Analysis of the propagation of Love waves in infinite media with arbitrary lateral boundaries using the thin layer method

Abstract

The main purpose in this thesis is to obtain the stiffness matrix for an irregular and non-vertical boundary to analyze the soil-structure interaction by Thin Layer Method (TLM). This method analyses the wave propagation in layered media as like as the surface soil in the earth. It is assumed that the variation of soil properties in the regularly layered media is perpendicular to the layer plains and is in vertical direction. The soil properties are homogenous in horizontal direction. In this method the wave propagation is analyzed using the continuum equations in horizontal direction. In the other direction, perpendicular to the layer plains, a numerical solution is used. This formulation leads to the stiffness matrix of a vertical boundary. An extra mesh with a set of nodes must be defined for the intersection of vertical boundary and an irregular zone to assemble the two systems. In this technique with assuming the non-vertical boundary with arbitrary shape a number of hyper elements which their boundaries contain the nodal points at the non-vertical boundary are assumed. With determining the stiffness matrices of hyper elements and assembling them to prepare the matrix of total system and condensing this matrix the stiffness matrix of the non-vertical boundary can be achieved.

The formulation of this method can be written in time or frequency domain; here it is written in frequency domain. The input of the written program are frequency of wave propagation and geometric properties of the medium. The results can be transfered to time domain by the Fourier transform to obtain the real nodal displacements.

Earthquake waves are commonly divided into two types, called Love waves and Rayleigh waves. For the Love waves the motion of particles is perpendicular to the propagation direction and in Rayleigh waves it is in the propagation plain. In this thesis the stiffness matrix is determined for the first type of waves and the results are checked by solving some examples.