Efficient sub-grid scale modeling of membrane wrinkling by a projection method.

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Efficient sub-grid scale modeling of membrane wrinkling by a projection method

A. Jarasjarungkiat ⚲ ✉ ⊕ ... K.-U. Bletzinger ✉

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Abstract

Considering wrinkling as an analogue to perfect plasticity, this study employs the projection method from inelasticity model to take into account wrinkling of thin membranes. Along the additive strain decomposition, the total strains within the wrinkled membranes are divided into an elastic part and a wrinkling part. The projection method removes the wrinkling strain part, which has zero strain energy, from the total strains. As a consequence, the outcome is a modified constitutive tensor which represents only energy of the elastic strain part. Due to its simplicity, this method is advantageous for implementation and combines a good rate of convergence and low computational costs. Within this work, the incremental constitutive equation is derived in a general form which is applicable both for isotropic and orthotropic materials. The potential of the proposed wrinkling model is verified via various numerical analyses of wrinkled membranes. Furthermore, the model is attractive to be implemented into

commercial finite element programs.

Keywords

Projection method; Wrinkling model; Element enrichment; Sub-grid scale model; Membrane structures; Modified material model; Isotropic and orthotropic materials

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