
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2008/2009

April/May 2009

REG 364 - Steel Structure Design
[Rekabentuk Struktur Keluli]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of TWENTY printed pages before you begin the examination.

Sila pastikan bahawa kertas peperiksaan ini mengandungi DUA PULUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

Students are allowed to answer all questions either in English **OR** in Bahasa Malaysia only.

*Pelajar dibenarkan menjawab semua soalan dalam Bahasa Inggeris **ATAU** Bahasa Malaysia sahaja.*

Answer **ALL** questions.

*Jawab **SEMUA** soalan.*

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1. **Figure 1** shows three connections A, B and C of a roof truss. In connection 'A', the diagonal member is subjected to compression force and in connection B the vertical angle member is subjected to tension force. In connection B, two bolts of 20mm diameter in Grade 4.6 are used to connect the angle member of 10mm thickness in Grade S275 to the gusset plate of 8mm thickness in Grade S355.

Calculate the design capacity of:-

- (i) Internal connection 'B'. Assume shear failure occurs at the shank area of the bolts.
- (ii) Splice connection 'C'

Gambarajah 1 menunjukkan 3 sambungan A, B dan C untuk kekuda besi. Untuk sambungan di A, daya tekanan di bahagian pepenjuru adalah jenis daya mampatan dan sambungan di B iaitu di bahagian pugak adalah daya regangan. Sambungan di B, dua pasak bergaris pusat 20mm dengan Gred 4.6 telah digunakan untuk menyambung besi kekuda berketebalan 10mm dengan Gred S275 kepada plet guset berketebalan 8mm dengan Gred S355.

Kirakan keupayaan rekabentuk untuk :-

- (i) Sambungan dalaman 'B'. Andaikan kegagalan ricihan berlaku di ruang pasak.
- (ii) Sambungan dibahagian penyambungan 'C'

Table/Jadual

Notation/Notasi	Variable/Angkubah
p_s	160 N/mm ²
p_{bb}	460 N/mm ²
p_{bs}	460 N/mm ²

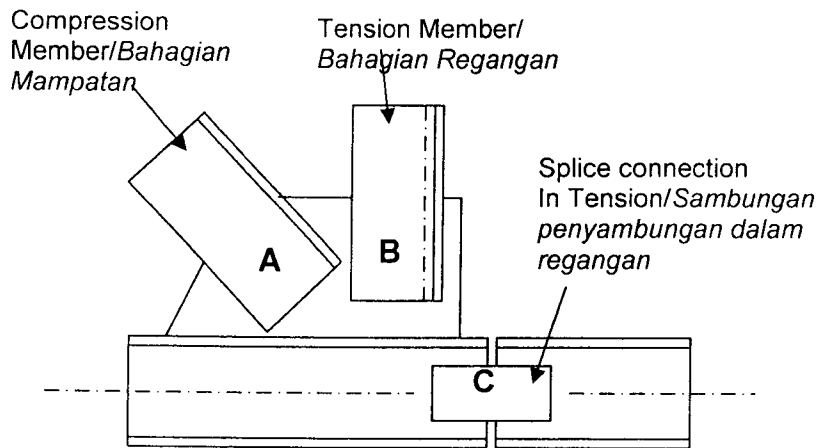


Figure A/Gambarajah A

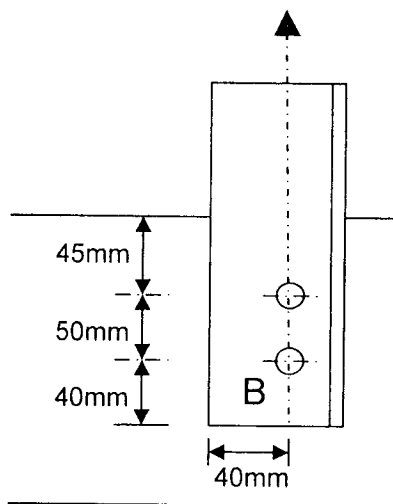


Figure B/Gambarajah B

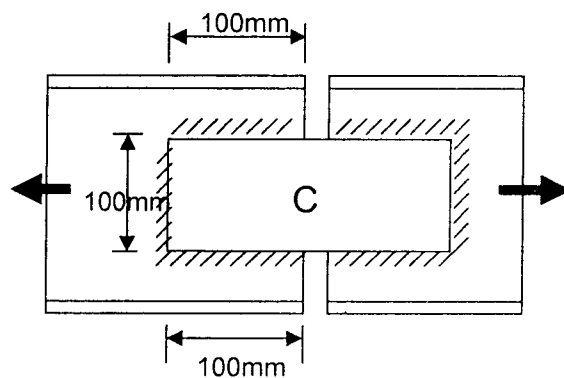


Figure C/Gambarajah C

Figure 1/Gambarajah 1

(20 marks/markah)

2. A proposed 5m long internal column in a 'rigid' jointed steel structure is to be loaded concentrically with 1500 kN dead and 1500 kN imposed load (**Figure 2**). Assuming that fixity at the top and bottom of the column gives effective rotational restraints, design column sections assuming the structure will be (a) braced and (b) unbraced.

Table

Notation	Formula
Effective Length (Braced)- L_e	$0.7L$
Effective Length (unbraced) - L_e	$1.2L$

Braced Column

254 x 254 x 107 UC			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 65.7 \text{ mm}$	$A_g = 13\,700 \text{ mm}^2$	$p_c = 208 \text{ N mm}^{-2}$

305 x 305 x 118 UC			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 77.5 \text{ mm}$	$A_g = 15\,000 \text{ mm}^2$	$p_c = 222 \text{ N mm}^{-2}$

Unbraced Column

305 x 305 x 158 UC			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 78.9 \text{ mm}$	$A_g = 20\,100 \text{ mm}^2$	$p_c = 165 \text{ N mm}^{-2}$

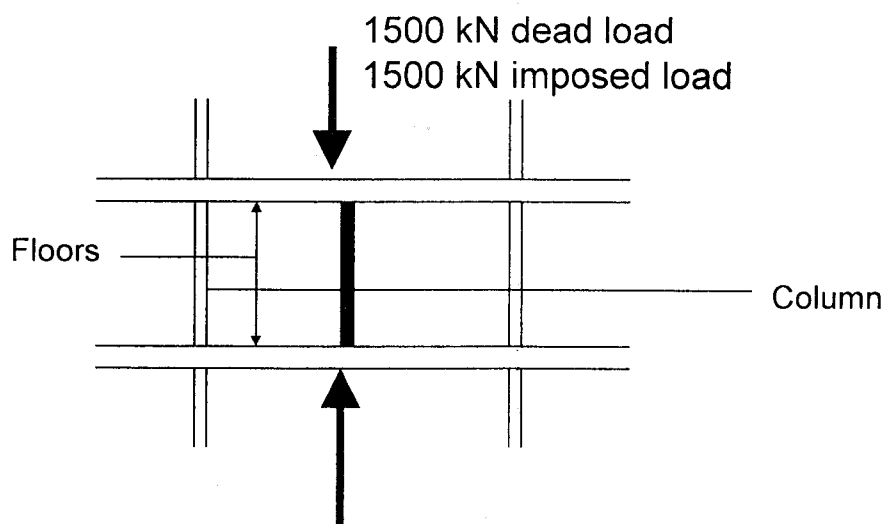


Figure 2

- 5 -

Cadangan tiang dalaman panjang 6m dengan sambungan struktur besi berkedudukan tetap dibebankan dengan 1500 kN beban mati dan 1500 kN beban keraan 1500 kN (**Gambarajah 2**). Andaikan sambungan di bahagian atas dan bawah struktur tiang memberi putaran tahanan berkesan, andaian rekabentuk seksyen untuk struktur tiang adalah (a) pendakap dan (b) tanpa pendakap.

Jadual

Notasi	Formula
Effective Length (Braced) - L_e	$0.7L$
Effective Length (unbraced) - L_e	$1.2L$

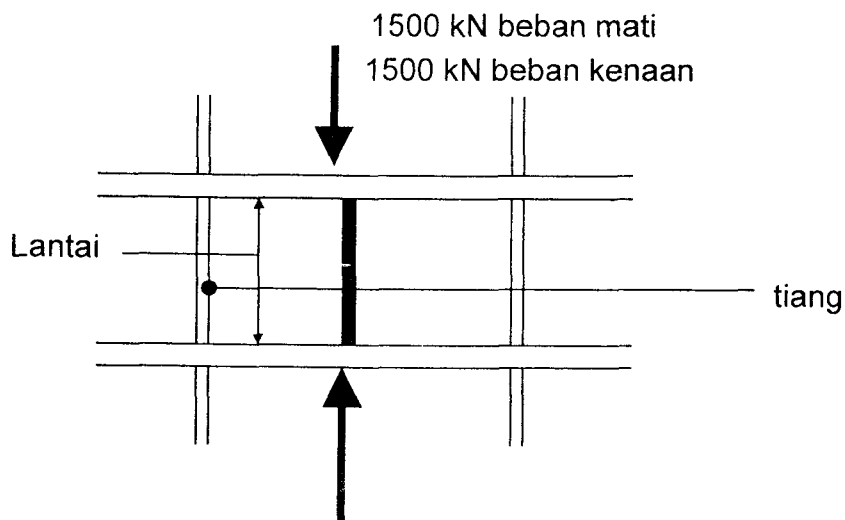
Tiang berpendakap

254 x 254 x 107 UC (Andaian 1)			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 65.7 \text{ mm}$	$A_g = 13\,700 \text{ mm}^2$	$p_c = 208 \text{ N mm}^{-2}$

305 x 305 x 118 UC (Andaian 2)			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 77.5 \text{ mm}$	$A_g = 15\,000 \text{ mm}^2$	$p_c = 222 \text{ N mm}^{-2}$

Tiang tanpa pendakap

305 x 305 x 158 UC			
$P_y = 265 \text{ N mm}^{-2}$	$r_y = 78.9 \text{ mm}$	$A_g = 20\,100 \text{ mm}^2$	$p_c = 165 \text{ N mm}^{-2}$



Gambarajah 2

(20 marks/markah)

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3. (a) Briefly explain the following terms:-

- (i) Plastic cross section
- (ii) Compact cross section
- (iii) Tension members

Secara ringkas terangkan terma berikut:-

- (i) *Keratan plastik*
- (ii) *Keratan padat*
- (iii) *Anggota tegangan*

(6 marks/markah)

(b) Design a rafter using section 100 x 50 x 3.2 (Rectangular Hollow Section) if the loads applied are as follow. Assume the rafter as simply supported beam. Given the rafter length is 3000mm.

