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Application of the Bending Theory on Square-Hollow Sections made from High-Strength Steel with a Changing Angle of the Bending Plane

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Abstract:

The bending behaviour of thin-walled profiles made from high-strength steels with respect to a changing angle of the bending plane or, in other words, the rotation of the section geometry on the longitudinal axis of the profile, has not yet been fully characterized. The investigations presented in this paper lead to an improvement of the description for bending square hollow sections under unified and constant loading conditions, and contribute to the general understanding of such bending problems. The methodological approach is based on analytic, numerical, and experimental analysis. The analytical formulation is primarily built on the principle of a simplified cantilever beam model. Bending curvatures are assumed to be generated with constant radiuses of curvatures. The change of the angle of the section, with respect to the direction of bending, is applied before bending and remains unchanged throughout the process. In this way, the effects of a changing angle with regard to the direction of bending are analysed for several constant curvatures and angles of 2D bent profiles. With a clear understanding of the 2D bending of high strength profiles, the same principles can also be used incrementally for analyses of 3D bending. The analytical theory is tested with an emphasis on using profiles with high-strength material properties compared to profiles made from standard low-carbon steel, by using the innovative Torque Superposed Spatial bending method (TSS). The results are supported by FE models generated with the Abaqus numerical FEM tool and verified with the results of actual experiments.

Keywords:

Elastic-plastic Bending, Spatial Profile Bending, Square-hollow Section, Torque Superposed Spatial, TSS

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