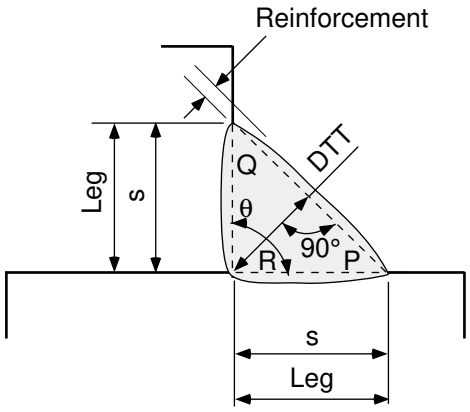
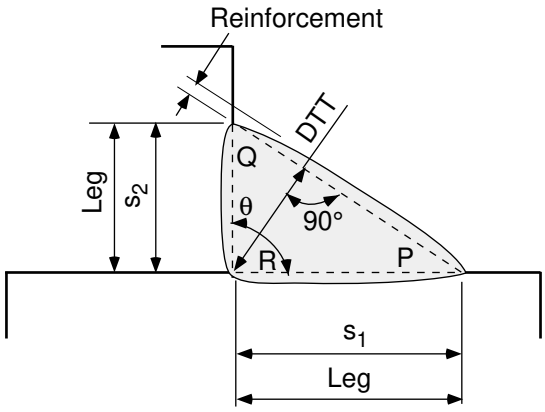
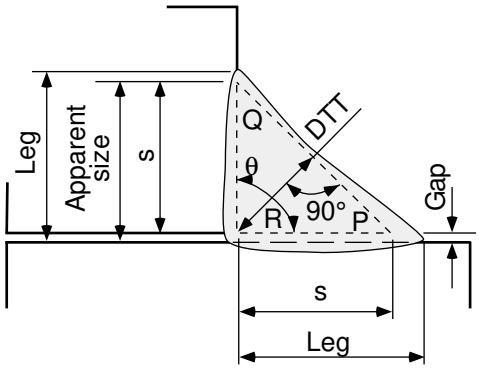


(a) Equal leg fillet weld

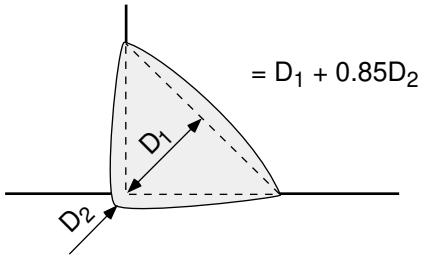


(b) Unequal leg fillet weld

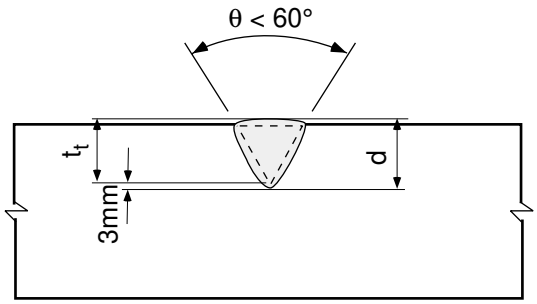


(c) Fillet weld with gap

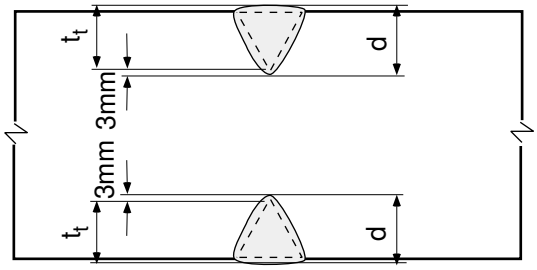
Design throat thickness for deep penetration welds made by fully automatic processes



(d) Deep penetration weld



(e) Incomplete penetration single V butt weld



(f) Incomplete penetration double V butt weld

FIGURE 9.3 NOTATION FOR WELDS

9.4 SIMPLE SHEAR CONNECTIONS

AS 4100 Ref.

