Corus Special Profiles

Bulb flats

For plate stiffening

Plate stiffening

Bulb flats are tailor made for plate stiffening applications. Their special shape provides significant benefits when compared with other types of stiffener.

Corus Special Profiles is part of Corus, the international metals company.

Our business is a leading producer of bulb flat profiles. We have been supplying the shipbuilding and bridge building industries for over 40 years from our rolling mill facility at Skinningrove, in the North East of England. We are certified to ISO 9002.

Bulb flats are tailor made for plate stiffening applications. Their special shape provides significant benefits compared with other types of stiffener. Bulb flats provide benefits during the initial steel construction phase, and also during the working life of a ship or other products on which they are used.

Recognition of the advantages that bulb flats provide is resulting in their increased usage for shipbuilding and bridge building.

Customer service

Our priority at Special Profiles is staying close to the customer. Daily contact is maintained through Corus' network of overseas offices and agents.

Bulb flats sales are co-ordinated from Corus' Skinningrove sales office. A rolling guideline is regularly produced, providing details of when each bulb flat size will be rolled and despatched. An electronic version is also available on our website: www.corus-specialprofiles.com

Customer service for bulb flats is co-ordinated from the Skinningrove office. The team at the mill utilises Corus' shipping and distribution organisation to meet customer delivery requirements on a world-wide basis.

At Special Profiles, we recognise that reducing building time and costs and minimising “through life costs” during a vessel’s life are major issues.

Bulb flats offer many unique benefits for achieving these objectives:

- They are “ready to use” plate stiffeners. Compared with welded or fabricated stiffeners, bulb flats are more cost effective.
- The unique shape of a bulb flat distributes steel to maximise resistance to buckling. This results in a more efficient strength to weight ratio compared with other stiffeners such as flat bars or structural angles.
- The compact shape of a bulb flat offers easy access for welding and painting.
- The asymmetric bulb flat shape lends itself to simplified collar connection when compared to alternative stiffeners such as ‘T’s and angles.
- The rounded profile of a bulb flat, with no sharp corners, assists effective and efficient painting.
- Bulb flats can also reduce coating material costs because they have a smaller surface area than other stiffeners with the same section modulus.

The advantages of bulb flats stretch beyond the initial building phase to provide benefits during the working life of a ship. Their shape has inherent corrosion resistance features, and they are more “user friendly” for repair and maintenance, compared with other stiffeners:

- The curved surface of a bulb flat is less likely to trap moisture or pollutants which can initiate corrosion.
- Bulb flats are easier and quicker to clean in ballast tanks and cargo holds. Material is less likely to become trapped in “blind corners” and require extended time in port for removal. This can dramatically reduce the lifetime maintenance cost.
- Access for inspection and welding is easier, and the compact shape of a bulb flat also results in less welding, if damaged profiles need to be replaced.

Please contact our sales office for further information or a copy of our rolling guideline.

Shipbuilding

Recognition of the benefits which bulb flats provide is resulting in increased usage in bridges around the world, both large and small. The Jiangyin and Øresund bridges are the most well known developments in recent years incorporating bulb flats.

