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Sensitivity Analysis and Optimal Design of Geometrically Nonlinear 3D Frames with Account for Stable Postbuckling Behaviour

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The postbuckling behaviour of optimal geometrically nonlinear 3D frames is usually not analyzed since the critical load constraints are included in the optimization problem. Therefore it is not clear whether behaviour of the optimal frame after buckling is stable or unstable. In order to overcome that it is possible to implement postbuckling constraints into the formulation of optimization problem that take care of the form of nonlinear equilibrium path and modify the design in order to obtain stable behaviour after buckling. To guarantee the stable postbuckling behaviour of the optimal frame we adopt the expression for the change of total potential energy which will allow us to investigate the stability of singular points. Implementation of postbuckling constraints into the problem of determination of the optimal joint positions and cross-sectional parameters of geometrically nonlinear space frames results in minimization of the global mass of the frame subject to elimination of snap-through. The sensitivity analysis of the small change of total potential energy is performed through analytic differentiation with respect to design parameters.

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