UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: May 2023

Module Number: CE5202 **Module Name**: Design of Steel Structures

Time allowed: Three Hours

Answer all questions, each question carries equal marks

Code of Practices EN 1993-1-1;2005, EN 1993-1-5 2006, EN 1993-1-8 2005 are provided

Q1. a) Flat bars of size 200 mm wide and 25 mm thick in Grade S275 steel are to be used as a tie member in a steel structure. Erection considerations require that the bar be constructed from three lengths connected together as shown in Fig. Q1(a) and (b) using six M20 bolts.

i) For the bolt configuration given in Fig 1(a), determine the tensile capacity of the tie member.

[4.0 Marks]

ii) For the bolt configuration given in Fig 1(b), determine the tensile capacity of the tie member.

[5.0 Marks]

b) An eccentrically connected tension member consists of a 150 × 75 × 10 single unequal angle whose ends are connected to gusset plates through the larger leg by a single row of 3 number of M22 bolts at 60 mm centers as shown in Fig. 1(c). Check the member for a design tension force 340 kN, if the angle section is made of Grade S275 steel.

[6.0 Marks]

Q2. The beam shown in Fig. Q2(a) is used in a multistory steel building at the top most level. The beam has moment resisting connections at its ends and carries concentrated loads due to roof supporting posts at 3m distance from each end. The design values of combined actions at ultimate limits state are calculated and indicated in Fig. Q2(a). The bending moment and shear forces diagrams obtained by analyzing the beam are given in Fig. Q2(b). Universal beam section of size 457x191x67 made in grade S275 steel has been selected as an initial section for the design check. Verify the adequacy of selected beam for the following design criteria.

a) Cross section resistance

i) Local buckling [2.5 Marks]

ii) Shear buckling and shear yielding resistance [2.5 Marks]

iii) Bending resistance [2.5 Marks]

iv) Web bearing and web buckling resistance at support A. Take the stiff bearing length s_s=75mm and end distance c= 0. [2.5 Marks]

b) Lateral torsional buckling resistance of segment AB using Cl. 6.3.2.3 EN 1993-1-1;2005. Use M_{cr}=355 kNm and k_c=0.61.

[5.0 Marks]

Q3. A ground floor column of a multi-story building is subjected to axial compression and bending. A square column section of size 305x305x10 is selected as an initial section for the design check. The height of a column is 4.0 m. The frame is moment resistance in-plane (y-y) and pinned out-of-plane (z-z), with diagonal bracing provided in both directions. Structural analysis was conducted for a column and the resulting bending moment diagrams for major and minor axis are indicated in Fig. Q3. The design axial force at ultimate limit state (ULS) is found as 2000 kN. Grade of steel S275.

a) Check the cross-section resistance (i.e., all relevant design criteria) of selected section is sufficient to carry the design forces and moments at ULS.

[6.0 Marks]

b) Check whether the member resistance against combined action of axial compression and bi-axis moments using Appendix B method in EN1993-1-1:2005.

[9.0 Marks]

Q4. Fig. Q4 (a) to Fig.Q4(c) show a beam-to-beam connection in a steel structure. The secondary beam of 254 x 146 x 37 UB transfers a design shear force V_{Ed} = 60 kN to the main beam of 356 x 171 x 57 UB. Grade of steel is S235 and M16 bolts of class 4.6 are used. Assumed that 6 no of M16 bolts transfer only the design shear force V_{Ed} from the secondary beam to the main beam without any simultaneous development of bending moment. In contrast, 3 no of M16 bolts connecting L angles to the web of secondary beam transfer both shear and bending and therefore horizontal shear also developed as indicated in Fig. Q4 (b). Tensile stress area, A_s of M16 bolts is 157 mm^2. [Hint: for moment balance, V_{Ed}x45=H_{Ed}x100]

a) Check whether the given detailing satisfy minimum and maximum end, edge, and spacing distances of the connections.

[5.0 Marks]

b) Estimate the design shear force for 3 no of M16 bolt group and 6 no of M16 bolt group separately.

[5.0 Marks]

c) Check the adequacy of above two bolt groups.

[5.0 Marks]

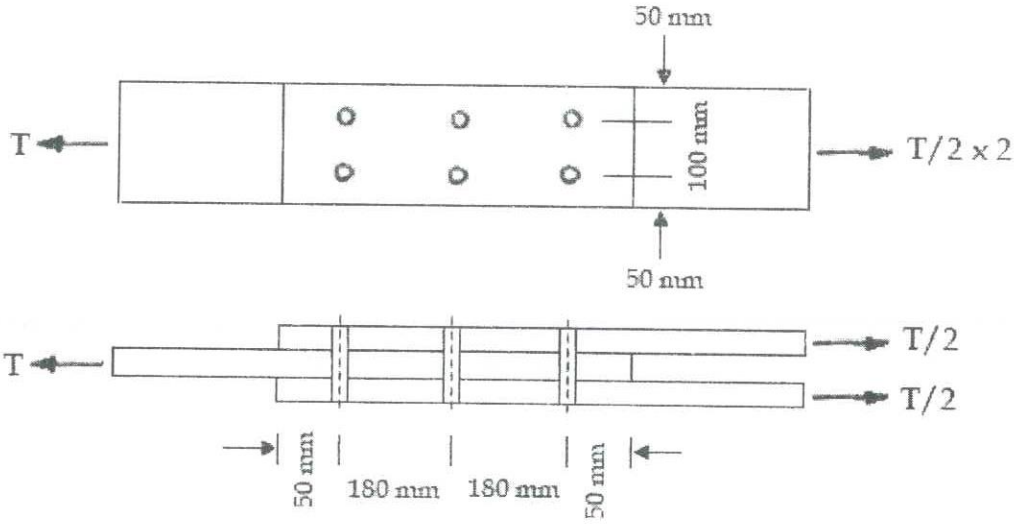


Fig. 1(a)

