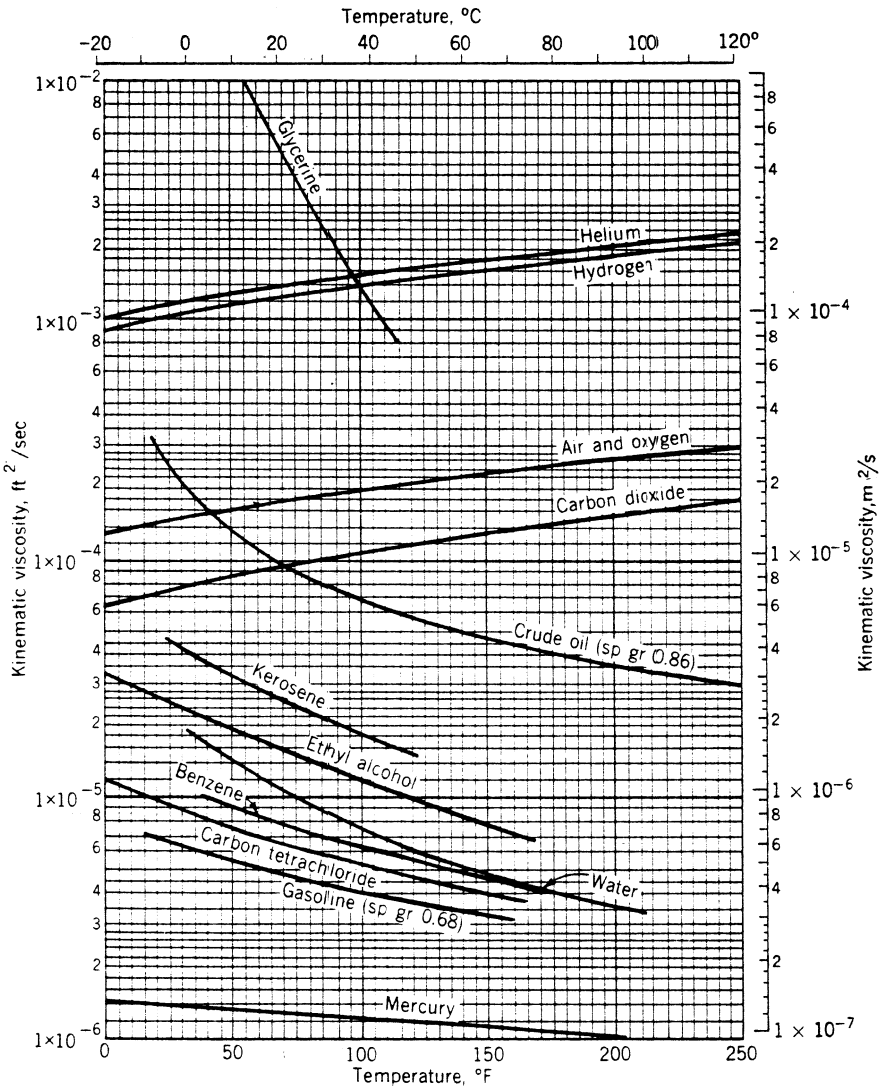
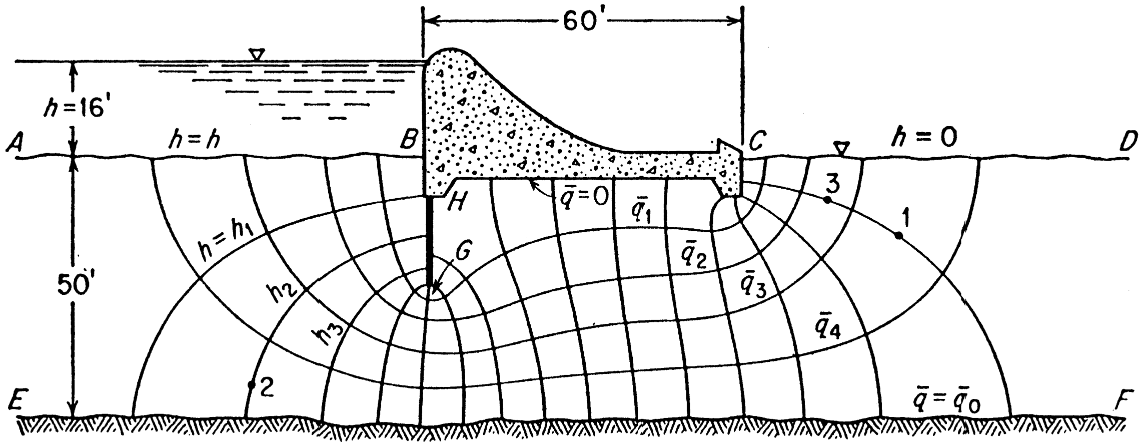
Ground-Water Modeling
15-040-504

