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

Safety and operability of steel buildings can be endangered by accidental actions. Today codes give general information only and lack much information that are required if robustness is envisaged. The project aims at evaluating those structural components and materials properties that can reduce the consequences, thus saving lives and reducing the costs in the aftermath of an extreme event. Different structural systems and details were tested experimentally under static and dynamic actions (blast), at room and elevated temperatures (fire), and the main response parameters were 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 .

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

Fig. 1a. Joint specimen after the test

Fig. 2a. Experimental T-stub

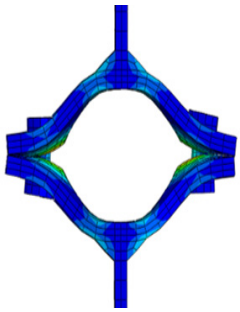

Fig. 2b. Numerical simulation T-stub

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
- Validation of numerical models against experimental tests
- Numerical simulation program
- Design guidelines and recommendations

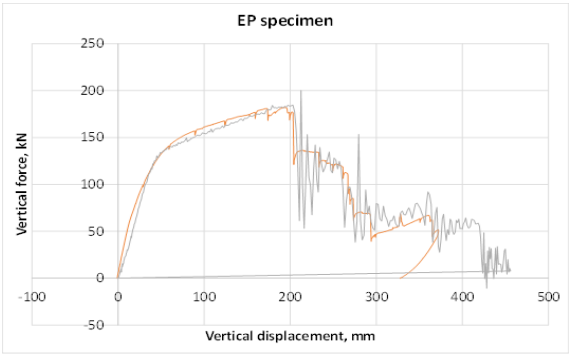

Fig. 1b. Experimental vs. numerical force-displacement curve

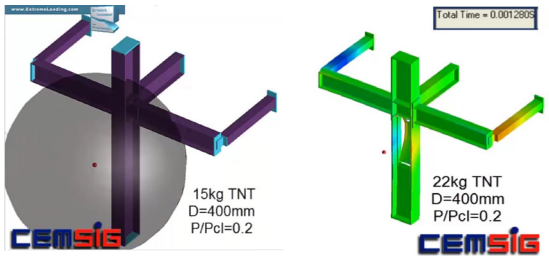

Fig. 3a (left) and 3B (right) Direct blast effect on steel assemblies

Results

- Experimental results (characteristic curves, failure modes, robustness) on T-stubs and weld detail tested in extreme conditions (loading rate, temperature)
- Experimental results on steel joints under column loss scenarios (characteristic curves, failure modes, robustness)
- Experimental results on steel and composite frame systems under column loss scenarios (characteristic curves, failure modes, robustness)
- Direct blast effects on steel elements and connections (influence of stand-off distances, charge size, charge characteristics).
- Numerical models validated against experimental tests.

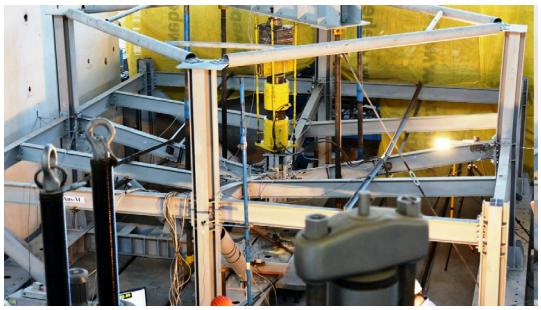

Fig. 4a. Experimental test on 3D steel frame system

Applicability and transferability of the results

• Construction and design practice, code and primer manuals drafting

Fig. 5. Experimental test on 3D composite frame system

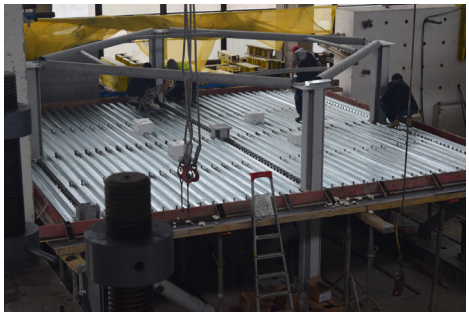

Fig. 6. Composite slab system during construction

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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)

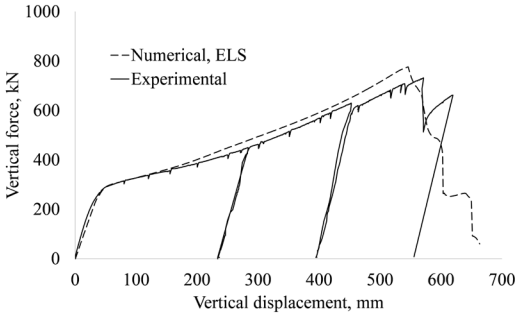

Fig. 4b. Experimental vs. numerical force displacement curve for 3D steel frame system

Research Team

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