Numerical study on lateral-torsional buckling of honeycomb beam

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Abstract

A honeycomb beam is a non-prismatic wide flange beam with constant spaced hexagonal holes throughout its length. Most design codes, including Specification for Structural Steel Buildings (ANSI/AISC 360-10) do not provide provisions for lateral-torsional buckling of non-prismatic beam. In this paper, lateral-torsional buckling of honeycomb beam is studied numerically using finite element analysis (FEA). Nonlinear time history analysis is performed to simulate the behavior of the beam loaded perpendicular to its major axis gradually from zero until lateral-torsional buckling occurs. Two loading conditions are considered, namely concentrated and uniformly distributed loads. Nonlinear behavior of steel material and the presence of residual stress in the beam are considered in the analysis. The beam is assumed to be simply supported and laterally supported at both ends so that the unbraced length of the beam is the same as the beam length. Honeycomb beams with various dimensions and various unbraced length are analyzed. The lateral-torsional buckling moments obtained from finite element analyses are compared with those computed using equations in ANSI/AISC 360-10 assuming the beams were prismatic without any holes. Based on this comparison, simplified equations to predict lateral-torsional buckling moments or LTB strength of honeycomb beams under major axis bending are proposed in this paper.

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Keywords: honeycomb beam; non-prismatic; lateral-torsional buckling; residual stress; nonlinear time history analysis

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