On formulas for the Rayleigh wave velocity in pre-strained elastic materials subject to an isotropic internal constraint

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Abstract: In the present paper, formulas for the velocity of Rayleigh waves propagating along principal directions of prestrain of an elastic half-space subject to a pure homogeneous prestrain, and an isotropic internal constraint have been derived using the theory of cubic equation. They have simple algebraic form, and hold for any strain-energy function and any isotropic constraint. In undeformed state, these formulas recover the exact value of the Rayleigh wave speed in incompressible isotropic elastic materials. Some specific cases of strain-energy function and isotropic constraint are considered, and the corresponding formulas become totally explicit in terms of the parameters characterizing the material and the prestrains. The necessary and sufficient conditions for existence of Rayleigh wave are examined in detail. The use of obtained formulas for nondestructive evaluation of prestrains and prestresses is discussed.

Author Keywords: Isotropic internal constraint; Prestrain; Prestress; Rayleigh wave velocity; Rayleigh waves

Index Keywords: Cubic equations; Elastic half space; Elastic materials; Internal constraints; Non destructive evaluation; Parameters characterizing; Pre-strain; Pre-stress; Prestresses; Principal directions; Rayleigh wave speed; Rayleigh wave velocity; Strain energy functions; Sufficient conditions; Undeformed state; Acoustic wave velocity; Constraint theory; Elasticity; Strain energy; Rayleigh waves

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