ERRATA for

Civil PE Sample Questions and Solutions

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Breadth Module

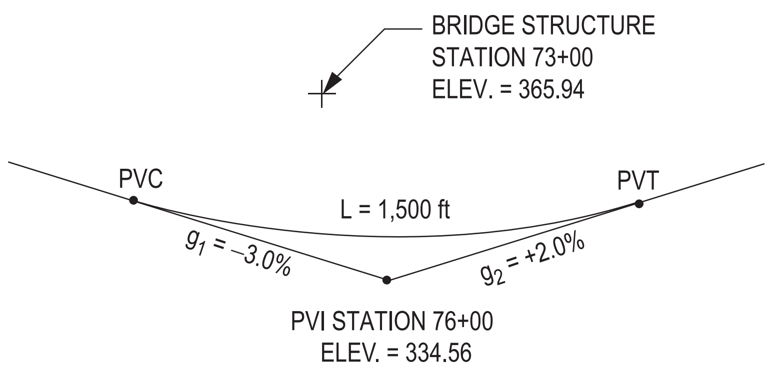
p. 31, Breadth Question 106:

Change line 4 as follows:

Plastic limit 25

p. 34, Breadth Question 113:

Replace the existing figure with the following:



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Breadth Module (Continued)

p. 34, Breadth Question 114:

Beginning with the April 2008 exam, traffic analysis is not covered in the Transportation portion of the Breadth exam. The Transportation portion of the Breadth exam will only contain questions about geometric design. The following is another example of a geometric design question.

The back tangent of a horizontal curve has a bearing of N 65°48′00″ E. The ahead (forward) tangent has a bearing of S 71°24′ E. The bearing from the PI to the center is most nearly:

(A) S 2°48′ E

(B) S 40°00′ E

(C) S 60°48′ E

(D) S 61°40′ E

Breadth Solution:

Solving for Δ,

$$90° - 65°48'00'' = 24°12'$$
$$90° - 71°24'00'' = 18°36'$$
$$\Delta = 24°12' + 18°36' = 42°48'$$
$$\Delta/2 = 42°48'/2 = 21°24'$$

Now solving for the angle subtended by the forward tangent to the line between the PI and center of curve,

$$90° - \Delta/2 = 90° - 21°24' = 68°36'$$
$$\text{Bearing} = 71°24' - 68°36' = \text{S } 2°48' \text{ E}$$

THE CORRECT ANSWER IS: (A)

Breadth Module (Continued)

p. 139, Breadth Solution 106:

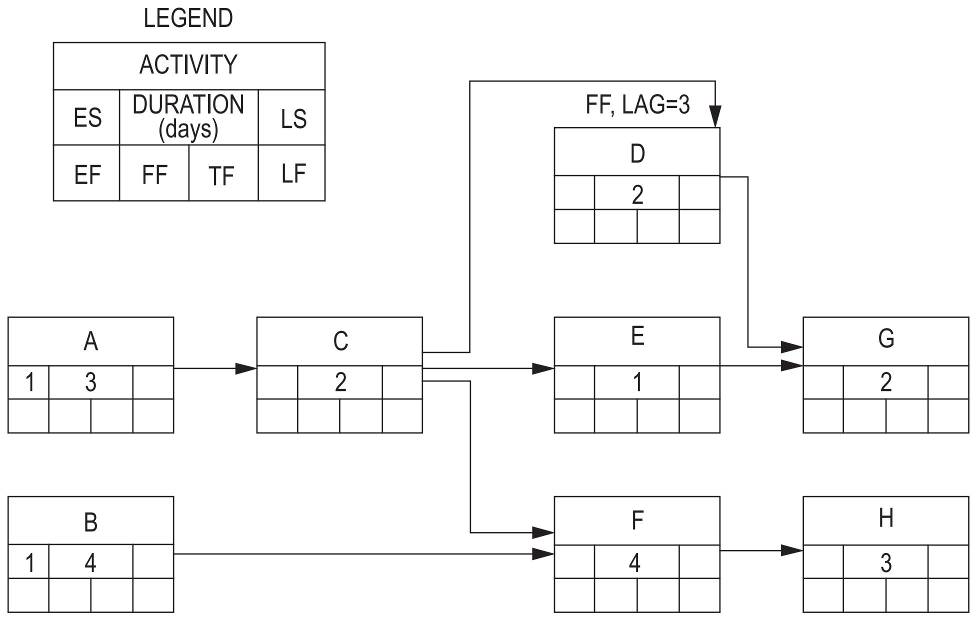
Add the following equation to the solution:

