Using a Custom Steel Section

In this tutorial:

- Creating a Custom Steel Section in Section Properties
- Importing the Custom Section into a Steel Floor Beam
- Designing a floor beam using the Custom Steel Section

Step 1 – Creating a Custom Steel Section in Section Properties

Using the **Structural Toolkit Section Properties** within the Steel section, we can design a custom steel section and import this into our other design modules.

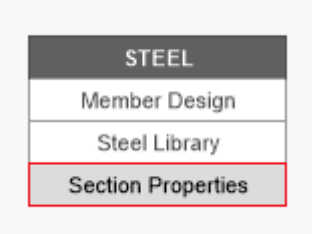


Figure 1 – Section Properties Icon

The section we will use will be a **UK** section of **610x229 140**.

We can input the following properties into the **Beam** section generator.

Depth (d) = 617.2mm
Breadth (bf) = 230.2mm
Flange thickness (tf) = 22.1mm
Web thickness (tw) = 13.1mm
Root radius (r) = 12.7mm

Be sure to name the section in the D**escription** box.

Figure 2 – Custom Section Description

Press the **[Scale]** button in the Notes area to refresh the section diagram.

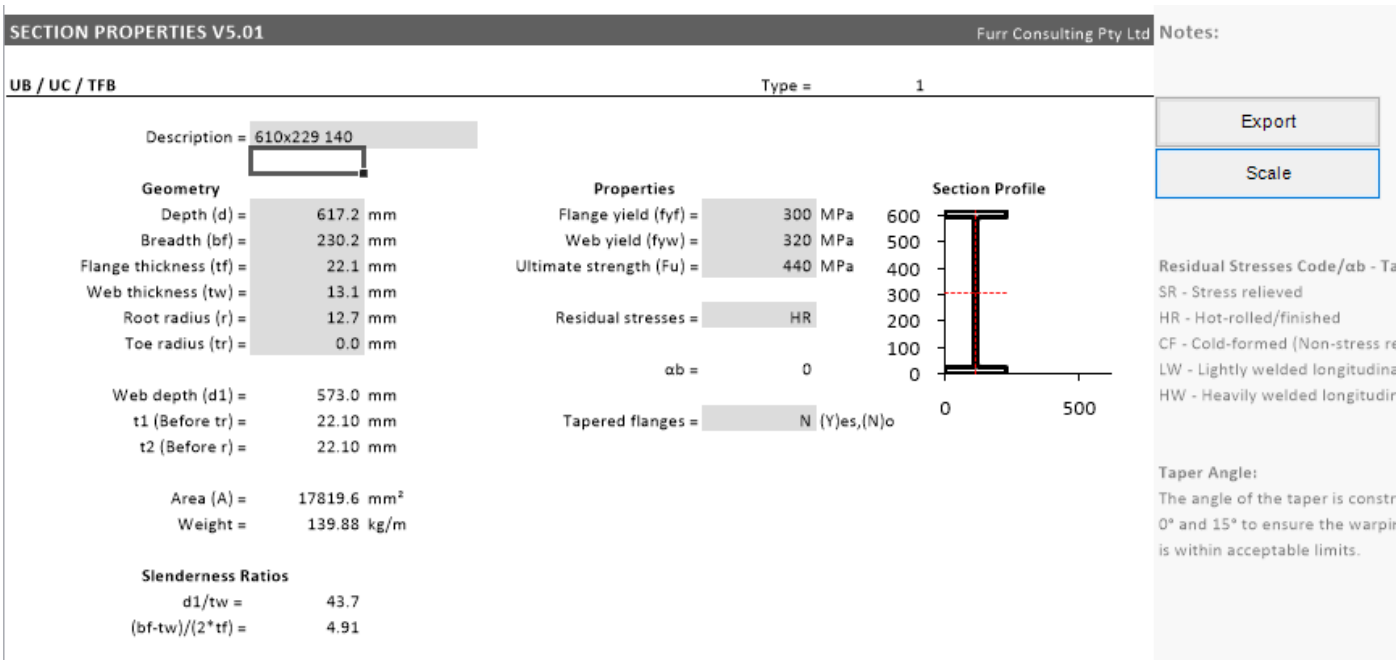


Figure 3 – Custom Section Inputs

Comparing the section **properties table** output at the bottom of the module to the published properties (refer Appendix A), you can see they have calculated comparably.

