

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:

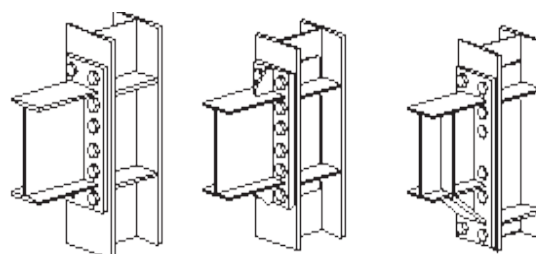
- Experimental investigations on 96 beam-to-column joint specimens covering: three typical European typologies and one US dog-bone joint typology made of heavy cross sections;
- Evaluation of the influence of different parameters (e.g. axial force, loading protocol and member sizes) on the joint performance;
- 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:

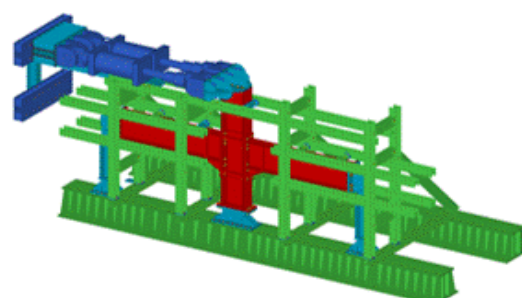
01.07.2013 – 31.06.2016



Main activities:

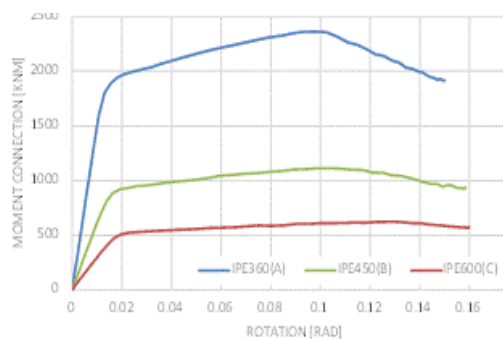
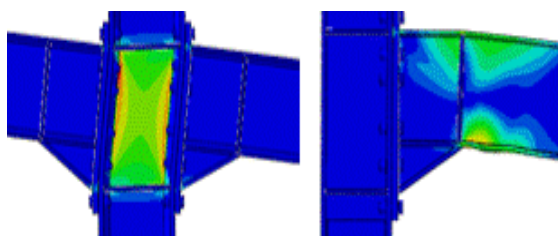
With respect to the aim and objectives of the project, a set of multi-storey building frames were analysed at CEMSIG centre for the selection of member cross sections for joint assemblies. The design procedure for joints was established according to the provisions of EC3, EC8 and AISC 358. Extensive pre-test finite element (FE) numerical simulations were carried out aimed to offer an accurate prediction of the joint behaviour and to find answers to problems for which decisions were taken in the design process. In addition, the experimental test set-up was designed, and validated through FE numerical simulations. As a result, shop drawings for specimens and test set-up were performed.

Future activities will be devoted to the experimental investigation of material samples, and 24 large-scale joint assemblies. In addition, the numerical models of the joints will be calibrated based on monotonic and cyclic test results, which will allow extending the experimental program with a parametrical study. Finally, the design procedure will be validated based on experimental and numerical results.



Results:

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.



Applicability and transferability of the results:

- The project provides easy-to-use design tools for engineers and promotes saving cost solutions. 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

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- Imperial College (IC)
- University of Coimbra (UC)
- University of Liege (ULg)
- Politehnica University of Timisoara (UPT)
- European Convention for Constructional Steelwork (ECCS)
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