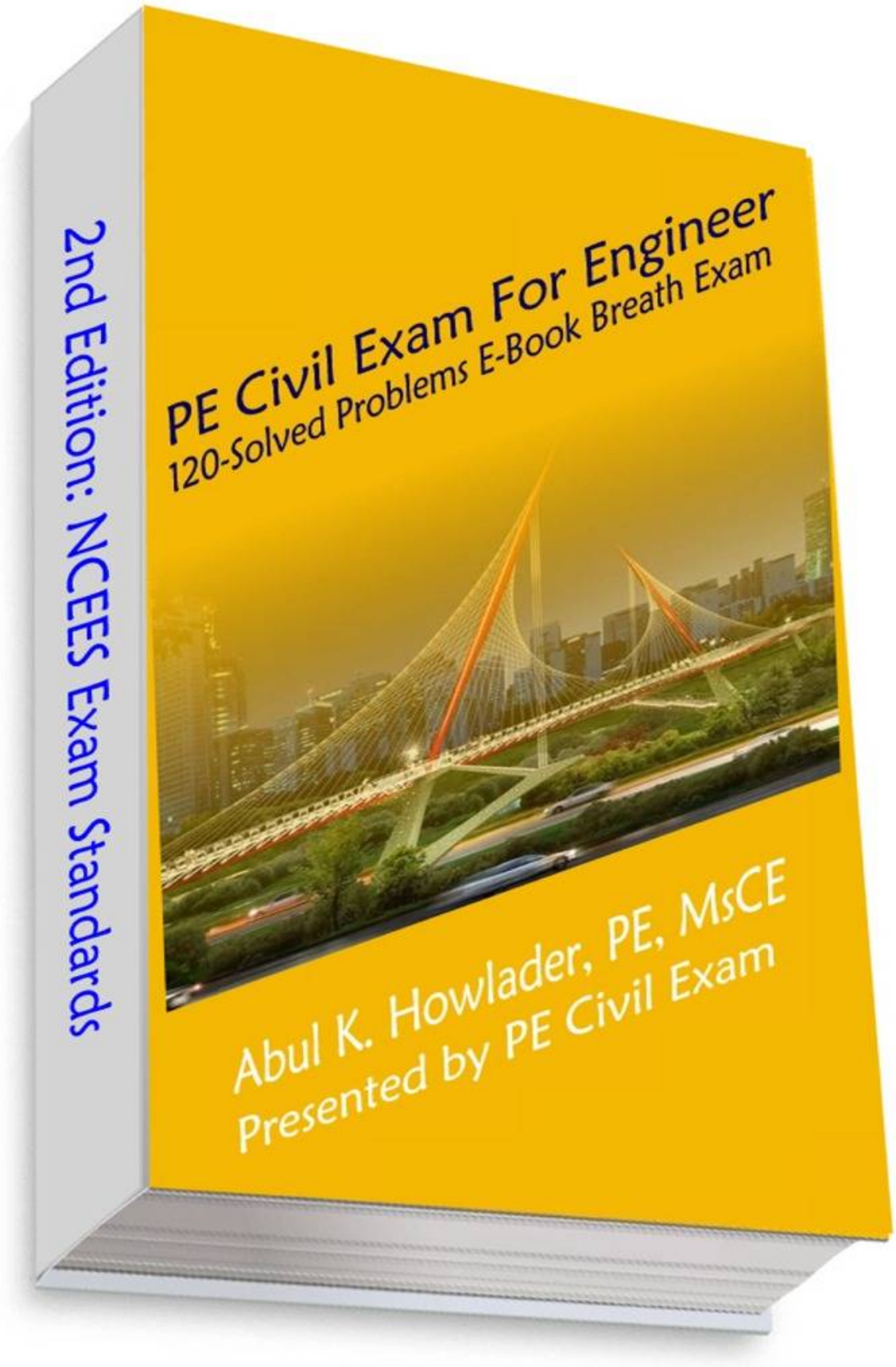


- Breadth Exam 120 solved Problems

PE Exam For Civil Engineer

120-Solved Problems E-Book Breath Exam (PDF Format)

Breadth Exam (morning session): This practice exam contains 120 mixed questions, and answers of five civil engineering areas. The five covered areas are construction, geotechnical, structural, transportation, and water resources & environment.

