
3rd Edition 2022 Exam Design Standards
PE Civil Exam E-Book
120-Breath Solved Problems-CBT
Construction
Transportation
Geotechnical
WR&E
Structural
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Presented by PE Civil Exam

PE Exam For Civil Engineer

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

Beginning in 2022, the PE Civil exams are Computer Based Test (CBT) 80 questions and 8 hours to complete. Questions 1 to 40 are the breadth exam and are the same in all five (construction, geotechnical, structural, transportation, and water resources & environment) areas. Questions 41 to 80 are the depth portion of the exam-specified discipline. All 80 questions are mixed with multiple-choice, point-and-click, drag-and-drop, and fill-in-the-blank.

The exam is computer based closed book with electronic references. You can sign up and download the NCEES PE Civil Reference Handbook. This reference handbook is included in the exam along with the design standards. These practice books can guide you step by step of the NCEES PE Civil Reference Handbook.

The information below contains NCEES PE Civil design standards for 2022 exams.

**The exam topics have not changed since April 2015 when they were originally published. (Ref. NCEES)

- Construction
- Geotechnical
- Structural
- Transportation
- Water Resources and Environmental

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.

Total Number of Problems =120

1. Project Planning: Number of Questions-12

A. Quantity take-off methods

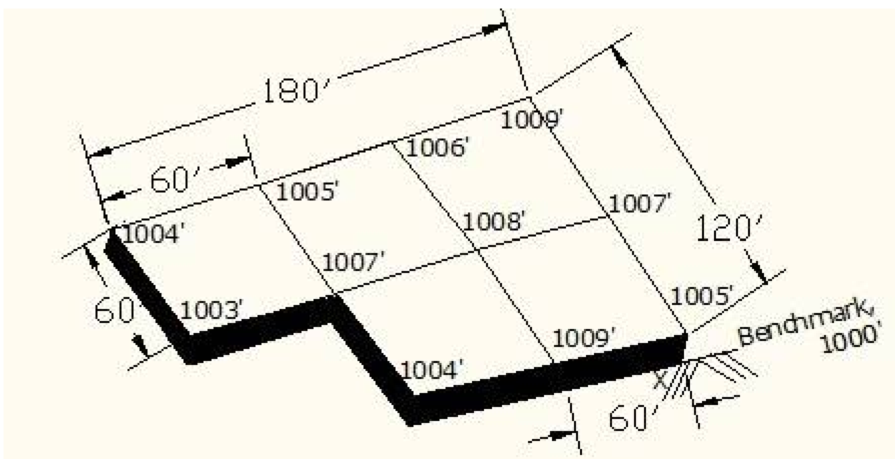
B. Cost estimating

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. $V = 4400\ yd^3$

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=[(4’x1+5’x2+6’x2+9’x1+7’x2+5’x1+9’x2+8’x4+4’x1+7’x3+3’x1)] x
[(3600/(4x27)]

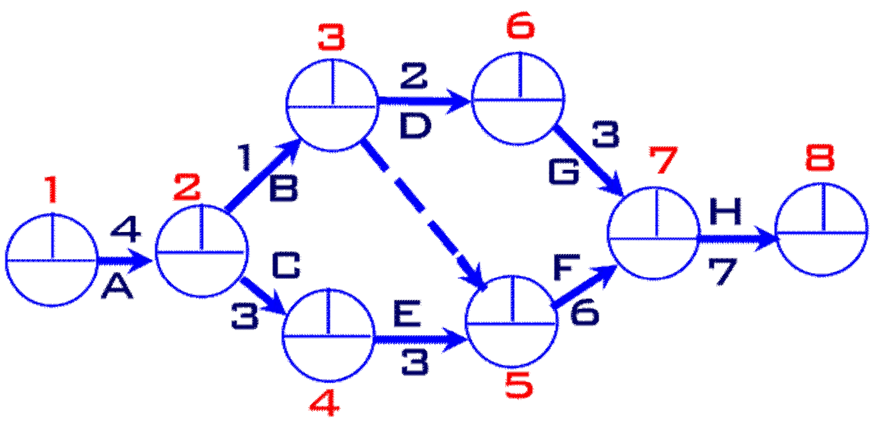
=132x [(3600/(4x27)]=4400 yd^3

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

The Correct Answer is: (D)

