

4. Connection design

4.1 Introduction

The design and detailing of end plate connections to ASB and RHSFB sections in braced frames should take into account:

- The width of beams and column flanges.
- Requirements for torsional resistance (particularly for edge beams).
- Requirements for sufficient bolts to resist shear, as well as those to resist tension.
- The requirements for fillet welding.
- Extension of the end plate above the beam flange (and below for wind moment frames).
- Connections to RHS or CHS columns.

Standard dimensions have been adopted to optimise these requirements. The same details may be used for either:

- Pure shear-resisting connections, or
- Moment-resisting connections.

The difference between the two forms is only in the thickness of the end plate. Some of the lighter columns cannot be used in moment-resisting connections, unless stiffened locally.

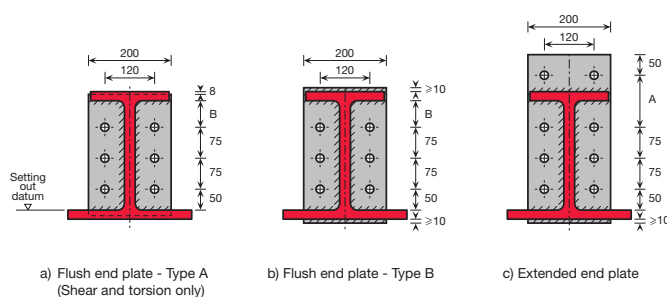
Where RHS or SHS columns are used, the use of Hollo-bolt or Flow-drill type connections may be used. For RHSFBs, the end plate should be extended above and below to facilitate the connection to the column. Other connections may be used to suit the particular construction method but the designer must take into account the need for torsional rigidity of the connection. Detailed guidance on connection design is given in SCI/BCSA publications on connections:

SCI-P-207: *Joints in steel construction: Moment connections*^[21].
 SCI-P-212: *Joints in steel construction: Simple connections*^[22].

4.2 ASB sections

4.2.1 Detailing

The setting out point for detailing of the connections is taken as the top of the bottom flange. This is done so that this level is the surface level of the slab minus the slab depth, and is consistent for all ASB sizes. The lower bolts are positioned at 50mm above the bottom flange. The recommended bolt-detailing rules are given in *Figure 4.1*.



Dimension	A	B
ASB280	110	44
ASB300	140	62

Figure 4.1 Detailing rules for end plate connections to ASBs

The end plate may be taken as a standard width of 200mm for all ASB sections, which allows connections to 203 UKC and larger columns. The bolt cross-spacing is taken as 120mm, in order that the bolts are efficient in both tension and torsion. The vertical distance between the bolts is 75mm for 3-bolt rows, and 150mm for 2-bolt rows. These detailing rules differ from the SCI/BCSA ‘*Moment Connections*’ publication because of the thicker flanges of ASB sections in comparison to UKB sections, and because of the shallower depth of section. These detailing rules provide connections that achieve sufficient shear resistance, bending resistance and stiffness. The recommended bolt size and end plate thickness for ASB connections are given in *Table 4.1*.

Table 4.1 Recommended bolt sizes and end plate thicknesses for ASB connections

	Grade 8.8 Bolt Diameter mm	End Plate Thickness (mm)	
		Shear-Resisting Connections	Moment-Resisting Connections
Spans ≤ 6m	20	10	12
Spans > 6m	24	10	15

4.2.2 Shear-resisting connections with torsional resistance – Flush type A end plates to ASB sections

The normal method of connecting ASBs to columns is to use a 4 or 6 bolt, full depth flush end plate connection, see Figure 4.1(a). These connections possess excellent shear and torsional resistance which is utilised at the construction stage, or where the beam is subjected to high out-of-balance forces (e.g., edge beams). Shear resistances (simplified) based on the standard end plate details are given in Table 4.2. For internal beams at ultimate limit state with equal slab spans, use the pure shear resistance value. For internal beams at construction state and for all edge beams, use the shear resistance for combined shear and torsion.