Roof asbestos	=	0.5 kN/m ²
Rafter selfweight and purlin	=	1.0 kN/m ²
Live load	=	0.75 kN/m ²

Rekabentuk kasau menggunakan keratan 100 x 50 x 3.2 (Rectangular Hollow Section) jika beban yang dikenakan adalah seperti berikut. Anggap kasau tersebut sebagai rasuk mudah. Diberi rentang kasau adalah 3000mm.

<i>Atap asbestos</i>	=	<i>0.5 kN/m²</i>
<i>Swa-berat rafter dan purlin</i>	=	<i>1.0 kN/m²</i>
<i>Beban hidup</i>	=	<i>0.75 kN/m²</i>

(14 marks/markah)

4. (a) What is the difference between the Ultimate Limit State Design and the Permissible Stress Method.

Apakah perbezaan di antara rekabentuk Keadaan Had dan Kaedah Tegasan dibenarkan.

(5 marks/markah)

- (b) A simply supported beam subjected to dead load and imposed of 10kN/m each (**Figure 3**). Compute the maximum moment at mid span using the following methods:-

- (i) The load factor method with a load factor = 1.8
 (ii) Ultimate limit state design

*Satu rasuk mudah dikenakan beban mati dan beban kenaan masing-masing 10kN/m (**Rajah 3**). Kira momen maksimum ditengah rentang rasuk tersebut menggunakan kaedah di bawah*

- (i) *Kaedah faktor beban dengan faktor beban = 1.8*
 (ii) *Rekabentuk keadaan had*

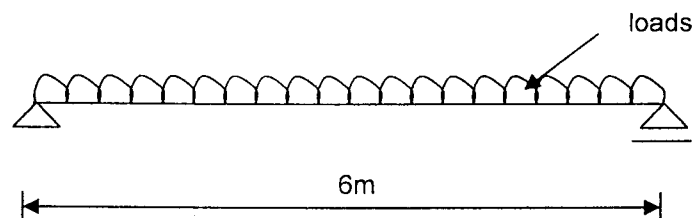


Figure 3/Rajah 3

(15 marks/markah)

5. (a) A cantilever steel beam of 5m length is required to carry uniform dead load and imposed load of 20 kN/m and 15 kN/m respectively. Design a suitable universal beam with grade 275 to satisfy bending and shear.

Rasuk mudah julur yang mempunyai panjang 5m diperlukan untuk menanggung beban mati seragam dan beban kenaan masing-masing 250 kN/m dan 150 kN/m. Rekabentuk rasuk semesta yang sesuai menggunakan keluli gred 275 terhadap lenturan dan ricihan.

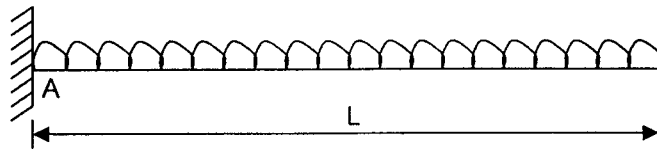


Figure 4/Rajah 4

(15 marks/markah)

- (b) Compute the maximum deflection (mm) of the beam if $E=205\text{kN/mm}^2$, $I= 87400 \text{ cm}^4$

Kira pesongan maksimum rasuk tersebut jika $E=205\text{kN/mm}^2$, $I= 87400 \text{ cm}^4$

(5 marks/markah)

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A check list for designers

Dimensions and properties of Structural steel sections

To BS4: Part 1: 1980 BS4848: Part 2: 1975 & Part 4: 1972

September 1986



The Steel Construction Institute

....10/-

THE STEEL CONSTRUCTION INSTITUTE is an independent organisation having the objective of developing and promoting the proper and effective use of steel as a construction material. It provides educational, research, design development, technical advisory, computing and QA Services to the building, civil engineering, marine and offshore engineering industries.

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By arrangement with the British Steel Corporation, it is undertaking the work previously carried out by the Constructional Steel Research & Development Organisation (Constrado) including, where appropriate, the supply of Constrado publications.

Membership information may be obtained from The Steel Construction Institute.

Introduction

The purpose of this publication is to provide structural steel designers with the dimensions and properties of the following sections:

- Universal sections, joists and channels listed in BS4: Part 1: 1980
- Equal and unequal angles listed in BS4848: Part 4: 1972
- Structural hollow sections listed in BS4848: Part 2: 1975

Certain other structural hollow sections (mainly thin wall) which are regularly produced by BSC Tubes Division are also included and identified with an +.

Metrication of steel sections.

Angles and structural hollow sections are produced in metric sizes selected from ranges agreed by the ISO.

Other sections listed (those included in BS4: Part 1) are rolled to metric equivalents of the imperial sizes since there are, as yet, no agreed ISO ranges for those shapes and none are anticipated for some time.

Designers are reminded that for maximum economy reference should be made to the relevant BSC price lists when selecting sizes.

Handbooks

Structural steelwork handbooks are available from The Steel Construction Institute as follows:

For use with BS5950: Part 1: 1985

Steelwork design		
Guide to BS5950: Part 1: 1985		
Volume 1 Section properties		
Member capacities	Member price £15.00	Non-member price £29.50
Volume 2, Worked examples	Member price £12.50	Non-member price £23.00

For use with BS449: Part 2: 1969

Structural steelwork handbook (BCSA/Constrado 1978)	Price £7.00
Structural steelwork handbook for metric angles	Price £2.50

The above prices refer to the UK only and are inclusive of postage and packing.

Enquiries regarding supply of sections should be addressed to:

For sections other than SHS

BSC General Steels Group
 BSC Sections
 PO Box 24
 Steel House
 Redcar
 Cleveland TS10 5QL
 Telephone 0642 474111
 Telex 587401

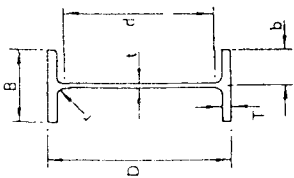
For structural hollow sections

BSC Tubes Division
 Divisional Sales Office
 Corby
 Northants NN17 1UA
 Telephone 053620 2121
 Telex 34418

UNIVERSAL BEAMS
To BS4: Part 1

PROPERTIES

DIMENSIONS



Designation Serial Size mm	Mass Per Metre kg	Depth Of Section D mm	Width Of Section B mm	Thickness		Root Radius r mm	Depth Between Flange Fillets d mm	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter u	Torsional Index x	Warping Constant H dm ⁶	Torsional Constant J cm ⁴	Area of Section A cm ²
				Web t mm	Flange T mm			Flange b/T	Web d/t	Axis x-x cm ⁴	Axis y-y cm ⁴	Axis x-x cm	Axis y-y cm	Axis x-x cm ³	Axis y-y cm ³	Axis x-x cm ³	Axis y-y cm ³					
914x419	388 343	920.5 911.4	420.5 418.5	36.6 32.0	24.1 24.1	799.1 799.1	5.74 6.54	37.2 41.2	719000 625000	454000 392000	38.1 37.8	9.58 9.46	15600 13700	2160 1870	17700 15500	3340 2890	0.884 0.883	26.7 30.1	88.7 75.7	1730 1190	494 437	
914x305	289 253 224 201	926.6 918.5 910.3 903.0	307.8 305.5 304.1 303.4	32.0 27.9 23.9 20.2	19.1 19.1 19.1 19.1	824.5 824.5 824.5 824.5	4.81 5.47 6.36 7.51	42.1 47.7 51.9 54.2	505000 437000 376000 326000	15600 13300 11200 9430	37.0 36.8 36.3 35.6	6.51 6.42 6.27 6.06	10900 9510 8260 7210	1010 872 738 621	12600 10900 9520 8360	1600 1370 1160 983	0.867 0.866 0.861 0.853	31.9 36.2 41.3 46.8	31.2 26.4 22.0 18.4	929 627 421 293	369 323 285 256	
838x297	226 194 176	850.9 840.7 834.9	293.8 292.4 291.5	26.8 21.7 18.8	17.8 17.8 17.8	761.7 761.7 761.7	5.48 6.74 7.76	47.3 51.8 54.4	340000 279000 246000	11400 9070 7790	34.3 33.6 33.1	6.27 6.06 5.90	7990 6650 5890	773 620 534	9160 7650 6810	1210 974 842	0.87 0.862 0.856	35.0 41.6 46.5	19.3 15.2 13.0	514 307 222	289 247 224	
752x267	197 173 147	769.6 762.0 753.9	268.0 266.7 265.3	25.4 21.6 17.5	16.5 16.5 16.5	685.8 685.8 685.8	5.28 6.17 7.58	44.0 48.0 53.2	240000 205000 169000	8170 6850 5470	30.9 30.5 30.0	5.71 5.57 5.39	6230 5390 4480	610 513 412	7170 6200 5170	959 807 649	0.869 0.864 0.857	33.2 38.1 45.1	11.3 9.38 7.41	405 267 161	251 220 188	
686x254	170 152 140 125	692.9 687.6 683.5 677.9	255.8 254.5 253.7 253.0	23.7 21.0 19.0 16.2	15.2 15.2 15.2 15.2	615.1 615.1 615.1 615.1	5.40 6.06 6.68 7.81	42.4 46.6 49.6 52.6	170000 150000 136000 118000	6620 5780 5180 4380	28.0 27.8 27.6 27.2	5.53 5.46 5.38 5.24	4910 4370 3990 3480	518 458 404 346	5620 5000 4560 4000	810 710 638 542	0.872 0.871 0.868 0.862	31.8 35.5 38.7 43.9	7.41 6.42 5.72 4.79	307 219 169 116	217 194 179 160	
610x305	238 179 149	633.0 617.5 609.6	311.5 307.0 304.8	31.4 23.6 19.7	16.5 16.5 16.5	537.2 537.2 537.2	4.96 6.50 7.74	28.9 38.1 45.1	208000 152000 125000	15800 11400 9300	26.1 25.8 25.6	7.22 7.08 6.99	6560 4910 4090	1020 743 610	7460 5520 4570	1570 1140 937	0.886 0.886 0.886	21.1 27.5 32.5	14.3 10.1 8.09	788 341 200	304 228 190	
610x229	140 125 113 101	617.0 611.9 607.3 602.2	230.1 229.0 228.2 227.6	22.1 19.6 17.3 14.8	12.7 12.7 12.7 12.7	547.3 547.3 547.3 547.3	5.21 5.84 6.60 7.69	41.8 46.0 48.9 51.6	112000 98600 87400 75700	4510 3930 3440 2910	25.0 24.9 24.6 24.2	5.03 4.96 4.88 4.75	3630 3220 2880 2510	392 344 301 256	4150 3680 3290 2880	612 536 470 400	0.875 0.873 0.87 0.863	30.5 34.0 37.9 43.0	3.99 3.45 2.95 2.51	217 155 102 77.2	178 160 144 129	
533x210	122 109 101 92 82	544.6 539.5 536.7 533.1 528.3	211.9 210.7 210.1 209.3 208.7	12.8 11.6 10.9 10.2 9.6	12.7 12.7 12.7 12.7 12.7	476.5 476.5 476.5 476.5 476.5	4.97 5.60 6.04 7.91 9.92	37.2 41.1 43.7 46.7 49.6	76200 66700 61700 55400 47500	3390 2940 2690 2300 2010	22.1 21.9 21.8 21.7 21.3	4.67 4.60 4.56 4.51 4.38	2800 2470 2300 2080 1800	320 279 257 229 192	3200 2820 2620 2370 2060	501 435 400 356 300	0.876 0.875 0.873 0.872 0.865	27.6 30.9 34.0 36.4 41.6	2.32 1.99 1.82 1.60 1.33	180 126 102 76.2 51.3	156 139 129 118 104	
457x191	98 89 82 74 67	467.4 463.6 460.2 457.2 453.6	192.8 192.0 191.3 190.5 189.9	11.4 10.6 9.9 9.1 8.5	10.2 10.2 10.2 10.2 10.2	407.9 407.9 407.9 407.9 407.9	4.92 5.42 5.98 7.57 7.48	35.8 38.5 41.2 44.8 48.0	45700 41000 37100 33400 29400	2340 2090 1870 1670 1450	19.1 19.0 18.8 18.7 18.5	4.33 4.28 4.23 4.19 4.12	1960 1770 1610 1460 1300	243 217 196 175 153	2230 2010 1830 1660 1470	378 338 304 272 237	0.88 0.879 0.877 0.876 0.873	25.8 28.3 30.9 33.9 37.9	1.17 1.04 0.923 0.819 0.706	121 90.5 69.2 52.0 37.1	125 114 105 95.0 85.4	

