

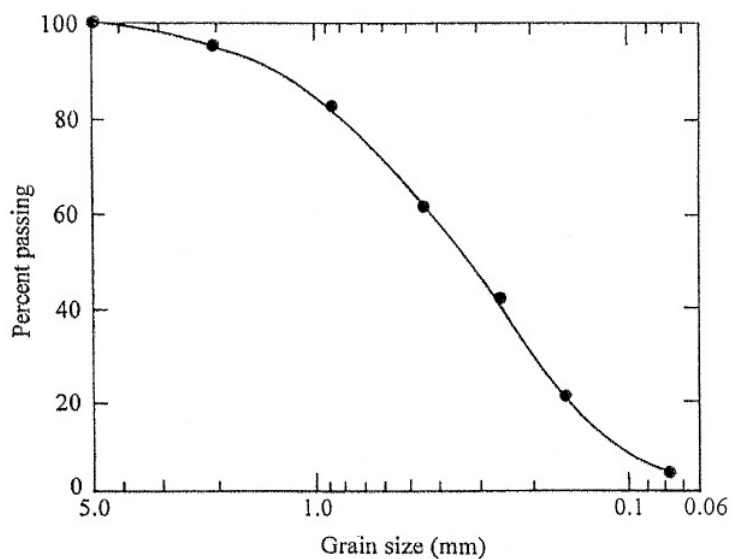
## Chapter 2

2.1 a.

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0.0	0.0	<b>100.0</b>
10	18.5	4.4	<b>95.6</b>
20	53.2	12.6	<b>83.0</b>
40	90.5	21.5	<b>61.5</b>
60	81.8	19.4	<b>42.1</b>
100	92.2	21.9	<b>20.2</b>
200	58.5	13.9	<b>6.3</b>
Pan	26.5	6.3	<b>0</b>

$\Sigma 421.2 \text{ g}$

The grain-size distribution is shown.



b. From the graph,  $D_{60} = 0.4 \text{ mm}$ ;  $D_{30} = 0.22 \text{ mm}$ ;  $D_{10} = 0.12 \text{ mm}$

c. 
$$C_u = \frac{D_{60}}{D_{10}} = \frac{0.4}{0.12} = 3.33$$

d. 
$$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})} = \frac{(0.22)^2}{(0.12)(0.4)} = 1.01$$

$$2.2 \quad C_u = \frac{D_{60}}{D_{10}} = \frac{0.41}{0.08} = \mathbf{5.13}$$

$$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})} = \frac{(0.22)^2}{(0.08)(0.41)} = \mathbf{1.48}$$

$$2.3 \quad C_u = \frac{D_{60}}{D_{10}} = \frac{1.81}{0.24} = \mathbf{7.54}$$

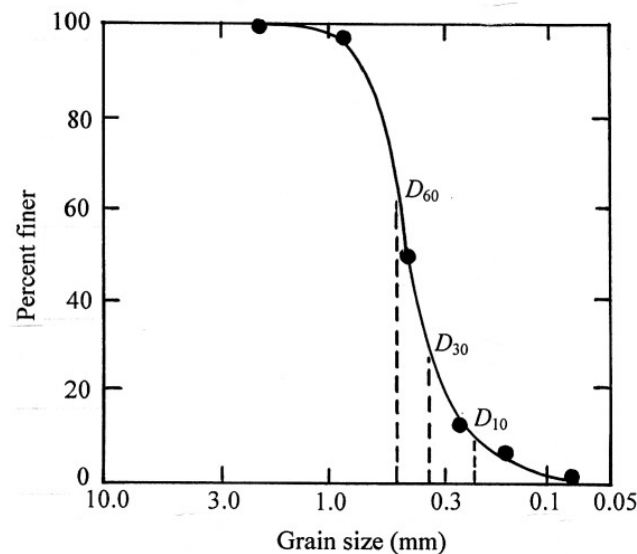
$$C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})} = \frac{(0.82)^2}{(0.24)(1.81)} = \mathbf{1.55}$$

2.4 a.

