Part 5
RIGID CONNECTIONS

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Part 5
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5.1 General

Rigid connections are those connections which are required to transmit bending moment as the primary design action. The behaviour of the connection is such that the design bending moment is resisted with very little joint rotation. A perfect rigid joint would have no joint rotation at the design bending moment, but this is never achieved in practice.

Beam-to-column connections in unbraced rectangular frames, and ridge and knee connections in portal frame structures are typical applications of rigid connections. This part of the manual gives suggested details for these connections, but design capacities are not provided. It is proposed that testing will be undertaken to confirm appropriate design models where appropriate.

5.2 Bolted Moment End Plate

5.2.1 General

The bolted moment end plate connection is a popular and efficient connection which can be used in almost every case. It is particularly suitable for site connections. It is also suitable for beam splices. Bolts may be arranged with 2 bolts at each flange, or 4 bolts at each flange as shown in Figure 5.1. This arrangement typically provides good rigid connection behaviour.

5.2.2 Design Method

The design model presented in Hogan and Thomas (1994) is commonly used to design bolted moment end plate connections of this type to Universal Beams, but would require some modification to be used with the LSB. The design capacities of the LSB member and the welds to the end plate must be determined in accordance with AS/NZS 4600.

Fillet welds are the most economical method of connecting the end plate to the LSB, and the flanges have a fillet weld on one side only whereas the web is welded on both sides. The designer must be aware that the design capacity of the single fillet welds to the flanges, as calculated from AS/NZS 4600, can not always achieve the full tension capacity of the LSB. This applies to the 1.6 mm and 2.0 mm thick LSB only, because the fillet welds to the thicker sections are designed to AS 4100.

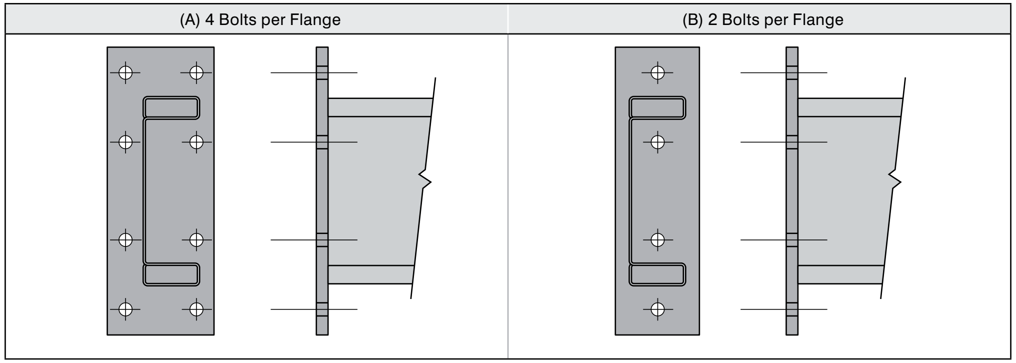

Figure 5.1: Typical Bolt Arrangement for Bolted Moment End Plate

The design of the end plate may also need to be modified to take account of the hollow flange which is effectively a rectangular hollow section. The method given by Packer and Henderson (1997) for rectangular HSS flange-plate connections bolted along two sides of the HSS (hollow structural section) would be more appropriate than the T-stub model which is generally used for I-beams and also used by Hogan & Thomas (1994). The rectangular tension flange of the LSB would be expected to behave in the same manner as a RHS with a flange plate connection, but no testing has been done at this time to verify this assumption. This would apply to the arrangement with 2 bolts at each flange (one bolt above and below the flange), but the arrangement shown in Figure 5.1 (A) with 4 bolts at each flange may require a different approach to account for different yield lines in the end plate. For the largest section, the 300 × 75 × 3.0 LSB, it should be possible to design a bolted moment end plate connection with 2 M20-8.8/S bolts at each flange which will achieve the full moment capacity of the LSB.