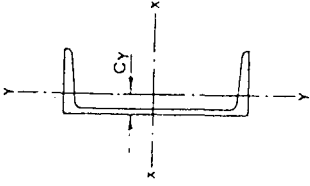
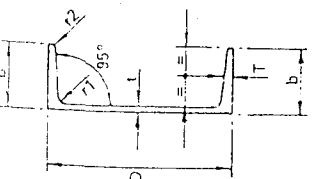
DIMENSIONS

UNIVERSAL BEAMS

PROPERTIES

[REG 364]

Designation	Serial Size	Mass Per Metre	Depth Of Section D	Width Of Section B	Thickness		Root Radius r	Depth Between Fillets d	Ratios For Local Buckling		Second Moment Of Area		Elastic Modulus		Plastic Modulus		Buckling Parameter U	Torsional Index X	Warping Constant H	Torsional Constant J	Area A
					Web t	Flange T			Web d/t	Flange b/t	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y					
457x152	82	465.1	153.5	18.9	10.2	407.0	4.06	38.0	36200	1140	18.6	3.31	1560	149	1800	235	0.872	27.3	0.569	89.3	104
457x152	74	461.3	152.7	17.0	10.2	407.0	4.49	41.1	32400	1010	18.5	3.26	1410	133	1620	209	0.87	30.0	0.499	66.6	95.1
457x152	67	457.2	151.9	15.0	10.2	407.0	5.06	44.7	28600	878	18.3	3.21	1250	116	1440	182	0.867	33.6	0.429	47.5	85.1
457x152	60	454.7	152.9	13.3	10.2	407.7	5.75	53.6	25500	794	18.3	3.23	1120	104	1280	163	0.859	37.5	0.387	33.6	75.5
457x152	52	449.8	152.4	10.9	10.2	407.7	6.99	53.6	21300	645	17.9	3.11	949	84.6	1090	133	0.859	43.9	0.311	21.3	66.5
406x178	74	412.8	179.7	16.0	10.2	360.5	5.62	37.2	27300	1540	17.0	4.03	1320	172	1500	267	0.881	27.6	0.508	63.0	95.1
406x178	67	409.4	178.8	14.3	10.2	360.5	6.25	41.0	24300	1360	16.9	4.00	1190	153	1350	237	0.88	30.5	0.533	46.0	85.1
406x178	60	406.4	177.8	12.8	10.2	360.5	6.95	46.2	21500	1200	15.8	3.97	1060	135	1190	208	0.88	33.9	0.464	32.9	76.1
406x178	54	402.6	177.6	10.9	10.2	360.5	8.15	47.4	18600	1020	16.5	3.85	925	114	1050	177	0.872	38.5	0.39	22.7	66.4
406x140	46	402.3	142.4	11.2	10.2	359.7	6.36	52.1	15600	539	16.3	3.02	778	75.7	888	118	0.87	38.8	0.206	19.2	59.1
406x140	39	397.3	141.3	8.6	10.2	359.7	8.24	57.1	12500	411	15.9	2.89	627	58.0	721	91.1	0.859	47.4	0.155	10.6	49.2
356x171	67	364.0	173.2	15.7	10.2	312.3	5.52	34.3	19500	1360	15.1	3.99	1070	157	1210	243	0.887	24.4	0.413	56.5	85.2
356x171	57	358.6	172.1	13.0	10.2	312.3	6.62	39.0	16100	1110	14.9	3.92	896	129	1010	199	0.884	28.9	0.31	33.1	72.2
356x171	51	355.6	171.5	11.5	10.2	312.3	7.46	42.8	14200	988	14.8	3.87	796	113	895	174	0.882	32.2	0.266	23.6	64.1
356x171	45	352.0	171.0	9.7	10.2	312.3	8.81	45.3	12100	812	14.6	3.78	687	95.0	774	147	0.875	36.9	0.238	15.7	57.1
356x177	39	352.8	126.0	10.7	10.2	311.2	5.89	47.9	10100	357	14.3	2.69	572	56.6	654	88.7	0.872	35.3	0.104	14.9	49.2
356x177	33	348.5	125.4	8.5	10.2	311.2	7.38	52.7	8200	280	14.0	2.59	471	44.7	540	70.2	0.864	42.2	0.081	8.68	41.1
305x155	54	310.9	166.8	13.7	8.9	265.7	6.06	34.5	11700	1060	13.1	3.94	753	127	845	195	0.89	23.7	0.234	34.5	68.4
305x155	46	307.1	165.7	11.8	8.9	265.7	7.02	39.7	9950	897	13.0	3.90	648	108	723	166	0.89	27.2	0.196	22.3	58.9
305x155	40	303.8	165.1	10.2	8.9	265.7	8.09	43.6	8520	763	12.9	3.85	561	92.4	624	141	0.888	31.1	0.164	14.7	51.5
305x127	48	310.4	125.2	14.0	8.9	264.6	4.47	29.7	9500	480	12.5	2.75	612	73.5	706	115	0.874	23.3	0.101	31.4	60.8
305x127	42	306.6	124.3	12.1	8.9	264.6	5.14	33.1	8140	388	12.4	2.70	531	62.5	610	98.2	0.872	26.5	0.0842	21.0	53.2
305x127	37	303.8	123.5	10.7	8.9	264.6	5.77	36.7	7160	337	12.3	2.67	472	54.6	540	85.7	0.871	29.6	0.0774	14.9	47.5
305x102	33	312.7	102.4	6.6	7.6	275.9	4.74	41.8	6490	193	12.5	2.15	415	37.8	480	59.8	0.866	31.7	0.0441	12.1	41.8
305x102	28	308.9	101.9	8.9	7.6	275.9	5.72	45.2	5420	157	12.2	2.08	351	30.8	407	48.9	0.858	37.0	0.0353	7.63	36.3
305x102	25	304.8	101.6	6.8	7.6	275.9	7.47	47.6	4390	120	11.8	1.96	288	23.6	338	38.0	0.844	43.8	0.0266	4.65	31.4
254x146	43	259.6	147.3	12.7	7.6	218.9	5.80	30.0	6560	677	10.9	3.51	505	92.0	568	141	0.880	21.1	0.103	24.1	55.1
254x146	37	256.0	146.4	10.9	7.6	218.9	6.72	34.2	5560	571	10.8	3.47	434	78.1	485	120	0.889	24.3	0.0858	15.5	47.5
254x146	31	251.5	146.1	8.6	7.6	218.9	8.49	35.9	4440	449	10.5	3.35	353	61.5	396	94.5	0.879	29.4	0.0662	8.73	40.0
254x102	28	260.4	102.1	10.0	7.6	225.1	5.10	35.2	4010	178	10.5	2.22	308	34.9	353	54.8	0.873	27.5	0.0279	9.64	36.2
254x102	25	257.0	101.9	8.4	7.6	225.1	6.07	36.9	3410	148	10.3	2.14	265	29.0	306	45.8	0.864	31.4	0.0228	6.45	32.2
254x102	22	254.0	101.6	6.8	7.6	225.1	7.47	38.8	2870	120	10.0	2.05	226	23.6	262	37.5	0.854	35.9	0.0183	4.31	28.4
203x133	30	206.8	133.8	9.6	7.6	172.3	6.97	27.3	2890	384	8.72	3.18	279	57.4	313	88.1	0.882	21.5	0.0373	10.2	38.0
203x133	25	203.2	133.4	7.8	7.6	172.3	8.55	29.7	2360	310	8.54	3.10	232	46.4	260	71.4	0.876	25.4	0.0291	6.12	32.3
203x102	23	203.2	101.6	9.3	7.6	169.4	5.46	32.6	2090	163	8.49	2.37	206	32.1	232	49.5	0.89	22.6	0.0153	6.87	29.0
178x102	19	177.8	101.6	7.9	7.6	146.8	6.43	31.2	1360	138	7.49	2.39	153	27.2	171	41.9	0.880	22.6	0.00608	4.37	24.2
152x89	16	152.4	89.9	7.7	7.6	121.8	5.77	26.5	838	90.4	6.40	2.10	110	20.3	124	31.4	0.889	19.5	0.00473	3.61	20.5
127x76	13	127.0	76.2	7.6	7.6	96.6	5.01	23.0	477	56.2	5.33	1.83	75.1	14.7	85	22.7	0.893	16.2	0.002	2.92	16.8

