A FEM formulation applied to nonlinear 2D frames with thermomechanical coupling

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This study investigates the behaviour of nonlinear 2D-frame considering the thermic effects through the Finite Element Method (FEM). The description of the problem is based on nodal positions. This variation of FEM, was introduced by Coda [1] to deal with large displacements. Furthermore, the shear effects are being considering in this work by adopting the Reissner's Kinematics.

In recent works was verified the importance of considering the coupled thermomechanical on the dynamic response of nonlinear lattice structures. As evidenced by [2] and [3], the interaction between thermal and mechanical behaviour can motivate expressive redistributions of tensions, mainly in impact problems.

The aim here is to show the results obtained for two-dimensional frame structures, in which the effects of bending are predominant. The first numerical example, found in [3] and similar in [2], is cantilever lattice beam submitted to a transversal dynamic force on its free edge. The response was satisfactory when compared with references, wherein Gough-Joule Effect was proved [4]. It was verified that higher reference temperature causes more differences between mechanical and thermomechanical results, as expected.

The last example is about a spin-up maneuver subjected to a turn function applied on the restricted node [5]. The consideration of the interaction between temperature and strain shows that the influence of temperature is more significant on longitudinal displacements. Over again, initial states with high temperatures causes more significant variations in the form of the solid. Also, in the case where the spin-up maneuver is subjected to a restrict temperature on the restricted node, it is observed a more evident gradual increase on longitudinal displacements, resulting in a bigger residual displacement after stabilization of the movement. No influence on the other direction was verified.

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