

Chapter 5

5.1 Refer to Figure 5.1.

Soil	Classification
A	Clay
B	Sandy clay
C	Loam
D	Sandy clay and sandy clay loam (borderline)
E	Sandy loam

5.2 SOIL A: From Table 5.1, the soil is A-2-4. The GI for A-2-4 is zero.
Classification: **A-2-4(0)**.

SOIL B: From Table 5.1, the soil is A-3. $GI = 0$. Classification: **A-3(0)**.

SOIL C: From Table 5.1, the soil is A-2-6. Equation 5.2:

$$GI = 0.01(F_{200} - 15)(PI - 10) = 0.01(12 - 15)(13 - 10) = -0.09 \approx 0$$
 Classification: **A-2-6(0)**

SOIL D: From Table 5.1, the soil is A-2-7. Equation 5.2:

$$GI = 0.01(F_{200} - 15)(PI - 10) = 0.01(30 - 15)(18 - 10) = 1.2 \approx 1$$
 Classification: **A-2-7(1)**

SOIL E: From Table 5.1, the soil is A-1-b. $GI = 0$. Classification: **A-1-b(0)**.

5.3 SOIL A: From Table 5.1, the soil is A-7-5. Note: $PI = 21 < LL - 30 = 22$
 Eq. (5.1):

$$GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$$

$$GI = (72 - 35)[0.2 + 0.005(52 - 40)] + 0.01(72 - 15)(21 - 10)$$

$$= 15.89 \approx 16$$
 Classification: **A-7-5(16)**.

SOIL B: From Table 5.1, the soil is A-6. Eq. (5.1):

$$GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$$

$$GI = (58 - 35)[0.2 + 0.005(38 - 40)] + 0.01(58 - 15)(12 - 10) = 5.23 \approx 5$$
 Classification: **A-6(5)**

SOIL C: From Table 5.1, the soil is A-7-6. Note: $PI = 14 > LL - 30 = 11$
 Eq. (5.1):
 $GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$
 $GI = (64 - 35)[0.2 + 0.005(41 - 40)] + 0.01(64 - 15)(14 - 10) = 7.9 \approx 8$
 Classification: **A-7-6(8)**

SOIL D: From Table 5.1, the soil is A-6. Eq. (5.1):
 $GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$
 $GI = (82 - 35)[0.2 + 0.005(32 - 40)] + 0.01(82 - 15)(12 - 10) = 8.86 \approx 9$
 Classification: **A-6(9)**

SOIL E: From Table 5.1, the soil is A-6. Eq. (5.1):
 $GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$
 $GI = (48 - 35)[0.2 + 0.005(30 - 40)] + 0.01(48 - 15)(11 - 10) = 2.28 \approx 2$
 Classification: **A-6(2)**

5.4 SOIL 1: Fine fraction = % passing No. 200 sieve = 30%
 Coarse fraction = $100 - 30 = 70\%$
 Gravel fraction = $100 - 70 = 30\%$
 Sand fraction = $70 - 30 = 40\%$
 More than 50% of coarse fraction passing No. 4 sieve, so sandy soil.
 Table 5.2 and Figure 5.3: **SC**
 Figure 5.4: More than 15% gravel. **Clayey sand with gravel.**

SOIL 2: Coarse fraction = $100 - 20 = 80\%$
 Gravel fraction = $100 - 48 = 52\%$
 Sand fraction = $80 - 52 = 28\%$
 Table 5.2 and Figure 5.3: **GC**
 Figure 5.4: Greater than 15% sand. **Clayey gravel with sand**

SOIL 3: Coarse fraction = $100 - 30 = 70\%$
 Gravel fraction = $100 - 95 = 5\%$
 Sand fraction = $95 - 70 = 25\%$
 Table 5.2: fine-grained soil; $LL = 52$; $PI = 28$.
 Table 5.2 and Figure 5.3: **CH**
 Figure 5.5: $\geq 30\%$ plus 200, % sand $>$ % gravel, $< 15\%$ gravel,
 so **sandy fat clay**

- SOIL 4: Coarse fraction = $100 - 82 = 18\%$
 Gravel fraction = $100 - 100 = 0\%$
 Sand fraction = $18 - 0 = 18\%$
 Table 5.2: fine-grained soil; $LL = 30$; $PI = 19$.
 Table 5.2 and Figure 5.3: **CL**
 Figure 5.5: **lean clay with sand**
- SOIL 5: Coarse fraction = $100 - 74 = 26\%$
 Gravel fraction = $100 - 100 = 0\%$
 Sand fraction = $26 - 0 = 26\%$
 Table 5.2: fine-grained soil; $LL = 35$; $PI = 21$.
 Table 5.2 and Figure 5.3: **CL**
 Figure 5.5: **lean clay with sand**
- SOIL 6: Coarse fraction = $100 - 26 = 74\%$
 Gravel fraction = $100 - 87 = 13\%$
 Sand fraction = $74 - 13 = 61\%$
 Table 5.2: coarse-grained soil; $LL = 38$; $PI = 18$.
 Table 5.2 and Figure 5.3: **SC**
 Figure 5.4: $< 15\%$ gravel; **clayey sand**
- SOIL 7: Coarse fraction = $100 - 78 = 22\%$
 Gravel fraction = $100 - 88 = 12\%$
 Sand fraction = $22 - 12 = 10\%$
 Table 5.2: fine-grained soil; $LL = 52$; $PI = 28$.
 Table 5.2 and Figure 5.3: **CH**
 Figure 5.5: $< 30\%$ plus 200, % sand $<$ % gravel; **fat clay with gravel**
- SOIL 8: Coarse fraction = $100 - 57 = 43\%$
 Gravel fraction = $100 - 99 = 1\%$
 Sand fraction = $43 - 1 = 42\%$
 Table 5.2: fine-grained soil; $LL = 54$; $PI = 26$.
 Table 5.2 and Figure 5.3: **CH**
 Figure 5.5: $\geq 30\%$ plus 200, % sand $>$ % gravel; **sandy fat clay**
- SOIL 9: Coarse fraction = $100 - 11 = 89\%$
 Gravel fraction = $100 - 71 = 29\%$
 Sand fraction = $89 - 29 = 70\%$
 $LL = 32$; $PI = 16$; $C_u = 4.8$; $C_c = 2.9$. Table 5.2 and Figure 5.3: **SP-SC**
 Figure 5.4: **poorly graded sand with clay and gravel**