Table Contents:

Total Number of Problems =120

I. Project Planning: Number of Questions-12

A. Quantity take-off methods

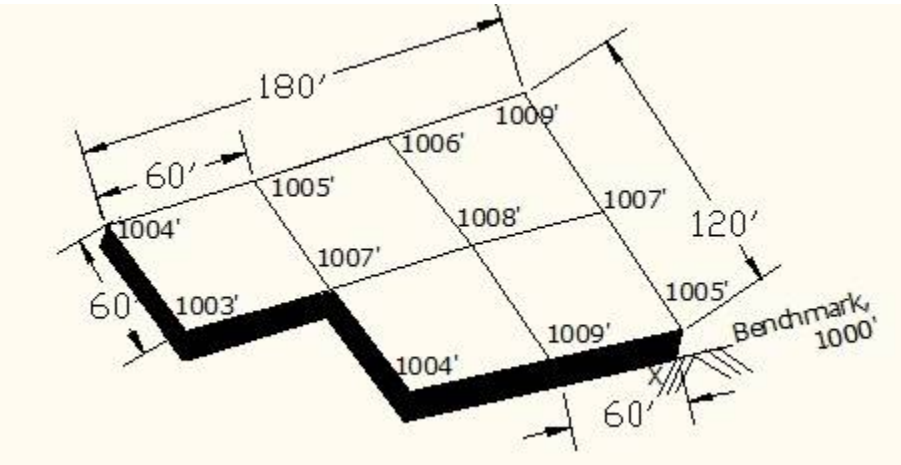
B. Cost estimating

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?



a. V=8330 yd^3

b. V=5660 yd^3

c. V=7530 yd^3

d. V=4400 yd^3

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1. **SOLUTION:**

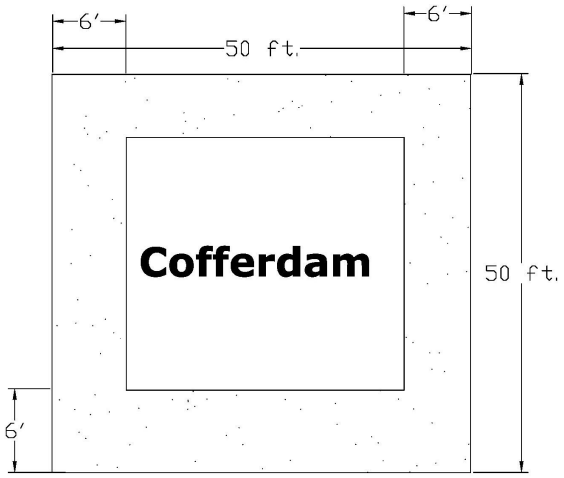
Volume, $V=\Sigma[h(i,j)n]x[A/(4x27)]$
h(i,j)= Height in ft above a datum surface at row i & column j
n=Number of corners, A= Area of grid in ft^2
Area of each grid, $A=60x60=3600\ ft^2$
V=[(Height from BM x No. of corners+…..)] x [(A/(4x27)]
V=[(4x1+5x2+6x2+9x1+7x2+5x1+9x2+8x4+4x1+7x3+3x1)] x [(3600/(4x27)]
$=132x\ [(3600/(4x27)]=4400\ yd^3$

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

The Correct Answer is: (d)

21. **PROBLEM** (Temporary structures and facilities)

A square cofferdam is 50 ft on each side, and it has been placed in the lake to allow for dry construction of a bridge pier. The cofferdam consists of two square sheets pile enclosure. The inner enclosure separated on all sides from the outer one by 6 ft. The bottom of the lake is practically impermeable. The space between sheet pile has filled with soil that resulted in a permeability of 0.035 ft/day in a laboratory test. Assuming the sheet pile was not water tight, and the lake surface was 20 ft above the lake bottom. How much water per day is to be pumped from the excavation to keep the cofferdam dry?



