

# Study of Column Buckling Lengths of Braced and Unbraced Frames in Fire Situations

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## 1 Abstract

The problem of fire resistance of steel structures is still a very actual topic, because there is a need to suitably evaluate the fire resistance and safety of structures exposed to fire hazard. Rules given in the parts of structural Eurocodes devoted to fire design do not cover all relevant design issues. In the case of the buckling resistance of steel columns exposed to fire the Eurocode gives rules only for braced frames in which each storey comprises a separate fire compartment, where it is possible to reduce the buckling length to 0.5L (intermediate storey) or 0.7L (top storey) thanks to the fact, that the hot column is „fixed“ to the cold ones in the storeys above and under. For the case of unbraced frames there are no special rules, the columns should be verified with the procedures as for normal temperature design. Several authors dedicated their efforts to the problem of modelling the real behaviour of entire frame buildings in fire situation. The aim of this paper is to show the behaviour of braced and unbraced frame structure by simple analysis with a FEM programme and to compare the results with some other procedures from the literature.

**Keywords:** steel structures, fire resistance, buckling length, braced and unbraced frames.

## 2 Introduction

Verification of structures in a fire situation requires calculation models, which reflect the expected behaviour of the structure during fire. Structural eurocodes enable one of three methods of analysis – analysis of the entire structure, analysis of a part of the structure and analysis of an individual member, which is simple for use and sufficient for the verification of fire safety of individual members. Columns in braced and unbraced frames are in fact not isolated members. Their buckling

resistance (either at normal temperature design or at fire design) is affected by their buckling length, which depends also on stiffnesses of adjacent columns and beams.

## 3 Frame columns in fire situation

The fire resistance of columns is very sensitive to the column slenderness. The correct evaluation of the buckling length of the columns in fire design situation is therefore very important [1].

The buckling length  $l_{fi}$  of a column for the fire design situation should generally be determined as