

APPENDIX D

SECTION DESIGNATIONS, DIMENSIONS AND CROSS-SECTION PROPERTIES

(Normative)

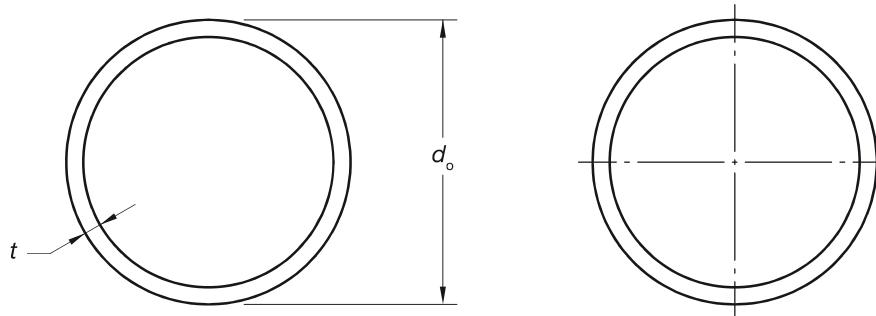
This Appendix provides lists of common cold-formed structural steel hollow sections (SSHS) available in Australia and New Zealand. The lists provide their section designation, respective nominal dimensions, cross-section properties and mass.

NOTE: Although they appear in the following tables, certain sizes may not always be available in all grades. Users are advised to check availability before incorporating hollow sections in major designs.

The formulae for calculating sectional properties of sections manufactured to the dimensional tolerances of this Standard, to be used for the purposes of structural design and also listed in this Appendix, are specified in Appendix E.

Figures D1 to D4 are not restrictive nor exhaustive. Other SSHS shapes and sizes with different designations and dimensions may be produced to this Standard. Manufacturers shall provide the designation, nominal dimensions, cross-sectional properties and mass for SSHS produced that are not listed in Figures D1 to D4.

Where CHS, RHS and SHS are not listed in this Appendix, Appendix E shall be used to evaluate cross-sectional properties and mass.

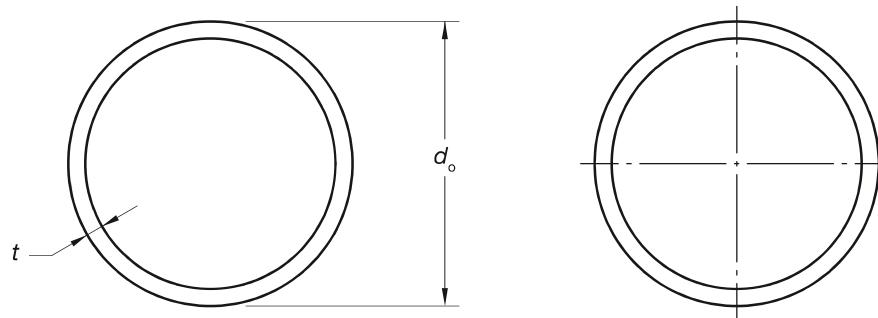


1 Designation Outside diameter d_o	2 Thickness t	3 Mass per unit length m	4 External surface area Per unit length A_{EL}	5 Ratio $\frac{d_o}{t}$	6 Gross area of cross-section A_g	About any axis				11 Torsion constant J	12 Torsion modulus C
Designation Outside diameter d_o	Thickness t	Mass per unit length m	External surface area Per unit mass A_{EM}	Ratio $\frac{d_o}{t}$	Gross area of cross-section A_g	Second moment of area I	Elastic section modulus Z	Plastic section modulus S	Radius of gyration r	Torsion constant J	Torsion modulus C
mm	mm	kg/m	m^2/m	m^2/t	mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$
610.0	× 12.7 CHS	187	1.92	10.2	23800	1060	3490	4530	211	2130	6970
610.0	× 9.5 CHS	141	1.92	13.6	17900	808	2650	3430	212	1620	5300
610.0	× 6.4 CHS	95.3	1.92	20.1	12100	553	1810	2330	213	1110	3620
508.0	× 12.7 CHS	155	1.60	10.3	19800	606	2390	3120	175	1210	4770
508.0	× 9.5 CHS	117	1.60	13.7	14900	462	1820	2360	176	925	3640
508.0	× 6.4 CHS	79.2	1.60	20.2	10100	317	1250	1610	177	634	2500
165.1	× 5.4 CHS	21.3	0.519	24.4	2710	8.65	105	138	56.5	17.3	209
165.1	× 5.0 CHS	19.7	0.519	26.3	2510	8.07	97.7	128	56.6	16.1	195

FIGURE D1 (in part) CIRCULAR HOLLOW SECTIONS (see also Figure D2 for other CHS listings)

