REFINED SHELL ELEMENTS FOR THE THERMO-MECHANICAL ANALYSIS OF MULTILAYERED STRUCTURES

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Summary. The present work deals with the static and dynamic analysis of multilayered plates and shells under thermo-mechanical loads. To this aim, the refined shell elements, recently formulated by the authors on the basis of Unified Formulation (UF), have been extended to the thermo-mechanical problem. The governing equations are derived using the Principle of Virtual Displacements (PVD) extended to the thermo-mechanical case. The Mixed Interpolated Tensorial Components (MITC) method is employed to contrast the membrane-shear locking phenomenon that usually affects shell finite elements. The temperature profile is not assumed linear in the thickness direction, but it is calculated by solving the Fourier's heat conduction equation. Results are compared with some reference solutions from the literature.

INTRODUCTION

Due to the discontinuity of the mechanical and thermal properties at the layer interfaces, an accurate description of the mechanical and thermal fields in the layers is essential. For these reasons, the use of classical plate theories based on Kirchhoff and Reissner-Mindlin hypotheses can lead to inaccurate results. Even if analytical models are available, the solution of practical problems often demand the use of computational methods such as the finite element method. The present paper presents shell finite elements for the analysis of multilayered composite structures under thermo-mechanical

loads, based on the Principle of Virtual Displacements (PVD) and the Unified Formulation. These shell elements have nine nodes, and the mixed interpolation of tensorial components method is employed to contrast the membrane and shear locking phenomenon. This formulation has already shown all its potentiality as a base for finite elements in the mechanical analysis of multilayered shells [1].
Moreover, plate finite elements based on UF for the analysis of thermo-mechanical problem have been already presented [2]. One of the most interesting features of the unified formulation consists in the possibility to keep the order of the expansion of the state variables along the thickness of the plate as a parameter of the model. In so doing, both equivalent single layer (ESL) and layer-wise (LW) descriptions of the variables are allowed. Some results from the static and dynamic analysis of plates and shells under thermo-mechanical loads will be provided in order to show the efficiency of models presented.

REFERENCES

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