2.97	2.48	2.12	1.86	1.65	1.49	94.9
100	75	8.0 CA	10.2	32.0	16.5	11.1	8.34	6.68	5.57	4.77	4.18	3.71	3.34	2.79	2.39	2.09	1.86	1.67	109
		6.0 CA	7.74	27.7	14.3	9.60	7.21	5.78	4.82	4.13	3.61	3.21	2.89	2.41	2.07	1.81	1.61	1.45	94.9
75	50	6.0 CA	5.38	12.2	6.23	4.17	3.13	2.51	2.09	1.79	1.57	1.39	1.25	1.04	0.896	0.784	0.697	0.627	56.0
		5.0 CA	4.34	9.91	5.03	3.36	2.52	2.02	1.68	1.44	1.26	1.12	1.01	0.842	0.722	0.632	0.562	0.505	50.3
		4.0 CA	3.54	8.15	4.13	2.76	2.08	1.66	1.38	1.19	1.04	0.923	0.831	0.692	0.594	0.519	0.462	0.416	41.6

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

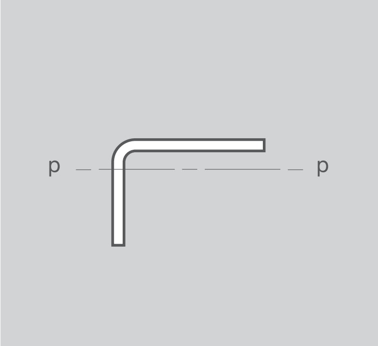


Table 17.2–6

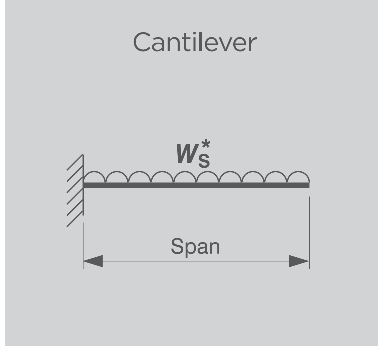
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg down)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles



Designation: Leg size b_1 x b_2, Nominal thickness (mm x mm x mm)	Mass per metre (kg/m)	Maximum design loads W^*_{Smax} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100 x 8.0 CA	14.9	169	42.2	18.7	10.5	6.75	4.68	3.44	2.63	2.08	1.69	1.17	0.860	0.659	0.520	0.422
6.0 CA	11.3	96.4	26.3	13.8	8.14	5.21	3.62	2.66	2.03	1.61	1.30	0.904	0.664	0.509	0.402	0.326
125 x 75 x 8.0 CA	11.7	70.3	17.6	7.81	4.39	2.81	1.95	1.43	1.10	0.868	0.703	0.488	0.359	0.275	0.217	0.176
6.0 CA	8.92	54.8	13.7	6.09	3.42	2.19	1.52	1.12	0.856	0.676	0.548	0.380	0.279	0.214	0.169	0.137
100 x 75 x 8.0 CA	10.2	65.9	16.5	7.32	4.12	2.63	1.83	1.34	1.03	0.813	0.659	0.457	0.336	0.257	0.203	0.165
6.0 CA	7.74	51.4	12.8	5.71	3.21	2.06	1.43	1.05	0.803	0.634	0.514	0.357	0.262	0.201	0.159	0.128
75 x 50 x 6.0 CA	5.38	14.8	3.69	1.64	0.924	0.591	0.410	0.302	0.231	0.182	0.148	0.103	0.0754	0.0577	0.0456	0.0369
5.0 CA	4.34	12.1	3.03	1.35	0.758	0.485	0.337	0.248	0.190	0.150	0.121	0.0843	0.0619	0.0474	0.0375	0.0303
4.0 CA	3.54	10.1	2.52	1.12	0.629	0.403	0.280	0.206	0.157	0.124	0.101	0.0699	0.0514	0.0393	0.0311	0.0252

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

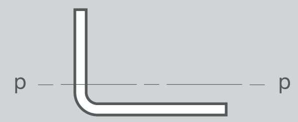


Table 17.2–7

Strength limit state

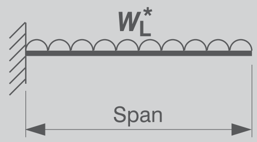
Maximum design loads

For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Grade C450L0 / C400L0

Profile unequal angles

Cantilever



Designation: Leg size b_1 (mm)	b_2 (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads: W^*_{L1max} (kN), Span, l (m): 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0	W^*_{L2max} (kN)
150	100	8.0 CA	14.9	57.5	30.4	20.5	15.4	12.4	10.3	8.84	7.74	6.88	6.19	5.16	4.43	3.87	3.44	3.10	155
		6.0 CA	11.3	48.3	25.4	17.1	12.9	10.3	8.61	7.39	6.46	5.75	5.17	4.31	3.70	3.23	2.88	2.59	134
125	75	8.0 CA	11.7	32.8	17.0	11.4	8.57	6.87	5.72	4.91	4.30	3.82	3.44	2.87	2.46	2.15	1.91	1.72	109
		6.0 CA	8.92	28.2	14.6	9.78	7.35	5.89	4.91	4.21	3.69	3.28	2.95	2.46	2.11	1.84	1.64	1.48	94.9
100	75	8.0 CA	10.2	32.0	16.5	11.1	8.34	6.68	5.57	4.77	4.18	3.71	3.34	2.79	2.39	2.09	1.86	1.67	109
		6.0 CA	7.74	27.7	14.3	9.60	7.21	5.78	4.82	4.13	3.61	3.21	2.89	2.41	2.07	1.81	1.61	1.45	94.9
75	50	6.0 CA	5.38	12.2	6.23	4.17	3.13	2.51	2.09	1.79	1.57	1.39	1.25	1.04	0.896	0.784	0.697	0.627	56.0
		5.0 CA	4.34	9.91	5.03	3.36	2.52	2.02	1.68	1.44	1.26	1.12	1.01	0.842	0.722	0.632	0.562	0.505	50.3
		4.0 CA	3.54	8.09	4.11	2.74	2.06	1.65	1.37	1.18	1.03	0.917	0.825	0.688	0.589	0.516	0.458	0.413	41.6

