

Four Practice Exams for PE Civil

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Preface

Beginning January 2015, the National Council of Examiners for Engineering and Surveying (NCEES) changed the Civil Engineering Specification for Civil PE exam. Now Civil PE are offered in the following Disciplines;

Transportation Construction
Structure Geotechnical
Engineering Water Resource and
Environmental

Each discipline is divided to two areas of breadth and Depth. The

breadth part is common for all disciplines and includes the following specifications.

a) Project Planning b) Means and Methods c) Soil Mechanics d) Structural Mechanics e) Hydraulics and Hydrology f) Geometrics g) Materials h) Site Development

In this book we have presented four Style PE Civil Practice exam to prepare you for the breadth part of exam. Problems in each specification have been separated. This way you may concentrate on your area of strength if you want to.

I hope you find this book helpful for passing the PE Civil exam.

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Practice Exams PE Civil Exam

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Practice Problems PE Style Exam (AM)

First PE Style Exam (AM) Questions

1

Practice Problems PE Style Exam (AM)

1) Find the remaining amount of soil after excavation and embankment in cubic yard considering swell coefficient as 0.26 and shrinkage coefficient as 0.1.

A) 32 B) 47 C) 78 D) 62

2

**STA
12+10**

Fill = 50 cf, C=0
cf

**STA
12+40**

Fill= 0, C= 60
cf

**STA
12+70**

Fill = 35 cf, C=20
cf

Practice Problems PE Style Exam (AM)

@seismicisolation
@seismicisolation

2) Find the elevation of BM2 if the following readings are given if the elevation of BM1 is 01+30:

Station BS FS

BM1 3.3

TP 2.4 1.5

BM2 1.2

A) 1+30 B) 1+31.2

C) 1+33 D) 1+31.8

3) For the pre-cast concrete bridge box girder which one is the most likely closer to the required volume of concrete for one box? Thickness is 8" for two sides and bottom chord and 4" for the top chord. Each corner has 3 by 3 inches hunches. Length of bridge is given equal to 200'

A) 1500 cf

B) 1000 cf

C) 1825 cf

D) 1250 cf

4) Which one of these 4 cost functions shows more increasing in rate of expenses over the time? (Horizontal axis shows time and vertical axis shows costs.)

A) B) C) D)

Practice Problems PE Style Exam (AM)

5) For the following paths find the critical path using the CPM?

A) 44 B) 48

C) 60 D) 64

6) A dump-hauler has a purchase price of \$109,000. Freight for delivery is \$5000. Tires are an additional 25,000 with the estimated life time of 4500 hours. The hauler expected to operate 1500 hours annually and for 11 years. Maintenance fees for the hauler is estimated at \$18000. What is the before-tax estimated hourly cost of operation excluding operator labor cost?

A) 35 B) 41

C) 23 D) 15

7) How many 4 by 8 in samples required for a 7000 sf shear wall with 180 cy³ of concrete?

A) 2 specimens

B) 3 specimens

C) 4 specimens

D) 5 specimens

Practice Problems PE Style Exam (AM)

Activity Time A. 4 weeks
 B. 16 weeks
 C. 8 weeks
 D. 24 weeks
 E. 28 weeks
 F. 4 weeks
 G. 8 weeks
 H. 4 weeks

Practice Problems PE Style Exam (AM)

8) For the wall form work, if the height of wall is equal to 10 ft. and the distance between inclined supports is 3 ft. find the force in the support assuming the 45 degree angle for it.

A) 7500 lb.

B) 10607 lb.

C) 1500 lb.

D) 150 lb.

9) If the maximum moisture content is given equal to 17% and specific gravity of soil is given equal to 2.67 find the dry density according to the modified proctor test procedure.

A) 125 pcf

B) 95 pcf

C) 115 pcf

D) 150 pcf

10) In the temporary structure in the referred picture if the soil is un-drained stiff clay

which one is correct?

A) Soil pressure has a uniform distribution. B) Soil pressure has a trapezoidal form C) Soil pressure is triangular and the maximum pressure is at base. D) Soil pressure is triangular and the maximum pressure is at top.

6

Practice Problems PE Style Exam (AM)

11) Which one of the following compactors shall be used for the compaction just behind the retaining wall?

A) A) sheepsfoot compactor B) Smooth drum B) C) Small plate compactor D) pneumatic

12) A fine grained soil has a Liquid Limit (LL) of 70% and a Plasticity limit (PL) of 30%. The soil can be classified as:

A) CL
B) CI
C) CH
D) MI

13) For a fully braced retaining wall in the basement of a 10 stories building, which formula will give the pressure at the bottom of the wall. (Height of wall is equal to 10 ft.)

