

Chapter 2

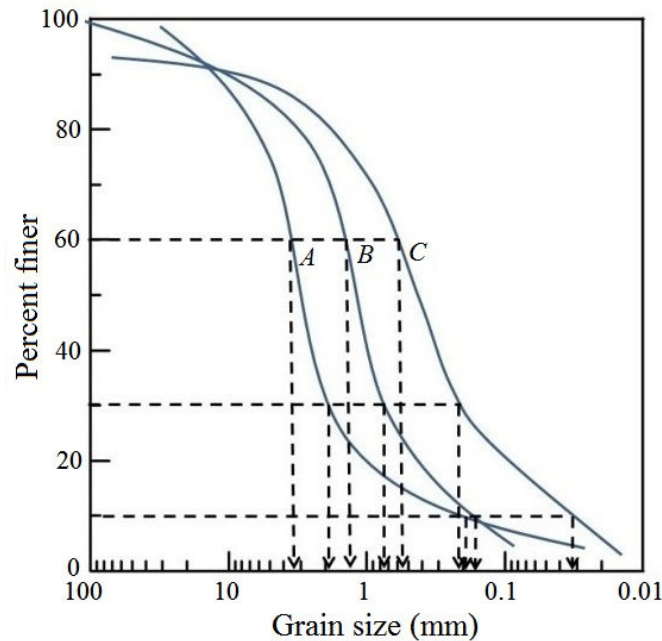
$$2.1 \quad C_u = \frac{D_{60}}{D_{10}} = \frac{0.48}{0.11} = \mathbf{4.36}; \quad C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.25^2}{(0.48)(0.11)} = \mathbf{1.18}$$

Since $C_u > 4$ and C_c is between 1 and 3, the soil is **well graded**.

$$2.2 \quad C_u = \frac{D_{60}}{D_{10}} = \frac{1.1}{0.18} = \mathbf{6.11}; \quad C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.41^2}{(1.1)(0.18)} = 0.727 \approx \mathbf{0.73}$$

Although $C_u > 6$, C_c is not between 1 and 3. The soil is **poorly graded**.

- 2.3 The D_{10} , D_{30} , and D_{60} for soils *A*, *B*, and *C* are obtained from the grain-size distribution curves.



$$\text{Soil A: } C_u = \frac{D_{60}}{D_{10}} = \frac{3.5}{0.2} = \mathbf{17.5}; \quad C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{1.95^2}{(3.5)(0.2)} = \mathbf{5.43}$$

Although $C_u > 6$, C_c is not between 1 and 3. The sand is **poorly graded**.

$$\text{Soil B: } C_u = \frac{D_{60}}{D_{10}} = \frac{1.5}{0.17} = \mathbf{8.82}; C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.75^2}{(1.5)(0.17)} = \mathbf{2.2}$$

$C_u > 6$ and C_c is between 1 and 3. The sand is **well graded**.

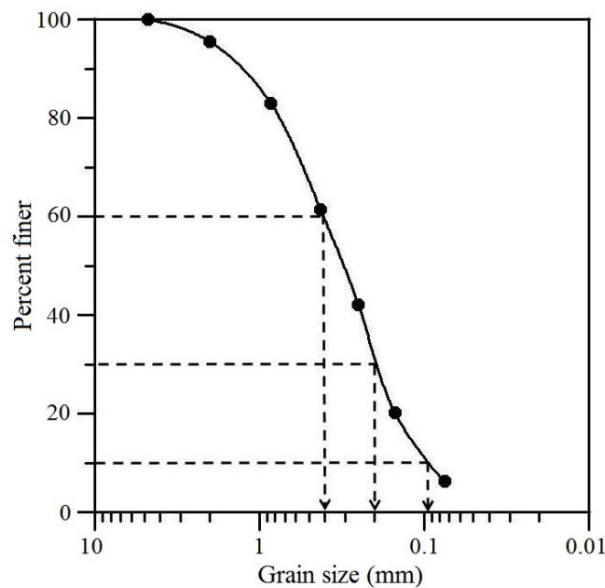
$$\text{Soil C: } C_u = \frac{D_{60}}{D_{10}} = \frac{0.55}{0.032} = \mathbf{17.2}; C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.22^2}{(0.55)(0.032)} = \mathbf{2.75}$$

$C_u > 6$ and C_c is between 1 and 3. The sand is **well graded**.