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
5. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

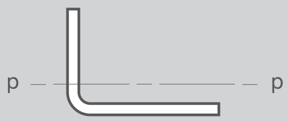


Table 17.2–8

Serviceability limit state
Maximum design loads

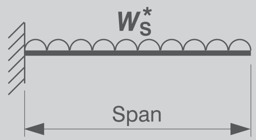
For beams *with* full lateral restraint
Bending about p-axis (short leg up)

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile unequal angles

Cantilever



Designation Leg size b_1 b_2	Nominal thickness	Mass per metre	Maximum design loads W^*_{Smax} (kN) Span, l (m)														
mm mm	mm	kg/m	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5	5.0
150 x 100	x 8.0 CA	14.9	158	41.7	18.7	10.5	6.75	4.68	3.44	2.63	2.08	1.69	1.17	0.860	0.659	0.520	0.422
	6.0 CA	11.3	110	30.2	14.0	8.10	5.21	3.62	2.66	2.03	1.61	1.30	0.904	0.664	0.509	0.402	0.326
125 x 75	x 8.0 CA	11.7	69.4	17.6	7.81	4.39	2.81	1.95	1.43	1.10	0.868	0.703	0.488	0.359	0.275	0.217	0.176
	6.0 CA	8.92	51.2	13.7	6.09	3.42	2.19	1.52	1.12	0.856	0.676	0.548	0.380	0.279	0.214	0.169	0.137
100 x 75	x 8.0 CA	10.2	65.9	16.5	7.32	4.12	2.63	1.83	1.34	1.03	0.813	0.659	0.457	0.336	0.257	0.203	0.165
	6.0 CA	7.74	49.9	12.8	5.71	3.21	2.06	1.43	1.05	0.803	0.634	0.514	0.357	0.262	0.201	0.159	0.128
75 x 50	x 6.0 CA	5.38	14.8	3.69	1.64	0.924	0.591	0.410	0.302	0.231	0.182	0.148	0.103	0.0754	0.0577	0.0456	0.0369
	5.0 CA	4.34	12.1	3.03	1.35	0.758	0.485	0.337	0.248	0.190	0.150	0.121	0.0843	0.0619	0.0474	0.0375	0.0303
	4.0 CA	3.54	9.84	2.52	1.12	0.629	0.403	0.280	0.206	0.157	0.124	0.101	0.0699	0.0514	0.0393	0.0311	0.0252

Notes:
1. W_{Smax} = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Channels

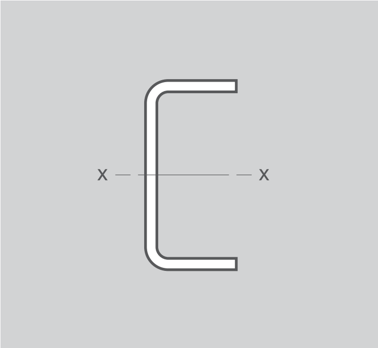


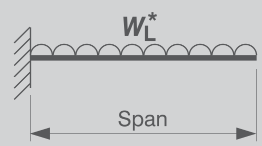
Table 17.3–1

Strength limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about x-axis

Grade C450L0 / C400L0

Profile channels



Designation d (mm)	b_f (mm)	Nominal thickness (mm)	Mass per metre (kg/m)	Maximum design loads W^*_{L1max} (kN), Span, l (m) 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	W^*_{L2max} (kN)	FLR (m) C_b 1.0
300	90	8.0 CC	28.5	195	160	136	118	104	83.6	69.9	60.1	52.7	42.2	35.2	30.2	26.5	23.5	21.2	494	1.40
		6.0 CC	21.6	155	128	108	93.2	82.0	66.0	55.2	47.5	41.6	33.3	27.8	23.8	20.9	18.6	16.7	423	1.31
250	90	6.0 CC	19.2	120	98.4	83.0	71.7	63.1	50.8	42.4	36.4	31.9	25.6	21.3	18.3	16.0	14.2	12.8	345	1.33
230	75	6.0 CC	16.9	101	82.6	69.6	60.0	52.8	42.4	35.4	30.4	26.7	21.4	17.8	15.3	13.4	11.9	10.7	314	1.11
200	75	6.0 CC	15.5	83.3	67.9	57.1	49.3	43.3	34.8	29.1	24.9	21.9	17.5	14.6	12.5	11.0	9.74	8.76	267	1.12
		5.0 CC	12.4	61.9	50.2	42.2	36.3	31.9	25.6	21.4	18.3	16.1	12.9	10.7	9.19	8.05	7.15	6.44	222	1.10
180	75	5.0 CC	11.6	53.4	43.3	36.3	31.3	27.4	22.0	18.4	15.8	13.8	11.1	9.22	7.91	6.92	6.15	5.54	198	1.11
150	75	5.0 CC	10.5	41.4	33.6	28.1	24.2	21.2	17.1	14.2	12.2	10.7	8.56	7.14	6.12	5.36	4.76	4.29	162	1.12
125	65	4.0 CC	7.23	23.6	19.0	15.9	13.7	12.0	9.63	8.04	6.89	6.03	4.83	4.03	3.45	3.02	2.69	2.42	108	0.968
100	50	4.0 CC	5.59	16.0	12.9	10.8	9.26	8.12	6.51	5.43	4.65	4.07	3.26	2.72	2.33	2.04	1.81	1.63	83.1	0.762
75	40	4.0 CC	4.25	9.72	7.82	6.53	5.61	4.91	3.94	3.28	2.81	2.46	1.97	1.64	1.41	1.23	1.10	0.986	58.5	0.641