1	2	3	4	5	6	7	8	9	10	11	12	
Designation		Mass per unit length	External surface area		Ratio $\frac{d_o}{t}$	Gross area of cross-section A_g	About any axis				Torsion constant J	Torsion modulus C
Outside diameter	Thickness		Per unit length	Per unit mass			Second moment of area I	Elastic section modulus Z	Plastic section modulus S	Radius of gyration r		
d_o	t		m	A_{EL}								
mm	mm	kg/m	m^2/m	m^2/t		mm^2	10^6 mm^4	10^3 mm^3	10^3 mm^3	mm	10^6 mm^4	10^3 mm^3
139.7	5.4 CHS	17.9	0.439	24.5	25.9	2280	5.14	73.7	97.4	47.5	10.3	147
139.7	5.0 CHS	16.6	0.439	26.4	27.9	2120	4.81	68.8	90.8	47.7	9.61	138
114.3	5.4 CHS	14.5	0.359	24.8	21.2	1850	2.75	48.0	64.1	38.5	5.49	96.1
114.3	4.5 CHS	12.2	0.359	29.5	25.4	1550	2.34	41.0	54.3	38.9	4.69	82.0
101.6	5.0 CHS	11.9	0.319	26.8	20.3	1520	1.77	34.9	46.7	34.2	3.55	69.9
101.6	4.0 CHS	9.63	0.319	33.2	25.4	1230	1.46	28.8	38.1	34.5	2.93	57.6
88.9	5.9 CHS	12.1	0.279	23.1	15.1	1540	1.33	30.0	40.7	29.4	2.66	59.9
88.9	5.0 CHS	10.3	0.279	27.0	17.8	1320	1.16	26.2	35.2	29.7	2.33	52.4
88.9	4.0 CHS	8.38	0.279	33.3	22.2	1070	0.963	21.7	28.9	30.0	1.93	43.3
76.1	5.9 CHS	10.2	0.239	23.4	12.9	1300	0.807	21.2	29.1	24.9	1.61	42.4
76.1	4.5 CHS	7.95	0.239	30.1	16.9	1010	0.651	17.1	23.1	25.4	1.30	34.2
76.1	3.6 CHS	6.44	0.239	37.1	21.1	820	0.540	14.21	8.9	25.7	1.08	28.4
60.3	5.4 CHS	7.31	0.189	25.9	11.2	931	0.354	11.8	16.3	19.5	0.709	23.5
60.3	4.5 CHS	6.19	0.189	30.6	13.4	789	0.309	10.2	14.0	19.8	0.618	20.5
60.3	3.6 CHS	5.03	0.189	37.6	16.8	641	0.259	8.58	11.6	20.1	0.517	17.2
48.3	5.4 CHS	5.71	0.152	26.6	8.9	728	0.170	7.04	9.99	15.3	0.340	14.1
48.3	4.0 CHS	4.37	0.152	34.7	12.1	557	0.138	5.70	7.87	15.7	0.275	11.4
48.3	3.2 CHS	3.56	0.152	42.6	15.1	453	0.116	4.80	6.52	16.0	0.232	9.59
42.4	4.9 CHS	4.53	0.133	29.4	8.7	577	0.103	4.87	6.93	13.4	0.206	9.74
42.4	4.0 CHS	3.79	0.133	35.2	10.6	483	0.0899	4.24	5.92	13.6	0.180	8.48
42.4	3.2 CHS	3.09	0.133	43.1	13.3	394	0.0762	3.59	4.93	13.9	0.152	7.19

FIGURE D1 (in part) CIRCULAR HOLLOW SECTIONS (see also Figure D2 for other CHS listings)

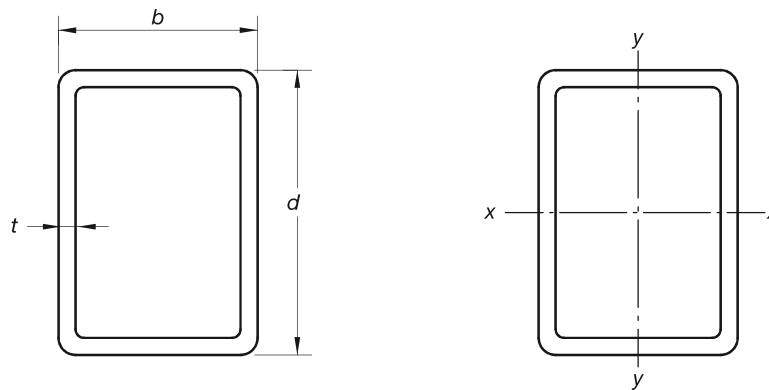


1 Designation	2 Mass per unit length	3 External surface area	4	5 Ratio	6 Gross area of cross-section	About any axis				11 Torsion constant	12 Torsion modulus
Outside diameter	Thickness	Per unit length	Per unit mass	$\frac{d_o}{t}$	A_g	Second moment of area	Elastic section modulus	Plastic section modulus	Radius of gyration	J	C
d_o	t	m	A_{EL}	A_{EM}		I	Z	S	r		
457.0	12.7 CHS	139	1.44	10.3	36.0	17700	438	1920	2510	157	876
457.0	9.5 CHS	105	1.44	13.7	48.1	13400	334	1460	1900	158	669
457.0	6.4 CHS	71.1	1.44	20.2	71.4	9060	230	1010	1300	159	460
406.4	12.7 CHS	123	1.28	10.4	32.0	15700	305	1500	1970	139	609
406.4	9.5 CHS	93.0	1.28	13.7	42.8	11800	233	1150	1500	140	467
406.4	6.4 CHS	63.1	1.28	20.2	63.5	8040	161	792	1020	141	322
355.6	12.7 CHS	107	1.12	10.4	28.0	13700	201	1130	1490	121	403
355.6	9.5 CHS	81.1	1.12	13.8	37.4	10300	155	871	1140	122	310
355.6	6.4 CHS	55.1	1.12	20.3	55.6	7020	107	602	781	123	214
323.9	2.7 CHS	97.5	1.02	10.4	25.5	12400	151	930	1230	110	301
323.9	9.5 CHS	73.7	1.02	13.8	34.1	9380	116	717	939	111	232
323.9	6.4 CHS	50.1	1.02	20.3	50.6	6380	80.5	497	645	112	161
											994

