CEPE Guidance on the use of Critical Temperatures for Structural Steelwork Protection from Fire

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The Intumescent Coating Technical Committee, part of CEPE, the European federation of paint manufacturers, are aware of a number of common misunderstandings which occur when calculating the amount of reactive coatings to be applied to provide fire protection of structural steel.

One of these misconceptions concerns the critical temperature values used in the calculation of the appropriate fire protection thickness. Therefore, CEPE ICTC have issued this guideline to alert stakeholders to ensure they are using the correct parameters for their calculations.

In the context of fire protection to structural steelwork, it is important that specifiers and material suppliers alike understand certain technical aspects. This note deals with one of these, namely the critical steel temperature.

At elevated temperature, steel will lose strength and stiffness. If not adequately protected, structural steel members may be weaken and not be able to sustain the load for which they are designed to carry. In this scenario, there is a possibility that the member may collapse which may have a detrimental effect of the stability of the frame of which it comprises. As an example, steel at approximately 550°C will have lost around 40% of its ambient yield strength.

Structural engineering codes including the Eurocodes and associated country-specific National Annexes contain recommendations for determining the critical temperature of steel under applied load. In certain codes and industry guidance documents, default temperatures are provided which may be adopted in the absence of a more rigorous calculation. Typically, different critical temperatures will be associated with whether the member is an open profile (I-shape) or closed profile (hollow), its function (i.e. column or beam), its exposure (i.e. exposed to fire on all sides or supporting a concrete slab) and its degree of applied load.

Default temperatures rightly adopt the conservative assumption that a member is loaded to its full capacity. Where the actual level of utilisation of a member is less than 100%, a higher temperature may be determined which will typically yield a reduced thickness of applied passive fire protection.

To be able to specify reactive coating thicknesses for different limiting steel temperatures the fire protection material will have had to be tested sufficiently to generate a multi-temperature assessment (MTA). These assessments provide a relationship between protection thickness and section factor A_m/V (H_p/A) for a given fire resistance rating period at limiting temperatures typically ranging from 350°C up to 750°C.

Specifiers should always check that any thickness they have been provided are appropriate for the required limiting steel temperature.

Without proper understanding, MTAs may be open to misuse and bad practice. In the absence of a structural engineering assessment, specifying protection thicknesses at the maximum limiting temperature given on a certified MTA will likely generate low

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thicknesses which may appear economically beneficial but could be very dangerous in the context of structural stability.

Responsibilities of the specifier/customer

The following is a list of questions that a specifier/customer should be aware of. It is not an exhaustive list but aims to highlight some of the key considerations: -

- What is the structural engineering code used for the design?
- Are conservative critical temperatures being adopted and if so, what are they?
- Are non-default critical temperatures available?
- Who has determined the non-default critical temperatures and are they qualified to do so?
- What are the temperatures used by the manufacturer or supplier to provide product thickness recommendations and do these align with the needs of the project?

Responsibilities of the manufacturer/supplier

The manufacturer/supplier has an obligation to provide the correct thicknesses in relation to limiting steel temperature and clearly state the temperature used for these calculations.