TRANSIENT CONSOLIDATION OF THE IMPERVIOUS POROELASTIC HALF SPACE DUE TO GROUNDWATER WITHDRAWAL

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Abstract

Based on Biot's three-dimensional consolidation theory of porous media, analytical solutions of the elastic consolidation deformation due to a point sink in saturated isotropic poroelastic half space are presented. The closed-form solutions of horizontal and vertical displacements of the ground surface and excess pore water pressure of the half space are obtained by using the Laplace-Hankel integral transformations. The study investigated the cases of pervious and impervious half space boundaries. The consolidation effected by the consolidation parameters are illustrated and discussed. The results show that the maximum ground surface horizontal displacement is around 30% of the maximum settlement for the pervious ground surface. It indicates that pumping from an impervious half space leads to much larger amount of land subsidence than from a pervious one. The study concludes that horizontal displacement and boundary condition are significant and should be properly considered in the prediction of transient consolidation deformations induced by groundwater withdrawal.

Keyword：Groundwater, Land Subsidence, Point Sink, Half Space