FIGURE D2 (in part) CIRCULAR HOLLOW SECTIONS (see also Figure D1 for other CHS listings)

1	2	3	4	5	6	7	8	9	10	11	12	
Designation		Mass per unit length <i>m</i>	External surface area			Gross area of cross-section <i>A_g</i>	About any axis				Torsion constant <i>J</i>	Torsion modulus <i>C</i>
Outside diameter <i>d_o</i>	Thickness <i>t</i>		Per unit length <i>A_{EL}</i>	Per unit mass <i>A_{EM}</i>	Ratio $\frac{d_o}{t}$		Second moment of area <i>I</i>	Elastic section modulus <i>Z</i>	Plastic section modulus <i>S</i>	Radius of gyration <i>r</i>		
mm	mm		kg/m	m ² /m	m ² /t		mm ²	10 ⁶ mm ⁴	10 ³ mm ³	10 ³ mm ³		
273.1	× 9.3 CHS	60.5	0.858	14.2	29.4	7710	67.1	492	647	93.3	134	983
273.1	× 6.4 CHS	42.1	0.858	20.4	42.7	5360	47.7	349	455	94.3	95.4	699
273.1	× 4.8 CHS	31.8	0.858	27.0	56.9	4050	36.4	267	346	94.9	72.8	533
219.1	× 8.2 CHS	42.6	0.688	16.1	26.7	5430	30.3	276	365	74.6	60.5	552
219.1	× 6.4 CHS	33.6	0.688	20.5	34.2	4280	24.2	221	290	75.2	48.4	442
219.1	× 4.8 CHS	25.4	0.688	27.1	45.6	3230	18.6	169	220	75.8	37.1	339
168.3	× 7.1 CHS	28.2	0.529	18.7	23.7	3600	11.7	139	185	57.0	23.4	278
168.3	× 6.4 CHS	25.6	0.529	20.7	26.3	3260	10.7	127	168	57.3	21.4	254
168.3	× 4.8 CHS	19.4	0.529	27.3	35.1	2470	8.25	98.0	128	57.8	16.5	196
165.1	× 3.5 CHS	13.9	0.519	37.2	47.2	1780	5.80	70.3	91.4	57.1	11.6	141
165.1	× 3.0 CHS	12.0	0.519	43.2	55.0	1530	5.02	60.8	78.8	57.3	10.0	122
139.7	× 3.5 CHS	11.8	0.439	37.3	39.9	1500	3.47	49.7	64.9	48.2	6.95	99.5
139.7	× 3.0 CHS	10.1	0.439	43.4	46.6	1290	3.01	43.1	56.1	48.3	6.02	86.2
114.3	× 6.0 CHS	16.0	0.359	22.4	19.1	2040	3.00	52.5	70.4	38.3	6.00	105
114.3	× 4.8 CHS	13.0	0.359	27.7	23.8	1650	2.48	43.4	57.6	38.8	4.96	86.8
114.3	× 3.6 CHS	9.83	0.359	36.5	31.8	1250	1.92	33.6	44.1	39.2	3.84	67.2
114.3	× 3.2 CHS	8.77	0.359	41.0	35.7	1120	1.72	30.2	39.5	39.3	3.45	60.4
101.6	× 3.2 CHS	7.77	0.319	41.1	31.8	989	1.20	23.6	31.0	34.8	2.40	47.2
101.6	× 2.6 CHS	6.35	0.319	50.3	39.1	809	0.991	19.5	25.5	35.0	1.98	39.0
88.9	× 5.5 CHS	11.3	0.279	24.7	16.2	1440	1.26	28.3	38.3	29.6	2.52	56.6
88.9	× 4.8 CHS	9.96	0.279	28.1	18.5	1270	1.12	25.3	34.0	29.8	2.25	50.6
88.9	× 3.2 CHS	6.76	0.279	41.3	27.8	862	0.792	17.8	23.5	30.3	1.58	35.6
88.9	× 2.6 CHS	5.53	0.279	50.5	34.2	705	0.657	14.8	19.4	30.5	1.31	29.6
76.1	× 3.2 CHS	5.75	0.239	41.6	23.8	733	0.488	12.8	17.0	25.8	0.976	25.6
76.1	× 2.3 CHS	4.19	0.239	57.1	33.1	533	0.363	9.55	12.5	26.1	0.727	19.1

FIGURE D2 (in part) CIRCULAR HOLLOW SECTIONS (see also Figure D1 for other CHS listings)