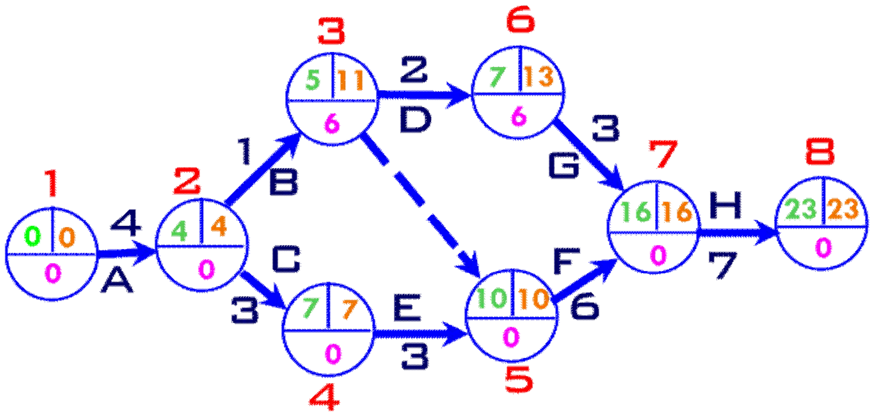
8. PROBLEM (Project schedule**)**

The flow net of activityof a project is shown in Figure. The duration of the activities is written along their arrows. What is the critical path of the activities?



- A. 1-2-4-5-7-8
- B. 1-2-3-6-7-8
- C. 1-2-3-5-7-8
- D. 1-2-4-5-3-6-7-8

8. SOLUTION:



The critical path of the activities are, 1-2-4-5-7-8.

Arrow Diagramming Method Calculation Steps:

Step 1: Forward pass calculation

Step 2: Backward pass calculation

Step 3: Float calculation for each Activity

The critical path is the longest path in the network diagram and the total float of critical path is zero

The Correct Answer is: (A)

2. Means and Methods: Number of Questions-9

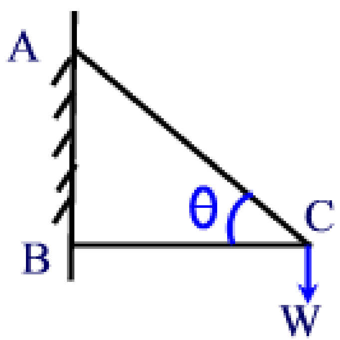
A. Construction loads

B. Construction methods

C. Temporary structures and facilities

14. PROBLEM (Construction loads)

The force induced in the string AC due to the load W, as shown in the Figure. Which of the following formula is correct?



- A. W x Sin⊖
- B. W x Cos⊖
- C. W x tan⊖
- D. W x Cosec⊖
- E. W x Cot⊖

14. SOLUTION:

String AC Force= W x Cosec⊖=W x (1/Cos⊖)

The Correct Answer is: (D)

3. Soil Mechanics: Number of Questions-18

A. Lateral earth pressure

B. Soil consolidation

C. Effective and total stresses

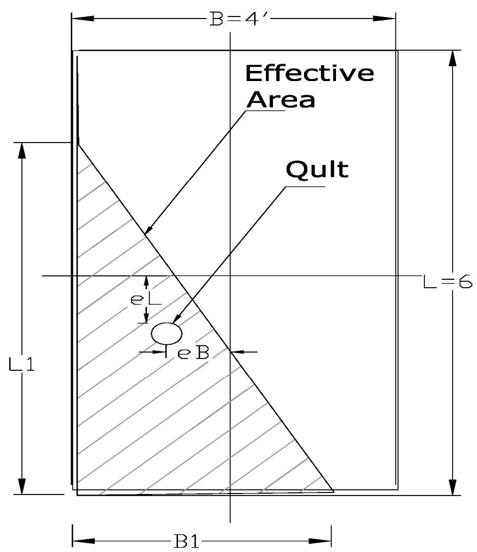
D. Bearing capacity

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 Figure. Soil Unit Weight, $\gamma = 118$ 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