Notes:
1. Maximum design load $W^*_{L max}$ is equal to W^*_{L1max}.
2. W^*_{L1max} = Maximum design load based on design moment capacity and combined moment and shear capacity.
3. W^*_{L2max} = Maximum design load based on design shear capacity only.
4. FLR is the maximum unbraced segment length for full lateral restraint.
5. Beam spans to the right of the solid line must be braced at intervals equal to or less than the FLR value to have full lateral restraint.
6. All supports are assumed to provide full lateral restraint.
7. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
8. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

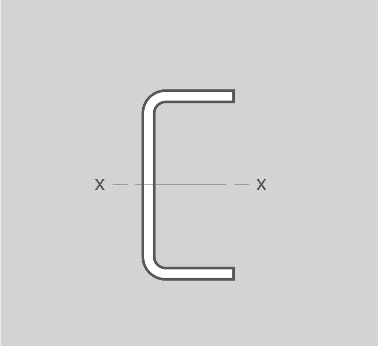


Table 17.3–2

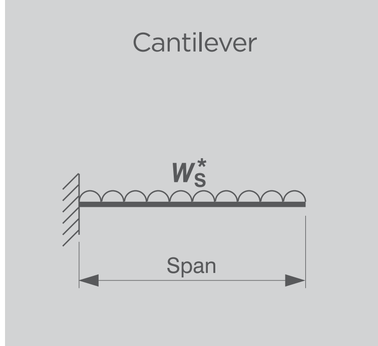
Serviceability limit state
Maximum design loads

For beams *with* full lateral restraint
Bending about x-axis

Deflection limit = span / 250

Grade C450L0 / C400L0

Profile channels



Designation d x b_f x Nominal thickness (mm x mm x mm)	Mass per metre (kg/m)	Maximum design loads $W^*_{S\max}$ (kN), Span, l (m): 1.0	1.25	1.5	1.75	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
300 x 90 x 8.0 CC	28.5	283	181	126	92.3	70.7	45.2	31.4	23.1	17.7	11.3	7.85	5.77	4.42	3.49	2.83
6.0 CC	21.6	205	133	93.7	69.8	54.1	34.8	24.2	17.8	13.6	8.71	6.05	4.44	3.40	2.69	2.18
250 x 90 x 6.0 CC	19.2	133	86.8	61.4	45.7	35.1	22.5	15.6	11.5	8.78	5.62	3.90	2.87	2.19	1.73	1.40
230 x 75 x 6.0 CC	16.9	100	64.4	44.8	32.9	25.2	16.1	11.2	8.22	6.29	4.03	2.80	2.06	1.57	1.24	1.01
200 x 75 x 6.0 CC	15.5	71.9	46.0	32.0	23.5	18.0	11.5	7.99	5.87	4.49	2.88	2.00	1.47	1.12	0.888	0.719
5.0 CC	12.4	55.4	36.3	25.7	19.1	14.7	9.41	6.53	4.80	3.67	2.35	1.63	1.20	0.918	0.726	0.588
180 x 75 x 5.0 CC	11.6	43.6	28.6	20.2	15.0	11.5	7.33	5.09	3.74	2.86	1.83	1.27	0.935	0.716	0.566	0.458
150 x 75 x 5.0 CC	10.5	28.9	19.0	13.3	9.76	7.47	4.78	3.32	2.44	1.87	1.20	0.830	0.610	0.467	0.369	0.299
125 x 65 x 4.0 CC	7.23	14.0	9.20	6.41	4.71	3.61	2.31	1.60	1.18	0.901	0.577	0.401	0.294	0.225	0.178	0.144
100 x 50 x 4.0 CC	5.59	6.93	4.43	3.08	2.26	1.73	1.11	0.770	0.566	0.433	0.277	0.192	0.141	0.108	0.0855	0.0693
75 x 40 x 4.0 CC	4.25	2.92	1.87	1.30	0.954	0.730	0.468	0.325	0.239	0.183	0.117	0.0812	0.0596	0.0457	0.0361	0.0292

Notes:
1. $W^*_{S\max}$ = Maximum design load based on the effective second moment of area with the stress limited to a maximum of f_y in the extreme compression fibres.
2. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
3. Maximum design loads are based on capacities calculated in accordance with AS/NZS 4600.