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
Designation		Mass per unit length		External surface area		Gross area of cross-section A_g	About x-axis				About y-axis				Torsion constant J	Torsion modulus C		
Depth	Width	Thickness	m	A_{EL}	A_{EM}		$\frac{b - 2t}{t}$	$\frac{d - 2t}{t}$	Second moment of area I_x	Elastic section modulus Z_x	Plastic section modulus S_x	Radius of gyration r_x	Second moment of area I_y	Elastic section modulus Z_y	Plastic section modulus S_y	Radius of gyration r_y		
$d \times b \times t$	$mm \times mm \times mm$	kg/m	m^2/m	m^2/t			mm^2	10^6 mm^4	10^3 mm^3	10^3 mm^3	mm	10^6 mm^4	10^3 mm^3	mm	10^6 mm^4	10^3 mm^3	mm	10^6 mm^4
250 × 150 × 9.0 RHS	51.8	0.761	14.7	14.7	25.8	6600	53.7	430	533	90.2	24.3	324	375	60.7	56.0	554		
250 × 150 × 6.0 RHS	35.6	0.774	21.8	23.0	39.7	4530	38.4	307	374	92.0	17.5	233	264	62.2	39.0	395		
250 × 150 × 5.0 RHS	29.9	0.779	26.0	28.0	48.0	3810	32.7	262	317	92.6	15.0	199	224	62.6	33.0	337		
200 × 100 × 9.0 RHS	37.7	0.561	14.9	9.11	20.2	4800	22.8	228	293	68.9	7.64	153	180	39.9	19.9	272		
200 × 100 × 6.0 RHS	26.2	0.574	22.0	14.7	31.3	3330	16.7	167	210	70.8	5.69	114	130	41.3	14.2	200		
200 × 100 × 5.0 RHS	22.1	0.579	26.2	18.0	38.0	2810	14.4	144	179	71.5	4.92	98.3	111	41.8	12.1	172		
200 × 100 × 4.0 RHS	17.9	0.583	32.5	23.0	48.0	2280	11.9	119	147	72.1	4.07	81.5	91.0	42.3	9.89	142		
150 × 100 × 6.0 RHS	21.4	0.474	22.1	14.7	23.0	2730	8.17	109	134	54.7	4.36	87.3	102	40.0	9.51	147		
150 × 100 × 5.0 RHS	18.2	0.479	26.3	18.0	28.0	2310	7.07	94.3	115	55.3	3.79	75.7	87.3	40.4	8.12	127		
150 × 100 × 4.0 RHS	14.8	0.483	32.7	23.0	35.5	1880	5.87	78.2	94.6	55.9	3.15	63.0	71.8	40.9	6.64	105		
150 × 50 × 5.0 RHS	14.2	0.379	26.6	8.00	28.0	1810	4.44	59.2	78.9	49.5	0.765	30.6	35.7	20.5	2.30	56.8		
150 × 50 × 4.0 RHS	11.6	0.383	32.9	10.5	35.5	1480	3.74	49.8	65.4	50.2	0.653	26.1	29.8	21.0	1.93	48.2		
150 × 50 × 3.0 RHS	8.96	0.390	43.5	14.7	48.0	1140	2.99	39.8	51.4	51.2	0.526	21.1	23.5	21.5	1.50	38.3		
125 × 75 × 5.0 RHS	14.2	0.379	26.6	13.0	23.0	1810	3.64	58.3	72.7	44.8	1.65	43.9	51.1	30.1	3.83	75.3		
125 × 75 × 4.0 RHS	11.6	0.383	32.9	16.8	29.3	1480	3.05	48.9	60.3	45.4	1.39	37.0	42.4	30.6	3.16	63.0		
125 × 75 × 3.0 RHS	8.96	0.390	43.5	23.0	39.7	1140	2.43	38.9	47.3	46.1	1.11	29.5	33.3	31.1	2.43	49.5		