2.4 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
Σ 421.2 g			

The grain-size distribution is shown in the figure.



b. $D_{60} = 0.4 \text{ mm}; D_{30} = 0.2 \text{ mm}; D_{10} = 0.095 \text{ mm}$

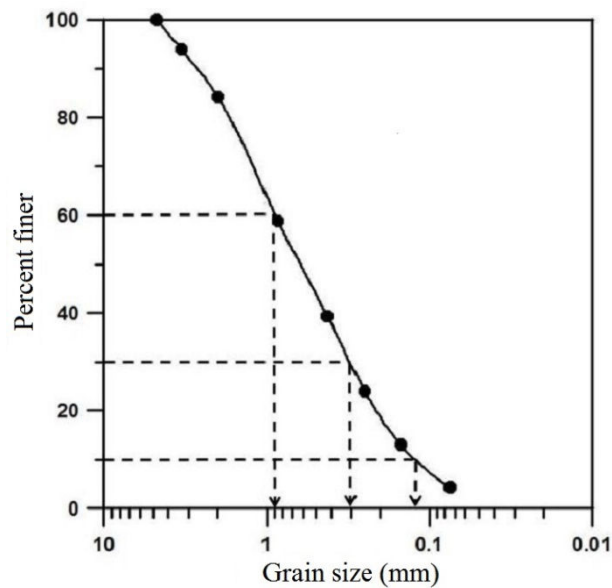
$$c. C_u = \frac{D_{60}}{D_{10}} = \frac{0.4}{0.095} = \mathbf{4.21}$$

$$d. C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})} = \frac{(0.2)^2}{(0.4)(0.095)} = \mathbf{1.05}$$

2.5 a.

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0	0.0	100
6	30	6.0	94.0
10	48.7	9.74	84.26
20	127.3	25.46	58.80
40	96.8	19.36	39.44
60	76.6	15.32	24.12
100	55.2	11.04	13.08
200	43.4	8.68	4.40
Pan	22	4.40	0
Σ 500 g			

The grain-size distribution is shown in the figure.



$$b. D_{10} = \mathbf{0.13 \text{ mm}}; D_{30} = \mathbf{0.3 \text{ mm}}; D_{60} = \mathbf{0.9 \text{ mm}}$$

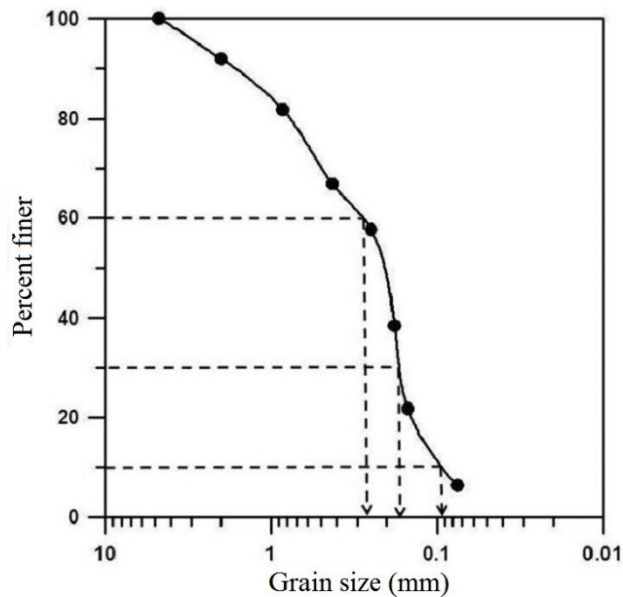
$$c. C_u = \frac{D_{60}}{D_{10}} = \frac{0.9}{0.13} = \mathbf{6.923 \approx 6.92}$$

$$d. C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.3^2}{(0.9)(0.13)} = \mathbf{0.769 \approx 0.77}$$

2.6 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 in the figure.



b. $D_{60} = \mathbf{0.28 \text{ mm}}$; $D_{30} = \mathbf{0.17 \text{ mm}}$; $D_{10} = \mathbf{0.095 \text{ mm}}$

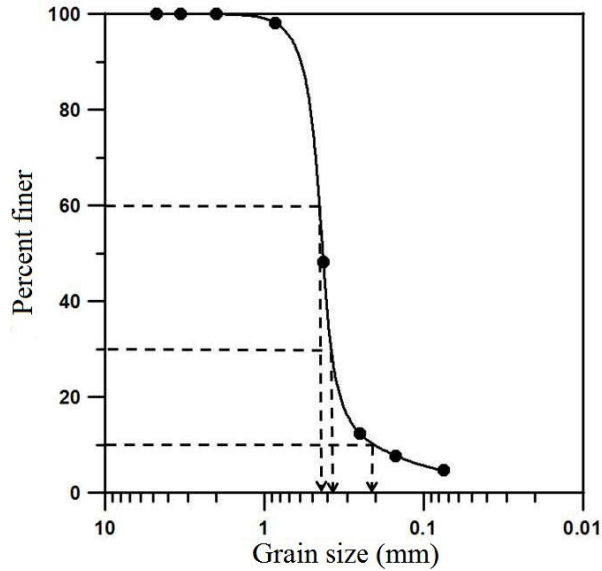
c. $C_u = \frac{0.28}{0.095} = \mathbf{2.95}$

d. $C_c = \frac{(0.17)^2}{(0.095)(0.28)} = \mathbf{1.09}$

2.7 a.