Truss web members

18

Contents

Page

Tables

Page

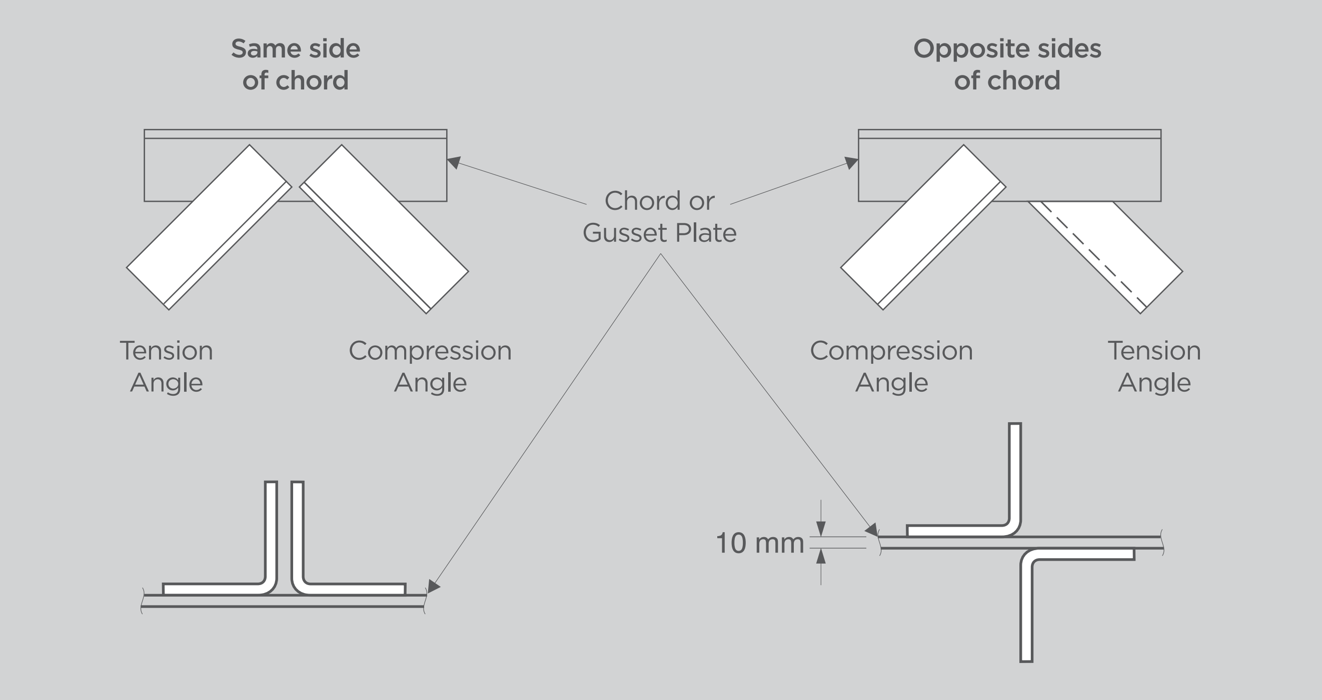
Axial compression force ($N^*_{c\,max}$)

18.1 Scope

Tables are provided in this section for eccentrically loaded single angles under compression used as web members in trusses. The angles are assumed to be bolted or welded to one leg only. Tables in Section 12 may be used for angles in tension connected to one leg only.

Tables are provided for angles connected on the same side of the truss chord, and connected on opposite sides of the chord as shown in Figure 18.1(1). For angles connected on opposite sides of the truss chord, the thickness of the gusset plate or element of the chord to which the angle web members are connected is assumed to be 10 mm.

Figure 18.1(1) Single angles as truss web member



18.2 Design method

A value of maximum design axial compression force ($N^*_{c\,max}$) is obtained from Tables 18.1-1 to 18.2-4 depending upon the effective length and end connection arrangement as shown in Figure 18.1(1). For unequal angles the option of short or long leg connected is also included.

The maximum design axial compression force ($N^*_{c\,max}$) for angle web members connected to the same side of the chord is independent of the thickness of the gusset plate or truss chord. The value given in the tables for angles connected on the opposite side of the chord assume a gusset plate / chord thickness of 10 mm. If the actual thickness of the gusset plate or chord is less than 10 mm, the value in the table can be conservatively used. Alternatively, the design procedure for angles as compression web members in trusses outlined in Appendix A8 may be used.

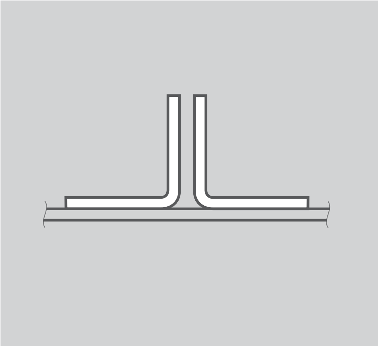


Table 18.1–1(A)