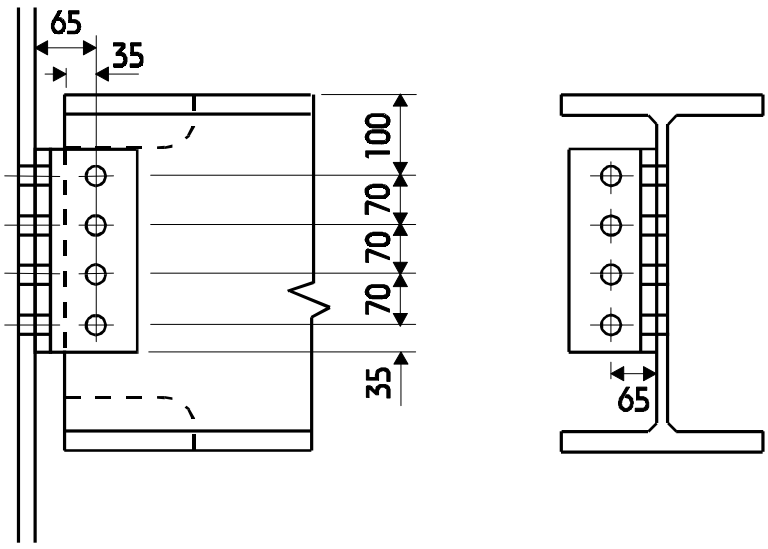
The shear capacity and the detailing requirements of a range of simple connections are given in Tables 9.4.1 to 9.4.6. For greater detail, reference should be made to the Australian Institute of Steel Construction publication *Standardized Structural Connections—4th edition*, due 2000.

Tables 9.4.1 to 9.4.6 are the original ones prepared for the 1993 edition and are based on a plate and section grade of 250. Thus some connection capacity values, those based on plate failure rather than bolt or weld failure, will be conservative if plate or sections of higher grade are used.

Table 9.4.1 Single Angle Cleat Connection Capacity

Member	Single angle cleat connections (kN)							
	9 Bolts	8 Bolts	7 Bolts	6 Bolts	5 Bolts	4 Bolts	3 Bolts	2 Bolts
760UB	531	472	413	354				
690UB		472	413	354	284			
610UB			413	354	284	207		
530UB				354	284	207	136	
460UB					284	207	136	
410UB						207	136	73
360UB							136	73
310UB							136	73
250UB								73*

* Double web cope not recommended



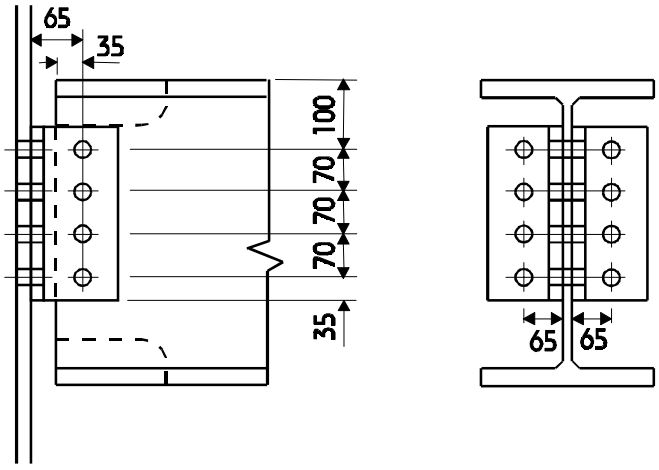
ANGLES: USE 100 × 100 × 6 ANGLE, LENGTH = 70 × No. ROWS BOLTS.
BOLTS: USE M20 8.8\S

