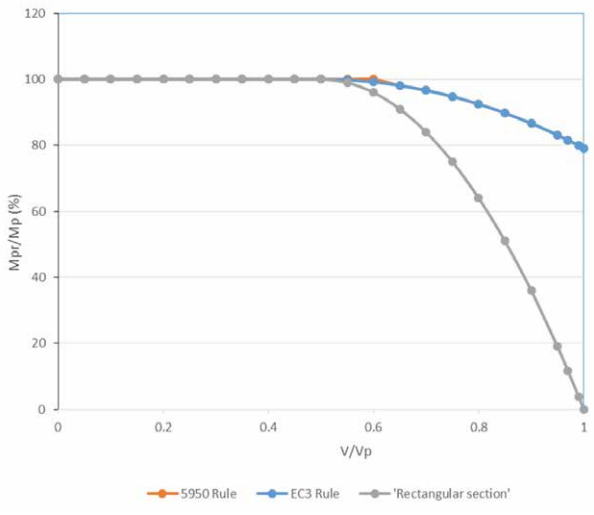

Figure 4 Reduction in resistance moment due to shear

moment according to both EC3 and BS 5950 for the 400 mm deep beam. The difference in the treatment is insignificant.

The reduction in minor axis bending resistance when the section is subject to a shear force is also shown in Figure 4, labelled Rectangular Section. Unlike the I section, the bending resistance reduces significantly under high shear and reduces to zero when the shear force reaches the shear resistance because the maximum shear stress of $f_y/\sqrt{3}$ is present over the full extent of the flanges. This effect also applies to rectangular sections. For a Tee section, the stem of the Tee provides the shear resistance but also develops longitudinal stresses to provide the bending resistance. These stresses are reduced in the presence of shear in a similar way to those in a rectangular section.

References

1 Sir John Baker, M R Horne and J Heyman, The Steel Skeleton, Volume Two, Plastic behaviour & design, 1956, Cambridge University Press

2 M R Horne, Plastic theory of structures, 1979, Pergamon Press

3 M R Horne and L J Morris, Plastic design of low resistance rise frames, 1981, Granada Publishing

AD 417: Resistance of sections to combined shear and bending

This Advisory Desk note reminds designers that the form of the section has a significant impact on the reduction of bending resistance under high shear.

Clause 6.2.8 of BS EN 1993-1-1:2005 deals with the resistance of cross sections to combined bending and shear and first of all states:

(1) Where the shear force is present allowance should be made for its effect on the moment resistance.

It then goes on to say:

(2) Where the shear force is less than half the plastic shear resistance its effect on the moment resistance may be neglected except where shear buckling reduces the section resistance, see EN 1993-1-5.

(3) Otherwise the reduced moment resistance should be taken as the design resistance of the cross-section, calculated using a reduced yield strength … for the shear area.

The reduced yield strength depends on the ratio of design shear force to the shear resistance of the section.

For an I section, the shear area approximates to the area of the web and the flanges still provide their full resistance moment so the reduction in bending resistance may not be more than about 20% when the design shear force equals the shear resistance. For a rectangular section, the full section forms the shear area so the bending resistance reduces to zero under the same circumstances. A Tee section would also behave in a similar way.

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