The numerical analysis and experimental tests of the rotational connection stiffness between the purlin and the truss top chord

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The paper is focused to the study of the rotational connection stiffness between the purlin and the top chord of a flat truss. The steel light trusses can be characterized by high stiffness and load-bearing capacity, but only in their plane. In each case the roof bracing system have to be design to ensure the structural stability out of the truss plane [1, 2]. The guidelines for the design of the roof cross braces can be found in the European standards [3]. The stiffness of the connection mentioned above can have a significant impact on the truss buckling load, especially in case of wind loading which can cause compression in the bottom chord [1].
In the present research the connection stiffness between the purlin (which is usually the part of the bracing system) and the truss top chord was taken into consideration for the structure without any additional braces located at the bottom chord. Based on the numerical analysis results (linear buckling analysis) performed for the shell model of the truss the relation between the buckling load (upward wind loading) and the described connection stiffness was found. Furthermore, the connection between the part of the purlin and the part of the top chord was tested experimentally. In this case, the prototype test stand was used to subject the bending load to the described element connection. As the result the relative rotation between the purlin and the top chord was found. On this basis the rotational connection stiffness was determined. Two different types of structural connection between separate steel profiles used in reality (purlin and the top chord) were taken into account. Also the comparison between the nonlinear static analysis results (geometric and material nonlinearity) performed for the shell model of the structural connection and the experimental test results was presented.

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[1] A. Biegus, "Trapezoidal sheet as a bracing preventing flat trusses from out-of-plane buckling", Archives of Civil and Mechanical Engineering, vol. 15, no. 3, pp. 735–741, 2015. https://doi.org/10.1016/j.acme.2014.08.007.

[2] M. Gajdzicki, J. Goczek, "Numerical simulation to determine torsional restraint of cold-formed Z purlin", Proc. International Conference on Metal Structures, Wrocław, 2011, pp. 424–433.

[3] PN-EN 1993-1-1, Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings, 2005.