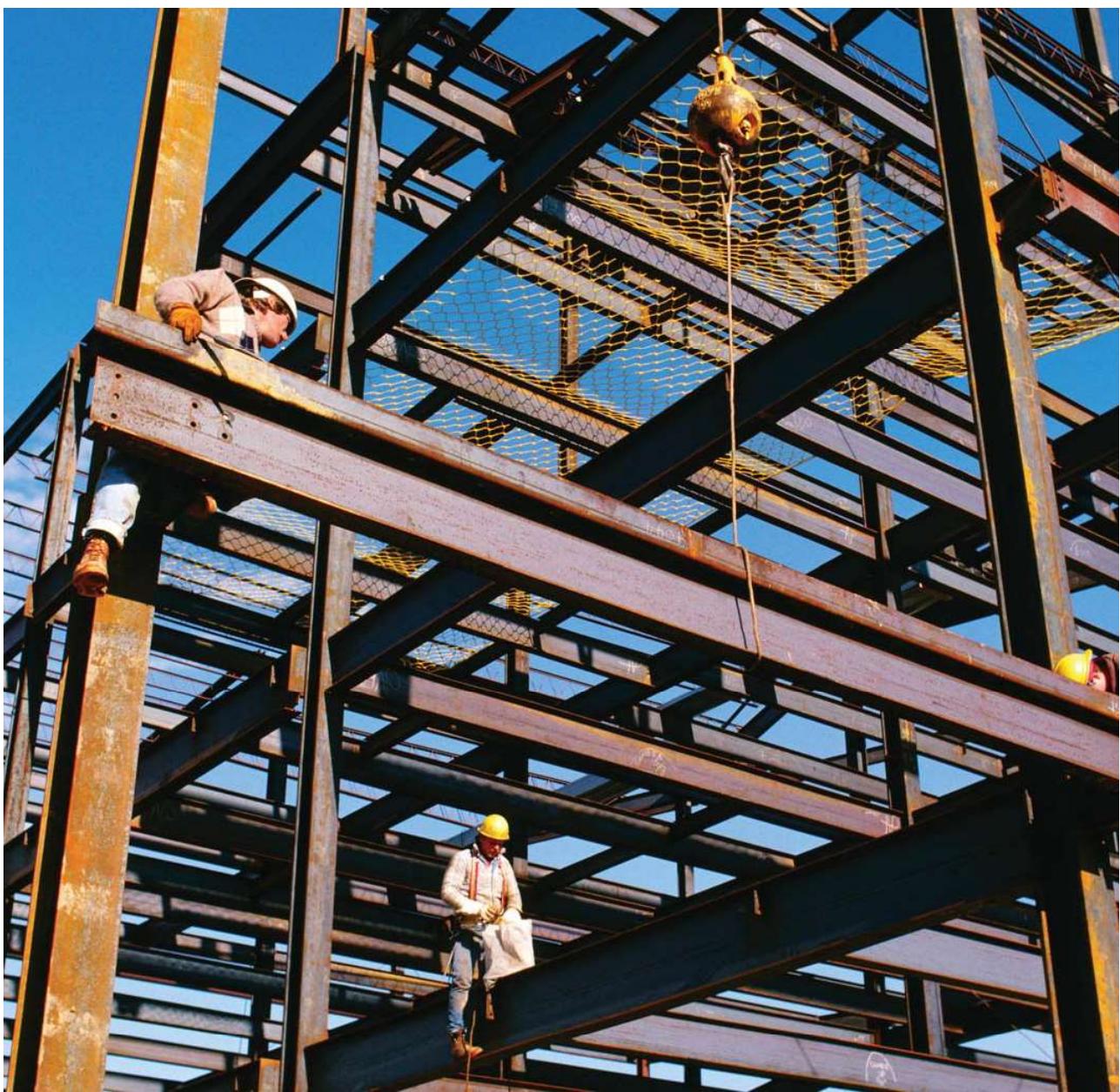
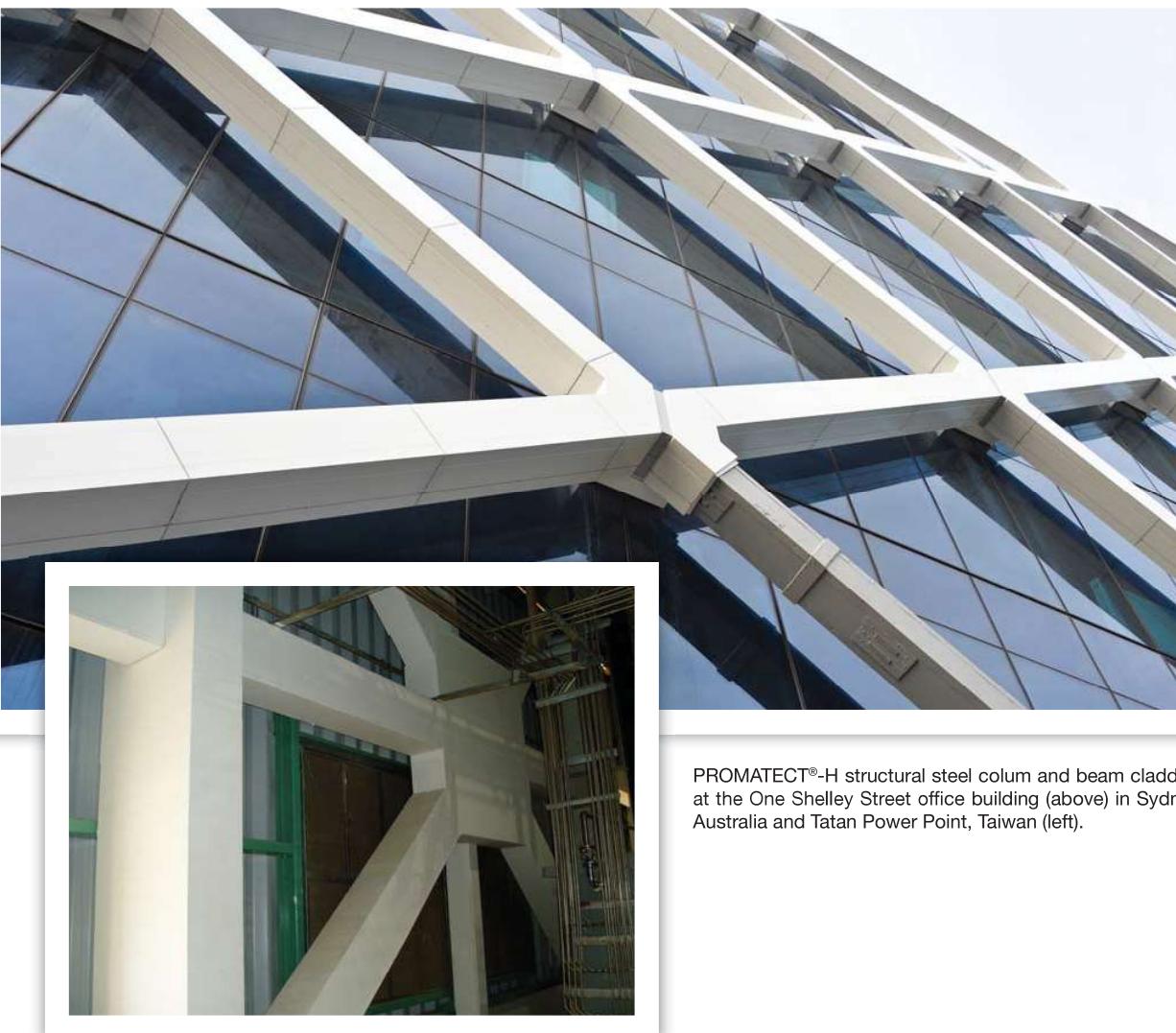


Promat

PASSIVE FIRE PROTECTION SYSTEMS

Application & Technical Manual: Structural Steel Fire Protection





PROMATECT®-H structural steel column and beam cladding at the One Shelley Street office building (above) in Sydney, Australia and Tatatan Power Point, Taiwan (left).

Numerous research programmes show that some types of fully stressed steel sections can achieve a 30 minute fire resistance without any additional protection materials being applied. However, these apply to a limited number of steel sections only, based on the allowable Section Factor H_p/A . Section Factor is a common term used in fire protection for steelwork and is discussed in detail below.

Typical building regulations usually require certain elements of structure to be fire resistant for more than 30 minutes and up to a specified minimum period of time. The thickness of any fire protection material depends on a number of factors, such as:

- Duration of fire resistance specified
- Type of protection used, e.g. board, paint, spray etc
- Perimeter of the part of steel section exposed to fire
- Shape and dimensions of the steel section

To determine how these various factors affect the fire resistance, all Promat products and systems have been tested at nationally accredited laboratories around the world to a variety of standards, e.g. BS 476: Part 21, AS 1530: Part 4, ASTM E119 and BS EN 13381.

Tests carried out in accordance with the above standards are performed on both loaded and unloaded beams and columns which are clad with fire protection material. Steel surface temperatures are monitored with thermocouples to assess the performance of the cladding. Steel that is fully stressed in accordance with the design guides BS 449 or BS 5950: Part 1 (Australian equivalent AS 4100),

begin to lose their design margin of safety at temperatures around 550°C.

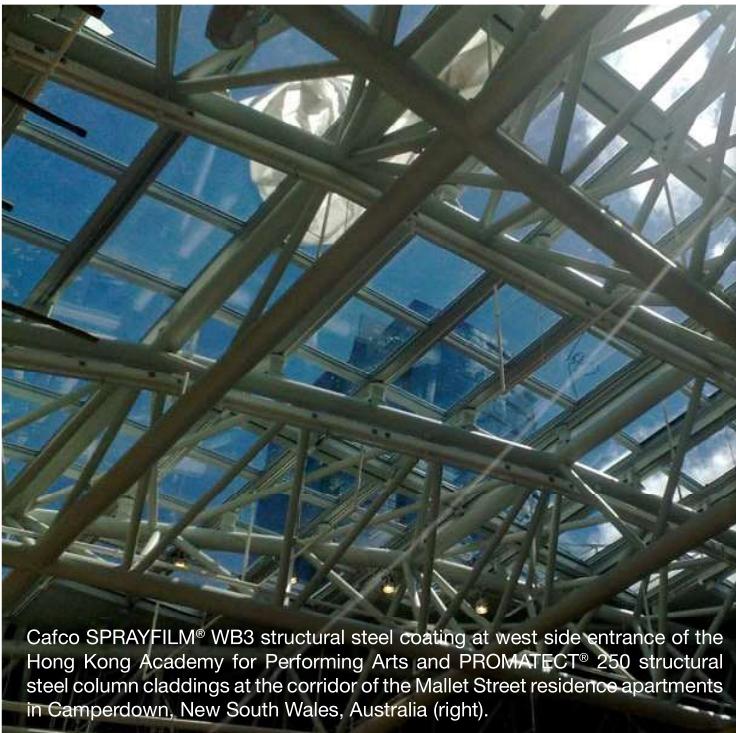
The table below shows how the strength of steel reduces as temperatures rise, i.e. variation of effective yield strength factor of normal structural steels with temperature.