Properties for 610x229 140

d =	617.2 mm	Fyf =	300 MPa
bf =	230.2 mm	Fyw =	320 MPa
tf =	22.1 mm	Fu =	440 MPa
tw =	13.1 mm	Residual =	HR
root r1 =	12.7 mm		
toe r2 =	0 mm	Tapered =	N
		Taper Angle =	0.0 °
A =	17800 mm²	S.Wt =	140 kg/m
Ix =	1120 x10⁶ mm⁴	Iy =	45.1 x10⁶ mm⁴
Zx =	3620 x10³ mm³	Zy =	391 x10³ mm³
Sx =	4140 x10³ mm³	Sy =	611 x10³ mm³
rx =	250 mm	ry =	50.3 mm
Iw =	3990 x10⁹ mm⁶	J =	2160 x10³ mm⁴
Zex =	4140 x10³ mm³	Zey =	587 x10³ mm³
Compact X =	C (Compact)	Compact Y =	C (Compact)
kf =	0.974 (3 decimals)	αb =	0
øMsx =	1120 kNm	øMsy =	159 kNm
øNs =	4690 kN		

Figure 4 – Custom Section Summary

Enter the relevant yield and ultimate strengths noting that we are designing a Eurocode section to Australian Standards and factors for design will differ.

Properties

Flange yield (fyf) =	275	MPa
Web yield (fyw) =	275	MPa
Ultimate strength (Fu) =	410	MPa
Residual stresses =	HR	

Figure 5 – Section Strengths

You can also adjust the **amount of significant figures** output on the **Options** tab.

Output Values

Value significant figures =	3	
Kf value decimal places =	3	
Rounding =	1	(0) Normal,(1) Sym,(2) Down

Example:

Number	Normal	Sym	Down
3044	3040	3040	3040
3045	3040	3050	3040
3046	3050	3050	3040

Figure 6 – Section Properties Output Options

Return to the top of the page and press the **[Export]** button to transfer the data into the **[Custom]** tab of the module.

SECTION PROPERTIES V5.01

Save Custom... Load Custom...

								d1	(bf-tw)			Zx1
Description	Weight	d	bf	tf	tw	r1	d1	tw	2tf	Ag	Ix	Zx4
	kg/m	mm	mm	mm	mm	mm	mm	mm	mm	mm²	x10⁶ mm⁴	x1
610x229 140	140	617	230	22.1	13.1	12.7	573	43.7	4.91	17800	1120	
1	2	3	4	5	6	7	8	9	10	11	12	

Figure 7 – Transfer of Custom Section Properties

Press the **[Save Custom]** button to open the windows explorer dialog and choose a suitable location to save the section as an XML file.

