

EUROPEAN PRE-QUALIFIED STEEL JOINTS (EQUALJOINTS)

Goal of the project:

The goal of the project is to introduce in the European practice a qualification procedure for the design of moment resisting connection in seismic resistant steel frames, in compliance with EC8 requirements.

Particular objectives of the project are to qualify a set of standard all-steel beam-to-column joints, develop pre-qualification charts and design tools that can be easily used by designers. The project is also intended as a pre-normative research aimed at proposing relevant design criteria to be included in the next version of EC8. Besides it would contribute to the advancement of knowledge in the field of seismic behavior of steel moment resisting joints usually adopted in moment resisting frames (MR), in un-braced bays of dual moment-resisting/concentrically braced frames (MR+CB) and in moment-resisting/eccentrically-braced frames (MR+EB).

Short description of the project:

The project is the first attempt in Europe to produce qualification tools for seismic-resistant joints. Novel design methodologies and details for beam-to-column connections that are reliable, feasible and economical, solving also the open issue of design by testing required by EC8 for partial strength/stiffness connections will be provided. The cyclic behavior of beam-to-column joints has a crucial role on the overall seismic response of both MR and dual frames. Recent studies highlighted the influence of joint rotation capacity on the seismic response of mid-rise MR frames designed according to EC8.

The innovative content of the project is represented by:

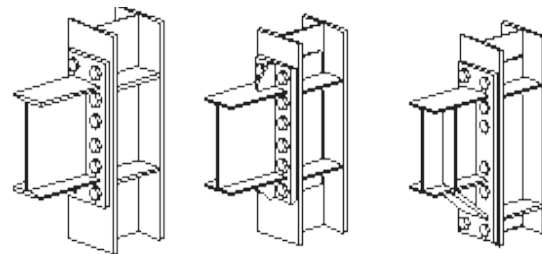
- Experimental investigations on 96 beam-to-column joint specimens covering: three typical European typologies and one US dog-bone joint typology made of heavy cross sections;
- Evaluation of the influence of different parameters (e.g. axial force, loading protocol and member sizes) on the joint performance;
- Development of codified pre-qualification charts of typical beam-to-column joints used in EU practice.
- In Europe these tools do not exist in design codes. Hence, this project was intended as pre-normative research aiming to propose design guidelines for the future version of EC8.

Project implemented by

- University of Naples "Federico II", Department of Structures for Engineering and Architecture.
- Politehnica University of Timișoara, Department of Steel Structures and Structural Mechanics

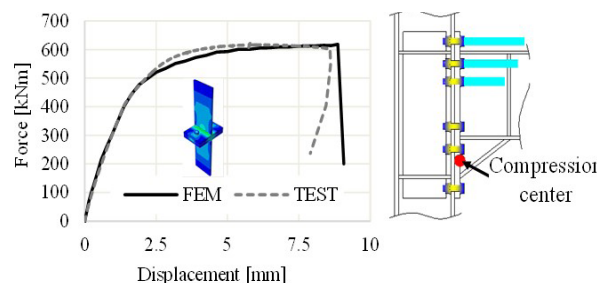
Implementation period:

01.07.2013 – 31.06.2016



Main activities:

Regarding the aim and objectives of the project, a design procedure for joints was established according to the provisions of EC3, EC8 and AISC 358. Extensive pre-test finite element (FE) numerical simulations were carried out with the purpose of evaluating the designed beam-to-column joint assemblies, and the influence of several parameters. The pre-test numerical simulation comprised the calibration of a T-stub model, including the material model for bolts. Based on the outcomes of the FE simulations, the design procedure of the joints was adjusted considering the actual position of the compression center and the active bolt rows.



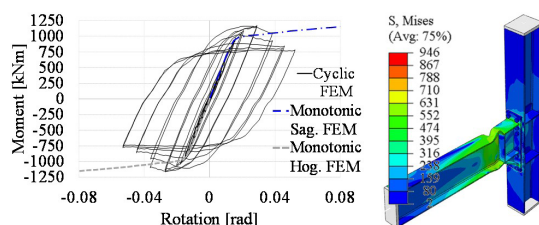
The cyclic response of a joint was evaluated as well. Future activities will be devoted to the experimental investigation of material samples, and 24 large-scale joint assemblies.



Particular results are represented by the selection of members (beams & columns) from the analyzed frames, and the development of a design procedure for bolted beam-to-column haunched connections. The pre-test numerical simulations lead to some adjustments of the joint design procedure and joint configurations. As a result, the joint configurations were established and the experimental test set-up was designed. Finally, the shop drawings for joint specimen and test set-up were completed.

Results:

- Particular results are represented by the development of a design procedure for bolted beam-to-column haunched connections. The pre-test numerical simulations lead to several adjustments of the joint design procedure and joint configurations. As a result, the joint configurations were established. The parametric study allowed investigating the influence of: member size, haunch geometry, web panel strength, and cyclic loading.



Applicability and transferability of the results:

- The project provides easy-to-use design tools for engineers and promotes saving cost solutions. Particular outcomes of the project are intended to be introduced within the new version of European seismic design code EN 1998-1.

- In addition, the outcomes of the project will be largely beneficial for the EU industry. Because the US joints examined within EQUALJOINTS will be made of heavy sections, which are produced only in Europe, this will be an important opportunity to get on the US Market, consolidating the gain of EU economy and having beneficial impact to exportation of EU products.
- The impact and transferability of the project is by no means restricted to the selected joint configurations and this project will open the door for other joints to be included in future updates of the guidelines.

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Fields of interest:

Seismic resistant structures for multi-storey building frames.

Research Center

The Research Centre for Mechanics of Materials and Structural Safety – CEMSIG, Politehnica University of Timisoara.

Research team

- University of Naples “Federico II” (UNINA) – Coordinator
- Imperial College (IC)
- University of Coimbra (UC)
- University of Liege (ULg)
- Politehnica University of Timisoara (UPT)
- European Convention for Constructional Steelwork (ECCS)
- ArcelorMittal Belval & Differdange S.A. (AM)
- CORDIOLI & C

Contact information

Acad. Prof. Dan DUBINĂ, PhD
 Member of Romanian Academy
 Department of Steel Structures and Structural Mechanics
 Address: Str. Ioan Cărea, No. 1, RO300224, Timisoara
 Phone: (+40) 256 403 920
 Fax: (+40) 256 403 917
 E-mail: dan.dubina@upt.ro