PE Civil Exam Review Guide: Breadth

Errata

(updated 6/28/2022)

This document will be updated regularly.

NOTE: When this book was published in 2019, the PE Civil exams were open book. This allowed students to bring outside materials into the exam, and our book was structured with this in mind. As of January 2, 2022, the PE Civil exam is now a computer-based test (CBT), meaning it is no longer open book and no additional materials may be brought into the exam. It is also organized differently now that it has become CBT. While the breadth and depth portions were once administered separately in the morning and afternoon, respectively, they are now integrated into the exam as a whole.

Any references to an open-book exam in the *PE Civil Exam Review Guide: Breadth* (1st edition) should now be ignored. For the most up-to-date information regarding changes to the PE Civil exams, please visit the NCEES site: https://ncees.org/engineering/pe/civil-cbt/.

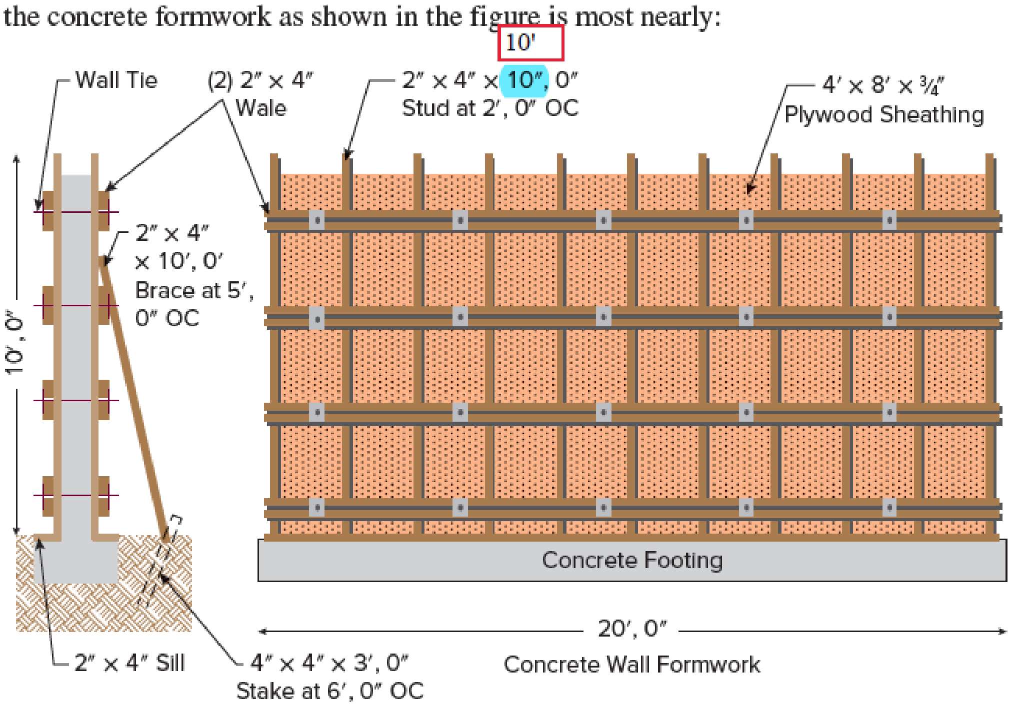
Rest assured—we are working on an updated edition that will still contain the most essential content you need to prepare for the PE Civil exam while helping you navigate the NCEES *PE Civil Reference Handbook*. Watch for this comprehensive guide, which will be released in the fall of 2022!

CHAPTER 1: Project Planning

(1) p. 5: In the image for Example 1.4, there is a typographical error in a measurement: 10", 0" should read 10', 0".

Example 1.4: Detailing Formwork

The total number of nominal 2-in × 4-in × 10-ft, 0-in wood studs needed to construct the concrete formwork as shown in the figure is most nearly:

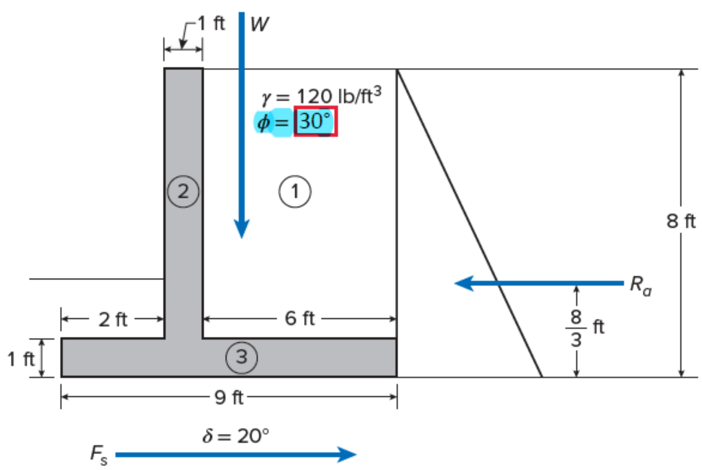


CHAPTER 3: Soil Mechanics

(1) p. 69: In the first image of Example 3.2, ϕ = 30° rather than 32°.