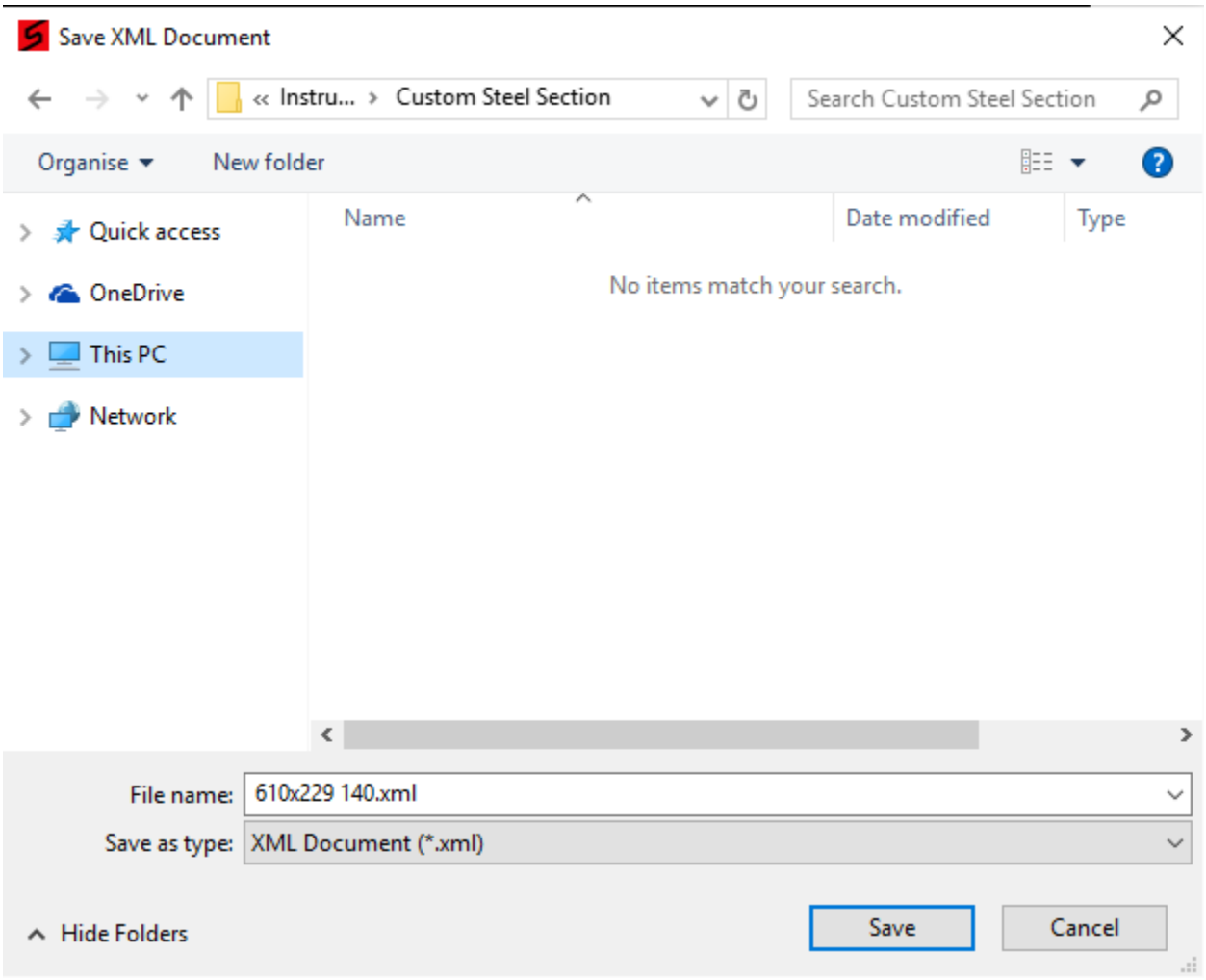


Figure 8 – Typical Windows Explorer Dialog (Saving Custom Section)

Remember where you save this section as we will need to import it in the next module.

Step 2 - Importing the Custom Section into a Steel Floor Beam

Select a **Steel Floor Beam** module to open the design.

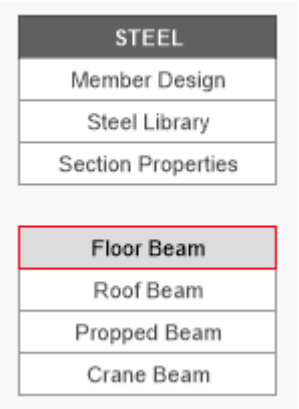


Figure 9 – Steel Floor Beam Icon

In the design module, press the member **[Select…]** button in the Notes area.

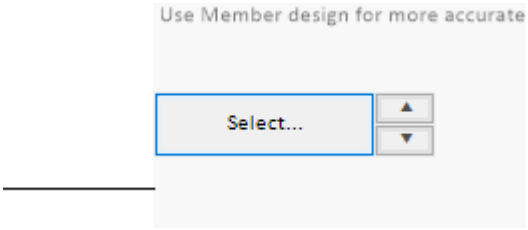


Figure 10 – Section Select Button

Press the **[Load]** button to open the windows explorer dialog and select the custom section which we created.