Table 9.4.2 Double Angle Cleat Connection Capacity

Member	Double angle cleat connections (kN)							
	9 Bolts	8 Bolts	7 Bolts	6 Bolts	5 Bolts	4 Bolts	3 Bolts	2 Bolts
760UB244-197	1061	943	826	708				
760UB173	1061*	943	826	708				
760UB147	1061*	905	826	708				
690UB140		943*	772	708	568			
690UB125		943*	750	708	554			
610UB125			808*	671	563	411		
610UB113			755*	625	530	386		
610UB101			710*	585	502	366		
530UB92				593*	481	352	230	
530UB82				551*	445	330	216	
460UB82					469*	342	224	
460UB78					430*	314	205	
460UB67					401*	293	192	
410UB60						269*	176	96
410UB54						262*	172	93
360UB57							175	97
360UB51							157	89
360UB45							144	82
310UB46							155*	82
310UB40							138*	75
250UB37								78**
250UB31								75**

* Double web cope not recommended

** Double **or** single web cope not recommended

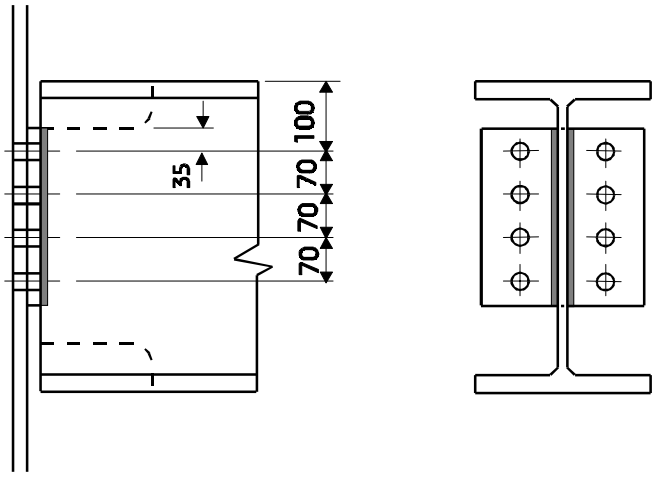


ANGLES: USE 100 × 100 × 6 ANGLE, LENGTH = 70 × No. ROWS BOLTS
BOLTS: USE M20 8.8\S

Table 9.4.3 Flexible End Plate Connection Capacity

Member	Flexible end plate connections (kN)							
	9 Bolts	8 Bolts	7 Bolts	6 Bolts	5 Bolts	4 Bolts	3 Bolts	2 Bolts
760UB244-197	1122	1095	958	821				
760UB173	1016	1016	946	811				
760UB147	1066*	905	853	731				
690UB140		918*	772	703	586			
690UB125		894*	750	690	575			
610UB125			808*	671	585	486		
610UB113			755*	625	550	440		
610UB101			710*	625*	521	417		
530UB92				583*	481	401	301	
530UB82				551*	445	375	282	
460UB82					485*	383	292	
460UB78					442*	348	268	
460UB67					409*	321	250	
410UB60						307	230	153
410UB54						298*	224	149
360UB57							234*	156
360UB51							215*	143
360UB45							202*	135
310UB46							198*	117
310UB40							179*	120*
250UB37								126**
250UB31								120**

* Double web cope not recommended
** Double **or** single web cope not recommended

