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A rate-dependent continuum model for rapid converting of paperboard. (English)
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Summary: A rate-dependent continuum model for paperboard is developed within a framework for finite strains and finite deformations. A multiplicative split of the deformation gradient into an elastic and an inelastic part is assumed. For the in-plane modes of deformation, viscoelasticity is introduced via a thermodynamically consistent generalization of the Maxwell formulation. The elastic transition between out-of-plane compression and out-of-plane tension is smooth, excluding the need for a switch function which is present in a number of existing paperboard models. The evolution of the inelastic part is modeled using two potential functions separating compression from shear and tension. To calibrate the material model, a set of experiments at different loading rates have been performed on single ply paperboard together with creep and relaxation tests for in-plane uniaxial tension. The model is validated by simulating two loading cases related to package forming, line-folding followed by subsequent force-relaxation and line-creasing during different operating velocities in conjunction with a creep study.

MSC:

74C20 Large-strain, rate-dependent theories of plasticity

Keywords:

paperboard; large strains; anisotropy; rate-dependent; creasing; folding

Software:

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