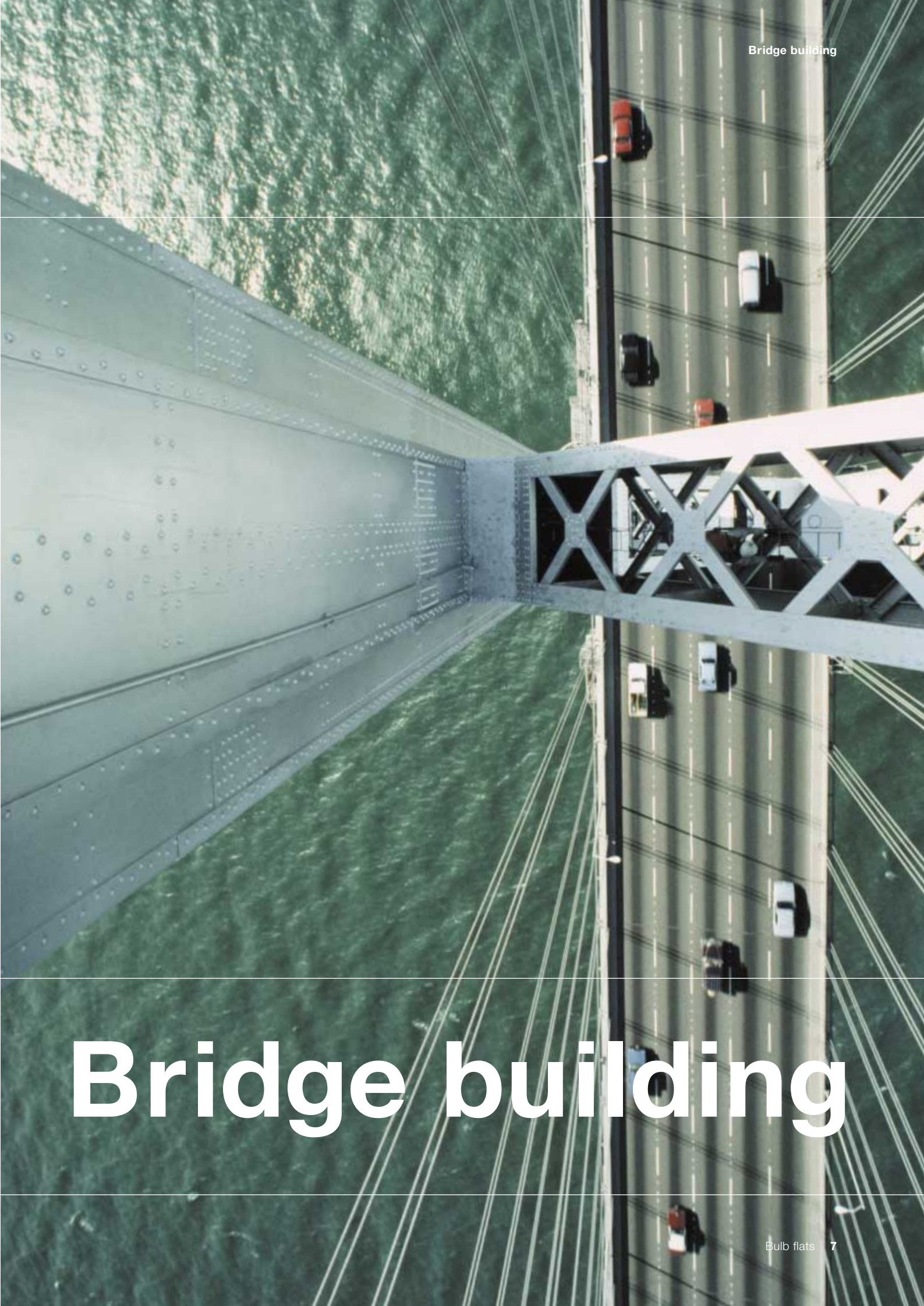
The advantages that bulb flats offer assist both the initial construction phase as well as the working life of the bridge:

- Bulb flats can save weight compared with flat bars and angles which offer equivalent buckling resistance.
- Bulb flats are more cost effective than fabricated plate stiffeners.
- Bulb flats reduce painting costs, by having a smaller surface area than other stiffener arrangements
- The compact shape of a bulb flat provides easy access for welding, painting and inspection.
- The rounded shape of a bulb flat provides inherent corrosion resistance features. It enhances drainage, and minimises dirt and moisture traps.

Corus offers advice to consultant engineers and designers on how to incorporate bulb flats in bridges. We have conducted research in conjunction with Imperial College, London and the Bridge Engineering Division of the UK Department of the Environment. This work investigated the buckling capacity of plate and bulb flat stiffener arrangements.

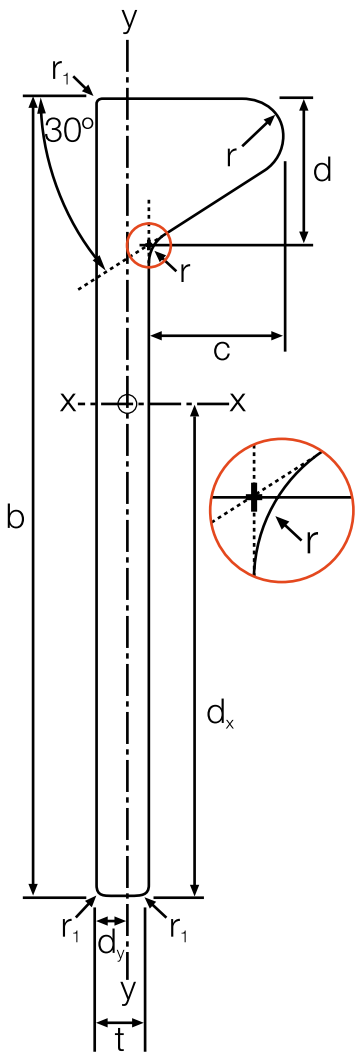
Please contact our sales office for further information.