4.2.3 Moment-resisting connections – Flush type B or extended end plates to ASB sections

Moment-resisting connections generally require the use of a thicker end plate fully welded to the ASB flanges. Extended end plates using 8 bolts can develop end moments of at least 10% of the moment capacity of the beam. The advantage of end fixity is not taken into account in the ASB design software, except by a nominal reduction in deflections. Moment resistance and shear and torsion capacities based on the standard end plate details and minimum weld sizes are given in Tables 4.3 to 4.10. The tables have been developed from the guidance given in the SCI/BCSA publication SCI-P-207^[21], and the assumptions made in developing the resistances are explained in Section 4.2.4.

4.2.4 Assumptions made in producing connection resistance tables

The shear resistance of the bolt group is calculated from:

- 40% of the shear resistance of the top pair of bolts
- 40% of the shear resistance any other bolts acting in tension
- The full shear resistance of the remaining bolts.

The torsional resistance of the bolt group is calculated from:

- The shear resistance of the bolts x their distance from the centre of rotation of the bolt group.

The analysis for torsion acting on the bolt group assumes that:

- The upper bolts resist tension and have a shear resistance of 0.4 times their normal shear resistance
- The number of bolts resisting the pure shear component of force is taken as $N - 2$, where N is the number of bolts between the flanges
- The shear forces due to pure torsion acting on the upper bolt group are limited to 0.4 times the normal shear resistance
- The eccentricity of force is taken as $0.5 \times$ bottom flange or plate width minus 25mm, which is half the assumed bearing length (50mm) of the decking on the support.

The torsional resistance of the bolt group is also dependent on the spacing of the bolts, as illustrated in Figure 4.2. Extended plated connections have greater torsional resistance than flush end-plated connections.

The bending resistance of the end plate connection is calculated on the basis of:

- A yield-line failure pattern in the end plate which is used to calculate the effective tensile resistance of the bolt group
- The moment contribution of these bolts is obtained by taking moments about the centre of the bottom flange.

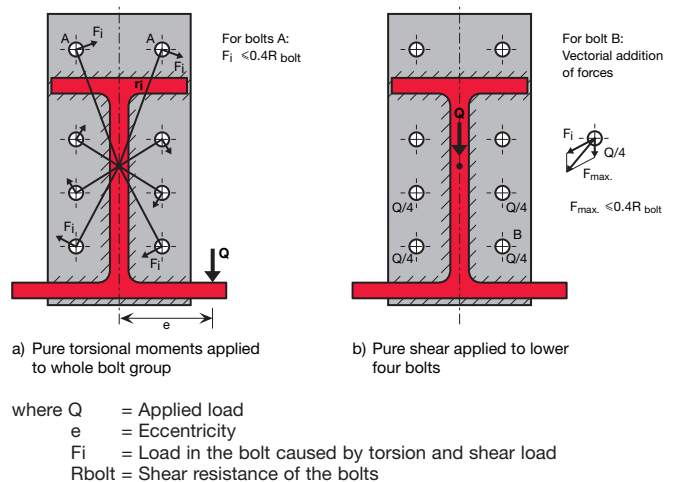


Figure 4.2 Torsional analysis of bolt group

Table 4.2 Shear resistance (simplified) for flush type A end plate connections to ASB sections										
Bolt diameter mm	End plate thickness mm	280 ASB (2-bolt rows)			280 ASB (3-bolt rows)			300 ASB (3-bolt rows)		
		Fillet weld size mm	Pure shear kN	Combined shear and torsion kN	Fillet weld size mm	Pure shear kN	Combined shear and torsion kN	Fillet weld size mm	Pure shear kN	Combined shear and torsion kN
20	10	6	257	83	6	441	169	6	441	161
20	12	6	257	83	6	441	169	6	441	161
24	12	6	371	120	6	635	244	6	635	232
24	15	6	371	120	6	635	244	6	635	232