Example 3.2: Rigid Retaining Walls

Use Rankine's earth pressure theory to check the stability (FS against sliding and overturning) of the retaining wall shown in the figure below. The unit weight of concrete is 150 lb/ft^3. The water table is well below the bottom of the footing and does not affect the bearing capacity. Neglect passive pressure and the weight of the backfill over the toe.



(2) p. 77: At the top of the page, (length/time^2) should be (length^2/time).

c_v = coefficient of consolidation (length^2/time)

t = time for the target degree of consolidation

H_d = length of the shortest drainage path (H_d for single (one-way) drainage; $\frac{H_d}{2}$ for double (two-way) drainage—see Fig. 3.14)

(3) p. 78: In the solution of Example 3.5, 7.5 should be squared in lines 5 and 6. (The solution is correct as is.)

$$t_{50} = \frac{T_v H^2{}_d}{C_v} = \frac{0.197 \times (7.5)^2}{0.3} = 37 \text{ days}$$

$$t_{90} = \frac{T_v H^2{}_d}{C_v} = \frac{0.848 \times (7.5)^2}{0.3} = 159 \text{ days}$$

(4) p. 85: In line 19, there is a typographical error. Table 3.5 should say Table 3.4.

(5) p. 86: In line 1, there is a typographical error. Equation 3-38 should say Equation 3-39.

(6) pp. 86-87: There are numerical errors in the solution of Example 3.8.

-In the second line of the solution, Table 3.5 should be Table 3.4.

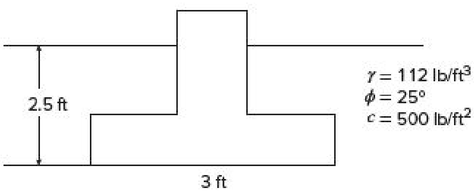
-13,529 lb/ft^2 should be 15,177 lb/ft^2 (two instances)

-13,249 lb/ft^2 should be 14,897 lb/ft^2 (two instances)

-5,300 lb/ft^2 should be 5,959 lb/ft^2

Example 3.8: Bearing Capacity

Determine the ultimate and the net allowable bearing capacities for the continuous footing shown. Assume a factor of safety of 2.5.



Solution

From Table 3.3: $N_c = 20.7, N_q = 10.7, N_\gamma = 10.9$

For continuous footings $B_f/L_f \approx 0$. From Table ~~3.5~~ $\boxed{3.4}$: $S_c = S_\gamma = 1.0$

Solve for the ultimate bearing capacity, q_{ult}:

$$q_{ult} = cN_cS_c + \gamma D_f N_q + 0.5\gamma BN_\gamma S_\gamma$$

$$q_{ult} = (500\ \text{lb/ft}^2 \times 20.7 \times 1) + (112\ \text{lb/ft}^3 \times 2.5\ \text{ft} \times 10.7) + (0.5 \times 112\ \text{lb/ft}^3 \times 3\ \text{ft} \times 10.9 \times 1) = \cancel{13{,}529}\ \boxed{15{,}177}\ \text{lb/ft}^2$$

Solve for the net bearing capacity, q_{net}:

$$q_{net} = q_{ult} - \gamma D_f$$

$$q_{net} = \cancel{13{,}529}\ \boxed{15{,}177}\ \text{lb/ft}^2 - 2.5\ \text{ft} \times 112\ \text{lb/ft}^3 = \cancel{13{,}249}\ \boxed{14{,}897}\ \text{lb/ft}^2$$

Example 3.8 *(continued)*

Solve for the net allowable bearing capacity, $(q_{net})_{all}$:

$$(q_{net})_{all} = \frac{q_{net}}{FS}$$

$$(q_{net})_{all} = \frac{\boxed{14{,}897}\ \cancel{13{,}249}\ \text{lb/ft}^2}{2.5\ \text{ft}} = \boxed{5{,}959}\ \cancel{5{,}300}\ \text{lb/ft}^2$$

(7) p. 87: Equation 3-46 is missing a variable (N_q). It should appear as follows:

$$q_{ult} = \gamma D_f N_q + 0.5\gamma BN_\gamma S_\gamma \qquad \textbf{Equation 3-46}$$

(8) p. 88. Case 2 should read: "The water table is located between the base of the footing and a depth of d below the base of the footing (B > d > 0)."

Case 2: The water table is located between the base of the footing and a depth of $\boxed{d}$ below the base of the footing ($B > d > 0$).

(9) p. 89: The value of the footing width *B* is missing in the solution of Example 3.11. Insert it as follows. The answer is correct as written.

