Static Analysis of Arbitrarily Shaped Composite Plates via GDQFEM

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This paper deals with the static behavior of moderately thick composite flat plates with geometric discontinuities, such as cracks and curved boundaries. The problem of elastic plates had been widely and deeply studied in the last years [1]. The application of laminate materials to every kind of structure has been widespread in the structural mechanics research field.

The theory of thick flat plates is considered in this work. This theory is widely known as First-order Shear Deformation Theory (FSDT). The constituent material of the plate under consideration is anisotropic. Displacements and the inter-laminar state of stress of these structures are caused by different forces that can have serious consequences for the structural strength and safety. Hence, an accurate determination of these parameters is considerably important for the technical design of these structural elements.

This work applies the Generalized Differential Quadrature Finite Element Method (GDQFEM) to carry out the static analysis of arbitrarily shaped flat plates with internal cracks. The present method has been discussed in literature [2-3]. The proposed numerical procedure is based on the Generalized Differential Quadrature (GDQ) method, from which it takes the derivatives calculation. The accuracy and correctness of GDQ method was already discussed in literature by the authors [4-6]. The DQ method discretizes the derivatives along a line. Thus, it requires a regular computational domain, so that the physical boundary could be a mesh line. If the physical boundary is generally curved, the DQ method cannot be directly applied. So, the proposed GDQFEM firstly decomposes the whole domain into several sub-domains of a generic shape and the DQ discretization is applied locally within the coordinate transformation approach.

References