PE Civil Exam Review Guide: Transportation Depth Preview Edition

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: Traffic Engineering

(1) p. 1-22: At the end of the solution to Example 1.1, following Part E, Table 1.9 should say Table 1.2.

(2) pp. 1-32 – 1-34: In Example 1.3, answer A in Part 1 should be changed to 38.2. In Step 2 of the solution, the values of S_{f0} are incorrect. This changes the calculations in Part 3, as well as the answer for Part 2. Corrections appear below.

Example 1.3: Urban Street Segment—Determine Free-Flow Speed

Determine the FFS for the following urban street segments given the following facts.

- Segment A and segment B are adjacent four-lane divided urban street segments.
- Both have a 40-mph speed limit, a raised curb, and 20 access points per mile.
- Segment A is 0.25 miles long with 80% restrictive median and 40% on-street parking.
- Segment B is 0.75 miles long with 40% restrictive median and 100% on-street parking.

Part 1: What is nearest to the FFS in miles per hour for segment A?

A. 38.2
B. 38.8
C. 39.2
D. 40.2

Part 2: What is nearest to the FFS in miles per hour for segment B?

A. 37.8
B. 38.8
C. 39.2
D. 40.2

Segment A: $f_L = 1.02 - 4.7\left(\frac{40.2 - 19.5}{1{,}320}\right) = 0.95$

Segment B: $f_L = 1.02 - 4.7\left(\frac{39.2 - 19.5}{3{,}960}\right) = 1.0$

<u>Step 3:</u> Calculate FFS.

$S_f = S_{f0} \times f_L$

Segment A: $S_f = 40.2 \times 0.95 = 38.2$ mph

Segment B: $S_f = 39.2 \times 1.0 = 39.2$ mph

Part 1
Answer: A

Part 2
Answer: C

(3) p. 1-47: In the problem statement for Example 1.4, the last bullet point should say "Four buses stopping per hour in the through lane" (not "two buses…").

(4) p. 1-48: In Equation 1-34, add 1.47 before *V*. In addition, T_p should instead read t_p.

interval also gives motorists approaching the intersection the option to stop safely or proceed through the intersection without accelerating.

$$Y = t_p + \frac{1.47V}{2a + 2gG}$$ **Equation 1-34** [12]

Where:

Y = yellow time (usually rounded up to the nearest 0.5 second)
t_p = driver perception/reaction time (usually taken as 1.0 second)
V = speed of approaching traffic (mph)
a = deceleration rate for the vehicle (usually taken as 10.0 ft/s^2)
g = acceleration due to gravity (32.2 ft/s^2)
G = percent grade divided by 100

(5) p. 1-48: In Example 1.5, t_r should read t_p.

$$Y = t_p + \frac{1.47V}{2a + 2gG} = 1.0 + \frac{1.47(55)}{2(10) + (2)(32.2)\frac{4.25}{100}} = 1.0 + \frac{80.85}{20 + 2.737} = 4.56 \text{ s}$$

(6) p. 1-52: A sentence is missing in the problem statement for Example 1.6 (Shown in red below). The problem statement should say:

> *The intersection of Third Avenue (northbound/southbound) and Main Street (eastbound/westbound) is located in a busy area within a large city. Assume no pedestrians are waiting at the corner to cross the major street. The street widths are shown in the figure.*

(7) p. 1-58: In the Example 1.9 solution, there is a typographical error in the last column of the chart: 30/1.47 should say 30 × 1.47. The answers are correct as is.

Solution

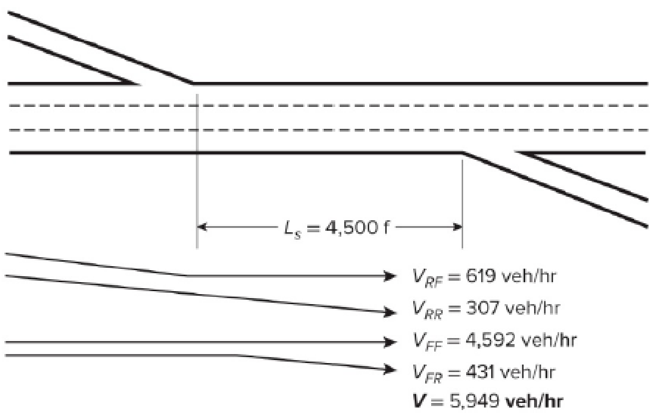
SIGNAL (DOWNSTREAM)	RELATIVE TO SIGNAL (UPSTREAM)	IDEAL OFFSET (SPACING/OFFSET)
2	1	1,000/30×1.47 = 22.7
3	2	2,000/30×1.47 = 45.4
4	3	1,500/30×1.47 = 34.0
	Offset between signals 1 to 4:	102.1 s

(8) p. 1-85: There is a mistake in the first line of the last paragraph, beneath Equation 1-84. Change "per hour" to "per mile", so that the first line instead reads: "D represents the density and is expressed in passenger cards per mile per lane."