Calculate net bearing capacity with the groundwater depth at 2 ft (case 1):

$\sigma'_D = \gamma D_1 + \gamma' D_2 = 116\ \text{lb/ft}^3 \times 2 + (120\ \text{lb/ft}^3 - 62.4) \times 1.5 = 318.4\ \text{lb/ft}^2$

$\gamma' = \gamma_{sat} - \gamma_w = 120\ \text{lb/ft}^3 - 62.4 = 57.6\ \text{lb/ft}^2$

$q_{net} = \sigma'_D(N_q - 1) + 0.5\gamma' B N_\gamma S\gamma$

$q_{net} = 318.4\ \text{lb/ft}^2 \times (29.4 - 1) + \boxed{0.5 \times 57.6\ \text{lb/ft}^2 \times 41.1 \times 0.6} = 9{,}043 + 3{,}551$

$= 12{,}594\ \text{lb/ft}^2$

0.5 × 57.6 lb/ft² × 5 × 41.1 × 0.6

Calculate net allowable bearing capacity:

$$(q_{net})_{all} = \frac{q_{net}}{FS}$$

$$(q_{net})_{all} = \frac{12{,}594\ \text{lb/ft}^2}{2} = 6{,}297\ \text{lb/ft}^2$$

(10) p. 91: In line 3, Table 3.5 should say Table 3.4.

(11) p. 92: There are some errors in the solution to Example 3.12. The corrections are marked below.

Example 3.12 *(continued)*

Calculate the ultimate bearing capacity:

$q_{ult} = \gamma D_f N_q + 0.5\gamma B' N_\gamma S_\gamma$

$q_{ult} = 118 \times 3 \times 18.4 + 0.5 \times 118 \times 1.75 \times 22.4 \times 0.88 = 6{,}513 + 2{,}035 = 8{,}548\ \text{lb/ft}^2$

$\boxed{q_{net} = 8{,}548\ \text{lb/ft}^2 - (3 \times 118) = 8{,}194\ \text{lb/ft}^2}$

Determine the maximum applied pressure, Q_{max}:

$$Q_{max} = \frac{4P}{3L(B - 2e)} = \frac{4(40{,}000\ \text{lb})}{3(6\ \text{ft})(3\ \text{ft} - 2(0.625\ \text{ft}))} = 5{,}079\ \text{lb/ft}^2$$

Determine the safety factor:

$$\text{safety factor} = \frac{\boxed{q_{net}}}{Q_{max}} = \frac{\boxed{8{,}194\ \text{lb/ft}^2}}{5{,}079\ \text{lb/ft}^2} = \boxed{1.61}$$

(11) p. 99: In the second to last line of the Example 3.15 solution, Figure 3.24 should read Figure 3.22.

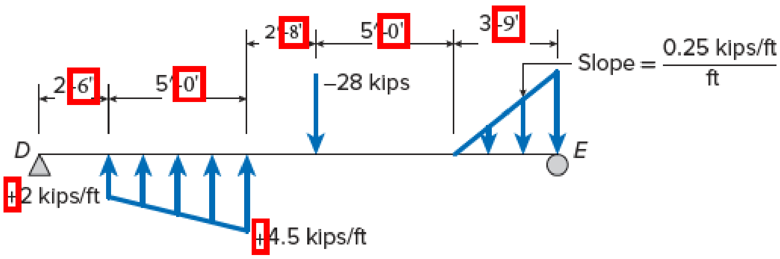
Using Figure 3.22, $I = 0.7$

CHAPTER 4: Structural Mechanics

(1) p. 116. There are some errors in Example 4.3. The corrections are marked in the figure below.

Example 4.3: Finding Reactions

Find reactions at D and E.



Solution

Resultant forces:

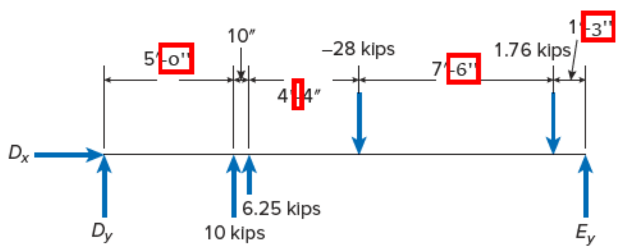
Trapezoidal loads decompose into:

1. Uniform load of +2.0 kips/ft Resultant = $(+2.0\ \text{kips/ft})(5\text{ft}-0\text{in}) = 10\ \text{kips}$
2. Triangular load of +2.5 kips/ft Resultant = $\dfrac{(+2.5\ \text{kips/ft})(5\text{ft}-0\text{in})}{2} = 6.25\ \text{kips}$

Second triangular load:

$$\text{Resultant} = 0.25\ \frac{\text{kip}}{\text{ft}}\ /\text{ft}\ \frac{(3\text{ft}-(9\text{in}/12\text{in}/12\text{in}/\text{ft}))^2}{2} = 1.76\ \text{kips}$$

Free body with resultant forces:



$$\curvearrowleft + \Sigma M_E = 0 = (1.76\ \text{kips})(1'+(3''/12) + (28\ \text{kips})(1'+(3''/12)+7'(6''/12)$$

$$-(6.25\ \text{kips})\left(1'+(3''/12)+7'+(6''/12)+4'+(4''/12)\right)$$

$$-(10\ \text{kips})(1'+3''/12+7'+6''/12+4'+4''/12+10''/12) - (D_y)(18.75\ \text{ft}) = 0$$

$$=(1.75\text{kips})(1.25\text{ft})+(28\text{kips})(8.75\text{ft})-(6.25\text{kips})(13.08\text{ft})-(10\text{kips})(13.93\text{ft})-(D_y)(18.75\text{ft})=0$$

$$D_y = 1.40\ \text{kips}\ \boxed{\uparrow}$$

$$+\uparrow\ \Sigma F_y = 0 \Rightarrow +1.40\ \text{kips} + 10\ \text{kips} + 6.25\ \text{kips} - 28\ \text{kips} - 1.76\ \text{kips} + E_y = 0$$

$$E_y = \boxed{12.11\ \text{kips}}\uparrow \qquad D_x = 0 \text{ by inspection}$$

(2) p. 128: There are some errors in the solution to Example 4.10. The corrections are marked in the figure below.