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5.2.3 Alternative End Plate Details

There are two alternative bolt arrangements shown in Figure 5.2 for bolted moment end plates which may also be used with the LSB. However, these connections may not provide fully rigid connections, but may tend to be more semi-rigid. Also, they may not be as economical because of the requirement to use larger bolts and thicker end plates to achieve the full moment capacity of the LSB. However, they may be suitable for connections which do not require the full moment capacity of the LSB.

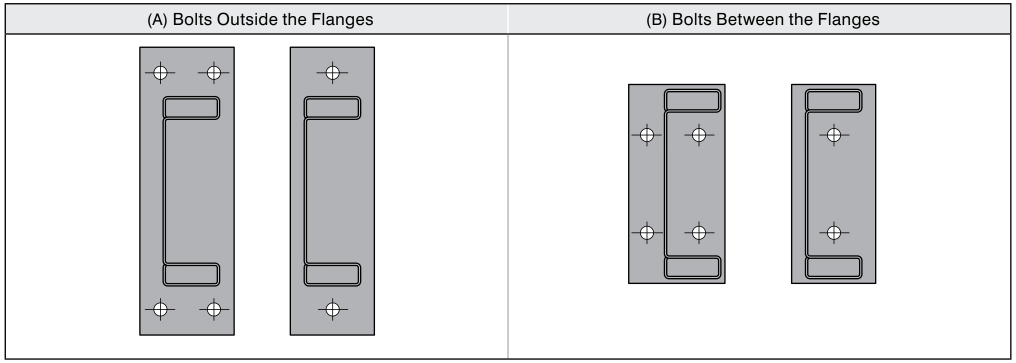

Figure 5.2: Alternative Bolt Arrangement for Bolted Moment End Plate

5.2.4 Typical Connection Configurations

Bolted moment end plate connections may be used in an orthogonal configuration (the end plate is perpendicular to the beam longitudinal axis) as in the beam to column and beam splice connections, or in a mitred configuration as used in portal frame knee and ridge joints. These are illustrated in Figure 5.3.

