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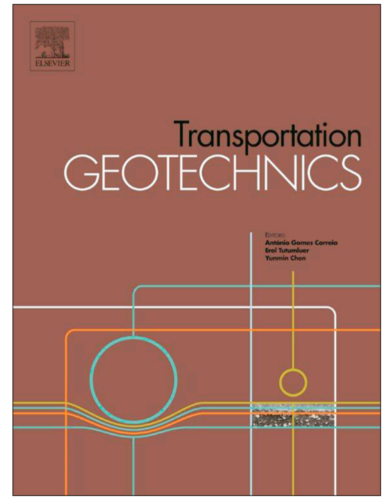

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Dynamic response of an elastic plate on a cross-anisotropic elastic half-plane to a load moving on its surface

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Abstract

The dynamic response of a plate resting on a half-plane soil medium to a load moving on its surface is analytically obtained under conditions of plane strain. The plate is assumed to be isotropic, linear elastic and obeying Kirchhoff's theory of bending. The soil is assumed to be homogeneous, cross-anisotropic and linear elastic. The load is assumed distributed over a finite length and moves on the surface of the plate with constant speed. The moving load is expanded in a complex Fourier series form involving the horizontal coordinate, time and speed. All the response quantities associated with the plate and the soil are also expanded in Fourier series of the same form. Thus, the governing partial differential equations of motion for the plate and the soil are reduced to algebraic and ordinary differential equations with respect to the vertical coordinate, respectively. Using compatibility and equilibrium at the plate-soil interface as well as the boundary conditions, these equations are easily solved to finally provide the response of the plate and the soil in analytic form. This analytic solution, after its verification on the basis of a comparison with the known analytic solution for the simpler case of a plate on isotropic soil, is used to assess the effect of anisotropy on the response for various values of the speed of the moving load. The simplicity of the present solution procedure over other known analytic solutions is also demonstrated.

Keywords: Elastic plate, Cross-anisotropic elastic soil, Moving load, Plane strain conditions, Analytic solution, Soil anisotropy effect.

1. Introduction

During the last 20 years or so, dynamic analysis of flexible and rigid road pavements subjected to moving vehicle loads has been an area of intensive research by engineers, in an effort to more accurately predict their loading response and more carefully assess the effects of the various problem parameters on that response and thus improve their design.

A recent comprehensive review on the subject of the dynamic response of road pavements to moving vehicle loads has been published by Beskou and Theodorakopoulos [1]. That review describes in detail both analytical and numerical methods for solving this dynamic soil-structure interaction problem.

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