SOIL 10: Coarse fraction = $100 - 2 = 98\%$
 Gravel fraction = $100 - 100 = 0\%$
 Sand fraction = $98 - 0 = 98\%$
 $C_u = 7.2$; $C_c = 2.2$. Table 5.2: **SW**
 Figure 5.4: <15% gravel; **well graded sand**

SOIL 11: Coarse fraction = $100 - 65 = 35\%$
 Gravel fraction = $100 - 89 = 11\%$
 Sand fraction = $35 - 11 = 24\%$
 Table 5.2: fine-grained soil; $LL = 44$; $PI = 21$.
 Table 5.2 and Figure 5.3: **CL**
 Figure 5.5: **sandy lean clay**

SOIL 12: Coarse fraction = $100 - 8 = 92\%$
 Gravel fraction = $100 - 90 = 10\%$
 Sand fraction = $92 - 10 = 82\%$
 $LL = 39$; $PI = 31$; $C_u = 3.9$; $C_c = 2.1$. Table 5.2 and Figure 5.3: **SP-SC**
 Figure 5.4: **poorly graded sand with clay**

- 5.5 a. 13% passing No. 200 sieve; 38% passing No. 40 sieve; 90% passing No. 10 sieve. $PI = 23 - 19 = 4$. Referring to Table 5.1, the soil is A-1-b. $GI = 0$. So the soil is **A-1-b(0)**.
- b. Coarse fraction = $100 - 13 = 87\%$
 Gravel fraction = $100 - 100 = 0\%$
 Sand fraction = $87 - 0 = 87\%$
 $LL = 23$; $PI = 4$. From Table 5.2 and Figure 5.3, the group symbol is **SC**.
 From Figure 5.4, the group name is **clayey sand**.

CRITICAL THINKING PROBLEM

- 5.C.1 1. Stratum 2
 18% passing No. 200 sieve; $PI = 5$. From Table 5.1, the soil is A-1-b.
 $GI = 0$; Soil classification: **A-1-b(0)**

Stratum 3
 8% passing No. 200 sieve; NP. From Table 5.1, the soil is A-3.
 $GI = 0$; Soil classification: **A-3(0)**

Stratum 4

67% passing No. 200 sieve; $LL = 52$; $PI = 10$. From Table 5.1, the soil is A-5.

$$GI = (F_{200} - 35)[0.2 + 0.005(LL - 40)] + 0.01(F_{200} - 15)(PI - 10)$$

$$GI = (67 - 35)[0.2 + 0.005(52 - 40)] + 0.01(67 - 15)(10 - 10) = 8.3 \approx 8$$

Soil classification: **A-5(8)**

Stratum 5

52% passing No. 200 sieve; $LL = 36$; $PI = 9$. From Table 5.1, the soil is A-4.

$$GI = (52 - 35)[0.2 + 0.005(36 - 40)] + 0.01(52 - 15)(9 - 10) = 2.69 \approx 3$$

Soil classification: **A-4(3)**

2. Stratum 2

Coarse fraction: $100 - 18 = 82\%$; Table 5.2: coarse-grained soil. From Table 5.4, most probable soil classification (corresponding to A-1-b): SW, SP, GM, SM. Since it is a fine sand, and since C_u is not between 1 and 3, it is a poorly graded sand. Classification: **SP**

Stratum 3

Coarse fraction: $100 - 8 = 92\%$; Table 5.2: coarse-grained soil. From Table 5.4, most probable soil classification (corresponding to A-3): SP. Since it is a non-plastic fine sand, classification: **SP**

Stratum 4

Coarse fraction: $100 - 67 = 23\%$; Table 5.2: fine-grained soil. From Table 5.4, most probable soil classification (corresponding to A-5): OH, MH, ML, OL. Since the soil is an organic sandy silt, and since $LL = 52 > 50$, the classification is **OH**.

Stratum 5

Coarse fraction: $100 - 52 = 48\%$; Table 5.2: fine-grained soil. From Table 5.4, most probable soil classification (corresponding to A-4): ML, OL. Since the soil is a sandy silt, and since $LL = 36 < 50$, the classification is **ML**.

