SOLUTION OF GAS TURBINE ENGINES ROTORS THERMOELASTICITY PROBLEM

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The working process of attached solid constructions like gas turbine rotors that are used in modern gas turbine engines is steadily influenced by various mechanical and thermal effects of high intense [1]. This fact causes a connection between changes of the matched solid bodies mechanical contact and a heat flow through their surfaces. Especially important this correlation is for details of gas turbine engines due to their extremely hard working process.

The considered mechanical deformable system energy state could be described by Lagrange variation principle. Thus:

$$\begin{gathered} \delta L = 0 \\ L = \Pi - T \end{gathered} \tag{1}$$

where L – Lagrange function; Π – potential energy of system's resistance to deformation; T – the work of external forces.

After FEM approximation [2] the main equation of the mechanical system balance (1) is transformed to:

$$[K]\{\delta\} = \{F\} \tag{2}$$

where $[K]$ – global stiffness matrix of finite elements model; $\{\delta\}$ – vector of finite elements nodes generalized displacement; $\{F\}$ – vector of external forces.

The mutual FEM dependences of the aforementioned assembly heat balance:

$$[K_T]\{T\} = \{Q\} \tag{3}$$

where $[K_T]$ – global matrix of the finite elements model thermal conductivity; $\{T\}$ – vector of temperatures located in the nodes of finite elements; $\{Q\}$ – vector of external heat load.

Therefore, for the solution of gas turbine engine rotors thermoelasticity problem we need to solve the set of matrix equations, that is formed by the usage of dependencies (2) and (3).

References:

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