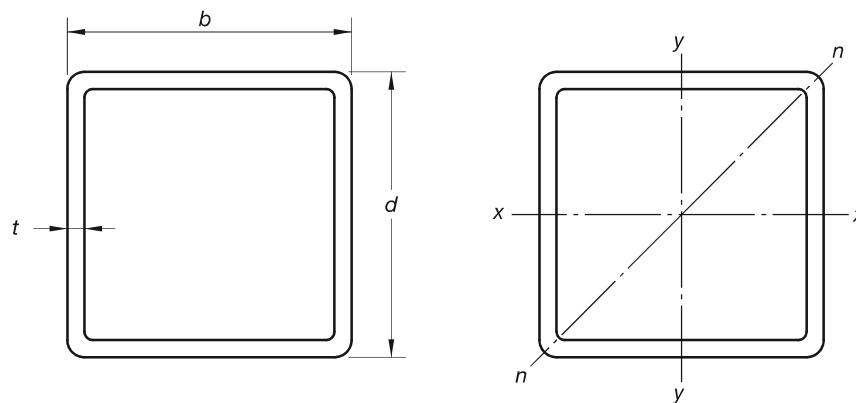
FIGURE D3 (in part) RECTANGULAR HOLLOW SECTIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
Designation		External surface area		Ratio		Gross area of cross-section A_g	About x-axis				About y-axis				Torsion constant J	Torsion modulus C		
Depth	Width	Thickness	Mass per unit length	Per unit length	Per unit mass		$b - 2t$	t	$d - 2t$	t	Second moment of area I_x	Elastic section modulus Z_x	Plastic section modulus S_x	Radius of gyration r_x	Second moment of area I_y	Elastic section modulus Z_y	Plastic section modulus S_y	Radius of gyration r_y
$d \times b \times t$	m	$\text{mm} \times \text{mm} \times \text{mm}$	kg/m	m^2/m	m^2/t		10^6 mm^4	10^3 mm^3	10^3 mm^3	mm	10^6 mm^4	10^3 mm^4	10^3 mm^3	mm	10^6 mm^4	10^3 mm^3	mm	10^6 mm^4
100 × 50 × 6.0 RHS	12.0	0.274	22.8	6.33	14.7	1530	1.71	34.2	45.3	33.4	0.567	22.7	27.7	19.2	1.53	40.9		
100 × 50 × 5.0 RHS	10.3	0.279	27.0	8.00	18.0	1310	1.53	30.6	39.8	34.1	0.511	20.4	24.4	19.7	1.35	36.5		
100 × 50 × 4.0 RHS	8.49	0.283	33.3	10.5	23.0	1080	1.31	26.1	33.4	34.8	0.441	17.6	20.6	20.2	1.13	31.2		
100 × 50 × 3.5 RHS	7.53	0.285	37.9	12.3	26.6	959	1.18	23.6	29.9	35.1	0.400	16.0	18.5	20.4	1.01	28.2		
100 × 50 × 3.0 RHS	6.60	0.290	43.9	14.7	31.3	841	1.06	21.3	26.7	35.6	0.361	14.4	16.4	20.7	0.886	25.0		
100 × 50 × 2.5 RHS	5.56	0.291	52.4	18.0	38.0	709	0.912	18.2	22.7	35.9	0.311	12.4	14.0	20.9	0.754	21.5		
100 × 50 × 2.0 RHS	4.50	0.293	65.1	23.0	48.0	574	0.750	15.0	18.5	36.2	0.257	10.3	11.5	21.2	0.616	17.7		
75 × 50 × 4.0 RHS	6.92	0.233	33.7	10.5	16.8	881	0.630	16.8	21.1	26.7	0.335	13.4	16.0	19.5	0.754	22.7		
75 × 50 × 3.0 RHS	5.42	0.240	44.2	14.7	23.0	691	0.522	13.9	17.1	27.5	0.278	11.1	12.9	20.0	0.593	18.4		
75 × 50 × 2.5 RHS	4.58	0.241	52.7	18.0	28.0	584	0.450	12.0	14.6	27.7	0.240	9.60	11.0	20.3	0.505	15.9		
75 × 50 × 2.0 RHS	3.72	0.243	65.4	23.0	35.5	474	0.372	9.91	12.0	28.0	0.199	7.96	9.06	20.5	0.414	13.1		
75 × 25 × 2.5 RHS	3.60	0.191	53.1	8.00	28.0	459	0.285	7.60	10.1	24.9	0.0487	3.89	4.53	10.3	0.144	7.14		
75 × 25 × 2.0 RHS	2.93	0.193	65.8	10.5	35.5	374	0.238	6.36	8.31	25.3	0.0414	3.31	3.77	10.5	0.120	6.04		
75 × 25 × 1.6 RHS	2.38	0.195	81.7	13.6	44.9	303	0.197	5.26	6.81	25.5	0.0347	2.78	3.11	10.7	0.0993	5.05		
65 × 35 × 3.0 RHS	4.25	0.190	44.7	9.67	19.7	541	0.281	8.65	11.0	22.8	0.106	6.04	7.11	14.0	0.259	10.4		
65 × 35 × 2.5 RHS	3.60	0.191	53.1	12.0	24.0	459	0.244	7.52	9.45	23.1	0.0926	5.29	6.13	14.2	0.223	9.10		
65 × 35 × 2.0 RHS	2.93	0.193	65.8	15.5	30.5	374	0.204	6.28	7.80	23.4	0.0778	4.44	5.07	14.4	0.184	7.62		
50 × 25 × 3.0 RHS	3.07	0.140	45.5	6.33	14.7	391	0.112	4.47	5.86	16.9	0.0367	2.93	3.56	9.69	0.0964	5.18		
50 × 25 × 2.5 RHS	2.62	0.141	54.0	8.00	18.0	334	0.0989	3.95	5.11	17.2	0.0328	2.62	3.12	9.91	0.0843	4.60		
50 × 25 × 2.0 RHS	2.15	0.143	66.6	10.5	23.0	274	0.0838	3.35	4.26	17.5	0.0281	2.25	2.62	10.1	0.0706	3.92		
50 × 25 × 1.6 RHS	1.75	0.145	82.5	13.6	29.3	223	0.0702	2.81	3.53	17.7	0.0237	1.90	2.17	10.3	0.0585	3.29		
50 × 20 × 3.0 RHS	2.83	0.130	45.8	4.67	14.7	361	0.0951	3.81	5.16	16.2	0.0212	2.12	2.63	7.67	0.0620	3.88		
50 × 20 × 2.5 RHS	2.42	0.131	54.2	6.00	18.0	309	0.0848	3.39	4.51	16.6	0.0192	1.92	2.32	7.89	0.0550	3.49		
50 × 20 × 2.0 RHS	1.99	0.133	66.8	8.00	23.0	254	0.0723	2.89	3.78	16.9	0.0167	1.67	1.96	8.11	0.0466	3.00		
50 × 20 × 1.6 RHS	1.63	0.135	82.7	10.5	29.3	207	0.0608	2.43	3.14	17.1	0.0142	1.42	1.63	8.29	0.0389	2.55		

NOTE: The calculation of sectional properties is based on the following corner geometry:

Size range	Inside corner radius mm	Outside corner radius mm
Thickness 3.0 mm and less	1.0t	2.0t
Thickness greater than 3.0 mm	1.5t	2.5t