Bulb flats fulfil a range of applications in bridges, such as stiffening of box girders and plate girders, and stiffening of steel decks on small bridges.



Bridge building

Dimensions and properties



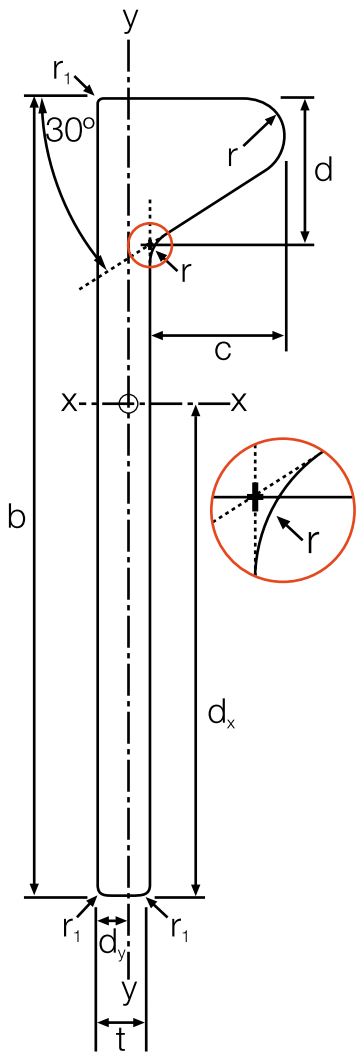
Width b [mm]	Thickness t [mm]	Mass per Unit Length G [kg/m]	Bulb Height c [mm]	Bulb Width d [mm]	Bulb Radius r [mm]	Area of cross-section F [cm²]	Surface Area U [m²/m]
120	6	7.31	17	17.7	5	9.31	0.276
	7	8.25	17	17.7	5	10.5	0.278
	8	9.19	17	17.7	5	11.7	0.280
140	6.5	9.21	19	19.7	5.5	11.7	0.319
	7	9.74	19	19.7	5.5	12.4	0.320
	8	10.8	19	19.7	5.5	13.8	0.322
	10	13.0	19	19.7	5.5	16.6	0.326
160	7	11.4	22	22.2	6	14.6	0.365
	8	12.7	22	22.2	6	16.2	0.367
	9	14.0	22	22.2	6	17.8	0.369
	11.5	17.3	22	22.2	6	21.8	0.374
180	8	14.8	25	25.5	7	18.9	0.411
	9	16.2	25	25.5	7	20.7	0.413
	10	17.6	25	25.5	7	22.5	0.415
	11.5	19.7	25	25.5	7	25.2	0.418
200	8.5	17.8	28	28.8	8	22.6	0.456
	9	18.5	28	28.8	8	23.6	0.457
	10	20.1	28	28.8	8	25.6	0.459
	11	21.7	28	28.8	8	27.6	0.461
	12	23.2	28	28.8	8	29.6	0.463
220	9	21.0	31	32.1	9	26.8	0.501
	10	22.8	31	32.1	9	29.0	0.503
	11	24.5	31	32.1	9	31.2	0.505
	12	26.2	31	32.1	9	33.4	0.507
240	9.5	24.4	34	35.4	10	31.2	0.546
	10	25.4	34	35.4	10	32.4	0.547
	11	27.4	34	35.4	10	34.9	0.549
	12	29.3	34	35.4	10	37.3	0.551
260	10	28.3	37	38.7	11	36.1	0.593
	11	30.3	37	38.7	11	38.7	0.593
	12	32.4	37	38.7	11	41.3	0.595
280	10.5	32.4	40	42.0	12	41.2	0.636
	11	33.5	40	42.0	12	42.6	0.637
	12	35.7	40	42.0	12	45.5	0.639
	13	37.9	40	42.0	12	48.4	0.641
300	11	36.7	43	45.3	13	46.7	0.681
	12	39.0	43	45.3	13	49.7	0.683
	13	41.5	43	45.3	13	52.8	0.685
320	11.5	41.2	46	48.6	14	52.6	0.727
	12	42.5	46	48.6	14	54.2	0.728
	13	45.0	46	48.6	14	57.4	0.730
	14	47.5	46	48.6	14	60.6	0.732
340	12	46.1	49	52.0	15	58.8	0.772
	13	48.8	49	52.0	15	62.2	0.774
	14	51.5	49	52.0	15	65.5	0.776
	15	54.2	49	52.0	15	69.0	0.778
370	12.5	53.1	53.5	56.9	16.5	67.8	0.839
	13	54.6	53.5	56.9	16.5	69.6	0.840
	14	57.5	53.5	56.9	16.5	73.3	0.842
	15	60.5	53.5	56.9	16.5	77.0	0.844
	16	63.5	53.5	56.9	16.5	80.7	0.846
400	13	60.8	58	61.9	18	77.4	0.907
	14	63.9	58	61.9	18	81.4	0.908
	15	67.0	58	61.9	18	85.4	0.910
	16	70.2	58	61.9	18	89.4	0.912
430	14	70.6	62.5	66.8	19.5	89.7	0.975
	15	73.9	62.5	66.8	19.5	94.1	0.976
	17	80.6	62.5	66.8	19.5	103.0	0.980
	20	90.8	62.5	66.8	19.5	115.0	0.986