$\therefore$ Q_{ult}= A'x q'_u= 2.81 x 3000= 8430=8.43 Kip

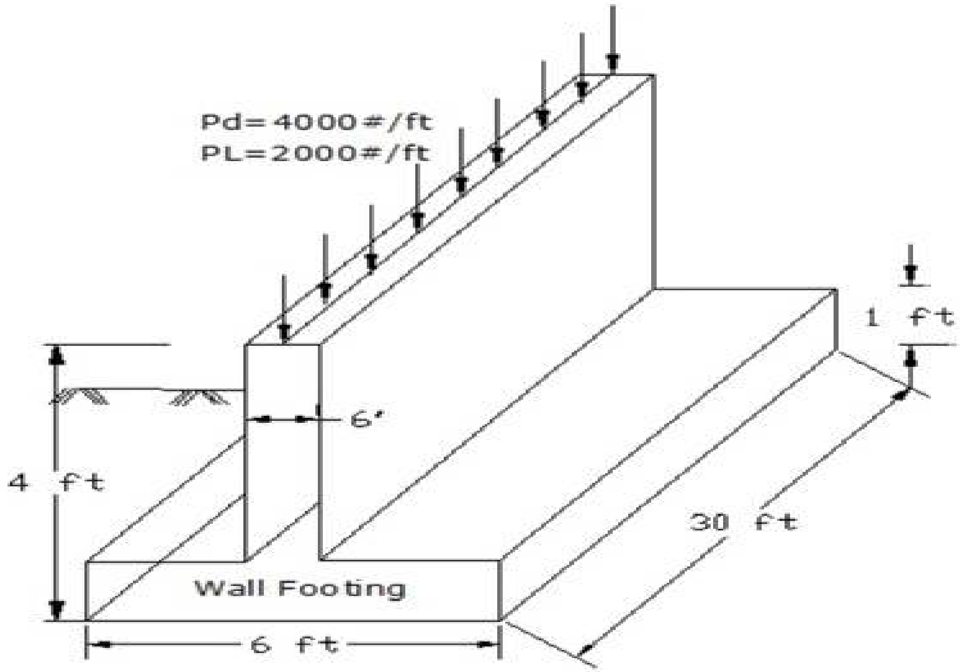
Correct Solution is (C)

4. 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 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)

5. 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)

