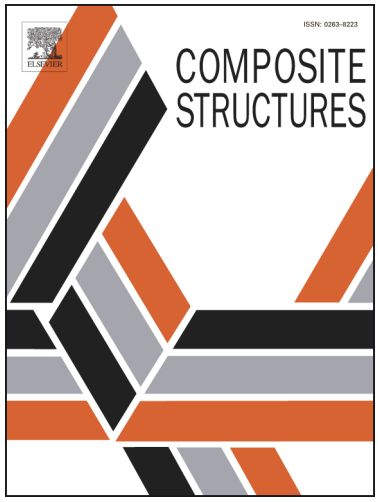

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PII: S0263-8223(16)32911-7
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.03.091
Reference: COST 8412

To appear in: *Composite Structures*

Received Date: 19 December 2016
Revised Date: 11 March 2017
Accepted Date: 27 March 2017

Please cite this article as: Wang, P., Chalal, H., Abed-Meraim, F., Quadratic prismatic and hexahedral solid–shell elements for geometric nonlinear analysis of laminated composite structures, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.03.091

Quadratic prismatic and hexahedral solid–shell elements for geometric nonlinear analysis of laminated composite structures

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Abstract

The current contribution proposes two quadratic, prismatic and hexahedral, solid–shell elements for the geometric nonlinear analysis of laminated composite structures. The formulation of the proposed solid–shell elements is based on a fully three-dimensional approach combining the assumed-strain method and the reduced-integration technique. In particular, only translational degrees of freedom are considered in the formulation and a preferential direction is chosen as the thickness direction, along which an arbitrary number of integration points are arranged. Making use of different physical local frames, these elements are coupled with fully three-dimensional orthotropic constitutive equations, which allows modeling multilayered composite structures with only a single element layer through the thickness. A series of popular nonlinear benchmark tests for laminated composite structures is performed to assess the performance of the proposed SHB elements. Compared to reference solutions taken from the literature, the results provided by the SHB elements show excellent agreement. Moreover, on the whole, the proposed SHB elements perform better than state-of-the-art ABAQUS elements, which have the same geometry and kinematics, using comparable mesh discretizations.

Keywords: quadratic solid–shell elements, assumed-strain method, geometric nonlinearities, orthotropic elasticity, composite structures.

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