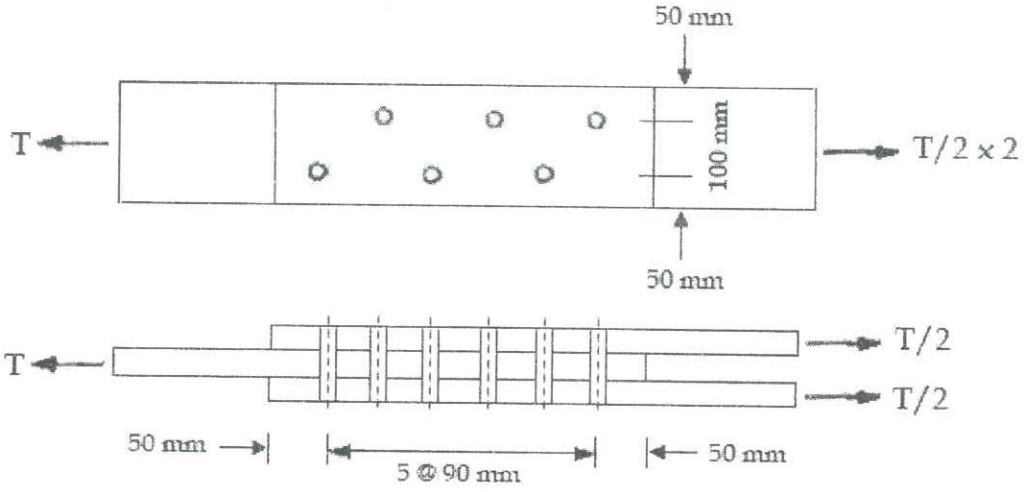


Fig. 1(b)

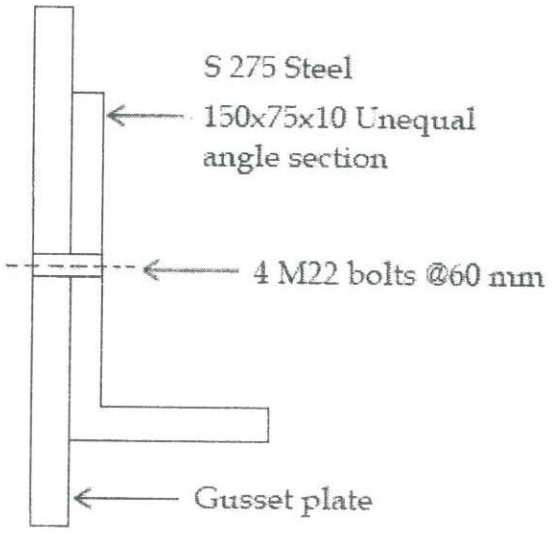


Fig. 1 (c)

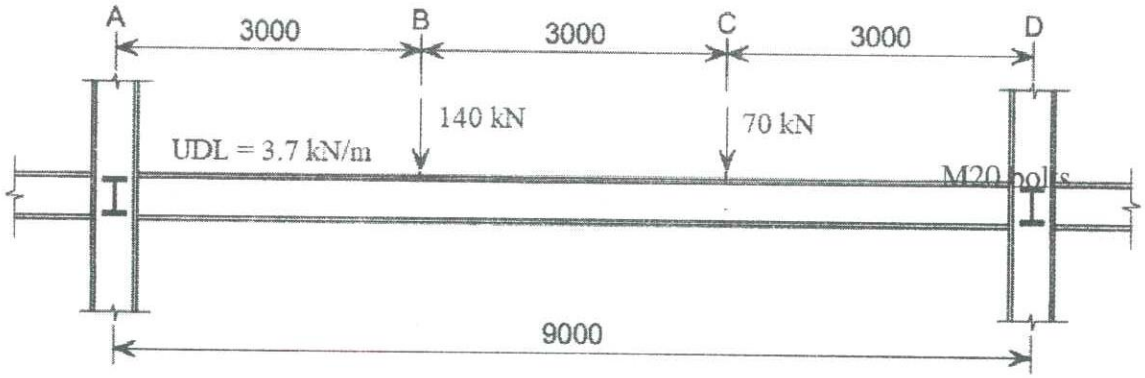


Fig. Q2(a)

