

## AD 379

# Tying resistances of full depth end plates

An SCI member has pointed out some inconsistencies in the tying resistances for full depth end plates given in P358 *Joints in steel construction; Simple joints to Eurocode 3 (2011)*. The tying resistance of standard full depth end plates are given on Pages T-42 to T-57, and follows the procedure laid out in check 11 (pages 79 and 80 of P358).

After some investigation, it has been found that the problem originates in the calculation of the alpha factor, for the bolts near the bottom flange. The alpha factor depends on the position of the bolt with respect to the flange and web and is taken from an "alpha chart" given in BS EN 1993-1-8:2005. This same chart is more commonly used in the calculation of moment resisting connections.

The several curves in the "alpha chart" may be represented by expressions. To calculate alpha for use in P358, SCI used the expressions given in P207 *Joints in Steel Construction: Moment Connections, 1995* (which covered connections designed in accordance with BS 5950-1). Whilst those expressions provide a good solution within the scope illustrated in P207, namely a maximum value of  $\lambda_2$  of 1.4, unfortunately when  $\lambda_2$  exceeds 1.4, the alpha value given by the expressions bears little resemblance to the correct value.

A more comprehensive expression for alpha can be found in P398 *Joints in steel construction: Moment-resisting joints to Eurocode 3, 2013* (The Eurocode version of P207). It is strongly recommended that designers use this expression in their own calculations, rather than

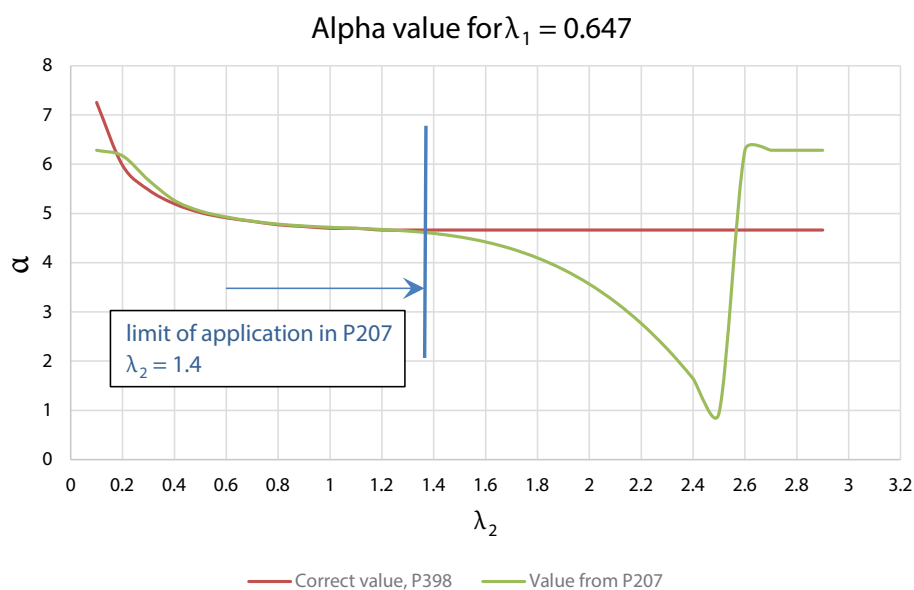


Figure 1  $\alpha$ , as calculated from P207 and P398

those from P207.

For interest, Figure 1 shows the relationship between the values calculated by the P207 expressions and the correct value from P398, for a particular value of  $\lambda_1$ .

Using the improved expression for alpha from P398 reduces the tying resistance for full depth end plates, in some cases, for beams deeper than 610mm. The reduction tends to occur with fewer bolt rows, when the lower bolt row becomes further from the bottom flange and  $\lambda_2$  increases.

Revised pages T-42, 43, 44 and T-50, 51, 52

are available on Steelbiz (Search for the file 'P358 Tying Corrections January 2014'). The version of P358 on Steelbiz has also been updated. In calculating the revised values, for simplicity alpha was limited to  $2\pi$  (6.28) rather than the maximum value of 8 presented in the alpha charts in P358 and P398.

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