SM22S_11962

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

A Unified Treatment for the Elastoplastic Bifurcation of Structural Elements

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This work is devoted to a unified method for the analysis of the elastoplastic bifurcation and post-bifurcation of structural elements such as beams, plates and shells. The plasticity is described within the frame of generalized standard materials, obeying the von Mises yield criterion and a linear isotropic hardening. The bifurcation theory makes use of asymptotic expansions as introduced by Hutchinson. The presented results focus on the significant case of uniaxial stress which enables us to obtain analytical relations for the structural elements in hand. First, the method is illustrated with a Timoshenko beam under axial compression, from which the well-known results for the Bernoulli beam model are straightforward. Next, it is shown that the same method applies again to the plastic buckling of axially compressed plates and cylindrical shells. In each case, the three-dimensional bifurcation equation is solved, giving rise to the critical load, the eigenmode as well as the initial slope of the bifurcating branch which is essential for the stability analysis.

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