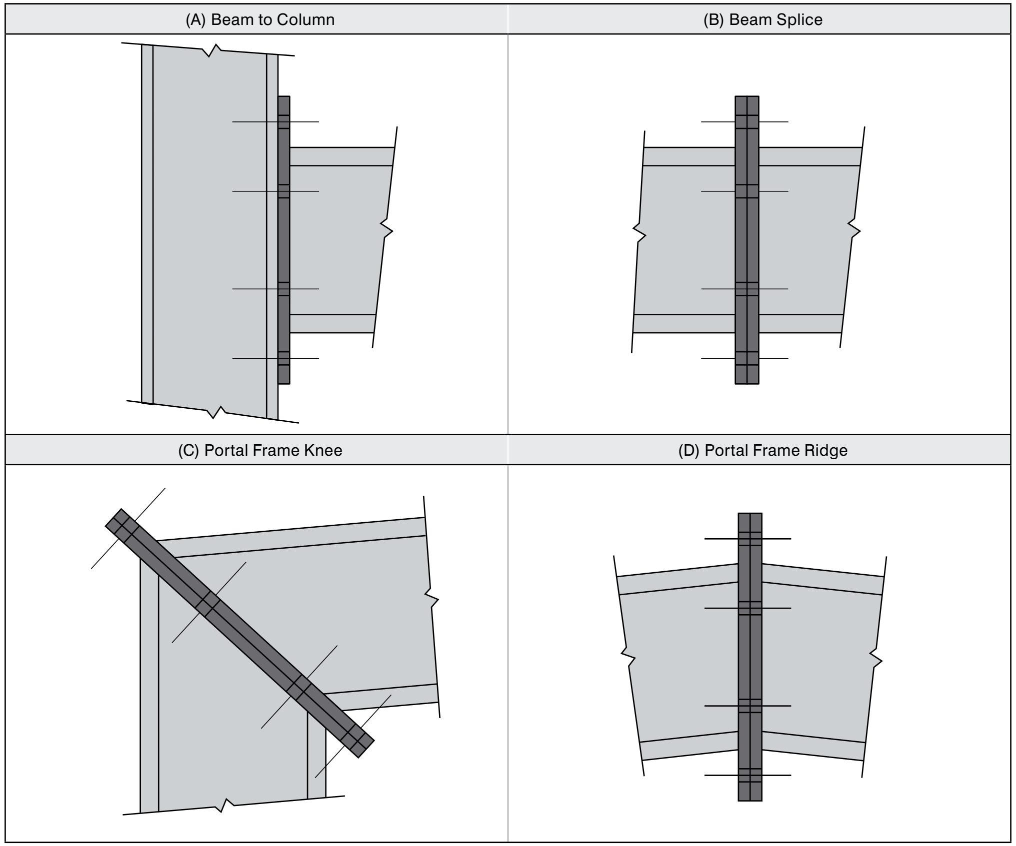

Figure 5.3: Typical Connection Configurations

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5.3 Welded Splice

Two methods of producing a welded splice in an LSB are illustrated in Figure 5.4. The first method, shown in Figure 5.4(A), utilises a complete penetration butt weld throughout the entire cross section profile of the LSB. All welding must be in accordance with either AS/NZS 1554.1 or ANSI/AWS D1.3 as appropriate, using prequalified preparations. Because the flanges can only be welded from one side, it is recommended that a backing strip is used inside the flanges to achieve the complete penetration. The butt weld design must be in accordance with Clause 5.2.2 of AS/NZS 4600. Guidance on design is also given in Section 3.2.2 of this manual.

An alternative (and perhaps more economical and easier) splice can be achieved by inserting a plate between the ends of the LSB sections and fillet welding each section to the plate as shown in Figure 5.4(B). The fillet welds must be designed in accordance with Clause 5.2.2 of AS/NZS 4600. Guidance on design is also given in Section 3.2.3 of this manual. Designers should be aware that using the AS/NZS 4600 design rules it is not possible to obtain the full strength of the flange for sections 1.6 mm and 2.0 mm thick, because the flanges are welded from only one side. However, the web may be welded from one side or two sides depending on the design forces in the web. There is no advantage welding the web on both sides if it is not necessary, although it should be welded on both sides if corrosion may be a problem in service or during construction.

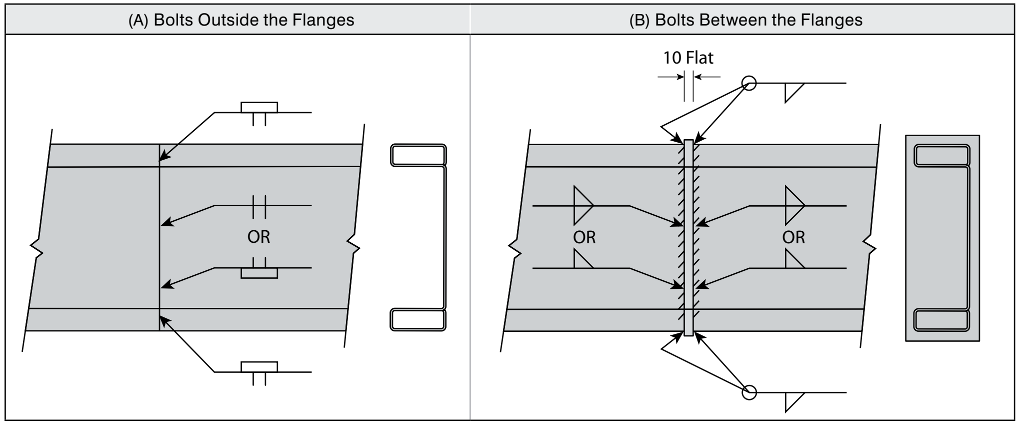

Figure 5.4: Welded Splice Details