(9) p. 1-87: There are errors in Example 1.14. Corrections appear below in red boxes.

Example 1.14: Weaving Segment—Two Sided—Minimum Rate of Lane Changes per Hour

Given the two-sided weaving segment and demand flow rates shown, determine the minimum rate of lane changing that must exist for all weaving vehicles to complete their weaving maneuvers successfully. Determine LC_{MIN}.



PHF = 0.93
Heavy vehicles = 10% trucks
Terrain = level

A. 599 lane changes per hour
B. 614 lane changes per hour
C. 795 lane changes per hour
D. 929 lane changes per hour

Solution

This is a three-lane two-sided ramp-weave configuration. On-ramp traffic must make two lane changes to diverge to the off-ramp. Therefore, LC_{RR} = 2.

Use Equation 1-68 to determine LC_{MIN}.

$$LC_{MIN} = (LC_{RR} \times v_{RR})$$

$$LC_{MIN} = (3 \times 307) = 614 \text{ lane changes per hour}$$

Answer: B

(10) p. 1-88: The solution to Example 1.15 is incorrect and should be replaced with the following:

Solution

Determine the volume ratio, *VR*.

V_{RR} = 307 veh/hr

V = 619 + 307 + 4,592 + 431 = 5,949 veh/hr

$VR = V_{RR}/V$ = 307/5,949 = 0.0516

Determine the maximum length over which weaving movements may exist. This is the length at which weaving turbulence no longer affects operations. The capacity of the weaving segment is determined by Equation 1-69.

$L_{MAX} = 5{,}728(1 + VR)^{1.6} - (1{,}566 N_{WL})$

$L_{MAX} = 5{,}728(1 + 0.0516)^{1.6} - (1{,}566 \times 0) = 6{,}208$ ft

Where

N_{WL} = number of lanes from which weaving maneuvers may be made with either one or no lane changes

As the maximum length of 6,208 ft is longer than the actual segment length of 4,500 ft, weaving operations do exist, and the analysis may continue with the weaving analysis methodology.

Answer: **6,208 ft**

(11) p. 1-93: In Equation 1-93, the second instance of v_F should be v_R.

$$v_{12} = v_R + (v_F - v_R) \times P_{FD}$$

Equation 1-93 (*HCM* Eqn. 14-8)

(12) p. 1-93: Three equations are listed but not labeled in the text. These three equations should be labeled in Table 1.24 as follows:

Table 1.24: Models for Predicting P_{FD} at Off-Ramps or Diverge Areas

NUMBER OF FREEWAY LANES[a]	MODEL(S) FOR DETERMINING P_{FD}
4	$P_{FD} = 1.000$
6	$P_{FD} = 0.760 - 0.000025v_F - 0.000046v_R$ **Equation 1-94** (*HCM* Eqn. 14-9)
	$P_{FD} = 0.717 - 0.000039v_F + 0.604(v_U/L_{UP})$ when $v_U/L_{UP} \leq 0.2$[b] **Equation 1-95** (*HCM* Eqn. 14-10)
	$P_{FD} = 0.616 - 0.000021v_F + 0.124(v_D/L_{DOWN})$ **Equation 1-96** (*HCM* Eqn. 14-11)
8	$P_{FD} = 0.436$
Selecting Equations for P_{FD} for Six-Lane Freeways	

(13) p. 1-115: There is a typographical error in the second part of the Part 1 solution of Example 1.16. It should read:

AADT = 58,937/12 – 4,911 vehicles per day

(14) p. 1-147: In the solution to Example 1.25, add the following line after this one:

For random pedestrian LOS criteria, see Table 1.37: 7 < 8.8; LOS C.

For platoon-adjusted pedestrian flow LOS criteria, see Table 1.38: 6 > 8.8 > 11; LOS E.

(15) p. 1-153: There is a typographical error in the problem statement for Example 1.29: 190 should be 200. The solution is correct as is.

(16) p. 1-164: There is a typographical error in Rating 6, bullet point 4: 2 ms should be 2 m.

Chapter 2: Horizontal Design

(1) p. 2-12: Equation 2-11 contains an error. It should appear as follows (corrections in red box):

Stopping Sight Distance ← $$SSD = 1.47Vt + \frac{V^2}{30\,[(a/32.2) \pm G]}$$ → Braking Distance

↓ Brake Reaction Distance

Equation 2-11

(2) p. 2-32: Equation 2-33 is misnumbered and should be listed as Equation 2-34.