A) $P = \text{Soil density} \times 10 \times K_a$ (active soil pressure) B) $P = \text{Soil density} \times 10 \times K_0$ (at rest soil pressure) C) $P = \text{Soil}$

density * 10 * K_p (passive soil pressure) D) P= Soil
density * 10 * K_a (active soil pressure) * 10/2

7

Practice Problems PE Style Exam (AM)

14) The ground water level is at 9ft. below ground. What is the total stress at 15 ft. below ground? Consider a footing on top layer with the width of 10 ft. which makes a pressure of 150 psf. Use both figures to find the pressure.

- A) 2200 psf
- B) 1778 psf
- C) 1200 psf
- D) 1860 psf

8

ft

ft

Practice Problems PE Style Exam (AM)

15) A soil sample has 30% passing the No. 4 sieve and 10% passing the No. 200 sieve. The coefficient of uniformity is greater than 4. Classify the soil according to the Unified Soil Classification System.

- A) SP-SM
- B) SW-SM
- C) SP D)
- GW

16) For the shown footing, find the maximum compressive stress. ($P = 1000$ lb. $M = 500$ lb-ft. $B = D = \text{width of footing} = 9$ ft.)

- A) 20.3 psf

- B) 8.2 psf
- C) 16.5 psf
- D) 12.3 psf

17) Referring to the figure, find the maximum tension force at the bottom chord if the force is equal to 1000 lb. the length of span is 20 ft.(4@5'), and height of the truss is given equal to 5 ft.

- A) 1200 N
- B) 1000 N
- C) 5000 N
- D) 2000 N

18) Which model has just compressive force in the diagonal members?

- A) Warren and roof trusses
- B) Howe truss C) K and
Warren trusses D) Pratt
truss

19) If a design engineer wants to use one of the following sections as a simple beam on the sloped roof, which section(s) may give a better results?

- A) I section B) Z and angle
sections C) I and channel sections
- D) Channel, Z, and Angle sections

Practice Problems PE Style Exam (AM)

20) For the beam in the referred picture find the maximum bending moment at the mid-span.

- A) 6 KN-m B)
- 16.6 KN-m C)
- 14.3 KN-m D)
- 8.3 KN-m

21) What is the ratio between plastic section modulus and elastic section modulus and (shape factor) for the rectangular section as follows:

- A) 1.5
- B) 1.33
- C) 2 D)
- 1.7

22) A contractor need to make a concrete with target strength of 4 KSI and 0.5KSI as standard deviation. What should be the average of compressive strength tests for the concrete mix design?

- A) 4.7 KSI
- B) 3.3 KSI
- C) 4.1 KSI
- D) 4.0 KSI

23) Concrete curing shall be maintained above 50 °F and in a moist condition for at least:

- A) 3 days after placement.
- B) 10 days after placement.
- C) 15 days after placement.
- D) 7 days after placement.

24) Find the maximum bending moment on a beam with the length of 20 ft. for the two 2000 lb. moving load (crane wheels) with the distance of 4 ft.

- A) 20000 lb-ft
- B) 16000 lb-ft
- C) 19200 lb-ft
- D) 18000 lb-ft

25) If the PVC station of 100+00 at 59 ft. elevation is connected to the PVT station at 104+00 referring to the following figure, find the station of the crest.

- A) 101+23 ft.
- B) 102+00 ft.
- C) 101+50 ft
- D) 101+15 ft.

26) A car is traveling at 50 mph in a county at night on a steep wet road with 6% uphill slope. Find the stopping sight distance.

- A) 300 ft.
- B) 389 ft.
- C) 112 ft.
- D) 241 ft.

27) In a close traverse, what is the bearing of NC?

- A) S5E
- B) N85W
- C) S85E
- D) N5W

28) A horizontal curve is designed with a 1500 ft. radius. The tangent length is 400 ft. and the PT station is 20+00. Find the length of the curve?

- A) 382 ft.
- B) 540 ft.
- C) 420 ft.
- D) 781 ft.

29) In the following intersections layouts, which one is strongly recommended in the both urban and the rural areas for the local road or street.

A B C D

30) A district road with a bituminous pavement (friction coefficient=0.16) has a horizontal curve of 700 ft. If the design speed is given equal to 45 mph find the super-elevation. A) 3% B) 5% C) 7% D) 9%

31) Degree of curve is

A) Equal to the interior angle. B) Bearing of the curve. C) Defined in degree. D) Proportion to the reciprocal of the radius.

