CONTENTS

Introduction to NCEES Exams.................................................................1
  About NCEES
  Exam format
  Examinee Guide
  Scoring and reporting
  Updates on exam content and procedures

PE Civil: Construction Practice Exam ..................................................3

PE Civil: Construction Solutions .........................................................63
About NCEES
NCEES is a nonprofit organization made up of the U.S. engineering and surveying licensing boards in all 50 states, the U.S. territories, and the District of Columbia. We develop and score the exams used for engineering and surveying licensure in the United States. NCEES also promotes professional mobility through its services for licensees and its member boards.

Engineering licensure in the United States is regulated by licensing boards in each state and territory. These boards set and maintain the standards that protect the public they serve. As a result, licensing requirements and procedures vary by jurisdiction, so stay in touch with your board (ncees.org/licensing-boards).

Exam format
The PE Civil: Construction exam is computer-based. It contains 80 questions and is administered year-round via computer at approved Pearson VUE test centers. A 9-hour appointment time includes a tutorial, the exam, and a break. You have 8 hours to complete the actual exam.

In addition to traditional multiple-choice questions with one correct answer, the exam uses common alternative item types such as

- Multiple correct options—allows multiple choices to be correct
- Point and click—requires examinees to click on part of a graphic to answer
- Drag and drop—requires examinees to click on and drag items to match, sort, rank, or label
- Fill in the blank—provides a space for examinees to enter a response to the question

To familiarize yourself with the format, style, and navigation of a computer-based exam, view the video tutorials on the NCEES YouTube channel.

Examinee Guide
The NCEES Examinee Guide is the official guide to policies and procedures for all NCEES exams. During exam registration and again on exam day, examinees must agree to abide by the conditions in the Examinee Guide, which includes the CBT Examinee Rules and Agreement. You can download the Examinee Guide at ncees.org/exams. It is your responsibility to make sure you have the current version.

Scoring and reporting
Results for computer-based exams are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. All results are reported as pass or fail.

Updates on exam content and procedures
Visit us at ncees.org/exams for updates on everything exam-related, including specifications, exam-day policies, scoring, and corrections to published exam preparation materials. This is also where you will register for the exam and find additional steps you should follow in your state to be approved for the exam.
31. An activity and relationship list for construction of a garage is given below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Activity</th>
<th>Successors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Start</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Sitework</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Footer</td>
<td>4, 10</td>
</tr>
<tr>
<td>4</td>
<td>Framing</td>
<td>5, 6, 8, 9</td>
</tr>
<tr>
<td>5</td>
<td>Roof</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Sheathing</td>
<td>7, 11</td>
</tr>
<tr>
<td>7</td>
<td>Electrical</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>Plumbing</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Doors/windows</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>Slab</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>Exterior finish</td>
<td>13</td>
</tr>
<tr>
<td>12</td>
<td>Interior finish</td>
<td>13</td>
</tr>
<tr>
<td>13</td>
<td>Finish</td>
<td></td>
</tr>
</tbody>
</table>

Place each activity number in the correct location on the network diagram.
36. A concrete mix design is specified to be proportional as 1:1.6:3 by weight for cement, sand, and coarse aggregate, respectively. The mixture contains 6 gal of water per 100 lb of cement. The following data apply:

- Weight of cement = 100 lb
- 1 ft³ of volume = 7.48 gal
- 1 gal of water = 8.34 lb
- Specific gravity of sand/aggregate = 2.64

Based on the mix design, the yield (ft³) of concrete per 100 lb of cement is most nearly:

- A. 3.29
- B. 4.09
- C. 10.20
- D. 610.00

37. You have been asked by the owner of a marine ocean terminal for guidelines on a concrete mix to repair the concrete at the site. Of the following options, your suggestion should be:

- A. 6,000-psi concrete with 0.45 water-to-cementitious-materials ratio
- B. 6,000-psi concrete with 0.42 water-to-cementitious-materials ratio and added corrosion inhibitor
- C. 6,000-psi concrete with lightweight aggregate, 0.40 water-to-cementitious-materials ratio, and added corrosion inhibitor
- D. 6,000-psi concrete with 0.40 water-to-cementitious-materials ratio and added corrosion inhibitor
38. The concrete specifications for a project stipulate that the water/cement (w/c) ratio must be 0.42. Laboratory trial mixes have indicated 33 gal/yd³ of water will be required to produce concrete with the slump necessary for placement. The cement content (lb/yd³) required for the w/c ratio of 0.42 is most nearly:

- A. 115
- B. 590
- C. 655
- D. 870

39. A concrete mixture is revised to make a 20% replacement of cement with a Class F fly ash at a pound-for-pound substitution rate. Which of the following best describes the effect on set time and strength gain of the concrete mixture over the first 24 hours (early strength)?