First Handout



Copied from p. 718:

Streeter, V.L. and Wylie, E.B. 1975. fluid Mechanics. McGrawHill Book Company: New York. 752p.



The following procedure is suggested for the construction of a flow net: 1. Draw the boundaries of the flow region to scale so that all equipotential lines and streamlines that are drawn can be terminated on these boundaries.

2. Sketch lightly three or four streamlines, keeping in mind that they are only a few of the infinite number of curves that must provide a smooth transition between the boundary streamlines. As an aid in the spacing of these lines, it should be noted that the distance between adjacent streamlines increases in the direction of the larger radius of curvature.

3. Sketch the equipotential lines, bearing in mind that they must intersect all streamlines, including the boundary streamlines, at right angles and that the enclosed figures must be squares.*

4. Adjust the locations of the streamlines and the equipotential lines to satisfy the requirements of step 3. This is a trial-and-error process with the amount of correction being dependent upon the position of the initial streamlines. The speed with which a successful flow net can be drawn is highly contingent on the experience and judgement of the individual. In this regard, the beginner will find the suggestions in A. Casagrande's paper [141 to be of particular assistance.

5. As a final check on the accuracy of the flow net, draw the diagonals of the squares. These should also form smooth curves which intersect each other at right angles.

* In speaking of squares, we except *singular* squares such as the *five-sided square* at H in Fig. 1-15 and the *threesided square* at G. However, when they are subdivided into smaller squares, it is immediately apparent that these deviations reduce in size and, in the limit, act only at singular *points,* the effects of which may be disregarded.

Harr, M.E. 1962. *Groundwater and Seepage.* McGraw-Hill Book Company: New York. p. 22-23.

