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Analytical determination of seeping soil slopes of a constant exit gradient

Kacimov A., Obnosov Y.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Soil slopes satisfying the condition of a constant exit gradient (constant Darcian velocity) and the seepage face (isobaricity) condition are found by complex analysis. For an empty drainage trench, soil is infinitely deep and the flow domain is bounded by two branches of a phreatic surface and the trench contour. The problem is solved by conformal mapping of the Zhukovskii domain (half-plane) onto the hodograph domain (lune). The ultimately stable seepage face and the inflow rate are determined as functions of a specified exit gradient. With decreasing of the gradient the trench flattens. If the gradient is 1, the depth-width aspect ratio of the trench reaches 0.21. Similar conformal mapping of a lune in the hodograph plane on a half-strip in the complex potential plane is used to solve the problem of a phreatic surface flow from a soil channel, whose equipotential contour satisfies the condition of constant "entrance" gradient. For a dam slope, the flow domain is underlain by an impermeable bottom and the hodograph is a circular triangle with a unit-gradient circle as the slope image. The Polubarinova-Kochina method of analytical differential equations is modified to reconstruct the complex coordinate and the complex potential as a function of an auxiliary variable. The resulting slope of unit exit gradient has a depth-width ratio of 1.22. © WILEY-VCH Verlag Berlin GmbH.

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Keywords

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