NUMERICAL SOLUTION OF THE COUPLED DYNAMIC PROBLEMS BASED ON THE DEFORMATION AND FLOW THERMOPLASTICITY THEORIES

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ABSTRACT

Thermo-mechanical coupling is the most common class of coupled problems, in which the mechanical response of the structure depends on its thermal behaviour and vice versa. Investigations in the field of coupled thermoplasticity are enormously developed due to their many applications in the advanced structural design problems.

The coupled thermoplasticity problems depending on which plasticity theory, the deformation or incremental (flow) theory are used can be formulated two types of coupled thermo-mechanical boundary value problems. The coupled boundary value problems based on deformation theory plasticity [1] consists of motion equation, thermoplasticity constitutive relations and the heat conduction equation with a corresponding initial and boundary conditions. In formulating the coupled thermoplasticity boundary value problems using the flow theories, the motion and heat equations, initial and boundary conditions should be written with respect to the displacement and temperature increments.

This paper deals with the numerical solution of the 3D coupled dynamic thermoplasticity boundary value problems for an isotropic parallelepiped. In formulating the boundary value problems the deformation[2] and strain space thermoplasticity theories [3, 4] are used. Usually, in numerical solution of thermoplasticity boundary problems the original problem is partitioned into several smaller sub-problems, which are solved sequentially. In case of deformation theory of thermoplasticity, the partition of the problem is not required. The explicit and implicit finite difference equations are constructed [4]. For numerical solution the elimination method and recurrence formulas, in case of explicit schemes, are used. Comparison the numerical results, obtained on the basis of explicit and implicit schemes shows that the results are quite close.

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