

ABSTRACT

The present study deals with a quadrilateral thin shell element of arbitrary shape. Special attention is paid to the geometric representation of arbitrary shaped shells and to maintain C^1 continuity across the interelement boundaries at all stages of deformation. Coons parametric surface representation technique is adopted to generate the geometric basis for the element. Ferguson's original formulation of quadrilateral surface patch is modified to adapt it for finite element formulation. The surface patch is described in terms of the nodal position vectors and surface tangents along the parametric surface coordinate directions. The shell middle surface is defined as a mosaic of quadrilateral patches and the magnitudes of the nodal tangents are calculated through a minimization scheme to generate a smoothest possible surface. An isoparametric definition of the deformed middle plane is chosen. The deformed middle plane is defined by the same interpolation functions and nodal *handles* with arbitrary incremental vector valued changes. The nodal increments of the vector valued *handles* are chosen as the finite element nodal unknowns. A nonlinear tangent stiffness matrix is derived using tensor approach in order to retain the coordinate invariance and objectivity of the formulation. Exactly six rigid body modes are present in the shell element. The formulated element is validated through varied numerical examples. Critical points on the load-deformation paths are identified and pre- and postbuckling characteristics of a variety of thin shells are predicted by modified Riks technique. Interelement jumps in the couple resultants are found to be appreciably low even with only C^1 continuity. The encouraging outcome of the present study reveals the advantages of integrated surface modelling and finite element developments which may proved to be ideal for the study of arbitrary shaped shells.

KEY WORDS: Finite element, Elastica, Arch, Thin shell, Arbitrary
curve representation, Arbitrary surface
representation, Computer aided geometric design,
Surface patch, C^1 continuity, Rigid body modes,
Continuity of stresses, Geometric nonlinearity,
Prebuckling analysis, Postbuckling analysis