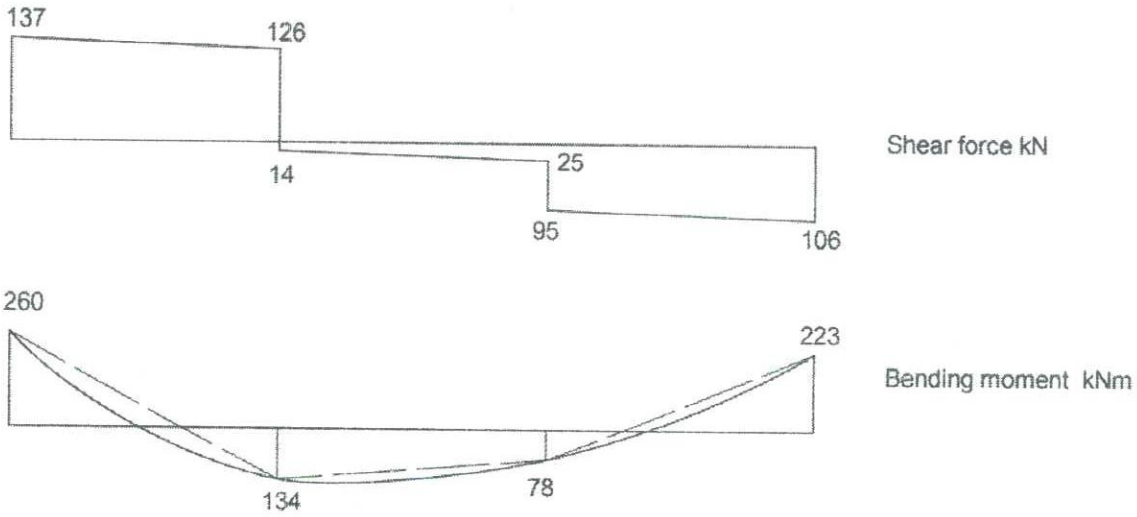


Fig. Q2 (b)

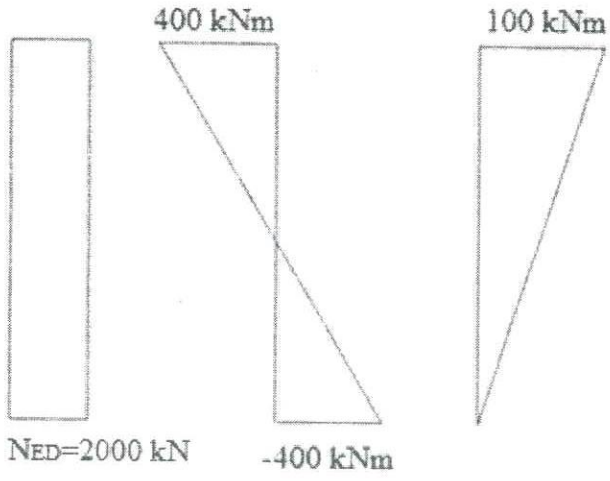
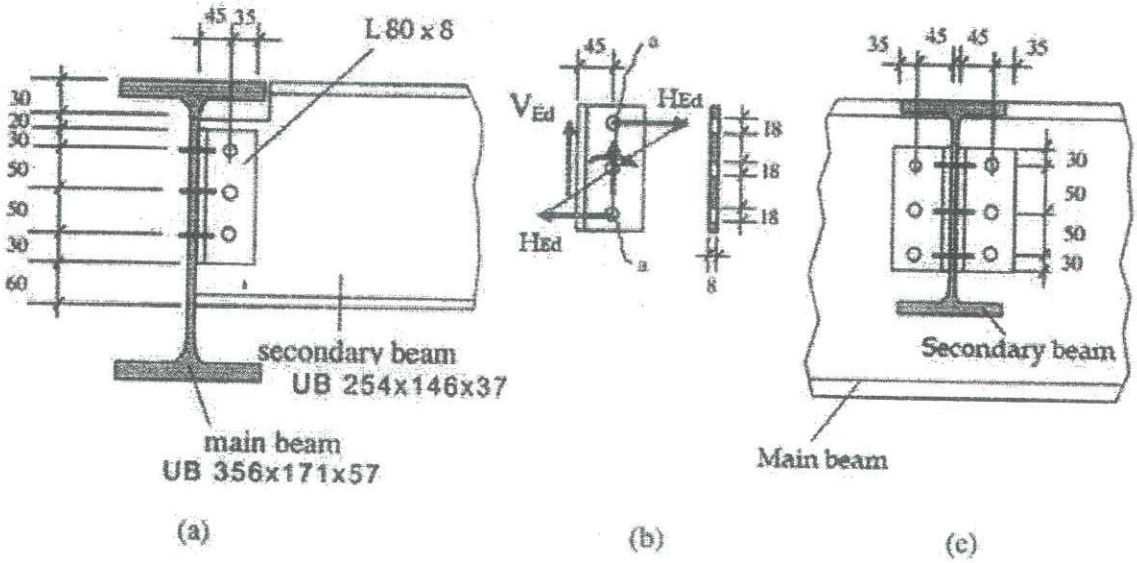


Fig. Q3


45 35
L 80 x 8
30
20
30
50
50
30
60
secondary beam
UB 254x146x37
main beam
UB 356x171x57
45
a
VEd
HEd
HEd
18
18
18
8
35 45 45 35
30
50
50
30
Secondary beam
Main beam

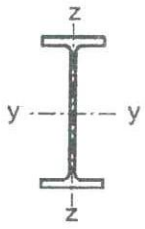
(a) (b) (c)