$$\begin{aligned} PI &= 55 - 25 \\ &= 30 \end{aligned}$$

Construction Module

p. 47, Construction Question 508:

Replace the existing figure with the following:



Construction Module (Continued)

p. 48, Construction Question 509:

Change the first sentence as follows:

In the activity-on-arrow network below, based on end-of-day calculations for starts and finishes, the early start of Activity N is most nearly:

p. 50, Construction Question 511:

Change the first sentence as follows:

A formal CPM analysis for a project shows the planned costs to date are \$85,000, and the accounting department reports charges to the job of \$95,000.

p. 54, Construction Question 518:

Change line 2 as follows:

The OSHA incidence rate for recordable cases is most nearly:

p. 149, Construction Solution 504:

Change line 5 as follows:

$$\text{Costs} = 9{,}000\left(A/P\right)_{5\text{ yr}}^{10\%} + 1{,}000\left(0.10\right)$$

Change line 8 as follows:

$$\text{Costs} = 10{,}000\left(A/P\right)_{5\text{ yr}}^{10\%} - 1{,}000\left(A/F\right)_{5\text{ yr}}^{10\%}$$

p. 155, Construction Solution 518:

Change the second sentence as follows:

The term *incidence rate* for recordable cases means the number of injuries and illnesses requiring treatment beyond first aid, those that result in lost workdays, and those that result in restricted or light duty, per 100 full-time workers.

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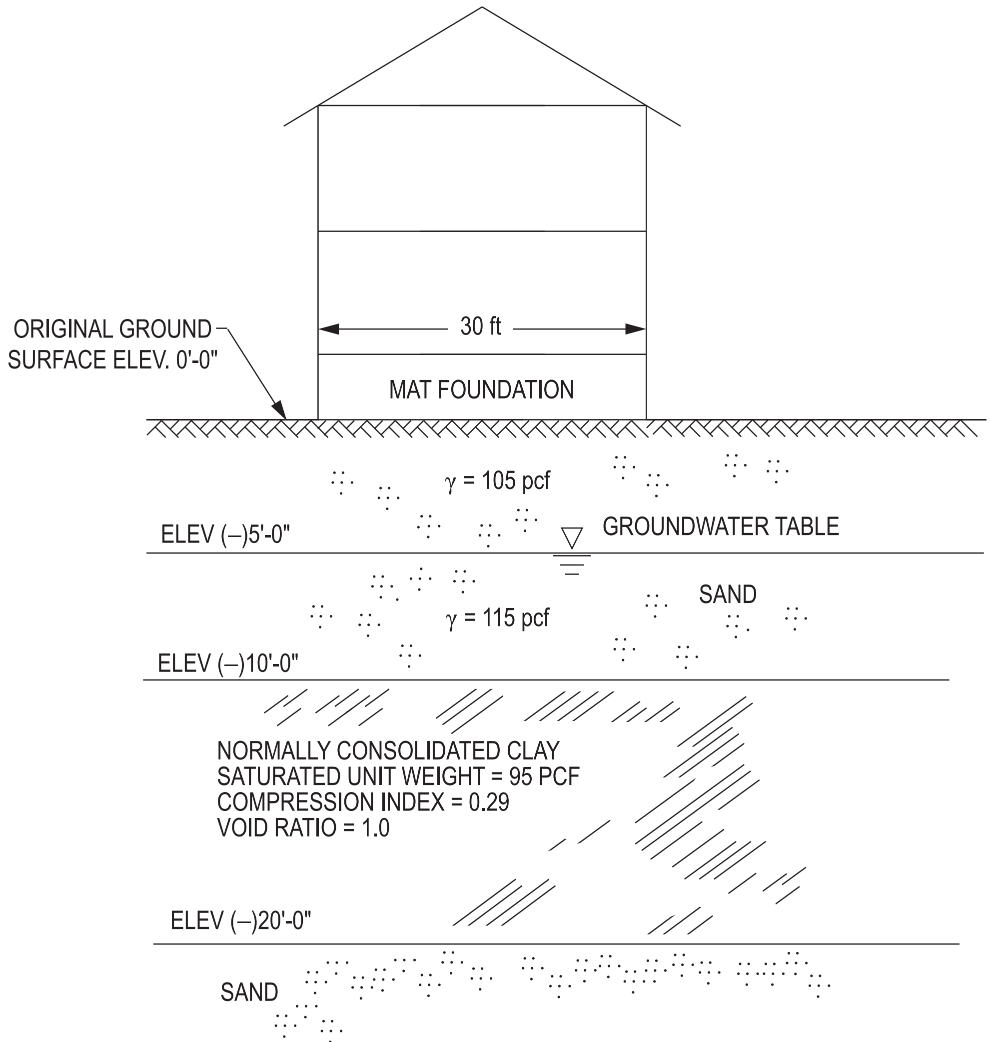
Geotechnical Module