Temperature (°C)	20	100	200	300	400	500	600	700	800
Effective yield strength factor	1.00	1.00	1.00	1.00	1.00	0.78	0.47	0.23	0.11

For example, at 700°C, the effective yield strength of Grade 43 (S275) steel is $0.23 \times 275 = 63.25\text{N/mm}^2$.

A range of unloaded sections are also tested to obtain data for analytical calculation, to measure exactly how much protection is needed for the most common steel sections and for providing fire resistance for different time periods.

IMPORTANT: When using Promat protection systems for structural steelwork, conservative limiting temperatures of 550°C and 620°C are referred to for columns and beams respectively and are in general use throughout this brochure. Apart from temperature data, the fire tests also need to demonstrate the ability of cladding to remain in place, usually described as the "stickability" of the material, for the maximum duration for which the protection may be required. The availability of thin materials and the low weight of Promat systems, plus the possibility of prefabrication, ensure maximum cost efficiency.



Section Factor (Hp/A)

The degree of fire protection provided depends on the Hp/A Section Factor for the steel section. The Hp/A factor is a function of the area of the steel exposed to the fire and the mass of the steel section. The higher the Hp/A, the faster the steel section heats up and so the greater the thickness of fire protection material required.

It should be noted that in European design standards, the section factor is presented as A/V which has the same numerical value as Hp/A. A/V measures the rate of temperature increase of a steel cross section by the ratio of the heated surface area to the volume. It is likely to gradually replace the use of Hp/A.

Depending on type of material used for protection, the calculation method for Hp/A value may differ. Generally there are two methods of construction for the protection materials: box protection and profile protection.

Box Protection Using Board Materials

For box protection, Hp is the sum of the inside dimensions of the smallest possible rectangular or square encasement of the steel section. One exception is circular hollow sections. See page 4.

Where a steel section abuts or is built into a fire resisting wall or floor, the surface in contact with or the surface within the wall or floor is ignored when calculating Hp.

However, the value A is always the total cross sectional area of the whole steel section.

Profile Protection Using Spray/Paint Materials

Encasements following the profile of the steel section will generally have a higher Hp/A section factor than a box encasement. One exception is circular hollow sections. See page 5.

The serial size and mass per metre of most steel sections are available in tables from steel manufacturers. Sometimes such tables also provide Hp/A values calculated for three or four sided box protection.

Following is an example of a calculation for a steel beam section of 406mm x 178mm x 54kg/m serial size to be encased on 3 sides using box protection method:

$$\begin{aligned} \text{Serial size} &= 406\text{mm} \times 178\text{mm} \\ \text{Actual size} &= 402.6\text{mm} \times 177.6\text{mm} \\ \text{Hp} &= B + 2D \\ &= 177.6 + 2 \times 402.6 \\ &= 982.8\text{mm} (0.9828\text{m}) \\ \text{A} &= 68.4\text{cm}^2 (0.00684\text{m}^2) \\ \text{Hp/A} &= 0.9828 \div 0.00684 \\ &= 144.7\text{m}^{-1} \\ &\approx 144\text{m}^{-1} \end{aligned}$$

The value of A, the cross sectional area, can be obtained either from steelwork tables or by accurate measurement. However, if the mass per metre is known then the Hp/A value can be calculated as follows:

$$\frac{\text{Hp}}{\text{A}} = \frac{7850 \times \text{Hp}}{\text{W}}$$

Where W = Mass of per metre (kg/m)

Where 7850 = Nominal density of steel

Sample calculation using the previous example:

$$\begin{aligned} \frac{\text{Hp}}{\text{A}} &= \frac{7850 \times 0.9828}{54} \\ &= 142.87\text{m}^{-1} \\ &\approx 143\text{m}^{-1} \end{aligned}$$

The shape of the steel section can also play an important role when determining the required thickness of a protection material. Following are some notes for reference. For details on steel profiles not outlined here, please consult Promat.

Castellated Sections / Cellform Beams

These steel members heat up more quickly than the original section from which they were produced. Common practice is that protection thickness should therefore be 20% greater than those calculated from the Hp/A value of the original section from which the castellated section is formed.

However, it should be noted that the above information is now superseded by a new, more scientific approach for the protection of castellated sections. The following is taken from "Fire Protection for Structural Steel in Buildings", 4th Edition, published by the ASFP (see www.asfp.org.uk).

The recently amended method of obtaining the section factor (Hp/A) for castellated sections is now specific. In fact, the recommendation from the Steel Construction Institute, published as RT 1085, for castellated sections and cellular beams manufactured from all rolled steel sections and from welded plate, the Section Factor for passive protection system is calculated as:

$$\text{Section factor (m}^{-1}\text{)} = 1400/t$$

Where t = the thickness (mm) of the lower steel web and applies for beams made from all steel rolled sections and from welded steel plate.

It should be noted that there are a number of conditions attached to the use of this calculation method, which are detailed in the ASFP "Yellow Book" publication.

Individual protection products, normally quite similar in performance when compared on the basis of rolled steel sections, may require radically different thicknesses for the same cellular beam.

Structural Hollow Section

The same thickness of board materials can be used on square, rectangular and circular hollow sections as on 'I' sections of the same Hp/A value.

Bracing

Bracing is included in a structure to give resistance to wind forces and provide overall stiffness. Masonry walls and steel cladding contribute to a structure's rigidity but these are rarely taken into account in design. Also, the probability of a major fire occurrence concurrent with maximum wind load is remote (see BS 5950: Part 8). It seems unreasonable therefore to apply the 550°C steel temperature criteria to bracing. While each case must be judged on individual merits, protection to bracing is generally not necessary, but where it is required the Hp/A value of the bracing section or 200m⁻¹ should be used, whichever is the lesser.

Lattice Members

As the determination of the protection necessary to protect lattice members requires broad consideration of the lattice design, please consult Promat concerning such steel sections.

Partially Exposed Members

Where columns or beams are partly built into or are in close contact with walls or floors, the protection afforded to the steelwork by the wall or floor should be taken into account. In those instances where the steel section sits within or against masonry or concrete constructions, this will give protection to the adjacent surface of the steelwork. Thus, for the purpose of determining the heated perimeter (Hp), this should be taken as only that part of the steel section which is exposed. It should be noted that where the steelwork penetrates both sides of a fire resisting construction, e.g. a wall protruding into a space which has an open end, simultaneous attack from fire on both sides may occur on columns partially exposed within the wall. In such an instance, the section factor should be calculated based upon the sum of the areas exposed to fire on either side of the wall and the total volume of the steel section.

Note that separating elements are generally required to offer a performance including the insulation criteria of 140°C or 180°C. Therefore, where a steel section passes through a separating element and is exposed on both sides, consideration must also be given to providing sufficient protection not only to maintain the temperature of the steel section below 550°C but also to ensure the surface temperature on the unexposed face does not exceed the 140°C or 180°C insulation criteria of the separating element. Due allowance for any expected building movement should also be considered.

External Lightweight Walls

Where the structural elements form portal legs supporting a lightweight external wall, the insulation performance required of the wall may contribute to the protection of any column flange falling within the thickness of the wall. In such cases, please consult Promat to confirm the board thickness and which areas of such columns should be protected.

Internal Lightweight Partitions/Walls

Where a column or beam is built into a fire resistant lightweight wall or partition, the protection to the steelwork can generally be designed on the assumption that only one side of the wall or partition will be exposed to fire at any one time. The wall or partition should be adequately secured to the column in such a way as to ensure the wall or partition will not apply stress on the protection encasement. Due allowance for any expected building movement should be considered.

Floors

Where beams are wholly within the cavity of a timber floor protected by a PROMATECT®-H ceiling, test evidence shows that the cavity air temperature of the floor is such that the beam will be adequately protected to the same fire resistance by the ceiling that protects the floor. Where the beam is wholly or partly below the line of the PROMATECT®-H ceiling then Hp should be based upon the portion of the steel beam that is below ceiling level.

Beams Supporting Composite Floors With Profiled Metal Decking

A series of fire resistance tests has demonstrated that it is not always necessary to fill the void formed between the top flange of a beam and the underside of a profiled steel deck. Recommendations based on the research have been published by the Steel Construction Institute (UK) and for decks running perpendicular to the beams, are as follows:

DOVETAIL DECKS

Voids may be left unfilled for all fire resistance period, unless a fire resisting wall or partition is located beneath the beam.

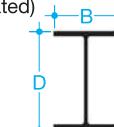
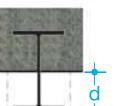
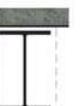
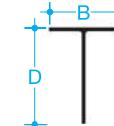
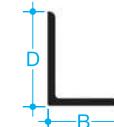
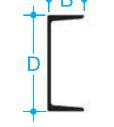
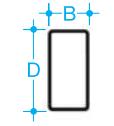
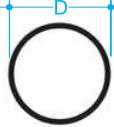
TRAPEZOIDAL DECKS

Generally, voids may be left unfilled for up to 60 minutes fire resistance. Also, for 90 minutes if the board thickness used is appropriate for the Hp/A + 15%. Care should be taken to ensure that if the voids are unfilled, the main encasement will need to be adequately secured. For periods over 90 minutes the voids should be filled.

In all instances, voids should also be filled if a fire wall is located beneath the beam, for all fire resistance periods. These recommendations apply to board encasements. The trapezoidal steel deck slab should be designed to act structurally with the beam. If this is not the case, the voids should be filled for all fire resistance periods.

Various Box Protection

Protection configurations with values of perimeter Hp for use in the calculation of section factor Hp/A (A/V)

Steel section	Box protection				
Universal beams, universal columns and joists (plain and castellated)  Hp	Four sides  2B + 2D	Three sides  B + 2D	Three sides (partially exposed)  B + 2d	Two sides  B + D	One side (partially exposed)  B
Structural and rolled tees  Hp	Four sides  2B + 2D	Three sides (flange to soffit)  B + 2D	Three sides (toe of web to soffit)  B + 2D		
Angles  Hp	Four sides  2B + 2D	Three sides (flange to soffit)  B + 2D	Three sides (toe of flange soffit)  B + 2D		
Channels  Hp	Four sides  2B + 2D	Three sides (web to soffit)  2B + D	Three sides (flange to soffit)  B + 2D		
Square or rectangular hollow sections  Hp	Four sides  2B + 2D	Three sides  B + 2D			
Circular hollow sections  Hp	Four sides  πD				

NOTE: The air space created in boxing a circular section improves the insulation and the value of Hp/A. Therefore, Hp higher than profile protection (p) would be anomalous. Hence, Hp is taken as the circumference of the circular section and not 4D.

