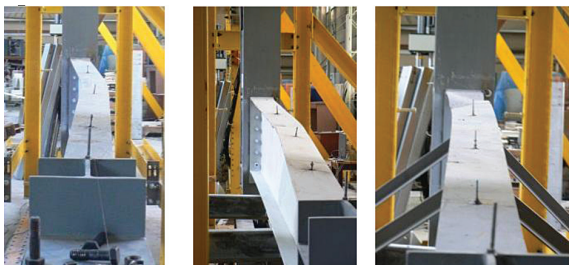


Goal of the project: The objective of the project is to bring to the attention of structural engineers, manufacturers and contractors, the importance of initial imperfections and lateral restraints in the real behavior of the steel frame, in order to obtain well configured and erected steel structures and prevent component elements stability loss, an unacceptable aspect.

Short description of the project: Steel structures in form of members, plates and shells must frequently be investigated by advanced numerical methods, in order to take into account specific cases of loadings, boundary conditions, geometrical and material imperfections. The aim of the present research program is to find some answers to the following answer: What is more important, the shape or the size of the initial imperfection?

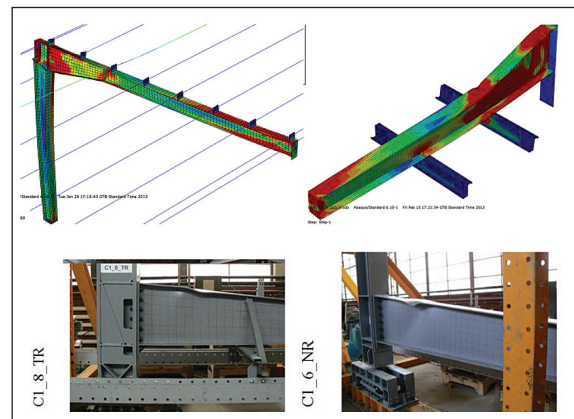


For this purpose parametric studies made by performant computer programs were used. Experimental tests were performed in the CEMSIG laboratory, in order to calibrate numerical models. The obtained results will be thereafter compared with the analytical ones, following the design methods/specifications of SR-EN1993-1-1.

Project implemented by: CEMSIG research Centre, Department of Steel Structures and Structural Mechanics, Politehnica University of Timisoara.

Implementation period:
01.09.2010-31.07.2013

Main activities: Imperfection influence study on isolated members with variable cross section (beams, columns) under combined bending and compression. The influence of different type lateral restraining on the element behavior - variable cross-section columns.



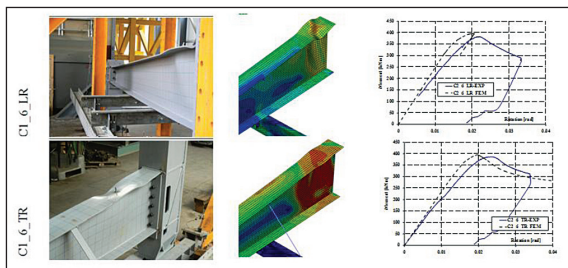
Imperfection influence study on single storey steel frames with slender elements under gravitational loading (permanent, technological and snow load) and extreme horizontal loading. Experimental testing of laterally restrained single storey steel frames. Calibration and parametrical study on the behavior of steel frames with elements of variable cross section.

Results: The out-of-plane buckling of the frame elements was noticed to be the main failure mode indifferent of the applied lateral restraints. There were cases for which the global lateral- torsional buckling of the frames was coupled with local buckling of the web. This was mainly observed when the restraints applied on the frame element are more effective against overall buckling (e.g. type 3 restraints). It was noticed that the considered imperfections has a low to significant influence on the final capacity of the frame, function of the applied lateral restraints.

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Colin Powell

The difference between considered imperfections is significant mainly for the combined cases. The difference between elastic (actual) and rigid lateral restraints increases by the span increasing, a maximum 10 % difference was recorded.



In what concerns the seismic behavior, even though the obtained behavior factor for type 1 and 2 lateral restraints characterizes the frames as low dissipative, this value can be improved significantly if more effective lateral restraints are applied.

The finite element modeling is reliable in predicting the ultimate capacity of the elements with tapered web under both compression and bending with sufficient accuracy.

From the experimental results - the restraining contribution from the purlins alone is reduced (their effect is small) for all specimen series. This might be explained by the small influence of the axial compressive force on the behaviour of beam-column elements with variable cross sections. The cross section twists rather than buckles laterally, due to the distribution of the normal stresses on the height of the cross section. The ultimate capacity can be improved by applying a supplementary restraining at the compressed flange, but this is only possible with the use of thicker web element (i.e. $t=8\text{mm}$).

Research Centre for Mechanics of Materials and Structural Safety- CEMSIG

Fields of interest:

The main field of interest, connected with the aim of the project, could be considered as follows: the stability and ductility of steel structures, design of steel structures, behavior of steel structures under extreme loadings, behavior of thin walled structures made of plated elements, reliability analysis of steel structures.

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Applicability and transferability of the results:

The results obtained during the project emphasize in a more realistic manner the behavior of tapered elements, made of plated steel, when lateral restraints and initial imperfections apply. Besides this the actual design (not covered very clear by the codes) of these types of elements can be made accounting for all external influences and boundary conditions.

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