p. 64, Geotechnical Question 507:

Replace the existing figure with the following:



p. 69, Geotechnical Question 513:

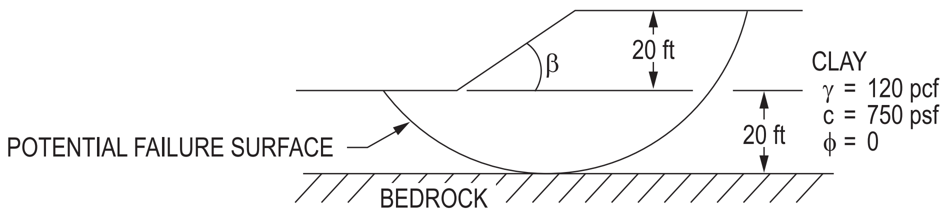
Change the first three sentences as follows:

The liquefaction potential of a site is to be evaluated. For Layer 3, the design earthquake-induced average shear stress is 450 psf, and the maximum allowable cyclic stress ratio is 0.29. The factor of safety against liquefaction in Layer 3 is most nearly:

Geotechnical Module (Continued)

p. 72, Geotechnical Question 515:

Replace the existing figure of slope dimensions with the following:



p. 74, Geotechnical Question 516:

Replace the existing question and options with the following:

The figure below shows the foundation and geotechnical data for a strip footing. To achieve a safety factor of 3, the allowable bearing capacity (psf) using the Terzaghi equation is most nearly:

(A) 1,995
(B) 2,187
(C) 2,730
(D) 5,985

p. 75, Geotechnical Question 517:

Options (A) through (D) are as follows:

(A) 1.6
(B) 1.7
(C) 1.9
(D) 2.3

p. 162, Geotechnical Solution 507:

Change line 6 as follows:

$$\sigma'_{vo} = 5(105) + 5(115 - 62.4) + 5(95 - 62.4) = 951 \text{ psf}$$

Geotechnical Module (Continued)

p. 165, Geotechnical Solution 515:

Replace the existing solution with the following:

$$\left.\begin{array}{ll} D & = 40 \\ D/H = & 2 \\ \beta & = 30 \end{array}\right\} \text{stability number} = 0.172 = \frac{c_r}{\gamma H} = \frac{c_r}{120 \times 20}$$

$$c_r \cong 413$$

$$FS = \frac{c}{c_r} = \frac{750}{413} = 1.82$$

p. 165, Geotechnical Solution 516:

Replace the existing solution with the following:

Given: Square footing $B = L = 5$ ft
$D_f = 2$ ft
$\gamma = 115$ pcf
$c = 200$ psf
$\phi = 20°$

Given: Bearing-capacity factors $N_c = 14.8$
$N_q = 6.4$
$N_\gamma = 5.4$

$$\begin{aligned} q_{ult} &= 0.5\,\gamma B N_\gamma + cN_c + \gamma D N_q \\ &= (0.5)(115\text{ pcf})(5\text{ ft})(5.4) + (200\text{ psf})(14.8) + (115\text{ pcf})(2\text{ ft})(6.4) \\ &= 1,552.5 + 2,960 + 1,472 = 5,984.5\text{ psf} \end{aligned}$$

$$q_{allowable} = \frac{5,984.5}{3} = 1,995$$

Geotechnical Module (Continued)

p. 166, Geotechnical Solution 517:

Replace resisting moment equation with the following:

Resisting moment = (2)(9)(155)(4.5) + (5)(18)(155)(4.5) + (2)(18)(105)(8) = 105,570 ft-lb

Replace calculation of FS with the following:

$$FS = \frac{105,570}{46,200} = 2.28$$

THE CORRECT ANSWER IS: (D)

p. 166, Geotechnical Solution 518:

Replace line 6 with the following:

$$\text{Overburden pressure at el.} - 20 \text{ ft}, \; P_o = 5(120) + \frac{30}{2}(115) = 2,325 \text{ psf}$$

Structural Module

p. 82, Structural Question 503:

Options (A) through (D) are as follows:

(A) 250
(B) 75
(C) 50
(D) 36

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Structural Module (Continued)

p. 86, Structural Question 506:

Add an assumption:

Neglect block shear and the capacity of the connection.

Options (A) through (D) are as follows:

(A) ┘└ 2 1/2 × 2 1/2 × 3/8

(B) ┘└ 3 1/2 × 3 1/2 × 5/16

(C) ┘└ 3 1/2 × 3 1/2 × 3/8

(D) ┘└ 4 × 4 × 3/8

p. 100, Structural Question 518:

Replace lines 5 and 6 with the following:

Assuming adequate basic allowable stress, the design stress range (ksi) for the fatigue limit state for the beam during 25 years of service is most nearly:

Options (A) through (D) are as follows:

(A) 16
(B) 24
(C) 29
(D) 38

p. 172, Structural Solution 503:

Change lines 6, 7, 8, and 9 as follows:

$$\text{Total weight} = 70\text{ kips} + 36\text{ kips} = 106\text{ kips} \times 0.6 = 63.6 \qquad (\text{ASCE 7-05, part 2.4.1})$$

$$\text{Weight per leg} = 106\text{ kips}/4 = 26.5\text{ kips} \times 0.6 = 15.9$$

$$\begin{aligned}\text{Net uplift} &= -50\text{ kips} + 15.9\text{ kips}\\ &= 36.1\text{ kips}\end{aligned}$$

Structural Module (Continued)

pp. 174–175, Structural Solution 506:

Replace the existing solution with the following:

ASD Provisions:

$$P \le \frac{P_n}{\Omega} \qquad \text{(Eq. B3-2)}$$

Check tensile yield:

$$P_n = F_y A_g \text{ with } \Omega_t = 1.67 \qquad \text{(D2-1)}$$

$$\therefore 85 \text{ kips} \le \frac{F_y\, A_g}{\Omega_t} = \frac{(36 \text{ ksi})A_g}{1.67}$$

$$A_{g\ min} \ge \frac{(85 \text{ kips})(1.67)}{36 \text{ ksi}} = 3.94 \text{ in}^2 \quad \text{select smallest area with } A_g \ge 3.94 \text{ in.}$$

∴ Try ⅃L 3 1/2 × 3 1/2 × 5/16

$$A_g = 4.21 \text{ in}^2 \ge A_{g\ min} = 3.94 \text{ in}^2 \quad \therefore \text{ OK}$$