Fig. Q4

BS EN 1993-1-1:2005
BS 4-1:2005

UNIVERSAL BEAMS

Advance UKB



Properties

Section Designation	Second Moment of Area		Radius of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter	Torsional Index	Warping Constant	Torsional Constant	Area of Section
	Axis y-y	Axis z-z	Axis y-y	Axis z-z	Axis y-y	Axis z-z	Axis y-y	Axis z-z					
	cm^4	cm^4	cm	cm	cm^3	cm^3	cm^3	cm^3	U	X	I_w dm^6	I_T cm^4	A cm^2
533x210x138 +	86100	3860	22.1	4.68	3140	361	3610	568	0.874	24.9	2.67	250	176
533x210x122	76000	3390	22.1	4.67	2790	320	3200	500	0.878	27.6	2.32	178	155
533x210x109	66800	2940	21.9	4.60	2480	279	2830	436	0.875	30.9	1.99	126	139
533x210x101	61500	2690	21.9	4.57	2290	256	2610	399	0.874	33.1	1.81	101	129
533x210x92	55200	2390	21.7	4.51	2070	228	2360	355	0.873	36.4	1.60	75.7	117
533x210x82	47500	2010	21.3	4.38	1800	192	2060	300	0.863	41.6	1.33	51.5	105
533x165x85 +	48500	1270	21.2	3.44	1820	153	2100	243	0.861	35.5	0.857	73.8	108
533x165x75 +	41100	1040	20.8	3.30	1550	125	1810	200	0.853	41.1	0.691	47.9	95.2
533x165x66 +	35000	859	20.5	3.20	1340	104	1560	166	0.847	47.0	0.566	32.0	83.7
457x191x161 +	79800	4250	19.7	4.55	3240	426	3780	672	0.881	16.5	2.25	515	206
457x191x133 +	63800	3350	19.4	4.44	2660	341	3070	535	0.879	19.6	1.73	292	170
457x191x106 +	48900	2510	19.0	4.32	2080	259	2390	405	0.876	24.4	1.27	146	135
457x191x98	45700	2350	19.1	4.33	1960	243	2230	379	0.881	25.8	1.18	121	125
457x191x89	41000	2090	19.0	4.29	1770	218	2010	338	0.878	28.3	1.04	90.7	114
457x191x82	37100	1870	18.8	4.23	1610	196	1830	304	0.879	30.8	0.922	69.2	104
457x191x74	33300	1670	18.8	4.20	1460	176	1650	272	0.877	33.8	0.818	51.8	94.6
457x191x67	29400	1450	18.5	4.12	1300	153	1470	237	0.873	37.8	0.705	37.1	85.5
457x152x82	36600	1180	18.7	3.37	1570	153	1810	240	0.872	27.4	0.591	89.2	105
457x152x74	32700	1050	18.6	3.33	1410	136	1630	213	0.872	30.1	0.518	65.9	94.5
457x152x67	28900	913	18.4	3.27	1260	119	1450	187	0.868	33.6	0.448	47.7	85.6
457x152x60	25500	795	18.3	3.23	1120	104	1290	163	0.868	37.5	0.387	33.8	76.2
457x152x52	21400	645	17.9	3.11	950	84.6	1100	133	0.859	43.8	0.311	21.4	66.6
406x178x85 +	31700	1830	17.1	4.11	1520	201	1730	313	0.880	24.4	0.728	93.0	109
406x178x74	27300	1550	17.0	4.04	1320	172	1500	267	0.882	27.5	0.608	62.8	94.5
406x178x67	24300	1360	16.9	3.99	1190	153	1350	237	0.880	30.4	0.533	46.1	85.5
406x178x60	21600	1200	16.8	3.97	1060	135	1200	209	0.880	33.7	0.466	33.3	76.5
406x178x54	18700	1020	16.5	3.85	930	115	1050	178	0.871	38.3	0.392	23.1	69.0
406x140x53 +	18300	635	16.4	3.06	899	88.6	1030	139	0.870	34.1	0.246	29.0	67.9
406x140x46	15700	538	16.4	3.03	778	75.7	888	118	0.871	39.0	0.207	19.0	58.6
406x140x39	12500	410	15.9	2.87	629	57.8	724	90.8	0.858	47.4	0.155	10.7	49.7
356x171x67	19500	1360	15.1	3.99	1070	157	1210	243	0.886	24.4	0.412	55.7	85.5
356x171x57	16000	1110	14.9	3.91	896	129	1010	199	0.882	28.8	0.330	33.4	72.6
356x171x51	14100	968	14.8	3.86	796	113	896	174	0.881	32.1	0.286	23.8	64.9
356x171x45	12100	811	14.5	3.76	687	94.8	775	147	0.874	36.8	0.237	15.8	57.3
356x127x39	10200	358	14.3	2.68	576	56.8	659	89.0	0.871	35.2	0.105	15.1	49.8
356x127x33	8250	280	14.0	2.58	473	44.7	543	70.2	0.863	42.1	0.081	8.79	42.1
305x165x54	11700	1060	13.0	3.93	754	127	846	196	0.889	23.6	0.234	34.8	68.8
305x165x46	9900	896	13.0	3.90	646	108	720	166	0.890	27.1	0.195	22.2	58.7
305x165x40	8500	764	12.9	3.86	560	92.6	623	142	0.889	31.0	0.164	14.7	51.3

Advance and UKB are trademarks of Corus. A fuller description of the relationship between Universal Beams (UB) and the Advance range of sections manufactured by Corus is given in section 12.

+ These sections are in addition to the range of BS 4 sections.

