

預應力下含彈性凸緣體疊層圓型板件大撓曲問題之解析探討

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摘要

The problem of large deflection of a pre-stressed layered plate with an elastic boss due to lateral pressure is studied. The governing equations were developed based on von-Karman plate theory for large deflection, which are further formulated in terms of lateral slope and radial force resultant via a non-dimensional and merging scheme. The solution approach follows the consideration of a small deflection, and thus the arising nonlinear terms are neglected, yielding a simplified linear problem and thus a modified Bessel equation for the lateral slope. Analytical solutions expressible in terms of modified Bessel functions are developed by considering the continuity at the interface between the boss and the annular plate as well as the boundary condition along the clamped edge. For a nearly monolithic plate with a thin boss, the solutions agree well with those of a single-layered plate available in literature. Emphasis is placed upon the exploration of the influences due to various parameters including the magnitudes of lateral pressure, pretension, as well as the geometry of the center boss upon the geometrical response (lateral deflection, slope, and curvature) of symmetrically-layered plates made of typical silicon-based materials. Following the obtained results, it is seen, the boss size and the modulus ratio between the layers of the annular plate can influence the geometrical behavior of the bossed plate significantly.

關鍵字 : Elastic Boss, von-Karman Large Deflection Plate Theory, Modified Bessel Function, Pre-stress.