Following is an example of calculation for a universal beam section using box protection of 305mm x 305mm x 240kg/m serial size to be encased on three or four sides when A = 305.6cm², B = 317.9mm, D = 352.6mm, t = 23mm.

Four sided box protection:

$$\begin{aligned} \text{Hp} &= 2B + 2D \\ &= (2 \times 317.9) + (2 \times 352.6) \\ &= 1341\text{mm (1.341m)} \end{aligned}$$

$$\begin{aligned} \text{Hp/A} &= 1.341 \div 0.03056 \\ &= 43.9\text{m}^{-1} \end{aligned}$$

Three sided box protection:

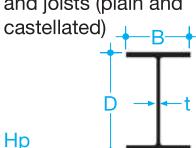
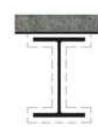
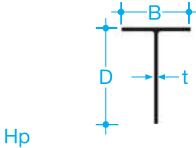
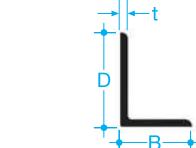
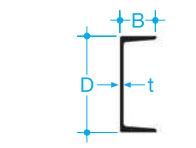
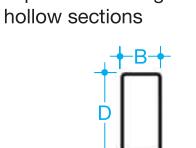
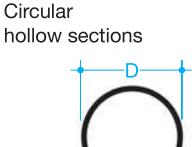
$$\begin{aligned} \text{Hp} &= B + 2D \\ &= 317.9 + (2 \times 352.6) \\ &= 1023.1\text{mm (1.023m)} \end{aligned}$$

$$\begin{aligned} \text{Hp/A} &= 1.023 \div 0.03056 \\ &= 33.5\text{m}^{-1} \end{aligned}$$

The above calculated values are approximate in that radii at corners and roots of all sections are ignored. In these figures, Hp/A = A/V.

Various Profile Protection

Protection configurations with values of perimeter Hp for use in the calculation of section factor Hp/A (A/V)

Steel section	Profile protection				
Universal beams, universal columns and joists (plain and castellated)  Hp	Four sides  $2B + 2D + 2(B - t) = 4B + 2D - 2t$	Three sides  $B + 2D + 2(B - t) = 3B + 2D - 2t$	Three sides (partially exposed)  $B + 2d + (B - t) = 2B + 2d - t$	Two sides  $B + D + 2(B - t)/2 = 2B + D - t$	One side (partially exposed)  B
Structural and rolled tees  Hp	Four sides  $2B + 2D$	Three sides (flange to soffit)  $B + 2D$	Three sides (toe of web to soffit)  $B + 2D + (B - t) = 2B + 2D - t$		
Angles  Hp	Four sides  $2B + 2D$	Three sides (flange to soffit)  $B + 2D$	Three sides (toe of flange soffit)  $B + 2D + (B - t) = 2B + 2D - t$		
Channels  Hp	Four sides  $2B + 2D + 2(B - t) = 4B + 2D - 2t$	Three sides (web to soffit)  $2B + D + 2(B - t) = 4B + D - 2t$	Three sides (flange to soffit)  $B + 2D + 2(B - t) = 3B + 2D - 2t$		
Square or rectangular hollow sections  Hp	Four sides  $2B + 2D$	Three sides  $B + 2D$			
Circular hollow sections  Hp	Four sides  πD				

Following is an example of calculation for a universal beam section using profile protection of 305mm x 305mm x 240kg/m serial size to be encased on three or four sides when A = 305.6cm², B = 317.9mm, D = 352.6mm, t = 23mm.

Four sided profile protection: $Hp = 4B + 2D - 2t = (4 \times 317.9) + (2 \times 352.6) - (2 \times 23) = 1930.8\text{mm (1.931m)}$

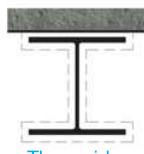
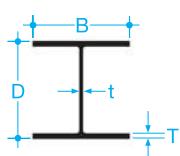
Three sided profile protection: $Hp = 3B + 2D - 2t = (3 \times 317.9) + (2 \times 352.6) - (2 \times 23) = 1612.9\text{mm (1.613m)}$

$Hp/A = 1.931 \div 0.03056 = 63.1\text{m}^{-1}$

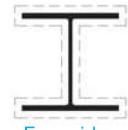
$Hp/A = 1.613 \div 0.03056 = 52.8\text{m}^{-1}$

The above calculated values are approximate in that radii at corners and roots of all sections are ignored. In these figures, Hp/A = A/V.

Universal Columns



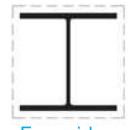
Three sides



Four sides



Three sides



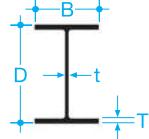
Four sides

Profile protection

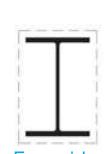
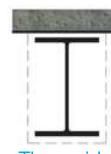
Box protection

Designation		Depth of section	Width of section	Thickness		Area of section (cm ²)	Profile protection		Box protection	
Serial size (mm)	Mass (kg/m)			D (mm)	B (mm)		Web t (mm)	Flange T (mm)	Three sides (m ⁻¹)	Four sides (m ⁻¹)
356 x 406	634	474.7	424.1	47.6	77.0	808.1	25	30	15	20
	551	455.7	418.5	42.0	67.5	701.8	30	35	20	25
	467	436.6	412.4	35.9	58.0	595.5	35	40	20	30
	393	419.1	407.0	30.6	49.2	500.9	40	45	25	35
	340	406.4	403.0	26.5	42.9	432.7	45	55	30	35
	287	363.7	399.0	22.6	36.5	366.0	50	65	30	45
	235	381.0	395.0	18.5	30.2	299.8	65	75	40	50
356 x 368	202	374.7	374.4	16.8	27.0	257.9	70	85	45	60
	177	368.3	372.1	14.5	23.8	255.7	80	95	50	65
	153	362.0	370.2	12.6	20.7	195.2	90	110	55	75
	129	355.6	368.3	10.7	17.5	164.9	105	130	65	90
305 x 305	283	365.3	321.8	26.9	44.1	360.4	45	55	30	40
	240	352.6	317.9	23.0	37.7	305.6	50	60	35	45
	198	339.9	314.1	19.2	31.4	252.3	60	75	40	50
	158	327.6	310.6	15.7	25.0	201.2	75	90	50	65
	137	320.5	308.7	13.8	21.7	174.6	85	105	55	70
	118	314.5	306.8	11.9	18.7	149.8	100	120	60	85
	97	307.8	304.8	9.9	15.4	123.3	120	145	75	100
254 x 254	167	289.1	264.5	19.2	31.7	212.4	60	75	40	50
	132	276.4	261.0	15.6	25.3	167.7	75	90	50	65
	107	266.7	258.3	13.0	20.5	136.6	90	110	60	75
	89	260.4	255.9	10.5	17.3	114.0	110	130	70	90
	73	254.0	254.0	8.6	14.2	92.9	130	160	80	110
203 x 203	127	241.4	213.9	18.1	30.1	162.0	65	80	45	55
	113	235.0	212.1	16.3	26.9	145.0	75	90	45	60
	100	228.6	210.3	14.5	23.7	127.0	80	100	55	70
	86	222.3	208.8	13.0	20.5	110.1	95	115	60	80
	71	215.9	206.2	10.3	17.3	91.1	110	135	70	95
	60	209.6	205.2	9.3	14.2	75.8	130	160	80	110
	52	206.2	203.9	8.0	12.5	66.4	150	180	95	125
	46	203.2	203.2	7.3	11.0	58.8	170	200	105	140
152 x 152	51	170.2	157.4	11.0	15.7	65.2	120	145	75	100
	44	166.0	155.9	9.5	13.6	56.1	132	165	85	115
	37	161.8	154.4	8.1	11.5	47.4	160	195	100	135
	30	157.5	152.9	6.6	9.4	38.2	195	235	120	160
	23	152.4	152.4	6.1	6.8	29.8	245	305	155	205

Universal Beams



Profile protection



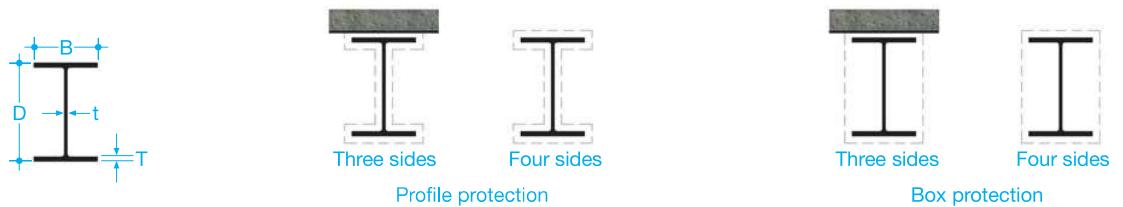
Box protection

Designation		Depth of section	Width of section	Thickness		Area of section (cm ²)	Profile protection		Box protection	
Serial size (mm)	Mass (kg/m)			D (mm)	B (mm)		Web t (mm)	Flange T (mm)	Three sides (m ⁻¹)	Four sides (m ⁻¹)
1016 x 305	487	1036.1	308.5	30.0	54.1	619.9	45	50	40	45
	438	1025.9	305.4	26.9	49.0	556.6	50	55	40	50
	393	1016.0	303.0	24.4	43.9	500.2	55	65	45	55
	349	1008.1	302.0	21.1	40.0	445.2	65	70	50	60
	314	1000.0	300.0	19.1	35.9	400.4	70	80	55	65
	272	990.1	300.0	16.5	31.0	346.9	80	90	65	75
	249	980.2	300.0	16.5	26.0	316.9	90	95	70	80
	222	970.3	300.0	16.0	21.1	282.8	95	110	80	90
914 x 419	388	920.5	420.5	21.5	36.6	494.5	60	70	45	55
	343	911.4	418.5	19.4	32.0	437.5	70	80	50	60
914 x 305	289	926.6	307.8	19.6	32.0	368.8	75	80	60	65
	253	918.5	305.5	17.3	27.9	322.8	85	95	65	75
	224	910.3	304.1	15.9	23.9	285.3	95	105	75	85
	201	903.0	303.4	15.2	20.2	256.4	105	115	80	95
838 x 292	226	850.9	293.8	16.1	26.8	288.7	85	95	70	80
	194	840.7	292.4	14.7	21.7	247.2	100	115	80	90
	176	834.9	291.6	14.0	18.8	224.1	110	125	90	100
762 x 267	197	769.6	268.0	15.6	25.4	250.8	90	100	70	85
	173	762.0	266.7	14.3	21.6	220.5	105	115	80	95
	147	753.9	265.3	12.9	17.5	188.1	120	135	95	110
	134	750.0	264.4	12.0	15.5	170.6	130	145	105	120
686 x 254	170	692.9	255.8	14.5	23.7	216.6	95	110	75	90
	152	687.6	254.5	13.2	21.0	193.8	105	120	85	95
	140	683.5	253.7	12.4	19.0	178.6	115	130	90	105
	125	677.9	253.0	11.7	16.2	159.6	130	145	100	115
610 x 305	238	633.0	311.5	18.6	31.4	303.8	70	80	50	60
	179	617.5	307.0	14.1	23.6	227.9	90	105	70	80
	149	609.6	304.8	11.9	19.7	190.1	110	125	80	95
610 x 229	140	617.0	230.1	13.1	22.1	178.4	105	120	80	95
	125	611.9	229.0	11.9	19.6	159.6	115	130	90	105
	113	607.3	228.2	11.2	17.3	144.5	130	145	100	115
	101	602.2	227.6	10.6	14.8	129.2	140	160	110	130
610 x 178	100	607.4	179.2	11.3	17.2	128.0	135	150	110	125
	92	603.0	178.8	10.9	15.0	117.0	145	160	120	135
	82	598.6	177.9	10.0	12.8	104.0	160	180	130	150
533 x 312	273	577.1	320.2	21.1	37.6	348.0	60	70	40	50
	219	560.3	317.4	18.3	29.2	279.0	70	85	50	65
	182	550.7	314.5	15.2	24.4	231.0	85	100	60	75
	151	542.5	312.0	12.7	20.3	192.0	105	120	75	90
533 x 210	138	549.1	213.9	14.7	23.6	176.0	95	110	75	85
	122	544.6	211.9	12.8	21.3	155.8	110	120	85	95
	109	539.5	210.7	11.6	18.8	138.6	120	135	95	110
	101	536.7	210.1	10.9	17.4	129.3	130	145	100	115
	92	533.1	209.3	10.2	15.6	117.8	140	160	110	125
	82	528.3	208.7	9.6	13.2	104.4	155	175	120	140
533 x 165	85	534.9	166.5	10.3	16.5	108.0	140	155	115	130
	75	529.1	165.9	9.7	13.6	95.2	160	175	130	145
	66	524.7	165.1	8.9	11.4	83.7	180	200	145	165

