Abstract

The paper deals with coupled flexural-torsional vibrations of straight prismatic elastic bars made of a linearly elastic isotropic and homogeneous material. One of the aims is to develop an effective method of modelling vibrations of train rails of cross-sections being mono-symmetric, taking into account warping due to torsion as well as transverse shear deformations. The Librescu-Song 1D model has been appropriately adapted to the above research aims by incorporating all the inertia terms corresponding to the kinematic hypotheses. The finite element(FE) program has been written and its correctness has been verified. The results concerning natural vibrations compare favourably with those predicted by 3D FE modelling using dense meshes. The paper proves that neglecting warping due to torsion leads to omitting several eigen-modes of vibrations, thus showing that the popular Timoshenko-like models are useless for the vibration analysis of bars of mono-symmetric cross sections.