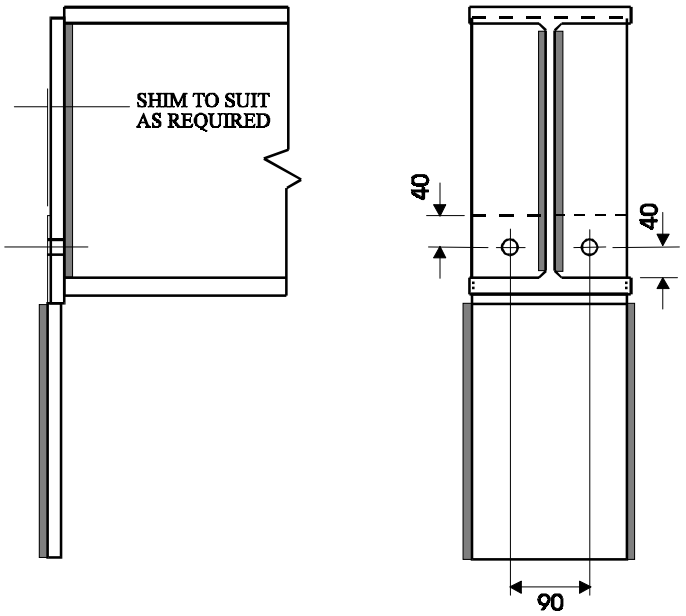


END PLATE: WIDTH = 150 mm, THICKNESS = 8 mm, LENGTH = 70 × No. ROWS BOLTS
BOLTS: USE M20, 8.8\S
ALL WELDS: USE 6E48 FILLET WELDS — FULL LENGTH OF PLATE

Table 9.4.4 Bearing Pad Connection Capacity

Member	Bearing pad connections (kN)		
	End plate	Bearing pad	CAP.
760UB244	140×800×25	140×650×25	1144
760UB220			1144
760UB197			1144
760UB173			1144
760UB147			1144
690UB140	140×700×25		1082
690UB125			1082
610UB125	140×630×25	140×600×25	962
610UB113			955
610UB101		140×550×25	896
530UB92	90×550×25	90×500×25	763
530UB82		90×450×25	708
460UB82	90×480×25	90×400×25	640
460UB74	90×470×20	90×400×20	583
460UB67		90×350×20	540
410UB60	90×420×20	90×300×20	445
410UB54			429
360UB57	90×380×20		400
360UB51		90×250×20	364
360UB45			339

Member	Bearing pad connections (kN)		
	End plate	Bearing pad	CAP.
310UB46	90×320×20	90×200×20	290
310UB40			260
250UB37	90×270×20	90×150×20	230
250UB31			215
200UB30	90×220×20		183
200UB25			167
310UC283	90×360×25	90×300×25	579
310UC240			579
310UC198			579
310UC158			579
310UC137			579
310UC118			525
310UC97			428
250UC89	90×280×20	90×250×20	352
250UC73		90×200×20	308
200UC60	90×230×20		273
200UC52			232
200UC46		90×150×20	209
150UC37	90×180×20		185
150UC30			145
150UC23			131

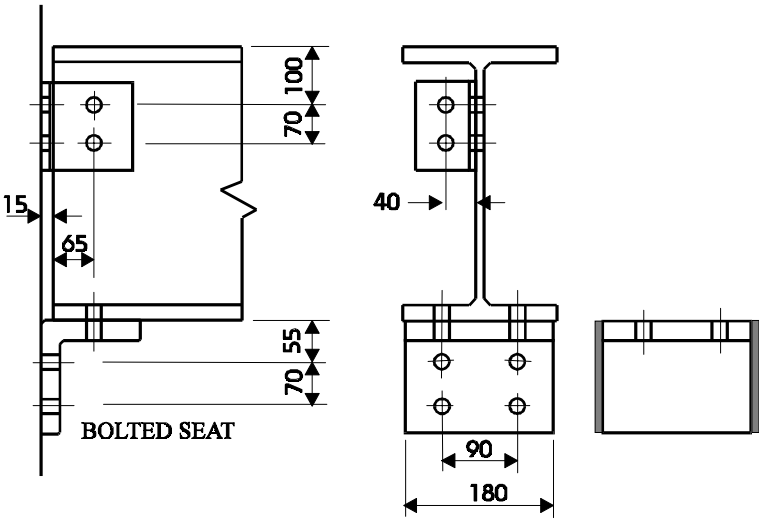


PLATES: USE DIMENSIONS AS GIVEN IN TABLE
BOLTS: USE M20, 8.8\S
WELDS: USE 6 mm E48 FILLET WELDS — FULL LENGTH OF PLATES , OR
USE 8 mm E48 FILLET WELDS — FULL LENGTH OF PLATES (310UC ONLY)