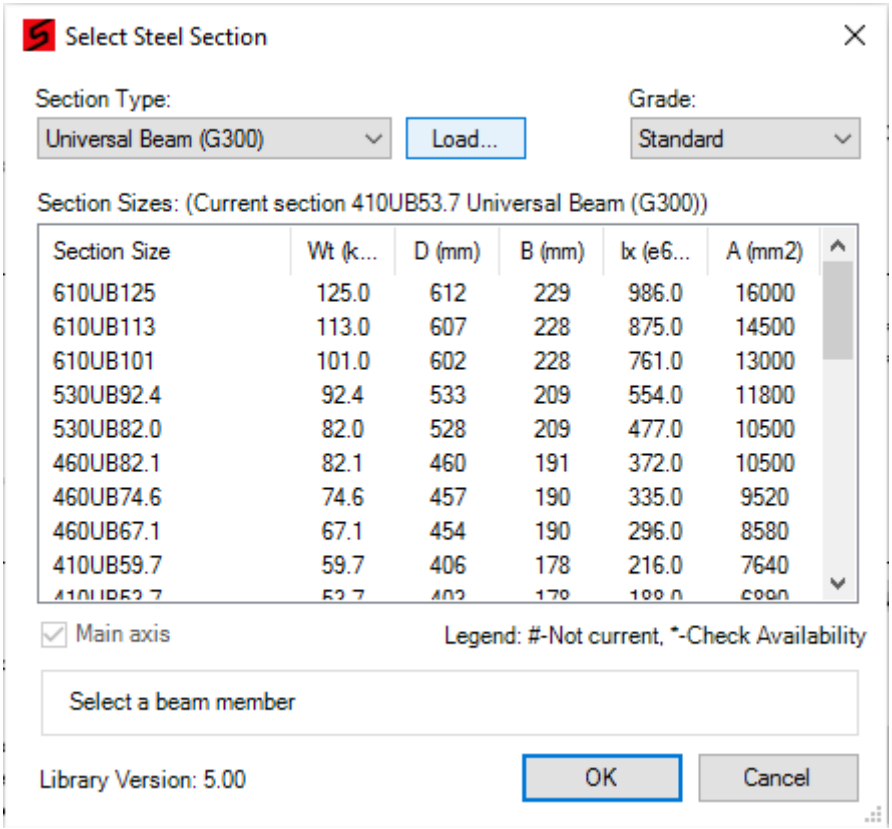


Figure 11 – Load section button

The section will import and can now be used as a standard beam size to design using Australia Standards.

Step 3 - Designing the Floor Beam using the Custom Steel Section

As the section has been selected, we can now input design values to verify the capacity.

STEEL FLOOR BEAM V5.01 — Furr Consulting Pty Ltd

Member:	**(Floor Beam FB03) 610x229 140 (Custom)**	
Bending:	**M(max)* = 338.3kNm < øMb(7500,αm=1.33) = 615.0kNm**	**OK (0.55)**
Shear:	**V.max*=90.2kN < øVvm = 1200.3kN**	**OK (0.08)**
Deflection:	**δdl = L/1159 (13mm), Ψs.δll = L/1618 (9mm), δtot. = L/675 (22mm), 1kN midspan δ =0.3mm**	**OK**
Precamber:	**Not required**	
Reactions:	**(Each end) Rdl = 33.0kN, Rll = 33.8kN, R* = 90.2kN**	

Geometry

Span (L) =	15000	mm	Effective length (Le) =	7500	mm
Centres (cts) =	3000	mm	αm =	1.33	
Design at =	M	mm from LHS, (M)ax, (S)eg			
Effective length (Le) =	7500	mm			
αm =	1.33				

Loadings

Floor area =	45.0	m²		Live load type =	N	(N)ormal, (S)torage, (M)anual	
Apply reduction =	N	(Y)es,(N)o				AS/NZS 1170.0 - Table 4.1	
Floor reduction (Ψa) =	1.00	AS/NZS 1170.1 - Cl 3.4.2					
Uniform dead loads							
Floor dead load (wdl) =	1.00	kPa *	3000	mm +		kN/m =	3.00 kN/m
Super. dead load (wdl) =		kPa *	3000	mm +		kN/m =	0.00 kN/m
Other dead load (wdl) =		kPa *		mm +		kN/m =	0.00 kN/m
Include S.Wt =	Y	(Y)es,(N)o				S.Wt =	1.40 kN/m
						Σwdl =	4.40 kN/m

Figure 12 – Steel Floor Beam module inputs

The C**apacity** section shows the imported design values from the section properties we created.