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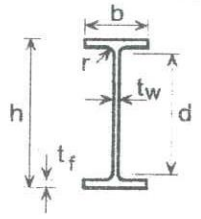
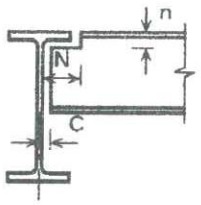
BS EN 1993-1-1:2005
BS 4-1:2005

UNIVERSAL BEAMS

Advance UKB





Dimensions

Section Designation	Mass per Metre	Depth of Section	Width of Section	Thickness		Root Radius	Depth between Fillets	Ratios for Local Buckling		Dimensions for Detailing			Surface Area	
				Web	Flange			Flange	Web	End Clearance	Notch		Per Metre	Per Tonne
		h	b	t_w	t_f	r	d	c_f / t_f	c_w / t_w	C	N	n		
	kg/m	mm	mm	mm	mm	mm	mm			mm	mm	mm	m^2	m^2
533x210x138 +	138.3	549.1	213.9	14.7	23.6	12.7	476.5	3.68	32.4	9	110	38	1.90	13.7
533x210x122	122.0	544.5	211.9	12.7	21.3	12.7	476.5	4.08	37.5	8	110	34	1.89	15.5
533x210x109	109.0	539.5	210.8	11.6	18.8	12.7	476.5	4.62	41.1	8	110	32	1.88	17.2
533x210x101	101.0	536.7	210.0	10.8	17.4	12.7	476.5	4.99	44.1	7	110	32	1.87	18.5
533x210x92	92.1	533.1	209.3	10.1	15.6	12.7	476.5	5.57	47.2	7	110	30	1.86	20.2
533x210x82	82.2	528.3	208.8	9.6	13.2	12.7	476.5	6.58	49.6	7	110	26	1.85	22.5
533x165x85 +	84.8	534.9	166.5	10.3	16.5	12.7	476.5	3.96	46.3	7	90	30	1.69	19.9
533x165x75 +	74.7	529.1	165.9	9.7	13.6	12.7	476.5	4.81	49.1	7	90	28	1.68	22.5
533x165x66 +	65.7	524.7	165.1	8.9	11.4	12.7	476.5	5.74	53.5	6	90	26	1.67	25.4
457x191x161 +	161.4	492.0	199.4	18.0	32.0	10.2	407.6	2.52	22.6	11	102	44	1.73	10.7
457x191x133 +	133.3	480.6	196.7	15.3	26.3	10.2	407.6	3.06	26.6	10	102	38	1.70	12.8
457x191x106 +	105.8	469.2	194.0	12.6	20.6	10.2	407.6	3.91	32.3	8	102	32	1.67	15.8
457x191x98	98.3	467.2	192.8	11.4	19.6	10.2	407.6	4.11	35.8	8	102	30	1.67	17.0
457x191x89	89.3	463.4	191.9	10.5	17.7	10.2	407.6	4.55	38.8	7	102	28	1.66	18.6
457x191x82	82.0	460.0	191.3	9.9	16.0	10.2	407.6	5.03	41.2	7	102	28	1.65	20.1
457x191x74	74.3	457.0	190.4	9.0	14.5	10.2	407.6	5.55	45.3	7	102	26	1.64	22.1
457x191x67	67.1	453.4	189.9	8.5	12.7	10.2	407.6	6.34	48.0	6	102	24	1.63	24.3
457x152x82	82.1	465.8	155.3	10.5	18.9	10.2	407.6	3.29	38.8	7	84	30	1.51	18.4
457x152x74	74.2	462.0	154.4	9.6	17.0	10.2	407.6	3.66	42.5	7	84	28	1.50	20.2
457x152x67	67.2	458.0	153.8	9.0	15.0	10.2	407.6	4.15	45.3	7	84	26	1.50	22.3
457x152x60	59.8	454.6	152.9	8.1	13.3	10.2	407.6	4.68	50.3	6	84	24	1.49	24.9
457x152x52	52.3	449.8	152.4	7.6	10.9	10.2	407.6	5.71	53.6	6	84	22	1.48	28.3
406x178x85 +	85.3	417.2	181.9	10.9	18.2	10.2	360.4	4.14	33.1	7	96	30	1.52	17.8
406x178x74	74.2	412.8	179.5	9.5	16.0	10.2	360.4	4.68	37.9	7	96	28	1.51	20.4
406x178x67	67.1	409.4	178.8	8.8	14.3	10.2	360.4	5.23	41.0	6	96	26	1.50	22.3
406x178x60	60.1	406.4	177.9	7.9	12.8	10.2	360.4	5.84	45.6	6	96	24	1.49	24.8
406x178x54	54.1	402.6	177.7	7.7	10.9	10.2	360.4	6.86	46.8	6	96	22	1.48	27.3
406x140x53 +	53.3	406.6	143.3	7.9	12.9	10.2	360.4	4.46	45.6	6	78	24	1.35	25.3
406x140x46	46.0	403.2	142.2	6.8	11.2	10.2	360.4	5.13	53.0	5	78	22	1.34	29.1
406x140x39	39.0	398.0	141.8	6.4	8.6	10.2	360.4	6.69	56.3	5	78	20	1.33	34.1
356x171x67	67.1	363.4	173.2	9.1	15.7	10.2	311.6	4.58	34.2	7	94	26	1.38	20.6
356x171x57	57.0	358.0	172.2	8.1	13.0	10.2	311.6	5.53	38.5	6	94	24	1.37	24.1
356x171x51	51.0	355.0	171.5	7.4	11.5	10.2	311.6	6.25	42.1	6	94	22	1.36	26.7
356x171x45	45.0	351.4	171.1	7.0	9.7	10.2	311.6	7.41	44.5	6	94	20	1.36	30.2
356x127x39	39.1	353.4	126.0	6.6	10.7	10.2	311.6	4.63	47.2	5	70	22	1.18	30.2
356x127x33	33.1	349.0	125.4	6.0	8.5	10.2	311.6	5.82	51.9	5	70	20	1.17	35.4
305x165x54	54.0	310.4	166.9	7.9	13.7	8.9	265.2	5.15	33.6	6	90	24	1.26	23.3
305x165x46	46.1	306.6	165.7	6.7	11.8	8.9	265.2	5.98	39.6	5	90	22	1.25	27.1
305x165x40	40.3	303.4	165.0	6.0	10.2	8.9	265.2	6.92	44.2	5	90	20	1.24	30.8

Advance and UKB are trademarks of Corus. A fuller description of the relationship between Universal Beams (UB) and the Advance range of sections manufactured by Corus is given in section 12.