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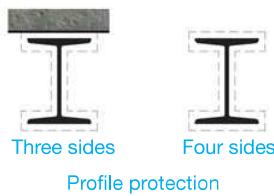
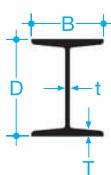
Universal Beams

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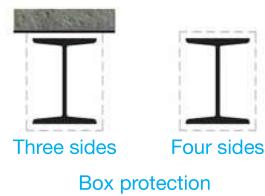


Designation		Depth of section	Width of section	Thickness		Area of section (cm ²)	Profile protection		Box protection	
Serial size (mm)	Mass (kg/m)			D (mm)	B (mm)		Web t (mm)	Flange T (mm)	Three sides (m ⁻¹)	Four sides (m ⁻¹)
457 x 191	161	492.0	199.4	18.0	32.0	206.0	75	85	60	65
	133	480.6	196.7	15.3	26.3	170.0	90	100	70	80
	106	469.2	194.0	12.6	20.6	135.0	110	125	85	100
	98	467.4	192.8	11.4	19.6	125.3	120	135	90	105
	89	463.6	192.0	10.6	17.7	113.9	130	145	100	115
	82	460.2	191.3	9.9	16.0	104.5	140	160	105	125
	74	457.2	190.5	9.1	14.5	95.0	150	175	115	135
	67	453.6	189.9	8.5	12.7	85.4	170	190	130	150
475 x 152	82	465.1	153.5	10.7	18.9	104.5	130	145	105	120
	74	461.3	152.7	9.9	17.0	95.0	140	155	115	130
	67	457.2	151.9	9.1	15.0	85.4	155	175	125	145
	60	454.7	152.9	8.0	13.3	75.9	175	195	140	160
	52	449.8	152.4	7.6	10.9	66.5	200	220	160	180
406 x 178	85	417.2	181.9	10.9	18.2	109.0	125	140	95	110
	74	412.8	179.7	9.7	16.0	95.0	140	160	105	125
	67	409.4	178.8	8.8	14.3	85.5	155	175	115	140
	60	406.4	177.8	7.8	12.8	76.0	175	195	130	155
	54	402.6	177.6	7.6	10.9	68.4	190	215	145	170
406 x 140	53	406.6	143.3	7.9	12.9	67.9	180	200	140	160
	46	402.3	142.4	6.9	11.2	59.0	205	230	160	185
	39	397.3	141.8	6.3	8.6	49.4	240	270	190	220
356 x 171	67	364.0	173.2	9.1	15.7	85.4	140	160	105	125
	57	358.6	172.1	8.0	13.0	72.2	165	190	125	145
	51	355.6	171.5	7.3	11.5	64.6	185	210	135	165
	45	352.0	171.0	6.9	9.7	57.0	210	240	155	185
356 x 127	39	352.8	126.0	6.5	10.7	49.4	215	240	170	195
	33	348.5	125.4	5.9	8.5	41.8	250	280	195	225
305 x 165	54	310.9	166.8	7.7	13.7	68.4	160	185	115	140
	46	307.1	165.7	6.7	11.8	58.9	185	210	130	160
	40	303.8	165.1	6.1	10.2	51.5	210	240	150	180
305 x 127	48	310.4	125.2	8.9	14.0	60.8	160	180	125	145
	42	306.6	124.3	8.0	12.1	53.2	180	200	140	160
	37	303.8	123.5	7.2	10.7	47.5	200	225	155	180
305 x 102	33	312.7	102.4	6.6	10.8	41.8	215	240	175	200
	28	308.9	101.9	6.1	8.9	36.3	245	275	200	225
	25	304.8	101.6	5.8	6.8	31.4	285	315	255	260
254 x 146	43	259.6	147.3	7.3	12.7	55.1	170	195	120	150
	37	256.0	146.4	6.4	10.9	47.5	195	225	140	170
	31	251.5	146.1	6.1	8.6	40.0	230	265	160	200
254 x 102	28	260.4	102.1	6.4	10.0	36.2	220	250	170	200
	25	257.0	101.9	6.1	8.4	32.2	245	280	190	220
	22	254.0	101.6	5.8	6.8	28.4	275	315	215	250
203 x 133	30	206.8	133.8	6.3	9.6	38.0	210	245	143	180
	25	203.2	133.4	5.8	7.8	32.3	240	285	165	210
203 x 102	23	203.2	101.8	5.4	9.3	29.4	235	270	175	205
178 x 102	19	177.8	101.2	4.8	7.9	24.3	260	305	190	230
152 x 89	16	152.4	88.7	4.5	7.7	20.3	270	315	195	235
127 x 76	13	127.0	76.0	4.0	7.6	16.5	280	326	200	245

Joists



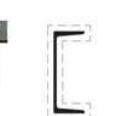
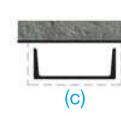
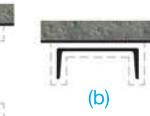
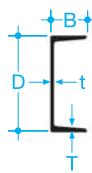
Profile protection



Box protection

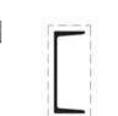
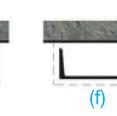
Designation		Depth of section D (mm)	Width of section B (mm)	Thickness		Area of section (cm²)	Profile protection		Box protection	
Serial size (mm)	Mass (kg/m)			Web t (mm)	Flange T (mm)		Three sides (m⁻¹)	Four sides (m⁻¹)	Three sides (m⁻¹)	Four sides (m⁻¹)
254 x 203	81.9	254.0	203.2	10.2	19.9	104.4	95	115	70	90
254 x 114	37.2	254.0	114.3	7.6	12.8	47.4	165	190	130	155
203 x 152	52.1	203.2	152.4	8.9	16.5	66.4	115	140	85	105
203 x 102	25.3	203.2	101.6	5.8	10.4	32.3	205	235	155	190
178 x 102	21.5	177.8	101.6	5.3	9.0	27.4	225	260	165	205
152 x 127	37.2	152.4	127.0	10.4	13.2	47.5	130	155	90	120
152 x 89	17.1	152.4	88.9	4.9	8.3	21.8	245	285	180	220
152 x 768	17.9	152.4	76.2	5.8	9.6	22.8	215	245	165	200
127 x 114	29.8	127.0	114.3	10.2	11.5	37.3	140	175	100	130
127 x 114	26.8	127.0	114.3	7.4	11.4	34.1	155	190	110	140
127 x 76	16.4	127.0	76.2	5.6	9.6	21.0	205	245	155	195
127 x 76	13.4	127.0	76.2	4.5	7.6	17.0	265	310	195	240
114 x 114	26.8	114.3	114.3	9.5	10.7	34.4	145	180	100	135
102 x 102	23.1	101.6	101.6	9.5	10.3	29.4	150	185	105	140
102 x 64	9.7	101.6	63.5	4.1	6.6	12.3	295	345	215	270
102 x 44	7.4	101.6	44.4	4.3	6.1	9.5	320	365	260	305
89 x 89	19.4	88.9	88.6	9.5	9.9	24.9	155	190	105	145
76 x 76	14.7	76.2	80.0	8.9	8.4	19.1	175	220	120	165
76 x 76	12.7	76.2	76.2	5.1	8.4	16.3	205	250	140	185

Channels



Examples of three sides

Profile protection

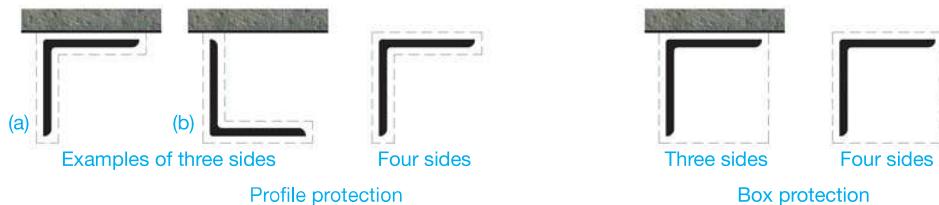
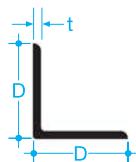