Sieve No.	Mass of soil retained on each sieve (g)	Percent retained on each sieve	Percent finer
4	0	0.0	100
6	0	0.0	100
10	0	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	3.1	4.7
Pan	23.5	4.7	0
Σ 500 g			

The grain-size distribution is shown in the figure.

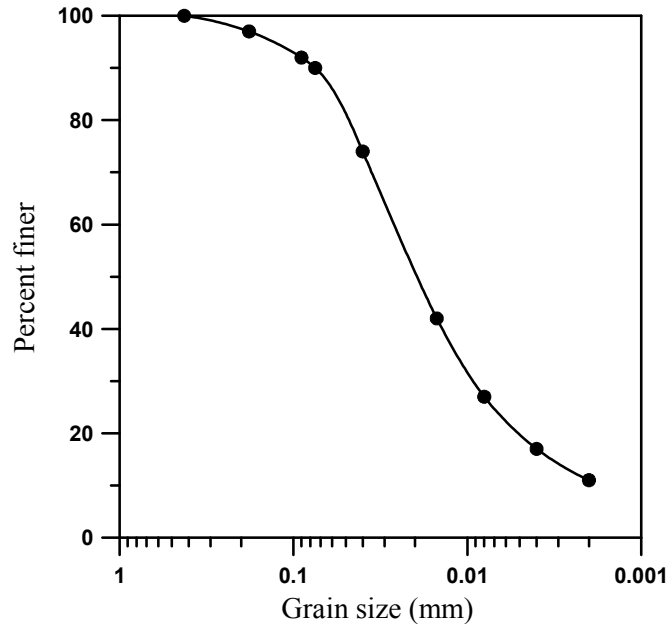


b. $D_{10} = \mathbf{0.21 \text{ mm}}$; $D_{30} = \mathbf{0.39 \text{ mm}}$; $D_{60} = \mathbf{0.45 \text{ mm}}$

c. $C_u = \frac{D_{60}}{D_{10}} = \frac{0.45}{0.21} = \mathbf{2.142 \approx 2.14}$

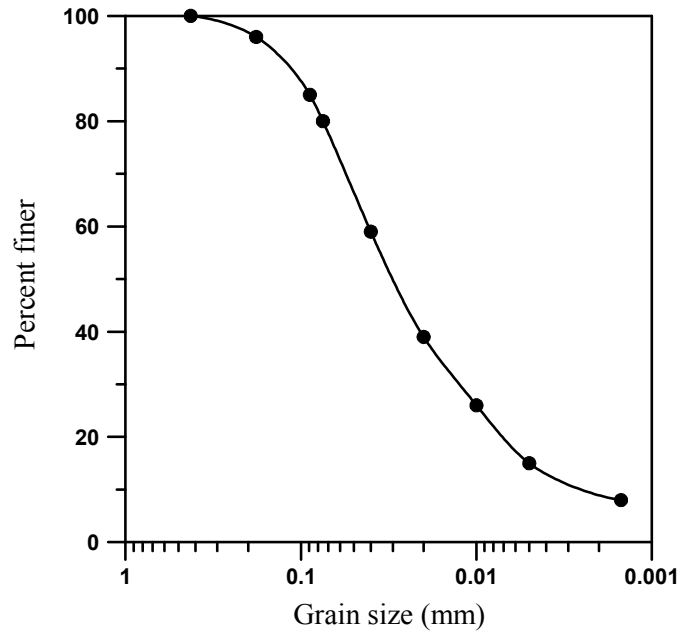
$$d. C_c = \frac{D_{30}^2}{(D_{60})(D_{10})} = \frac{0.39^2}{(0.45)(0.21)} = 1.609 \approx 1.61$$