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0	0	<b>100</b>
6	0	0	<b>100</b>
10	0	0	<b>100</b>
20	9.1	1.82	<b>98.18</b>
40	249.4	49.88	<b>48.3</b>
60	179.8	35.96	<b>12.34</b>
100	22.7	4.54	<b>7.8</b>
200	15.5	3.10	<b>4.7</b>
Pan	23.5	4.70	<b>0</b>

Σ500 g

The grain-size distribution is shown.



b. From the graph,  $D_{60} = 0.48 \text{ mm}$ ;  $D_{30} = 0.33 \text{ mm}$ ;  $D_{10} = 0.23 \text{ mm}$ .

c.  $C_u = \frac{0.48}{0.23} = 2.09$

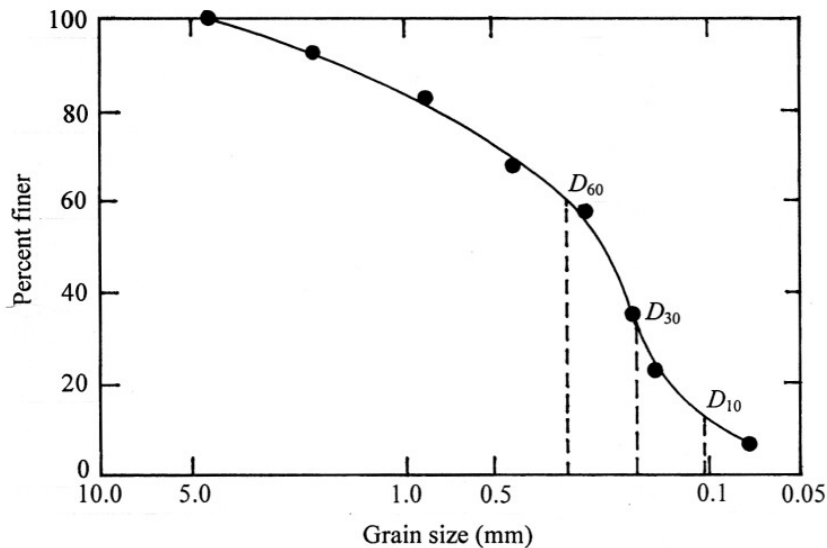
d.  $C_c = \frac{(0.33)^2}{(0.48)(0.23)} = 0.99$

2.5

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0	0	100
10	44	7.99	92.01
20	56	10.16	81.85
40	82	14.88	66.97
60	51	9.26	57.71
80	106	19.24	38.47
100	92	16.70	21.77
200	85	15.43	6.34
Pan	35	5.34	0

$\Sigma 551 \text{ g}$

The grain-size distribution is shown.

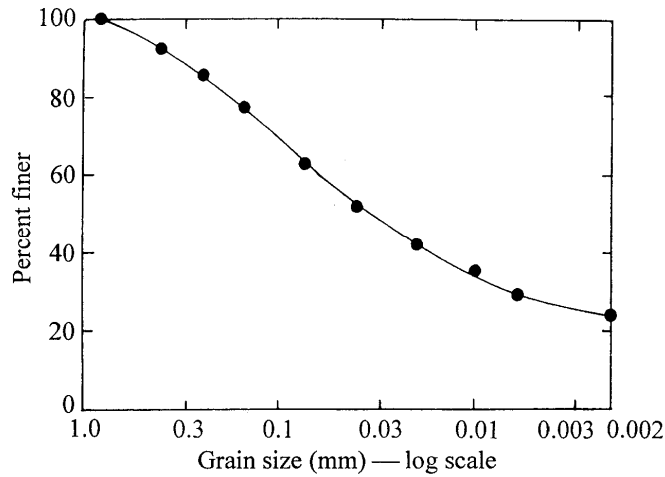


b. From the graph,  $D_{60} = 0.3 \text{ mm}$ ;  $D_{30} = 0.17 \text{ mm}$ ;  $D_{10} = 0.11 \text{ mm}$

c.  $C_u = \frac{0.3}{0.11} = 2.73$

$$d. C_c = \frac{(0.17)^2}{(0.11)(0.3)} = \mathbf{0.88}$$

2.6 The grain-size distribution is shown.



From the graph, percent passing 2 mm = 100%; percent passing 0.06 mm = 58%; percent passing 0.002 mm = 23%. See Table 2.3, so