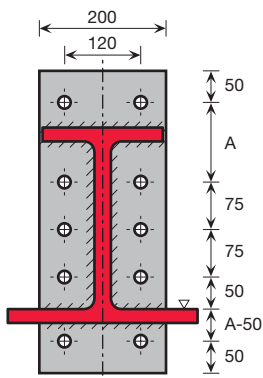
Notes:

1. "Bolt rows" refer to rows of bolts between flanges.
2. Flush type A connections are suitable for shear and torsion only.
3. Flush type B or extended connections must be used where moment resistance is required.

4.2.5 Wind moment connections

Connections with extended end plates above and below the section may be used in 'wind moment' frames (sway frames). At present, this design approach is limited to buildings of up to four storeys in height in order to limit sway deflections. The stiffness of ASB connections has not yet been determined by test and designers should make their own assessment for frame analysis.

Wind moment connections may be designed by extending the end plate above and below the beam in order to resist negative and positive moments when the unbraced frame is subject to horizontal wind forces. In this case, 8 or 10 bolts are used based on the detailing dimensions in *Figure 4.3* and the preferred end plate thickness is 15mm in grade S275. The vertical pitch of the lower bolt pair may be taken as the dimension A so that the bolt group is symmetric. The moment capacity of the connection may be taken from *Table 4.8* applied to resist both negative and positive moments.



Dimension	A
ASB280	110
ASB300	140

Figure 4.3 Wind moment extended end plate

4.3 RHSFB sections

For RHSFB connections, the end plate width is variable depending on the RHS section. However, it is reasonable to use a minimum dimension of 200mm, increasing in 50mm increments depending on the RHS size. The connections are extended above and below the RHS. For detailing purposes, the bolts are set out at a standard distance of 50mm from the top and bottom edges of the RHS (i.e., again using the top of the bottom flange plate as a setting out level). Four M20 or M24 bolts would normally be used (two above and two below), which should be checked for their shear and torsional resistance. These connections are relatively stiff for serviceability design. A typical detail is shown in *Figure 4.4(a)*.

Heavily loaded connections may require the use of additional bolts by further extending the end plate below the beam, as shown in *Figure 4.4(b)*.

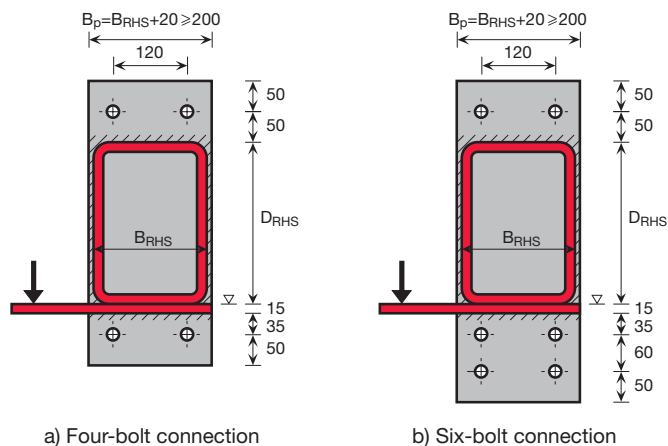


Figure 4.4 Connection to RHSF beam

Table 4.3 Moment capacity (kNm)

Column size		M20 8.8 bolts 12mm S275 flush type B end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 6					300 ASB No. of bolts = 6					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	38 (184)	38 (184)	39 (184)	39 (184)	39 (184)	39 (184)	40 (184)	39 (184)	40 (184)	40 (184)	312
	52	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	347
	60	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	420
	71	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	447
	86	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	584
254 x 254 x	73	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	465
	89	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	555
	107	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	707
	132	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	875
	167	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1149
305 x 305 x	97	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	649
	118	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	781
	137	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	916
	158	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1070
	198	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1344
	240	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1678
	283	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1968
356 x 368 x	129	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	766
	153	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	922
	177	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1098
	202	39 (186)	40 (191)	39 (187)	40 (188)	41 (193)	41 (192)	40 (185)	42 (195)	41 (187)	44 (201)	1279
Shear capacity (kN)												
No torsion		441	441	441	441	441	441	441	441	441	441	
Shear & torsion		180	174	179	178	169	169	177	166	174	161	
Welds (mm)												
Flange		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.4 Moment capacity (kNm)