Additional sizes may be available by agreement: 80 & 100 DIN range
180, 200, 230 and 250 JIS range

* Values for H are taken about the line of attachment.

Distance of Centre of Gravity		Second Moment of Area		Elastic Modulus		Radius of Gyration		Warping Constant	Torsional Constant
d_x [mm]	d_y [mm]	Axis x - x [cm^4]	Axis y - y [cm^4]	Axis x - x [cm^3]	Axis y - y [cm^3]	Axis x - x [cm]	Axis y - y [cm]	H* [cm^6(x10^3)]	J [cm^4]
72.0	5.3	133	2.34	18.4	4.42	3.78	0.50	0.242	1.595
70.7	5.6	148	2.70	21.0	4.82	3.75	0.51	0.251	2.100
69.6	6.0	164	3.10	23.6	5.17	3.74	0.51	0.263	2.773
83.7	5.8	228	3.57	27.3	6.16	4.41	0.55	0.504	2.383
83.1	5.9	241	3.80	29.0	6.44	4.41	0.55	0.508	2.708
81.8	6.3	266	4.32	32.5	6.86	4.39	0.56	0.528	3.501
79.2	7.0	316	5.56	39.9	7.94	4.36	0.58	0.575	5.752
96.6	6.4	373	5.86	38.6	9.16	5.05	0.63	1.12	3.681
94.9	6.8	411	6.55	43.3	9.63	5.04	0.64	1.16	4.600
93.6	7.1	448	7.32	47.9	10.3	5.02	0.64	1.20	5.763
91.1	8.1	544	9.62	59.8	11.9	5.00	0.66	1.31	9.936
109	7.4	609	9.90	55.9	13.4	5.68	0.72	2.45	6.352
107	7.7	665	10.93	62.1	14.2	5.67	0.73	2.51	7.686
106	8.1	717	12.05	67.8	14.9	5.65	0.73	2.58	9.328
104	8.6	799	13.93	76.8	16.2	5.63	0.74	2.71	12.44
122	8.2	902	15.07	74.0	18.4	6.32	0.82	4.67	9.129
121	8.4	941	15.76	77.7	18.8	6.31	0.82	4.72	9.924
119	8.7	1020	17.21	85.0	19.8	6.31	0.82	4.83	11.70
118	9.0	1090	18.77	92.3	20.9	6.28	0.82	4.93	14.00
117	9.4	1160	20.46	99.6	21.8	6.26	0.83	5.09	16.65
136	9.1	1296	22.03	95.3	24.2	6.95	0.91	8.64	13.24
134	9.3	1400	23.89	105	25.7	6.95	0.91	8.80	15.31
132	9.6	1500	25.86	113	26.9	6.93	0.91	8.98	17.81
130	10.0	1590	27.98	122	28.0	6.90	0.92	9.18	20.76
148	9.9	1800	31.15	123	31.5	7.60	1.00	14.8	18.16
147	10.0	1860	32.34	126	32.3	7.58	1.00	14.9	19.37
146	10.3	2000	34.81	137	33.8	7.57	1.00	15.3	22.46
144	10.6	2130	37.43	148	35.3	7.56	1.00	15.6	25.73
162	10.7	2477	42.84	153	40.0	8.28	1.09	24.7	25.03
160	11.0	2610	45.90	162	41.7	8.21	1.09	25.0	28.09
158	11.3	2770	49.11	175	43.5	8.19	1.09	25.4	31.68
175	11.6	3223	57.55	184	49.6	8.84	1.18	39.0	33.05
174	11.7	3330	59.44	191	50.8	8.84	1.18	39.2	34.80
172	11.9	3550	63.34	206	53.2	8.83	1.18	40.1	39.19
170	12.2	3760	67.42	221	55.3	8.81	1.18	41.0	44.25
189	12.4	4190	75.74	222	61.1	9.47	1.27	59.9	43.25
187	12.6	4460	80.44	239	63.8	9.47	1.27	60.5	47.55
185	12.9	4720	85.33	256	66.1	9.45	1.27	61.8	53.06
202	13.3	5370	97.92	266	73.6	10.10	1.36	89.9	56.02
201	13.4	5530	100.8	274	75.2	10.10	1.36	90.3	58.45
199	13.6	5850	106.6	294	78.6	10.10	1.36	91.2	63.86
197	13.9	6170	112.6	313	81.0	10.09	1.36	92.3	70.06
215	14.1	6760	124.6	313	88.4	10.72	1.46	131	71.17
213	14.3	7160	131.5	335	92.0	10.73	1.45	132	77.02
211	14.6	7540	138.6	357	94.9	10.73	1.45	133	83.00
209	14.8	7920	145.9	379	98.6	10.71	1.45	135	91.30
236	15.4	9213	172.3	390	112	11.66	1.59	221	97.66
235	15.4	9470	176.7	402	115	11.66	1.59	221	100.7
232	15.6	9980	185.7	428	119	11.67	1.59	223	108.1
230	15.9	10490	194.8	455	123	11.67	1.59	225	116.6
228	16.1	10980	204.3	481	127	11.66	1.59	227	126.0
258	16.6	12280	232.4	476	140	12.60	1.73	357	131.0
255	16.8	12930	243.6	507	145	12.60	1.73	359	139.3
252	17.0	13580	255.0	537	150	12.61	1.73	362	148.7
250	17.2	14220	266.6	568	155	12.61	1.73	364	159.6
277	17.9	16460	313.9	594	175	13.55	1.87	557	176.6
274	18.1	17260	327.9	628	181	13.54	1.87	562	187.9
269	18.5	18860	356.7	700	193	13.53	1.86	576	215.6
263	19.3	21180	402.6	804	209	13.57	1.87	570	252.6

