22 POSTSCRIPTS

This chapter collects comments, revisions, and commentary which cannot be incorporated into the body of the text until the next edition. New postscript sections are added as needed when the *Civil Engineering Reference Manual* is reprinted. Subjects in this chapter are not necessarily represented by entries in the index. **It is suggested that you make a note in the appropriate text pages to refer to this chapter.**

Update: October, 1986

Chapter 1: VARIANCE

The statistical term *variance* is used in example 1.42 (page 1-27) but is not defined in the text. The variance is the square of the standard deviation. Since there are two standard deviations (s and σ), there are two variances. The sample variance is s^2. The population variance is σ^2.

Chapter 3: WATER HAMMER IN DUCTILE PIPE

The speed of sound used in water hammer calculations (i.e., c in equations 3.198 and 3.199) must account for the expansion of ductile pipe walls as the water pressure builds up. Equation 3.20 can be used to calculate c, but the modulus of elasticity used should include the elastic contributions of the water and pipe material both. In the equation below, t_{pipe} is the pipe wall thickness, and d_{pipe} is the inside diameter.

$$E = \frac{E_{\text{water}} t_{\text{pipe}} E_{\text{pipe}}}{t_{\text{pipe}} E_{\text{pipe}} + d_{\text{pipe}} E_{\text{water}}}$$

Chapter 8: HEATING VALUE OF DIGESTER GAS

The heating value of digester gas is listed (page 8-29) as 600 BTU/ft^3. This value is appropriate for digester gas with the composition given: 65% methane, 35% carbon dioxide. The actual heating value will depend on the fraction of combustible methane, as well as the temperature and pressure. At 60°F and 14.7 psia, pure methane has a lower heating value of 900 BTU/ft^3. Carbon dioxide does not contribute to the heating effect.

Chapter 14: NEUTRAL AXES IN CONCRETE BEAMS

Figures 14.4 and 14.5 (page 14-10) both contain the variable c, the distance from the neutral axis to the top of beam. However, these two distances are not the same, even though the symbol is the same. The location of the neutral axis changes as the ultimate strength is approached.

Chapter 14: MODULUS OF ELASTICITY FOR MASONRY

Masonry structures are generally designed using the alternate (working stress) design method, which requires knowing the modulus of elasticity. Equation 14.1 for concrete cannot be used. An approximate value can be found from the masonry's compressive strength.

$$E_m = 1000 f'_m \quad (< 3 \text{ EE}\mathfrak{C} \text{ psi})$$

Chapter 17: LENGTH OF VERTICAL CURVE

Equation 17.52 (page 17-16) can be solved without trial and error.

$$LC = 2d \left(\frac{\sqrt{\frac{EG}{EF}} + 1}{\sqrt{\frac{EG}{EF}} - 1} \right)$$

Update: April, 1987

Chapter 5: CHANNEL SLOPE

In uniform flow, the slopes of the channel bottom, water surface, and energy grade line are identical. For

uniform flow, then, equation 5.6 could be written using the geometric slope, S_o, instead of the hydraulic slope, S:

$$v = C\sqrt{r_H S_o}$$

Similarly, other equations in chapter 5 could also be written using S_o, but only under the condition of uniform flow. Using S_o, however, is clearly a special case of a general rule.

Chapter 5: OPEN CHANNEL FLOW in SI

The factor 1.49 in equations 5.7–5.9 (and others) converts customary SI to English units. For problems in SI units (m/sec, etc.), replace the 1.49 with 1.00.

Chapter 7: RAPID SAND FILTERS

Rapid sand filters usually operate with hydraulic heads (distance between water surfaces in filter and clearwell) of 9–12 feet.

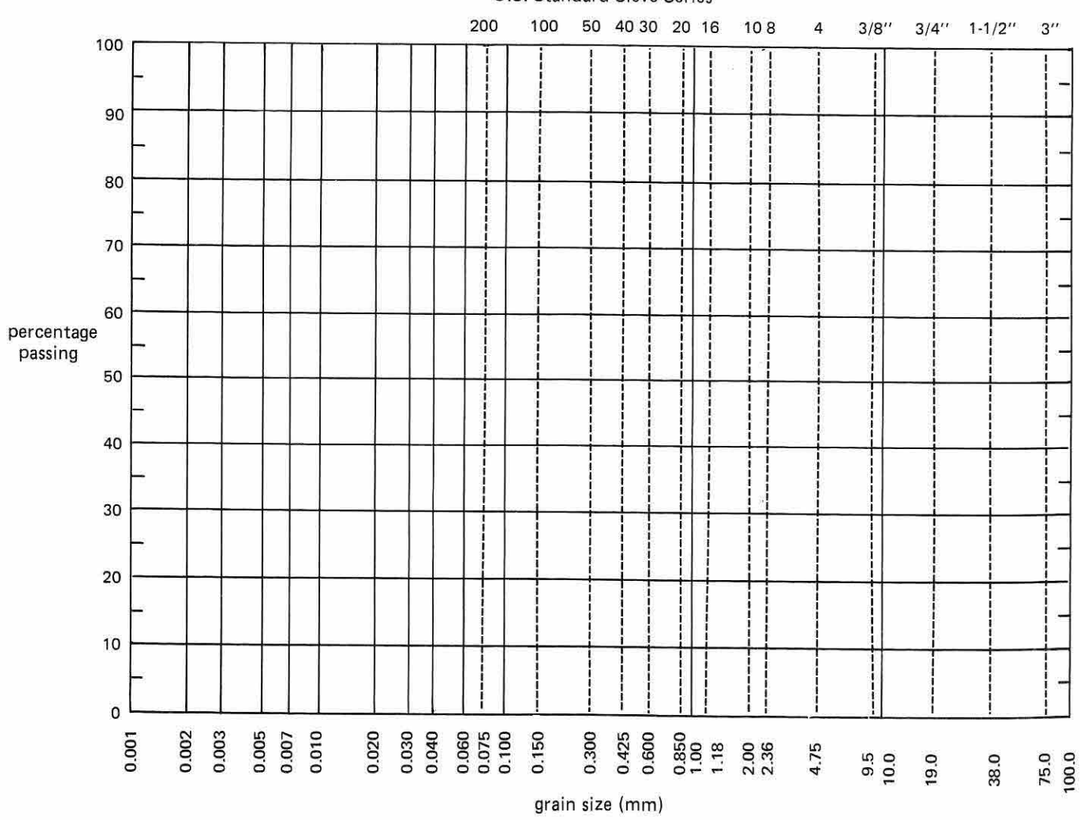
Prior to backwashing with clear water, the filter material may be expanded by an *air prewash* of 1–8 (2–5 typical) cfm/ft^2 for 2–10 (3–5 typical) minutes.