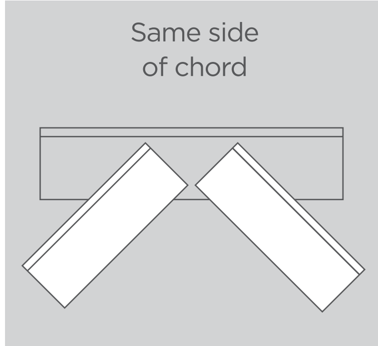
Limit state design

Truss web member
Axial compression force

One leg connected – same side of truss chord

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness		Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm		kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150	150	8.0	CA	18.0	547	164	163	162	161	159	157	154	151	147	143	134	125	115	105
		6.0	CA	13.6	355	92.8	92.6	92.3	91.8	90.9	89.9	88.7	87.4	86.0	84.5	81.0	77.1	72.8	68.1
		5.0	CA	10.8	219	50.6	50.6	50.5	50.2	49.8	49.4	48.9	48.4	47.9	47.3	46.0	44.4	42.7	40.9
125	125	8.0	CA	14.9	521	155	154	152	150	147	143	139	134	128	122	110	97.1	84.7	73.4
		5.0	CA	8.95	214	55.2	55.1	54.9	54.3	53.7	52.9	52.1	51.1	50.1	49.0	46.4	43.5	40.4	37.2
		4.0	CA	7.27	145	32.6	32.6	32.4	32.2	31.9	31.5	31.1	30.7	30.2	29.7	28.5	27.2	25.8	24.4
100	100	8.0	CA	11.7	481	136	134	131	127	122	116	109	102	94.1	86.5	72.3	60.0	49.8	41.6
		6.0	CA	8.92	329	96.1	95.2	93.6	91.2	88.0	84.2	80.0	75.4	70.5	65.5	55.6	46.4	38.7	32.5
90	90	8.0	CA	10.5	454	123	121	118	113	107	100	92.6	84.7	77.0	69.6	56.5	45.9	37.5	31.0
		5.0	CA	6.37	203	60.0	59.4	58.4	56.8	54.8	52.4	49.8	46.9	43.8	40.6	34.4	28.7	23.9	19.9
75	75	8.0	CA	8.59	372	101	98.8	94.6	88.8	81.8	74.0	66.1	58.5	51.6	45.3	35.2	27.7	22.2	–
		6.0	CA	6.56	299	83.1	81.0	77.5	72.7	66.8	60.3	53.7	47.4	41.6	36.4	28.1	22.1	17.7	–
		5.0	CA	5.26	194	58.1	57.0	55.2	52.5	49.3	45.6	41.5	37.5	33.5	29.7	23.2	18.4	14.8	–
		4.0	CA	4.29	135	39.2	38.7	37.6	36.2	34.4	32.3	30.1	27.7	25.2	22.8	18.5	14.8	12.0	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 / C350L0 (for t = 2.5 mm f_y = 350 MPa and f_u = 400 MPa, for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

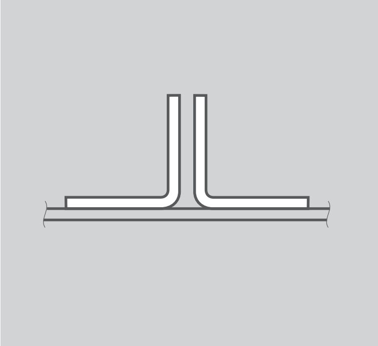


Table 18.1–1(B)

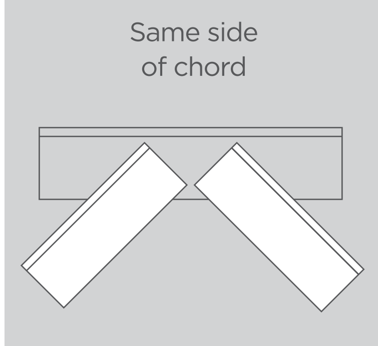
Limit state design

Truss web member
Axial compression force

One leg connected – same side of truss chord

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
65 x	65 x	6.0 CA	5.62	274	72.3	69.7	65.4	59.6	53.0	46.2	39.8	34.1	29.2	25.0	18.8	14.5	–	–
		5.0 CA	4.52	186	54.7	53.1	50.5	46.7	42.3	37.6	32.9	28.4	24.5	21.2	16.0	12.4	–	–
		4.0 CA	3.69	131	38.6	37.8	36.2	34.0	31.4	28.4	25.4	22.4	19.6	17.0	13.1	10.2	–	–
50 x	50 x	6.0 CA	4.21	205	53.6	49.9	44.3	37.5	30.9	25.1	20.4	16.7	13.9	11.6	–	–	–	–
		5.0 CA	3.42	166	44.5	41.7	37.5	32.1	26.8	22.0	18.0	14.8	12.3	10.3	–	–	–	–
		4.0 CA	2.79	121	34.5	32.6	29.6	25.8	21.7	18.0	14.8	12.2	10.2	8.56	–	–	–	–
		2.5 CA	1.81	46.3	13.7	13.4	12.7	11.8	10.7	9.54	8.35	7.24	6.24	5.37	–	–	–	–
45 x	45 x	4.0 CA	2.50	116	31.7	29.4	25.8	21.5	17.5	14.0	11.3	9.16	7.56	6.32	–	–	–	–
		2.5 CA	1.62	45.2	13.5	12.9	12.0	10.8	9.51	8.14	6.86	5.75	4.84	4.10	–	–	–	–
40 x	40 x	4.0 CA	2.20	107	28.1	25.4	21.3	17.0	13.3	10.3	8.15	6.55	–	–	–	–	–	–
		2.5 CA	1.43	43.8	12.9	12.2	10.9	9.44	7.88	6.42	5.22	4.27	3.54	–	–	–	–	–
30 x	30 x	2.5 CA	1.06	39.2	10.4	9.10	7.23	5.46	4.07	3.08	–	–	–	–	–	–	–	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 / C350L0 (for t = 2.5 mm f_y = 350 MPa and f_u = 400 MPa, for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

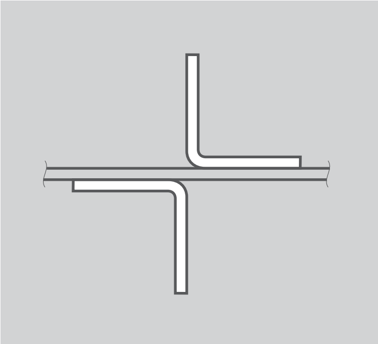


Table 18.1–2(A)