32) Spiral (transition) curves

A) are never used. B) have a particular radius. C) are used to produce a transition between two tangents. D) are used to produce a gradual transition from tangents to circular curve.

33) Which one has more pressure at the depth of h?

A) B) C)

D) They have equal pressure

34) A 3h storm over a 150 km^2 area produces a total runoff volume of $7 \times 10^6 \text{ m}^3$ With a peak discharge of $360 \text{ m}^3/\text{Sec}$. What is the total excess precipitation?

- A) 1.4 cm
- B) 2.6 cm
- C) 3.6 cm
- D) 4.6 cm

35) A 3h storm over a 150 km^2 area produces a total runoff volume of $7 \times 10^6 \text{ m}^3$ with a peak discharge of $360 \text{ m}^3/\text{Sec}$. find the unit hydrograph discharge?

- A) $78 \text{ m}^3/\text{s.cm}$
- B) $120 \text{ m}^3/\text{s.cm}$
- C) $210 \text{ m}^3/\text{s.cm}$
- D) $260 \text{ m}^3/\text{s.cm}$

Practice Problems PE Style Exam (AM)

36) What is the flow rate for a street V channel finished (clean) concrete channel with a width of 1', channel slope of 0.5%, with a "normal" water depth of 0.5'?

- A) 0.55 cfs
- B) 1.20 cfs
- C) 0.25 cfs
- D) 2.41 cfs

37) Rainfall intensity is

- A) The amount of precipitation per second.
- B) The runoff after a rainfall.
- C) The amount of precipitation per hour.
- D) The design storm.

38) What is the definition According to the US environment protection (EPA) which area needs permit for the land disturbing and it will called as "disturb"?

- A) 10 or more acres
- C) 1 or more acres
- B) 100 or more acres
- D) 1000 or more acres

39) 8 MGD (million gallon per day) of water flows into the new schedule-40 steel pipe network as shows below. Find the rate of flow in the upper branch.

8", L=200', C80
D=8", L=150

4", L= 100, C=100

- A) 1.1 MGD
- B) 6.2 MGD
- C) 5.0 MGD
- D) 1.95 MGD

1
7

Practice Problems PE Style Exam (AM)

40) In a drainage project for an underground subway station if the required amount of well drawdown is 3 ft. in the 50 ft. depth of the aquifer. The hydraulic conductivity is given equal to 120 gal/(day-ft²), well radius is equal to 0.3 ft. and the water table recover at radius of 1000 ft. find the required pumping flow rate ?

- A) 13524 gal/day
- B) 71020 gal/day
- C) 18520 gal/day
- D) 5624 gal/day

Solutions First Style exam

1) Find the remaining amount of soil after excavation and embankment in cubic yard considering swell coefficient as 0.26 and shrinkage coefficient as 0.1.

A) 32 B) 47 C) 78 D) 62

The Answer is A

This method is used widely and most of the estimators use this method where length is much greater than width.

Earthworks

Formulas

$$= ()$$

L=Distance between

Also, 1 mile = 5280 ft. = 1760yards and 1 yard = 3 ft.

Each station introduced with the distance from the origin in feet, so STA 12+10 means:

1210 ft. Then distance between 2 stations in this problem is given equal to 30 ft. using the average area method:

$$V_{\text{cut}}(a-b) = (0+60)/2 * 30 = 30*30 = 900 \text{ cf}$$

$$V_{\text{fill}}(a-b) = (50+0)/2 * 30 = 25*30 = 750 \text{ cf}$$

$$V_{\text{cut}}(b-c) = (20+60)/2 * 30 = 40*30 = 1200 \text{ cf}$$

2
0

**STA
12+10**

Fill = 50 cf, C=0
cf

**STA
12+40**

Fill= 0, C= 60
cf

**STA
12+70**

Fill = 35 cf, C=20
cf

Practice Problems PE Style Exam (AM)

$$V_{\text{fill}}(b-c) = (0+35)/2 * 30 = 17.5*30 = 525 \text{ cf}$$

$$\text{Total volume of excavation} = 900+1200 = 2100 \text{ cf} = 77.8 \text{ cy}$$

$$\text{Total volume of embankment} = 750+525 = 1275 \text{ cf} = 47.2 \text{ cy} = \text{CCY (Compacted material)}$$

$$\text{BCY} = \text{CCY} / (1 - \text{Shrinkage}) = 47.2 / (1 - 0.1) = 52.4 \text{ cy}$$

This is the required amount of soil at bank after excavation.

