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PE Civil Exam Review Guide: Geotechnical Depth
Preview Edition
Errata

(updated 11/10/2021)

This document will be updated regularly.

CHAPTER 1: Site Characterization

(1) p. 1-23: In the solution of Example 1.6, there are two typographical errors. In the second sentence under Sample A, Table 1.4 should be Table 1.5. In the second sentence under Sample B, PI = 23 should be PI = 13. The corrections appear below in red boxes.

Sample A

The major component is sand (75%), the minor component is gravel (23%), and fine, which is coarse silt, is trace (2%).

Major component: All sand sizes are > 10%. Therefore, from Table 1.5, classification is cf S.

Sample B

The major component is fine (85%) combined clay and silt (minus No. 200 sieve) with PI = 23, the minor component is sand (12%), and gravel is trace (3%).

Major component: From Table 1.6, when PI = 13, soil is classified as C and $.

(2) p. 1-32: There are errors in the Sample B portion of the solution to Example 1.8. The corrections appear below in red boxes.

Use Figure 1.14. Follow the flowchart. Fines 8% → 5% - 12%
For $C_u = 19$ and $C_c = 2$
To get the type of fines, use the Casagrande plasticity chart (Fig. 1.16).
Plot LL = 20, PI = 15. The intersection point will be in the CL or OL zone. The soil is inorganic. Therefore, the soil is CL.

CHAPTER 2: Soil Mechanics, Laboratory Testing, and Analysis

(1) p. 2-10: In the second sentence of Section 2.1.3, there is a typographical error. "Were" should be "where." See the correction below.

2.1.3: Atterberg Limits [1,2,3]

As the moisture content of a slurry of fine-grained soil gradually decreases, the soil passes from a liquid state to a plastic state, from a plastic state to a semisolid state, and finally from a semisolid state to a solid state. The moisture contents or limits where these transitions occur were created by Atterberg (1911) [4] and were

(2) p. 2-27: In the second sentence on the page, there is a typographical error. "Is" should be "in." See the correction below.

Volume change also affects the stress response. Particle rearrangement during compression results in a gradual increase in shear resistance until volume change is complete and a maximum deviator stress is attained. In dilative behavior, closely packed particles roll up and over one another until volume change is

(3) p. 2-45: There is an error in the solution for Example 2.11. See the correction below.

Then the total vertical stress at point A after the addition of fill is:

$$\sigma_v = \sum \gamma_i z_i + \Delta\sigma_v = \boxed{5\ \text{ft} \times 125\ \text{lb/ft}^3 + 10\ \text{ft} \times 130\ \text{lb/ft}^3} + 360\ \text{lb/ft}^2 = 2{,}285\ \text{lb/ft}^2$$

CHAPTER 3: Field Materials Testing, Methods, and Safety

(1) p. 3-4: There is a typographical error in last line of the solution of Example 3.2. The 2 should be 12. The answer remains the same. See the correction below.

The total number of trucks required is:

$52{,}164 \times 10^3/(12 \times 10^3) = 4{,}347$

CHAPTER 5: Earth Structures

(1) p. 5-34: The source for Figure 5.23 is incorrect. It should be:
Transportation Research Board. 1978. *Landslides, Analysis and Control, Transportation Research Board, Special Report No. 176*. Reproduced with permission from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C..

2() p. 5-54: In the following equation, the + should be a minus sign (shown in red below). The calculation is correct as is.

$$W = \frac{\gamma H^2}{2}\left(\frac{1}{\tan\alpha} \boxed{-} \frac{1}{\tan\beta}\right) = \frac{132\ \text{lb/ft}^3 \times (30\ \text{ft})^2}{2}\left(\frac{1}{\tan 20} - \frac{1}{\tan 33.7}\right) = 74{,}134\ \text{lb/ft}$$

CHAPTER 7: Problematic Soil and Rock Conditions

(1) p. 7-9: Section 7.4: Corrosive Soils has some corrections, shown in red boxes below.

Corrosive soils typically:

- Are saturated or frequently so.
- Contain dissolved chemical constituents including sulfates, sulfides, and chlorides.
- Have low resistivity values.
- Have very low or very high pH values.

The more there is fluctuation in moisture and oxygen content, the more corrosion is seen in buried ferrous metal pipes. Ferrous metal pipes installed above the water table will corrode more compared with pipes installed below the water table because of fluctuation in moisture and oxygen contents above the groundwater table compared with below the water table. Soils types with high corrosion potential are given in Table 7.4.

