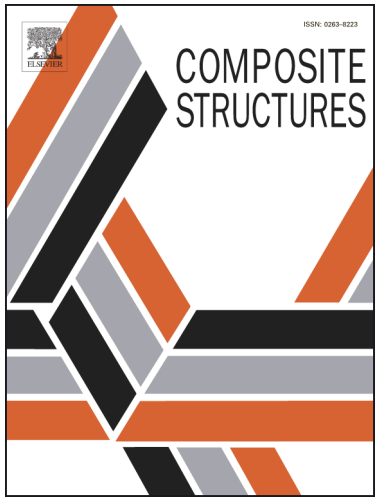

Review

Equivalent single layer theories for composite and sandwich structures: A review

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EQUIVALENT SINGLE LAYER THEORIES FOR COMPOSITE AND SANDWICH STRUCTURES: A REVIEW

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Abstract

This article describes one type of plate theories called equivalent single layer theories that are characterized by a single approximation of the displacements through the thickness. This approach is also used for beams and for shells. The presentation focuses on the basic assumptions of the theories to bring out similarities and differences and to organize the existing approaches in a logical manner. Two broad categories are retained. In the first one the displacement field is expressed in terms of polynomials functions of the transverse variables while in the second category, non-polynomial functions are used. In each category, theories are grouped in terms of the number of unknown variables to be determined. This is a very active research area and it is shown that most theories retain only three, four or five variables even though more terms can be added.

Keywords:

Equivalent single layer theories, beams, plates, shells, composites

1- INTRODUCTION

The objective of this article is to present a comprehensive view of the development of equivalent single layer (ESL) theories for beams, plates and shells. Analyzing such structures as two- or three-dimensional solids is usually not practical and simpler more efficient models are needed. The development of such models proceed using (a) an asymptotic expansion approach that reduces the 3D elasticity problem to a 2D problem in the case of plates; or (b) an axiomatic