The remaining volume between required BCY and excavation is the amount of soil that

will not be used = $77.8 - 52.4 = 25.4$ cy

The remaining volume of excavated soil after swelling (LCY) that should be hauled out of the site = excavation at bank * (1+swell) = $25.4 * (1 + 0.26) = 32$ cy

2

1

Practice Problems PE Style Exam (AM)

2) Find the elevation of BM2 if the following readings are given if the elevation of BM1 is 01+30:

Station BS FS

BM1 3.3

TP 2.4 1.5

BM2 1.2

A) 1+30 B) 1+31.2

C) 1+33 D) 1+31.8

The Answers is

B

The height between two points are given equal to: Back sight (BS) - Foresight (FS)
= height, positive answer means FS is higher than the BS.

BM1 to TP = BS-FS= 3.3-1.5=
+1.8

TP to BM2 = BS-FS= 2.4-1.2=
+1.2

Elevation at BM2 = Elevation at BM1 + height = 130 + 1.8 + 1.2 = 133=1+33

3) For the pre-cast concrete bridge box girder which one is the most likely closer to the required volume of concrete for one box? Thickness is 8" for two sides and bottom chord and 4" for the top chord. Each corner has 3 by 3 inches hunches. Length of bridge is given equal to 200'

- A) 1500 cf
- B) 1000 cf
- C) 1825 cf
- D) 1250 cf

The Answers is C

To find the answer the section can be divided in the certain geometric shapes. Then the area of each section can be found. Volume is equal to the area multiplied by the length of girder. All dimensions in inches have been converted to ft by dividing by 12.

$$A = ((36*4 + (66-4-8) * 8*2 + (36*8) + 4*(3*3)/2)) / (12*12) = 9.125 \text{ sf (area of section)}$$

$$\text{Volume} = 9.125 * 200 = 1825 \text{ cf}$$

2
3

4) Which one of these 4 cost functions shows more increasing in rate of expenses over the time? (Horizontal axis shows time and vertical axis shows costs.)

A) B) C) D)

The Answer is A

The question shows different cost functions. The choice B shows the decreasing in rate over the time (Log function), choice C shows the constant expenses over the time. Choice A, is an exponential function and shows for rate of change over the time than D.

Practice Problems PE Style Exam (AM)

2
4

5) For the following paths find the critical path using the CPM?

A) 44 B) 48

C) 60 D) 64

The Answer is D

The critical path is the path with the longest time.

Practice Problems PE Style Exam (AM)

2
5

Activity Time I. 4
weeks J. 16
weeks K. 8 weeks
L. 24 weeks M. 28
weeks N. 4 weeks
O. 8 weeks P. 4
weeks

Paths'

Lengths

ACDFH = 44

ACDGH = 48

ACEFH = 48

ACEGH = 52

BCDFH = 56

BCDGH = 60

BCEFH = 60

BCEGH = 64

Practice Problems PE Style Exam (AM)

6) A dump-hauler has a purchase price of \$109,000. Freight for delivery is \$5000. Tires are an additional 25,000 with the estimated life time of 4500 hours. The hauler expected to operate 1500 hours annually and for 11 years. Maintenance fees for the hauler is estimated at \$18000. What is the before-tax estimated hourly cost of operation excluding operator labor cost?

A) 35 B) 41

C) 23 D) 15

The Answer is C

The best way to estimate the hourly cost is to find all expenditures and cost for a year, then the hourly cost can be estimated prorate:

The total hauler cost = $109000 + 5000 = \$114,000$

The hauler price per year: $114,000 / 12 = \$9,500$ per year

Tires will work 4500 hr and every year 1500 years of operation is expected so:
 $4500 / 1500 = 3$ years is the life time for the tires

Therefore, tire costs for a year is become: $21000 / 3 = \$7000$

Total annual expenditures = $\$9,500 + \$7,000 + \$18,000 = \$34,500$

Hourly rate = $34500 / 1500 \text{ hr/year} =$
23

2
6

Practice Problems PE Style Exam (AM)

7) How many 4 by 8 in samples required for a 7000 sf shear wall with 180 cy^3 of

concrete? A) 2 specimens B) 3 specimens C) 4 specimens D) 5 specimens

The Answers is

B

P70-71, ACI 318-08, 5.6.2.1 and 5.6.2.4.

Based on the code instructions, 3 specimens are required for the 4 by 8 in cylinder samples and for each 150 cy³ or 5000 sf needs one sample. So for 180cy³ 2 samples are required and for the 7000 sf also 2 samples are required. So, with this size of samples 3 samples are required.

