Finite element formulation of a third order laminated finite rotation shell element

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Abstract: The present paper describes a geometrically nonlinear finite element formulation of a four-node isoparametric laminated shell element based on a cubic displacement field over the shell thickness. The finite element implementation is based on a formulation proposed recently by the authors [Acta Mech., submitted for publication]. A singularity free parametrization of the rotation field is adopted. A geometrically exact configuration update scheme which uses the exponential mapping is developed. A particular attention is devoted to the consistent linearization of the equilibrium equations in order to achieve quadratic rate of convergence typical for the Newton-Raphson solution procedure. The capability of the element to deal with strongly nonlinear situations is demonstrated by examples involving large rotations, buckling and postbuckling analysis. The results are compared with other formulations available in the literature.