Example 4.10 *(continued)*

Solution

Find reactions. There is no symmetry of loading, so use the equation of equilibrium.

$$\curvearrowleft +\Sigma M_A = 0 \Rightarrow -(20 \text{ kips})(30 \text{ ft}) - (15 \text{ kips})(60 \text{ ft}) + \boxed{R_F}(150 \text{ ft}) = 0$$

$$\boxed{R_F} = 10 \text{ kips}\uparrow$$

$$+\uparrow \Sigma F_{\boxed{y}} = 0 \Rightarrow \boxed{R}_{A_y} - 20 \text{ kips} - 15 \text{ kips} + 10 \text{ kips} = 0$$

$$\boxed{R}_{A_y} = 25 \text{ kips}\uparrow$$

$$\boxed{R}_{A_{\boxed{x}}} = \boxed{0} \text{ by inspection}$$

Joint A

$$\theta = \tan^{-1}\left(\frac{40 \text{ ft}}{30 \text{ ft}}\right) = 53.13°$$

$$+\uparrow \Sigma \boxed{F_y} = 0 \Rightarrow F_{AG} \times \sin(53.13°) + 25 \text{ kips} = 0$$

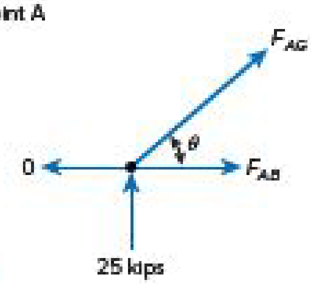
$$\Rightarrow F_{AG} = -31.25 \text{ kips (compression)}$$

$$\Sigma F_x = 0 \Rightarrow F_{AG} \times \cos(53.13°) + F_{AB} = 0$$

$$\boxed{}-31.25 \text{ kips } (\cos(53.13°))\boxed{+F_{AB} = 0}$$

$$\boxed{F_{AB} = 18.75 \text{ kips (tension)}}$$

Joint A



Joint B

$$+\uparrow \Sigma F_{\boxed{y}} = 0 \Rightarrow F_{BG} = \boxed{0}$$

$$+\rightarrow \Sigma Fx = 0 \Rightarrow F_{BC} = F_{AB} = 18.75 \text{ kips (tension)}$$

Joint B

Joint $\boxed{G}$

$$\theta_2 = \tan^{-1}\left(\frac{10}{45}\right) = 12.53°$$

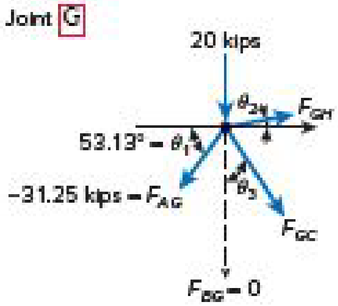
$$\theta_3 = \tan^{-1}\left(\frac{30 \text{ ft}}{40 \text{ ft}}\right) = 36.87°$$

$$+\rightarrow \Sigma Fx = 0 \Rightarrow \boxed{(-31.25)} \text{ kips} \times \cos(53.13°)$$
$$\boxed{+} F_{GH} \cos(12.53°) \boxed{+F_{GC} \sin(36.87°) = 0}$$

$$\cancel{+F_{GC} \sin(36.87°) = 0}$$

$$\Rightarrow 18.75 \text{ kips} + 0.98\, F_{GH} + 0.6\, F_{GC} = 0 \qquad (1)$$

Joint $\boxed{G}$



$$+\boxed{\uparrow}\Sigma F_{\boxed{y}} = 0 \Rightarrow \boxed{(-31.25)} \text{ kips} \times \sin(53.13°) + F_{GH}\boxed{\times \sin(12.53°)}$$
$$-F_{GC} \times \cos(36.87°) - 20 \text{ kips} = 0$$
$$\Rightarrow 25 \text{ kips} + 0.22\, F_{GH} - 0.80\, F_{GC} - 20 \text{ kips} = 0 \qquad (2)$$

There are two equations with two unknowns. Solve Equation (1) for F_{GC} and plug the answer into Equation (2).

$$F_{GC} = \frac{-18.75}{0.6} - \frac{0.98}{0.6} F_{GH}$$
$$= -31.25 \text{ kips} - 1.63\, F_{GH}$$

$\boxed{\text{Plug } (-31.25 \text{ kips} - 1.63\, F_{GH}) \text{ for } F_{GC} \text{ into Equation (2).}}$

$$25 \text{ kips} + 0.22 F_{GH} - 0.80(-31.25 \text{ kips} - 1.63 F_{GH}) - 20 \text{ kips} = 0$$
$$25 \text{ kips} + 0.22 F_{GH} + 25 \text{ kips} + 1.30 F_{GH} - 20 \text{ kips} = 0$$
$$1.52 F_{GH} = -30 \text{ kips}$$
$$F_{GH} = \boxed{-19.74} \text{ kips (compression)}$$

(3) p. 156: There is a correction in Section 4.9.1.1: One-Way Flexural Slab Design.

