Economical Structural Steelwork

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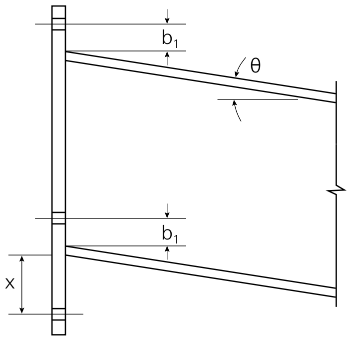
AUSTRALIAN STEEL INSTITUTE

Contents

TABLE 8.1: Wrench clearances



θ	Recommended Minimum Dimensions			Remarks
		X		
	b_1	For Air Wrench*	For Hand Wrench	
0°	60	60	60	M20 & M24 Bolts only
5°	60	100	60	
7.5°	60	100	60	
10°	60	100	60	

Note:

* The use of a universal joint does offer some possibility of reducing this dimension, and while this may be seen as an advantage from a design point of view, it should be noted that an impact wrench with a universal joint and socket is generally difficult to handle for an operator some height from ground level. In addition, the use of a universal joint reduces the efficiency of the impact wrench and this can be a problem in tensioning M24 bolts or larger, especially if located some distance from the source of the compressed air supply.

8.5 Portal Frames

8.5.1 CONNECTIONS

A discussion of various aspects of the economics of portal frame steel buildings is contained in Clause 4.2. A number of other items of concern to the economic detailing of these frames is contained in this Section.

In portal frames using bolted end plate connections for the knee and apex joints (see Figure 4.2), close attention must be paid to the detailing of these connections, especially where tensioned bolts (8.8/TB category) are employed - the most common practice. Any cost savings obtained by simplifying connection details to make fabrication simpler can be lost during site erection if clearance problems are encountered during site assembly. Recommended dimensions for such connections, extracted from Ref. 1, are given in Table 8.1. These dimensions are sufflcient to ensure that the bolts can be installed and tensioned, since sufflcient clearance is provided to accommodate either hand or air wrenches.

In the design of the end plates, designers can approach the proportioning of the end plate to resist the bending moment developed due to the behaviour of the plate under loading in two ways:

(a) Use a thick unstiffened end plate.

(b) Use a thin stiffened end plate.

Figure 8.24(a) shows an excessively stiffened thin end plate which would be an extremely expensive detail compared to the thicker end plate detail of Figure 8.24(b). For this reason, (b) is much preferred. Another problem with excessively stiffened end-plates is that insufflcient clearance may then exist to allow the bolts to be installed. Design guidance on the design of end plates without stiffening may be found in Ref. 2.

At a bolted apex joint, care must also be taken to allow sufflcient clearance between the adjacent purlin cleat and the end plate to enable the end plate bolts to be installed and tensioned. The dimension 'Z' (see Figure 8.25) must be larger than the bolt length to be installed plus a clearance dimension, and also be large enough to permit the wrench socket to be placed on the nut.

Where split universal sections are used to haunch a portal frame rafter (see Figure 4.2), stopping short the flllet weld joining the split haunch to the ange of the rafter is suggested as an economical and structurally sound device. Any flllet weld placed in the tight conflnes of the junction is likely to be of doubtful quality due to the difficult access involved – see Figure 8.26.

The recommended method of attaching purlins and girts in portal frame buildings is illustrated in Figure 8.27.

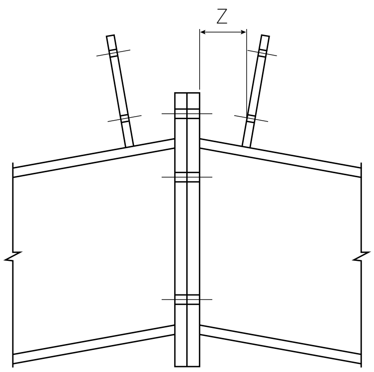


FIGURE 8.25: Clearance at apex joint

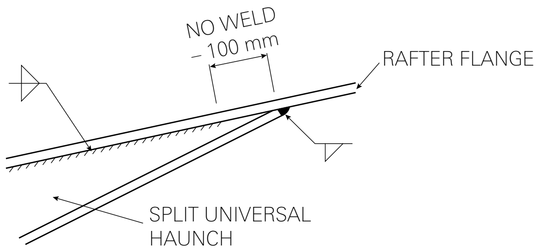
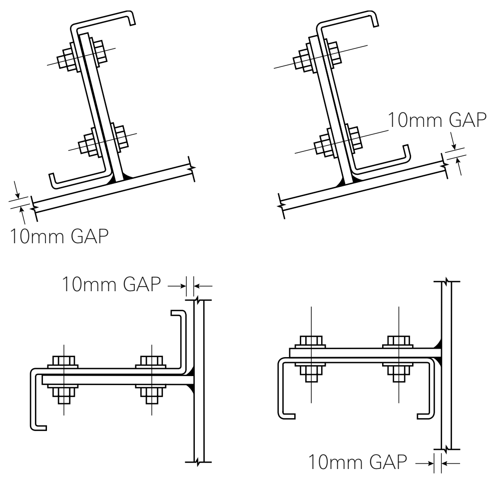