Examples of three sides

Box protection

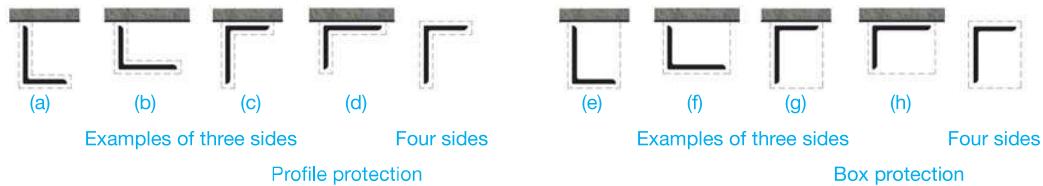
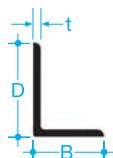
Designation		Depth of section D (mm)	Width of section B (mm)	Thickness		Area of section (cm²)	Profile protection				Box protection			
Serial size (mm)	Mass (kg/m)			Web t (mm)	Flange T (mm)		(a) Three sides (m⁻¹)	(b) Three sides (m⁻¹)	(c) Three sides (m⁻¹)	Four sides (m⁻¹)	(d) Three sides (m⁻¹)	(e) Three sides (m⁻¹)	(f) Three sides (m⁻¹)	Four sides (m⁻¹)
430 x 100	64.4	430	100	11.0	19.0	82.1	135	95	75	150	115	75	75	130
380 x 100	54.0	380	100	9.5	17.5	68.7	150	110	85	165	125	85	85	140
300 x 100	45.5	300	100	9.0	16.5	58.0	150	115	85	165	120	85	85	140
300 x 90	41.4	300	90	9.0	15.5	52.8	160	120	90	175	130	90	90	150
260 x 90	34.8	260	90	8.0	14.0	44.4	170	135	100	190	135	100	100	160
260 x 75	27.6	260	75	7.0	12.0	35.1	205	150	115	225	170	115	115	190
230 x 90	32.2	230	90	7.5	14.0	41.0	170	140	100	195	135	100	100	155
230 x 75	25.7	230	75	6.5	12.5	32.7	200	155	115	225	165	115	115	185
200 x 90	29.7	200	90	7.0	14.0	37.9	170	140	100	195	130	100	100	155
200 x 75	23.4	200	75	6.0	12.5	29.9	200	160	115	225	160	115	115	185
180 x 90	26.1	180	90	6.5	12.5	33.2	185	155	110	210	135	110	110	165
180 x 75	20.3	180	75	6.0	10.5	25.9	215	175	125	245	170	125	125	195
150 x 90	23.9	150	90	6.5	12.0	30.4	180	160	110	210	130	110	110	160
150 x 75	17.9	150	75	5.5	10.0	22.8	220	190	130	255	165	130	130	200
125 x 65	14.8	125	65	5.5	9.5	18.8	225	195	135	260	170	135	135	200
100 x 50	10.2	100	50	5.0	8.5	13.0	225	215	155	295	190	155	155	230

Equal Angles



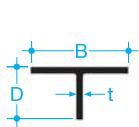
Designation		Thickness (mm)	Area of section (cm ²)	Profile protection			Box protection	
Size D x D (mm)	Mass (kg/m)			(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	Four sides (m ⁻¹)	Three sides (m ⁻¹)	Four sides (m ⁻¹)
200 x 200	71.1	24	90.6	65	85	85	65	90
	59.9	20	76.3	75	100	105	80	105
	54.2	18	69.1	85	110	115	85	115
	48.5	16	61.8	95	125	125	95	130
150 x 150	40.1	18	51.0	85	110	115	90	115
	33.8	15	43.0	100	135	135	105	140
	27.3	12	34.8	125	165	170	130	170
	23.0	10	29.3	150	200	200	155	205
120 x 120	26.6	15	33.9	105	135	140	105	140
	21.6	12	27.5	125	170	170	130	175
	18.2	10	23.2	150	200	200	155	205
	14.7	8	18.7	185	250	250	190	255
100 x 100	21.9	15	27.9	105	135	140	105	145
	17.8	12	22.7	130	170	170	130	175
	15.0	10	19.2	150	200	205	155	210
	12.2	8	15.5	185	250	250	195	260
90 x 90	15.9	12	20.3	130	170	175	135	175
	13.4	10	17.1	150	200	205	155	210
	10.9	8	13.9	190	245	250	195	260
	9.6	7	12.2	215	280	285	220	295
80 x 80	11.9	10	15.1	155	205	205	160	210
	9.6	8	12.3	190	250	255	195	260
	7.3	6	9.4	250	330	335	255	340
70 x 70	10.3	10	13.1	155	205	210	160	215
	8.4	8	10.6	190	250	255	195	260
	6.4	6	8.1	250	330	335	255	340
60 x 60	8.7	10	11.1	155	205	210	160	215
	7.1	8	9.0	190	250	260	200	265
	5.4	6	6.9	250	330	335	260	345
	4.6	5	5.8	300	395	400	305	410
50 x 50	5.8	8	7.4	195	255	260	200	270
	4.5	6	5.7	255	335	340	260	350
	3.8	5	4.8	300	400	405	310	415
45 x 45	4.0	6	5.1	255	335	340	265	350
	3.4	5	4.3	300	400	405	310	415
	2.7	4	3.5	370	490	495	385	510
40 x 40	3.5	6	4.5	255	340	345	265	355
	3.0	5	3.8	305	400	410	315	420
	2.4	4	3.1	375	495	500	390	515
25 x 25	1.8	5	2.3	315	415	430	335	445
	1.5	4	1.9	390	515	525	405	545
	1.1	3	1.4	505	680	685	530	710

Unequal Angles



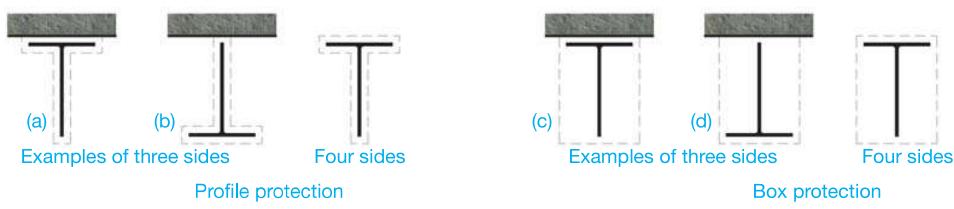
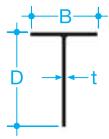
Designation		Thickness t (mm)	Area of section (cm ²)	Profile protection					Box protection					
Size D x B (mm)	Mass (kg/m)			(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	(c) Three sides (m ⁻¹)	(d) Three sides (m ⁻¹)	Four sides (m ⁻¹)	(e) Three sides (m ⁻¹)	(f) Three sides (m ⁻¹)	(g) Three sides (m ⁻¹)	(h) Three sides (m ⁻¹)	Four sides (m ⁻¹)	
200 x 150	47.1	18	60.0	110	110	90	80	115	90	85	90	85	115	
	39.6	15	50.5	135	135	105	95	135	110	100	110	100	140	
	32.0	12	40.8	165	165	130	120	170	135	120	135	120	170	
200 x 100	33.7	15	43.0	135	135	115	90	135	115	95	115	95	140	
	27.3	12	34.8	165	165	140	110	170	145	115	145	115	170	
	23.0	10	29.2	195	195	165	135	200	170	135	170	135	205	
150 x 90	26.6	15	33.9	135	135	110	95	140	115	95	115	95	140	
	21.6	12	27.5	165	165	140	115	170	140	120	140	120	175	
	18.2	10	23.2	200	200	165	140	205	170	140	170	140	205	
150 x 75	24.8	15	31.6	135	135	115	90	140	120	95	120	95	140	
	20.2	12	25.7	165	165	140	115	170	145	115	145	115	175	
	17.0	10	21.6	200	200	170	135	205	175	140	175	140	210	
125 x 75	17.8	12	22.7	165	165	140	115	170	145	120	145	120	175	
	15.0	10	19.1	200	200	165	140	205	170	145	170	145	210	
	12.2	8	15.5	245	245	205	170	250	210	175	210	175	260	
100 x 75	15.4	12	19.7	170	170	135	125	175	140	125	140	125	180	
	13.0	10	16.6	200	200	160	145	205	165	150	165	150	210	
	10.6	8	13.5	250	250	200	180	255	205	185	205	185	260	
100 x 65	12.3	10	15.6	200	200	165	140	205	170	145	170	145	210	
	9.9	8	12.7	245	245	200	175	255	210	180	210	180	260	
	8.8	7	11.2	280	280	230	200	290	235	205	235	205	295	
80 x 60	8.3	8	10.6	250	250	200	180	255	210	190	210	190	265	
	7.4	7	9.4	285	285	225	205	290	235	215	235	215	300	
	6.4	6	8.1	330	330	265	240	335	270	250	270	250	345	
75 x 50	7.4	8	9.4	250	250	205	180	260	210	185	210	185	265	
	5.7	6	7.2	330	330	270	235	340	275	240	275	240	345	
65 x 50	6.8	8	8.6	250	250	205	185	260	210	190	210	190	265	
	5.2	6	6.6	335	335	265	245	340	275	250	275	250	350	
	4.4	5	5.5	395	395	315	290	405	325	295	325	295	415	

Structural Tees of Universal Columns



Designation		Depth of section	Width of section	Thickness	Area of section	Profile protection			Box protection		
Serial size (mm)	Mass (kg/m)					D (mm)	B (mm)	t (mm)	(cm²)	(a) Three sides (m⁻¹)	(b) Three sides (m⁻¹)
406 x 178	118	190.5	395.0	18.5	149.9	50	75	75	50	50	80
368 x 178	101	187.3	374.4	16.8	129.0	55	85	85	60	60	85
	89	184.2	372.1	14.5	112.9	65	95	95	65	65	100
	77	181.0	370.2	12.6	97.6	75	110	110	75	75	115
	65	177.8	368.3	10.7	82.5	85	130	130	90	90	130
	79	163.6	310.6	15.7	100.6	60	90	95	65	65	95
305 x 152	69	160.3	308.7	13.8	87.3	70	105	105	70	70	110
	59	157.2	306.8	11.9	74.9	80	120	120	85	85	125
	49	153.9	304.8	9.9	61.6	95	145	145	100	100	150
	84	144.5	265.2	19.2	106.0	50	75	75	50	50	75
254 x 127	66	138.2	261.0	15.6	84.5	65	90	95	65	65	95
	54	133.4	258.3	13.0	68.3	75	110	115	75	75	115
	45	130.2	255.9	10.5	57.0	90	130	135	90	90	135
	37	127.0	254.0	8.6	46.4	105	160	160	110	110	165
	64	120.7	213.9	18.1	81.2	55	80	80	55	55	80
203 x 102	57	117.5	212.1	16.3	72.3	60	90	90	60	60	90
	50	114.3	210.3	14.5	63.4	70	100	100	70	70	100
	43	111.1	208.8	13.0	55.0	75	110	115	80	80	115
	36	108.0	206.2	10.3	45.5	90	135	135	95	95	140
	30	104.8	205.2	9.3	37.9	105	160	160	110	110	165
	26	103.1	203.9	8.0	33.2	120	180	180	125	125	185
	23	101.6	203.2	7.3	29.4	135	200	205	140	140	205
152 x 76	26	85.1	157.4	11.0	32.6	100	145	145	100	100	150
	22	83.0	155.9	9.5	28.0	110	165	170	115	115	170
	19	80.9	154.4	8.1	23.7	130	195	195	135	135	200
	15	78.7	152.9	6.6	19.1	160	235	240	160	160	240
	12	76.2	152.4	6.1	14.9	200	300	305	205	205	310

