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On Numerical Analysis of Finite Length Cylinders Under Pressure: An Elastostatic Computational Approach

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Abstract

Theory of three dimensional (3D) elasticity is utilized here in this paper for boundary value problems (BVPs) of finite length cylinders. A diaphragm supported cylinder under mechanical sinusoidal and uniformly distributed pressure loads is considered as a two dimensional (2D) generalized plane strain problem of elasticity in (r, z) direction. The 2D problem is reduced to a one dimensional (1D) one by assuming an analytical solution in longitudinal direction (z) in terms of Fourier series expansion which satisfies the simply (diaphragm) supported boundary conditions exactly at the two ends z = 0, *l*. Fundamental (basic) dependent variables are chosen in the radial direction of the cylinder. The resulting first order simultaneous ordinary differential equations are integrated through an effective numerical integration technique by first transforming the BVP as a set of initial value problems (IVPs). Numerical solutions for isotropic cylinders are first validated for their accuracy with available 1D solution of an infinitely long cylinder. Stresses and displacements in axial and radial directions in cylinders having various *l*/R and h/R ratios are presented for future reference.

Keywords: Boundary Value Problem, Initial Value Problem, Elasticity Theory, Circular Cylinder, Numerical Integration.

Introduction

Cylinders are widely used in various engineering applications such as aerospace vehicles, nuclear pressure vessels, piping and many other engineering structures and