FIGURE D3 (in part) RECTANGULAR HOLLOW SECTIONS



1	2	3	4	5	6	7	8	9	10	11	12	13	
Designation		Mass per unit length	External surface area		Ratio	Gross area of cross-section	About x, y and n-axes					Torsion constant	Torsion modulus
Depth	Width	Thickness	Per unit length	Per unit mass			Second moment of area	Elastic section modulus	Elastic section modulus	Plastic section modulus	Radius of gyration		
$b \times b \times t$	m	A_{EL}	A_{EM}	$b - 2t$	A_g	I_x, I_y	Z_x, Z_y	Z_n	S_x, S_y	r_x, r_y	J	C	
mm \times mm \times mm	kg/m	m^2/m	m^2/t	t	mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$	
250 \times 250 \times 9.0 SHS	65.9	0.961	14.6	25.8	8400	79.8	639	477	750	97.5	129	972	
250 \times 250 \times 6.0 SHS	45.0	0.974	21.7	39.7	5730	56.2	450	330	521	99.0	88.7	681	
200 \times 200 \times 9.0 SHS	51.8	0.761	14.7	20.2	6600	39.2	392	297	465	77.1	64.5	599	
200 \times 200 \times 6.0 SHS	35.6	0.774	21.8	31.3	4530	28.0	280	207	327	78.6	44.8	425	
200 \times 200 \times 5.0 SHS	29.9	0.779	26.0	38.0	3810	23.9	239	175	277	79.1	37.8	362	
150 \times 150 \times 9.0 SHS	37.7	0.561	14.9	14.7	4800	15.4	205	159	248	56.6	26.1	316	
150 \times 150 \times 6.0 SHS	26.2	0.574	22.0	23.0	3330	11.3	150	113	178	58.2	18.4	229	
150 \times 150 \times 5.0 SHS	22.1	0.579	26.2	28.0	2810	9.70	129	96.1	151	58.7	15.6	197	
125 \times 125 \times 9.0 SHS	30.6	0.461	15.1	11.9	3900	8.38	134	106	165	46.4	14.5	208	
125 \times 125 \times 6.0 SHS	21.4	0.474	22.1	18.8	2730	6.29	101	76.5	120	48.0	10.4	154	
125 \times 125 \times 5.0 SHS	18.2	0.479	26.3	23.0	2310	5.44	87.1	65.4	103	48.5	8.87	133	
125 \times 125 \times 4.0 SHS	14.8	0.483	32.7	29.3	1880	4.52	72.3	53.6	84.5	49.0	7.25	110	

FIGURE D4 (in part) SQUARE HOLLOW SECTIONS

1	2	3	4	5	6	7	8	9	10	11	12	13				
Designation		Depth mm × Width mm × Thickness mm	Mass per unit length kg/m	External surface area		Ratio $b - 2t$	About x, y and n- axes					Torsion constant J	Torsion modulus C			
Depth	Width			Per unit length A_{EL}	Per unit mass A_{EM}		Gross area of cross-section A_g	Second moment of area I_x, I_y	Elastic section modulus Z_x, Z_y	Elastic section modulus Z_n	Plastic section modulus S_x, S_y					
$b \times b \times t$	m			t	A_g		mm^2	$10^6 mm^4$	$10^3 mm^3$	$10^3 mm^3$	$10^3 mm^3$	mm	$10^6 mm^4$	$10^3 mm^3$		
mm × mm × mm	kg/m			m^2/m	m^2/t											
100 × 100 × 9.0 SHS	23.5	0.361	15.4	9.11	3000		3.91		78.1		63.6		98.6	36.1	7.00	123
100 × 100 × 6.0 SHS	16.7	0.374	22.4	14.7	2130		3.04		60.7		47.1		73.5	37.7	5.15	93.6
100 × 100 × 5.0 SHS	14.2	0.379	26.6	18.0	1810		2.66		53.1		40.5		63.5	38.3	4.42	81.4
100 × 100 × 4.0 SHS	11.6	0.383	32.9	23.0	1480		2.23		44.6		33.5		52.6	38.8	3.63	68.0
100 × 100 × 3.0 SHS	8.96	0.390	43.5	31.3	1140		1.77		35.4		26.0		41.2	39.4	2.79	53.2
89 × 89 × 6.0 SHS	14.6	0.330	22.5	12.8	1870		2.06		46.2		36.3		56.6	33.2	3.54	71.6
89 × 89 × 5.0 SHS	12.5	0.334	26.7	15.8	1590		1.81		40.7		31.4		49.1	33.7	3.05	62.7
89 × 89 × 3.5 SHS	9.06	0.341	37.6	23.4	1150		1.37		30.9		23.2		36.5	34.5	2.24	47.1
75 × 75 × 6.0 SHS	12.0	0.274	22.8	10.5	1530		1.16		30.9		24.7		38.4	27.5	2.04	48.2
75 × 75 × 5.0 SHS	10.3	0.279	27.0	13.0	1310		1.03		27.5		21.6		33.6	28.0	1.77	42.6
75 × 75 × 4.0 SHS	8.49	0.283	33.3	16.8	1080		0.882		23.5		18.0		28.2	28.6	1.48	36.1
75 × 75 × 3.5 SHS	7.53	0.285	37.9	19.4	959		0.797		21.3		16.1		25.3	28.8	1.32	32.5
75 × 75 × 3.0 SHS	6.60	0.290	43.9	23.0	841		0.716		19.1		14.2		22.5	29.2	1.15	28.7
75 × 75 × 2.5 SHS	5.56	0.291	52.4	28.0	709		0.614		16.4		12.0		19.1	29.4	0.971	24.6
65 × 65 × 3.0 SHS	5.66	0.250	44.1	19.7	721		0.454		14.0		10.4		16.6	25.1	0.733	21.0
65 × 65 × 2.5 SHS	4.78	0.251	52.6	24.0	609		0.391		12.0		8.91		14.1	25.3	0.624	18.1
65 × 65 × 2.0 SHS	3.88	0.253	65.3	30.5	494		0.323		9.94		7.29		11.6	25.6	0.509	14.9
50 × 50 × 4.0 SHS	5.35	0.183	34.2	10.5	681		0.229		9.15		7.33		11.4	18.3	0.403	14.3
50 × 50 × 3.0 SHS	4.25	0.190	44.7	14.7	541		0.195		7.79		5.92		9.39	19.0	0.321	11.8
50 × 50 × 2.5 SHS	3.60	0.191	53.1	18.0	459		0.169		6.78		5.09		8.07	19.2	0.275	10.2
50 × 50 × 2.0 SHS	2.93	0.193	65.8	23.0	374		0.141		5.66		4.20		6.66	19.5	0.226	8.51
50 × 50 × 1.6 SHS	2.38	0.195	81.7	29.3	303		0.117		4.68		3.44		5.46	19.6	0.185	7.03
40 × 40 × 4.0 SHS	4.09	0.143	34.9	8.00	521		0.105		5.26		4.36		6.74	14.2	0.192	8.33
40 × 40 × 2.5 SHS	2.82	0.151	53.7	14.0	359		0.0822		4.11		3.13		4.97	15.1	0.136	6.21
40 × 40 × 2.0 SHS	2.31	0.153	66.4	18.0	294		0.0694		3.47		2.61		4.13	15.4	0.113	5.23
40 × 40 × 1.6 SHS	1.88	0.155	82.3	23.0	239		0.0579		2.90		2.15		3.41	15.6	0.0927	4.36