Chapter 3: Vertical Design

(1) p. 3-8: There are typographical errors in the solution to Example 3.1 (corrections shown below).

Solution

Draw a rough sketch.

Find R. (Grades are in percent, L is in stations)

$$R = \frac{G_2 - G_1}{L} = \frac{-2-3}{1.8} = -2.778$$

Find the VPC station.

$$sta_{VPC} = sta_{VPI} - \frac{L}{2} = 3{,}020 - \frac{180}{2} = 2{,}930 = 29 + 30$$

Find VPT station.

$$sta_{VPT} = sta_{VPI} + \frac{L}{2} = 3{,}020 + \frac{180}{2} = 3{,}110 = 31 + 10$$

Find the VPC elevation.

$$ele_{VPC} = ele_{VPI} - G_1\left(\frac{L}{2}\right) = 600.40 - (3)\left(\frac{1.8}{2}\right) = 597.70 \text{ ft}$$

Find VPT elevation.

$$ele_{PVI} = ele_{VPI} + G_2\left(\frac{L}{2}\right) = 600.40 + (-2)\left(\frac{1.8}{2}\right) = 598.60 \text{ ft}$$

Find x distance of interest for the turning point (high point).

$$x_{\text{turning point}} = \frac{-G_1}{R} = \frac{-3}{-2.778} = 1.0799 \approx 1.08 \text{ stations}$$

The turning point occurs at station:

$$2{,}930 + 108 = 3{,}038 = 30{+}38$$

See the following chart for 25-ft stations and elevations along the curve.

STATION	x (STATIONS FROM VPC)	ELEVATION $\left(ele_x = \frac{Rx^2}{2} + G_1x + ele_{VPC}\right)$
29+30 (VPC)	0.00	597.70
29+55	0.25	598.36
29+80	0.50	598.85
30+05	0.75	599.17
30+30	1.00	599.31
30+38	1.08	599.32
30+55	1.25	599.28
30+80	1.50	599.07

Calculate elevation at point of interest.

$$ele_x = \frac{Rx^2}{2} + G_1x + ele_{VPC} = \frac{(-0.2778)(1.08)^2}{2} + (3)(1.08) + 597.70 \text{ ft} = 599.32 \text{ ft}$$

(2) p. 3-10: Equation 3-15 is incorrect as written. It should be:

$$L = 2S - \frac{2{,}158}{A} \text{ for } S > L$$ **Equation 3-15**

(2) p. 3-20: The table corresponding to Equation 3-22 is incorrect as written. It should be Table 3.1.

Chapter 4: Intersection Geometry

(1) p. 4-12: Equation 4-2 contains an error: *major* should be *minor*. The correction appears below.

$$t_g = t_a + \frac{w+L_a}{0.88V_{\text{minor}}}$$ **Equation 4-2** (*Green Book* Eqn. 9-2)

(2) p. 4-21: Example 4-5 contains an error. Option D should read "Travel speeds through modern roundabouts exceed 40 mph."

Chapter 5: Roadside and Cross-Section Design

(1) p. 5-11: There is an error in the last line of the solution to Example 5.1. The corrections appear below.

Solution

From Table 5.1, the minimum nominal clear-zone width is 34 ft.

From Table 5.2, the horizontal curve adjustment factor is 1.3.

Adjusted clear-zone width = 34 ft × 1.3 = 44.2 ft

Offset to outside edge of right-side clear zone: 12 ft + 44.2 ft = 56.2 ft (RT)

Chapter 6: Signal Design

(1) p. 6-32: The title of Figure 6.13 is incorrect. It should be **Figure 6.13: Warrant 4, Pedestrian Peak Hour**.

Chapter 8: Geotechnical and Pavement Design

(1) p. 8-15: Equation 8-1 is incorrect. The corrections appear below.

$$w(\%) = \frac{W_1 - W_2}{W_2 - W_3} \times 100 \qquad \textbf{Equation 8-1}$$

Where:

$w(\%)$ = moisture content

W_1 = weight of wet soil sample and container

W_2 = weight of oven-dry soil sample and container

W_3 = weight of container

Chapter 9: Drainage

(1) p. 9-55: The title of Example 9.12 should be changed to Bernoulli Energy Balance.

(2) p. 9-70: The following text should be added at the end of the problem statement for Example 9.16:
Assume a Manning's coefficient of 0.05.

(3) p. 9-71: In the first sentence of Example 9.17, m/s^3 should be changed to m^3/s.