Structural Tees of Universal Beams

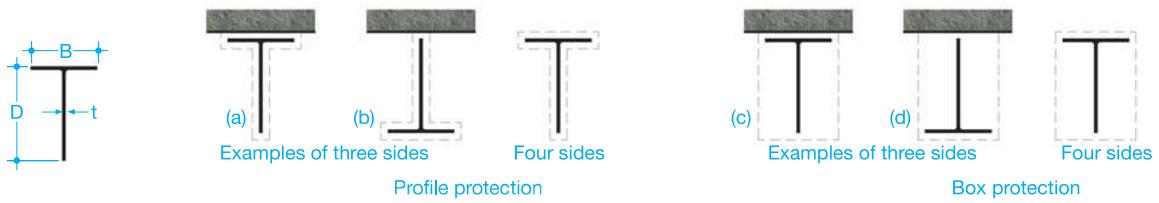


Designation		Depth of section	Width of section	Web thickness	Area of section	Profile protection			Box protection		
Serial size (mm)	Mass (kg/m)					D (mm)	B (mm)	t (mm)	(cm²)	(a) Three sides (m⁻¹)	(b) Three sides (m⁻¹)
305 x 457	127	459.2	305.5	17.3	161.4	75	95	95	75	75	95
	112	455.2	304.1	15.9	142.6	85	105	105	85	85	105
	101	451.5	303.4	15.2	128.2	95	115	115	95	95	120
292 x 419	113	425.5	293.8	16.1	144.4	80	100	100	80	80	100
	97	420.4	292.4	14.7	123.6	90	115	115	90	90	115
	88	417.4	291.6	14.0	112.1	100	125	125	100	100	125

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Structural Tees of Universal Beams

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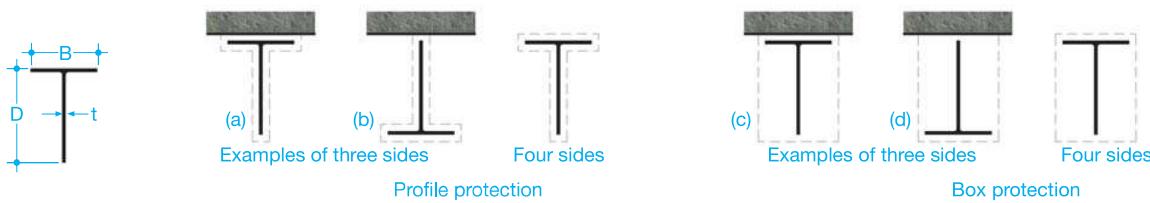


Designation		Depth of section	Width of section	Web thickness	Area of section (cm ²)	Profile protection			Box protection		
Serial size (mm)	Mass (kg/m)					(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	Four sides (m ⁻¹)	(c) Three sides (m ⁻¹)	(d) Three sides (m ⁻¹)	Four sides (m ⁻¹)
267 x 381	99	384.8	268.0	15.6	125.4	80	100	105	85	85	105
	87	381.0	266.7	14.3	110.2	90	115	115	90	90	120
	74	376.9	265.3	12.9	94.0	105	135	135	110	110	135
254 x 343	85	346.5	255.8	14.5	108.3	85	10	110	90	90	110
	76	343.8	254.5	13.2	96.9	95	120	120	95	95	125
	70	341.8	253.7	12.4	89.3	105	130	130	105	105	135
	63	339.0	253.0	11.7	79.8	115	145	145	115	115	150
305 x 305	119	316.5	311.8	18.6	151.9	60	80	80	60	60	85
	90	308.7	307.0	14.1	114.0	80	105	102	80	80	110
	75	304.8	304.8	11.9	95.1	95	125	125	95	95	130
229 x 305	70	308.5	230.1	13.1	89.2	95	120	120	95	95	120
	63	305.9	229.0	11.9	79.8	105	130	135	105	105	135
	57	303.7	228.2	11.2	72.2	115	145	145	115	115	145
	51	301.1	227.6	10.6	64.6	125	160	160	130	130	165
210 x 267	61	272.3	211.9	12.8	77.9	95	120	125	95	95	125
	55	269.7	210.7	11.6	69.3	105	135	135	110	110	140
	51	268.4	210.1	10.9	64.6	115	145	145	115	115	150
	46	266.6	209.3	10.2	58.9	125	160	160	125	125	160
	41	264.2	208.7	9.6	52.2	140	175	180	140	140	180
165 x 267	42	267.1	166.5	10.3	54.0	130	155	160	130	130	160
	37	264.5	165.9	9.7	47.6	145	175	180	145	145	180
	33	262.4	165.1	8.9	41.9	160	200	200	165	165	205
191 x 229	81	246.0	199.4	18.0	103.0	65	85	85	65	65	85
	67	240.3	196.7	15.3	84.9	80	100	100	80	80	105
	53	234.6	194.0	12.6	67.4	95	125	125	100	100	125
	49	233.7	192.8	11.4	62.6	105	135	135	105	105	135
	45	231.8	192.0	10.6	57.0	115	145	145	115	115	150
	41	230.1	191.3	9.9	52.3	125	160	160	125	125	160
	37	228.6	190.5	9.1	47.5	135	175	180	135	135	175
	34	226.8	189.9	8.5	42.7	150	135	135	150	150	195
152 x 229	41	232.5	153.5	10.7	52.2	115	145	145	120	120	150
	37	230.6	152.7	9.9	47.5	125	155	160	130	130	160
	34	228.6	151.9	9.1	42.7	140	175	175	145	145	180
	30	227.3	152.9	8.0	38.0	150	190	195	160	160	200
	26	224.9	152.4	7.6	33.2	180	220	225	180	180	225
178 x 203	43	208.6	181.9	10.9	54.3	110	140	140	110	110	145
	37	206.4	179.7	9.7	47.5	120	160	160	125	125	160
	34	204.7	178.8	8.8	42.7	135	175	175	140	140	180
	30	203.2	177.8	7.8	38.0	150	195	200	155	155	200
	27	201.3	177.6	7.6	34.2	165	215	220	170	170	220
140 x 203	27	203.3	143.3	7.9	34.0	160	200	200	160	160	205
	23	201.2	142.4	6.9	29.5	180	230	230	185	185	235
	20	198.6	141.8	6.3	24.7	215	270	275	220	220	275

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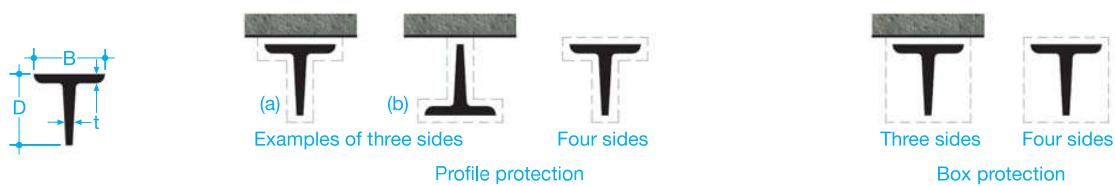
Structural Tees of Universal Beams

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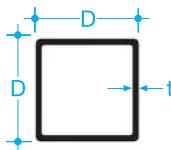
Designation		Depth of section	Width of section	Web thickness	Area of section	Profile protection			Box protection		
Serial size (mm)	Mass (kg/m)					D (mm)	B (mm)	t (mm)	(cm²)	(a) Three sides (m⁻¹)	(b) Three sides (m⁻¹)
171 x 178	34	182.0	173.2	9.1	42.7	125	160	165	125	125	165
	29	179.3	172.1	8.0	36.1	145	190	190	145	145	195
	26	177.8	171.5	7.3	32.3	160	210	215	165	165	215
	23	176.0	171.0	6.9	28.5	180	240	240	185	185	245
127 x 178	20	176.4	126.0	6.5	24.7	190	240	240	195	195	245
	17	174.2	125.4	5.9	20.9	225	280	285	225	225	285
165 x 152	27	155.4	166.8	7.7	34.2	140	185	185	140	140	190
	23	153.5	165.7	6.7	29.5	160	210	215	160	160	215
	20	151.9	165.1	6.1	25.8	180	240	245	180	180	245
127 x 152	24	155.2	125.2	8.9	30.4	140	180	180	145	145	185
	21	153.3	124.3	8.0	26.6	160	200	205	160	160	210
	19	151.9	123.5	7.2	23.7	175	225	230	180	180	230
102 x 152	17	156.3	102.4	6.6	20.9	195	240	245	200	200	245
	14	154.5	101.9	6.1	18.2	220	275	280	225	225	280
	13	152.4	101.6	5.8	15.7	255	320	320	260	260	325
146 x 127	22	129.8	147.3	7.3	27.6	145	195	200	150	150	200
	19	128.0	146.4	6.4	23.7	165	225	230	170	170	230
	16	125.7	146.1	6.1	20.0	195	265	270	200	200	270
102 x 127	14	130.2	102.1	6.4	18.1	195	250	250	200	200	255
	13	128.5	101.9	6.1	16.1	220	280	280	220	220	285
	11	127.0	101.6	5.8	14.2	245	315	320	250	250	325
133 x 102	15	103.4	133.8	6.3	19.0	175	245	245	180	180	250
	13	101.6	133.4	5.8	16.1	205	285	290	210	210	290

Rolled Tees



Designation		Depth of section	Width of section	Thickness	Area of section	Profile protection			Box protection		
Serial size (mm)	Mass (kg/m)					D (mm)	B (mm)	t (mm)	(cm²)	(a) Three sides (m⁻¹)	(b) Three sides (m⁻¹)
51 x 51	6.9	50.8	50.8	9.5	8.8	175	220	230	175	175	230
	4.8	50.8	50.8	6.4	6.1	250	325	335	250	250	335
44 x 44	4.1	44.4	44.4	6.4	5.2	255	325	340	255	255	340
	3.1	44.4	44.4	4.8	4.0	335	430	445	335	335	445

Square Hollow Sections



Three sides

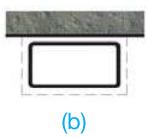
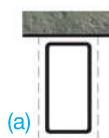
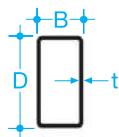


