In-plane circumferential vibrations of layered pipes

Vasudeva.R.Yerikalapudy and AnuRadha Vema

Applied Mathematics Department
Andhra University
Visakhapatnam-530 003
India
vasudevary@hotmail.com

Interfaces in layered structural elements are prone to develop cracks. Obtaining signature of elastic wave propagation in healthy layered components can serve as a benchmark in USNDT of such elements. Layered pipes of anisotropic materials are widely used in industry, but to the best of our knowledge, dispersion spectra of circumferential waves in anisotropic layered pipe elements are not found to have been illustrated. Assuming perfect contact between adjacent layers of a N layered cylindrical pipe, a Galerkin type weighted residual method (GWRM) is developed in this paper. The method is a modified extension of Towfighi et al's [1] weighted residual method for single layered pipes. Two and three layered pipes are considered for numerical illustration of the GWRM.

1) The GWRM is shown to perform better than the originally proposed.
2) It is shown to give results that match very well with those obtained employing analytical methods in the case of Lamb waves in isotropic and anisotropic layered plates, which can be viewed as pipes of large diameters.
3) It is also shown to give results that agree very well with the exact in the case of isotropic-layered pipes.
4) For pipes made of fiber-reinforced materials, the dispersion spectra are presented using GWRM with fiber orientations at right angles in adjacent layers.
5) An attempt is made to observe the influence of curvature on mode dispersion by plotting the curves for different outer radii.

Material models used in the present work are borrowed from earlier published works.

References

[1] S.Towfighi, T.Kundu and M.Ehsani, " Elastic wave propagation in Circumferential direction in anisotropic curved cylindrical plates," J.Appl.Mech. **69**, 283-291, 2002

Keywords: pipes, circumferential waves