Abstract

IMPACT OF WAVE PROPAGATION IN COMPOSITE ELASTIC MEDIA

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In recent years, problems of diffraction of elastic waves by cracks or inclusions at the interface of layered media have gained considerable importance because of their application in Seismology, Geophysics etc. A primary objective is to observe stress singularity near the edge of a crack and to arrest a running crack once it is initiated. This thesis contains the following problems on the impact of wave propagation in composite elastic media:

Problem-1: Shear wave propagation through an orthotropic strip with an edge crack has been analyzed based on dual integral equations, the Hankel transform technique, and the Fredholm integral equation of the second kind. Influence of material orthotropy and normalized strip width on stress intensity factor (SIF) and crack opening displacement (COD) displayed graphically.

Problem-2: Fourier transformation and inverse Fourier transformation techniques, and the Wiener-Hopf equation have been used to the problem of a semi-infinite moving crack inside a semi-infinite half-space of orthotropic medium subjected to anti-plane shear wave. The impact of relevant parameters such as crack velocity, layer depth from the surface to crack and, orthotropic material properties on SIF and COD have been displayed graphically. It is observed that SIF decay with an increase in crack velocity and layer depth and finally tends to zero as crack velocity approaches near SH-wave velocity. Also, the value of COD decays near the crack tip along the negative x-axis and finally tends to zero at the crack tip. The results are validated for isotropic material with some reported work and are well in agreement.

Problem-3: Hankel and Laplace transform have been used to study the effect of the sudden impact of torsional load on a penny-shaped crack sandwiched between two elastic layers embedded in an elastic medium. Values of stress intensity factor (SIF) at the tip of the crack have been plotted for different parameters and materials by solving relevant pair of dual integral equations reducing to a Fredholm integral equation of the second kind.

Problem-4: The torsional wave propagation of a penny-shaped crack in an orthotropic layer and two circular discs bonded between the layer and half-spaces is considered. Solution for the system is obtained with aid of a set of dual integral equations, Hankel transform technique, Abel's transform method, and Fredholm integral equations of the second kind. The impact of material non-homogeneity, normalized disc radius, and layer depth on SIFs near the rims of crack and disc has been portrayed by virtue of graphs. The analysis of the physical quantity SIF leads to speculation about the stability of composites against the propagation of cracks in layered engineering solids by surveilling geometric parameters of orthotropic materials and layer depth.

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