- A. Sets faster with higher early strength
- B. Sets slower with higher early strength
- C. Sets faster with lower early strength
- D. Sets slower with lower early strength
53. The rational method must be used to determine the maximum runoff rate for a 90-acre downtown area. The time of concentration for the 50-yr frequency storm is 1 hr. Intensity-duration-frequency curves and a table of runoff coefficients are provided. The maximum runoff rate (cfs), based on the maximum runoff coefficient for a 50-yr storm, is most nearly:

- A. 160
- B. 220
- C. 300
- D. 340

<table>
<thead>
<tr>
<th>Description of Area</th>
<th>Runoff Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>0.70–0.95</td>
</tr>
<tr>
<td>Downtown areas</td>
<td>0.50–0.70</td>
</tr>
<tr>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>Single-family areas</td>
<td>0.30–0.50</td>
</tr>
<tr>
<td>Multiunits, detached</td>
<td>0.40–0.60</td>
</tr>
<tr>
<td>Multiunits, attached</td>
<td>0.60–0.75</td>
</tr>
<tr>
<td>Residential (suburban)</td>
<td>0.25–0.40</td>
</tr>
<tr>
<td>Apartment dwelling areas</td>
<td>0.50–0.70</td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
</tr>
<tr>
<td>Light areas</td>
<td>0.50–0.80</td>
</tr>
<tr>
<td>Heavy areas</td>
<td>0.60–0.90</td>
</tr>
<tr>
<td>Parks, cemeteries</td>
<td>0.10–0.25</td>
</tr>
<tr>
<td>Playgrounds</td>
<td>0.20–0.35</td>
</tr>
<tr>
<td>Railroad yard areas</td>
<td>0.20–0.40</td>
</tr>
<tr>
<td>Unimproved areas</td>
<td>0.10–0.30</td>
</tr>
<tr>
<td>Streets</td>
<td></td>
</tr>
<tr>
<td>Asphalt</td>
<td>0.70–0.95</td>
</tr>
<tr>
<td>Concrete</td>
<td>0.80–0.95</td>
</tr>
<tr>
<td>Brick</td>
<td>0.70–0.85</td>
</tr>
<tr>
<td>Drives and walks</td>
<td>0.75–0.85</td>
</tr>
</tbody>
</table>
67. The contract documents for a project do not specify the stripping time or stripping strength required for the removal of formwork. The contractor will use the guidance provided by ACI 347R-14 to determine the stripping time for several formwork elements on the project.

Select the three scenarios that are permissible in accordance with ACI 347R-14. For all cases, the structural live load is not greater than the structural dead load.

- □ A. Formwork for a wall that also supports beam soffit formwork with less than 10-ft clear span between structural supports will be removed after 12 hours.
- □ B. Formwork for a wall that also supports formwork for a one-way floor slab with 8-ft clear span between structural supports will be removed after 48 hours. The forms can be removed without disturbing the shoring.
- □ C. Formwork for a wall that also supports formwork for a one-way floor slab with 15-ft clear span between structural supports will be removed after 7 days. The forms can be removed without disturbing the shoring.
- □ D. Formwork for a wall that also supports formwork for a one-way floor slab with 18-ft clear span between structural supports will be removed after 5 days. The forms can be removed without disturbing the shoring.
- □ E. Formwork for a wall that also supports formwork for a one-way floor slab with 25-ft clear span between structural supports will be removed after 10 days. The forms can be removed without disturbing the shoring.
- □ F. Formwork for a wall that also supports formwork for a one-way floor slab with 22-ft clear span between structural supports will be removed after 6 days. The forms cannot be removed without disturbing the shoring.

