Summary

In my thesis the lateral-torsional buckling behavior of trapezoidally corrugated web girders is investigated. Currently, there is no commonly accepted and reliable design method to determine the lateral-torsional buckling (LTB) resistance of steel trapezoidally corrugated web girders. There are two approaches to determine the LTB resistance: (1) experiment-based semi-empirical procedures (reduction factor method) and (2) numerical model-based design. In the case of the first approach, the LTB reduction factor can be determined using the corresponding buckling curve based on the relative slenderness. In the case of using the numerical model-based design method, imperfections are directly taken into account in the finite element model, and the LTB resistance is determined as a result of a geometrical and material nonlinear analysis. Since the imperfections are diverse and show a significant deviation, it is customary to use equivalent geometric imperfections in practice. Therefore, the aims of my study were (1) to determine the required equivalent geometric imperfection shape and magnitude being applicable for geometrical and material nonlinear imperfect analysis, and (2) to determine which of the lateral-torsional or flexural buckling curves of EN1993-1-1 can be used for the determination of the LTB resistance of trapezoidally corrugated web girders.

An advanced finite element model was developed and validated using the results of laboratory test performed at the Budapest University of Technology and Economics, Department of Structural Engineering. Based on the experimental background virtual tests were performed on a simply supported beam subjected by pure bending. The effect of the different flange sizes, corrugation layouts, boundary conditions and steel grade including high-strength steel as well, were investigated. The required equivalent geometric imperfection magnitude was determined in such a way to achieve the same impact as the initial geometric imperfection with magnitude of L/1000 combined with the residual stresses. The L/1000 is defined by the EN 1090 as the largest tolerated value for member out-of-straightness. The results suggested that the equivalent geometric imperfection is slenderness dependent. As a simplification, a constant value of *L*/350 for equivalent geometric imperfection magnitude is proposed to be on the safe side for all geometries and slenderness ranges analyzed. A deterministic parametric study was performed using nonlinear analysis. The scaled-up first global buckling eigenmode was applied as artificial geometric imperfection_with magnitude of L/1000, and it was combined with the residual stresses. Using statistical evaluation, the safety levels of the proposed buckling curves are determined in order to obtain the required partial safety factor (γ_{M1}). The deterministic analysis combined with reliability assessment results showed that the flexural buckling curve *b* could be applicable with partial safety factor γ_{M1} =1.0.

Some further scientific results are also obtaind in my thesis, which are the followings:

- The corrugated web layout has practically no effect on the elastic critical moment and LTB resistance for corrugation angles larger than 30°.
- Three different boundary conditions were studied according to the warping and transverse rotation capabilities of the end cross-sections. It is revealed that the literature proposals fit well for the elastic critical moment.
- Normal-strength steel (NSS), high-strength steels (HSS) and hybrid girders were also studied. The results show that the flanges govern the LTB resistance of the girders. The use of HSS is advantages for short, unbraced spans while for longer spans the extra material strength vanishes since the buckling governs the failure. In addition, in the inelastic range of the buckling curve the HSS flanges result in slightly greater reduction factors than the NSS flanges having the same relative slenderness.