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Dispersion of Love Wave in a Heterogeneous Orthotropic Layer Under Compressive Pre-Stress Lying Over an Isotropic Elastic Half-space With Rectangular Irregularity

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Abstract

This paper gives a theoretical take a look at on a dispersion of Love waves in a heterogeneous orthotropic layer under compressive pre-stress lying over an isotropic elastic half-space with rectangular irregularity. The heterogeneity within the layer is believed to get up due to exponential variation in shear moduli, pre-stress, and density. A closed-form solution has been gotten for the displacement within the assumed layer as well as infinite half-space. Numerical consequences are introduced for propagation characteristic within the terms of some of the dimensionless parameters and have been produced graphically.

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Keywords: Heterogeneity; isotropy; rectangular irregularity; pre-stress; phase velocity.

1 Introduction

The take a look at of dispersion seismic waves lets in making inferences about specific properties of the parts of the Earth through which the waves have travelled as well as the source of waves. Numerous problems in seismology may be solved with the aid of representing the Earth as a layered medium with the specific thickness and mechanical properties. dispersion of seismic waves in layered media, because of its essential utility in Seismology, Geophysics, and Applied Mathematics has been the subject of numerous investigators. The study has been made of the present paper, on the propagation of Love waves in a heterogeneous orthotropic layer under compressive pre-stress lying over an isotropic elastic half-space with rectangular irregularity. In orthotropic material, the mechanical or thermal

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properties are unique and autonomous in three commonly opposite headings.

The dispersion of Love waves in a non-homogeneous elastic media is of extensive significance in earthquake engineering and seismology due to the occurrence of non-homogeneities inside the earth crust, as the earth is comprised of various layers. The propagation of Love waves has been studied by means of many authors assuming distinct forms of heterogeneity and irregularities at the interface. Relatively a just right quantity of knowledge about the propagation of seismic waves is contained in the notable book by Ewing et al. [1] and Chapman [2]. Love waves in a non-homogeneous orthotropic medium has been studied by Ahmed and Abd-Dahab [3]. Mechanical properties of porous materials have been described by the means of Biot [4, 5]. In addition, Chattaraj et al. [6], Gupta et al. [7], Gupta et al. [8], Gupta et al. [9], Chattopadhyay and Singh [10] and Sethi et al. [11] discussed the surface wave in porous media.

In the present paper inhomogeneity of the heterogeneous orthotropic layer is taken as $p = p_1(1 + \cos\beta z)$, $\rho = \rho_1(1 + \cos\beta z)$ and $Q_i = a_i(1 + \cos\beta z)$. Where p, ρ and Q_i is the compressive pre-stress, density and, shear moduli in the heterogeneous orthotropic layer respectively. Also, β is constants whose dimension is inverse to the length. Here, p_1, ρ_1 and a_i are the values of p, ρ and Q_i at $z = 0$.

2. Formulation of the Problem

We consider a pre-stressed heterogeneous orthotropic layer of finite thickness H, lying over an isotropic elastic half-space with rectangular irregularity. Here, heterogeneous orthotropic layer is free from traction boundary. The z-axis is taken vertically downward in the isotropic elastic half-space and the x-axis is considered parallel to the layer in the direction of wave propagation. The rectangular irregular surface has been taken at the interface of the heterogeneous orthotropic layer and isotropic elastic half-space with length $2a$ and depth h. The existing geometry of the problem is depicted in Fig. 1. The shape of the irregularity at the interface of the heterogeneous orthotropic layer and isotropic elastic half-space is taken as $z = \varepsilon f(x)$ where

$$f(x) = \begin{cases} 0; & |x| > 0 \\ 2a; & |x| \leq 0 \end{cases} \tag{1}$$

$$\epsilon = \frac{h}{a} \ll 1$$

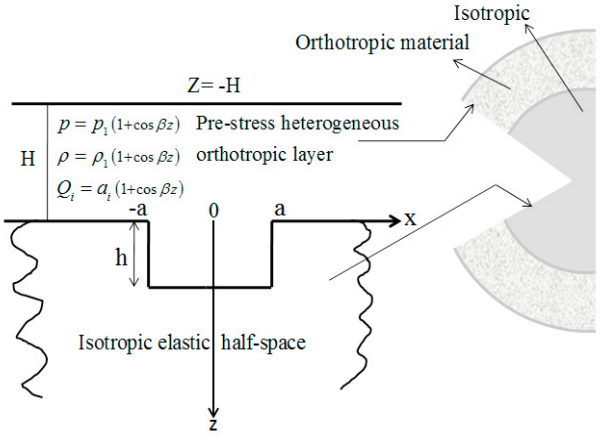

Fig. 1: Geometry of the problem

3. Dynamic of the Layer

3.1. Dynamic of heterogeneous orthotropic layer