Chapter 8: SANITARY LANDFILLS

Many large-scale sanitary landfills do not apply daily cover to deposited solid waste. Time and cost are typically cited as the reasons that the landfill is not covered with soil. To account for the absence of such cover, the loading factor in equation 8.62 must have a value of 1.0.

Chapter 9: PERCENT PASSING SIEVE

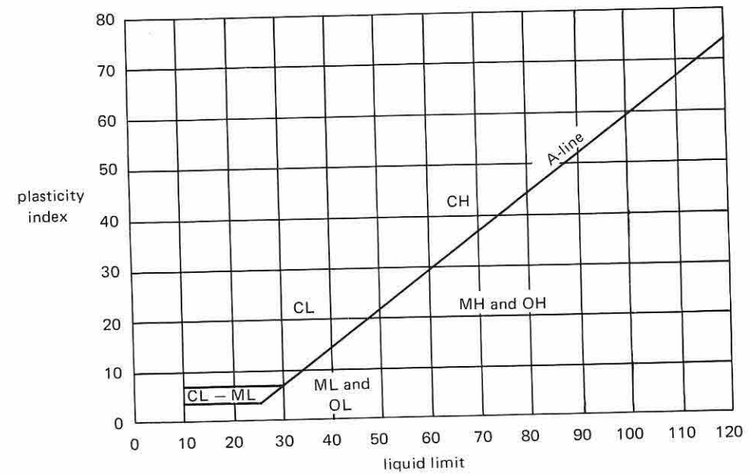
Equations 9.2 and 9.3, as well as various soils classification schemes, require knowing percentages of soil passing through specific sieve sizes. When sieve data is incomplete, the needed values can be interpolated by plotting the known data on a *particle size distribution chart.* (Also, see figure 9.2.)



THE UNIFIED SOIL CLASSIFICATION SYSTEM

Major Division		Group Symbol	Laboratory Classification Criteria: Finer than 200 Sieve (%)	Laboratory Classification Criteria: Supplementary Requirements	Soil Description
Coarse-grained (over 50% by weight coarser than No. 200 sieve)	Gravelly soils (over half of coarse fraction larger than No. 4)	GW	0–5*	D_{60}/D_{10} greater than 4 $D_{30}{}^2/(D_{60} \times D_{10})$ between 1 & 3	Well-graded gravels, sandy gravels
		GP	0–5*	Not meeting above gradation for GW	Gap-graded or uniform gravels, sandy gravels
		GM	12 or more*	PI less than 4 or below A-line	Silty gravels, silty sandy gravels
		GC	12 or more*	PI over 7 and above A-line	Clayey gravels, clayey sandy gravels
	Sandy soils (over half of coarse fraction finer than No. 4)	SW	0–5*	D_{60}/D_{10} greater than 4, $D_{30}{}^2/(D_{60} \times D_{10})$ between 1 & 3	Well-graded, gravelly sands
		SP	0–5*	Not meeting above gradation requirements	Gap-graded or uniform sands, gravelly sands
		SM	12 or more*	PI less than 4 or below A-line	Silty sands, silty gravelly sands
		SC	12 or more*	PI over 7 and above A-line	Clayey sands, clayey gravelly sands
Fine-grained (over 50% by weight finer than No. 200 sieve)	Low compressibility (liquid limit less than 50)	ML	Plasticity chart		Silts, very fine sands, silty or clayey fine sands, micaceous silts
		CL	Plasticity chart		Low plasticity clays, sandy or silty clays
		OL	Plasticity chart, organic odor or color		Organic silts and clays of low plasticity
	High compressibility (liquid limit more than 50)	MH	Plasticity chart		Micaceous silts, diatomaceous silts, volcanic ash
		CH	Plasticity chart		Highly plastic clays and sandy clays
		OH	Plasticity chart, organic odor or color		Organic silts and clays of high plasticity
Soils with fibrous organic matter		Pt	Fibrous organic matter; will char, burn, or glow		Peat, sandy peats, and clayey peat

*For soils having 5 to 12% passing the No. 200 sieve, use a dual symbol such as GW–GC.



Plasticity chart for the classification of fine-grained soils. Tests made on fraction finer than No. 40 sieve, 0.425 mm.