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A six-node prismatic solid finite element for geometric nonlinear problems in elasticity.

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Summary: The present work deals with an extended six-node prismatic 3D solid finite element to the analysis of nonlinear geometrical problems. The kinematic formulation is based on a virtual Space Fiber Rotation (SFR) concept which conducts to improve the displacement fields with additional displacement terms, presenting rotational degrees of freedom (DOFs). Once the standard and patch tests for linear validation are previously achieved, the present element is assessed again for large displacement and moderate rotation. For this purpose, the total Lagrangian approach is used and the Green-Lagrange strain Piola-Kirchhoff stress tensors are considered. The material behavior considered in this work is restricted to Saint-Venant-Kirchhoff model for 3D large displacements elasticity To demonstrate the efficiency and accuracy of the developed finite element model, extensive and standard nonlinear benchmarks are presented. The obtained results show a good convergence and accuracy compared to similar finite elements and consequently well capability of the present element to deal with geometric nonlinear problems, including prediction of several limit points.

MSC:

74Cxx Plastic materials, materials of stress-rate and internal-variable type
74Sxx Numerical and other methods in solid mechanics

Keywords:

3D finite elements; six-node prismatic elements; rotational DOFs; geometric nonlinearity

Software:

ABAQUS

Full Text: DOI

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