(2) p. 7-10: Example 7.4 is incorrect as written. The revised version appears below.

Example 7.4: Corrosive Soil

Soils *most* likely to be corrosive to underground utilities made of ferrous materials have:

A. High resistivity values, moderate pH values, and trace amounts of sulfates.
B. Moderate resistivity values, low pH values, and an absence of sulfates.
C. Low resistivity values, high pH values, and measurable sulfates.
D. Moderate resistivity values, high pH values, and trace amounts of sulfates.

Solution

Low resistivity values, low or high pH values, and the presence of sulfates, sulfides, or chlorides are, in and of themselves, characteristics of corrosive soils. Soils having moderate resistivity values and traces of dissolved chemicals are also mildly to moderately corrosive. However, the most corrosive soils typically possess each of these characteristics.

Answer: C

(3) p. 7-14: In Example 7.6, “sulphate” should be “sulfate” in answer choice C and solution point C.

CHAPTER 8: Retaining Structures

(1) p. 8-8: At the top of the page, replace “For a vertical wall and horizontal backslope” with “For vertical walls with a horizontal backslope and no wall friction.” In Equation 8-7, replace K_a with K_p.

For vertical walls with a horizontal backslope and no wall friction, the Rankine and Coulomb equations both reduce to the following:

$$K_a = \frac{1 - \sin\phi}{1 + \sin\phi} = \tan^2\left(45 - \frac{\phi}{2}\right) \qquad \textbf{Equation 8-6}$$

$$K_p = \frac{1 + \sin\phi}{1 - \sin\phi} = \tan^2\left(45 + \frac{\phi}{2}\right) \qquad \textbf{Equation 8-7}$$

(2) p. 8-15: In the problem statement for Example 8.4, there is a missing phrase (highlighted below). The second sentence should read as follows:

Determine the resulting lateral stress applied to the back of the wall at the center of the loaded area at depths of 2.5, 5, 10, and 15 ft.

(3) p. 8-18: In the solution to Example 8.5, there are a few errors. Please see corrections to the end of the problem below.

Check eccentricity.

$$e = \frac{B}{2} - \frac{M_R - M_o}{\sum V} = \frac{B}{2} - \frac{W\overline{x} + (P_A)_v\overline{x} - (P_A)_h \times H/3}{W + (P_A)_v}$$

$$e = \frac{14\text{ ft}}{2} - \frac{19{,}198\text{ lb/ft} \times 5.744\text{ ft} + 10{,}538\text{ lb/ft} \times 10\text{ ft} - 10{,}177\text{ lb/ft} \times 20\text{ ft}/3}{19{,}198\text{ lb/ft} + 10{,}538\text{ lb/ft}} = \boxed{2.03}\text{ ft}$$

Compare the eccentricity with the criteria for foundations on soil.

$$\frac{B}{6} = \frac{14\text{ ft}}{6} = \boxed{2.33 > 2.03\text{ ft} \quad \text{OK}}$$

The wall meets the eccentricity criteria, but does not meet the criterion for sliding resistance. Thus, the base width should be increased along with other changes to the geometry.

(4) p. 8-51: In the solution diagram for Example 8.11, there is a typographical error: 18.34° should be 18.43°.

(5) p. 8-52: There are some typographical errors in the solution to Example 8.11. The corrections appear in red boxes below.

$$p_s = \frac{1}{2}\gamma_R 0.7Hk_a \tan\beta = 0.35\gamma_R Hk_a \tan\beta = 0.35 \times 128\text{ lb/ft}^3 \times 24\text{ ft} \times 0.352 \times \tan\boxed{18.43} = 126.1\text{ lb/ft}^2$$

Calculate the active lateral earth pressure at midheight of the wall.

$$p_a = \gamma\frac{H}{2}k_a = 128\text{ lb/ft}^3 \times \frac{24\text{ ft}}{2} \times 0.352 = 540.7\text{ lb/ft}^2$$

To calculate the inertia force, divide the mass into areas representing the wall backfill (A_1) and the backslope fill (A_2).

$$A_1 = \frac{1}{2}H^2\tan\alpha = \frac{1}{2}(24\text{ ft})^2\tan 2\,8 = \boxed{153.1\text{ ft}^2}$$

Making use of the law of sines, calculate the maximum height of the backfill wedge.

$$h = H\frac{\sin\beta\sin\alpha}{\sin(\psi-\beta)} = 24\text{ ft} \times \frac{\sin 18.43 \times \sin 28}{\sin(62-18.43)} = 5.17\text{ ft}$$

Calculate the area.

