International Conference on Science and Technology of Heterogeneous Materials and Structures
Wuhan University, 11-13 October 2013

H. Hu, A. J. M. Ferreira (Editors)
www.icsthms.com

A REISSNER-MIXED VARIATIONAL APPROACH FOR THE ANALYSIS OF LAMINATED COMPOSITES USING COLLOCATION WITH RADIAL BASIS FUNCTIONS

A. J. M. Ferreira[†], E. Carrera[*], M. Cinefra[*]

[†]Faculdade de Engenharia da Universidade do Porto (FEUP)
Universidade do Porto
Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
e-mail: ferreira@fe.up.pt

[*] Politecnico di Torino
Torino, Italy
e-mail: erasmo.carrera@polito.it, maria.cinefra@polito.it

Key words: Laminated composites, Collocation, Radial Basis Functions.

Summary. In this paper, we combine the Carrera's Unified Formulation and a radial basis function (RBF) collocation technique for predicting the static deformations and free vibrations behavior of thin and thick cross-ply laminated plates. Here, the Reissner-Mixed Variational Theorem is used together with the RBF collocation to achieve a highly accurate approach. The accuracy and efficiency of this collocation technique demonstrated through numerical examples.

1 INTRODUCTION

Multilayered structures are common in airplanes, automobiles, aerospace applications.

The analysis of multilayered plates can be performed by two-dimensional analysis of layered structures, but it should consider the discontinuity of the mechanical properties at each layer-interface that may produce high shear and normal transverse strains.

A recent development by Carrera has found that many theories can be developed and implemented by various techniques in an automatic way by defining only the displacement expansion. This automatic technique was called Unified Formulation and can be implemented in weak-form methods, such as the finite element method, or more recently in meshless methods based upon collocation with radial basis functions

The Unified Formulation (here referred as CUF-Carrera's Unified Formulation) may consider both equivalent single layer theories (ESL), or layerwise theories (LW), using the Principle of Virtual Displacements (PVD). However, a more interesting (at a higher computational cost) approach is to use the layerwise formulation with the Reissner's Variational Mixed Theorem (RMVT). The RMVT considers two independent fields for displacement and transverse stress variables. As a result, a priori interlaminar continuous transverse shear and normal stress fields can be achieved, which is quite important for sandwich-like structures.

The RMVT has been implemented successfully with finite elements, but never with collocation with radial basis functions. Therefore, this paper serves to fill the gap of knowledge in this research area.

2 ACKNOWLEDGMENTS

The authors acknowledge the kind support of FCT to Project PTDC/EMS-PRO/2044/2012.