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An extension to classical lamination theory for buckling and vibration of functionally graded plates

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2019-08

https://hdl.handle.net/10539/29151

Catanho, Roberto Vincent, (2019). An extension to classical lamination theory for buckling and vibration of functionally graded plates, University of the Witwatersrand, https://hdl.handle.net/10539/29151

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Abstract

An extension to classical lamination theory (CLT) is presented to analyse the natural frequencies and critical buckling loads of simply supported functionally graded plates. The variation of the through-thickness properties of the plate is governed by a power law which is subsequently represented by a polynomial series of sufficient order and varies according to the law of mixtures or the Mori-Tanaka Homogenization method. The stiffness matrices are found, from which the position of the neutral plane is established which allows for the governing equations for the natural frequency and critical buckling load to be derived using the Rayleigh-Ritz method. The natural frequency and critical buckling loads are determined for various volume indices, aspect and span ratios and the accuracy thereof is validated against 2D, 3D and quasi-3D solutions found in literature. A comparison with CLT found that the present study produces natural frequencies and critical bucking loads which are more accurate and which converge faster than CLT.