Capacity

Description =	610x229 140 (Custom)		Warping constant (Iw) =	3990	x10³ mm⁶
Flange yield (fyf) =	275	MPa	Torsional constant (J) =	2160	x10³ mm⁴
Web yield (fyw) =	275	MPa	Effective section mod. (Zex) =	4140	x10³ mm³
Area (Ag) =	17800	mm²	Effective section mod. (Zey) =	587	x10³ mm³
Stiffness (Ix) =	1120	x10⁶ mm⁴	Elastic modulus (E) =	200000	MPa - Cl 1.4
Stiffness (Iy) =	45.1	x10⁶ mm⁴	Shear modulus (G) =	80000	MPa - Cl 1.4
ø =	0.9	Table 3.4			
Msx = min(fyf,fyw)*Zex =	1138.5	kNm - Cl 5.2.1	øMsx =	1024.7	kNm
Moa =	703.6	kNm - Cl 5.6.1.1(3)	øMsy =	145.3	kNm
αs = 0.451		αm = 1.33	øMbx = αs*αm*øMsx =	615.0	kNm

Figure 13 – Steel Beam Capacity Properties

END OF TUTORIAL

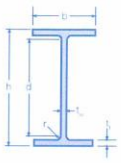
V5.0.1.2

Appendix A – Section Tables

TATA Steel - Advance® sections, CE marked structural sections, Eurocode version, 2013