Check tensile rupture:

$$P_n = F_u A_e \text{ with } \Omega_t = 2.00 \qquad \text{(D2-2)}$$

$$85 \text{ kips} < \frac{F_u\, A_e}{2.00}$$

$$A_e = A_n U \qquad \text{(p. 16.1-28)}$$

$$A_n = [(4.21 \text{ in}^2) - 2(7/8 \text{ in.} + 1/16 \text{ in.} + 1/16 \text{ in.})(5/16 \text{ in.})]$$

$$A_n = 3.585 \text{ in}^2$$

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Structural Module (Continued)

Structural Solution 506 (continued):

All elements of angle not connected,

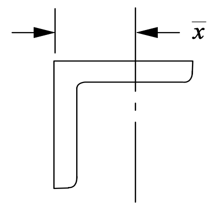
$\therefore$ U $\neq$ 1 $\rightarrow$ Shear lag (Table D3.1)

Per code, permissible to use largest "U"

Case 8 $\rightarrow$ Table D3.1

U = 0.6 (3 fasteners/line)

Case 2



$$U = 1 - \frac{\bar{x}}{l} = 1 - \frac{0.979 \text{ in.}}{6 \text{ in.}} = 0.837$$

Largest U = 0.837 $\rightarrow$ lightest ⅃L

$A_e = (3.585 \text{ in}^2)(0.837) = 3.00 \text{ in}^2$

$$85 \text{ kips} \leq \frac{(58 \text{ ksi})(3.00 \text{ in}^2)}{2.0} = 87.0 \text{ kips} \quad \therefore \text{OK}$$

Use ⅃L 3 1/2 × 3 1/2 × 5/16

THE CORRECT ANSWER IS: (B)

LRFD Provisions:

$$P_u \leq \phi_t P_n \qquad \text{(B3-1)}$$

Check tensile yield:

$P_n = F_y A_g$ (D2-1)

$P_u = \phi_t F_y A_g$ with $\phi_t = 0.9$

130 kips $\leq$ 0.9 (36 ksi) A_g

$$A_{g_{min}} \geq \frac{(130 \text{ kips})}{(0.9)(36 \text{ ksi})} = 4.01 \text{ in}^2$$

$$A_g = 4.21 \text{ in}^2 > A_{g_{min}} = 4.01 \text{ in}^2$$

$\therefore$ Try ⅃L 3 1/2 × 3 1/2 × 5/16

Structural Module (Continued)

Structural Solution 506 (continued):

Check tensile rupture:

$P_u \leq \phi_t F_u A_e$

130 kips ≤ 0.75 (58 ksi) A_e

$A_e = A_n U =$ [(4.21 in^2) – (7/8 in. + 1/16 in. + 1/16 in.)(5/16 in.)(2)] (0.837)

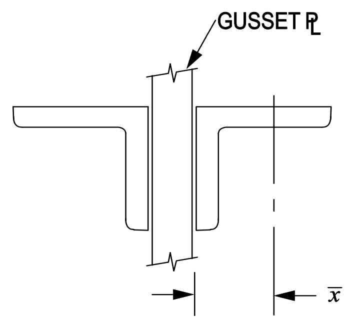
U = 0.837 (from ASD)

A_e = 3.00 in^2

$P_u \leq \phi_t F_u A_e$

130 kips ≤ 0.75 (58 ksi)(3.00 in^2) = 130.5 in^2 ∴ OK

∴ Use ⅃L3 1/2 × 3 1/2 × 5/16



THE CORRECT ANSWER IS: (B)

p. 177, Structural Solution 510:

The following information clarifies the existing solution.

The critical section for shear occurs at the distance d from the face of the columns. In this case, the section must be checked on the far, or exterior, side of the columns.