Four sides

Profile or box protection

Designation		Thickness t (mm)	Area of section (cm ²)	Profile or box protection		Designation		Thickness t (mm)	Area of section (cm ²)	Profile or box protection	
Size D x D (mm)	Mass (kg/m)			Three sides (m ⁻¹)	Four sides (m ⁻¹)	Size D x D (mm)	Mass (kg/m)			Three sides (m ⁻¹)	Four sides (m ⁻¹)
20 x 20	1.1	2.0	1.4	425	565	140 x 140	21.1	5.0	26.9	155	210
	1.4	2.5	1.7	350	465		26.3	6.3	33.5	125	165
25 x 25	1.4	2.0	1.8	410	550		32.9	8.0	41.9	100	135
	1.7	2.5	2.2	340	450		40.4	10.0	51.5	80	110
	2.0	3.0	2.6	290	385		49.5	12.5	63.0	65	90
	2.2	3.2	2.7	275	365	150 x 150	22.7	5.0	28.9	155	210
30 x 30	2.1	2.5	2.7	330	440		28.3	6.3	36.0	125	165
	2.5	3.0	3.2	280	375		35.4	8.0	45.1	100	135
	2.6	3.2	3.4	265	355		43.6	10.0	55.5	80	110
40 x 40	2.9	2.5	3.7	325	430		53.4	12.5	68.0	65	90
	3.5	3.0	4.4	275	365		66.4	16.0	84.5	55	70
	3.7	3.2	4.7	260	345	160 x 160	24.1	5.0	30.7	160	210
	4.0	3.6	5.1	235	315		30.1	6.3	38.3	125	170
	4.5	4.0	5.7	210	280		37.6	8.0	48.0	100	135
	5.4	5.0	6.9	175	235		46.3	10.0	58.9	85	110
	3.7	2.5	4.7	320	425		56.6	12.5	72.1	70	90
50 x 50	4.4	3.0	5.6	270	355		63.3	14.2	80.7	60	80
	4.7	3.2	5.9	255	335		70.2	16.0	89.4	55	75
	5.1	3.6	6.5	230	305	180 x 180	27.3	5.0	34.7	155	210
	5.7	4.0	7.3	205	275		34.2	6.3	43.6	125	165
	7.0	5.0	8.9	170	225		43.0	8.0	54.7	100	130
	8.5	6.3	10.8	140	185		53.0	10.0	67.5	80	105
	5.4	3.0	6.8	265	355		65.2	12.5	83.0	65	85
60 x 60	5.7	3.2	7.2	250	330		72.2	14.2	92.0	60	80
	6.3	3.6	8.0	225	300		81.4	16.0	104.0	50	70
	7.0	4.0	8.9	205	270	200 x 200	30.4	5.0	38.7	155	210
	8.5	5.0	10.9	165	220		38.2	6.3	48.6	125	165
	10.5	6.3	13.3	135	180		48.0	8.0	61.1	100	130
	12.8	8.0	16.3	110	145		59.3	10.0	75.5	80	105
	6.3	3.0	8.0	260	350		73.0	12.5	93.0	65	85
70 x 70	6.6	3.2	8.4	250	335		81.1	14.2	103.0	60	80
	7.5	3.6	9.5	220	295		91.5	16.0	117.0	50	70
	8.2	4.0	10.4	205	270	250 x 250	48.1	6.3	61.2	125	165
	10.1	5.0	12.9	165	215		60.5	8.0	77.1	95	130
	12.5	6.3	15.9	130	175		75.0	10.0	95.5	80	105
	15.3	8.0	19.5	110	145		92.6	12.5	118.0	65	85
	7.2	3.0	9.2	260	350		117.0	16.0	149.0	50	65
80 x 80	7.6	3.2	9.7	250	330		49.9	6.3	63.5	125	165
	8.6	3.6	10.9	220	295		62.8	8.0	80.0	100	130
	9.4	4.0	12.0	200	270		77.7	10.0	98.9	80	105
	11.7	5.0	14.9	160	215		95.8	12.5	122.0	65	85
	14.4	6.3	18.4	130	175	260 x 260	108.0	14.2	137.0	60	75
	17.8	8.0	22.7	105	140		120.0	16.0	153.0	55	70
90 x 90	9.7	3.6	12.4	220	290		57.8	6.3	73.6	125	165
	10.7	4.0	13.6	200	265		72.8	8.0	92.8	100	130
	13.3	5.0	16.9	160	215		90.7	10.0	116.0	80	105
	16.4	6.3	20.9	130	170		112.0	12.5	143.0	65	85
	20.4	8.0	25.9	105	140	300 x 300	126.0	14.2	160.0	60	75
	10.8	3.6	13.7	220	295		142.0	16.0	181.0	50	65
100 x 100	12.0	4.0	15.3	195	260		85.4	8.0	109.0	100	130
	14.8	5.0	18.9	160	210		106.0	10.0	135.0	75	105
	18.4	6.3	23.4	130	170		132.0	12.5	168.0	60	85
	22.9	8.0	29.1	105	135		148.0	14.2	189.0	55	75
	27.9	10.0	35.5	85	115	350 x 350	167.0	16.0	213.0	50	65
	14.4	4.0	18.4	195	260		97.9	8.0	125.0	100	130
120 x 120	18.0	5.0	22.9	155	210		122.0	10.0	156.0	75	105
	22.3	6.3	28.5	125	170		152.0	12.5	193.0	60	85
	27.9	8.0	35.5	100	135		170.0	14.2	217.0	55	75
	34.2	10.0	43.5	85	110		192.0	16.0	245.0	50	65
	41.6	12.5	53.0	70	90	400 x 400	235.0	20.0	300.0	40	55

Rectangular Hollow Sections



Examples of three sides

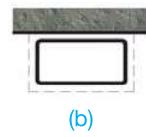
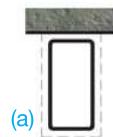
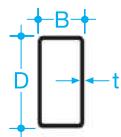


Four sides

Profile or box protection

Designation		Thickness (mm)	Area of section (cm ²)	Profile or box protection		
Size D x B (mm)	Mass (kg/m)			(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	Four sides (m ⁻¹)
50 x 50	2.7	2.5	3.5	360	290	430
	3.2	3.0	4.1	305	245	365
	3.4	3.2	4.3	290	230	345
50 x 30	2.9	2.5	3.7	350	295	430
	3.5	3.0	4.4	290	250	365
	3.7	3.2	4.7	280	235	345
	4.0	3.6	5.1	255	215	315
	4.5	4.0	5.7	230	195	280
	5.4	5.0	6.9	190	160	235
60 x 40	3.7	2.5	4.7	340	295	425
	4.4	3.0	5.6	285	250	355
	4.7	3.2	5.9	270	235	335
	5.1	3.6	6.5	245	215	305
	5.7	4.0	7.3	220	190	275
	7.0	5.0	8.9	180	160	225
	8.5	6.3	10.8	150	130	185
	5.3	3.0	6.8	295	235	355
80 x 40	5.7	3.2	7.2	275	220	330
	6.3	3.6	8.0	250	200	300
	7.0	4.0	8.9	225	180	270
	8.5	5.0	10.9	185	145	220
	10.5	6.3	13.3	150	120	180
	12.8	8.0	16.3	125	100	145
	6.3	3.0	8.0	290	240	350
90 x 50	6.6	3.2	8.4	275	225	335
	7.5	3.6	9.5	240	200	295
	8.2	4.0	10.4	225	185	270
	10.1	5.0	12.9	180	145	215
	12.5	6.3	15.9	145	120	175
	15.3	8.0	19.5	120	95	145
	6.8	3.0	8.6	290	235	350
100 x 50	7.2	3.2	9.1	275	220	330
	8.0	3.6	10.1	250	200	300
	8.9	4.0	11.3	220	175	265
	10.9	5.0	13.9	180	145	215
	13.4	6.3	17.1	145	115	175
	16.6	8.0	21.1	120	95	145
	7.2	3.0	9.2	285	240	350
100 x 60	7.6	3.2	9.7	270	230	330
	8.6	3.6	10.9	240	200	295
	9.4	4.0	12.0	220	185	270
	11.7	5.0	14.9	175	150	215
	14.4	6.3	18.4	140	120	175
	17.8	8.0	22.7	115	95	140
	9.7	3.6	12.4	240	195	290
120 x 60	10.7	4.0	13.6	220	180	265
	13.3	5.0	16.9	180	140	215
	16.4	6.3	20.9	145	115	170
	20.4	8.0	25.9	115	95	140
	24.3	10.0	30.9	100	80	120
120 x 80	10.8	3.6	13.7	235	205	295
	11.9	4.0	15.2	210	185	265
	14.8	5.0	18.9	170	150	210
	18.4	6.3	23.4	135	120	170
	22.9	8.0	29.1	110	95	135
	27.9	10.0	35.5	90	80	115
150 x 100	15.1	4.0	19.2	210	185	260
	18.7	5.0	23.9	165	145	210
	23.3	6.3	29.7	135	120	170
	29.1	8.0	37.1	110	95	135
	35.7	10.0	45.5	90	75	110
	43.6	12.5	55.5	70	65	90
150 x 125	16.6	4.0	21.2	200	190	260
	20.6	5.0	26.2	165	155	210
	25.6	6.3	32.6	130	125	170
	32.0	8.0	40.8	105	100	135
	39.2	10.0	49.9	85	80	110
	47.7	12.5	60.8	70	70	90

Rectangular Hollow Sections



Examples of three sides

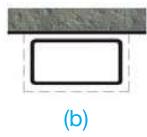
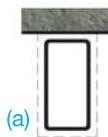
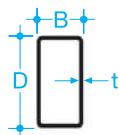


Four sides

Profile or box protection

Designation		Thickness (mm)	Area of section (cm ²)	Profile or box protection		
Size D x B (mm)	Mass (kg/m)			(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	Four sides (m ⁻¹)
160 x 80	14.4	4.0	18.4	220	175	260
	18.0	5.0	22.9	175	140	210
	22.3	6.3	28.5	140	110	170
	27.9	8.0	35.5	115	90	135
	34.2	10.0	43.5	90	75	110
	41.6	12.5	53.0	75	60	90
200 x 100	22.6	5.0	28.7	175	140	210
	28.1	6.3	35.8	140	115	170
	35.1	8.0	44.8	110	90	135
	43.1	10.0	54.9	95	75	110
	52.7	12.5	67.1	75	60	90
	65.2	16.0	83.0	60	50	75
200 x 120	24.1	5.0	30.7	170	145	210
	30.1	6.3	38.3	140	115	170
	37.6	8.0	48.0	110	95	135
	46.3	10.0	58.9	90	75	110
	56.6	12.5	72.1	75	65	90
	63.3	14.2	80.7	65	55	80
200 x 150	70.2	16.0	89.4	60	50	75
	26.5	5.0	33.7	165	150	210
	33.0	6.3	42.1	135	120	170
	41.4	8.0	52.8	105	95	135
	41.0	10.0	64.9	80	80	110
	62.5	12.5	79.6	70	65	90
250 x 100	70.0	14.2	89.2	65	60	80
	77.7	16.0	99.0	55	55	70
	26.5	5.0	33.7	180	135	210
	33.0	6.3	42.1	145	110	170
	41.4	8.0	52.8	115	85	135
	51.0	10.0	64.9	95	70	110
250 x 150	62.5	12.5	79.6	75	60	90
	70.0	14.2	89.2	70	50	80
	77.7	16.0	99.0	65	45	70
	30.4	5.0	38.7	170	145	210
	38.0	6.3	48.4	135	115	165
	47.7	8.0	60.8	110	90	135
250 x 200	58.8	10.0	74.9	90	75	110
	72.3	12.5	92.1	75	60	90
	81.1	14.2	103.0	65	55	80
	90.3	16.0	115.0	60	50	70
	66.7	10.0	84.9	85	80	110
	82.1	12.5	105.0	70	65	90
260 x 140	92.3	14.2	118.0	60	55	80
	30.4	5.0	38.7	170	140	210
	38.0	6.3	48.4	140	115	165
	47.7	8.0	60.8	110	90	135
	58.8	10.0	74.9	90	75	110
	72.3	12.5	92.1	75	60	90
300 x 100	81.1	14.2	103.0	65	55	80
	90.3	16.0	115.0	60	50	70
	30.4	5.0	38.7	180	130	210
	38.0	6.3	48.4	145	105	156
	47.7	8.0	60.8	115	85	135
	58.8	10.0	74.9	95	70	110
300 x 150	72.3	12.5	92.1	80	55	90
	81.1	14.2	103.0	70	50	80
	90.3	16.0	115.0	65	45	70
	54.0	8.0	68.8	110	90	130
	66.7	10.0	84.9	90	70	110
	82.1	12.5	105.0	75	60	90
	92.3	14.2	118.0	65	55	80
	103.0	16.0	131.0	60	50	70

