IMPLEMENTATION OF COMPOSITE 7-PARAMETERS FORMULATION OF SHELL ELEMENTS APPLYING USER SUBROUTINE UEL

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Keywords: Shell elements, Composite structures, High-order parameters formulation.

ABSTRACT

In the context of Finite Element Analysis, the main efforts are focused on developing the needed high performance element technology to have a good characterisation of the mechanical response of composite specimens. Thus, one of the main topics is the use of arbitrary 3-dimensional material law without order-reduction in case of thin walled structures (where composite structures are included) like higher order elements or continuum/solid shells.

The finite element technology used in this research is based on the previous work due to [1]. The theoretical development that is exposed in this paper is intended to be applied to laminates specimens where similar values for the nominal thicknesses and material properties of each layer used for its manufacture. As a consequence of the closed nature between the constitutive layers, none multidirector model is needed to be developed. This kind of structures is especially representative in aeronautical applications as fuselage parts, wind components and others.

The implementation of the Shell 7-parameters Formulation in the commercial Finite Element software ABAQUS, via user subroutine UEL, for laminates is presented. To avoid numerical locking is needed the inclusion of Enhanced Assumed Strain (EAS) and Assumed Natural Strain (ANS) procedures in the formulation, preserving the basic nature of a pure displacement formulation.

Finally, in order to validate the numerical implementation, a series of numerical examples is included.

REFERENCES