a Q =1645.00 gal/day
b Q =2653.00 gal/day
c Q =678.00 gal/day

d. Q =177.00 gal/day

21. SOLUTION:

Coefficient of permeability, k = 0.035 ft /day

Seepage Surface area,

$A=(50-12) \times 4 \times 20= 3040\ ft^2$

H=20 ft

L=6ft

i=H/L=20/6=3.33

$Q=VA=KiA=.035 \times 3.33 \times 3040=354.66\ ft^3/day$

$Q =354.66 \times 7.48=2652.90\ gal/day$ (1 ft^3=7.48 gal)

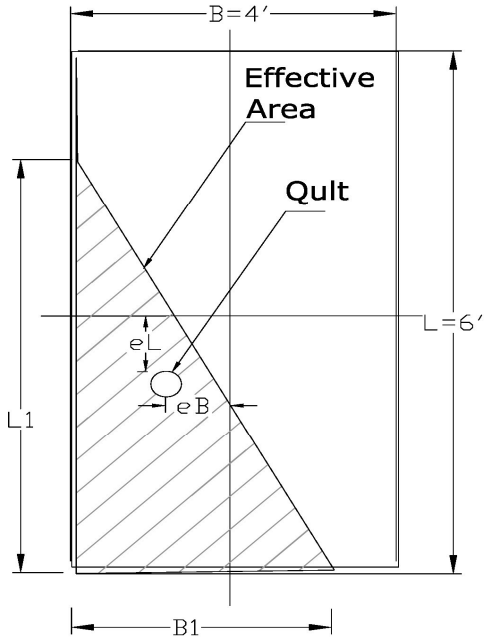
The Correct Answer is: (b)

III. Soil Mechanics: Number of Questions-18

A. Lateral earth pressure
B. Soil consolidation
C. Effective and total stresses
D. Bearing capacity
E. Foundation settlement
F. Slope stability

33. PROBLEM (Bearing Capacity)

Determine the ultimate load of a rectangular footing 6'x 4' with eccentric load as shown in the Figure. Soil Unit Weight, γ= 118 lb/ft^3, Ultimate Bearing Capacity, q'_u=3000 lb/ft^2, eB=1.5' and eL=1.75'.



a 12.5 Kip
b 48.5 Kip
c 8.5 Kip
d 31.0 Kip

33. SOLUTION:

Where, eL/L=1.75/6= 0.292> 1/6, and eB/B=1.5/4= 0.375>1/6;
Therefore,
B1=B(1.5-3eB/B)= 4[(1.5-(3 x 1.5/4)]= 1.5 ft
L1=L(1.5-3eL/L)= 6[(1.5-(3 x 1.75/6)]= 3.750 ft
Effective Area, A'=1/2(L1B1)=1/2 (1.5 x 3.750)= 2.81 ft^2
q'_u=3000 lb/ft^2
∴ Q_{ult}= A'x q'_u= 2.81 x 3000= 8430=8.43 Kip

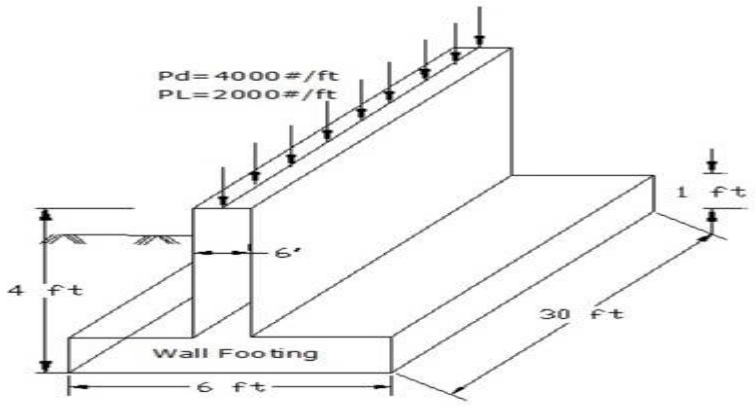
Correct Solution is (c)

IV. Structural Mechanics: Number of Questions-18

A. Dead and live loads
B. Trusses
C. Bending (e.g., moments and stresses)
D. Shear (e.g., forces and stresses)
E. Axial (e.g., forces and stresses)
F. Combined stresses
G. Deflection
H. Beams
I. Columns
J. Slabs
K. Footings
L. Retaining walls

