عنوان مقاله:

Nonlinear analytical solution of nearly incompressible hyperelastic cylinder with variable thickness under non-uniform pressure by perturbation technique

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خلاصه مقاله:

In this paper, nonlinear analytical solution of pressurized thick cylindrical shells with variable thickness made of hyperelastic materials is presented. The governing equilibrium equations for the cylindrical shell with variable thickness under non-uniform internal pressure are derived based on first-order shear deformation theory (FSDT). The shell is assumed to be made of isotropic and homogenous hyperelastic material in nearly incompressible condition. Two-term Mooney-Rivlin type material is considered which is a suitable hyperelastic model for rubbers. Boundary Layer Method of the perturbation theory which is known as Match Asymptotic Expansion (MAE) is used for solving the governing equations. In order to validate the results of the current analytical solution in analyzing pressurized hyperelastic thick cylinder with variable thickness, a numerical solution based on Finite Element Method (FEM) have been investigated. Afterwards, for a rubber case study, displacements, stresses and hydrostatic pressure distribution resulting from MAE and FEM solution have been presented. Furthermore, the effects of geometry, loading, material properties and incompressibility parameter have been studied. Considering the applicability of the rubber elasticity theory to aortic soft tissues such as elastin, the behaviour of blood vessels under non-uniform pressure distribution has been investigated. The results prove the effectiveness of FSDT and MAE combination to derive and solve the governing equations of nonlinear problems such as nearly incompressible hyperelastic shells.

کلمات کلیدی:

Variable thickness, Blood vessel, Hyperelastic material, Mooney-Rivlin model, Match Asymptotic Expansion