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Large displacement analysis of space-frame structures. (English) Zbl 0675.73034

Comput. Methods Appl. Mech. Eng. 72, No. 1, 57-75 (1989).

Summary: The current research is mainly concerned with the geometrically nonlinear static analysis of three-dimensional space-frame structures. The elastic analysis of frame structures by means of the finite element method in the post-buckling range inevitably involves the solution of large systems of nonlinear equations. The most satisfactory way of solving such problems is to combine the arc-length method [*M. A. Crisfield*, Comput. Struct. 13, 55-62 (1981; Zbl 0479.73031)] within each increment with the Newton-Raphson method (NR method) as the iteration strategy. For large joint rotations, the joint orientation matrix suggested by *C. Oran* [ASCE J. Structural Div. 99, 987-1001 (1973)] has been used to update the rotational displacement of a joint. The present study deals with the "imperfect" approach to trace the secondary paths of three-dimensional frame structures, the particular examples studied being a two-hinged deep arch and a shallow geodesic dome. Eigenvectors are calculated at bifurcation points to force the structure on to the secondary path by introducing a small perturbation either in load or in geometry.

MSC:

74S05 Finite element methods applied to problems in solid mechanics
74B20 Nonlinear elasticity
74G60 Bifurcation and buckling
74K10 Rods (beams, columns, shafts, arches, rings, etc.)

Keywords:

updated Lagrangian approach; geometrically nonlinear static analysis; arc-length method; Newton-Raphson method; iteration strategy; large joint rotations; joint orientation matrix; "imperfect" approach; secondary paths; three-dimensional frame structures; two-hinged deep arch; shallow geodesic dome; Eigenvectors; bifurcation points; small perturbation

Full Text: DOI

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