2.8 a. The grain-size distribution curve is shown in the figure



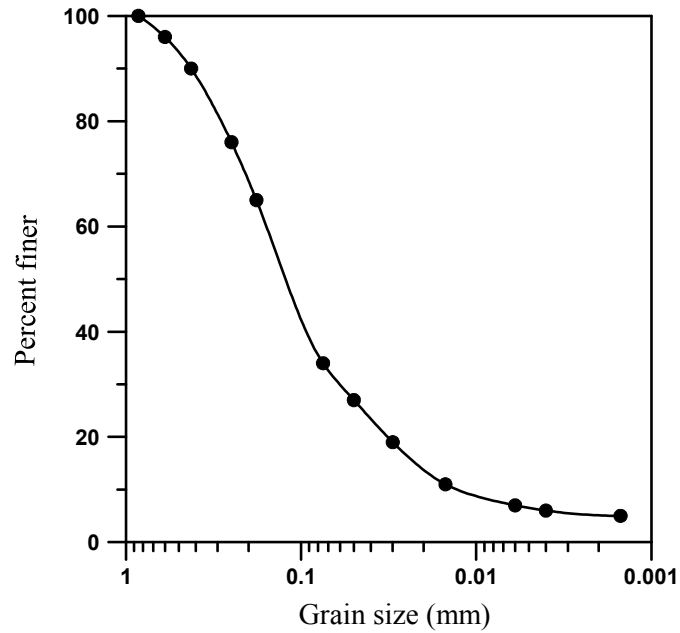
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|-------------------------------|-------------------------------|
| b. Percent passing 2 mm = 100 | GRAVEL: 100 – 100 = 0% |
| Percent passing 0.06 mm = 84 | SAND: 100 – 84 = 16% |
| Percent passing 0.002 mm = 11 | SILT: 84 – 11 = 73% |
| | CLAY: 11 – 0 = 11% |
| | |
| c. Percent passing 2 mm = 100 | GRAVEL: 100 – 100 = 0% |
| Percent passing 0.05 mm = 80 | SAND: 100 – 80 = 20% |
| Percent passing 0.002 mm = 11 | SILT: 80 – 11 = 69% |
| | CLAY: 11 – 0 = 11% |
| | |
| d. Percent passing 2 mm = 100 | GRAVEL: 100 – 100 = 0% |
| Percent passing 0.075 mm = 90 | SAND: 100 – 90 = 10% |
| Percent passing 0.002 mm = 11 | SILT: 90 – 11 = 79% |
| | CLAY: 11 – 0 = 11% |

2.9 a. The grain-size distribution curve is shown in the figure.



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|---|---|
| <p>b. Percent passing 2 mm = 100
 Percent passing 0.06 mm = 73
 Percent passing 0.002 mm = 9</p> | <p>GRAVEL: $100 - 100 = 0\%$
 SAND: $100 - 73 = 27\%$
 SILT: $73 - 9 = 64\%$
 CLAY: $9 - 0 = 9\%$</p> |
| <p>c. Percent passing 2 mm = 100
 Percent passing 0.05 mm = 68
 Percent passing 0.002 mm = 9</p> | <p>GRAVEL: $100 - 100 = 0\%$
 SAND: $100 - 68 = 32\%$
 SILT: $68 - 9 = 59\%$
 CLAY: $9 - 0 = 9\%$</p> |
| <p>d. Percent passing 2 mm = 100
 Percent passing 0.075 mm = 80
 Percent passing 0.002 mm = 9</p> | <p>GRAVEL: $100 - 100 = 0\%$
 SAND: $100 - 80 = 20\%$
 SILT: $80 - 9 = 71\%$
 CLAY: $9 - 0 = 9\%$</p> |

2.10 a. The grain-size distribution curve is shown in the figure.



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|-------------------------------|---------------------------|
| b. Percent passing 2 mm = 100 | GRAVEL: $100 - 100 = 0\%$ |
| Percent passing 0.06 mm = 30 | SAND: $100 - 30 = 70\%$ |
| Percent passing 0.002 mm = 5 | SILT: $30 - 5 = 25\%$ |
| | CLAY: $5 - 0 = 5\%$ |
| | |
| c. Percent passing 2 mm = 100 | GRAVEL: $100 - 100 = 0\%$ |
| Percent passing 0.05 mm = 28 | SAND: $100 - 28 = 72\%$ |
| Percent passing 0.002 mm = 5 | SILT: $28 - 5 = 23\%$ |
| | CLAY: $5 - 0 = 5\%$ |
| | |
| d. Percent passing 2 mm = 100 | GRAVEL: $100 - 100 = 0\%$ |
| Percent passing 0.075 mm = 34 | SAND: $100 - 34 = 66\%$ |
| Percent passing 0.002 mm = 5 | SILT: $34 - 5 = 29\%$ |
| | CLAY: $5 - 0 = 5\%$ |

