New Edition: Updated to 2015 Exam Design Standards

PE Civil Exam
Morning Session

E-book 120 solved problems for morning session

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2015 PE Exam Standard Specification

PE Civil Exam E- Book 120- Mix Questions & Answers (pdf Format)
For Breath Exam (Morning Session)
Breadth Exam (morning session): These practice exams contain 120 mixed questions and answers of five civil engineering areas. The five covered areas are construction, geotechnical, structural, transportation, and water resources & environment.

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**Total Number of Problems = 120**
I. Project Planning: Number of Questions- 12
A. Quantity take-off methods
B. Cost estimating
C. Project schedules
D. Activity identification and sequencing

1. PROBLEM (Quantity take-off methods)

A borrow pit contour elevation shown in the figure has to be cut. What is the average volume to be cut from the borrow pit?

![Borrow Pit Diagram]

a. $V=8330 \text{ yd}^3$
b. $V=5660 \text{ yd}^3$
c. $V=7530 \text{ yd}^3$
d. $V=4400 \text{ yd}^3$
1. **SOLUTION:**

   Volume, \( V=\sum h(i,j)n \times \frac{A}{(4\times 27)} \)

   \( h(i,j) = \) Height in ft above a datum surface at row \( i \) & column \( j \)

   \( n = \) Number of corners, \( A = \) Area of grid in ft\(^2\)

   Area of each grid, \( A = 60 \times 60 = 3600 \) ft\(^2\)

   \( V = \left[ ( \text{Height from BM} \times \text{No. of corners} + \ldots ) \right] \times \left[ \frac{A}{(4\times 27)} \right] \)

   \( V = \left[ (4 \times 1 + 5 \times 2 + 6 \times 2 + 9 \times 1 + 7 \times 2 + 5 \times 1 + 9 \times 2 + 8 \times 4 + 4 \times 1 + 7 \times 3 + 3 \times 1) \right] \times \left[ \frac{3600}{(4\times 27)} \right] \)

   \( = 132 \times \left[ \frac{3600}{(4\times 27)} \right] = 4400 \) yd\(^3\)

   Total Volume of Borrow pit, \( V = 4400 \) yd\(^3\)

   **The Correct Answer is:** (d)
20. **PROBLEM** (Temporary structures and facilities)

Determine the Factor of Safety for a braced cut in clay soil shown in Figure. Where, Length of braced cut, \( L = 15 \text{m} \), Clay soil, \( \gamma = 16 \text{kN/m}^3 \), \( N_c = 5.14 \), \( \phi' = 0^\circ \) and \( c = 40 \text{kN/m}^2 \).

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<tr>
<td>a</td>
<td>6.0</td>
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<tr>
<td>b</td>
<td>4.0</td>
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<tr>
<td>c</td>
<td>3.0</td>
</tr>
<tr>
<td>d</td>
<td>5.0</td>
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20. **SOLUTION:**

\[ L = 15 \text{m}, \quad B = 4 \text{m}, \quad \gamma = 16 \text{kN/m}^3, \quad N_c = 5.14, \quad c = 40 \text{kN/m}^2 \quad \text{and} \quad \phi' = 0^\circ \]

\[ B/\sqrt{2} = 4/\sqrt{2} = 2.828 > T = 2 \text{m} \]

Or, \( T = 2 \text{m} < B/\sqrt{2} = 2.828 \)

Hence, \( B' = T = 2 \text{m} \) and \( B'' = \sqrt{2}B' = 2.828 \) and surcharge, \( q = 0.0 \)

\[ F.S. = [N_c c((1 + 0.2B''/L) + cH/B')]/(\gamma H + q), \]

\[ F.S. = [5.14 \times 40 \{(1 + 0.2 \times 2.83/15) + 40 \times 5/2\} / (16 \times 5 + 0.0)] \]

\[ F.S. = 3.917 \]

**The Correct Answer is:** (b)
33. **PROBLEM (Bearing Capacity)**

Determine the ultimate load of a rectangular footing 6’ x 4’ with eccentric as shown in the Figure. Where, the Soil Unit Weight, \( \gamma = 118 \text{ lb/ft}^3 \), Ultimate Bearing Capacity, \( q'_u = 3000 \text{ lb/ft}^2 \), \( e_B = 1.5' \) and \( e_L = 1.75' \).