FIGURE D4 (in part) SQUARE HOLLOW SECTIONS

1	2	3	4	5	6	7	8	9	10	11	12	13	
Designation		Mass per unit length	External surface area		Ratio	Gross area of cross-section	About x, y and n- axes					Torsion constant	Torsion modulus
Depth	Width	Thickness	Per unit length	Per unit mass			Second moment of area	Elastic section modulus	Elastic section modulus	Plastic section modulus	Radius of gyration		
$b \times b \times t$	m	A_{EL}	A_{EM}	$b - 2t$	A_g	I_x, I_y	Z_x, Z_y	Z_n	S_x, S_y	r_x, r_y	J	C	
mm × mm × mm	kg/m	m^2/m	m^2/t	t	mm^2	10^6 mm^4	10^3 mm^3	10^3 mm^3	10^3 mm^3	mm	10^6 mm^4	10^3 mm^3	
35 × 35 × 3.0 SHS	2.83	0.130	45.8	9.67	361	0.0595	3.40	2.67	4.23	12.8	0.102	5.18	
35 × 35 × 2.5 SHS	2.42	0.131	54.2	12.0	309	0.0529	3.02	2.33	3.69	13.1	0.0889	4.58	
35 × 35 × 2.0 SHS	1.99	0.133	66.8	15.5	254	0.0451	2.58	1.95	3.09	13.3	0.0741	3.89	
35 × 35 × 1.6 SHS	1.63	0.135	82.7	19.9	207	0.0379	2.16	1.62	2.57	13.5	0.0611	3.26	
30 × 30 × 2.0 SHS	1.68	0.113	67.4	13.0	214	0.0272	1.81	1.39	2.21	11.3	0.0454	2.75	
30 × 30 × 1.6 SHS	1.38	0.115	83.3	16.8	175	0.0231	1.54	1.16	1.84	11.5	0.0377	2.32	
25 × 25 × 3.0 SHS	1.89	0.0897	47.4	6.33	241	0.0184	1.47	1.21	1.91	8.74	0.0333	2.27	
25 × 25 × 2.5 SHS	1.64	0.0914	55.7	8.00	209	0.0169	1.35	1.08	1.71	8.99	0.0297	2.07	
25 × 25 × 2.0 SHS	1.36	0.0931	68.3	10.5	174	0.0148	1.19	0.926	1.47	9.24	0.0253	1.80	
25 × 25 × 1.6 SHS	1.12	0.0945	84.1	13.6	143	0.0128	1.02	0.780	1.24	9.44	0.0212	1.54	
20 × 20 × 1.6 SHS	0.873	0.0745	85.4	10.5	111	0.00608	0.608	0.474	0.751	7.39	0.0103	0.924	

NOTE: The calculation of sectional properties is based on the following corner geometry.

Size range	Inside corner radius mm	Outside corner radius mm
Thickness 3.0 mm and less	1.0t	2.0t
Thickness greater than 3.0 mm	1.5t	2.5t

FIGURE D4 (in part) SQUARE HOLLOW SECTION

APPENDIX E

FORMULAE FOR THE CALCULATION OF SECTIONAL PROPERTIES
(Normative)**E1 GENERAL**

The Tables in Figures D1, D2, D3 and D4 of this Standard give nominal sectional properties for a limited range of sizes of cold-formed structural steel hollow sections. The nominal sectional properties of hollow sections supplied to the requirements of this Standard shall be calculated using the formulae given below.

NOTE: The designation of the section's major axis (x) and its minor axis (y) align with the axis designation used for structural design in AS 4100, AS 5100.6 and NZS 3404.

E2 CIRCULAR HOLLOW SECTIONS

The sectional properties for circular hollow sections (CHS) in Figures D1 and D2 are calculated using the formulae given below.

Nominal outside diameter	d_o	(mm)
Nominal thickness	t	(mm)
Inside diameter	$d_i = (d_o - 2t)$	(mm)

These parameters, which characterize the shape of CHS, may vary within the tolerances allowed by this Standard and the nominal sectional properties still remain valid.

