From: Principles of Soil Physics (Lal R. Shukla M.K., 2004)

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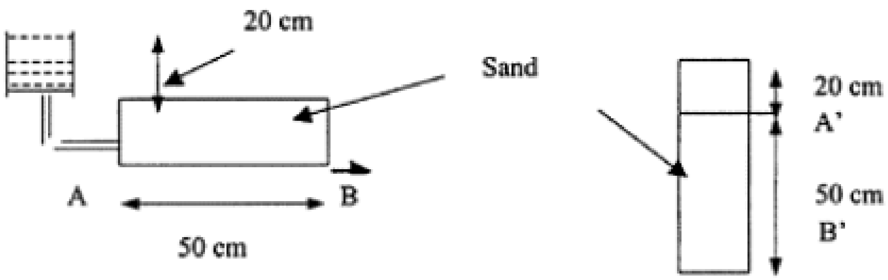
Example 12.1

Consider two soil columns given in the following figure. Horizontal flow is taking place from one and the vertical flow is taking place in the other. The saturated hydraulic conductivity of sand inside both columns is 5×10^{-3} cm/sec. Estimate the hydraulic head, pressure head, and gravitation head at both ends of the columns. Calculate the Darcy's flux through both soil columns. Use the data shown in the figures. Make necessary assumptions.

Solution on the next page



Note, the end of each column is free draining, i.e., pressure is atmospheric

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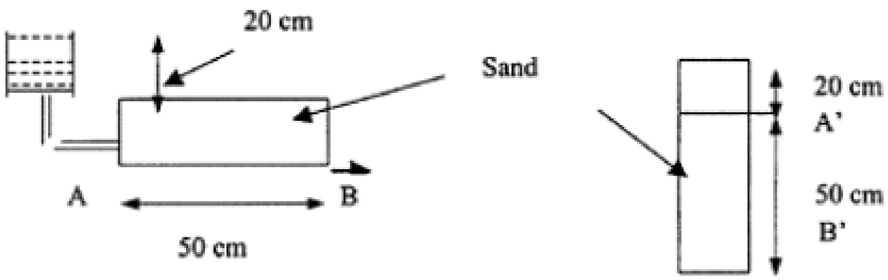
Solution

Assuming a reference at the middle of soil column, the pressure head at *A*=20 cm and gravitational head=0. The pressure head and gravitational head at B are both zero. The Darcy's flux through the soil column

$$q = K\frac{\Delta H}{L} = 5 \times 10^{-3}\,\frac{(20-0)}{50} = 2 \times 10^{-3}\ \text{cm/sec}$$



Assuming a reference point at the bottom of the vertical soil column, the pressure and gravitational head for the vertical flow are 20 cm and 50 cm, respectively, at point A′. At point B′ both are zeros. The Darcy's flux through this soil column

$$q = 5 \times 10^{-3}\,\frac{(70-0)}{50} = 7 \times 10^{-3}\ \text{cm/sec}$$

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What vacuum is needed to draw all the water out of a sintered glass funnel if the minimum pore size is 4 μm in diameter?

Solution next page

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Solution

As the water is withdrawn from the pores, the maximum pressure is reached when a hemispherical bubble is formed with a radius just equal to that of the pore. Therefore, the

$\Delta P=(2\gamma/r)=2(72.75 \text{ dynes/cm})/2\times10^{-4} \text{ cm}=72.75\times10^{4} \text{ dynes/cm}$

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