$A_2 = \frac{1}{2}hH\tan\alpha = \frac{1}{2} \times 5.17\text{ ft} \times 24\text{ ft} \times \tan 28 = 33\text{ ft}^2$

Calculate the inertia force, noting that the areas just calculated are per foot of wall.

$P_I = (A_1 + A_2)\gamma_R \frac{a}{g} = (153.1\text{ ft}^2 + 33\text{ ft}^2) \times 128\text{ lb/ft}^3 \times 0.2 = 4{,}764\text{ lb/ft}$

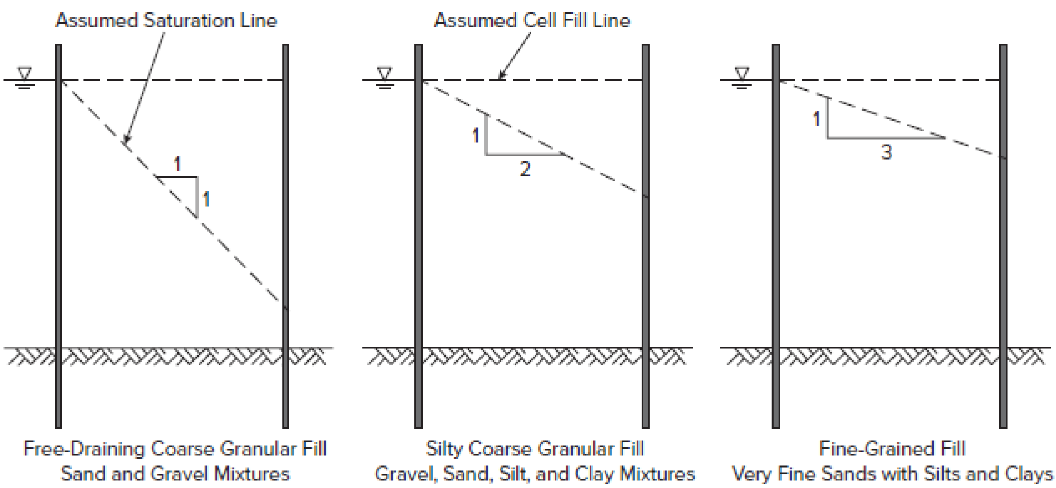
Calculate the total tie force. The inertial force is distributed equally to each reinforcement layer, and the surcharge and lateral earth pressures at the reinforcement layer are multiplied by the vertical spacing.

$$F_T = (p_s + p_a)S_V + \frac{1}{n}P_I$$

$$F_T = (126.1\text{ lb/ft}^2 + 540.7\text{ lb/ft}^2) \times 2\text{ ft} + \frac{1}{11} \times 4{,}764\text{ lb/ft} = 1{,}767\text{ lb/ft}$$

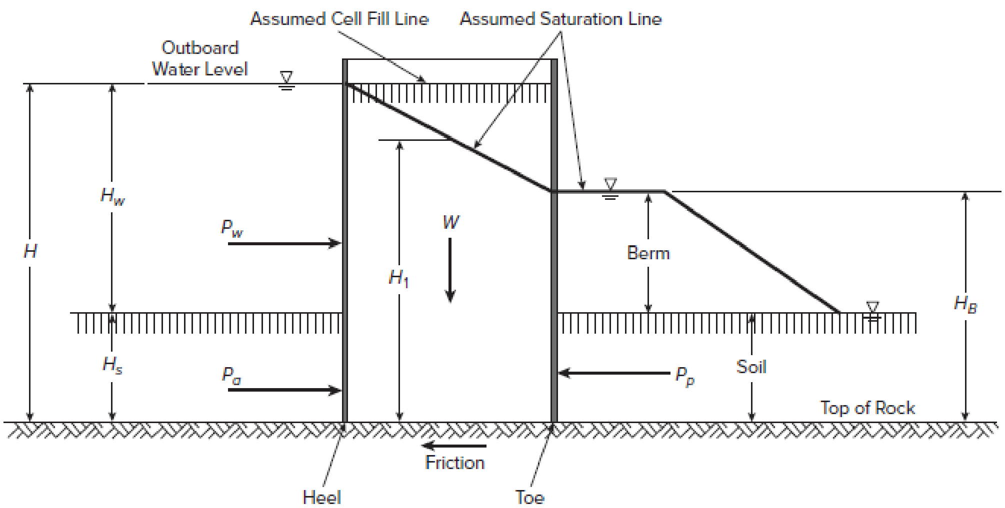
(6) p. 8-79: In section 8.5.2, add the following sentence at the end of the first paragraph: “Cell fill can be assumed to extend up to the outboard water level.”