Dimensions and properties

Advance® UK Beams



Designation		Mass per metre	Depth of section	Width of section	Thickness of web	Thickness of flange	Root radius	Depth between fillets	Ratios for local buckling		Second moment of area		Radius of gyration	
Serial size		kg/m	h mm	b mm	t_w mm	t_f mm	r mm	d mm	Flange c_f/t_f	Web c_w/t_w	I Axis y-y cm^4	I Axis z-z cm^4	i Axis y-y cm	i Axis z-z cm
➤ 1016x305	487	486.7	1036.3	308.5	30.0	54.1	30.0	868.1	2.02	28.9	1021884	26721	40.6	6.57
➤	437	437.0	1026.1	305.4	26.9	49.0	30.0	868.1	2.23	32.3	910322	23447	40.4	6.49
➤	393	392.7	1015.9	303.0	24.4	43.9	30.0	868.1	2.49	35.6	807503	20496	40.2	6.40
➤	349	349.4	1008.1	302.0	21.1	40.0	30.0	868.1	2.76	41.1	723131	18460	40.3	6.44
➤	314	314.3	999.9	300.0	19.1	35.9	30.0	868.1	3.08	45.5	644063	16232	40.1	6.37
➤	272	272.3	990.1	300.0	16.5	31.0	30.0	868.1	3.6	52.6	553974	14004	40.0	6.35
➤	249	248.7	980.1	300.0	16.5	26.0	30.0	868.1	4.3	52.6	481192	11754	39.0	6.09
➤	222	222.0	970.3	300.0	16.0	21.1	30.0	868.1	5.31	54.3	407961	9546	38.0	5.81
914x419	388	388.0	921.0	420.5	21.4	36.6	24.1	799.6	4.79	37.4	719635	45438	38.2	9.59
	343	343.3	911.8	418.5	19.4	32.0	24.1	799.6	5.48	41.2	625780	39156	37.8	9.46
914x305	289	289.1	926.6	307.7	19.5	32.0	19.1	824.4	3.91	42.3	504187	15597	37.0	6.51
	253	253.4	918.4	305.5	17.3	27.9	19.1	824.4	4.48	47.7	436305	13301	36.8	6.42
	224	224.2	910.4	304.1	15.9	23.9	19.1	824.4	5.23	51.8	376414	11236	36.3	6.27
	201	200.9	903.0	303.3	15.1	20.2	19.1	824.4	6.19	54.6	325254	9423	35.7	6.07
838x292	226	226.5	850.9	293.8	16.1	26.8	17.8	761.7	4.52	47.3	339704	11360	34.3	6.27
	194	193.8	840.7	292.4	14.7	21.7	17.8	761.7	5.58	51.8	279175	9066	33.6	6.06
	176	175.9	834.9	291.7	14.0	18.8	17.8	761.7	6.44	54.4	246021	7799	33.1	5.90
762x267	197	196.8	769.8	268.0	15.6	25.4	16.5	686.0	4.32	44.0	239957	8175	30.9	5.71
	173	173.0	762.2	266.7	14.3	21.6	16.5	686.0	5.08	48.0	205282	6850	30.5	5.58
	147	146.9	754.0	265.2	12.8	17.5	16.5	686.0	6.27	53.6	168502	5455	30.0	5.40
	134	133.9	750.0	264.4	12.0	15.5	16.5	686.0	7.08	57.2	150692	4788	29.7	5.30
686x254	170	170.2	692.9	255.8	14.5	23.7	15.2	615.1	4.45	42.4	170326	6630	28.0	5.53
	152	152.4	687.5	254.5	13.2	21.0	15.2	615.1	5.02	46.6	150355	5784	27.8	5.46
	140	140.1	683.5	253.7	12.4	19.0	15.2	615.1	5.55	49.6	136267	5183	27.6	5.39
	125	125.2	677.9	253.0	11.7	16.2	15.2	615.1	6.51	52.6	117992	4383	27.2	5.24
610x305	238	238.1	635.8	311.4	18.4	31.4	16.5	540.0	4.14	29.3	209471	15837	26.3	7.23
	179	179.0	620.2	307.1	14.1	23.6	16.5	540.0	5.51	38.3	153024	11408	25.9	7.07
	149	149.2	612.4	304.8	11.8	19.7	16.5	540.0	6.6	45.8	125876	9308	25.7	7.00
610x229	140	139.9	617.2	230.2	13.1	22.1	12.7	547.6	4.34	41.8	111777	4505	25.0	5.03
	125	125.1	612.2	229.0	11.9	19.6	12.7	547.6	4.89	46.0	98610	3932	24.9	4.97
	113	113.0	607.6	228.2	11.1	17.3	12.7	547.6	5.54	49.3	87318	3434	24.6	4.88
	101	101.2	602.6	227.6	10.5	14.8	12.7	547.6	6.48	52.2	75780	2915	24.2	4.75
➤ 610x178	100	100.3	607.4	179.2	11.3	17.2	12.7	547.6	4.14	48.5	72528	1658	23.8	3.60
➤	92	92.2	603.0	178.8	10.9	15.0	12.7	547.6	4.75	50.2	64577	1436	23.4	3.50
➤	82	81.8	598.6	177.9	10.0	12.8	12.7	547.6	5.57	54.8	55869	1207	23.2	3.40
➤ 533x312	272	273.3	577.1	320.2	21.1	37.6	12.7	476.5	3.64	22.6	198578	20615	23.9	7.70
➤	219	218.8	560.3	317.4	18.3	29.2	12.7	476.5	4.69	26.0	150976	15589	23.3	7.48
➤	182	181.5	550.7	314.5	15.2	24.4	12.7	476.5	5.61	31.3	123222	12667	23.1	7.40
➤	150	150.6	542.5	312.0	12.7	20.3	12.7	476.5	6.75	37.5	100633	10285	22.9	7.32
➤ 533x210	138	138.3	549.1	213.9	14.7	23.6	12.7	476.5	3.68	32.4	86088	3864	22.1	4.68
	122	122.0	544.5	211.9	12.7	21.3	12.7	476.5	4.08	37.5	76043	3388	22.1	4.67
	109	109.0	539.5	210.8	11.6	18.8	12.7	476.5	4.62	41.1	66822	2943	21.9	4.60
	101	101.0	536.7	210.0	10.8	17.4	12.7	476.5	4.99	44.1	61519	2692	21.9	4.57
	92	92.1	533.1	209.3	10.1	15.6	12.7	476.5	5.57	47.2	55227	2389	21.7	4.51
	82	82.2	528.3	208.8	9.6	13.2	12.7	476.5	6.58	49.6	47539	2007	21.3	4.38
➤ 533x165	85	84.8	534.9	166.5	10.3	16.5	12.7	476.5	3.96	46.3	48631	1275	21.2	3.44
➤	74	74.7	529.1	165.9	9.7	13.6	12.7	476.5	4.81	49.1	41058	1040	20.8	3.30
➤	66	65.7	524.7	165.1	8.9	11.4	12.7	476.5	5.74	53.5	35028	859	20.5	3.20

Dimensions and properties to BS4-1.

