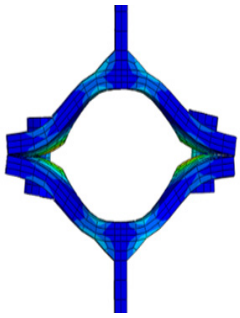
STRUCTURAL CONCEPTION AND COLLAPSE CONTROL PERFORMANCE BASED DESIGN OF MULTISTORY STRUCTURES UNDER ACCIDENTAL ACTIONS (CODEC)

Goal of the project

The main goal of the project is the development of a performance based robustness design methodology for mitigation of progressive collapse of multi-story frame buildings against extreme load events coming from both natural and man-made hazards.

Short description of the project

Steel building structural performance and safety can be endangered due to extreme loading caused by accidental actions. Direct and indirect methods can be used in design to improve the resistance and to reduce the consequences. The project aimed to evaluate the structural components and material properties that are responsible for an improved response. Thus, different structural systems and detailing were tested experimentally under all kind of actions, i.e. static, dynamic, blast or fire, and the main response parameters have been quantified. Afterwards, numerical models were validated, as a first step to perform extensive parametric studies. When all completed, these studies will allow the development of a collapse control design methodology for reducing the consequences associated with the extreme loading events (properties damages, structural failures, fatalities).



Main activities

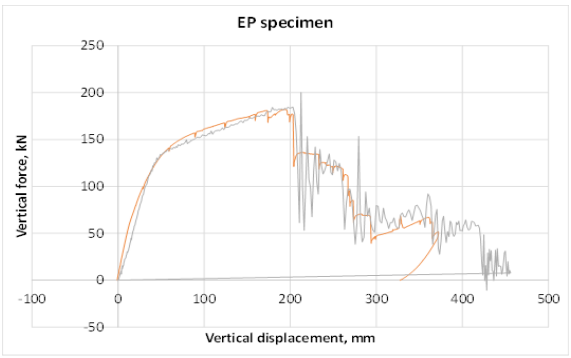
- Preliminary investigations (Review of existing methods, identification of research needs; Preliminary analysis and selection of case study structures)
- Design of experimental and numerical simulation programs
- Experimental program on materials, weld details and connection macro-components
- Experimental program on joints (column loss scenarios and blast conditions)
- Experimental program on sub-assemblies
- Numerical simulation program
- Design guidelines and recommendations

Project implemented by

- Coordinator (CO) – Politehnica University of Timisoara
- Partner 1 (P1) - Technical University of Cluj-Napoca
- Partner 2 (P2) - URBAN-INCERC (Cluj Branch)
- Partner 3 (P3) - INSEMEX Petrosani
- Partner 4 (P4) - SC ACI SA Cluj-Napoca

Implementation period

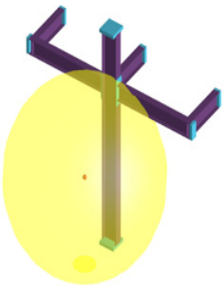
July 2012 - June 2016

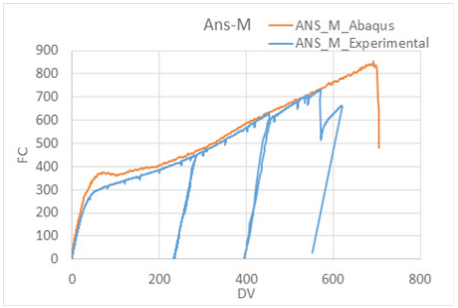


Joint specimen after the test (left) and experimental vs. numerical force-displacement curve (right)

Results

- T-stub and weld detail specimens have been tested in four different conditions: imposed displacement of 0.05mm/sec and of 10 mm/sec, combined with room temperature T=20C and elevated temperature T=542C conditions
- Monotonic experimental tests on joints under column loss scenarios have been performed for different connection typologies: welded (reduced beam section, cover plate) and bolted (extended end plate, extended end plate with haunch)
- Performance of two bay - two span steel frames has been studied experimentally. External links were introduced to simulate ties to the rest of the structure. Assemblies with and without reinforced concrete floor were tested.
- The direct blast effect on columns and joints was tested for intermediate and marginal columns. In the experiments different stand-off distances were employed.





• Experimental tests on T-stub elements (top), blast T assemblies (middle) and 3D assemblies (bottom)

Applicability and transferability of the results

• Construction and design practice, code and primer manuals drafting

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Research Centre

• The Research Center for Mechanics of Materials and Structural Safety – CEMSIG (www.ct.upt.ro/ centre/cemsig/index.htm)

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