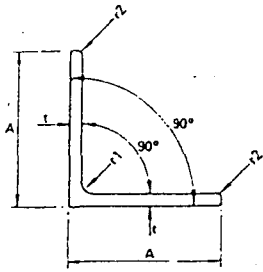


CHANNELS
To BS4: Part 1

DIMENSIONS

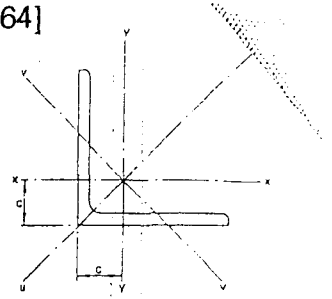
PROPERTIES

Designation Serial Size	Mass Per Metre kg	Depth Of Section D mm	Width Of Section B mm	Thickness		Root Radius r1 mm	Toe Radius r2 mm	Depth Between Fillets d mm	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter u	Torsional Index x	Warping Constant H cm ⁶	Torsional Constant J cm ⁴	Area of Section A cm ²
				Web t mm	Flange T mm				Flange b/T	Web d/t	Axis x-x cm ⁴	Axis y-y cm ⁴	Axis x-x cm	Axis y-y cm	Axis x-x cm ³	Axis y-y cm ³	Axis x-x cm ³	Axis y-y cm ³					
432x102	65.54	431.8	101.6	12.2	16.8	15.2	4.8	362.4	6.05	29.7	21400	629	16.0	2.74	991	80.1	1210	153	0.876	24.6	0.217	61.0	83.5
381x102	55.10	381.0	101.6	10.4	16.3	15.2	4.8	312.4	6.23	30.0	14900	580	14.6	2.87	782	75.9	933	144	0.895	22.7	0.153	46.0	70.2
305x102	46.18	304.8	101.6	10.2	14.8	15.2	4.8	239.2	6.86	23.5	8210	499	11.8	2.91	539	66.6	638	128	0.9	18.9	0.0842	35.4	58.8
305x89	41.69	304.8	88.9	10.2	13.7	13.7	3.2	245.4	6.49	24.1	7060	325	11.5	2.48	463	48.5	557	92.6	0.887	20.4	0.0551	27.6	53.1
254x89	35.74	254.0	88.9	9.1	13.6	13.7	3.2	194.7	6.54	21.4	4450	302	9.88	2.58	350	46.7	414	89.6	0.906	17.1	0.0347	22.9	45.5
254x76	28.29	254.0	76.2	8.1	10.9	12.2	3.2	203.8	6.99	25.2	3370	163	9.67	2.12	565	28.2	317	54.1	0.886	21.2	0.0194	12.3	36.0
229x89	32.76	228.6	88.9	8.6	13.3	13.7	3.2	169.8	6.68	19.7	3390	285	9.01	2.61	296	44.8	348	86.4	0.912	15.5	0.0263	20.4	41.7
229x76	26.06	228.6	76.2	7.6	11.2	12.2	3.2	178.0	6.80	23.4	2610	159	8.87	2.19	228	28.2	270	54.2	0.9	18.0	0.0151	11.4	33.2
203x89	29.78	203.2	88.9	8.1	12.9	13.7	3.2	145.2	6.89	17.9	2490	264	8.10	2.64	245	42.3	287	81.6	0.915	14.1	0.0192	17.8	37.9
203x76	23.82	203.2	76.2	7.1	11.2	12.2	3.2	152.5	6.80	21.5	1950	151	8.02	2.23	192	27.5	225	53.3	0.911	16.7	0.0112	10.4	30.3
178x89	26.81	177.8	88.9	7.6	12.3	13.7	3.2	121.0	7.23	15.9	1750	241	7.16	2.66	197	39.3	230	75.4	0.915	12.7	0.0134	15.1	34.2
178x76	20.84	177.8	76.2	6.6	10.3	12.2	3.2	128.8	7.40	19.5	1340	134	7.10	2.25	150	24.7	175	48.1	0.911	15.5	0.00764	8.13	26.5
152x89	23.84	152.4	88.9	7.1	11.6	13.7	3.2	97.0	7.66	13.7	1170	215	6.20	2.66	153	35.7	178	68.1	0.909	11.3	0.00881	12.4	30.4
152x76	17.88	152.4	76.2	6.4	9.0	12.2	2.4	105.9	8.47	16.5	852	114	6.11	2.24	112	21.0	130	41.3	0.902	14.5	0.00486	5.94	22.8
127x64	14.90	127.0	63.5	6.4	9.2	10.7	2.4	84.0	6.90	13.1	483	67.2	5.04	1.88	76.0	15.3	89.4	29.3	0.91	11.7	0.00187	4.92	19.0
102x51	10.42	101.6	50.8	6.1	7.6	9.1	2.4	65.7	6.68	10.8	208	29.1	3.96	1.48	40.9	8.160	48.8	15.7	0.9	10.8	0.000513	2.55	13.3
76x38	6.70	76.2	38.1	5.1	6.8	7.6	2.4	45.8	5.60	8.98	74.1	10.7	2.95	1.12	19.5	4.070	23.4	7.76	0.908	9.170	0.000101	1.23	8.53



EQUAL ANGLES
To BS4848: Part 4

DIMENSIONS AND PROPERTIES



Designation		Mass Per Metre kg	Radius		Area Of Section cm ²	Distance Of Centre Of Gravity cx and cy cm	Second Moment Of Area			Radius Of Gyration			Elastic Modulus Axis x-x, y-y cm ³
Size A A mm	Thickness t mm		Root r1 mm	Toe r2 mm			Axis x-x, y-y cm ⁴	Axis u-u cm ⁴	Axis v-v cm ⁴	Axis x-x, y-y cm	Axis u-u cm	Axis v-v cm	
250x250	35	128	20.0	4.8	163	7.49	9250	14600	3860	7.53	9.47	4.86	529
	32	118	20.0	4.8	150	7.38	8600	13600	3560	7.57	9.53	4.87	488
	28	104	20.0	4.8	133	7.23	7690	12200	3170	7.61	9.59	4.89	433
	25	93.6	20.0	4.8	119	7.12	6970	11100	2860	7.65	9.64	4.9	390
200x200	24	71.1	18.0	4.8	90.6	5.84	3330	5280	1380	6.06	7.64	3.9	235
	20	59.9	18.0	4.8	76.3	5.68	2850	4530	1170	6.11	7.7	3.92	199
	18	54.2	18.0	4.8	69.1	5.6	2600	4130	1070	6.13	7.73	3.93	181
	16	48.5	18.0	4.8	61.8	5.52	2340	3720	960	6.16	7.76	3.94	162
150x150	18	40.1	16.0	4.8	51.0	4.37	1050	1660	435	4.54	5.71	2.92	98.7
	15	33.8	16.0	4.8	43.0	4.25	898	1430	370	4.57	5.76	2.93	83.5
	12	27.3	16.0	4.8	34.8	4.12	737	1170	303	4.6	5.8	2.95	67.7
	10	23.0	16.0	4.8	29.3	4.03	624	991	258	4.62	5.82	2.97	56.9
120x120	15	26.6	13.0	4.8	33.9	3.51	445	705	185	3.62	4.56	2.33	52.4
	12	21.6	13.0	4.8	27.5	3.4	368	584	152	3.65	4.6	2.35	42.7
	10	18.2	13.0	4.8	23.2	3.31	313	497	129	3.67	4.63	2.36	36.0
	8	14.7	13.0	4.8	18.7	3.23	255	405	105	3.69	4.65	2.37	29.1
100x100	15	21.9	12.0	4.8	27.9	3.02	249	393	104	2.98	3.75	1.93	35.6
	12	17.8	12.0	4.8	22.7	2.9	207	328	85.7	3.02	3.8	1.94	29.1
	8	12.2	12.0	4.8	15.5	2.74	145	230	59.9	3.06	3.85	1.96	19.9
90x90	12	15.9	11.0	4.8	20.3	2.66	148	234	61.7	2.7	3.4	1.74	23.3
	10	13.4	11.0	4.8	17.1	2.58	127	201	52.6	2.72	3.43	1.75	19.8
	8	10.9	11.0	4.8	13.9	2.5	104	166	43.1	2.74	3.45	1.76	16.1
	7	9.61	11.0	4.8	12.2	2.45	92.5	147	38.3	2.75	3.46	1.77	14.1
	6	8.3	11.0	4.8	10.6	2.41	80.3	127	33.3	2.76	3.47	1.78	12.2
	5	7.1	11.0	4.8	9.2	2.37	70.1	112	29.5	2.77	3.48	1.79	10.6
80x80	10	11.9	10.0	4.8	15.1	2.34	87.5	139	36.4	2.41	3.03	1.55	15.4
	8	9.63	10.0	4.8	12.3	2.26	72.2	115	29.9	2.43	3.06	1.56	12.6
	6	7.34	10.0	4.8	9.35	2.17	55.8	88.5	23.1	2.44	3.08	1.57	9.57
70x70	10	10.3	9.0	2.4	13.1	2.09	57.2	90.5	24.0	2.09	2.63	1.35	11.7
	8	8.36	9.0	2.4	10.6	2.01	47.5	75.3	19.7	2.11	2.66	1.36	9.52
	6	6.38	9.0	2.4	8.13	1.93	36.9	58.5	15.3	2.13	2.68	1.37	7.27
60x60	10	8.69	8.0	2.4	11.1	1.85	34.9	55.1	14.8	1.78	2.23	1.16	8.41
	8	7.09	8.0	2.4	9.03	1.77	29.2	46.1	12.2	1.8	2.26	1.16	6.89
	6	5.42	8.0	2.4	6.91	1.69	22.8	36.1	9.44	1.82	2.29	1.17	5.29
	5	4.57	8.0	2.4	5.82	1.64	19.4	30.7	8.03	1.82	2.3	1.17	4.45
50x50	8	5.82	7.0	2.4	7.41	1.52	16.3	25.7	6.87	1.48	1.86	0.963	4.68
	6	4.47	7.0	2.4	5.69	1.45	12.8	20.3	5.34	1.5	1.89	0.968	3.61
	5	3.77	7.0	2.4	4.8	1.4	11.0	17.4	4.55	1.51	1.9	0.973	3.05
	4	3.06	7.0	2.4	3.89	1.36	8.97	14.2	3.73	1.52	1.91	0.979	2.46
	3	2.33	7.0	2.4	2.96	1.31	6.86	10.8	2.88	1.52	1.91	0.986	1.86
45x45	6	4.0	7.0	2.4	5.09	1.32	9.16	14.5	3.83	1.34	1.69	0.867	2.88
	5	3.38	7.0	2.4	4.3	1.28	7.84	12.4	3.26	1.35	1.7	0.871	2.43
	4	2.74	7.0	2.4	3.49	1.23	6.43	10.2	2.68	1.36	1.71	0.876	1.97
	3	2.09	7.0	2.4	2.66	1.18	4.93	7.78	2.07	1.36	1.71	0.882	1.49
40x40	6	3.52	6.0	2.4	4.48	1.2	6.31	9.98	2.65	1.19	1.49	0.77	2.26
	5	2.97	6.0	2.4	3.79	1.16	5.43	8.59	2.26	1.2	1.51	0.773	1.91
	4	2.42	6.0	2.4	3.08	1.12	4.47	7.09	1.86	1.21	1.52	0.777	1.55
30x30	5	2.18	5.0	2.4	2.78	0.918	2.16	3.41	0.917	0.883	1.11	0.575	1.04
	4	1.78	5.0	2.4	2.27	0.878	1.8	2.85	0.754	0.892	1.12	0.577	0.85
	3	1.36	5.0	2.4	1.74	0.835	1.4	2.22	0.585	0.899	1.13	0.581	0.649
25x25	5	1.77	3.5	2.4	2.26	0.799	1.21	1.9	0.524	0.731	0.915	0.481	0.711
	4	1.45	3.5	2.4	1.85	0.762	1.02	1.61	0.43	0.741	0.931	0.482	0.586
	3	1.11	3.5	2.4	1.42	0.723	0.803	1.27	0.334	0.751	0.945	0.484	0.452