Current: If the length is less than the width, it can be treated as a two-way slab.
Corrected: If the length is less than twice the width, it can be treated as a two-way slab.

CHAPTER 5: Hydraulics and Hydrology

(1) p. 217: In the solution to Example 5.15, a division symbol is missing. The calculation is correct as is. Please see the correction below.

Solution

First, solve for the velocity in the first pipe section.

$$v = \frac{Q}{A}$$

$$Q = 10\ \text{ft}^3/\text{s}$$

$$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi(2.0\ \text{ft})^2}{4} = 3.14\ \text{ft}^2$$

$$v_1 = (10\ \text{ft}^3/\text{s})\boxed{/(3.14\ \text{ft}^2) = 3.2\ \text{ft/s}}$$

(2) p. 219: In Equation 5-61, the variables for velocity and kinematic viscosity look too similar. Please see the corrections below.

$$R_e = \frac{D_h \mathrm{v}}{\nu} \qquad \textbf{Equation 5-61}$$

D_h = hydraulic diameter (ft)
v = velocity (ft/s)
ν = kinematic viscosity (ft^2/s)

CHAPTER 6: Geometrics

(1) p. 248: In the last line of the solution to Example 6.8, the bearing of line $\overline{\mathrm{GH}}$ is incorrect and should read as follows:

Bearing of line $\overline{\mathrm{GH}} = \mathrm{N}59°02'24''\mathrm{E}$

(2) p. 252: Under Equation 6-6, the following note should be added:
Where a friction factor, *f*, is provided, Equation 6-6 should be revised to replace $\frac{a}{32.2}$ with *f*.

(3) p. 262: In the paragraph at the bottom of the page, there are three numbers in parenthesis (22, 32, and 42) where the second digit 2 needs to be a superscript. See correction below marked by red boxes.

FIGURE 6.12 Forces Acting on a Vehicle Traveling on a Superelevated Horizontal Curve

As indicated by the equation above, the magnitude of the centripetal acceleration is determined by the vehicle speed squared and curve radius. Based on the above equation, centripetal/centrifugal acceleration is not linearly proportional to speed. On a constant radius curve, as vehicle speed increases, a_n increases by the square of the speed increase factor.

For example, a vehicle traveling on a constant radius curve at 30 mph is subject to a_n. If the vehicle speed increases by a factor of 2 to 60 mph, a_n increases by 4 (or $\boxed{2^2}$) to $4a_n$. If the vehicle speed increases by a factor of 3 from 30 mph to 90 mph, a_n increases by a factor of 9 (or $\boxed{3^2}$) to $9a_n$. If the vehicle speed increases by a factor of 4 from 30 mph to 120 mph, a_n increases by a factor of 16 (or $\boxed{4^2}$) to $16a_n$, and so forth. When multiplied by the mass of a vehicle, centripetal acceleration becomes centripetal force.

(4) p. 284: There are some errors in questions on page 294.

Equation 6-48 is for S < L. So "S < L" should be added to the right of the equation.

Equation 6-49 is for S > L. So "S > L" should be added to the right of the equation.

(5) p. 294: There are some errors in the solution to Example 6.31. The corrections are marked in the figure below. 775 turns into 755, and 3,630 turns into 3,610.

Solution

The first step is to find the total traffic volume for each 15-minute period.

TIME INTERVAL	LEFT TURN	RIGHT TURN	ST TRUCKS	ST CARS	TOTAL
8:00–8:15 a.m.	120 × 2 = 240	90 × 1.5 = 135	80 × 2.5 = 200	400	975
8:15–8:30 a.m.	70 × 2 = 140	100 × 1.5 = 150	90 × 2.5 = 225	450	965
8:30–8:45 a.m.	60 × 2 = 120	80 × 1.5 = 120	110 × 2.5 = 275	400	915
8:45–9:00 a.m.	50 × 2 = 100	70 × 1.5 = 105	60 × 2.5 = 150	400	$\boxed{755}$

Refer to the *HCM (6th ed)* [2].

V_{15} = maximum 15-minute volume within the hour = 975

V = total one-hour volume = $975 + 965 + 915 + \boxed{755} = \boxed{3{,}610}$

$$\mathrm{PHF} = \frac{V}{4 \times V_{15}} = \frac{\boxed{3{,}610}}{975} = 0.93$$

Answer: C

CHAPTER 7: Materials

(1) p. 318: There are two typographical errors in the solution to Example 7.1. In Sample B, No. 200 = 30 (not 87 as listed); in Sample C, No. 200 = 87 (not 30 as listed).