+ These sections are in addition to the range of BS 4 sections.

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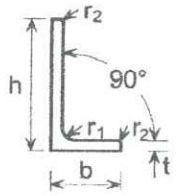
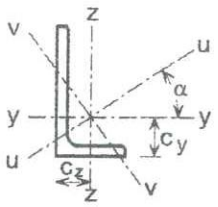
BS EN 1993-1-1:2005
BS EN 10056-1:1999

UNEQUAL ANGLES

Advance UKA - Unequal Angles





Dimensions and properties (continued)

Section Designation		Elastic Modulus		Angle Axis y-y to Axis u-u	Torsional Constant	Equivalent Slenderness Coefficient		Mono-symmetry Index	Area of Section
Size	Thickness	Axis y-y	Axis z-z			Min	Max		
h x b	t			Tan α	I_T	ϕ_a	ϕ_a	ψ_a	
mm	mm	cm^3	cm^3		cm^4				cm^2
200x150	18 +	174	103	0.549	67.9	2.93	3.72	4.60	60.0
	15	147	86.9	0.551	39.9	3.53	4.50	5.55	50.5
	12	119	70.5	0.552	20.9	4.43	5.70	6.97	40.8
200x100	15	137	38.5	0.260	34.3	3.54	5.17	9.19	43.0
	12	111	31.3	0.262	18.0	4.42	6.57	11.5	34.8
	10	93.2	26.3	0.263	10.66	5.26	7.92	13.9	29.2
150x90	15	77.7	30.4	0.354	26.8	2.58	3.59	5.96	33.9
	12	63.3	24.8	0.358	14.1	3.24	4.58	7.50	27.6
	10	53.3	21.0	0.360	8.30	3.89	5.56	9.03	23.2
150x75	15	75.2	21.0	0.253	25.1	2.62	3.74	6.84	31.7
	12	61.3	17.1	0.258	13.2	3.30	4.79	8.60	25.7
	10	51.6	14.5	0.261	7.80	3.95	5.83	10.4	21.7
125x75	12	43.2	16.9	0.354	11.6	2.66	3.73	6.23	22.7
	10	36.5	14.3	0.357	6.87	3.21	4.55	7.50	19.1
	8	29.6	11.6	0.360	3.62	4.00	5.75	9.43	15.5
100x75	12	28.0	16.5	0.540	10.05	2.10	2.64	3.46	19.7
	10	23.8	14.0	0.544	5.95	2.54	3.22	4.17	16.6
	8	19.3	11.4	0.547	3.13	3.18	4.08	5.24	13.5
100x65	10 +	23.2	10.5	0.410	5.61	2.52	3.43	5.45	15.6
	8 +	18.9	8.54	0.413	2.96	3.14	4.35	6.86	12.7
	7 +	16.6	7.53	0.415	2.02	3.58	5.00	7.85	11.2
100x50	8	18.2	5.08	0.258	2.61	3.30	4.80	8.61	11.4
	6	13.8	3.89	0.262	1.14	4.38	6.52	11.6	8.71
80x60	7	10.7	6.34	0.546	1.66	2.92	3.72	4.78	9.38
80x40	8	11.4	3.16	0.253	2.05	2.61	3.73	6.85	9.01
	6	8.73	2.44	0.258	0.899	3.48	5.12	9.22	6.89
75x50	8	10.4	4.95	0.430	2.14	2.36	3.18	4.92	9.41
	6	8.01	3.81	0.435	0.935	3.18	4.34	6.60	7.19
70x50	6	7.01	3.78	0.500	0.899	2.96	3.89	5.44	6.89
65x50	5	5.14	3.19	0.577	0.498	3.38	4.26	5.08	5.54
60x40	6	5.03	2.38	0.431	0.735	2.51	3.39	5.26	5.68
	5	4.25	2.02	0.434	0.435	3.02	4.11	6.34	4.79
60x30	5	4.07	1.14	0.257	0.382	3.15	4.56	8.26	4.28
50x30	5	2.86	1.11	0.352	0.340	2.51	3.52	5.99	3.78
45x30	4	1.91	0.910	0.436	0.166	2.85	3.87	5.92	2.87
40x25	4	1.47	0.619	0.380	0.142	2.51	3.48	5.75	2.46
40x20	4	1.42	0.393	0.252	0.131	2.57	3.68	6.86	2.26
30x20	4	0.807	0.379	0.421	0.1096	1.79	2.39	3.95	1.86
	3	0.621	0.292	0.427	0.0486	2.40	3.28	5.31	1.43

Advance and UKA are trademarks of Corus. A fuller description of the relationship between Angles and the Advance range of sections manufactured by Corus is given in section 12.

+ These sections are in addition to the range of BS EN 10056-1 sections.

