AD 370
Weld design for beam end plate connections in accordance with SCI P358

This Advisory Desk Note provides guidance on (1) the design of beam to end plate welds and (2) the "Alternative weld design" noted in Appendix C of P358, when the shear force in the connection is modest and the designer wishes to provide a weld that is less than 'full strength'.

The SCI Publication *Joints in Steel Construction: Simple Joints to Eurocode 3* (P358) includes guidance for the design of partial depth and full depth flexible end plate connections. In P358, **Check 2, on pages 16 and 74** respectively for the two types of connection, gives the requirements for sizing the weld between the end plate and the beam. The recommended weld size is "effectively a full strength weld", as explained in Appendix C. This was considered by the by ECCS/ TC10 committee to be sufficient to ensure that the weld would not fracture prematurely (although the reduction factor mentioned in Section C.2 was not included in the recommendations in their publication). **Check 2** also comments "See Appendix C for more details about the weld requirements"; this was intended to offer guidance on determining smaller weld sizes in situations where the shear force is less than the shear resistance of the beam web (determined over the length of the weld to the end plate).

Appendix C.4 of P358 simply notes that designing for the minimum sizes (given by Check 2) might be "too conservative" and that the connection could be designed in accordance with BS EN 1993-1-8 "accounting for the vertical shear and the inevitable coexisting moment in the connection". Neither the Standard nor P358 define the 'coexisting moment' or how to calculate it.

Guidance on the coexisting moment can be taken from **Check 8 (page 21 or 76)** in P358, where the procedure for design of the bolt group uses a reduction factor of 0.8 on the shear resistance of the bolt to allow for the presence of tension in the bolts, and from **Check 9 (page 23)** where the procedure for the design of partial depth end-plate in shear suggests that the effects of the 'coexisting moment' can be accounted for by reducing the shear resistance of the end-plate by a factor of 1.27. Based on those recommendations, the following pragmatic approach can be used to determine the minimum required size of the beam web to end-plate weld:

Step 1

Use **Check 2** to determine the minimum throat size of web to end-plate weld "a" for an 'effective full strength' connection.

Step 2

Determine the size of weld required for the actual design value of shear force, V_{Ed}:

$a_1 = a \times V_{Ed} / V_{c,Rd}$

where $V_{c,Rd}$ is the design shear resistance of the length of web attached to the end plate **(see Check 4 (page 17 or 75)** in P358)

Step 3

To allow for the effect of the 'coexisting bending', increase the weld size by the factor 1.27.

$a_2 = a_1 \times 1.27$ but $a_2 \leq a$

This value of weld size is the minimum size of web to end-plate weld needed to support the design shear with 'coexistent bending'. It should be noted that this approach has not been verified by test and is based on the simplifications given in P358 for estimating the effect of the 'coexisting moment'.

If the tying force is greater than the shear force then the adequacy of the weld should be demonstrated in accordance with clause 4.5.3.2 or 4.5.3.3 of BS EN 1993-1-8:2005, replacing γ_{M2}.with γ_{Mu} (=1.1).

For practical reasons and for compliance with the requirements of clause 4.5.2 (2) of BS EN 1993-1-8, the throat thickness of the fillet weld should not be less than 3 mm.

Contact: **Abdul Malik**
Tel: **01344 636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates July & August 2012

BS EN PUBLICATIONS

BS EN ISO 16834:2012
Welding consumables. Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels. Classification
Supersedes BS EN ISO 16834:2007

BS EN ISO 18275:2012
Welding consumables. Covered electrodes for manual metal arc welding of high-strength steels. Classification
Supersedes BS EN 757:1997

BS EN ISO 22825:2012
Non-destructive testing of welds. Ultrasonic testing. Testing of welds in austenitic steels and nickel-based alloys
Supersedes BS EN ISO 22825:2006

BRITISH STANDARDS WITHDRAWN

BS EN 757:1997
Welding consumables. Covered electrodes for manual metal arc welding of high strength steels. Classification
Superseded by BS EN ISO 18275:2012

BS 5400-10C -1999
Steel, concrete and composite bridges. Charts for classification of details for fatigue
This standard has been withdrawn following the publication of BS EN 1993-1-9:2005

ISO PUBLICATIONS

ISO 630-3:2012
Structural steels. Techinical delivery conditions for fine-grain structural steels.
Will not be implemented as a British Standard

ISO 630-4:2012
Structural steels. Technical delivery conditions for high-yield-strength quenched and tempered structural steel plates
Will not be implemented as a British Standard

ISO 898-5:2012
(Edition 3)
Mechanical properties of fasteners made of carbon steel and alloy steel. Set screws and similar threaded fasteners with specified hardness classes. Coarse thread and fine pitch thread
Will be implemented as an identical British Standard

NEW WORK STARTED

EN WI 00127277
Test methods for determining the contribution to the fire resistance of structural members. Contribution of fire resistance to steel beams with web opening

ISO 15614-1
Specification and qualification of welding procedures for metallic materials. Welding procedure test. Arc and gas welding of steels and arc welding of nickel and nickel alloys

ISO 15614-7
Specification and qualification of welding procedures for metallic materials. Welding procedure test. Overlay welding