(7) p. 8-80: Figure 8.52 has been revised. The corrected figure appears below.



(8) p. 8-80: In Section 8.5.2.1: Resistance to Sliding, a sentence should be added for clarification. After the third sentence, add the following: “Inboard passive pressure is included in the example.”

(9) p. 8-80: Figure 8.53 has been revised. The corrected figure appears below.



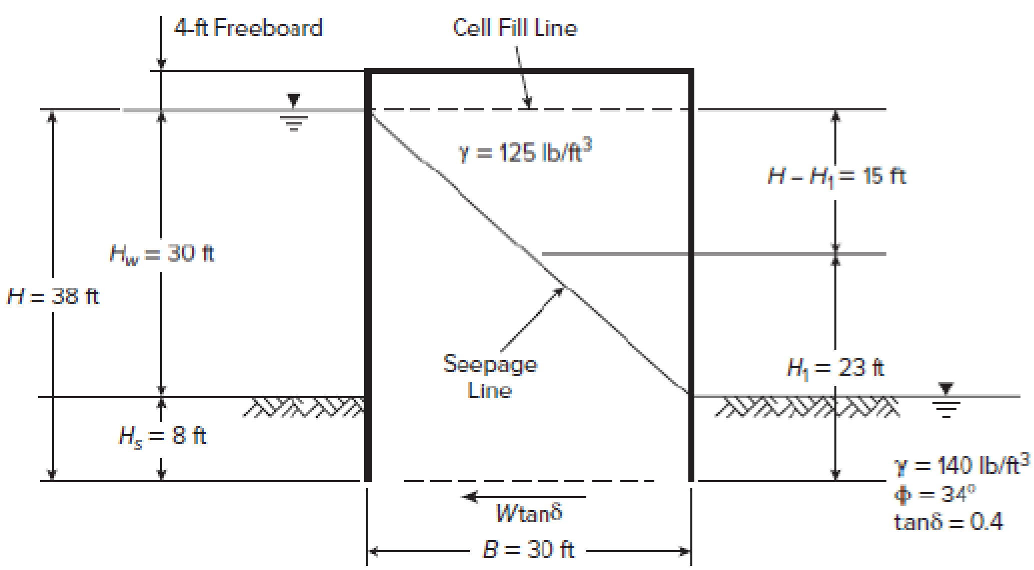
(10) p. 8-81: Under Equation 8-76, in the first line of the following "Where" statement, the following text should be added (shown in red below).

$$P_a = \frac{\gamma' H_s^2 K_a}{2} \qquad \textbf{Equation 8-76}$$

Where:

H = height of the cofferdam from the heel to the design water surface (discounting freeboard)

(11) p. 8-82: In Example 8.16, there are errors in the figure and the solution. See the corrections below.



Solution

Calculate the active and passive earth pressure coefficients by Rankine's theory.

$K_a = \tan^2\left(45 - \frac{\phi}{2}\right) = \tan^2\left(45 - \frac{34}{2}\right) = 0.283$ and $K_p = \frac{1}{K_a} = 3.537$

Calculate the average effective weight of the cell fill.

$W = B[\gamma(H - H_1) + \gamma' H_1] = 30\text{ ft}[125\text{ lb/ft}^3\ (\boxed{38}\text{ ft} - 23\text{ ft}) + (125\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3)\ 23\text{ ft}]$
$= \boxed{99{,}444}\text{ lb/ft}$

Calculate the external water and soil forces acting on the cell.

$$P_w = \gamma_w \frac{H_w^2}{2} = 62.4\text{ lb/ft}^3 \times \frac{(38\text{ ft})^2}{2} = 45{,}053\text{ lb/ft}$$

$$P_a = \gamma' \frac{H_s^2}{2} K_a = (140\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3) \times \frac{(8\text{ ft})^2}{2} \times 0.283 = 703\text{ lb/ft}$$

$$P_p = \gamma' \frac{H_s^2}{2} K_p = (140\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3) \times \frac{(8\text{ ft})^2}{2} \times 3.537 = 8{,}783\text{ lb/ft}$$

Calculate the FS.

$$FS = \frac{W \tan\delta + P_p}{P_w + P_a} = (\boxed{99{,}444}\text{ lb/ft} \times 0.4 + 8{,}783\text{ lb/ft})/(45{,}053\text{ lb/ft} + 703\text{ lb/ft}) = \boxed{1.06}$$

This FS is too low, so additional support is needed. This can be accomplished by adding an inboard berm, increasing the diameter of the cell, or increasing the weight of the cell fill by selecting a different material.