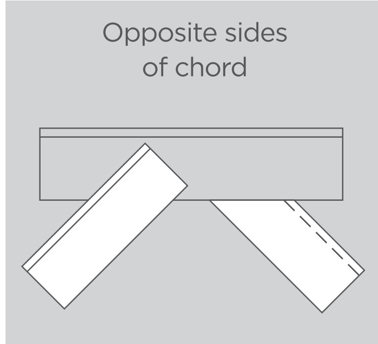
Limit state design

Truss web member
Axial compression force

One leg connected – opposite sides of truss chord

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force n^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150	150	8.0 CA	18.0	547	92.1	91.9	91.5	90.9	90.2	89.2	87.9	86.4	84.8	83.1	79.3	75.3	71.0	66.5
		6.0 CA	13.6	355	60.5	60.3	60.2	59.8	59.1	58.4	57.6	56.7	55.8	54.7	52.5	50.1	47.6	44.9
		5.0 CA	10.8	219	36.6	36.6	36.5	36.2	35.8	35.4	35.0	34.5	34.0	33.5	32.3	30.9	29.5	28.1
125	125	8.0 CA	14.9	521	80.8	80.4	79.8	79.0	78.0	76.6	74.9	73.0	71.0	68.8	64.2	59.3	54.3	49.3
		5.0 CA	8.95	214	36.6	36.5	36.4	35.9	35.4	34.8	34.2	33.5	32.8	32.0	30.4	28.6	26.7	24.9
		4.0 CA	7.27	145	23.6	23.6	23.4	23.1	22.8	22.5	22.1	21.7	21.3	20.8	19.7	18.7	17.6	16.7
100	100	8.0 CA	11.7	481	64.9	64.4	63.6	62.4	61.0	59.1	56.9	54.5	52.0	49.4	44.2	39.2	34.4	30.3
		6.0 CA	8.92	329	50.5	50.2	49.6	48.7	47.4	46.0	44.3	42.6	40.7	38.8	34.9	30.9	27.1	23.9
90	90	8.0 CA	10.5	454	56.5	56.0	55.1	53.8	52.3	50.3	48.1	45.7	43.2	40.6	35.7	31.0	26.9	23.3
		5.0 CA	6.37	203	33.1	32.8	32.4	31.6	30.7	29.7	28.5	27.3	26.0	24.7	22.0	19.4	17.0	14.8
75	75	8.0 CA	8.59	372	43.6	43.0	42.0	40.7	39.0	37.0	34.8	32.4	30.1	27.9	23.6	19.9	16.9	–
		6.0 CA	6.56	299	38.4	37.8	36.9	35.5	33.8	31.8	29.7	27.5	25.4	23.3	19.5	16.3	13.7	–
		5.0 CA	5.26	194	29.1	28.7	28.1	27.2	26.0	24.7	23.3	21.8	20.3	18.8	15.9	13.4	11.4	–
		4.0 CA	4.29	135	21.4	21.2	20.7	20.0	19.2	18.3	17.4	16.4	15.4	14.3	12.4	10.6	9.04	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 / C350L0 (for t = 2.5 mm f_y = 350 MPa and f_u = 400 MPa, for $t \le 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

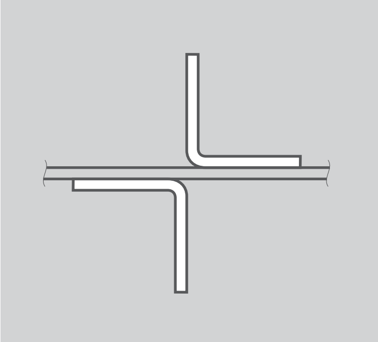


Table 18.1–2(B)

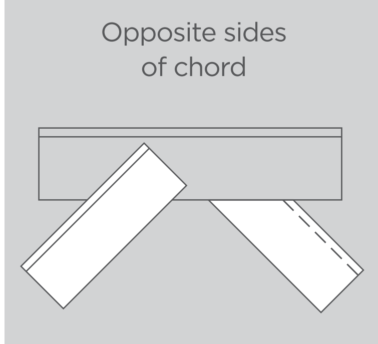
Limit state design

Truss web member
Axial compression force

One leg connected – opposite sides of truss chord

Grade C450L0 / C400L0 / C350L0

Profile equal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
65 x	65 x	6.0 CA	5.62	274	31.6	30.9	29.9	28.4	26.6	24.6	22.6	20.6	18.6	16.8	13.7	11.3	–	–
		5.0 CA	4.52	186	25.5	25.0	24.3	23.2	21.8	20.4	18.8	17.2	15.6	14.2	11.6	9.54	–	–
		4.0 CA	3.69	131	19.4	19.1	18.5	17.7	16.8	15.7	14.6	13.5	12.4	11.3	9.30	7.72	–	–
50 x	50 x	6.0 CA	4.21	205	21.0	20.3	19.2	17.7	16.0	14.3	12.6	11.1	9.74	8.57	–	–	–	–
		5.0 CA	3.42	166	18.4	17.9	16.9	15.6	14.1	12.6	11.1	9.77	8.59	7.57	–	–	–	–
		4.0 CA	2.79	121	15.1	14.6	13.8	12.8	11.6	10.4	9.19	8.08	7.11	6.27	–	–	–	–
		2.5 CA	1.81	46.3	6.85	6.72	6.45	6.11	5.73	5.31	4.87	4.44	4.02	3.62	–	–	–	–
45 x	45 x	4.0 CA	2.50	116	13.2	12.7	11.8	10.7	9.53	8.36	7.26	6.30	5.48	4.79	–	–	–	–
		2.5 CA	1.62	45.2	6.29	6.13	5.83	5.45	5.03	4.58	4.12	3.67	3.26	2.90	–	–	–	–
40 x	40 x	4.0 CA	2.20	107	11.1	10.6	9.67	8.59	7.47	6.42	5.48	4.69	–	–	–	–	–	–
		2.5 CA	1.43	43.8	5.62	5.43	5.09	4.68	4.23	3.74	3.28	2.87	2.51	–	–	–	–	–
30 x	30 x	2.5 CA	1.06	39.2	3.92	3.67	3.27	2.82	2.39	2.00	–	–	–	–	–	–	–	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 / C350L0 (for t = 2.5 mm f_y = 350 MPa and f_u = 400 MPa, for $t \leq$ 6.0 mm f_y = 450 MPa and f_u = 500 MPa, and for t > 6.0 mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

