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ELASTOPLASTIC COMPUTING SAINT-VENANT FLEXURE-TORSION AND WARPING TORSION IN THREE DIMENSIONS

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ABSTRACT

A prismatic rod of arbitray cross section shape --- singly or multi-connected solid sections, open or closed thin-walled sections, even multi-cell sections --- is studied. For this rod the Saint-Venant flexure-torsion theory is unified with the theory of warping moment and warping torsion, allowing the stress function and warping function to vary along the axial direction and establishing formulae between warping moment and axial stresses. A case study of H shape illustrates the variation of warping moment (i.e. the so-called bimoment), axial stresses, warping torsion, and warping displacements.

The centroid for axial force and the shear center for transverse forces are investigated both for thin-walled sections and for solid sections. The computation excuted for the rod made of elastic material is further extended to flow elastoplastic material modeled by an evolving cubic distortional yield hypersurface with a normality plastic flow and combined isotropic-kinematic rule of hardening-softening.

Reference :
1. Hong-Ki Hong, Computing Saint-Venant flexure-torsion and warping in three dimensions, Plenary Lecture, The 1st Annual Meeting and Conference of Association of Computational Mechanics Taiwan (ACMT) 2023, National Taiwan Ocean University, Keelung, 28-29 October 2023.
2. Hong-Ki Hong, Li-Wei Liu, Ya-Po Shiao, and Shao-Fu Yan, Yield Surface Evolution and Elastoplastic Model with Cubic Yield Surface, ASCE Journal of Engineering Mechanics, 148(6):04022027, 2022.