A COMPARISON OF MEMBRANE SHELL THEORIES OF HYBRID ANISOTROPIC MATERIALS

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ABSTRACT

Membrane shell theories are simple and widely used but also care must be taken to prevent secondary bending moments due to the unbalanced arrangement of laminates of anisotropic materials. At times, bending theory may have to be adopted and the current design codes, such as ASME, API and ACI must be reviewed for the case of anisotropic materials. The stresses and strains can be significantly different between the pure membrane and bending theories. This paper derives a membrane type shell theory of hybrid anisotropic materials, governing differential equations together with the procedures to locate the mechanical neutral axis. The theory is derived by first considering generalized stress strain relationship of a three dimensional anisotropic body which is subjected to 21compliance matrix and then non-dimensionalizing each variable with asymptotically expansion. After applying to the equilibrium and stress-displacement equations, we are allowed to proceed asymptotic integration to reach the first approximation theory. Also possible secondary moments due to the unbalanced built up of lamination are quantifiably expressed. The theory is different from the so called pure membrane or the semi-membrane analysis.

Key Words: Hybrid anisotropic materials; Asymptotic integration; Length scales; Membrane Stresses; Secondary Bending moments.

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