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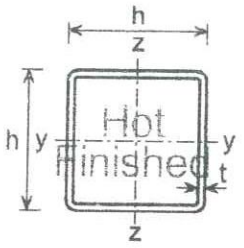
BS EN 1993-1-1:2005
BS EN 10210-2:2006

HOT-FINISHED SQUARE HOLLOW SECTIONS

Celsius® SHS



Dimensions and properties

Section Designation		Mass per Metre	Area of Section	Ratio for Local Buckling	Second Moment of Area	Radius of Gyration	Elastic Modulus	Plastic Modulus	Torsional Constants		Surface Area	
Size	Thickness			c/t [1]							Per Metre	Per Tonne
h x h	t		A		I	i	W_{el}	W_{pl}	I_T	W_t		
mm	mm	kg/m	cm^2		cm^4	cm	cm^3	cm^3	cm^4	cm^3	m^2	m^2
250 x 250	6.3	47.9	61.0	36.7	6010	9.93	481	556	9240	712	0.984	20.5
	8.0	60.3	76.8	28.3	7460	9.86	596	694	11500	880	0.979	16.3
	10.0	74.5	94.9	22.0	9060	9.77	724	851	14100	1070	0.974	13.1
	12.5	91.9	117	17.0	10900	9.66	873	1040	17200	1280	0.968	10.5
	14.2	103	132	14.6	12100	9.58	967	1160	19100	1410	0.963	9.31
	16.0	115	147	12.6	13300	9.50	1060	1280	21100	1550	0.959	8.31
260 x 260	6.3	49.9	63.5	38.3	6790	10.3	522	603	10400	773	1.02	20.5
	8.0	62.8	80.0	29.5	8420	10.3	648	753	13000	956	1.02	16.2
	10.0	77.7	98.9	23.0	10200	10.2	788	924	15900	1160	1.01	13.1
	12.5	95.8	122	17.8	12400	10.1	951	1130	19400	1390	1.01	10.5
	14.2	108	137	15.3	13700	9.99	1060	1260	21700	1540	1.00	9.30
	16.0	120	153	13.3	15100	9.91	1160	1390	23900	1690	0.999	8.29
300 x 300	6.3	57.8	73.6	44.6	10500	12.0	703	809	16100	1040	1.18	20.5
	8.0	72.8	92.8	34.5	13100	11.9	875	1010	20200	1290	1.18	16.2
	10.0	90.2	115	27.0	16000	11.8	1070	1250	24800	1580	1.17	13.0
	12.5	112	142	21.0	19400	11.7	1300	1530	30300	1900	1.17	10.5
	14.2	126	160	18.1	21600	11.6	1440	1710	33900	2110	1.16	9.25
	16.0	141	179	15.8	23900	11.5	1590	1900	37600	2330	1.16	8.25
350 x 350	8.0	85.4	109	40.8	21100	13.9	1210	1390	32400	1790	1.38	16.2
	10.0	106	135	32.0	25900	13.9	1480	1720	39900	2190	1.37	13.0
	12.5	131	167	25.0	31500	13.7	1800	2110	48900	2650	1.37	10.4
	14.2	148	189	21.6	35200	13.7	2010	2360	54900	2960	1.36	9.21
	16.0	166	211	18.9	38900	13.6	2230	2630	61000	3260	1.36	8.20
400 x 400	10.0	122	155	37.0	39100	15.9	1960	2260	60100	2900	1.57	12.9
	12.5	151	192	29.0	47800	15.8	2390	2780	73900	3530	1.57	10.4
	14.2	170	217	25.2	53500	15.7	2680	3130	83000	3940	1.56	9.18
	16.0	191	243	22.0	59300	15.6	2970	3480	92400	4360	1.56	8.17
	20.0 ^	235	300	17.0	71500	15.4	3580	4250	112000	5240	1.55	6.58

Celsius® is a trademark of Corus. A fuller description of the relationship between Hot Finished Square Hollow Sections (HFSHS) and the Celsius® range of sections manufactured by Corus is given in section 12.

(1) For local buckling calculation c = h - 3t.

^ SAW process (single longitudinal seam weld, slightly proud)

Check availability

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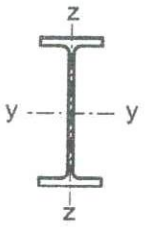
BS EN 1993-1-1:2005
BS 4-1:2005