Example 7.1 *(continued)*

(Note: Using Equation 7.1 will yield a negative GI, which should be reported as zero.)

Classification: A-1-b (0)

Sample B:

No. 200 = $\boxed{30}$ < 35%: cohesionless soil

LL = 25, PI = 25 − 14 = 11 > 6: use Fig. 7.1 (AASHTO Classification Table)

Plot LL = 25 and PI = 11 on Figure 7.1.

First match: soil type A-2-6

PGI = $0.01(F_{200} - 15)(PI - 10) = 0.01(30 - 15)(11 - 10) = 0.15$ (reported as 0) (from Equation 7-2)

Classification: A-2-6 (0)

Sample C:

No. 200 = $\boxed{87}$ > 35%: cohesive soil

LL = 71, PI = 71 − 40 = 31: use Fig. 7.1 (AASHTO Classification Table)

Plot LL = 71 and PI = 31 on Figure 7.1.

First match: A-7-5

GI = $(F_{200} - 35)(0.2 + 0.005(LL - 40)) + 0.01(F_{200} - 15)(PI - 10) = 33.58$ (reported as 34) (from Equation 7-1)

Classification: A-7-5 (34)

(2) p. 333: The third line of the solution to Example 7.6 needs to be deleted.

Example 7.6: Phase Relationships

A soil sample has a dry unit weight of 85 lb/ft^3 and a porosity of 0.4. What is the specific gravity of the solids?

Solution

Use Table 7.5 to solve directly for the required parameters:

$$e = \frac{n}{1-n} = \frac{0.4}{1-0.4} = 0.667$$

$$\cancel{G_S = \frac{\gamma_d(1+e)}{\gamma_w} = \frac{95(1+0.667)}{62.4} = 2.54}$$

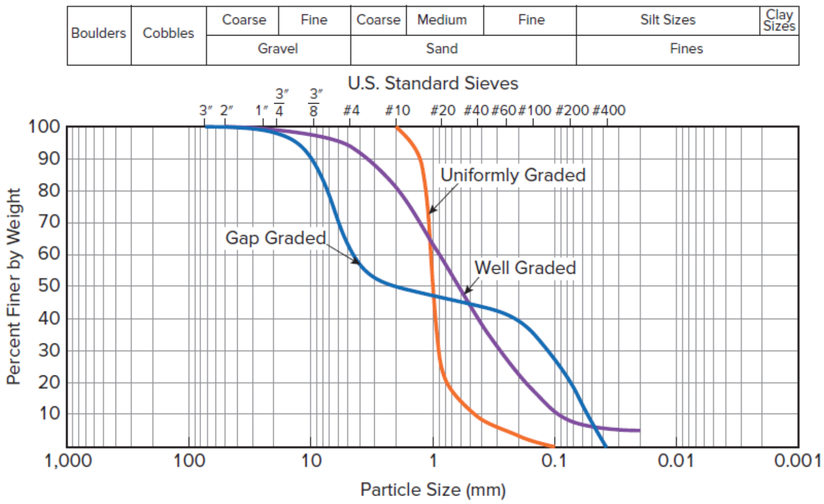
Sample dry unit weight = γ_d = 85 lb/ft^3

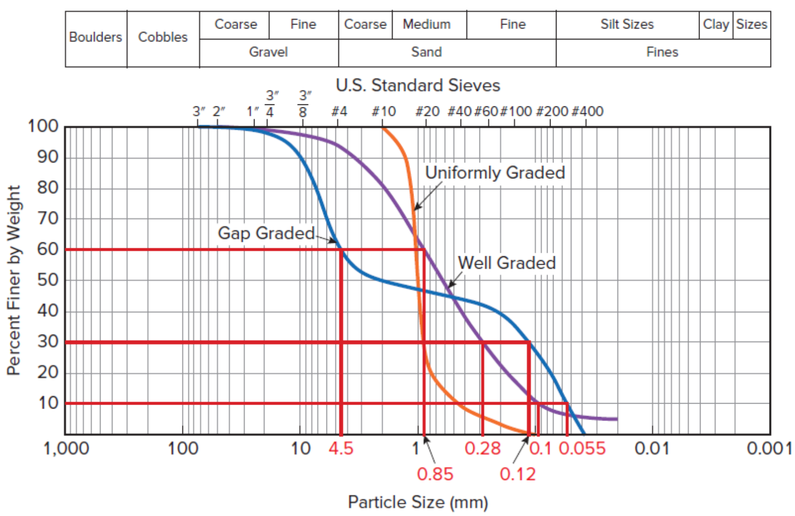
Specific gravity of water = γ_w = 62.4 lb/ft^3

$$\text{Specific gravity of solids, } G_S = \frac{85\ \text{lb/ft}^3\ (1 + 0.667)}{62.4\ \text{lb}}$$

$$= 2.27$$

(3) p. 337: There are four typographical errors in Figure 7.13 and in the figure in the Example 7.9 Solution. Course was replaced by Coarse (twice), Gap-graded was replaced by Gap Graded, and Uniformely was replaced by Uniformly.