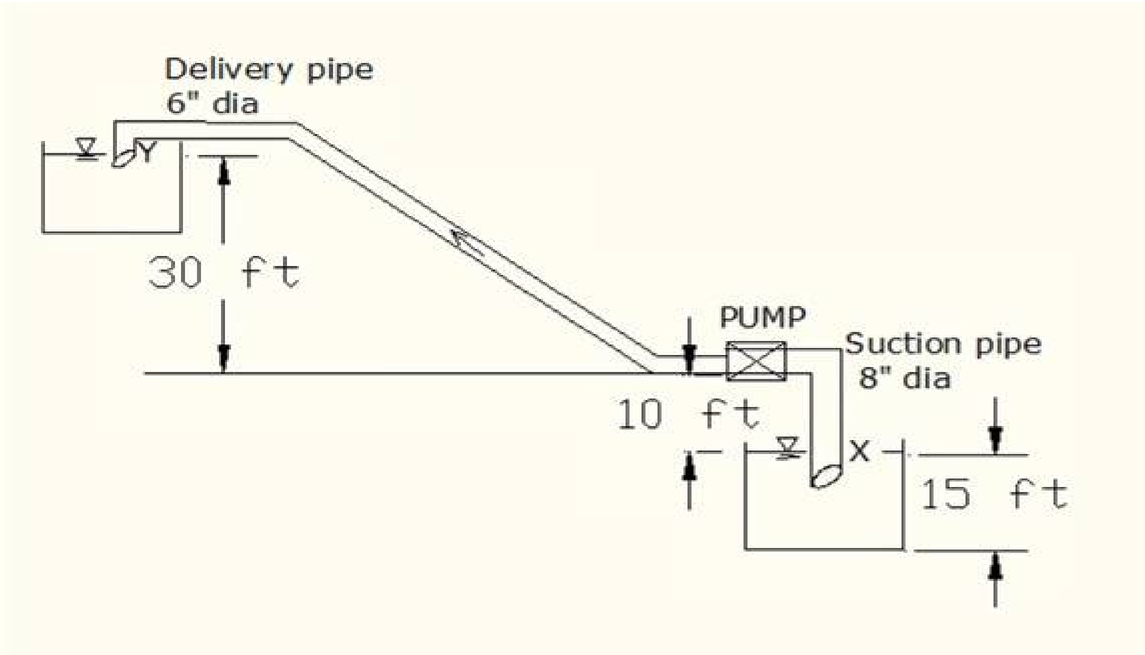
E. Detention/retention ponds

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)

77. PROBLEM (Bernoulli)

What is the total head at point Y from base of the bottom reservoir datum? The pump discharge is $5.0 ft^3/sec$, where $\gamma_w = 62.4$ lb/ ft^3 and the Specific Gravity of Mercury=13.6.



- A. 65.0 ft
- B. 55.0 ft
- C. 40.0 ft
- D. 75.0 ft

77. SOLUTION:

Where, Q= 5.0ft^3/sec

Pressure head=P/ϱ.g, Velocity Head=V^2/2g, Elevation Head=z

Total Head point, Y=z+ Vy^2/2g+ Py/ϱ.g

Velocity for delivery Pipe, Vy=Q/A=Q/[π/4(d^2)]

= 5/[(3.14/4)(6/12)^2]=25.47 ft/see

Total Head at Point Y= z+ Vy^2/2g+ Py/ϱ.g

=(15+10+30)+(25.47)^2/(2x32.2)+0=65.0 ft

The Correct Answer is: (A)

5. Geometrics: Number of Questions-9

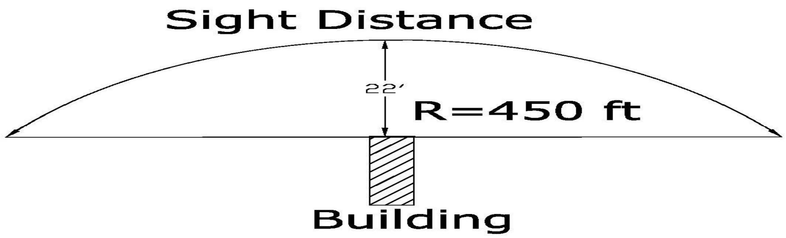
A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)

B. Basic vertical curve elements

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

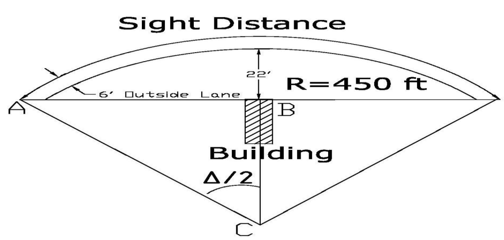
80. PROBLEM (Basic circular curve elements)

A two-lane highway has a center line shown in Figure. A car was passing by near a building, and the building is 22 feet from the center on the highway. Determine the sight distance for the driver in the outside lane, where each lane is 12 ft wide.



- A. 240 ft
- B. 320 ft
- C. 260 ft
- D. 300 ft

80. SOLUTION:



BC=450-22=428 ft

AC=450 + 6=456 ft (For the driver in outside lane)

$\text{Cos}\Delta/2 = BC/AC = 428/456$

$\Delta/2 = 20.18$, $\Delta = 2 \times 20.18 = 40.37$

$D = 2 \times AC = 2 \times 456 = 912$

$\text{Arc}/\Delta = \pi D/360$

$\text{Arc} = \Delta\pi D/360 = 40.37 \times 3.14 \times 912 / 360 = 321.13$ ft

Sight Distance, S= 321.13 ft

The Correct Answer is: (B)

