Class 4 cross-sections in the fire limit state

AD 556

SCI's advisory desk is sometimes asked about the classification of cross-sections in the fire limit state. The purpose of this Advisory Desk Note is to remind designers of the additional reduction factor in BS EN 1993-1-2:2005 and to provide guidance on the treatment of Class 4 cross-sections.

When classifying members in the fire limit state, the constant ε, is reduced by applying a factor of 0.85, as required by clause 4.2.2 of BS EN 1993-1-2:2005.

$$\varepsilon = 0.85\sqrt{\frac{235}{f_y}}$$

where:

f_y is the is the yield strength at 20 °C.

This means that steel sections may become a higher Class in the fire limit state. Sections that are class 2 in ambient design may become Class 3 and similarly, sections that are Class 3 in ambient design may become Class 4.

Class 4 cross-sections

Subclause 4.2.3.6(1) states that 'For members with Class 4 cross-sections other than tension members it may be assumed that 4.2.1(1) is satisfied "(i.e. the resistance is greater than the design effect)" if at time t the steel temperature θ_a at all cross-sections is not more than θ_{crit}'. In BS EN 1993-1-2:2005, the recommended value of θ_{crit} = 350°C which is also adopted in the UK National Annex to BS EN 1993-1-2:2005.

It may be difficult and expensive to provide fire protection for a steel section with a critical temperature of 350°C. It is therefore recommended that checks are carried out during the ambient temperature design to ensure that the section dimensions are not such that the section becomes Class 4 in fire.

As an alternative, Annex E of BS EN 1993-1-2:2005 provides an approach to calculate the resistance of members in axial compression, bending and combined axial compression and bending by using effective section properties.

Using this approach, effective section properties are calculated at the ambient temperature in accordance with BS EN 1993-1-5:2006, with no reduction to ε. The reduction factors for the design yield strength of carbon steels relative to the yield strength at 20°C may then be taken from Table E.1 of BS EN 1993-1-2:2005.

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