Tolerances & Steel Specifications



Tolerances (In accordance with BS EN 10067:1997)

1. Dimensional Variation - All Dimensions in mm

Width b			Thickness t		
Over	Up to	Permitted Variation	From	Up to	Permitted Variation
-	120	±1.5	-	8	+ 0.7 - 0.3
120	180	±2.0	7	11	+ 1.0 - 0.3
180	300	±3.0	9	13	+ 1.0 - 0.4
300	430	±4.0	12	20	+ 1.2 - 0.4

Improved tolerances may be available by agreement

Radius of curvature of corners r_1 for thicknesses		
Over	Up to	Max.
-	5	1.5
5	9	2.0
9	13	3.0
13	20	4.0

2. Weight Variation

The weights shown in the tables have been calculated from the cross section with a density of 0.785 kilogram per square centimetre per metre run.

Permitted weight variations:
+6.0% - 2.0% of the total weight for consignments of 5 tonnes and over.
+8.0% - 2.7% of the total weight for consignments under 5 tonnes.

3. Straightness Variation in Accordance with BS EN 10067: 1997

Straightness tolerance q shall be 0.0035 L (the entire length of the bar)
Improved straightness tolerances may be available by agreement

Steel specifications

1. Shipbuilding

Classification Society	A	B	D	A32/36*	D32/36*	D40
Lloyds	F	F	F	F	F	
DNV	F	F	O	F	F	
ABS	F	F	F	F	F	F**
BV	F	F	F	F	F	
GL	F	F	F	F	F	
Class NK	F	F	F	F	F	
RINA	F	F	F	F	F	

F = Full approval O = Approval obtained on an order by order basis
* = Equivalent to AH32/36 and DH 32/36 for Lloyds Register.
Equivalent to KA 32/36 and KD 32/36 for class NK.
** up to 12mm thickness

2. Construction

Bulb flats are available in a range of steel grades suitable for bridge construction in accordance with BS EN 10025: 1993 and BS EN 10113-3 S420M (upto 12mm thickness)

www.corus-specialprofiles.com

Care has been taken to ensure that this information is accurate, but Corus Group plc, including its subsidiaries, does not accept responsibility or liability for errors or information which is found to be misleading.

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