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BUCKLING ANALYSIS OF STEEL FRAMES EXPOSED TO NATURAL FIRE SCENARIOS

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ABSTRACT

The fire design of a steel frame is defined according to Part 1.2 of Eurocode 3 (EN 1993-1-2). It is based on security check to standard ISO 834 fire, where the structure must resist to fire during time set by regulation. For a natural fire, the structural resistance is ensured in the way that the collapse does not occur during the fire, including fire decline phase, or alternatively for a certain period. The Eurocode makes it clear that to check the standard fire resistance requirements it is enough to perform analysis of elements but does not report if such analysis is sufficient for a natural fire design and some uncertainties remain.

This study focus on the clarification of the use of the simplified design methods for assessment of the fire resistance of steel frames exposed to natural fire scenarios. Special attention is drawn to the use of the buckling lengths suggested in EN 1993-1-2 for the fire design of columns in braced frames and a recent proposal for unbraced frames suggesting the use of a buckling length of $1.0L$ for all columns except those belonging to the first storey of pinned frames where $2.0L$ should be taken instead.

Finally, a comparison is made between simple and advanced calculation models and it is demonstrated that the simple design methods, using the suggested buckling lengths to calculate the fire resistance of the frames are safe sided when compared to the use of more advanced calculations by means of the finite element method (FEM).

Keywords: structural fire design; steel frames; buckling analysis; natural fire; Eurocodes;

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