Note: 100 x 100 x 10mm angle is also frequently rolled; as an ISO size its properties are given in Appendix A (Table A1) to BS4848: Part 4. Other non-standard sections, particularly other thicknesses of the standard range, may also be available. Enquiries should be made to BSC General Steels Group BSC Sections.

T SECTIONS

Ts cut from Universal Beams and Columns listed in this publication are available in all sizes. Enquiries should be made to BSC General Steels Group BSC Sections. Properties are listed in Volume 1 of the Steelwork Design Guide to BS5950: Part 1, publication produced by the Steel Construction Institute.

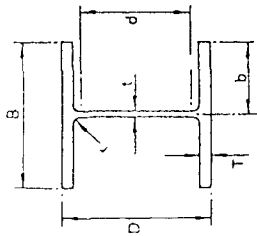
BULB FLATS

These are now produced in metric sizes and are listed in BS4848: Part 5. Enquiries should be made to BSC General Steels Group BSC Sections.

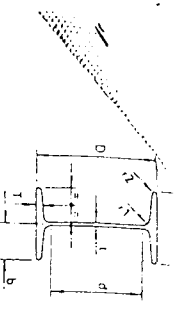
UNIVERSAL COLUMNS
To BS4: Part 1

PROPERTIES

DIMENSIONS



Designation Serial Size	Mass Per Metre kg	Depth Of Section D mm	Width Of Section B mm	Thickness		Root Radius r mm	Depth Between Fillet d mm	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter u	Torsional Index x	Warping Constant H dm ⁶	Torsional Constant J cm ⁴	Area of Section A cm ²
				Web t mm	Flange T mm			Flange b/t	Web d/t	Axis x-x cm ⁴	Axis y-y cm ⁴	Axis x-x cm	Axis y-y cm	Axis x-x cm ³	Axis y-y cm ³	Axis x-x cm ³	Axis y-y cm ³					
356x406	634	474.7	424.1	47.6	77.0	15.2	290.2	2.75	6.10	275000	98200	18.5	11.0	11600	4630	14200	7110	0.843	5.46	38.8	13700	808
	551	455.7	418.5	42.0	67.5	15.2	290.2	3.10	6.91	227000	82700	18.0	10.9	9960	3950	12100	6060	0.841	6.05	31.1	9240	702
	467	436.6	412.4	35.9	58.0	15.2	290.2	3.56	8.08	183000	67900	17.5	10.7	8390	3290	10000	5040	0.839	6.86	24.3	5820	595
	393	419.1	407.0	30.6	49.2	15.2	290.2	4.14	9.48	147000	55400	17.1	10.5	7000	2720	8230	4160	0.837	7.86	19.0	3550	501
	340	406.4	403.0	26.5	42.9	15.2	290.2	4.70	11.0	122000	46800	16.8	10.4	6030	2320	6990	3540	0.836	8.85	15.5	2340	433
	287	393.7	399.0	22.6	36.5	15.2	290.2	5.47	12.8	100000	38700	16.5	10.3	5080	1940	5820	2950	0.835	10.2	12.3	1440	366
	235	381.0	395.0	18.5	30.2	15.2	290.2	6.54	15.7	79100	31000	16.2	10.2	4150	1570	4690	2380	0.834	12.1	9.54	812	300
COLCORE	477	427.0	424.4	48.0	53.2	15.2	290.2	3.99	6.05	172000	68100	16.8	10.6	8080	3210	9700	4980	0.815	6.91	23.8	5700	607
356x368	202	374.7	374.4	16.8	27.0	15.2	290.2	6.93	17.3	66300	23600	16.0	9.57	3540	1260	3980	1920	0.844	13.3	7.14	560	258
	177	368.3	372.1	14.5	23.8	15.2	290.2	7.82	20.0	57200	20500	15.9	9.52	3100	1100	3460	1670	0.844	15.0	6.07	383	226
	153	362.0	370.2	12.6	20.7	15.2	290.2	8.94	23.0	48500	17500	15.8	9.46	2680	944	2960	1430	0.844	17.0	5.09	251	195
	129	355.6	368.3	10.7	17.5	15.2	290.2	10.5	27.1	40200	14600	15.6	9.39	2260	790	2480	1207	0.843	19.9	4.16	153	165
305x305	283	355.3	321.8	26.9	44.1	15.2	246.6	3.65	9.17	78800	24500	14.8	8.25	4310	1530	5100	2340	0.855	7.65	6.33	2030	360
	240	352.6	317.9	23.0	37.7	15.2	246.6	4.22	10.7	64200	20200	14.5	8.14	3640	1270	4250	1950	0.854	8.73	5.91	1270	306
	198	339.9	314.1	19.2	31.4	15.2	246.6	5.00	12.8	50800	16200	14.2	8.02	2990	1030	3440	1580	0.854	10.2	3.86	734	252
	158	327.2	310.6	15.7	25.0	15.2	246.6	6.21	15.7	38700	12500	13.9	7.89	2370	806	2680	1230	0.852	12.5	2.86	379	201
	137	320.5	308.7	13.8	21.7	15.2	246.6	7.11	17.9	32800	10700	13.7	7.82	2050	691	2300	1050	0.851	14.1	2.38	250	175
	118	314.5	306.3	11.9	18.7	15.2	246.6	8.20	20.7	27600	9010	13.6	7.75	1760	587	1950	892	0.851	16.2	1.97	160	150
	97	307.8	304.8	9.9	15.4	15.2	246.6	9.90	24.9	22200	7270	13.4	7.68	1440	477	1590	723	0.85	19.3	1.55	91.1	123
254x254	167	289.1	264.5	19.2	31.7	12.7	200.3	4.17	10.4	29900	9800	11.9	6.79	2070	741	2420	1130	0.852	8.49	1.62	625	212
	132	276.4	261.0	15.6	25.3	12.7	200.3	5.16	12.8	22600	7520	11.6	6.67	1630	576	1870	879	0.85	10.3	1.18	322	169
	107	266.7	258.3	13.0	20.5	12.7	200.3	6.30	15.4	17500	5900	11.3	6.57	1310	457	1490	695	0.848	12.4	0.894	173	137
	89	260.4	255.9	10.5	17.3	12.7	200.3	7.40	19.1	14300	4850	11.2	6.52	1100	379	1230	575	0.849	14.4	0.716	104	114
	73	254.0	254.0	8.6	14.2	12.7	200.3	8.94	23.3	11400	3870	11.1	6.46	894	305	989	462	0.849	17.3	0.557	57.3	92.9
203x203	86	222.3	208.8	13.0	20.5	10.2	160.9	5.09	12.4	9460	3120	9.27	5.32	651	293	979	456	0.85	10.2	0.317	138	110
	71	215.9	206.2	10.3	17.3	10.2	160.9	5.96	15.6	7650	2540	9.16	5.28	708	246	802	374	0.852	11.9	0.25	81.5	91.1
	60	209.6	205.2	9.3	14.2	10.2	160.9	7.23	17.3	6090	2040	8.96	5.19	581	199	652	303	0.847	14.1	0.195	46.6	75.8
	52	206.2	203.9	8.0	12.5	10.2	160.9	8.16	20.1	5260	1770	8.90	5.16	510	174	588	264	0.848	15.8	0.166	32.0	66.4
	46	203.2	203.2	7.3	11.0	10.2	160.9	9.24	22.0	4560	1540	8.81	5.11	449	151	497	230	0.846	17.7	0.142	22.2	58.8
152x152	37	161.8	154.4	8.1	11.5	7.6	123.5	6.71	15.2	2220	709	6.84	3.87	274	91.8	310	140	0.848	13.3	0.04	19.5	47.4
	30	157.5	152.9	6.6	9.4	7.6	123.5	8.13	18.7	1740	558	6.75	3.82	221	73.1	247	111	0.848	16.0	0.0306	10.5	38.2
	23	152.4	152.4	6.1	6.8	7.6	123.5	11.2	20.2	1260	403	6.51	3.68	166	52.9	184	80.9	0.837	20.4	0.0214	4.87	29.8