68. Formwork is required for a 9-ft-high concrete wall. The rate of placement is estimated to be 15 ft/hr with normal internal vibration and vibrator immersion not exceeding 4 ft. The concrete to be used contains Type II cement and has a 6-in. slump after retarder is added. The concrete will be placed at a concrete temperature of 80°F and weighs 155 lb/ft³. The maximum design lateral concrete pressure (lb/ft²) based on ACI 347R-14 is most nearly:

- □ A. 1,302
- □ B. 1,395
- □ C. 1,461
- □ D. 1,561
69. A multistory concrete building is being constructed using two levels of shores and forms and two levels of reshores. Construction has been completed through Level 8 as shown in the figure. An analysis has been made to the step shown using the assumption that the shores and reshores are infinitely stiff, the slabs have equal stiffness, and the reshores are initially installed snug tight. Actual (or unfactored) loads and forces are expressed as a multiple of the typical floor dead load, D. The forms and shores combined weigh 0.10 D at each level installed, and the reshores weigh 0.05 D at each level installed. At the end of the previous operation shown, there is no worker live load. In the next operation, the forms and shores between Levels 6 and 7 are stripped, flown upward, and shored on top of Level 8 for re-erection. The load of workers imposed on Levels 6 and 8 during this next operation is 0.40 D on each. The reshores will be moved from between Levels 4 and 5 to between Levels 6 and 7 in the future operation.

As the operation to move the forms and shores from between Levels 6 and 7 to Level 8 is ending, but while the workers are still on the floor at Level 8, the load (D) carried by the floor at Level 7 is ___________.

Enter your response in the blank.
31. 

THE CORRECT ANSWER IS SHOWN.

32. Duration = \( \frac{420 \text{ fixtures}}{\left( \frac{1 \text{ fixture}}{20 \text{ min} \times 2 \text{ electricians}} \right) \times 6 \text{ electricians} \times 0.8 \times 60 \text{ min/hr} \times 8 \text{ hr/day}} \) 

   \[= 7.29 \text{ workdays}\]

THE CORRECT ANSWER IS: C

33. Network calculations are shown below. Since FF in E \( \geq 2 \text{ days} \), delay will not affect any other activity.

THE CORRECT ANSWER IS: A
36. The correct answer is: B

<table>
<thead>
<tr>
<th>Material</th>
<th>Ratio</th>
<th>Weight (lb)</th>
<th>Solid Density (lb/ft³)</th>
<th>Absolute Volume (ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>1</td>
<td>100</td>
<td>195</td>
<td>100/195 = 0.51</td>
</tr>
<tr>
<td>Sand</td>
<td>1.6</td>
<td>160</td>
<td>165</td>
<td>160/165 = 0.96</td>
</tr>
<tr>
<td>Coarse</td>
<td>3.0</td>
<td>300</td>
<td>165</td>
<td>300/165 = 1.82</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td>6/7.98 = 0.80</td>
<td>6/7.98 = 0.80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>4.09</strong></td>
<td></td>
<td><strong>4.09</strong></td>
</tr>
</tbody>
</table>

The correct answer is: B


A dense mix is best (low permeability; pp. 181 and 240). Low water–cement ratio (≤0.40) is required for seawater exposure (p. 240). Normal-weight aggregate is more dense than lightweight (p. 94). Corrosion inhibitors arrest the formation of rust (p. 131).

The correct answer is: D

38. Cement required for water/cement ratio of 0.42

   Water: 8.33 lb/gal

   \[
   33 \text{ gal/yd}^3 \times 8.33 \text{ lb/gal} = 275 \text{ lb of water per cubic yard}
   \]

   \[
   275 \text{ lb/yd}^3 / 0.42 = 654.8 \text{ lb of cement per cubic yard}
   \]

The correct answer is: C


Replacement of cement with fly ash (Class F) in a concrete mixture retards both set time (Table 3-9) and early strength gain (Table 3-10). Class F fly ash involves a secondary reaction and needs lime (byproduct of primary cement reaction) to react chemically in the mixture.

The correct answer is: D
52. According to the arithmetic mean method, the average precipitation is simply the average of all the rainfall gauges.

Average precipitation = \((2.1 + 3.6 + 1.3 + 1.5 + 2.6 + 6.1 + 5.1 + 4.8 + 4.1 + 2.8 + 3.0)/11\)  
= 3.4 in.