Gross area of the cross-section $A_g = \frac{\pi (d_o^2 - d_i^2)}{4}$ (mm²)

External surface area per unit length $A_{EL} = \frac{\pi d_o}{10^3}$ (m²/m)

External surface area per unit mass $A_{EM} = \frac{A_{EL} \times 10^9}{7850 A_g}$ (m²/t)

Mass per unit length $m = 0.00785 A_g$ (kg/m)

Second moment of area $I = \frac{\pi (d_o^4 - d_i^4)}{64}$ (mm⁴)

Radius of gyration $r = \sqrt{\frac{I}{A}}$ (mm)

Elastic section modulus $Z = \frac{2I}{d_o}$ (mm³)

Plastic section modulus $S = \frac{d_o^3 - d_i^3}{6}$ (mm³)

Torsion constant
(polar moment of inertia) $J = 2I$ (mm⁴)

Torsion modulus $C = 2Z$ (mm³)

E3 RECTANGULAR OR SQUARE HOLLOW SECTIONS

The sectional properties for rectangular hollow sections (RHS) in Figure D3 and for square hollow sections (SHS) in Figure D4 are calculated using the formulae given below.

Nominal dimension of the longer side of a RHS	d	(mm)
Nominal side dimension of a SHS or shorter side of a RHS	b	(mm)
Nominal thickness	t	(mm)
External corner radius for calculations	r_o	(mm)
Internal corner radius for calculations	$r_i (= r_o - t)$	(mm)

Unless subject to agreement between the finished product manufacturer, supplier and purchaser, r_o shall be taken as noted in Figure D3 for RHS and Figure D4 for SHS.

Gross area of the cross-section $A_g = 2t(d + b - 2t) - (4 - \pi)(r_o^2 - r_i^2)$ (mm²)

External surface area per unit length $A_{EL} = \frac{2}{10^3}(d + b - 4r_o + \pi r_o)$ (m²/m)

External surface area per unit mass $A_{EM} = \frac{A_{EL} \times 10^9}{7850 A_g}$ (m²/t)

Mass per unit length $m = 0.00785 A_g$ (kg/m)

Second moment of area

Major axis $I_x = \left[\frac{bd^3}{12} - \frac{(b-2t)(d-2t)^3}{12} - 4(I_{cro} + A_{cro}h_{cro}^2) + 4(I_{cri} + A_{cri}h_{cri}^2) \right]$ (mm⁴)

Minor axis $I_y = \left[\frac{db^3}{12} - \frac{(d-2t)(b-2t)^3}{12} - 4(I_{cro} + A_{cro}h_{cro}^2) + 4(I_{cri} + A_{cri}h_{cri}^2) \right]$ (mm⁴)

Radius of gyration

Major axis $r_x = \sqrt{\frac{I_x}{A}}$ (mm)

Minor axis $r_y = \sqrt{\frac{I_y}{A}}$ (mm)

Elastic section modulus

Major axis $Z_x = \frac{2I_x}{d}$ (mm³)

Minor axis $Z_y = \frac{2I_y}{b}$ (mm³)

Diagonal axis (n) for SHS only $Z_n = \frac{2I_x}{y_n}$ (mm³)

Plastic section modulus

$$\text{Major axis } S_x = \left[\frac{bd^2}{4} - \frac{(b-2t)(d-2t)^2}{4} - 4(A_{\text{cro}} h_{\text{cro}}) + 4(A_{\text{cri}} h_{\text{cri}}) \right] \quad (\text{mm}^3)$$

$$\text{Minor axis } S_y = \left[\frac{db^2}{4} - \frac{(d-2t)(b-2t)^2}{4} - 4(A_{\text{cro}} h_{\text{cro}}) + 4(A_{\text{cri}} h_{\text{cri}}) \right] \quad (\text{mm}^3)$$

$$\text{Torsion constant } J = \left(t^3 \frac{h}{3} + 2KA_h \right) \quad (\text{mm}^4)$$

$$\text{Torsion modulus } C = \left(\frac{J}{t + K/t} \right) \quad (\text{mm}^3)$$

$$\text{where } A_{\text{cro}} = \left(1 - \frac{\pi}{4} \right) r_o^2 \quad (\text{mm}^2)$$

$$A_{\text{cri}} = \left(1 - \frac{\pi}{4} \right) r_i^2 \quad (\text{mm}^2)$$

$$\text{Major axis } h_{\text{cro}} = \frac{d}{2} - \left(\frac{10 - 3\pi}{12 - 3\pi} \right) r_o \quad (\text{mm})$$

(For minor axis substitute b for d)

$$\text{Major axis } h_{\text{cri}} = \frac{d - 2t}{2} - \left(\frac{10 - 3\pi}{12 - 3\pi} \right) r_i \quad (\text{mm})$$

(For minor axis substitute b for d)

$$I_{\text{cro}} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)} \right) r_o^4 \quad (\text{mm}^4)$$

$$I_{\text{cri}} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)} \right) r_i^4 \quad (\text{mm}^4)$$

$$h = 2[(b-t)+(d-t)] - 2R_c(4-\pi) \quad (\text{mm})$$

$$A_h = [(b-t)(d-t)] - R_c^2(4-\pi) \quad (\text{mm}^2)$$

$$K = \frac{2A_h t}{h} \quad (\text{mm}^2)$$

$$R_c = \frac{r_o + r_i}{2} \quad (\text{mm})$$

$$y_n = \left[\left(\frac{d}{2} - r_o \right)^2 + \left(\frac{b}{2} - r_o \right)^2 \right]^{0.5} + r_o \quad (\text{mm})$$