Gravel: **0%**  
 Sand: 100 – 58 = **42%**  
 Silt: 58 – 23 = **35%**  
 Clay: 23 – 0 = **23%**

2.7 Refer to the graph for Problem 2.6. From the graph, percent passing 2 mm = 100%; percent passing 0.05 mm = 54%; percent passing 0.002 mm = 23%. See Table 2.3, so

Gravel: **0%**  
 Sand: 100 – 54 = **46%**  
 Silt: 54 – 23 = **31%**  
 Clay: 23 – 0 = **23%**

2.8 Refer to the graph for Problem 2.6 and Table 2.3. From the graph, percent passing 2 mm = 100%; percent passing 0.075 mm = 62%; percent passing 0.002 mm = 23%.

Gravel: **0%**  
 Sand: 100 – 62 = **38%**  
 Silt: 62 – 23 = **39%**  
 Clay: 23 – 0 = **23%**

- 2.9  $G_s = 2.60$ ; temperature =  $24^\circ$ ; hydrometer reading = 43; time = 60 min.  
Referring to Table 2.7,  $L = 9.2$  cm.

$$\text{Eq. (2.5): } D \text{ (mm)} = K \sqrt{\frac{L \text{ (cm)}}{t \text{ (min)}}}$$

From Table 2.6, for  $G_s = 2.60$  and temperature =  $24^\circ$ ,  $K = 0.0132$ .

$$D = 0.0132 \sqrt{\frac{9.2}{60}} = \mathbf{0.0052 \text{ mm}}$$

- 2.10 For  $G_s = 2.70$  and temperature =  $23^\circ$ ,  $K = 0.013$  (Table 2.6),  $L = 12.2$  (Table 2.7).

$$D \text{ (mm)} = K \sqrt{\frac{L \text{ (cm)}}{t \text{ (min)}}} = 0.013 \sqrt{\frac{12.2}{120}} = \mathbf{0.0041 \text{ mm}}$$



# Chapter 3

3.1 a.  $w = \left( \frac{711.2 - 623.9}{623.9} \right) (100) = \mathbf{14\%}$

b.  $\rho = \frac{M}{V} = \frac{711.2}{0.4} = \mathbf{1778 \text{ kg/m}^3}$

c.  $\rho_d = \frac{623.9}{0.4} = \mathbf{1559.75 \text{ kg/m}^3}$

d.  $\rho_d = \frac{G_s \rho_w}{1 + e}$

$$e = \frac{G_s \rho_w}{\rho_d} - 1 = \frac{(2.68)(1000)}{1559.75} - 1 = \mathbf{0.718}$$

e.  $n = \frac{e}{1 + e} = \frac{0.718}{1 + 0.718} = \mathbf{0.418}$

3.2 Moisture content:  $w = \frac{W_w}{W_s} = \left( \frac{177.6 \times 10^{-3} - 153.6 \times 10^{-3}}{153.6 \times 10^{-3}} \right) (100) = \mathbf{15.6\%}$

Moist unit weight:  $\gamma = \frac{W}{V} = \frac{177.6 \times 10^{-3}}{9.35 \times 10^{-3}} = \mathbf{18.99 \text{ kN/m}^3}$

Dry unit weight:  $\gamma_d = \frac{\gamma}{1 + w} = \frac{18.99}{1 + \frac{15.6}{100}} = \mathbf{16.43 \text{ kN/m}^3}$

Void ratio:  $e = \frac{G_s \gamma_w}{\gamma_d} - 1 = \frac{(2.67)(9.81)}{16.43} - 1 = \mathbf{0.59}$

Porosity:  $n = \frac{e}{1 + e} = \frac{0.59}{1 + 0.59} = \mathbf{0.37}$

Degree of saturation:  $S = \frac{w G_s}{e} = \left[ \frac{(0.156)(2.67)}{0.59} \right] (100) = \mathbf{70.6\%}$