International Conference on Computational &
Experimental Engineering and Sciences
ICCES'13
Seattle (USA), 24-28 May 2013
S.N. Atluri (Editor)
www.icces.org

On Static Analysis of Composite Plane State Structures via GDQFEM and Cell Method

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Abstract. This study deals with structural modeling of composite structures by using Generalized Differential Quadrature Finite Element Method (GDQFEM), compared with Cell Method (CM) and Finite Element Method (FEM). In particular, results on stress and strain at fiber/matrix interface of the composite material are here provided.

The GDQFEM is based on the classic Generalized Differential Quadrature (GDQ) technique applied to simple geometries [1]. A GDQ rule is applied upon each sub-domain, or element, in which the problem domain is divided. When the problem domain is not regular, the mapping technique is used to transform the fundamental system of equations, the compatibility conditions of the adjacent sub-domains and the boundary conditions defined on the physical sub-domain, into the regular master element in the computational domain. Pursuing the following GDQFEM, a differential problem can be turned into an algebraic system. With respect to the very well-known Finite Element Method (FEM), the GDQFEM is based on a different approach: the direct derivative calculation is performed by using the GDQ rule. The imposition of the compatibility conditions between two boundaries are also used in the CM for solving contact problems [4,5]. Since the GDQFEM is an higher-order tool connected with the resolution of the strong form, the compatibility conditions must be applied at each disconnection in order to capture the discontinuity between two boundaries, without losing accuracy. A comparison between GDQFEM, CM and FEM is presented and very good agreement is observed.

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