Column size		M20 8.8 bolts 12mm S275 extended end plate										
		280 ASB No. of bolts = 8					300 ASB No. of bolts = 8					Web panel shear capacity (kN)
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	66 (271)	67 (275)	73 (289)	77 (302)	73 (289)	68 (267)	75 (284)	72 (277)	86 (309)	86 (309)	312
	52	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (327)	347
	60	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	420
	71	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	447
	86	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	584
254 x 254 x	73	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	465
	89	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	555
	107	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	707
	132	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	875
	167	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1149
305 x 305 x	97	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	649
	118	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	781
	137	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	916
	158	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1070
	198	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1344
	240	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1678
356 x 368 x	283	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1968
	129	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	766
	153	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	922
	177	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1098
	202	67 (279)	70 (286)	74 (298)	81 (317)	76 (304)	71 (282)	78 (294)	76 (294)	91 (328)	90 (331)	1279
Shear capacity (kN)												
No torsion		515	515	515	515	515	515	515	515	515	515	
Shear & torsion		212	205	211	210	200	206	216	202	212	196	
Welds (mm)												
Flange		8F	8F	8F	10F	8F	8F	8F	8F	10F	8F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.5 Moment capacity (kNm)

Column size		M20 8.8 bolts 15mm S275 flush type B end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 6					300 ASB No. of bolts = 6					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	38 (184)	38 (184)	39 (184)	39 (184)	39 (184)	39 (184)	40 (184)	39 (184)	40 (184)	40 (184)	312
	52	42 (202)	42 (202)	43 (202)	43 (202)	43 (202)	43 (202)	44 (202)	43 (202)	44 (202)	44 (202)	347
	60	46 (221)	47 (225)	47 (222)	47 (222)	48 (225)	47 (223)	47 (217)	48 (225)	48 (219)	50 (225)	420
	71	46 (221)	47 (225)	47 (222)	47 (222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	447
	86	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	584
254 x 254 x	73	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	465
	89	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	555
	107	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	707
	132	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	875
	167	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1149
305 x 305 x	97	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	649
	118	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	781
	137	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	916
	158	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1070
	198	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1344
	240	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1678
	283	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1968
356 x 368 x	129	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	766
	153	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	922
	177	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1098
	202	46 (221)	47 (225)	47 (222)	47(222)	48 (226)	47 (223)	47 (217)	48 (225)	48 (219)	51 (230)	1279
Shear capacity (kN)												
No torsion		441	441	441	441	441	441	441	441	441	441	
Shear & torsion		180	174	179	178	169	169	177	166	174	161	
Welds (mm)												
Flange		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.6 Moment capacity (kNm)