From the critical bending shear calculation,
8'-0" is the edge of footing to center of column
1'-0" is the center of column to outside face of column
3'-0" is d, effective footing depth

10'-0" is the width of the footing.

p. 182, Structural Solution 518:

Replace calculation of F_{SR} with the following:

$$F_{SR} = \left(\frac{250(10^8)}{48 \times 365 \times 25}\right)^{0.333} = (57,077)^{0.333} = 38.4 \text{ ksi} > F_{TH} = 24$$

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Transportation Module

p. 192, Transportation Solution 511:

Replace lines 2, 3, 7, and 8 with the following:

$$S_1 = \left(V_1^2 - V_f^2\right) / 30f$$

$$25 = \left(V_1^2 - (30)^2\right) / (30 \times 0.55)$$

$$S_2 = \left(V_2^2 - V_1^2\right) / (30 \times 0.71)$$

$$(150 + 24) = \left(V_2^2 - (36.23)^2\right) / (30 \times 0.71)$$

Water Resources and Environmental Module

p. 122, Water Resources and Environmental Question 501:

Change sentence 2 as follows:

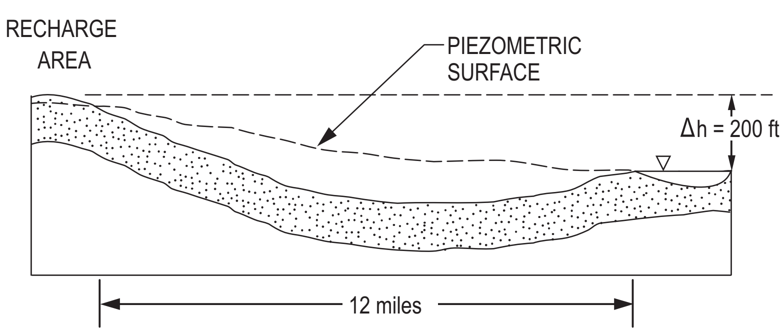
The elevation of the hydraulic grade line is 495 ft at the beginning of the pipe and 365 ft at the end of the pipe.

p. 127, Water Resources and Environmental Question 510:

Replace the existing question with the following:

Groundwater flows through a sandstone aquifer (effective porosity = 0.3) that is shown in the figure below. The distance from the recharge area to the discharge point is 12 miles, and the head difference is 200 ft. The hydraulic conductivity is 15 ft/day. The time (years) it will take for water to travel from the recharge area to the discharge area is most nearly:

(A) 0.5
(B) 20
(C) 1,100
(D) 3,700



Water Resources and Environmental Module (Continued)

p. 201, Water Resources and Environmental Solution 501:

Replace the existing solution with the following:

At end of pipe

$$P_h = \text{Pressure head (ft)} = P_h = \Delta H - h_L - \frac{V_E^{\,2}}{2g}$$

where ΔH is total drop in hydraulic grade line, h_L is the head loss caused by friction in the pipe, and V_E is the velocity of flow at the end of the pipe. Find h_L using Hazen-Williams equation (implied by use of C in problem).

$$V = 1.318\,CR^{0.63}s^{0.54}$$

$$s = \frac{h_L}{L} \text{ and } R = \frac{D}{4} \text{ for pipes flowing full}$$

solve for h_L

$$h_L = \left(\frac{V}{1.318C\left(\frac{D}{4}\right)^{0.63}}\right)^{1/0.54} L$$

$$V = \frac{Q}{A} = \frac{500\text{ CON}}{} \left|\frac{1\text{ gpm}}{\text{CON}}\right| \frac{\text{ft}^3}{7.48\text{ gal}} \left|\frac{\text{min}}{60\text{ sec}}\right| \frac{4}{\pi\left(\frac{8}{12}\right)^2}$$

$$V = 3.1916\text{ ft/sec}$$

$$h_L = \left[\frac{3.1916}{(1.318)(140)\left(\frac{8}{12(4)}\right)^{0.63}}\right]^{1/0.54} 15{,}000 = 66.21\text{ ft}$$

$$\Delta H = 495 - 365 = 130\text{ ft}$$

$$\frac{V_E^{\,2}}{2g} = \frac{(3.1916)^2}{2(32.2)} = 0.158\text{ ft} \qquad \text{not significant}$$

$$P_h = 130 - 66.21 - 0.158 = 63.6\text{ ft}$$

$$P_{psi} = \frac{63.6\text{ ft}}{} \left|\frac{62.4\text{ lb}}{\text{ft}^3}\right| \frac{\text{ft}^2}{144\text{ in}^2} = 27.6\text{ psi}$$

