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Ain Shams University
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LATERAL TORSIONAL BUCKLING RESISTANCE OF TRIANGULAR WEB PROFILE STEEL BEAM

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STATEMENT

This Dissertation is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering.

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Abstract

Built up I-beams with flat web profile (FWP) are widely used as main structural elements in bridges, buildings and many fields because of its favorable properties. For these built-up I-beams, it has been common practice to use more steel material in web although it has little contribution to bending resistance. This results in uneconomical sections as steel material is an expensive one. The use of corrugated web profile in I-beam consistently reduces the out-of-plane web instability and eliminate the use of transverse stiffeners. Using a slender web for deep FWP steel beam is necessary for large spans and large loads, thus, making the web buckling problems more relevant in design. For that reason, the webs of FWP steel beams are usually strengthened with stiffeners. The stiffeners are designed to divide the web into panels supported along the stiffener lines. Stiffeners welding has two disadvantages; the first is reducing fatigue life, and the second is increasing the fabrication cost. The introduction of corrugated profile in web of I-sections consistently reduced the web instability and the application of transverse stiffeners. Triangular web profile (TWP) steel section is special case of corrugated web profile (CWP) but with much easier fabrication technique. In this thesis, previous research on the subject of lateral-torsional buckling of steel beams with trapezoidal and triangular corrugated webs is presented and critically reviewed. The critical buckling moment is strongly increased by the torsion and warping constants, which are well established for TWP steel beams. This thesis develops a simplified approach to calculate the elastic critical lateral torsional buckling strength of TWP steel beams. This approach incorporates the web triangulation along the beam length by modifying shear modulus, torsional constant and warping constant into the classical equation of elastic lateral torsional buckling. A three-dimensional linear finite element model is used to validate the proposed approach. The elastic critical lateral torsional buckling strength obtained through the proposed approach is used to predict the inelastic strength of TWP steel beams using Euro code equations and the results are compared to those of three-dimensional non-linear finite element model. Results show that lateral torsional critical moment increases with a change of web profile from flat to triangular. Moreover, the effect of triangulation parameters on the critical moment are presented.

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