Column size		M20 8.8 bolts 15mm S275 extended end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 8					300 ASB No. of bolts = 8					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	81 (316)	81 (316)	86 (316)	88 (316)	85 (316)	85 (314)	97 (342)	91 (329)	101 (342)	101 (342)	312
	52	86 (342)	89 (349)	95 (361)	98 (361)	95 (361)	90 (336)	102 (365)	97 (353)	109 (371)	109 (371)	347
	60	91 (366)	94 (373)	103 (396)	106 (396)	103 (396)	95 (360)	109 (395)	102 (376)	118 (409)	118 (409)	420
	71	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	447
	86	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	584
254 x 254 x	73	92 (371)	95 (380)	106 (410)	110 (414)	104 (406)	97 (369)	111 (402)	104 (386)	122 (426)	122 (426)	465
	89	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	555
	107	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	707
	132	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	875
	167	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1149
305 x 305 x	97	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	649
	118	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	781
	137	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	916
	158	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1070
	198	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1344
	240	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1678
356 x 368 x	283	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1968
	129	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	766
	153	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	922
	177	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1098
	202	92 (371)	95 (380)	106 (410)	113 (428)	104 (406)	97 (369)	111 (402)	104 (386)	123 (433)	125 (438)	1279
Shear capacity (kN)												
No torsion		515	515	515	515	515	515	515	515	515	515	
Shear & torsion		212	205	211	210	200	206	216	202	212	196	
Welds (mm)												
Flange		10F	10F	12F	12F	10F	10F	12F	10F	12F	12F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.7 Moment capacity (kNm)

Column size		M24 8.8 bolts 15mm S275 flush type B end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 6					300 ASB No. of bolts = 6					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	45 (218)	45 (218)	46 (218)	47 (218)	46 (218)	46 (218)	47 (218)	47 (218)	48 (218)	48 (218)	312
	52	53 (257)	54 (257)	54 (257)	55 (257)	54 (257)	55 (257)	56 (257)	55 (257)	57 (257)	57 (257)	347
	60	57 (276)	58 (281)	58 (277)	59 (278)	59 (281)	60 (281)	59 (274)	60 (281)	61 (277)	62 (281)	420
	71	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	447
	86	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	584
254 x 254 x	73	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	465
	89	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	555
	107	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	707
	132	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	875
	167	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1149
305 x 305 x	97	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	649
	118	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	781
	137	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	916
	158	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1070
	198	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1344
	240	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1678
	283	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1968
356 x 368 x	129	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	766
	153	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	922
	177	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1098
	202	57 (276)	59 (283)	58 (277)	59 (278)	60 (286)	60 (283)	59 (274)	62 (288)	61 (277)	65 (296)	1279
Shear capacity (kN)												
No torsion		635	635	635	635	635	635	635	635	635	635	
Shear & torsion		260	250	259	256	244	244	255	239	251	232	
Welds (mm)												
Flange		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.8 Moment capacity (kNm)

Column size		M24 8.8 bolts 15mm S275 extended end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 8					300 ASB No. of bolts = 8					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	81 (316)	81 (316)	86 (316)	89 (316)	85 (316)	92 (343)	97 (343)	95 (343)	104 (343)	103 (343)	312
	52	100 (403)	102 (410)	106 (410)	110 (410)	106 (410)	102 (392)	116 (427)	109 (408)	128 (445)	128 (445)	347
	60	104 (427)	107 (434)	117 (461)	126 (485)	117 (461)	109 (421)	121 (451)	116 (438)	140 (499)	140 (499)	420
	71	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	447
	86	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	584
254 x 254 x	73	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	119 (454)	142 (509)	144 (514)	465
	89	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	555
	107	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	707
	132	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	875
	167	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1149
305 x 305 x	97	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	649
	118	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	781
	137	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	916
	158	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1070
	198	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1344
	240	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1678
	283	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1968
356 x 368 x	129	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	766
	153	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	922
	177	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1098
	202	105 (431)	109 (443)	118 (466)	127 (491)	120 (474)	112 (434)	123 (459)	120 (455)	142 (509)	145 (522)	1279
Shear capacity (kN)												
No torsion		741	741	741	741	741	741	741	741	741	741	
Shear & torsion		306	295	305	302	288	297	311	291	306	282	
Welds (mm)												
Flange		12F	12F	12F (4P)	12F (4P)	12F	12F	12F	12F	12F (4P)	12F (4P)	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.9 Moment capacity (kNm)