➤ These sizes are in addition to our standard range of BS4 sections.

* Values in italics indicate the section is Class 4 in pure compression and allowance has been made in calculating the resistance.

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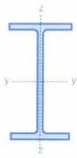
Table



UKB

Elastic modulus W_{el}		Plastic modulus W_{pl}		Buckling parameter U	Torsional index X	Warping constant I_w	Torsional constant I_T	Area of section	Indicative values for S355 steel		Designation	
Axis y-y cm^3	Axis z-z cm^3	Axis y-y cm^3	Axis z-z cm^3			dm^6	cm^4	cm^2	$M_{c,y,Rd}$ kNm	$N_{b,z,Rd}$* for Lcr=3.5m kN		Serial size
19722	1732	23208	2799	0.867	21.1	64.4	4299	620	7770	15300	487	1016x305
17743	1535	20769	2467	0.868	23.1	56.0	3185	557	6970	13700	437	
15897	1353	18538	2167	0.868	25.5	48.4	2330	500	6200	*12200*	393	
14346	1223	16593	1940	0.872	27.9	43.3	1718	445	5730	*11700*	349	
12883	1082	14850	1712	0.872	30.7	37.7	1264	400	5110	*10100*	314	
11190	934	12827	1469	0.873	35.0	32.2	835	347	4420	*8470*	272	
9819	784	11350	1244	0.861	39.8	26.8	582	317	3900	*7510*	249	
8409	636	9808	1019	0.850	45.7	21.5	390	283	3380	*6440*	222	
15627	2161	17666	3340	0.885	26.7	88.9	1734	494	6110	*15200*	388	914x419
13726	1871	15478	2889	0.883	30.1	75.8	1193	437	5350	*12900*	343	
10883	1014	12570	1601	0.867	31.9	31.2	926	368	4350	*9450*	289	914x305
9501	871	10942	1370	0.866	36.2	26.4	626	323	3760	*8030*	253	
8269	739	9535	1163	0.861	41.3	22.1	422	286	3290	*6880*	224	
7204	621	8352	982	0.854	46.8	18.4	291	256	2880	*5960*	201	
7985	773	9155	1211	0.870	35.0	19.3	514	289	3160	*7140*	226	838x292
6641	620	7640	974	0.862	41.6	15.2	306	247	2640	*5860*	194	
5893	535	6808	842	0.856	46.5	13.0	221	224	2350	*5160*	176	
6234	610	7167	958	0.869	33.2	11.3	404	251	2470	*5980*	197	762x267
5387	514	6198	807	0.864	38.1	9.39	267	220	2140	*5070*	173	
4470	411	5156	647	0.858	45.2	7.40	159	187	1780	*4110*	147	
4018	362	4644	570	0.854	49.8	6.46	119	171	1650	*3710*	134	
4916	518	5631	811	0.872	31.8	7.42	308	217	1940	*5350*	170	686x254
4374	455	5001	710	0.871	35.5	6.42	220	194	1730	*4450*	152	
3987	409	4558	638	0.868	38.7	5.72	169	178	1570	*4000*	140	
3481	346	3994	542	0.862	43.9	4.80	116	159	1380	*3450*	125	
6589	1017	7486	1574	0.886	21.3	14.5	785	303	2580	8620	238	610x305
4935	743	5548	1144	0.886	27.7	10.2	340	228	1910	*6430*	179	
4111	611	4594	937	0.886	32.7	8.17	200	190	1580	*5040*	149	
3622	391	4142	611	0.875	30.6	3.99	216	178	1430	*4070*	140	610x229
3221	343	3676	535	0.873	34.1	3.45	154	159	1270	*3460*	125	
2874	301	3281	469	0.870	38.0	2.99	111	144	1130	*3010*	113	
2515	256	2881	400	0.864	43.1	2.52	77.0	129	1020	*2640*	101	
2388	185	2786	296	0.855	38.7	1.44	95.0	128	963	*1980*	100	610x178
2142	161	2511	258	0.848	42.8	1.24	71.0	117	891	*1760*	92	
1867	136	2194	218	0.843	48.5	1.04	48.8	104	777	*1490*	82	
6882	1288	7859	1985	0.890	15.9	15.0	1288	348	2720	10100	272	533x312
5389	982	6109	1514	0.884	19.8	11.0	642	279	2110	8040	219	
4475	806	5030	1237	0.885	23.4	8.77	373	231	1740	6630	182	
3710	659	4142	1009	0.885	27.8	7.01	216	192	1430	*5490*	150	
3136	361	3613	568	0.873	25.0	2.67	250	176	1250	3760	138	533x210
2793	320	3196	500	0.877	27.6	2.32	178	155	1100	*3300*	122	
2477	279	2829	436	0.875	30.9	1.99	126	139	976	*2920*	109	
2292	256	2612	399	0.874	33.2	1.81	101	129	900	*2690*	101	
2072	228	2360	355	0.872	36.5	1.60	75.7	117	838	*2440*	92	
1800	192	2059	300	0.864	41.6	1.33	51.5	105	731	*2010*	82	
1818	153	2107	243	0.862	35.5	0.857	73.8	108	725	*1570*	85	533x165
1552	125	1808	200	0.853	41.1	0.691	47.9	95.2	643	*1310*	74	
1335	104	1561	166	0.847	47.0	0.566	32.0	83.7	554	*1100*	66	