41. PROBLEM (Dead and live loads)

A wall 6" thick is shown in the Figure. Calculate the total design load per linear ft on the footing, where unit weight of concrete is 145 lb/ft^3 and soil weight is neglected.



a. 7680.0 lb/ft
b. 10678.0 lb/ft
c. 9305.0 lb/ft
d. 8405.0 lb/ft

41. SOLUTION:

Where,
L=30 ft
W_{LL}=2000 lb/ft
W_{DL}=4000 lb/ft
Dead load of the footing per linear ft,
Dwall=[6x1+0.5x(4-1)]x145=1087.5 lb/ft
Total Dead load per linear ft, W_{TDL}=4000+1087.5=5087.5 lb/ft
Considering LRFD Load Combinations
∴ Design load, W=1.2D + 1.6L=1.2x5087.5+1.6x2000.0=9305.0 lb/ft

The Correct Answer is: (c)

V. Hydraulics and Hydrology: Number of Questions-21

A. Open-channel flow

B. Stormwater collection and drainage (e.g., culvert, Stormwater inlets, gutter flow, street flow, storm sewer pipes)

C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)

D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)

E. Detention/retention ponds

F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)

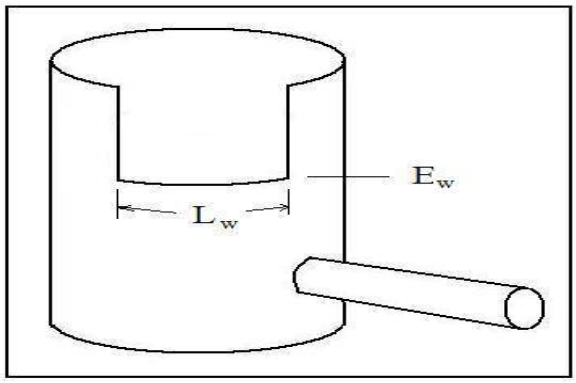
G. Energy and/or continuity equation (e.g., Bernoulli)

71. PROBLEM (Detention/retention ponds**)**

A detention pond with a single stage weir outlet flow control is shown in the Figure-A. Water elevation at design volume is 6.0 ft, Weir crest elevation is 3.0

ft, Pre-development peak runoff rate 12 ft^3/sec and Weir coefficient 3.0. Calculate the weir length.

a. 1.20 ft
b. 0.55 ft
c. 0.77 ft
d. 0.25 ft



Weir Outlet Flow Control Parameters

(Figure-A)

71. SOLUTION:

Given,

Water elevation at design volume, Es= 6.0 ft

Weir crest elevation, Ew=3.0 ft

Pre-development peak runoff rate, qpq= $12ft^3/s$ and

Weir coefficient, Cw= 3.0.

Equation for Outlet Flow Control Design with a Weir.

Weir length, $Lw = qpb/[Cw(Es - Ew)^{1.5}]=12/[3.0(6.0-3.0)^{1.5}]$

L_W=0.77 ft

The Correct Answer is: (c)

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VI. Geometrics: Number of Questions-9

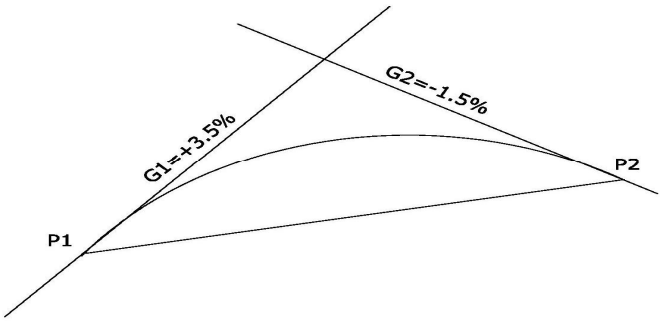
A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)

B. Basic vertical curve elements

C. Traffic volume (e.g., vehicle mix, flow, and speed)

83. PROBLEM (Basic vertical curve elements)

A vertical curve has an ascending slope of 3.5% and a descending slope of-1.5%, 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. 558.00 ft
b. 458.00 ft
c. 528.00ft
d. 568.00 ft