![Diagram of rectangular footing with eccentric loading]

**SOLUTION:**

Where, \( e_L / L = 1.75 / 6 = 0.292 > 1 / 6 \), and \( e_B / B = 1.5 / 4 = 0.375 > 1 / 6 \);
Therefore,

\[
B_1 = B(1.5 - 3e_B / B) = 4[(1.5 - (3 \times 1.5 / 4))] = 1.5 \text{ ft}
\]

\[
L_1 = L(1.5 - 3e_L / L) = 6[(1.5 - (3 \times 1.75 / 6))] = 3.750 \text{ ft}
\]

Effective Area, \( A' = 1/2(L_1B_1) = 1/2 (1.5 \times 3.750) = 2.81 \text{ ft}^2 \)

\[
q'_u = 3000 \text{ lb/ft}^2
\]

\[
Q_{ult} = A' \times q'_u = 2.81 \times 3000 = 8430 = 8.43 \text{ Kip}
\]

**Correct Solution is (c)**

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49. **PROBLEM (Deflection)**

Determine the deflection of the rectangular beam shown in the figure. A 20 Kips point load “P” is applied at its free end. Consider, concrete strength 3000 psi, cross-section of beam 10” x 16”.

![Diagram of a cantilever beam with a point load applied at the free end.]

a. - 1.60 in
b. - 2.50 in
c. - 3.64 in
d. - 5.2 in

49. **SOLUTION:**

Where, P=20 Kip, L=15 ft, B=10”, H=16” and
\[
E=57000 \sqrt{f_{c'}}=57000 \sqrt{3000}=3122018 \text{ psi}/1000=3122 \text{ Ksi}
\]
Moment of inertia, \( I=BH^3/12= 10 \times 16^3/12=3413 \text{ in}^4 \)
Deflection at the tip, \( \delta_{\text{max}}=-\frac{PL^3}{3EI} \)
\[
\delta_{\text{max}} =- \frac{20 \times (15 \times 12)^3}{[3(3122 \times 3413)]} = -3.64 \text{ in}
\]

The sign is negative, because the deflection is downward.

**The Correct Answer is: (c)**
83. **PROBLEM** (Basic vertical curve elements)

A vertical curve has required for ascending 3.5% and descending -1.5% grade, the design speed is 55 mph & the stopping sight distance is $S=495$ ft. Calculate the length of the vertical curve required for stopping sight distance.

A graphic illustrates a vertical curve with gradients $G_1=+3.5\%$ and $G_2=-1.5\%$.

a. 558.00 ft  
b. 458.00 ft  
c. 528.00 ft  
d. 568.00 ft

83. **SOLUTION:**

\[ A = G_2 - G_1 = -1.5\% - (+3.5\%) = -5\% = 5\% \]

Assume $S > L$, $S=495$ ft

\[ L = \frac{2S - 2158}{A} = 2 \times 495 - 2158 \div 5 = 558.4 \text{ ft} \]

And

$L > S$,

\[ L = \frac{AS^2}{2158} = 5 \times 495^2 \div 2158 = 567.71 \text{ ft} \] is the correct length.

**The Correct Answer is:** (d)
120. **PROBLEM** (Safety)

According to **OSHA**, which of the following should be considered for the maximum deflection of a platform when loaded?

a. The platform may not deflect more than $1/60$ of the span.
b. The platform may not deflect more than $1/50$ of the span.
c. The platform may not deflect more than $1/40$ of the span.
d. The platform may not deflect more than $1/30$ of the span.

120. **SOLUTION:**

The platform may not deflect more than $1/60$ of the span.

**The Correct Answer is: (a)**