DIMENSIONS

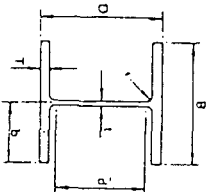
JOISTS
To BS4: Part 1

PROPERTIES

[REG 364]

Designation	Serial Size	Mass Per Metre	Depth Of Section D	Width Of Section B	Thickness		Root Radius r1	Toe Radius r2	Depth Between Fillets d	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter U	Torsional Index X	Warping Constant H	Torsional Constant J	Area of Section A
					Web t	Flange T				Flange b/T	Web d/t	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y					
254x203	81.85	254.0	203.2	10.2	19.9	19.6	9.7	166.7	5.11	16.3	12000	2280	10.7	4.67	946	224	1080	370	0.89	11.0	0.312	153	104	
254x114	37.20	254.0	114.3	7.6	12.8	12.4	6.1	199.2	4.46	26.2	5090	270	10.4	2.39	401	47.2	460	79.3	0.885	18.6	0.0393	25.5	47.4	
203x152	52.09	203.2	152.4	8.9	16.5	15.5	7.6	133.3	4.62	15.0	4790	813	8.49	3.50	471	107	540	176	0.891	10.7	0.0709	64.9	66.4	
152x127	37.20	152.4	127.0	10.4	13.2	13.5	6.6	94.4	4.81	9.08	1820	379	6.19	2.82	239	59.6	279	99.8	0.866	9.29	0.0183	34.2	47.5	
127x114	29.76	127.0	114.3	10.2	11.5	9.9	4.8	79.4	4.97	7.78	979	242	5.12	2.55	154	42.3	181	70.8	0.853	8.74	0.00807	20.9	37.3	
114x114	26.79	114.3	114.3	7.4	11.4	9.9	5.0	79.5	5.01	10.7	945	235	5.26	2.63	149	41.2	172	68.1	0.859	9.30	0.00787	16.9	34.1	
102x102	23.07	101.6	101.6	9.5	10.7	14.2	3.2	60.9	5.34	6.41	735	223	4.62	2.55	129	39.1	151	65.6	0.841	7.90	0.00599	19.0	34.4	
102x44	7.44*	101.6	44.5	4.3	6.1	6.9	3.2	55.2	4.93	5.81	486	154	4.07	2.29	95.7	30.4	113	50.7	0.836	7.39	0.00321	14.4	29.4	
89x89	19.35	88.9	88.9	9.5	9.9	11.1	3.3	74.7	3.65	17.4	153	77.4	4.01	0.904	30.0	3.48	35.3	5.99	0.871	14.9	0.00177	1.25	9.48	
76x76	14.67*	76.2	80.0	8.9	8.4	9.4	4.6	44.2	4.49	4.85	307	101	3.51	2.02	69.0	22.8	82.8	38.0	0.83	6.54	0.00158	11.6	24.9	
	12.65	76.2	76.2	5.1	8.4	9.4	4.6	38.1	4.76	4.28	158	52.0	3.12	1.79	45.1	15.2	54.2	25.7	0.852	7.16	0.000699	6.83	19.1	
							4.6	38.0	4.54	7.45					41.6	13.7	48.8	22.5	0.852		0.000597	4.67	16.3	

*These sections are only rolled to specific order



DIMENSIONS

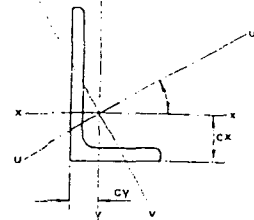
UNIVERSAL BEARING PILES
To BS4: Part 1

PROPERTIES

104

Designation	Serial Size	Mass Per Metre	Depth Of Section D	Width Of Section B	Thickness		Root Radius r1	Depth Between Fillets d	Ratios For Local Buckling		Second Moment Of Area		Radius Of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter U	Torsional Index X	Warping Constant H	Torsional Constant J	Area of Section A
					Web t	Flange T			Flange b/T	Web d/t	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y	Axis x-x	Axis y-y					
356x368	174	361.5	378.1	20.4	20.4	15.2	290.2	10.27	14.2	51100	18400	15.2	9.11	2830	976	3190	1500	0.821	15.7	5.36	334	222	
	152	356.4	375.5	17.9	17.9	15.2	290.2	9.25	16.2	43900	15900	15.1	9.03	2460	841	2760	1290	0.821	17.8	4.53	224	194	
	133	351.9	373.3	15.6	15.6	15.2	290.2	12.0	18.6	37800	13600	15.0	8.96	2150	727	2400	1110	0.822	20.2	3.84	151	169	
	109	346.4	370.5	12.9	12.9	15.2	290.2	14.4	22.5	30500	10900	14.8	8.87	1760	588	1950	897	0.823	24.2	3.03	84.3	138	
305x305	223	338.0	325.4	30.5	30.5	15.2	246.6	5.33	8.09	52800	17500	13.6	7.85	3130	1080	3660	1680	0.826	9.51	4.15	953	285	
	186	328.3	320.5	25.6	25.6	15.2	246.6	6.26	9.63	42600	14100	13.4	7.71	2600	880	3010	1370	0.827	11.1	3.23	564	237	
	149	318.5	315.6	20.7	20.7	15.2	246.6	7.62	11.9	33000	10900	13.2	7.56	2080	689	2370	1060	0.828	13.5	2.41	297	190	
	126	312.6	312.7	17.8	17.8	15.2	246.6	8.78	13.9	27700	9070	13.1	7.47	1770	580	2010	893	0.829	15.5	1.97	188	162	
	110	307.9	310.3	15.4	15.4	15.2	246.6	10.1	16.0	23600	7690	13.0	7.40	1530	496	1720	761	0.83	17.7	1.64	123	121	
	95	303.8	308.3	13.4	13.4	15.2	246.6	11.5	18.4	20100	6330	12.9	7.33	1320	388	1480	649	0.831	20.1	1.38	81.0	81.0	
	88	301.7	307.2	12.3	12.3	15.2	246.6	12.5	20.0	18400	5960	12.8	7.30	1120	368	1360	594	0.831	23.8	1.25	63.9	63.9	
	79	299.2	306.0	11.1	11.1	15.2	246.6	13.8	22.2	16400	5290	12.8	7.26	1100	346	1220	529	0.832	23.8	1.10	47.0	112	
254x254	85	254.3	259.7	14.3	14.3	12.7	200.3	9.08	14.0	12300	4190	10.7	6.22	965	323	1090	496	0.826	15.6	0.603	81.6	108	
	71	249.9	257.5	12.1	12.1	12.7	200.3	10.6	16.6	10200	3450	10.6	6.15	813	288	911	411	0.827	18.2	0.488	49.7	91.1	
	63	246.9	256.0	10.6	10.6	12.7	200.3	12.1	18.9	8780	2970	10.5	6.11	711	232	793	355	0.827	20.5	0.415	33.8	79.7	
203x203	54	203.9	207.2	11.3	11.3	10.2	160.9	9.17	14.2	4990	1680	8.54	4.96	489	162	553	250	0.827	15.9	0.156	32.3	32.3	
	45	200.2	205.4	9.5	9.5	10.2	160.9	10.8	16.9	4080	1370	8.46	4.90	408	133	457	204	0.828	18.7	0.124	19.0	57.0	