THE CORRECT ANSWER IS: A

53. From the IDF curve, read a rainfall intensity of 3.5 in./hr for a 50-yr frequency rainfall with a 60-min duration.

From the table, the runoff coefficient for a downtown area is 0.70–0.95. For the maximum runoff rate, use the high value of 0.95.

\[ Q = CiA = 0.95 \times 3.5 \text{ in./hr} \times 90 \text{ ac} \]

\[ Q = 300 \text{ cfs} \]

THE CORRECT ANSWER IS: C

54. Time = \(\frac{V}{Q}\)

\[ V = 400,000 \text{ gal} \times \frac{\text{ft}^3}{7.48 \text{ gal}} = 53,476 \text{ ft}^3 \]

\[ Q = 1.5 \text{ ft}^3/\text{sec} \]

Time = \(\frac{53,476 \text{ ft}^3}{1.5 \text{ ft}^3/\text{sec}} \times \frac{1 \text{ hr}}{3,600 \text{ sec}} = 9.9 \text{ hr} \)

THE CORRECT ANSWER IS: B

55. \(\tan(x) = \frac{40}{30} \quad x = 53.13^\circ\)

\(\cos(53.13^\circ) \times 100 \text{ ft} = 60 \text{ ft} \)

60 ft – 35 ft = 25 ft

THE CORRECT ANSWER IS: B
66. Type B soil has a maximum permissible slope of 1:1.

Therefore, a 12-ft depth requires a 12-ft distance.

Because there is a 5-ft perimeter strip, the minimum distance from the toe of the slope to the face of the structure = 12 ft + 5 ft = 17 ft.

THE CORRECT ANSWER IS: C


A. Not correct. While wall formwork can be removed at 12 hours, because it supports beam soffit formwork, the latter removal time should govern.

B. Not correct. While wall formwork can be removed at 12 hours, because it supports slab formwork, the latter removal time should govern. The forms can be removed without disturbing the shoring, so the time can be half the value shown in the table, but the time cannot be less than 3 days.

C. Correct. The forms can be removed after 7 days. Since the forms can be removed without disturbing the shoring, they could be removed after 3.5 days, but the stricter criterion is still acceptable.

D. Correct. The forms can be removed after 3.5 days (7 days/2 because the forms can be removed without disturbing the shoring).

E. Correct. The forms can be removed after 5 days (10 days/2 because the forms can be removed without disturbing the shoring).

F. Not correct. The forms can be removed after 10 days. The forms cannot be removed without disturbing the shoring so the time cannot be divided in half.

THE CORRECT ANSWERS ARE: C, D, E
68. Reference: ACI 347R, *Guide to Formwork for Concrete*, 2014, American Concrete Institute, Section 4.2.2.

Lateral pressure of concrete for placement rates of 7–15 ft/hr:

\[ C_{CP_{\text{max}}} = C_C C_w \left[ 150 + \frac{43,400}{T} + 2,800 \frac{R}{T} \right] \]

with a minimum of 600 \( C_w \), but in no case greater than \( w h \)

\[ p_{\text{max}} = (1.2) \left[ \frac{155}{145} \right] \left[ 150 + \frac{43,400}{80} + 2,800(15)/(80) \right] \]

\[ = (1.2)(1.069)(1,217.5) = 1,561 \text{ lb/ft}^2 \]

Check minimum \[ = 600 C_w \]

\[ = 600 \times 1.07 \]

\[ = 641 \text{ lb/ft}^2 \]

Check maximum \[ = w h \]

\[ = 155 \times 9 \]

\[ = 1,395 \text{ lb/ft}^2 \]

Therefore use the maximum of 1,395 lb/ft\(^2\) (cannot exceed a liquid head)

**THE CORRECT ANSWER IS: B**


<table>
<thead>
<tr>
<th>Load</th>
<th>Net change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carried by Floors 7 and 8 with shore removal from under Level 7</td>
<td>((1.50 \text{ D} – 0.10 \text{ D})/2 \text{ levels} = 0.70 \text{ D}) each</td>
</tr>
<tr>
<td>Carried by Floors 7 and 8 due to form storage on Level 8</td>
<td>(0.10 \text{ D}/2 \text{ levels} = 0.05 \text{ D}) each</td>
</tr>
<tr>
<td>Carried by Floors 7 and 8 due to worker live load on Level 8</td>
<td>(0.40 \text{ D}/2 \text{ levels} = 0.20 \text{ D}) each</td>
</tr>
</tbody>
</table>

The load carried by Floor 7 as operation indicated is nearing its end is:

\[ \text{Existing load} + \text{added load due to shore removal} + \text{added load due to stored forms} + \text{added load due to worker live load} \]

\[ = 0.70 \text{ D} + 0.70 \text{ D} + 0.05 \text{ D} + 0.20 \text{ D} \]

\[ = 1.65 \text{ D} \]

**THE CORRECT ANSWER IS: 1.65**