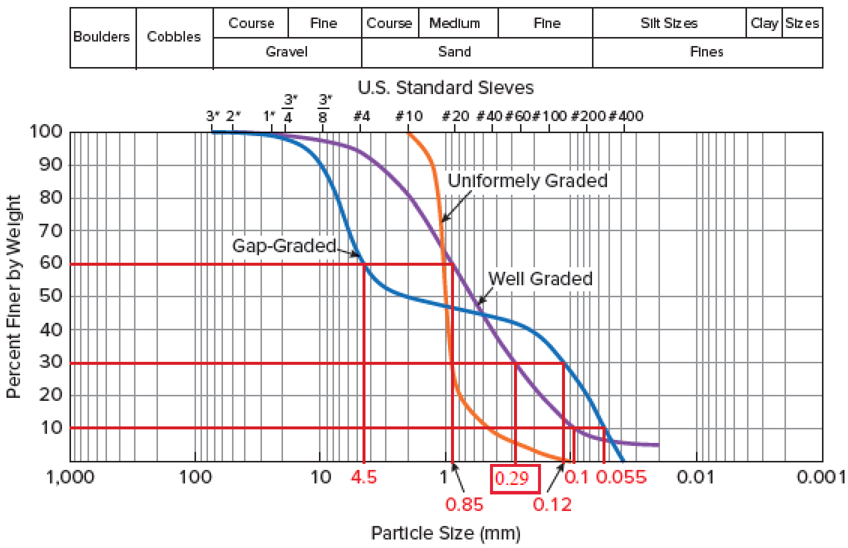


(4) pp. 337-338: There are some corrections to Example 7.9, which appear in red boxes below.

Example 7.9: Grain Size Distribution

Determine the coefficient of uniformity and the coefficient of curvature of the gap-graded and well-graded soils, as shown in Figure 7.13.

Solution



For gap-graded soil:

$D_{60} \approx 4.50$ mm, $D_{30} \approx 0.12$ mm, $D_{10} \approx 0.055$ mm

$$C_u = \frac{D_{60}}{D_{10}} = \frac{4.50\text{ mm}}{0.055\text{ mm}} = 81.8$$

$$C_c = \frac{D_{30}{}^2}{D_{60}D_{10}} = \frac{(0.12\text{ mm})^2}{(4.50\text{ mm})(0.055\text{ mm})} = \boxed{0.058}$$

For well-graded soil:

$D_{60} \approx 0.85$ mm, $D_{30} \approx \boxed{0.29}$ mm, $D_{10} \approx \boxed{0.09\text{ mm}}$

Example 7.9 *(continued)*

$$C_u = \frac{D_{60}}{D_{10}} = \frac{0.85\text{ mm}}{\boxed{0.09\text{ mm}}} = \boxed{9.4}$$

$$C_c = \frac{D_{30}{}^2}{D_{60}D_{10}} = \frac{\boxed{(0.29\text{ mm})}^2}{(0.85\text{ mm})\boxed{(0.09\text{ mm})}} = \boxed{1.1}$$

(5) p. 345: There is a typographical error in the last line of the solution: *L* should not appear in the denominator. The last line should appear as follows:

$$Q = \frac{k \cdot \Delta h \cdot N_f}{N_d} \cdot L = \frac{1.64{\times}10^{-4} \cdot 12\text{ ft} \cdot 4}{8} \times 100 = 0.0984\text{ ft}^3/\text{min}$$

(6) p. 346: Equation 7-32 is incorrect as written. It should appear as follows:

$$C_v = \frac{k}{\gamma_w{\times}m_v}$$ **Equation 7-32**

~~ρ_w = density of water~~

γ_w = unit weight of water (62.4 lbf/ft^3 – English unit)

CHAPTER 8: Site Development

(1) p. 364: The units are incorrect on two numbers: 3,300 and 2,700. The units should be lb/yd^3 and are corrected below.

The preceding can be applied to an example of an excavation operation involving clay with a bank density of 3,300 lb/yd^3 and a loose density of 2,700 lb/yd^3. If one ton of the soil is excavated from the initial borrow area, this mass would occupy 0.61 bank cubic yards (BV) in the ground.

$$\frac{2{,}000 \text{ lb}}{3{,}300 \ \boxed{\text{lb/yd}^3}} = 0.61 \text{ BV}$$

When this same soil is hauled to be stockpiled, it occupies 0.74 loose cubic yards (LV).

$$\frac{2{,}000 \text{ lb}}{2{,}700 \ \boxed{\text{lb/yd}^3}} = 0.74 \text{ LV}$$

(2) p. 365: Equation 8-1 has been expanded, and the units on two numbers have been corrected, as shown below.

