Example of Application of Darcy's Law to a Laboratory Test Evaluation

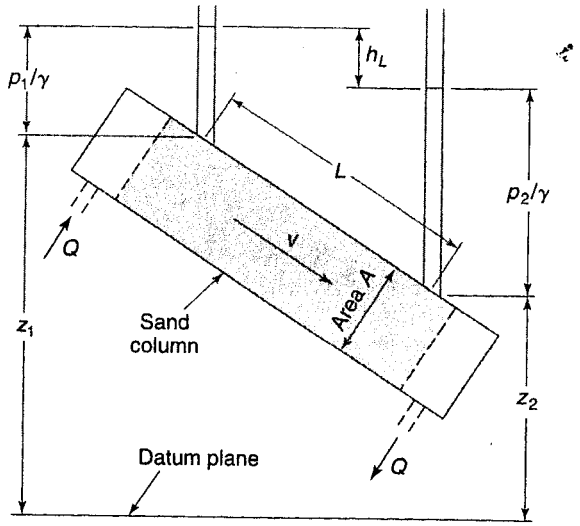

Figure 3.1.1 Pressure distribution and head loss in flow through a sand column.

EXAMPLE 3.1.1

A field sample of an unconfined aquifer is packed in a test cylinder (see Figure 3.1.1). The length and the diameter of the cylinder are 50 cm and 6 cm, respectively. The field sample is tested for a period of 3 min under a constant head difference of 16.3 cm. As a result, 45.2 cm^3 of water is collected at the outlet. Determine the hydraulic conductivity of the aquifer sample.

SOLUTION

The cross-sectional area of the sample is

$$A=\frac{\pi D^2}{4}=\frac{\pi(0.06\text{ m})^2}{4}=0.00283\text{ m}^2$$

The hydraulic gradient, *dh/dl*, is given by

$$\frac{dh}{dl}=\frac{(-16.3\text{ cm})}{50\text{ cm}}=-0.326$$

and the average flow rate is

$$Q=\frac{45.2\text{ cm}^3}{3\text{ min}}=15.07\text{ cm}^3/\text{min}=0.0217\text{ m}^3/\text{day}$$

Apply Darcy's law, Equation (3.1.4), to obtain the hydraulic conductivity as

$$Q=-KA\frac{dh}{dl}\rightarrow K=-\frac{Q}{A(dh/dl)}=-\frac{0.0217\text{ m}^3/\text{day}}{(0.00283\text{ m}^2)(-0.326)}=23.5\text{ m}^3/\text{day}$$

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