THE CORRECT ANSWER IS: (B)

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p. 203, Water Resources and Environmental Solution 503:

Change line 14 as follows:

$$= 12.65 \times \left[7/(3.14 \times 0.5^2)\right]^2 /(2 \times 32.2)$$

p. 206, Water Resources and Environmental Solution 506:

Replace lines 6, 7, 8, and 9 with the following:

$$Q = 3.33 \times LH^{3/2}$$

$$H = \left(\frac{4.62}{3.33} \times \frac{1}{4 \text{ ft}}\right)^{2/3} = 0.494 \text{ ft}$$

$$H_b = 100.69 - 100.00 = 0.69 \text{ ft}$$

$$\frac{H_b}{H_a} = \frac{0.69}{1.31} = 0.53 \le 0.6$$

Elevation at B = 100.2 ft + H = 100.2 + 0.494 = 100.69 ft

p. 207, Water Resources and Environmental Solution 508:

The following information clarifies the existing solution.

Rainfall 1 is from time = 0 hr to time = 1 hr at an intensity of 1.5 in./hr.

Rainfall 2 is from time = 1 hr to time = 2 hr at an intensity of 0.7 in./hr.

The discharge in the watershed during the second hour will consist of:

The second hour of Rainfall 1 (1.2 cfs/in. × 1.5 in./hr × 1 hr) plus the first hour of Rainfall 2 (0.5 cfs/in. × 0.7 in./hr × 1 hr), or 2.15 cfs.

Water Resources and Environmental Module (Continued)

p. 208, Water Resources and Environmental Solution 510:

Replace the existing solution with the following:

Applying Darcy's equation, the Darcy velocity can be found as:

$$V = -K\frac{dh}{dL} \approx -K\frac{\Delta h}{\Delta L}$$

$$= -15 \text{ ft/day}\left(\frac{-200 \text{ ft}}{12 \times 5,280 \text{ ft}}\right)$$

$$= 0.047 \text{ ft/day} \text{ (this is the Darcy velocity)}$$

The seepage velocity or the linear velocity is therefore:

$$\frac{\text{Darcy velocity}}{\text{porosity}} = \frac{0.047 \text{ ft/day}}{0.3} = 0.157 \text{ ft/day}$$

$$\therefore \text{Travel time} = \frac{12 \times 5,280 \text{ ft}}{0.157 \text{ ft/day}} = 403,566 \text{ days} = 1,105 \text{ years}$$

THE CORRECT ANSWER IS: (C)

Water Resources and Environmental Module (Continued)

p. 213, Water Resources and Environmental Solution 517:

Replace the existing solution with the following:

Sediment weight entering reservoir = total flow rate × solids concentration × conversion factor
$= 2.1 \times 10^9$ ft^3/day × 172 mg/L × 28.32 L/ft^3 × lb/4.54 × 10^5 mg
$= 2.253 \times 10^7$ lb/day

Sediment volume allotted = reservoir volume × reserved %
$= 1.41 \times 10^{10}$ ft^3 × 22% = 3.102×10^9 ft^3

Weight of sediment in reservoir = sediment volume allotted × solids specific weight
$= 3.102 \times 10^9$ ft^3 × 80 lb/ft^3
$= 2.482 \times 10^{11}$ lb

Reservoir service life = sediment weight ÷ sludge weight entering reservoir/day
$= 2.482 \times 10^{11}$ lb ÷ 2.253×10^7 lb/day
$= 1.102 \times 10^4$ days
$= 1.102 \times 10^4$ days ÷ 365 days/year
$= 0.302 \times 10^2$ years
= 30.2 years