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Lateral Torsional Buckling Resistance of Trapezoidally Corrugated Web Girders

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Abstract : Due to the numerous advantages of steel corrugated web girders, its application field is growing for bridges as well as for buildings. The global stability behavior of such girders is significantly larger than those of conventional I-girders with flat web, thus the application of the structural steel material can be significantly reduced. Design codes and specifications do not provide clear and complete rules or recommendations for the determination of the lateral torsional buckling (LTB) resistance of corrugated web girders. Therefore, the authors made a thorough investigation regarding the LTB resistance of the corrugated web girders. Finite element (FE) simulations have been performed to develop new design formulas for the determination of the LTB resistance of trapezoidally corrugated web girders. FE model is developed considering geometrical and material nonlinear analysis using equivalent geometric imperfections (GMNI analysis). The equivalent geometric imperfections involve the initial geometric imperfections and residual stresses coming from rolling, welding and flame cutting. Imperfection sensitivity analysis was performed to determine the necessary magnitudes regarding only the first eigenmodes shape imperfections. By the help of the validated FE model, an extended parametric study is carried out to investigate the LTB resistance for different trapezoidal corrugation profiles. First, the critical moment of a specific girder was calculated by FE model. The critical moments from the FE calculations are compared to the previous analytical calculation proposals. Then, nonlinear analysis was carried out to determine the ultimate resistance. Due to the numerical investigations, new proposals are developed for the determination of the LTB resistance of trapezoidally corrugated web girders through a modification factor on the design method related to the conventional flat web girders.

Keywords : corrugated web, lateral torsional buckling, critical moment, FE modeling
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