Column size		M24 8.8 bolts 15mm S355 flush type B end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 6					300 ASB No. of bolts = 6					
S355		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	45 (218)	45 (218)	46 (218)	47 (218)	46 (218)	46 (218)	47 (218)	47 (218)	48 (218)	48 (218)	312
	52	53 (257)	54 (257)	54 (257)	55 (257)	54 (257)	55 (257)	56 (257)	55 (257)	57 (257)	57 (257)	347
	60	58 (281)	58 (281)	59 (281)	60 (281)	59 (281)	60 (281)	61 (281)	60 (281)	62 (281)	62 (281)	420
	71	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	447
	86	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	584
254 x 254 x	73	61 (297)	62 (297)	63 (297)	63 (297)	63 (297)	63 (297)	64 (297)	64 (297)	65 (297)	65 (297)	465
	89	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	555
	107	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	707
	132	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	875
	167	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1149
305 x 305 x	97	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	649
	118	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	781
	137	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	916
	158	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1070
	198	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1344
	240	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1678
	283	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1968
356 x 368 x	129	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	766
	153	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	922
	177	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1098
	202	63 (306)	64 (310)	65 (306)	65 (306)	66 (313)	65 (308)	65 (300)	67 (312)	67 (303)	70 (319)	1279
Shear capacity (kN)												
No torsion		635	635	635	635	635	635	635	635	635	635	
Shear & torsion		260	250	259	256	244	244	255	239	251	232	
Welds (mm)												
Flange		10F	8F	10F	8F	8F	8F	8F	8F	8F	8F	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

Table 4.10 Moment capacity (kNm)

Column size S355		M24 8.8 bolts 15mm S355 extended end plate										Web panel shear capacity (kN)
		280 ASB No. of bolts = 8					300 ASB No. of bolts = 8					
		74	100	105	124	136	153	155	185	196	249	
203 x 203 x	46	85 (316)	86 (316)	91 (316)	91 (316)	90 (316)	97 (343)	104 (343)	101 (343)	106 (343)	106 (343)	312
	52	106 (410)	107 (410)	112 (410)	116 (410)	112 (410)	118 (437)	127 (445)	124 (445)	134 (445)	134 (445)	347
	60	118 (470)	121 (479)	133 (508)	137 (508)	133 (508)	123 (461)	139 (501)	132 (484)	154 (521)	154 (521)	420
	71	125 (505)	129 (518)	141 (549)	151 (574)	143 (555)	132 (503)	147 (538)	142 (528)	170 (592)	170 (592)	447
	86	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	584
254 x 254 x	73	121 (485)	125 (494)	137 (528)	141 (528)	137 (528)	126 (476)	142 (516)	135 (499)	158 (540)	158 (540)	465
	89	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	555
	107	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	707
	132	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	875
	167	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1149
305 x 305 x	97	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	171 (599)	171 (599)	649
	118	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	781
	137	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	916
	158	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1070
	198	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1344
	240	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1678
	283	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1968
356 x 368 x	129	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	766
	153	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	922
	177	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1098
	202	125 (505)	129 (518)	141 (549)	153 (580)	143 (555)	132 (503)	147 (538)	142 (528)	172 (602)	174 (611)	1279
Shear capacity (kN)												
No torsion		741	741	741	741	741	741	741	741	741	741	
Shear & torsion		306	295	305	302	288	297	311	291	306	282	
Welds (mm)												
Flange		12F (4P)	12F (5P)	12F (6P)	12F (7P)	12F (5P)	12F (4P)	12F (5P)	12F (4P)	12F (7P)	12F (6P)	
Web		8F	8F	8F	8F	8F	8F	8F	8F	8F	8F	

Notes:

1. Normal type = Mode 1 failure; *Italic type* = Mode 2 failure.
2. Figure in brackets gives the sum of the maximum available bolt row forces, in tension (kN), on the beam side when no axial forces are present.
3. Flange welds are full strength or 1.4 times over strength of the connection (F = Fillet, P = Penetration).
4. Web welds are a nominal 8mm fillet.