FIGURE 8.26: Termination of haunch



Notes:

1. Place girts and purlins to most effectively shed water and debris with due consideration to ease of erection.
2. Ensure adequate clearance to avoid interference with cleat welding.
3. Design cleats to accommodate standard punching – refer to manufacturers' brochures.
4. Ensure adequate capacity in top girt to carry load from sag rods.

Figure 8.27: Attachment of purlins and girts

8.5.2 PORTAL FRAME PRE-SET

In order to ensure that the columns of a portal frame will be within the basic erection tolerances in the flnal erected position, it is necessary to provide a 'pre-set' of the frame during fabrication.

This is done by determining the de ection at the frame ridge under dead loads and calculating the resultant horizontal de ection at the knee joints. This latter dimension is then used in the set-out for fabrication to pre-set the geometry of the frame – see Figure 8.28.

8.6 Connection Detailing

8.6.1 GENERAL

In general, the greatest economy in detailing of beam-to-column and beam-to-beam connections is achieved by selecting combinations of connections to require only one type of operation to be executed on each member in the fabrication shop. Preferred ways in which this can be achieved are suggested in Figure 8.29.

Such a method of selecting connections enables the fabricator to reduce the handling operations required to fabricate the member and lends itself readily to a ‘ ow-through’ system in the shop.

The designer and detailer should look at rationalising the selection of details and connections in this way. Naturally, holing operations on any group of similar members would use the same set-out parameters (gauge lines, pitch, hole diameter, etc.).

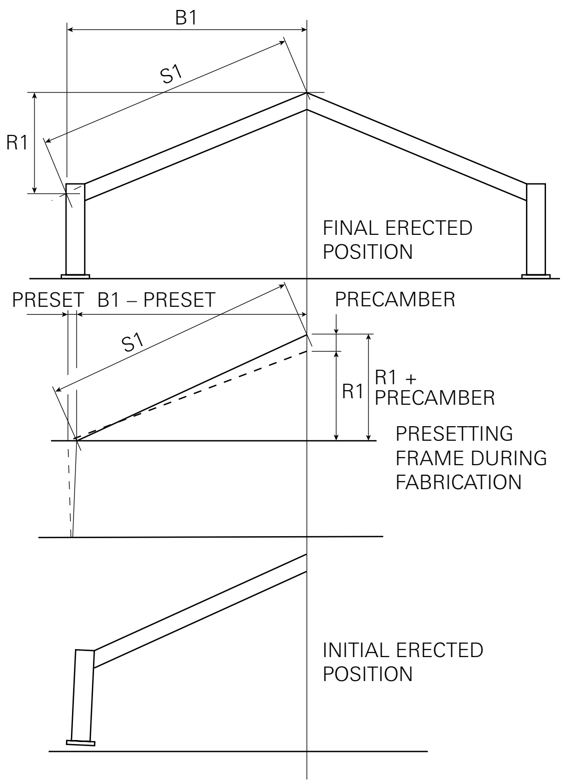


FIGURE 8.28: Precambering details of a rigid frame

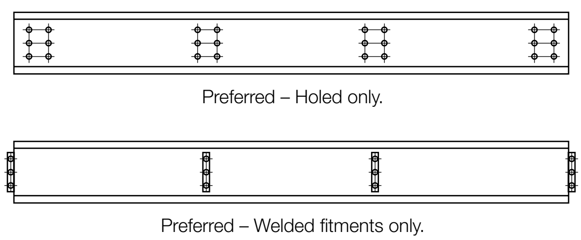


FIGURE 8.29: Typical beam details for fabrication economy

An example of this type of selection process can be illustrated using the beam marking plan shown in Figure 8.30. In this instance, the frame is braced in both planes and exible connections only are to be used.

In this frame the critical connections are those to the two box columns. If these columns are small they cannot accept connections requiring bolting through their walls. If they are large, bolting through may be possible (with