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Displacement Solution for a Static Vertical Rigid Movement of an Interior Circular Disc in a Transversely Isotropic Tri-Material Full-Space

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Abstract : This article is concerned with the determination of the static interaction of a vertically loaded rigid circular disc embedded at the interface of a horizontal layer sandwiched in between two different transversely isotropic half-spaces called as tri-material full-space. The axes of symmetry of different regions are assumed to be normal to the horizontal interfaces and parallel to the movement direction. With the use of a potential function method, and by implementing Hankel integral transforms in the radial direction, the government partial differential equation for the solely scalar potential function is transformed to an ordinary 4th order differential equation, and the mixed boundary conditions are transformed into a pair of integral equations called dual integral equations, which can be reduced to a Fredholm integral equation of the second kind, which is solved analytically. Then, the displacements and stresses are given in the form of improper line integrals, which is due to inverse Hankel integral transforms. It is shown that the present solutions are in exact agreement with the existing solutions for a homogeneous full-space with transversely isotropic material. To confirm the accuracy of the numerical evaluation of the integrals involved, the numerical results are compared with the solutions exists for the homogeneous full-space. Then, some different cases with different degrees of material anisotropy are compared to portray the effect of degree of anisotropy.

Keywords : transversely isotropic, rigid disc, elasticity, dual integral equations, tri-material full-space
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