Ding, Boyang; **Dang, Gaihong**; **Yuan, Jinhua**

Lamb's integral formulas of two-phase saturated medium for soil dynamic with drainage.

(English) Zbl 1385.76012

Appl. Math. Mech., Engl. Ed. 31, No. 9, 1113-1124 (2010).

Summary: When dynamic force is applied to a saturated porous soil, drainage is common. In this paper, the saturated porous soil with a two-phase saturated medium is simulated, and Lamb's integral formulas with drainage and stress formulas for a two-phase saturated medium are given based on Biot's equation and Betti's theorem (the reciprocal theorem). According to the basic solution to Biot's equation, Green's function G_{ij} and three terms of Green's function G_{4i}, G_{i4}, and G_{44} of a two-phase saturated medium subject to a concentrated force on a spherical coordinate are presented. The displacement field with drainage, the magnitude of drainage, and the pore pressure of the center explosion source are obtained in computation. The results of the classical Sharpe's solutions and the solutions of the two-phase saturated medium that decays to a single-phase medium are compared. Good agreement is observed.

MSC:

76S05	Flows in porous media; filtration; seepage
76T99	Multiphase and multicomponent flows
45B05	Fredholm integral equations
65M38	Boundary element methods for initial value and initial-boundary value problems involving PDEs
74L10	Soil and rock mechanics
74S15	Boundary element methods applied to problems in solid mechanics

Full Text: DOI

References:

[1] Chen, J. Time domain function solution to Biot's complete equations of dynamic poroelasticity, part II, two dimensional solution. International Journal of Solids and Structures 31(10), 1447–1490 (1994) · Zbl 0945.74669 · doi:10.1016/0020-7683(94)90186-4

[2] Chen, J. Time domain function solution to Biot's complete equations of dynamic poroelasticity, part I, three dimensional solution. International Journal of Solids and Structures 31(2), 169–202 (1994) · Zbl 0816.73001 · doi:10.1016/0020-7683(94)90049-3

[3] Biot, M. A. Theory of propagation of elastic wave in a fluid-saturated soil. Journal of the Acoustical Society of America 28, 168–178 (1956)· doi:10.1121/1.1908239

[4] Biot, M. A. Mechanics of deformation and acoustic propagation in porous media. Journal of Applied Physics 33, 1482–1498 (1962) · Zbl 0104.21401 · doi:10.1063/1.1728759

[5] Cleary, M. P. Fundament solutions for a fluid-saturated porous solid. International Journal of Solids and Structures 13, 785–806 (1977) · Zbl 0367.73088 · doi:10.1016/0020-7683(77)90065-8

[6] Burridge, R. and Vargas, C. A. The fundamental solutions in dynamic poroelasticity. Geophysical Journal of the Royal Astronomical Society 58(1), 61–90 (1979) · Zbl 0498.73018

[7] Norris, A. N. Radiation from a point source and scattering theory in a fluid saturated porous solid. Journal of the Acoustical Society of America 77, 2012–2023 (1985) · Zbl 0579.73107 · doi:10.1121/1.391773

[8] Ding, B. Y., Song, X. C., and Yuan, J. H. The solution of Green function on fluid phase in two-phase saturated medium (in Chinese). Chinese Journal of Geophysics 52(7), 1858–1866 (2009)

[9] Liu, Y. B., Li, Y. M., and Wu, R. S. Seismic wave propagation in transversely isotropic porous media (in Chinese). Chinese Journal of Geophysics 37(4), 499–514 (1994)

[10] Ding, B. Y., Fan, L. B., and Wu, J. H. The Green function and wave field on two-phase saturated medium by concentrated force (in Chinese). Chinese Journal of Geophysics 42(6), 800–808 (1999)

[11] Ding, B. Y., Ding, C. H., and Meng, F. L. The Green function on two-phase saturated medium by concentrated force (in Chinese). Acta Mechanica Sinica 33(2), 234–241 (2001)

[12] Ding, B. Y., Meng, F. L., and Hu, M. Y. The source vector and static displacement field by elastic dislocation on the two-phase saturated medium. Acta Seismologica Sinica 14(3), 239–245 (2001)· doi:10.1007/s11589-001-0002-x

[13] Eringen, A. C. and Suhubi, E. S. Elastic Dynamics, Vol. 2, Linear Theory, Academic Press, New York/San-Francisco/London, 76–138 (1975) · Zbl 0344.73036

[14] Miao, T. D., Zhu, J. J., and Ding, B. Y. Essay on constitutive relation of wave propagation in saturated porous media (in Chinese). Acta Mechanica Sinica 27(5), 536–543 (1995)

[15] Ding, B. Y., Song, X. C., and Yuan, J. H. Solution for displacement response of saturated soil by a concentrated load in tunnel of rectangular section (in Chinese). The Engineering Mechanics 30(3), 153–157 (2009)

[16] Ding, B. Y., Dang, G. H., and Yuan, J. H. Calculation for displacement response of saturated soil by a concentrated load in tunnel of rectangular section (in Chinese). Journal of Vibration and Shock 28(11), 110–114 (2009)

[17] Ding, B. Y., Yuan, J. H., and Pan, X. D. The abstracted and integrated Green functions and OPP of BEM in soil dynamics. Science in China, Series G 51(12), 1926–1937 (2008)· doi:10.1007/s11433-008-0184-5

[18] Sharpe, J. A. The production of elastic waves by explosion pressure, I. Theory and empirical field observations. Geophysics 7(2). 144–152 (1942)· doi:10.1190/1.1445002

[19] Ding, B. Y., Fan, L. B., and Meng, F. L. The displacement field of dislocation on the half-space of two-phase saturated medium (in Chinese). Chinese Journal of Geophysics 46(3), 408–414 (2003)

[20] Ding, B. Y., Ding, C. H., Chen, Y., and Tao, H. B. Green function on two-phase saturated medium by concentrated force in two-dimensional displacement field. Applied Mathematics and Mechanics (English Edition) 25(8), 951–956 (2004) DOI 10.1007/BF02438804 · Zbl 1088.74511 · doi:10.1007/BF02438804