CHAPTER 9: Shallow Foundations

(1) p. 9-34: In the solution to Example 9.13, there are 4 typographical errors. The corrections are shown below in red boxes.

Solution

For this case, the rectangular area is divided into four 5 ft × 8 ft equal quadrants. The influence factor is then $4I_{mn}$ where $m = \boxed{5/8 = 0.625}$ and $n = 8/8 = 1$.

From Figure 9.13, $I = \boxed{0.14}$ and the vertical stress increase is:

$A\sigma_v = 4I_{mn}q = 4 \times \boxed{0.14} \times 4\text{ k/ft}^2 = \boxed{2.24}\text{ k/ft}^2$

(2) p. 9-51: The first equation in the solution to Example 9.19 is incorrect. It should read:

$$\sigma_v' = \gamma D_f = 125\text{ lb/ft}^3 \times 3\text{ ft} + [(125\text{ lb/ft}^3 - 62.4\text{ lb/ft}^3) \times 3\text{ ft}] = 563\text{ lb/ft}^2 \times 1\text{ t/2,000 lb} = 0.282\text{ t/ft}^2$$

In the last line of the solution (the allowable net load), " × 78.4 tons" should be " = 78 tons."

(3) p. 9-54: In the paragraph just under the figure on the page, three numbers are incorrect. The corrections are shown below in red boxes.

For the corrected blowcounts for each sublayer, find the bearing capacity index, C', for each sublayer based on the well-graded silty sand curve in Figure 9.28 as follows: 0 to 10 ft, C' = 62.5; 10 to 20 ft, C' = 72; and 20 to 30 ft, C' = 87.

CHAPTER 10: Deep Foundations

(1) p. 10-19: The source for Table 10.7 is incorrect. It should be:

Republished with permission. Das, Braja M. 2006. *Principles of Foundation Engineering*. 7th ed. Boston, MA: Cengage Learning.

(2) p. 10-30: There are typographical errors in the variable descriptions (following "Where:") in Section 10.6.2.2. The corrections appear below in red boxes.

Where:

S_x = slope at any depth x along the pile due to lateral load Q_g and moment M_g
S_A = slope due to lateral load Q_g
S_B = slope due to moment M_g
M_x = moment at any depth x along the pile due to lateral load Q_g and moment M_g
M_A = moment due to lateral load Q_g
M_B = moment due to moment M_g
V_x = shear force at any depth x along the pile due to lateral load Q_g and moment M_g
V_A = shear force due to lateral load Q_g
V_B = shear force due to moment M_g
p_x = soil reaction at any depth x along the pile due to lateral load Q_g and moment M_g
p_A = soil reaction due to lateral load Q_g
p_A = soil reaction due to moment M_g

(2) p. 10-34: In Example 10.9, there are a few typographical errors in units (corrections in red below).

Example 10.9: Lateral Load on Partially Fixed-Headed Pile

For the previous example, assume 75% fixity at the head of the pile and determine the groundline displacement (inches) for a 20-kip lateral load and 60 kip-ft moment.

Solution

Recall that $T = 70.81$ in and $EI = 44.49 \times 10^9$ lb/in^2. From Table 10.12, for $Z = 0$, find $A_y = 2.435$ and $B_y = 1.623$. The displacement is given by:

$$y_x = A_y \frac{Q_g T^3}{EI} + B_y \lambda \frac{M_g T^2}{EI}$$

$$y_x = 2.435 \times \frac{20 \text{ kip} \times 1{,}000 \text{ lb/kip} \times (70.81 \text{ in})^3}{44.49 \times 10^9 \text{ lb/in}^2} + 1.623 \times 0.75 \times \frac{60 \text{ kip-ft} \times 12{,}000 \text{ lb/in/kip-ft} \times (70.81 \text{ in})^2}{44.49 \times 10^9 \text{ lb/in}^2}$$

$$y_x = 0.39 \text{ in} + 0.10 \text{ in} = 0.49 \text{ in}$$