

Abstract

Due to their geometries, helicopter rotor blade have one dimension that is much larger than the other two. Such flexible structure can often be treated as a beam, a one-dimensional body. This idealization of actual structure leads to much simpler mathematical formulation than than would be obtained if complete three-dimensional elasticity were used to model it. Variational asymptotic beam method is a mathematical tool to capture the behaviour associated with the two dimensions that are being eliminated by correctly accounting for geometry and material distribution. The 3-D strain energy based on the strain field is dimensionally reduced via the variational asymptotic method. The formulation also naturally leads to geometrically exact, 1-D kinematically and intrinsic equilibrium for the beam deformation.

In this present work, an attempt has been made to find the full scale linear three dimensional finite element analysis of cantilever composite helicopter rotor blade root subjected to normal pressure and shear tractions, to get the cross sectional displacement and stress- strain field that can be feeded into the variational asymptotic method to get the the stiffness constants and warping field over the cross section. Along with 1-D code beam results can be generated and 3-D stress/strain distribution can be recovered. In the present study is the basic step towards developing a general framework for variational asymptotic method.

Furthermore, the effect of delamination between two laminae have been studied and examined how the displacement, stress-strain field varies in longitudinal direction of the beam. In delamination model, the Ladeveze's Meso-Scale Damage Models is introduced to implement the delamination between two layers of composite laminates. The displacement and stress-strain variation in the vicinity of delamination as well as away from delamination are studied and identified the critical parameter for the delamination damage.