World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:9, No:06, 2015

Time/Temperature-Dependent Finite Element Model of Laminated Glass Beams

Authors : Alena Zemanová, Jan Zeman, Michal Šejnoha

Abstract : The polymer foil used for manufacturing of laminated glass members behaves in a viscoelastic manner with temperature dependence. This contribution aims at incorporating the time/temperature-dependent behavior of interlayer to our earlier elastic finite element model for laminated glass beams. The model is based on a refined beam theory: each layer behaves according to the finite-strain shear deformable formulation by Reissner and the adjacent layers are connected via the Lagrange multipliers ensuring the inter-layer compatibility of a laminated unit. The time/temperature-dependent behavior of the interlayer is accounted for by the generalized Maxwell model and by the time-temperature superposition principle due to the Williams, Landel, and Ferry. The resulting system is solved by the Newton method with consistent linearization and the viscoelastic response is determined incrementally by the exponential algorithm. By comparing the model predictions against available experimental data, we demonstrate that the proposed formulation is reliable and accurately reproduces the behavior of the laminated glass units.

Keywords : finite element method, finite-strain Reissner model, Lagrange multipliers, generalized Maxwell model, laminated glass, Newton method, Williams-Landel-Ferry equation
Conference Title : ICEMA 2015 : International Conference on Engineering Materials and Applications
Conference Location : Vienna, Austria
Conference Dates : June 21-22, 2015