

# Long-time prediction of mechanical behaviors for composite laminates based on cell-based smoothed finite element formulation

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## Abstract

In the present study, the time-dependent or viscoelastic analysis is investigated for composite laminated plates using a smoothed finite element method called cell/element based smoothed discrete shear gap method. Moreover, the hygrothermal effect is considered on the viscoelastic responses of composite laminated plates. The first-order shear deformation theory is employed due to its simplicity and accuracy. With the help of the convolution theorem in Laplace transformation, the complex stress-strain relationship in integral form is simplified to linear in the transformed domain. Therefore, all computing procedures are performed in the transformed domain and then employing the fast Fourier transform to convert back all results to the real-time domain. The study provides an effective computational tool to predict long-time stress and strain responses of laminated composite taking into account the influence of hygrothermal effects.

Key words: Viscoelastic analysis, smoothed finite element methods, first-order shear deformation theory, Laplace transform, hygrothermal effect.