The resultant decimal swell factor (SWF) is 0.22.

$$\text{SWF} = \frac{\text{BV}}{\text{LV}} - 1 \ \boxed{\text{or}} \ \frac{\textbf{BD}}{\textbf{LD}} - \textbf{1} \qquad \textbf{Equation 8-1}$$

$$= \frac{3{,}300 \ \boxed{\text{lb/yd}^3}}{2{,}700 \ \boxed{\text{lb/yd}^3}} - 1 = 0.22 \text{ SWF}$$

(3) p. 366: There is a numerical error in the problem statement and in the solution (highlighted below): 45 minutes should be 40 minutes in the problem statement, and 45-min/cycle should be 40-min/cycle in the solution. The answer is correct as is.

Example 8.3: Swell/Shrinkage

A contractor was awarded a contract to excavate and haul 500,000 yd^3 of clay to cap a construction and demolition debris (C&DD) landfill. Job specifications require a final compaction of 95% of maximum dry density. The on-site geotechnical engineer has determined that the clay has a bulking factor of 22%. The contractor has elected to use dump trucks with a capacity of 26 yd^3. The time to load the trucks, travel to the site, unload, and travel back to the borrow site has been determined to be 40 minutes. The contract features an incentive payment of $15,000/day for each day completed prior to 80 calendar days, with a maximum incentive of $150,000. The number of dump trucks working 8 hours per day, 5 days per week that must be utilized to achieve the maximum incentive payment is most nearly:

A. 39 trucks
B. 35 trucks
C. 40 trucks
D. 43 trucks

Solution

1. Apply a bulking factor (swell) of 22% to the total volume.
2. 500,000 yd^3 × 1.22 = 610,000 yd^3 (volume to be trucked off site)
3. $150,000/$15,000 = 10 calendar days (working days to achieve maximum incentive)
   80 calendar days – 10 calendar days = 70 calendar days, or 10 workweeks
4. 5 days/week × 8 hr/day × 10 weeks = 400 work hours (working hours in 10 workweeks)
5. $\frac{610{,}000 \text{ yd}^3}{400 \text{ hr}} = 1{,}525 \text{ yd}^3\text{/hr}$ (required haulage per hour)
6. $\left[26 \text{ yd}^3\text{/truck} \Big/ \frac{\boxed{40}\text{-min/cycle}}{60 \text{ min/hr}}\right] = 39.0 \text{ yd}^3\text{/truck-hr}$ (total possible haul per truck per hour)
7. $\frac{1{,}525 \text{ yd}^3\text{/hr}}{39 \text{ yd}^3\text{/truck-hr}} = 39.1$ trucks (total trucks needed)
8. Remember that to receive the maximum incentive payment, the contract requires completion prior to 70 days. Since a fraction of a truck cannot be used, the answer must be rounded up or down. If 39 trucks are used, the total hauled in the 70-day period would only be 608,400 yd^3. This would result in the contractor failing to meet the maximum incentive requirements. The answer is 40 trucks.

Answer: C

(4) p. 380: There is a typographical error in the diagram for Example 8.11. HI should read 5.41 ft (not 5.14 ft). The solution and answer are correct as is.

Appendix A.3: Engineering Economics

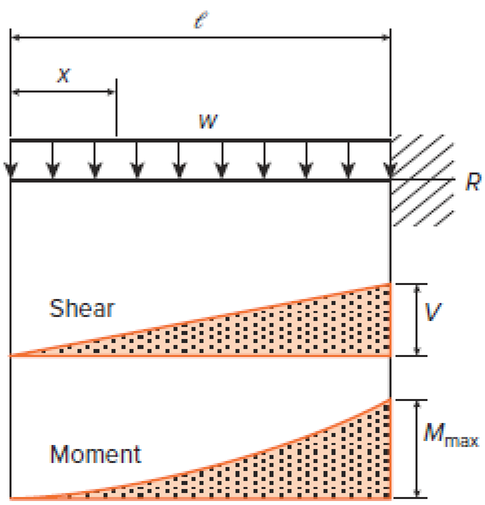
(1) p. 404: In the solution to Example A.3, "*P* of cost = \$25 million" should be "*P* of cost = \$35 million."

Appendix A.4: Diagrams and Equations for Beam Designs

(1) p. 428: In Section A.4.4, the deflection equation for Δ_x is incorrect (it is missing a superscript). The corrected equation appears as follows:

$$\Delta_x = \frac{wx}{24El}(\ell^3 - 2\ell x^2 + x^3)$$

(2) p. 433: In Section A.4.12, the figure is incorrect. The corrected figure appears as follows:



Appendix A.9: Equation Quick Reference

(1) p. 458: Equation 3-46 is missing a variable (N_q). It should appear as follows:

$q_{ult} = \gamma D_f N_q + 0.5\gamma B N_\gamma S_\gamma$ **Equation 3-46** **87**

(2) p. 479: Equation 7-32 is incorrect. It should appear as follows:

$C_v = \frac{k}{\gamma_w \times m_v}$ **Equation 7-32** **346**

(3) p. 480: Equation 8-1 has been expanded. It should appear as follows:

$\mathrm{SWF} = \frac{\mathrm{BV}}{\mathrm{LV}} - 1 \text{ or } \frac{\mathrm{BD}}{\mathrm{LD}} - 1$ **Equation 8-1** **365**