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Guided Wave Propagation in a Fluid-Loaded Transversely Isotropic Plate

Farkhanda Yusaf CHOHAN

1. Introduction

This research is related with:
(1) Generalized form of Rayleigh-Lamb dispersion relations for transversely isotropic materials. (2) Energy leakage while guided waves propagate in fluid-loaded transversely isotropic plate which is being treated first time. (3) Comparison of the attenuation spectra of less dense and highly dense transversely isotropic fluid-loaded plate. (4) Comparison of attenuation spectrum in case of symmetric and antisymmetric wave propagation modes in case of fluid loading.

2. Results and Discussions

The study of elastic waves in solids is considered as the tool for the non-destructive evaluation of solid structures. The reflected acoustic field from solid has assets of information which if exploited, reveals details of many characteristics of the solid, e.g. solid property, existence of internal defects, and quality of interface.

This thesis has generalized the Rayleigh–Lamb dispersion relations of wave propagation for transversely isotropic plate of infinite length, both in case of symmetric and antisymmetric cases.

Then extended this to the case when the plate is immersed in inviscid fluid (where the case of water is considered).

When the phase velocity of Lamb waves exceeds that of velocity of sound in surrounding fluid, energy is radiated into the fluid and term used to describe this is “Leaky Lamb Waves”, which was treated here for the first time in transversely isotropic plate.

3. Conclusions

Wave propagation in different transversely isotropic plates (e.g. magnesium, cobalt) immersed in water has been studied. The result shows that when the ratio of the densities of the fluid and elastic materials is small, modes spectrum of loaded plate is only slightly different from that of free plate. However an increase in this ratio leads to an interaction between various modes until in limiting case the ratio going to infinity.

Next attenuation spectra in both case for the symmetric and antisymmetric modes for fluid-loaded plate have been studied. Comparison of the two modes shows that

1) Attenuation spectra in case of symmetric modes are relatively higher as compared to antisymmetric modes.

2) For the high frequency, the leaky modes approach the Rayleigh modes and in this limit, the attenuation is proportional to the frequency.

3) The water loaded spectrum is more distinguishable in case of less dense plate as compared to highly dense plate. This is because of the high ratio of densities.

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