SECTION I: ROMANIAN-POLISH SCIENTIFIC RESEARCH COOPERATION IN THE FIELD OF THIN-WALLED STRUCTURES

EDITORIAL

In 2015 a joint research project agreement in the field of Twin Walled Cold Formed Steel has been initiated between the Division of Steel Structures and Welding of Centre for Fundamental and Advanced Technical Research – CCTFA, from Romanian Academy, the Timişoara Branch, Romania, and the Department of Strength of Materials of Faculty of Mechanical Engineering from Lódź University of Technology, Poland.

The project has been approved and integrated within the Agreement on Scientific Cooperation between Romanian Academy and Polish Academy of Sciences for 2016–2018 years.

The project concerns theoretical and experimental analysis of load-carrying capacity of thin-walled, cold formed members (TWCF) subjected to single or combined loads, such as compression, bending or eccentric compression. TWCS members are widely used in civil engineering, in vehicle structures, in aircraft engineering and in many other areas of technology. Load-capacity of such structural members subjected to simple states of loading (pure bending or pure axial compression) is relatively well determined (with high accuracy) both on the basis of the theory of thin-walled structures and in the code specifications. However, determination of the load-capacity of TWCF members subjected to combined load is still an open question and the code specifications for that case should be improved. It is very well known that cold-formed steel structures are usually made of thin-walled members of class 4 sections and they are characterised by a reduced post-elastic strength and by a reduced ductility, being sensitive to imperfections and interactive buckling. These sections are prematurely prone to local or distortional buckling and the failure at ultimate stage of such members always occurs by forming a local plastic mechanism. This fact suggests the possibility to use the local plastic mechanism to characterise the ultimate strength of such

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members. This method can be used to study post-elastic behaviour, load-carrying capacity, ductility, rotation capacity and energy absorption. In the range of the project theoretical analysis of the load-capacity of TWCF members of different typologies of cross-sections (open and closed cross-sections) have been carried out using the plastic mechanisms approach and finite element method (FEM). The results of the theoretical analyses were planned to be validated with results of experimental investigations.

As already known, the short members of thin-walled cold-formed (TWCF) steel sections, in compression and bending, fail by forming local plastic mechanisms. Taking into account the localized buckling pattern, the collapse of slender members, due to the interaction between local and overall buckling modes, is always characterised by local plastic mechanism failure mode. Based on these two observations, the ultimate strength in interactive buckling of these members can be regarded as an interaction between localized plastic mode and overall elastic one. Also the imperfections (local or distortional ones) play an important role in the definition of local plastic mechanisms. The yield line mechanism method has been widely used to predict the sectional strength (e.g. local) of thin-walled cold-formed steel members that involve failure mode characterized by local collapse mechanisms. This method can be also used to study post-collapse behaviour and to evaluate the load-carrying capacity, ductility and energy absorption. The main problem is to identify correctly the type of plastic mechanism to be used in analysis.

Under these circumstances, and accounting for previous research contributions of both teams, the main aim of the project was develop and promote a theoretical approach for evaluation of ultimate load-carrying capacity of TWCF steel members subjected to eccentric compression. On this base it was expected to draft a proposal for relevant the EU Code Specification (i.e. Eurocode 1993-1-3: Eurocode 3: Design of steel structures. Part 1–3: General Rules. Supplementary rules for cold-formed thin gauge members and sheeting. European Committee for Standardization) for such members.

The first paper within the series included in present Volume, is a review paper which summarizes the results of joint research activity obtained by the two teams, Romanian and Polish, on the application of plastic mechanisms theory for characterisation of ultimate load-carrying capacity of TWCF members. This paper is

- *Ultimate limit capacity of thin-walled cold-formed steel members* (Authors V. Ungureanu, M. Kotełko, D.Dubina)

The other three papers are provided by the Polish Colleagues and cover their actual research subjects in the field of Twin Walled Structures i.e.

- *Influence of boundary condition on channel section column behaviour* (Authors: F. Kaźmierczyk, T. Kubiak)

The paper summarizes the numerical studies carried-out on the aim to evaluate of the influence of the boundary conditions on distortional lateral buckling phenolmena during bending of cold formed steel bars with different channel sections.

- *Non-linear stability of cylindrical panels made of transversally functionally graded material with uniformly shortened edges* (Authors: Z. Kołakowski, L. Czechowski)

This paper deals with FGM (*Functionally Graded Materials*) cylindrical panels with uniformly shortened edges when the shear lag phenomenon and distortional deformations are taken into account. A shell model (2D) was adopted and a method of the modal solution to the nonlinear stability problem within Koiter's asymptotic theory, using the semi-analytical method (SAM) and the transition matrix method, have been applied in order to characterize the behaviour of these structures.

- *Tubular thin-walled energy absorbing structures with triggers – recent advances* (Authors: M. Kotełko, M. Ferdynus)

The paper presents a *State of art* review concerning recent advances in research into crashworthiness performance and energy absorption capacity of tubular thin-walled energy absorbing with triggers promoting the most desirable crushing process is presented.

At the end, following the fruitful collaboration of the two teams involved in this project (see the joint papers in the References of first paper), a subsequent project, aiming to continue and extend the research cooperation within the same thematic aria, has been prepared to be integrated into the further Scientific Cooperation Agreement between Romanian Academy and Polish Academy of Sciences for 2020–2021 period.

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