**UNEQUAL ANGLES
To BS4848: Part 4**

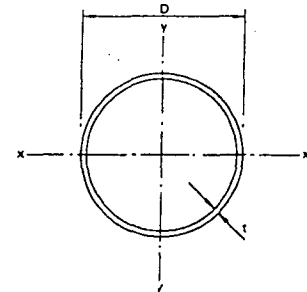


DIMENSIONS AND PROPERTIES

Designation Size A B mm	Thickness t mm	Mass Per Metre kg	Radius		Area Of Section cm ²	Distance Centre Of Gravity		Second Moment Of Area				Radius Of Gyration				Elastic Modulus		Angle x-x Axis to u-u Axis Tan
			Root r1 mm	Toe r2 mm		cx cm	cy cm	Axis x-x cm ⁴	Axis y-y cm ⁴	Axis u-u cm ⁴	Axis v-v cm ⁴	Axis x-x cm	Axis y-y cm	Axis u-u cm	Axis v-v cm	Axis x-x cm ³	Axis y-y cm ³	
200x150	18	47.1	15.0	4.8	60.0	6.33	3.85	2380	1150	2900	618	6.29	4.37	6.96	3.21	174	103	0.548
	15	39.6	15.0	4.8	50.5	6.21	3.73	2020	979	2480	526	6.33	4.4	7.0	3.23	147	86.9	0.551
	12	32.0	15.0	4.8	40.8	6.08	3.61	1650	803	2030	430	6.36	4.44	7.04	3.25	119	70.5	0.552
200x100	15	33.7	15.0	4.8	43.0	7.16	2.22	1760	299	1860	194	6.4	2.64	6.58	2.12	137	38.4	0.26
	12	27.3	15.0	4.8	34.8	7.03	2.1	1440	247	1530	159	6.43	2.67	6.63	2.14	111	31.3	0.262
	10	23.0	15.0	4.8	29.2	6.93	2.01	1220	210	1290	135	6.46	2.68	6.65	2.15	93.2	26.3	0.263
150x90	15	26.6	12.0	4.8	33.9	5.21	2.23	761	205	841	126	4.74	2.46	4.98	1.93	77.7	30.4	0.354
	12	21.6	12.0	4.8	27.5	5.08	2.12	627	171	694	104	4.77	2.49	5.02	1.94	63.3	24.8	0.358
	10	18.2	12.0	4.8	23.2	5.0	2.04	533	146	591	88.3	4.8	2.51	5.05	1.95	53.3	21.0	0.36
150x75	15	24.8	11.0	4.8	31.6	5.53	1.81	713	120	754	78.8	4.75	1.94	4.88	1.58	75.3	21.0	0.254
	12	20.2	11.0	4.8	25.7	5.41	1.69	589	99.9	624	64.9	4.79	1.97	4.93	1.59	61.4	17.2	0.259
	10	17.0	11.0	4.8	21.6	5.32	1.61	501	85.8	532	55.3	4.81	1.99	4.96	1.6	51.8	14.6	0.261
125x75	12	17.8	11.0	4.8	22.7	4.31	1.84	354	95.5	391	58.5	3.95	2.05	4.15	1.61	43.2	16.9	0.354
	10	15.0	11.0	4.8	19.1	4.23	1.76	302	82.1	334	49.9	3.97	2.07	4.18	1.61	36.5	14.3	0.357
	8	12.2	11.0	4.8	15.5	4.14	1.68	247	67.6	274	40.9	4.0	2.09	4.21	1.63	29.6	11.6	0.36
100x75	12	15.4	10.0	4.8	19.7	3.27	2.03	189	90.2	230	49.5	3.1	2.14	3.42	1.59	28.0	16.5	0.54
	10	13.0	10.0	4.8	16.6	3.19	1.95	162	77.6	197	42.2	3.12	2.16	3.45	1.59	23.8	14.0	0.544
	8	10.6	10.0	4.8	13.5	3.1	1.87	133	64.1	162	34.6	3.14	2.18	3.47	1.6	19.3	11.4	0.547
100x65	10	12.3	10.0	4.8	15.6	3.36	1.63	154	51.0	175	30.1	3.14	1.81	3.35	1.39	23.2	10.5	0.41
	8	9.94	10.0	4.8	12.7	3.27	1.55	127	42.2	144	24.8	3.16	1.83	3.37	1.4	18.9	8.54	0.413
	7	8.77	10.0	4.8	11.2	3.23	1.51	113	37.6	128	22.0	3.17	1.83	3.39	1.4	16.6	7.53	0.415
80x60	8	8.34	8.0	4.8	10.6	2.55	1.56	66.3	31.8	80.8	17.3	2.5	1.73	2.76	1.27	12.2	7.16	0.544
	7	7.36	8.0	4.8	9.38	2.51	1.52	59.0	28.4	72.0	15.4	2.51	1.74	2.77	1.28	10.7	6.34	0.546
	6	6.37	8.0	4.8	8.11	2.47	1.48	51.4	24.8	62.8	13.4	2.52	1.75	2.78	1.29	9.2	5.49	0.547
75x50	8	7.39	7.0	2.4	9.41	2.52	1.29	52.0	18.4	59.6	10.8	2.35	1.4	2.52	1.07	10.4	4.95	0.43
	6	5.65	7.0	2.4	7.19	2.44	1.21	40.5	14.4	46.6	8.36	2.37	1.42	2.55	1.08	8.0	3.81	0.435
55x50	8	6.75	6.0	2.4	8.6	2.11	1.37	34.8	17.7	43.0	9.57	2.01	1.44	2.23	1.05	7.9	4.89	0.569
	6	5.16	6.0	2.4	6.58	2.04	1.29	27.2	14.0	33.8	7.43	2.03	1.46	2.27	1.06	6.1	3.77	0.575
	5	4.35	6.0	2.4	5.54	1.99	1.25	23.2	11.9	28.8	6.32	2.05	1.47	2.28	1.07	5.1	3.19	0.577
50x30	6	3.99	6.0	2.4	5.08	2.2	0.72	18.2	3.0	19.2	1.99	1.89	0.771	1.95	0.626	4.7	1.32	0.252
	5	3.37	6.0	2.4	4.29	2.15	0.68	15.6	2.6	16.5	1.7	1.9	0.779	1.96	0.629	4.0	1.12	0.256
40x25	4	1.93	4.0	2.4	2.46	1.36	0.62	3.8	1.1	4.3	0.70	1.26	0.688	1.33	0.534	1.4	0.61	0.38

Note: Additional non-standard sizes may be available, especially other thicknesses of the standard range and certain sizes in the old imperial range, namely 125 x 75 x 6.5 and 137 x 102 x 9.5, 7.9 and 6.4 (purlin angles) and 100 x 75 x 6.5. Enquiries should be made to BSC General Steels Group BSC Sections.

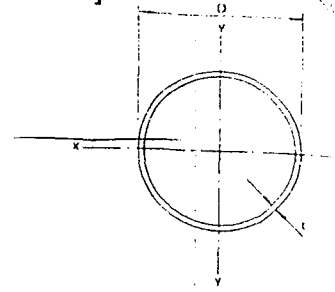
**CIRCULAR HOLLOW SECTIONS
To BS4848: Part 2
unless marked +**



DIMENSIONS AND PROPERTIES

Designation Outside Diameter D mm	Thickness t mm	Mass Per Metre kg	Area Of Section A cm ²	Second Moment Of Area I cm ⁴	Radius Of Gyration r cm	Elastic Modulus Z cm ³	Plastic Modulus S cm ³	Torsional Constants	
								J cm ⁴	C cm ³
21.3	3.2	1.43	1.82	0.768	0.65	0.722	1.06	1.54	1.44
26.9	3.2	1.87	2.38	1.70	0.846	1.27	1.81	3.41	2.53
31.7	2.6	1.99	2.54	3.09	1.10	1.84	2.52	6.19	3.67
	3.2	2.41	3.07	3.60	1.08	2.14	2.99	7.21	4.28
	4.0	2.93	3.73	4.19	1.06	2.49	3.55	8.38	4.97
42.4	2.6	2.55	3.25	6.46	1.41	3.05	4.12	12.9	6.10
	3.2	3.09	3.94	7.52	1.39	3.59	4.93	15.2	7.19
	4.0	3.78	4.83	8.99	1.36	4.24	5.92	18.0	8.48
48.3	3.2	3.56	4.53	11.6	1.60	4.80	6.52	23.2	9.59
	4.0	4.37	5.57	13.8	1.57	5.70	7.87	27.5	11.4
	5.0	5.34	6.80	16.2	1.54	6.69	9.42	32.3	13.4
60.3	3.2	4.51	5.74	23.5	2.02	7.78	10.4	46.9	15.6
	4.0	5.55	7.07	28.2	2.00	9.34	12.7	56.3	18.7
	5.0	6.82	8.69	33.5	1.96	11.1	15.3	67.0	22.2
76.1	3.2	5.75	7.33	48.6	2.58	12.8	17.0	97.6	25.6
	4.0	7.11	9.06	59.1	2.55	15.5	20.8	118	31.0
	5.0	8.77	11.2	70.9	2.52	18.6	25.3	142	37.3