Table 9.4.5 Angle Seat Connection Capacity

Member	Angle seat connections (kN)		
	Bolted seat	6E48 Welded seat	8E48 Welded seat
760UB244	-	-	386
760UB220	-	287	386
760UB197	357	287	386
760UB173	357	287	386
760UB147	342	287	342
690UB140	331	287	331
690UB125	308	287	308
610UB125	318	287	318
610UB113	287	287	287
610UB101	259	287	259
530UB92	225	252	255
530UB82	228	228	228
460UB82	237	237	237
460UB74	213	213	213
460UB67	192	192	192
410UB60	180	180	180
410UB54	168	168	168
360UB57	183	183	183
360UB51	165	165	165
360UB45	151	151	151

Member	Angle seat connections (kN)		
	Bolted seat	6E48 Welded seat	8E48 Welded seat
310UB46	151	151	151
310UB40	135	135	135
250UB37	357	287	386
250UB31	357	287	386
200UB30	357	287	386
200UB25	357	287	386
310UC283	357	287	385
310UC240	329	287	329
310UC198	260	260	260
310UC158	NR	NR	NR
310UC137	NR	NR	NR
310UC118	NR	NR	NR
310UC97	NR	NR	NR
250UC89	NR	NR	NR
250UC73	NR	NR	NR
200UC60	NR	NR	NR
200UC52	NR	NR	NR
200UC46	NR	NR	NR
150UC37	NR	NR	NR
150UC30	NR	NR	NR
150UC23	NR	NR	NR



ANGLE SEAT: USE 150 × 90 × 12 ANGLE, LENGTH = 180 mm, SHORT LEG IS USED AS SEAT (MAY BE BOLTED OR WELDED AS GIVEN)

RESTRAINING CLEAT: USE 100 × 75 × 6 ANGLE, LENGTH = 140 mm

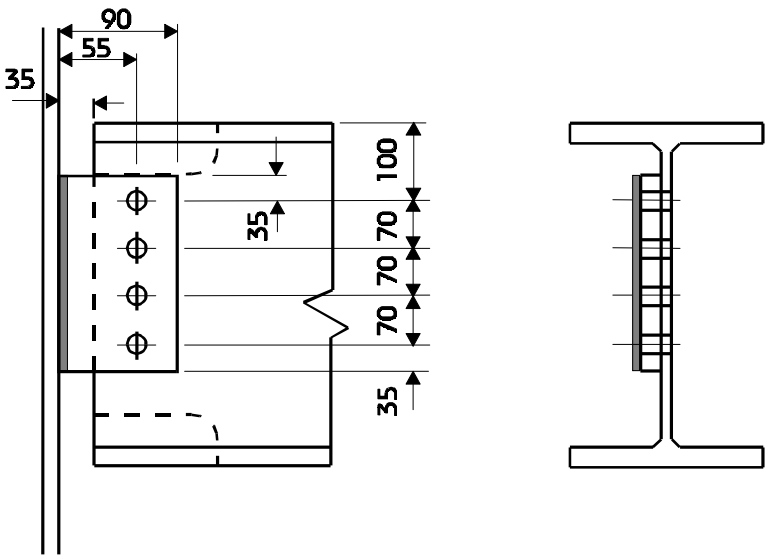
BOLTS: USE M20, 8.8\S

WELDS: USE 6 mm E48 FILLET WELDS—FULL LENGTH OF SEAT LEG (2 × 150 mm), OR USE 8 mm E48 FILLET WELDS—FULL LENGTH OF SEAT LEG (2 × 150 mm) (AS GIVEN IN TABLE)

Table 9.4.6 Web Side Plate Connection Capacity

Member	Web side plate connections (kN)							
	9 Bolts	8 Bolts	7 Bolts	6 Bolts	5 Bolts	4 Bolts	3 Bolts	2 Bolts
760UB	726*	632	538	444				
690UB		632*	538	444	351			
610UB			538*	444	351	260		
530UB				444*	351	260	173	
460UB					351*	260	173	
410UB						260*	173	96
360UB							173	96
310UB							173*	85
250UB								85*

