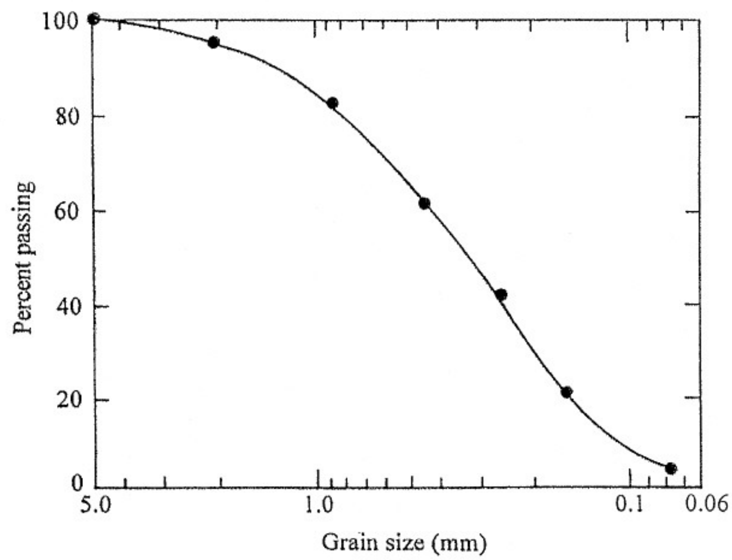
Chapter 2

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	**100.0**
10	18.5	4.4	**95.6**
20	53.2	12.6	**83.0**
40	90.5	21.5	**61.5**
60	81.8	19.4	**42.1**
100	92.2	21.9	**20.2**
200	58.5	13.9	**6.3**
Pan	26.5	6.3	**0**
	Σ421.2 g		

The grain-size distribution is shown.



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

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

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

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

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

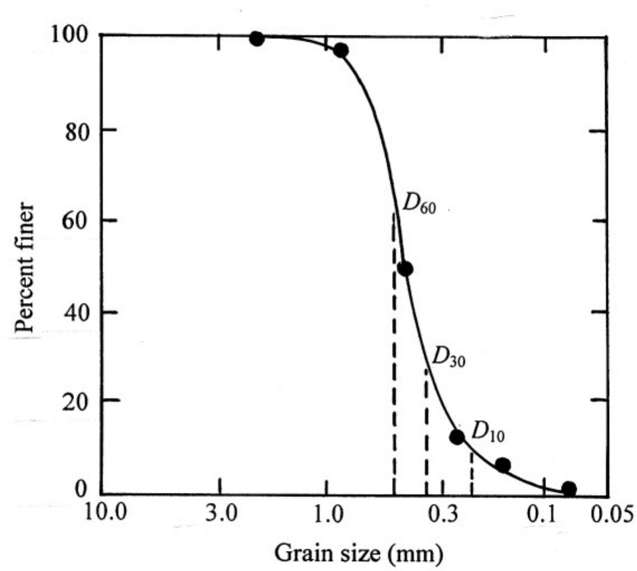
2.3 $C_u = \frac{D_{60}}{D_{10}} = \frac{1.81}{0.24} = \mathbf{7.54}$

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

2.4 a.

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0	0	**100**
6	0	0	**100**
10	0	0	**100**
20	9.1	1.82	**98.18**
40	249.4	49.88	**48.3**
60	179.8	35.96	**12.34**
100	22.7	4.54	**7.8**
200	15.5	3.10	**4.7**
Pan	23.5	4.70	**0**
	Σ500 g		

The grain-size distribution is shown.



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

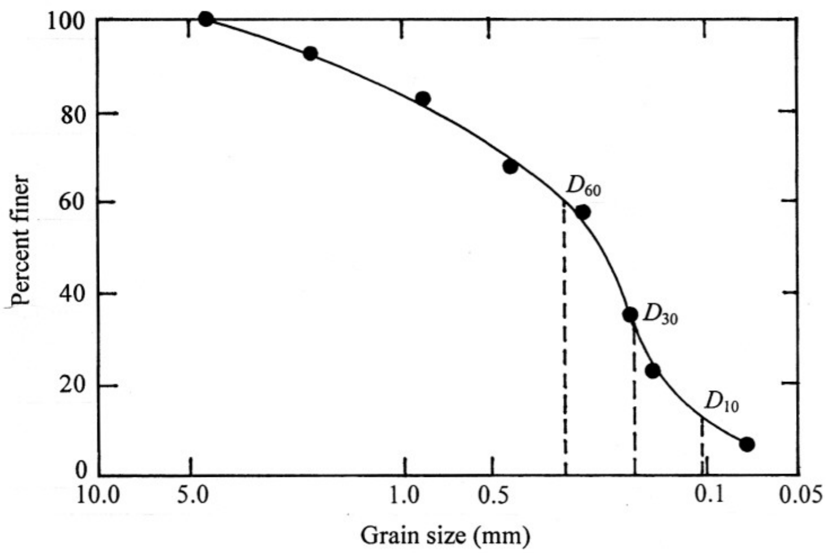
c. $C_u = \dfrac{0.48}{0.23} = \mathbf{2.09}$

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

2.5 a.

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**
	Σ 551 g		

The grain-size distribution is shown.

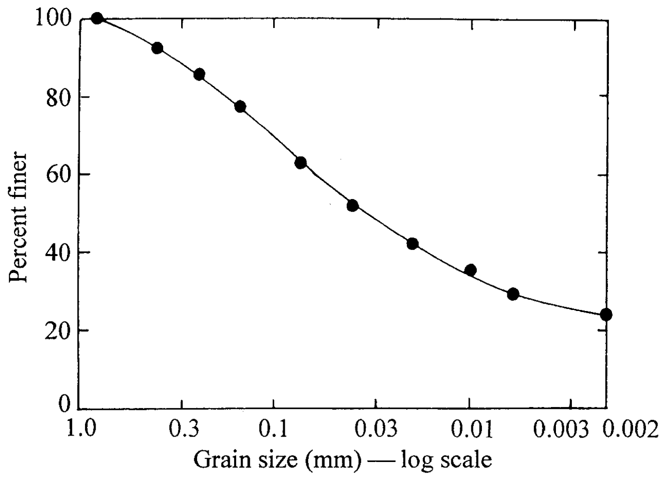


b. From the graph, D_{60} = **0.3 mm**; D_{30} = **0.17 mm**; D_{10} = **0.11 mm**

c. $C_u = \dfrac{0.3}{0.11} = \mathbf{2.73}$

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°; hydrometer reading = 43; time = 60 min.
Referring to Table 2.7, L = 9.2 cm.

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°, K = 0.0132.

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

2.10 For G_s = 2.70 and temperature = 23°, K = 0.013 (Table 2.6), L = 12.2 (Table 2.7).

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

Chapter 3

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

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

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

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: $w = \frac{W_w}{W_s} = \left(\frac{177.6\times10^{-3} - 153.6\times10^{-3}}{153.6\times10^{-3}}\right)(100) = \mathbf{15.6\%}$

Moist unit weight: $\gamma = \frac{W}{V} = \frac{177.6\times10^{-3}}{9.35\times10^{-3}} = \mathbf{18.99\ kN/m^3}$

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

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: $S = \frac{wG_s}{e} = \left[\frac{(0.156)(2.67)}{0.59}\right](100) = \mathbf{70.6\%}$