

Moving phreatic surface in a porous slab: An analytical solution

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Abstract

Transient Darcian flow in an inclined rigid fully saturated porous layer is studied. A phreatic surface of fixed shape driven by uniformly increasing (but generally not equal) water levels in the contiguous reservoirs moves upward with a constant velocity. In a system of coordinates travelling with the reservoir water level the real and imaginary parts of the complex potential (an analytic function) and complex coordinate are linearly interconnected along the boundary of the flow domain that allows implementing the Polubarinova-Kochina method. An explicit analytic equation of the free surface is derived and shown to result in non-trivial configurations including the saturated zone overhanging dry areas.

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Keywords

Complex potential, Free surface, Hodograph, Polubarinova-kochina, Porous media