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Thermoelastic Analysis of a Tube Subjected to Internal Heating with Temperature Dependent Material Properties

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Abstract : In this study, the thermoelastic behavior of a long tube is studied by taking into account the temperature dependency of all mechanical and thermal properties. As the tube is heated slowly, an uncoupled solution procedure is adopted under free and radially constrained boundary conditions. The nonlinear heat conduction equation is solved by a finite element collocation procedure and the corresponding distributions of stress and strain are computed by shooting iterations. The computational model is verified in comparison to the analytical solution by shutting down the temperature dependency of physical properties. In the analysis, experimental data available in the literature is used to describe the coefficient of thermal expansion α, the thermal conductivity k, the modulus of rigidity G, the yield strength σ_{0}, and the Poisson's ratio ν of Nickel. Results of the analysis are presented in comparison to those having constant physical properties. As a result of the calculations, the temperature dependency of the material properties should be taken into account at higher temperature ranges.

Keywords : thermoelasticity, long tube, temperature-dependent properties, internal heating
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