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A Creep Continuum Damage Theory for Beams, Plates and Shells

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The widely used approach in modelling the creep-damage behavior of structures is the continuum damage mechanics, which is based on constitutive equations for the creep strain rate tensor, and evolution equations for internal state variables. This approach is usually not compatible with those theories of beams, plates and shells which are based on cross-section approximations of displacement and/or stress fields. In this case there is no unique possibility to transform three-dimensional constitutive and evolution equations to the averaged equations for tensors of forces and moments and the corresponding strain or strain rate measures. We discuss an extension of the theory of simple shells recently proposed for problems of finite elasticity to the creep-damage analysis. The balance equations are formulated directly without any cross-section approximation. A general structure of creep-damage constitutive equations is discussed considering the symmetries of a shell and within the framework of continuum thermodynamics. Based on simplified examples of rods and plates we compare our approach with the three-dimensional analysis by the finite element method.

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