83. SOLUTION:

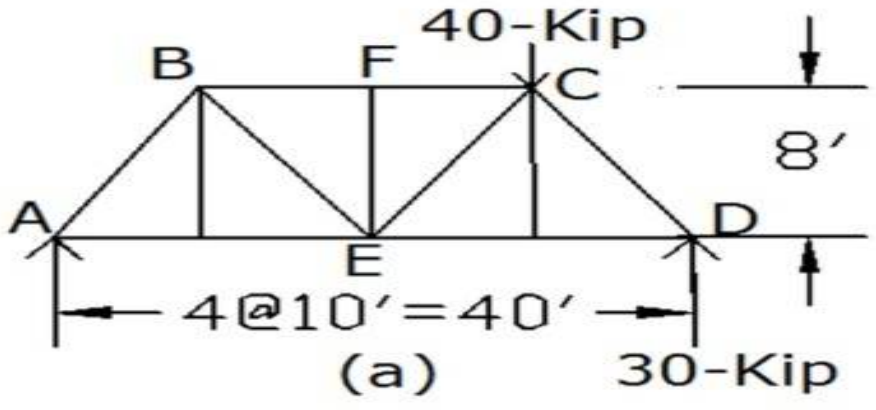
A=G2-G1= -1. 5% -(+3.5%)= -5%=5%
Assume S>L, S=495 ft
L=2S-2158/A=2 x 495-2158/ 5= 558.4 ft
And
L>S,
$L=AS^2/2158=5 \times 495^2/2158=$ 567.71 ft is the correct length.
The Correct Answer is: (d)

VII. Materials: Number of Questions-18
A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

99. PROBLEM (Structural steel)

A steel truss is shown in the Figure (a). Calculate the member force of BE.

a. 40 Kip
b. 16 Kip
c. 10 Kip
d. 12 Kip



99. SOLUTION:

Taking Moment at D, $\Sigma M = Ax40 - 40x10 = 0$

Reaction at A=10 K.

A free body diagram Figure (b),

Taking Moment at E, $\Sigma M = 30x20 - 40x10 - BFx8 = 0$

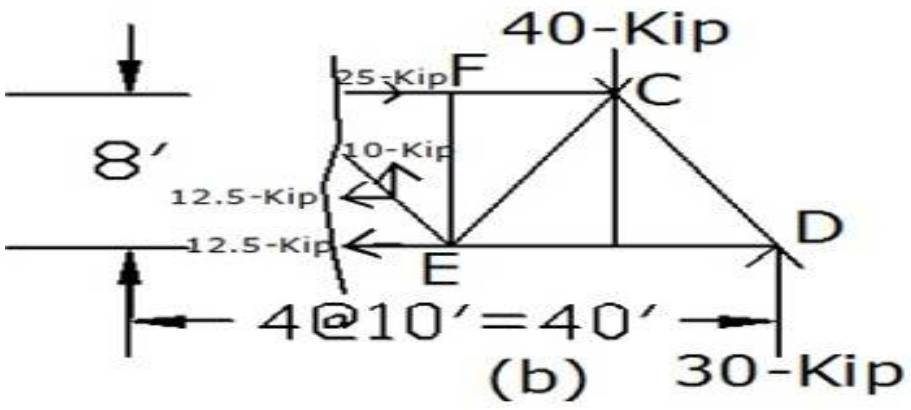
Member Force of BF=25 K.

Taking Moment at B, $\Sigma M = -10x10 - 40x30 + 30x40 - AEx8 = 0$

Member Force of AE=12.5 K.

Sum of Horizontal force, $BE_h = 25.0 - 12.5 = 12.5$ K

Member force of $BE = \sqrt{(12.5^2 + 10^2)} = 16$ K



The Correct Answer is: (b)

VIII. Site Development: Number of Questions-15

A. Excavation and embankment (e.g., cut and fill)

B. Construction site layout and control

C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel /outlet protection)

D. Impact of construction on adjacent facilities

E. Safety (e.g., construction, roadside, work zone)

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)

----------END----------