CIRCULAR HOLLOW SECTIONS
To BS4848: Part 2
unless marked +

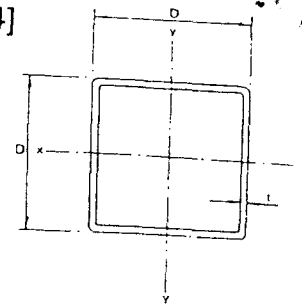


DIMENSIONS AND PROPERTIES

Designation		Mass Per Metre	Area Of Section	Second Moment Of Area	Radius Of Gyration	Elastic Modulus	Plastic Modulus	Torsional Constants	
Outside Diameter	Thickness							J	C
D	t	kg	A	I	r	Z	S	cm ⁴	cm ³
mm	mm		cm ²	cm ⁴	cm	cm ³	cm ³		
88.9	3.2	6.76	8.62	79.2	3.03	17.8	23.5	158	35.6
	4.0	8.38	10.7	96.3	3.00	21.7	28.9	193	43.3
	5.0	10.3	13.2	116	2.97	26.2	35.2	233	52.4
114.3	3.6	9.83	12.5	192	3.92	33.6	44.1	384	67.2
	5.0	13.5	17.2	257	3.87	45.0	59.8	514	89.9
	6.3	16.8	21.4	313	3.82	54.7	73.6	625	109
139.7	5.0	16.6	21.2	481	4.77	68.8	90.8	961	138
	6.3	20.7	26.4	589	4.72	84.3	112	1180	169
	8.0	26.0	33.1	720	4.66	103	139	1440	206
	10.0	32.0	40.7	862	4.60	123	169	1720	247
168.3	5.0	20.1	25.7	856	5.78	102	133	1710	203
	6.3	25.2	32.1	1050	5.73	125	165	2110	250
	8.0	31.6	40.3	1300	5.67	154	206	2590	308
	10.0	39.0	49.7	1550	5.61	186	251	3130	372
193.7	5.0 +	23.3	29.6	1320	6.67	136	178	2640	273
	6.3	29.1	37.1	1630	6.63	168	221	3280	337
	8.0	36.6	46.7	2020	6.57	208	276	4030	416
	10.0	45.3	57.7	2440	6.50	252	338	4880	504
	12.5	55.9	71.2	2930	6.42	303	411	5870	606
	16.0	70.1	89.3	3550	6.31	367	507	7110	734
219.1	5.0 +	26.4	33.6	1930	7.57	176	229	3860	352
	6.3	33.1	42.1	2390	7.53	218	285	4770	436
	8.0	41.6	53.1	2960	7.47	270	357	5920	540
	10.0	51.6	65.7	3600	7.40	328	438	7200	657
	12.5	63.7	81.1	4340	7.32	397	534	8690	793
	16.0	80.1	102	5300	7.20	483	661	10600	967
244.5	6.3	37.0	47.1	3350	8.42	274	358	6690	547
	8.0	46.7	59.4	4160	8.37	340	448	8320	681
	10.0	57.8	73.7	5070	8.30	415	550	10100	830
	12.5	71.5	91.1	6150	8.21	503	673	12300	1010
	16.0	90.2	115	7530	8.10	616	837	15100	1230
	20.0	111	141	8960	7.97	733	1010	17900	1470
273.0	6.3	41.4	52.8	4700	9.43	344	448	9390	588
	8.0	52.3	66.6	5850	9.37	429	562	11700	857
	10.0	64.9	82.6	7150	9.31	524	692	14300	1050
	12.5	80.3	102	8700	9.22	637	849	17400	1270
	16.0	101	129	10700	9.10	784	1060	21400	1570
	20.0	125	159	12800	8.97	938	1280	25600	1890
323.9	6.3 +	49.3	62.9	7930	11.2	490	636	15900	979
	8.0	62.3	79.4	9910	11.2	612	799	19800	1220
	10.0	77.4	98.6	12200	11.1	751	986	24300	1500
	12.5	96.0	122	14800	11.0	917	1210	29700	1830
	16.0	121	155	18400	10.9	1140	1520	36800	2270
	20.0	150	191	22100	10.8	1370	1850	44300	2730
355.8	25.0	184	235	26400	10.6	1630	2240	52800	3260
	8.0	68.6	87.4	13200	12.3	742	967	26400	1820
	10.0	85.2	109	16200	12.2	912	1190	32400	2230
	12.5	106	135	19900	12.1	1120	1470	39700	2770
	16.0	134	171	24700	12.0	1390	1850	49300	3350
	20.0	166	211	29800	11.9	1680	2260	59600	4010
406.4	25.0	204	260	35700	11.7	2010	2740	71400	4010
	10.0	97.8	125	24500	14.0	1200	1570	49000	2410
	12.5	121	155	30000	13.9	1480	1940	60100	2960
	16.0	154	196	37400	13.8	1840	2440	74900	3690
	20.0	191	243	45400	13.7	2240	2990	90900	4470
	25.0	235	300	54700	13.5	2690	3640	109000	5380
457.0	32.0	295	376	66400	13.3	3270	4500	133000	6540
	10.0	110	140	35100	15.8	1540	2000	70200	3070
	12.5	137	175	43100	15.7	1890	2470	86300	3780
	16.0	174	222	54000	15.6	2360	3110	108000	4720
	20.0	216	275	65700	15.5	2870	3820	131000	5750
	25.0	266	339	79400	15.3	3480	4670	159000	6950
508.0	32.0	335	427	97000	15.1	4250	5790	194000	8490
	40.0	411	524	115000	14.8	5030	6980	230000	10100
	10.0 +	123	156	48500	17.6	1910	2480	97000	3820
	12.5 +	153	195	59800	17.5	2350	3070	120000	4710
16.0 +	194	247	74900	17.4	2950	3870	150000	5900	

106

SQUARE HOLLOW SECTIONS
To BS4848: Part 2
unless marked +



DIMENSIONS AND PROPERTIES

Designation		Mass Per Metre	Area Of Section	Second Moment Of Area	Radius Of Gyration	Elastic Modulus	Plastic Modulus	Torsional Constants	
Size	Thickness							J	C
D	D	kg	A	I	r	Z	S	J	C
mm	mm		cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³
20x20	2.0	1.12	1.42	0.759	0.731	0.759	0.951	1.22	1.07
	2.5+	1.35	1.72	0.865	0.709	0.865	1.12	1.41	1.21
25x25	2.0+	1.43	1.82	1.59	0.935	1.27	1.56	2.52	1.81
	2.5+	1.74	2.22	1.85	0.914	1.48	1.86	2.97	2.09
	3.0+	2.04	2.60	2.06	0.892	1.65	2.12	3.36	2.31
	3.2+	2.15	2.74	2.14	0.883	1.71	2.21	3.49	2.38
30x30	2.5+	2.14	2.72	3.40	1.12	2.27	2.79	5.40	3.22
	3.0+	2.51	3.20	3.84	1.10	2.56	3.21	6.17	3.61
	3.2	2.65	3.38	4.00	1.09	2.67	3.37	6.45	3.75
40x40	2.5+	2.92	3.72	8.67	1.53	4.33	5.21	13.6	6.23
	3.0+	3.45	4.40	9.96	1.51	4.98	6.07	15.7	7.11
	3.2	3.66	4.66	10.4	1.50	5.22	6.40	16.5	7.43
	4.0	4.46	5.68	12.1	1.48	6.07	7.61	19.5	8.56
	5.0+	5.40	6.88	13.8	1.42	6.92	8.92	22.6	9.65
50x50	2.5+	3.71	4.72	17.7	1.94	7.07	8.38	27.4	10.2
	3.0+	4.39	5.60	20.5	1.91	8.20	9.83	32.0	11.8
	3.2	4.66	5.94	21.6	1.91	8.62	10.4	33.8	12.4
	4.0	5.72	7.28	25.5	1.87	10.2	12.5	40.4	14.5
	5.0	6.97	8.88	29.6	1.83	11.9	14.9	47.6	16.7
	6.3+	8.49	10.8	33.9	1.77	13.6	17.5	55.3	18.9
60x60	3.0+	5.34	6.80	36.6	2.32	12.2	14.5	56.9	17.7
	3.2	5.67	7.22	38.7	2.31	12.9	15.3	60.1	18.6
	4.0	6.97	8.88	46.1	2.28	15.4	18.6	72.4	22.1
	5.0	8.54	10.9	54.4	2.24	18.1	22.3	86.3	25.8
	6.3+	10.5	13.3	63.4	2.18	21.1	26.6	102	29.7
	8.0+	12.8	16.3	72.4	2.11	24.1	31.4	119	33.5
	70x70	3.0+	6.28	8.00	59.6	2.73	17.0	20.0	52.1
3.6		7.46	9.50	69.5	2.70	19.9	23.6	108	28.7
5.0		10.1	12.9	90.1	2.64	25.7	31.2	142	36.8
6.3+		12.5	15.9	106	2.59	30.4	37.6	169	43.0
8.0+		15.3	19.5	123	2.51	35.3	45.0	200	49.4
80x80	3.0+	7.22	9.20	90.6	3.14	22.7	26.5	139	33.1
	3.6	8.59	10.9	106	3.11	26.5	31.3	164	38.5
	5.0	11.7	14.9	139	3.05	34.7	41.7	217	49.8
	6.3	14.4	18.4	165	3.00	41.3	50.5	261	58.8
	8.0+	17.8	22.7	194	2.92	48.6	60.9	312	68.5
90x90	3.6	9.72	12.4	154	3.52	34.1	40.0	237	49.7
	5.0	13.3	16.9	202	3.46	45.0	53.6	315	64.9
	6.3	16.4	20.9	242	3.41	53.9	65.3	381	77.1
	8.0+	20.4	25.9	288	3.33	64.0	79.2	459	90.7
100x100	4.0	12.0	15.3	234	3.91	46.8	54.9	361	68.2
	5.0	14.8	18.9	283	3.87	56.6	67.1	429	81.9
	6.3	18.4	23.4	341	3.81	68.2	82.0	533	97.9
	8.0	22.9	29.1	408	3.74	81.5	99.9	646	116
	10.0	27.9	35.5	474	3.65	94.9	119	761	134
120x120	5.0	18.0	22.9	503	4.69	83.8	98.4	775	122
	6.3	22.3	28.5	610	4.63	102	121	949	147
	8.0	27.9	35.5	738	4.56	123	149	1160	176
	10.0	34.2	43.5	870	4.47	145	178	1380	206
150x150	12.5+	41.6	53.0	1010	4.36	168	212	1620	237
	5.0	22.7	28.9	1010	5.91	135	157	1550	197
	6.3	28.3	36.0	1240	5.86	165	194	1910	240
	8.0	35.4	45.1	1510	5.78	201	240	2350	291
	10.0	43.6	55.5	1800	5.70	240	290	2830	345
	12.5	53.4	68.0	2120	5.59	283	348	3370	403
180x180	15.0	66.4	84.5	2500	5.44	333	421	4030	468
	6.3	34.2	43.6	2190	7.08	243	283	3360	355
	8.0	43.0	54.7	2690	7.01	299	352	4160	434
	10.0	53.0	67.5	3240	6.92	360	429	5040	519
	12.5	65.2	83.0	3860	6.82	428	519	6060	613
200x200	16.0	81.4	104	4610	6.66	512	634	7340	725
	6.3	38.2	48.6	3030	7.90	303	353	4650	444
	8.0	48.0	61.1	3740	7.83	374	439	5770	545
	10.0	59.3	75.5	4520	7.74	452	536	7020	655
	12.5	73.0	93.0	5420	7.63	542	651	8480	779
250x250	16.0	91.5	117	6520	7.48	652	799	10300	929
	6.3	48.1	61.2	6050	9.94	484	559	9230	712
	8.0	60.5	77.1	7510	9.87	601	699	11500	880
	10.0	75.0	95.5	9140	9.78	731	858	14100	1070
	12.5	92.6	118	11000	9.68	884	1050	17100	1280
300x300	16.0	117	149	13500	9.53	1080	1300	21100	1550
	10.0	90.7	116	16200	11.8	1080	1250	24800	1900
	12.5	112	143	19500	11.7	1310	1540	30300	2300
350x350	16.0	142	181	24200	11.6	1610	1920	37600	2800
	10.0	106	136	26100	13.9	1490	1730	39800	2190
	12.5	132	168	31800	13.8	1820	2120	48900	2660
400x400	16.0	167	213	39400	13.6	2250	2650	60900	3260
	10.0	122	156	39400	15.9	1970	2270	50000	2900
	12.5	152	193	48200	15.8	2410	2800	73800	3530
	16.0	192	245	59900	15.7	3000	3510	92300	4360

Sections marked thus are rolled in grade 43C only