* Double web cope not recommended



SIDE PLATE: WIDTH = 90 mm, THICKNESS = 10 mm, LENGTH = 70 × No. ROWS BOLTS
BOLTS: USE M20, 8.8\S
WELDS: USE 6E48 FILLET WELDS — FULL LENGTH OF PLATE

10 BRITTLE FRACTURE

	AS 4100 Ref.
Brittle fracture is unlikely if all of the following conditions apply: • Thickness does not exceed 70 mm • Not exposed to sub zero temperature • Fabrication does not result in a bending radius of less than 50 times the plate thickness	10.4

This Handbook highlights the conditions under which brittle fracture is not a problem; otherwise refer to AS 4100 for detailed consideration.

11 FATIGUE

11.1 LIMITATIONS

	AS 4100 Ref.
The advice in this Section is applicable to conditions where all cyclic loadings can be assumed to be equal to the most severe and where metal thickness does not exceed 25 mm.	11

This Handbook highlights the conditions under which fatigue is not a problem; otherwise refer to AS 4100 for detailed consideration.

11.2 METHOD OF ASSESSMENT

	AS 4100 Ref.
(a) *Number of stress cycles*: estimate the number of stress cycles n_i for the expected life of the detail. If $n_i < 10^4$ (i.e. one application every day for 25 years), no further assessment is required. (b) *Stress range*: estimate the stress range f^*, i.e. the algebraic difference between two extremes of stress. The stresses are calculated taking into account all cyclic design actions but excluding stress concentrations due to the geometry of the detail. The loading is to be the actual cyclic service loading including dynamic effects. No further assessment is required if: (i) $f^* < 26$ MPa or (ii) $n_i < 5\times10^6\left(\frac{27}{f^*}\right)^3 \quad \left(=\frac{10^{11}}{(f^*)^3}\right)$ (c) *Detail category*: select the appropriate detail category in accordance with Table 11, to obtain the constant stress range fatigue limit f_3. (i) if $f^* < f_3$ no further assessment is required. (ii) if $f^* > f_3$ the number of cycles the detail can survive is $$n_{i\,max} = 5\times10^6\left(\frac{f_3}{f^*}\right)^3$$	11.1.6 11.4 11.5 11.7

If the structural system is such that failures of the detail lead to the collapse of the structure, AS 4100 requires that the expected life should be increased by a factor of at least 3.0. To avoid this penalty it is necessary to modify the structural system to one that is fail-safe (i.e. with alternative load paths).

Table 11 Detail Category

Type of detail	f_3 (MPa)
• Bolts and threaded rods in tension • Joints with partial penetration butt welds or fillet welds (stress range on the weld throat) • Cover plates in beams and plate girders	27
• Beams subjected to bending with stiffeners fillet-welded to flanges and webs • Tapered built-up members connected by full penetration butt-welds perpendicular to the direction of applied stress • Stud-welded base metal • Base metal having fillet welded attachments	52
• Prismatic members connected by full penetration butt-welds perpendicular to the direction of applied stress • Bolt in shear 8.8/TB • Any continuous longitudinal butt or fillet weld other than those with an f_3 value of 92 MPa	66
• Manual flame-cut base metal, automatic flame-cut base metal with drag line • Built-up members connected by continuous full penetration butt-welds or continuous fillet welds parallel to the direction of applied stress (no unrepaired stop-start positions and welded from both sides)	92
• Automatic flame-cut or shear edge base metal • Material for bolted connection using 8.8/TF procedure	103
• Rolled and extruded products	118

This Table is based on AS 4100 but has been simplified greatly to be used for preliminary fatigue assessment. For detailed fatigue assessment refer to AS 4100.

For bolts subject to fluctuating stresses in tension it is common practice to fully tension the bolt to alleviate fatigue problems.