UNIVERSAL BEAMS

Advance UKB



Properties

Section Designation	Second Moment of Area		Radius of Gyration		Elastic Modulus		Plastic Modulus		Buckling Parameter	Torsional Index	Warping Constant	Torsional Constant	Area of Section
	Axis y-y	Axis z-z	Axis y-y	Axis z-z	Axis y-y	Axis z-z	Axis y-y	Axis z-z					
	cm^4	cm^4	cm	cm	cm^3	cm^3	cm^3	cm^3	U	X	I_w dm^6	I_T cm^4	A cm^2
305x127x48	9570	461	12.5	2.74	616	73.6	711	116	0.873	23.3	0.102	31.8	61.2
305x127x42	8200	389	12.4	2.70	534	62.6	614	98.4	0.872	26.5	0.0846	21.1	53.4
305x127x37	7170	336	12.3	2.67	471	54.5	539	85.4	0.872	29.7	0.0725	14.8	47.2
305x102x33	6500	194	12.5	2.15	416	37.9	481	60.0	0.867	31.6	0.0442	12.2	41.8
305x102x28	5370	155	12.2	2.08	348	30.5	403	48.4	0.859	37.3	0.0349	7.40	35.9
305x102x25	4460	123	11.9	1.97	292	24.2	342	38.8	0.846	43.4	0.027	4.77	31.6
254x146x43	6540	677	10.9	3.52	504	92.0	566	141	0.891	21.1	0.103	23.9	54.8
254x146x37	5540	571	10.8	3.48	433	78.0	483	119	0.890	24.3	0.0857	15.3	47.2
254x146x31	4410	448	10.5	3.36	351	61.3	393	94.1	0.879	29.6	0.0660	8.55	39.7
254x102x28	4000	179	10.5	2.22	308	34.9	353	54.8	0.873	27.5	0.0280	9.57	36.1
254x102x25	3410	149	10.3	2.15	266	29.2	306	46.0	0.866	31.4	0.0230	6.42	32.0
254x102x22	2840	119	10.1	2.06	224	23.5	259	37.3	0.856	36.3	0.0182	4.15	28.0
203x133x30	2900	385	8.71	3.17	280	57.5	314	88.2	0.882	21.5	0.0374	10.3	38.2
203x133x25	2340	308	8.56	3.10	230	46.2	258	70.9	0.876	25.6	0.0294	5.96	32.0
203x102x23	2100	164	8.46	2.36	207	32.2	234	49.7	0.888	22.4	0.0154	7.02	29.4
178x102x19	1360	137	7.48	2.37	153	27.0	171	41.6	0.886	22.6	0.0099	4.41	24.3
152x89x16	834	89.8	6.41	2.10	109	20.2	123	31.2	0.890	19.5	0.00470	3.56	20.3
127x76x13	473	55.7	5.35	1.84	74.6	14.7	84.2	22.6	0.894	16.3	0.00200	2.85	16.5

Advance and UKB are trademarks of Corus. A fuller description of the relationship between Universal Beams (UB) and the Advance range of sections manufactured by Corus is given in section 12.

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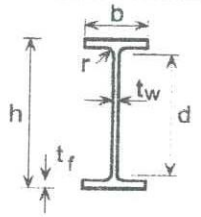
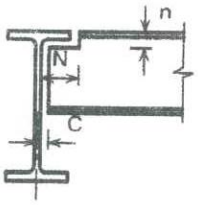
BS EN 1993-1-1:2005
BS 4-1:2005

UNIVERSAL BEAMS

Advance UKB





Dimensions

Section Designation	Mass per Metre	Depth of Section	Width of Section	Thickness		Root Radius	Depth between Fillets	Ratios for Local Buckling		Dimensions for Detailing			Surface Area	
				Web	Flange			Flange	Web	End Clearance	Notch		Per Metre	Per Tonne
		h	b	t_w	t_f	r	d	c_f / t_f	c_w / t_w	C	N	n		
	kg/m	mm	mm	mm	mm	mm	mm			mm	mm	mm	m^2	m^2
305x127x48	48.1	311.0	125.3	9.0	14.0	8.9	265.2	3.52	29.5	7	70	24	1.09	22.7
305x127x42	41.9	307.2	124.3	8.0	12.1	8.9	265.2	4.07	33.2	6	70	22	1.08	25.8
305x127x37	37.0	304.4	123.4	7.1	10.7	8.9	265.2	4.60	37.4	6	70	20	1.07	28.9
305x102x33	32.8	312.7	102.4	6.6	10.8	7.6	275.9	3.73	41.8	5	58	20	1.01	30.8
305x102x28	28.2	308.7	101.8	6.0	8.8	7.6	275.9	4.58	46.0	5	58	18	1.00	35.5
305x102x25	24.8	305.1	101.6	5.8	7.0	7.6	275.9	5.76	47.6	5	58	16	0.992	40.0
254x146x43	43.0	259.6	147.3	7.2	12.7	7.6	219.0	4.92	30.4	6	82	22	1.08	25.1
254x146x37	37.0	256.0	146.4	6.3	10.9	7.6	219.0	5.73	34.8	5	82	20	1.07	28.9
254x146x31	31.1	251.4	146.1	6.0	8.6	7.6	219.0	7.26	36.5	5	82	18	1.06	34.0
254x102x28	28.3	260.4	102.2	6.3	10.0	7.6	225.2	4.04	35.7	5	58	18	0.904	31.9
254x102x25	25.2	257.2	101.9	6.0	8.4	7.6	225.2	4.80	37.5	5	58	16	0.897	35.7
254x102x22	22.0	254.0	101.6	5.7	6.8	7.6	225.2	5.93	39.5	5	58	16	0.890	40.5
203x133x30	30.0	206.8	133.9	6.4	9.6	7.6	172.4	5.85	26.9	5	74	18	0.923	30.8
203x133x25	25.1	203.2	133.2	5.7	7.8	7.6	172.4	7.20	30.2	5	74	16	0.915	36.5
203x102x23	23.1	203.2	101.8	5.4	9.3	7.6	169.4	4.37	31.4	5	60	18	0.790	34.2
178x102x19	19.0	177.8	101.2	4.8	7.9	7.6	146.8	5.14	30.6	4	60	16	0.738	38.7
152x89x16	16.0	152.4	88.7	4.5	7.7	7.6	121.8	4.48	27.1	4	54	16	0.638	40.0
127x76x13	13.0	127.0	76.0	4.0	7.6	7.6	96.6	3.74	24.2	4	46	16	0.537	41.4

Advance and UKB are trademarks of Corus. A fuller description of the relationship between Universal Beams (UB) and the Advance range of sections manufactured by Corus is given in section 12.

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