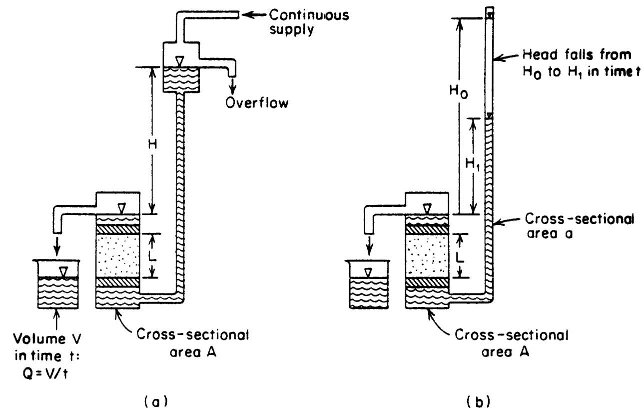


Table 2.2 Range of Values of Hydraulic Conductivity and Permeability

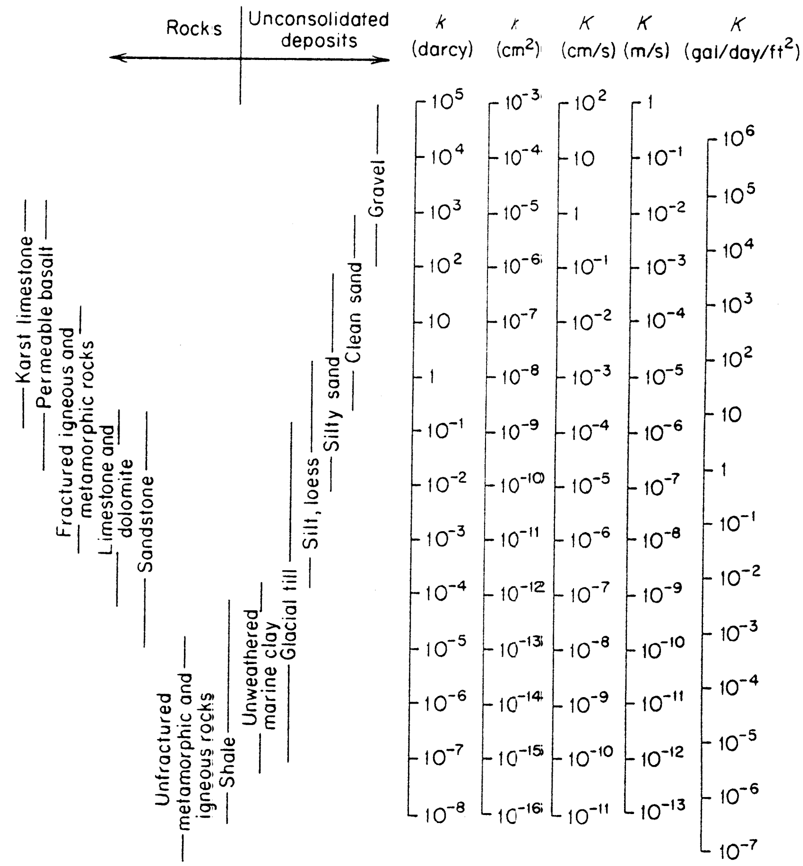


Table 2.3 Conversion Factors for Permeability and Hydraulic Conductivity Units

	Permeability, *k**			Hydraulic conductivity, *K*		
	cm²	ft²	darcy	m/s	ft/s	U.S. gal/day/ft²
cm²	1	1.08×10^{-3}	1.01×10^{8}	9.80×10^{2}	3.22×10^{3}	1.85×10^{9}
ft²	9.29×10^{2}	1	9.42×10^{10}	9.11×10^{5}	2.99×10^{6}	1.71×10^{12}
darcy	9.87×10^{-9}	1.06×10^{-11}	1	9.66×10^{-6}	3.17×10^{-5}	1.82×10^{1}
m/s	1.02×10^{-3}	1.10×10^{-6}	1.04×10^{5}	1	3.28	2.12×10^{6}
ft/s	3.11×10^{-4}	3.35×10^{-7}	3.15×10^{4}	3.05×10^{-1}	1	6.46×10^{5}
U.S. gal/day/ft²	5.42×10^{-10}	5.83×10^{-13}	5.49×10^{-2}	4.72×10^{-7}	1.55×10^{-6}	1

*To obtain k in ft², multiply k in cm² by 1.08×10^{-3}.

Tracer	Lowest Detectable Concentrations	Advantages	Disadvantages
Dyes: Uranine (Sodium fluorescein) Rhodamine B Sulforhodamine G. Extra	0.01-0.04,µg/l	Easy to use, safe. Concentrations can be measured in the field.	Some dyes affected by pH. temperature, or are absorbed by clays and organic soils.
Strong Electrolytes Sodium Chloride Potassium Chloride Ammonium Chloride Lithium Chloride	1-0.001 mg/l	Can be measured in field or laboratory by electrical conductivity or electrical resistivity. Smaller concentrations measured by atomic absorption spectroscopy.	Must use large amounts of salts if ordinary analytical methods are used.
Radioactive Isotopes Tritiated Water Iodine ion Many others	0.001 mg/l or lower	Can be used in such small quantities that no effect on physical and chemical properties of water occurs. Concentrations easily measured by sophisticated equipment. Cost of tritiated water very low.	May be radiation danger (not in case of tritiated water). Requires expensive detection equipment.
Detergents Alkylbenzol-sulfonates	0.05 mg/l	Easy to use, safe	May be confused with sewage-related detergents. Material disperses aggregated soils thereby changing permeabilities.

Copied from p. 84 of
Driscoll, F.G. 1986. *Groundwater and Wells*. Johnson Division: St. Paul. 1089p.