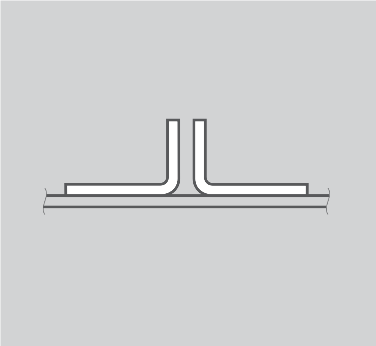


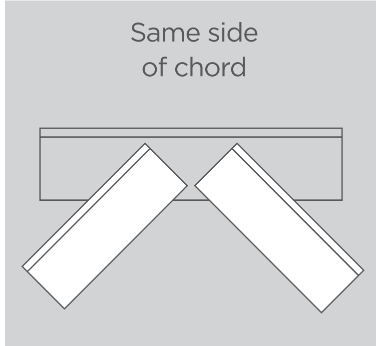
Table 18.2-1

Limit state design
Truss web member
Axial compression force

Long leg connected – same side of truss chord

Grade C450LO / C400LO

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m) 0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
mm	mm	mm	kg/m	kN														
150	100	8.0 CA	14.9	514	183	154	151	147	141	134	125	115	105	94.6	76.6	62.7	52.0	43.7
		6.0 CA	11.3	342	94.4	93.6	92.2	90.2	87.6	84.5	80.7	76.3	71.5	66.4	56.5	47.3	39.6	33.4
125	75	8.0 CA	11.7	447	153	134	128	119	108	95.1	81.5	70.0	60.4	52.7	40.7	32.3	26.2	21.6
		6.0 CA	8.92	322	94.2	92.1	88.6	83.4	76.6	68.8	61.1	53.6	46.7	40.8	31.7	25.2	20.4	16.8
100	75	8.0 CA	10.2	426	122	119	114	105	93.3	81.1	69.1	59.0	50.8	44.0	33.9	26.8	21.7	17.8
		6.0 CA	7.74	314	91.3	89.2	85.6	80.4	73.1	64.3	54.8	46.8	40.3	35.0	26.9	21.2	17.1	14.0
75	50	6.0 CA	5.38	252	72.0	66.4	56.6	45.1	35.0	27.7	22.4	18.3	15.3	12.9	9.56	–	–	–
		5.0 CA	4.34	180	53.6	50.4	44.8	37.2	29.3	23.4	18.9	15.6	13.0	11.0	8.16	–	–	–
		4.0 CA	3.54	128	37.9	36.1	32.9	28.1	23.3	18.8	15.3	12.7	10.6	9.02	6.70	–	–	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm $f_y = 450$ MPa and $f_u = 500$ MPa, and for $t > 6.0$ mm $f_y = 400$ MPa and $f_u = 450$ MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

Table 18.2–2

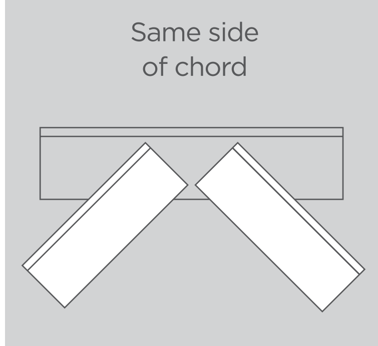
Limit state design

Truss web member
Axial compression force

Short leg connected – same side of truss chord

Grade C450LO / C400LO

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150 x	100 x	8.0 CA	14.9	514	136	120	118	116	112	108	103	96.2	89	81.6	67.9	56.8	47.9	40.5
		6.0 CA	11.3	342	79.3	78.7	77.8	76.5	74.8	72.6	69.9	66.8	63.2	59.3	51.4	43.4	36.4	30.8
125 x	75 x	8.0 CA	11.7	447	104	95.1	92.3	88.1	82.3	74.7	66.2	58.5	51.7	45.9	36.5	29.6	24.2	20.1
		6.0 CA	8.92	322	71.5	70.4	68.5	65.5	61.4	56.5	51.2	45.9	40.8	36.3	28.7	23.0	18.7	15.5
100 x	75 x	8.0 CA	10.2	426	96.7	94.9	91.6	86.0	78.5	70.0	60.9	53.0	46.3	40.6	31.9	25.5	20.7	17.1
		6.0 CA	7.74	314	75.5	74.2	71.9	68.5	63.4	56.8	49.4	42.9	37.4	32.7	25.3	20.1	16.3	13.4
75 x	50 x	6.0 CA	5.38	252	52.6	49.9	44.5	37.2	30.1	24.5	20.2	16.9	14.3	12.1	9.05	–	–	–
		5.0 CA	4.34	180	40.7	39.0	35.8	31.0	25.3	20.8	17.2	14.4	12.1	10.3	7.69	–	–	–
		4.0 CA	3.54	128	30.2	29.1	27.1	23.9	20.4	16.9	14.1	11.7	9.87	8.40	6.27	–	–	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450LO / C400LO (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