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Specifying Advance® sections to the Eurocode

The simplified naming protocol adopted for Advance® sections covering both section designation and material specification makes it easier to specify steel sections which are fully compliant with CE marking.

Steel specification

Steel sections used in the UK should comply with EN10025. Non alloy structural steels are manufactured in accordance with Part 2 and thermo-mechanically rolled weldable fine grain structural steels in accordance with Part 4.

The tables here show the typical UK grades and properties for structural sections to EN10025:Parts 2 and 4 and how these relate to the simplified material specification for *Advance* sections from Tata Steel.

Advance® sections		EN10025:Part2			
Grade	Grade	Yield (R_{eH}[a]) min Strength at t=16mm (N/mm²)	Tensile R_m[a]	Charpy v-notch longitudinal Temp(°C)	Energy (J)
*Advance*275JR	S275JR	275	410/560	20	27
*Advance*275J0	S275J0	275	410/560	0	27
*Advance*275J2	S275J2	275	410/560	-20	27
*Advance*355JR	S355JR	355	470/630	20	27
*Advance*355J0	S355J0	355	470/630	0	27
*Advance*355J2	S355J2	355	470/630	-20	27
*Advance*355K2	S355K2	355	470/630	-20	40

Advance® sections		EN10025: Part4			
Grade	Grade	Yield (R_{eH}[a]) min Strength at t=16mm (N/mm²)	Tensile R_m[a]	Charpy v-notch longitudinal Temp(°C)	Energy (J)
*Advance*355M	S355M	355	470/630	-20	40
*Advance*355ML	S355ML	355	470/630	-50	27
*Advance*420M	S420M	420	520/680	-20	40
*Advance*420ML	S420ML	420	520/680	-50	27
*Advance*460M	S460M	460	540/720	-20	40
*Advance*460ML	S460ML	460	540/720	-50	27

a Values apply parallel to the rolling direction

It should be noted that *Advance* sections can be specified in JR, J0 and J2 sub-grades but for situations where greater toughness is required, sub-grade K2 is available in S355 grade steel. In addition, M and ML specifications are available for heavily loaded parts of welded structures such as, bridges, flood gates, storage tanks, water supply tanks, etc., for service at ambient and low temperatures.

It is vitally important that structural steelwork is specified correctly by the design engineer. The steel specification must cover the strength grade and the steel sub-grade. Specifying the correct steel sub-grade is important to ensure that brittle fracture is avoided.