7. 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

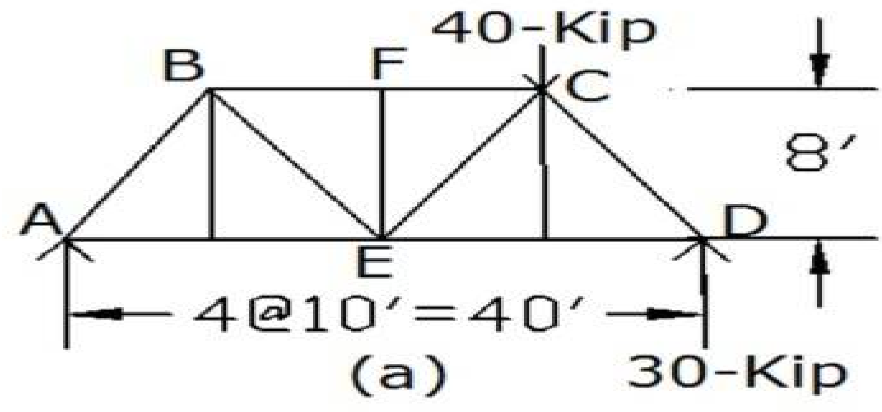
E. Material test methods and specification conformance

F. Compaction

99. PROBLEM (Structural steel)

A steel truss is shown in 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, $\Sigma M = A x 40 - 40 x 10 = 0$

Reaction at A=10 K.

A free body diagram Figure (b),

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

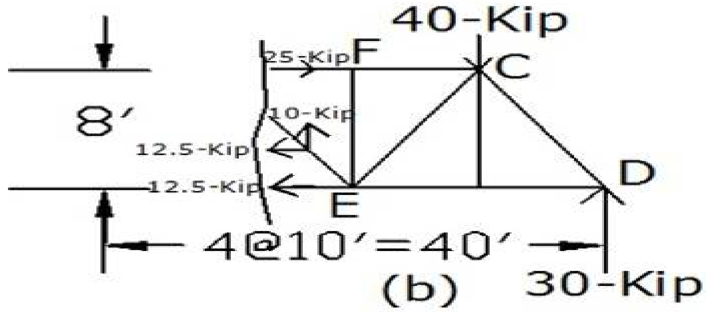
Member Force of BF=25 K.

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)

104. PROBLEM (Soil Compaction)

The ----------- is most effective compaction method for clayey soils.

A. Pneumatic Rubber-Tired Roller
B. Sheepsfoot Roller
C. Smooth –Wheel Roller
D. Vibratory Roller

104. SOLUTION:

Sheepsfoot Rollers are the most effective compaction method for clayey soils.

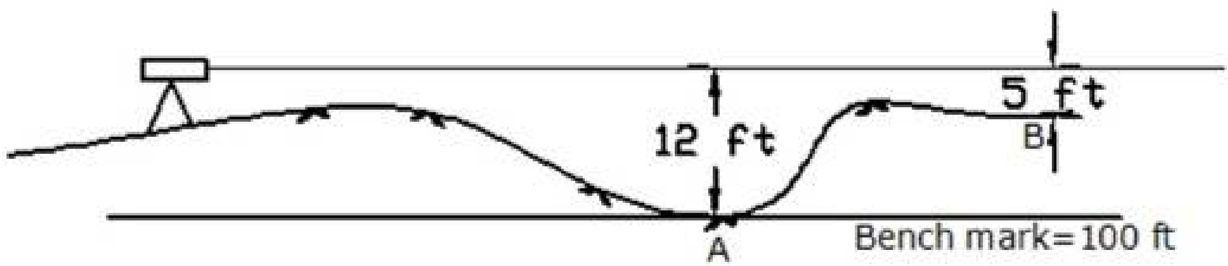
The Correct Answer is: (B)

8. 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)

111. PROBLEM (Construction site layout and control)

What is the elevation of point B of the following surveying profile figure?

- A. 105.0 ft
- B. 88.0 ft
- C. 112.0 ft
- D. 107.0 ft



111. SOLUTION:

Elevation of level sight=100.0 ft + 12.0ft = 112.0 ft
Elevation at point B, 112 ft – 5.0 ft = 107.0 ft

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)

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