# BEHAVIOUR OF COLD-FORMED BEAM-COLUMNS IN CASE OF FIRE

Flavio Arrais

LABEST - Civil Engineering Department, University of Aveiro, Portugal

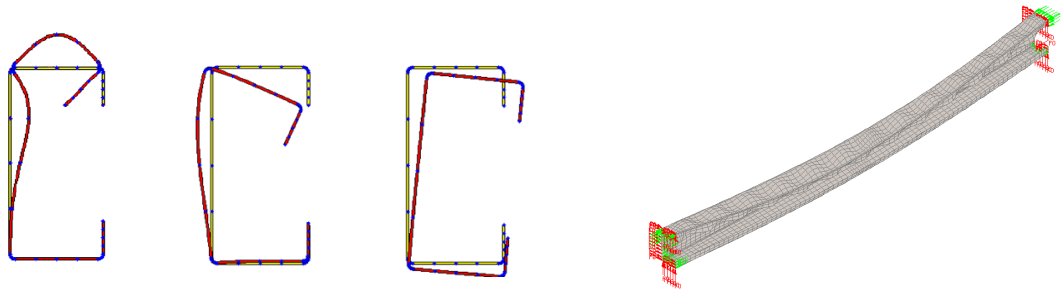
The cold-formed steel profiles can be applied to almost all existing buildings typologies. These elements are common in buildings due to their lightness and ability to support large spans, being quite common as roof or walls support elements.

Cold-formed profiles are more susceptible to the occurrence of local buckling. Additionally, in these members the global buckling (flexural buckling in columns or lateral-torsional buckling in beams) and distortional buckling are also common failure modes. These instability phenomena are intensified at high temperatures.

The manufacturing process of thin cold-formed steel members introduces residual stresses and increases the yield strength in the folding regions (corners).

This work has the main objective of presenting a numerical study on the fire behaviour of cold-formed beam-columns with thin walled sections when subjected to high temperatures. The different instability modes will be analysed with different software CUFSM (developed at Johns Hopkins University in the United States) [1] and RUBY (developed at the University of Aveiro in Portugal) [2]. These obtained instability modes will be used to define the initial geometrical imperfections (Figure 1).

Thus, the influence of the different geometrical imperfections and their combinations added to the consideration of residual stresses on the ultimate load is going to be evaluated. Moreover, comparisons between the finite element numerical results, obtained with geometric and material non-linear analyses, which are performed with SAFIR (developed at the University of Liege in Belgium) [3], and the Eurocode 3 Parts 1-2 and 1-3 [4,5] design rules are also going to be presented (Figure 2).



a) Local b) Distortional c)Global d) Imperfections combination

Figure 1 – Initial geometrical imperfections (C-section beam) and graphical representation from SAFIR software with local, distortional and global imperfections combination (amplified 50 times) of a beam with 2 m length.

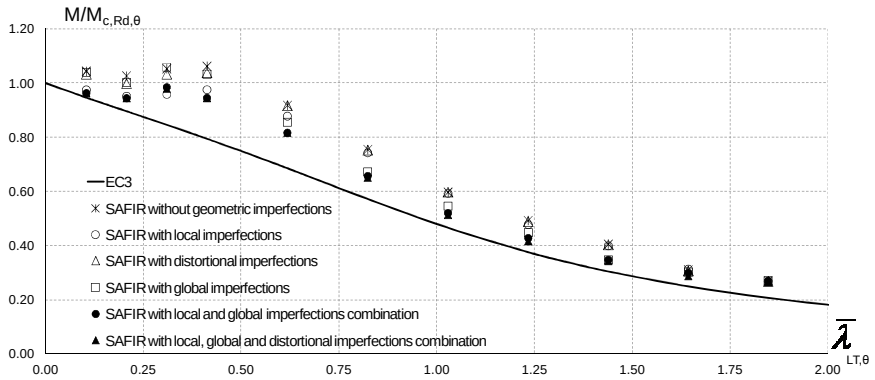



Figure 2 – Results of initial imperfections influence and comparison with the EC3 at 500 °C.

References

[1] Schafer, B.W., Ádány, S., "Buckling analysis of cold-formed steel members using CUFSM: conventional and constrained finite strip methods", 18th International Specialty Conference on Cold-Formed Steel Structures, Orlando, Florida, 2006.

[2] Couto C., Vila Real P., Lopes N., RUBY "an interface software for running a buckling analysis of SAFIR models using Cast3M", University of Aveiro, 2013

[3] Franssen, J.-M., "SAFIR. A Thermal/Structural Program Modelling Structures under Fire"; Engineering Journal, A.I.S.C., Vol. 42, No. 3, pp. 143-158, 2005.

[4] CEN. "EN 1993-1-2, Eurocode 3: Design of Steel Structures - Part 1-2: General rules - Structural fire design", Belgium, 2005.

[5] CEN. "EN 1993-1-3, Eurocode 3: Design of Steel Structures - Part 1-3: Supplementary rules for cold-formed members and sheeting", Belgium, 2006.