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FIRE BEHAVIOUR OF STEEL COLUMNS

Summary

The fires in the buildings cause high amount of material damages and also, what is most important, people injuries and loss of human lives.

The process of rapid heating and high temperature influences negatively on structural steel mechanical properties, lead to rapid decrease in load bearing capacity of the fire exposed structures. Possibilities of potential structural collapse and associated consequences are regulated by request for sufficient structural fire resistance.

The effects that thermally induced forces and deformations have on the performance and safety of steel columns subjected to fire are not well understood and are not clearly treated in building codes and standards.

The calculation of critical/limit temperature, based on limit state condition of structural elements at elevated temperatures, is carried out by an analytical model. The calculation procedure, proposed in the model, deals with both non-linearities, material and geometrical. The material non-linearity is included with temperature dependant changes in σ-ε diagram of structural steels, according to EC3: p.1-2. The geometrical non-linearity is considered by iterative procedure for P-Δ effect calculation. The stiffness of elastic supports is used to present the influence of structural continuity on the fire exposed element behavior, or the interaction between the element and adjacent structure.

The beneficial effect of rotational restraint and the detrimental effect of axial restraint are estimated. The results are compared with corresponding values taken from series of theoretical and experimental investigations. The results obtained with proposed calculation procedure by EC3: p.1-2, as a relevant comparative level is also used.

When evaluating the safety of a column in a fire, it is important to recognize that the total axial force in the column is the sum of the force generated by external gravity load on the frame and the force generated by restraint to thermal expansion. Analyses conducted in this research indicate that force generated by restraint to thermal expansion depend on the degree of axial restraint, and can have a very large impact on the behavior of a steel column in fire. Neglecting this force can lead to unsafe designs.

Key words: *steel structures, fire, critical temperature, fire resistance*