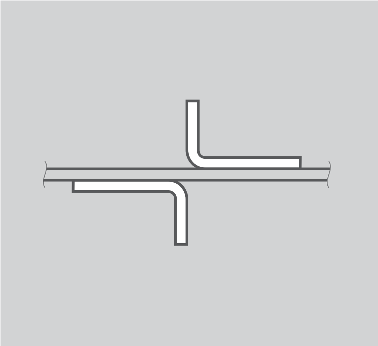


Table 18.2-3

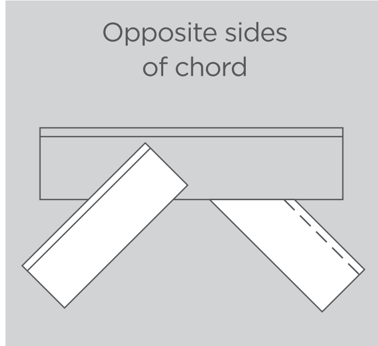
Limit state design

Truss web member
Axial compression force

Long leg connected – opposite sides of truss chord

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1 x b_2 x Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm mm mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150 x 100 x 8.0 CA	14.9	514	82.5	75.9	74.9	73.5	71.7	69.4	66.6	63.3	59.6	55.7	48.1	41.6	36.1	31.4
6.0 CA	11.3	342	54.1	53.7	53.0	52.1	51.0	49.6	47.9	46.0	43.9	41.6	36.9	32.2	28.0	24.5
125 x 75 x 8.0 CA	11.7	447	61.4	57.9	56.4	54.2	51.4	47.7	43.5	39.5	35.9	32.6	27.0	22.6	19.1	16.3
6.0 CA	8.92	322	46.3	45.6	44.4	42.8	40.5	37.8	35.0	32.0	29.1	26.4	21.8	18.2	15.3	13.0
100 x 75 x 8.0 CA	10.2	426	51.6	50.9	49.6	47.5	44.7	41.2	37.4	33.9	30.6	27.7	22.8	19.0	16.0	13.7
6.0 CA	7.74	314	42.7	42.0	40.9	39.4	37.2	34.4	31.1	28.1	25.3	22.8	18.7	15.5	12.9	10.9
75 x 50 x 6.0 CA	5.38	252	27.2	26.2	24.2	21.5	18.5	15.9	13.7	11.9	10.4	9.12	7.14	–	–	–
5.0 CA	4.34	180	22.2	21.5	20.2	18.2	15.8	13.6	11.8	10.2	8.90	7.81	6.11	–	–	–
4.0 CA	3.54	128	17.2	16.6	15.7	14.3	12.7	11.1	9.61	8.36	7.31	6.42	5.03	–	–	–

Notes:
1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

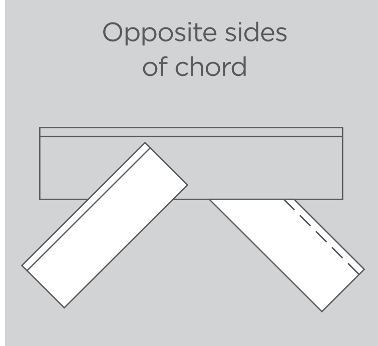
Table 18.2–4

Limit state design
Truss web member
Axial compression force

Short leg connected – opposite sides of truss chord

Grade C450L0 / C400L0

Profile unequal angles



Designation b_1	b_2	Nominal thickness	Mass per metre	Design section capacity $\phi_c N_s$	Design axial compression force N^*_{cmax} (kN) — Web member unbraced length, l (m)													
mm	mm	mm	kg/m	kN	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0	4.5
150 x	100 x	8.0 CA	14.9	514	67.6	63.1	62.6	61.8	60.8	59.4	57.5	55.3	52.7	49.8	43.9	38.6	34.0	29.6
		6.0 CA	11.3	342	47.0	46.8	46.4	45.9	45.1	44.2	43.1	41.7	40.1	38.4	34.7	30.2	26.2	22.7
125 x	75 x	8.0 CA	11.7	447	49.4	47.2	46.4	45.2	43.5	41.2	38.3	35.3	32.6	30.0	25.4	21.6	18.3	15.6
		6.0 CA	8.92	322	38.7	38.3	37.6	36.6	35.2	33.3	31.3	29.1	26.8	24.6	20.5	17.0	14.2	12.0
100 x	75 x	8.0 CA	10.2	426	44.6	44.2	43.4	42.0	39.9	37.4	34.4	31.5	28.8	26.3	22.0	18.5	15.6	13.3
		6.0 CA	7.74	314	37.7	37.3	36.7	35.6	34.1	31.9	29.2	26.6	24.2	22.0	18.0	14.9	12.4	10.5
75 x	50 x	6.0 CA	5.38	252	23.5	22.9	21.6	19.6	17.3	15.1	13.2	11.6	10.2	8.93	6.99	–	–	–
		5.0 CA	4.34	180	19.4	18.9	18.0	16.6	14.7	12.9	11.3	9.93	8.66	7.58	5.91	–	–	–
		4.0 CA	3.54	128	15.3	15.0	14.4	13.3	12.0	10.6	9.34	8.10	7.05	6.15	4.78	–	–	–

Notes: 1. The web member unbraced length exceeds $200r_y$ for values to the right of the solid line.
2. Values are not listed when the effective length exceeds $300r_y$.
3. Steel grade C450L0 / C400L0 (for $t \leq 6.0$ mm f_y = 450 MPa and f_u = 500 MPa, and for $t > 6.0$ mm f_y = 400 MPa and f_u = 450 MPa).
4. Axial compression forces are calculated in accordance with AS/NZS 4600.

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