Rectangular Hollow Sections



Examples of three sides

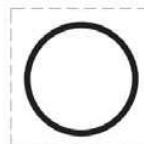
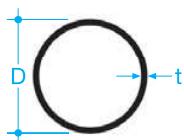


Four sides

Profile or box protection

Designation		Thickness (mm)	Area of section (cm ²)	Profile or box protection		
Size D x B (mm)	Mass (kg/m)			(a) Three sides (m ⁻¹)	(b) Three sides (m ⁻¹)	Four sides (m ⁻¹)
300 x 200	38.3	5.0	48.7	165	145	205
	47.9	6.3	61.0	135	115	165
	60.3	8.0	76.8	105	95	130
	74.5	10.0	94.9	85	75	105
	91.9	12.5	117.0	70	60	85
	103.0	14.2	132.0	60	55	75
	115.0	16.0	147.0	55	50	70
300 x 250	52.8	6.3	67.3	130	120	165
	66.5	8.0	84.8	100	95	130
	82.4	10.0	105.0	85	80	105
	102.0	12.5	130.0	65	65	85
	115.0	14.2	146.0	60	55	75
	128.0	16.0	163.0	55	50	70
	47.9	6.3	61.0	140	110	165
350 x 150	60.3	8.0	76.8	110	85	130
	74.5	10.0	94.9	90	70	105
	91.9	12.5	117.0	75	55	85
	103.0	14.2	132.0	65	50	75
	115.0	16.0	147.0	60	45	70
	57.8	6.3	73.6	130	115	165
	72.8	8.0	92.8	105	95	130
350 x 250	90.2	10.0	115.0	85	75	105
	112.0	12.5	142.0	70	60	85
	126.0	14.2	160.0	60	55	75
	141.0	16.0	179.0	55	50	70
	49.9	6.3	63.5	145	100	165
	62.8	8.0	80.0	115	80	130
	77.7	10.0	98.9	95	65	105
400 x 120	95.8	12.5	122.0	75	55	85
	108.0	14.2	137.0	70	50	80
	120.0	16.0	153.0	65	45	70
	52.8	6.3	67.3	145	105	165
	66.5	8.0	84.8	115	85	130
	82.4	10.0	105.0	90	70	105
	102.0	12.5	130.0	75	55	85
400 x 150	115.0	14.2	146.0	65	50	75
	128.0	16.0	163.0	60	45	70
	57.8	6.3	73.6	140	110	165
	72.8	8.0	92.8	110	90	130
	90.2	10.0	115.0	90	70	105
	112.0	12.5	142.0	70	60	85
	126.0	14.2	160.0	65	50	75
400 x 200	141.0	16.0	179.0	60	45	70
	85.4	8.0	109.0	105	95	130
	106.0	10.0	135.0	85	75	105
	131.0	12.5	167.0	70	60	85
	148.0	14.2	189.0	60	55	75
	166.0	16.0	211.0	55	50	70
	85.4	8.0	109.0	105	90	130
450 x 250	106.0	10.0	135.0	85	70	105
	131.0	12.5	167.0	70	60	85
	148.0	14.2	189.0	65	50	75
	166.0	16.0	211.0	55	45	70
	85.4	8.0	109.0	110	85	130
	106.0	10.0	135.0	90	70	105
	131.0	12.5	167.0	75	55	85
500 x 200	148.0	14.2	189.0	65	50	75
	166.0	16.0	211.0	60	45	70
	85.4	8.0	109.0	110	85	130
	106.0	10.0	135.0	90	70	105
	131.0	12.5	167.0	75	55	85
	148.0	14.2	189.0	65	50	75
	166.0	16.0	211.0	60	45	70
500 x 300	97.9	8.0	125.0	105	90	130
	122.0	10.0	155.0	85	75	105
	151.0	12.5	192.0	70	60	85
	170.0	14.2	217.0	60	50	75
	191.0	16.0	249.0	55	45	70
	235.0	20.0	300.0	45	40	55

Circular Hollow Sections



Designation		Thickness t (mm)	Area of section (cm ²)	Profile or box protection (m ⁻¹)
Outside diameter D (mm)	Mass (kg/m)			
21.3	1.2	2.6	1.5	440
	1.3	2.9	1.7	400
	1.4	3.2	1.8	370
26.9	1.6	2.9	2.0	425
	1.7	2.9	2.2	385
	1.9	3.2	2.4	355
33.7	2.0	2.6	2.5	415
	2.2	2.9	2.8	375
	2.4	3.2	3.1	345
	2.7	3.6	3.4	310
	2.9	4.0	3.7	285
	3.1	4.0	3.3	410
42.4	2.6	2.6	3.3	370
	2.8	2.9	3.6	340
	3.1	3.2	3.9	305
	3.4	3.6	4.4	275
	3.8	4.0	4.8	230
	4.6	5.0	5.9	230
48.3	3.3	2.9	4.1	365
	3.6	3.2	4.5	355
	4.0	3.6	5.1	300
	4.4	4.0	5.6	275
	5.3	5.0	6.8	225
	4.1	2.9	5.2	360
60.3	4.5	3.2	5.7	330
	5.0	3.6	6.4	295
	5.6	4.0	7.1	270
	6.8	5.0	8.7	220
	4.1	2.9	6.7	358
	5.8	3.2	7.3	325
76.1	6.4	3.6	8.2	290
	7.1	4.0	9.1	265
	8.8	5.0	11.2	215
	10.8	6.3	13.8	175
	6.2	2.9	7.8	355
	6.8	3.2	8.6	325
88.9	7.6	3.6	9.7	290
	8.4	4.0	10.7	260
	10.3	5.0	13.2	210
	12.8	6.3	16.3	170
	8.8	3.2	11.2	320
	9.8	3.6	12.5	285
114.3	10.9	4.0	13.9	260
	13.5	5.0	17.2	210
	16.6	6.3	21.4	170
	10.8	3.2	13.7	320
	12.1	3.6	15.4	285
	13.4	4.0	17.1	255
139.7	16.6	5.0	21.2	205
	20.7	6.3	26.4	165
	26.0	8.0	33.1	135
	32.0	10.0	40.7	110
	20.1	5.0	25.7	205
	25.2	6.3	32.1	165
168.3	31.6	8.0	40.3	130
	39.0	10.0	49.7	105
	48.0	12.5	61.2	85
	23.3	5.0	29.6	205
	25.1	5.4	31.9	190
	29.1	6.3	37.1	165
193.7	36.6	8.0	46.7	130
	45.3	10.0	57.7	105
	55.9	12.5	71.2	85
	70.1	16.0	89.3	70

Profile protection

Box protection

Designation		Thickness t (mm)	Area of section (cm ²)	Profile or box protection (m ⁻¹)
Outside diameter D (mm)	Mass (kg/m)			
219.1	26.4	5.0	33.6	205
	33.1	6.3	42.1	165
	41.6	8.0	53.1	130
	51.6	10.0	65.7	105
	63.7	12.5	81.1	85
	71.8	14.2	91.4	75
	80.1	16.0	102.0	65
	98.2	20.0	125.0	55
	29.5	5.0	37.6	205
	37.0	6.3	47.1	165
244.5	46.7	8.0	59.4	130
	57.8	10.0	73.7	105
	71.5	12.5	91.1	85
	80.6	14.2	103.0	75
	90.2	16.0	115.0	65
	111.0	20.0	141.0	55
	33.0	5.0	42.1	205
	41.4	6.3	52.8	160
	52.3	8.0	66.6	130
	64.9	10.0	82.6	105
273	80.3	12.5	102.0	85
	90.6	14.2	115.0	75
	101.0	16.0	129.0	65
	125.0	20.0	159.0	55
	153.0	25.0	195.0	45
	39.3	5.0	50.1	205
	49.3	6.3	62.9	160
	62.3	8.0	79.4	130
	77.4	10.0	98.6	105
	96.0	12.5	122.0	85
323.9	108.0	14.2	138.0	75
	121.0	16.0	155.0	65
	150.0	20.0	191.0	55
	184.0	25.0	235.0	45
	54.3	6.3	69.1	160
	68.6	8.0	87.4	130
	85.2	10.0	109.0	100
	106.0	12.5	135.0	85
	120.0	14.2	152.0	75
	134.0	16.0	171.0	65
355.6	166.0	20.0	211.0	55
	204.0	25.0	260.0	45
	62.2	6.3	79.2	160
	78.6	8.0	100.0	130
	97.8	10.0	125.0	100
	121.0	12.5	155.0	80
	137.0	14.2	175.0	75
	154.0	16.0	196.0	65
	191.0	20.0	243.0	55
	235.0	25.0	300.0	45
406.4	295.0	32.0	376.0	35
	70.0	6.3	89.2	160
	88.6	8.0	113.0	130
	110.0	10.0	140.0	105
	137.0	12.5	175.0	80
	155.0	14.2	198.0	75
	174.0	16.0	222.0	65
	216.0	20.0	275.0	50
	266.0	25.0	339.0	40
	335.0	32.0	427.0	35
457.0	411.0	40.0	524.0	25
	77.9	6.3	99.3	160
	98.6	8.0	126.0	125
	123.0	10.0	156.0	100
	153.0	12.5	195.0	80
	173.0	14.2	220.0	75
	194.0	16.0	247.0	65
	233.0	20.0	300.0	35
	274.0	25.0	360.0	30
	325.0	32.0	427.0	25
508.0	386.0	40.0	524.0	25
	77.9	6.3	99.3	160
	98.6	8.0	126.0	125
	123.0	10.0	156.0	100
	153.0	12.5	195.0	80
	173.0	14.2	220.0	75
	194.0	16.0	247.0	65
	233.0	20.0	300.0	35
	274.0	25.0	360.0	30
	325.0	32.0	427.0	25