Conference on Applications of Structural Fire Engineering
COST TU0904 Integrated Fire Engineering and Response

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COUPLED STRUCTURAL-THERMAL CALCULATIONS FOR RESTRAINED STEEL COLUMNS IN FIRE

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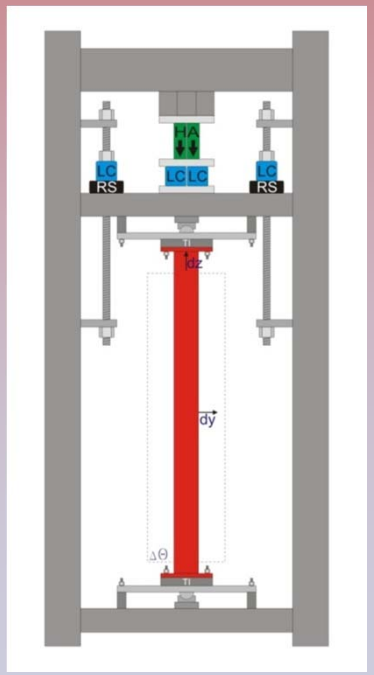
Study on numerical modeling of steel columns subjected to axial and rotational restraints and time dependent temperatures

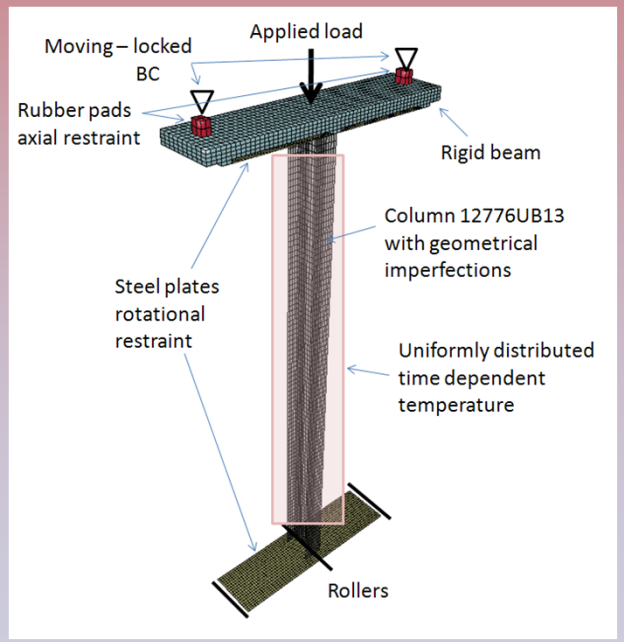
- Computer simulations with coupled stress - thermal analysis implemented in LS-DYNA
- The study focused on improving prediction capabilities for the purpose of virtual testing
- Column's average temperature vs. axial force, axial displacement, and lateral displacement

SELECTED EXPERIMENTAL FURNACE TESTS

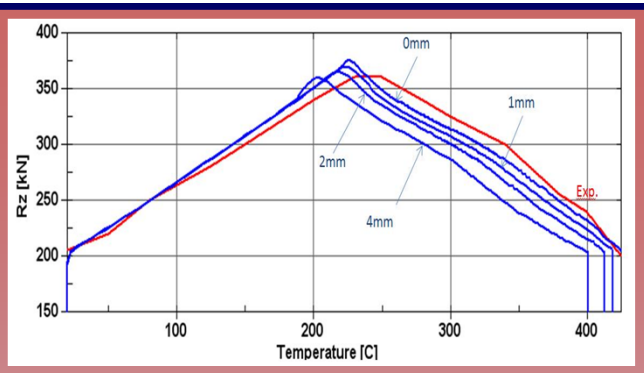


Ali F., O'Connor D. 2001. Structural performance of rotationally restrained steel columns in fire, *Fire Safety Journal* 36.

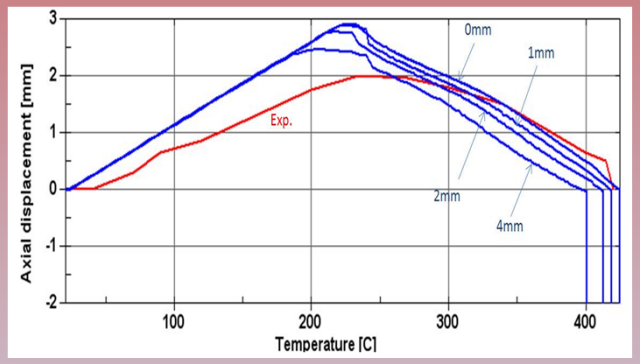
FE MODEL DEVELOPMENT



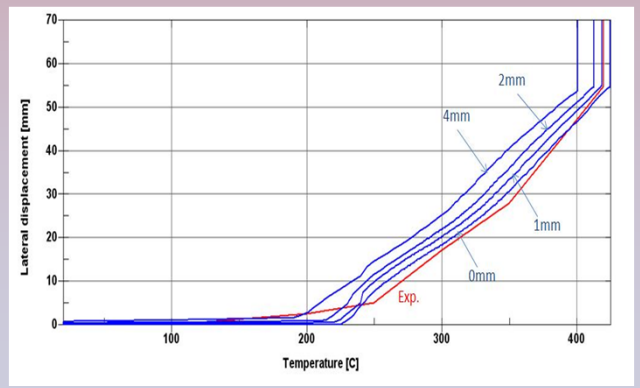
L. Kwaśniewski, P. A. Król, K. Łącki 2010. Virtual tests on axially and rotationally restrained steel columns under fire, *Journal of Structural Fire Engineering, JSFE 2-2, in press*.



Axial force vs. column temperature



Axial displacement vs. column temperature



Lateral displacement vs. column temperature

Comparison to the experiment for different magnitudes of imperfections

EFFECT OF:

- Material properties
- Geometrical imperfections
- Reduction of heated column area
- Temperature variation along the length of the column
- Variation of applied force
- Modification of constraints

Comparison for other test cases

Tab. 1 Comparison of maximum generated forces

Column ref.	Loading level	Max. force generated in column [kN]	Calculated max. generated force in column
P3UB1	0	260	279
P3UB2	0.2	220	218
P3UB3	0.4	179	191
P3UB4	0.6	142	160
P3UB5	0.8	69	112

SUMMARY

Common model calibration replaced by experimental validation and extensive parametric study

Three critical modeling characteristics were determined

- material behavior
- geometrical imperfections
- longitudinal variation of the column temperature

It is not possible to correlate better numerical results with the existing experimental data without reducing model uncertainties through additional experiments and measurements