8) For the wall form work, if the height of wall is equal to 10 ft. and the distance between inclined supports is 3 ft. find the force in the support assuming the 45 degree angle for it.

A) 7500 lb.

B) 10607
lb.

C) 1500
lb.

D) 150 lb.

**The Answers is
B**

**P18, ASCE 37-02,
4.7.1.**

Concrete density = 150 lb/cf (ASCE 7-10, Chapter 3, 3.1 and C3, table C3-1 & C3-2.)

$C_c = 150 \times 10 = 1500$ psf/ft., is the lateral pressure at the base of the wall.

The pressure is distributed in the triangular form so the problem is like a beam with triangular load.

We need to find the reaction of this beam then we can find the force in the lateral support.

So we can find R_A as: R_A

$(1500 \times 10/2) \times 1/3 \times 3 = 7500$
lb.

To find the force in the soldier

$\alpha=45$
degree

$$F = RA / \cos 45 = 7500 / \cos 45 = 10606.6$$

lb.

Practice Problems PE Style Exam (AM)

9) If the maximum moisture content is given equal to 17% and specific gravity of soil is given equal to 2.67 find the dry density according to the modified proctor test procedure.

- A) 125 pcf
- B) 95 pcf
- C) 115 pcf
- D) 150 pcf

The Answers is C

According to the modified proctor test procedure, the dry density is equal to:

=

$$+ \frac{1}{0.17} = 62.4$$

$$+ \frac{1}{2.67} = 114.59 /$$

29

10) In the temporary structure in the referred picture if the soil is un-drained stiff clay which one is correct?

- A) Soil pressure has a uniform distribution. B) Soil pressure has a trapezoidal form C) Soil pressure is triangular and the maximum pressure is at base. D) Soil pressure is triangular and the maximum pressure is at top.

The Answers is

B

This is the definition for the temporary structures. In the clay soil the pressure has trapezoid form and in sand it is uniform. In none of the conditions it has triangular form.

11) Which one of the following compactors shall be used for the compaction just behind the retaining wall?

C) A) sheepsfoot compactor B) Smooth drum D) C) Small plate compactor D) pneumatic

The Answer is C

As general rule, heavy compactor equipment cannot be driven within 3 feet (0.3 m) of the back of the wall and based on definitions in this zone (settlement zone) only the small plate compactor shall be used.

12) A fine grained soil has a Liquid Limit (LL) of 70% and a Plasticity limit (PL) of 30%.
The soil can be classified as:

- A) CL
- B) CI
- C) CH
- D) MI

The Answer is C

For the fine grained soil according to the unified chart easily the soil classification can be defined as follows:

$$PI = LL - PL \text{ So, } PI = 70 - 30 = 40\%$$

So the soil is classified as CH.

Practice Problems PE Style Exam (AM)

13) For a fully braced retaining wall in the basement of a 10 stories building, which formula will give the pressure at the bottom of the wall. (Height of wall is equal to 10 ft.)

- A) $P = \text{Soil density} \times 10 \times K_a$ (active soil pressure) B) $P = \text{Soil density} \times 10 \times K_0$ (at rest soil pressure) C) $P = \text{Soil density} \times 10 \times K_p$ (passive soil pressure) D) $P = \text{Soil density} \times 10 \times K_a$ (active soil pressure) $\times 10/2$

The Answer is

B

Rankine and Coulomb theories assume that wall moves slightly and then active and passive pressure will start acting on the wall. If the wall is fully braced or considered as at rest, then K_0 or at rest soil pressure coefficient shall be considered. Since in all basements, walls are designed as perimeter walls and braced with floors, and other walls, K_0 shall be considered for them.

14) The ground water level is at 9ft. below ground. What is the total stress at 15 ft. below ground? Consider a footing on top layer with the width of 10 ft. which makes a pressure of 150 psf. Use both figures to find the pressure.

- A) 2200 psf
- B) 1778 psf
- C) 1200 psf
- D) 1860 psf

The Answers is

B

To solve the problem, the amount of density for each layer shall be estimated.

For the first layer (Brown Silty Sand):

$$= . () = 2.65 * 62.4 = 104.65 /$$

$$= (1 +) = 104.65 * (1 + 0.205) = 125.32 /$$

3

4

ft

ft

Total stresses are equal to:

$$() = h = 125.32 * 9 = 1127.88$$

$$() = h = 104.65 * 6 = 627.9$$

Foundation stress is estimated from the figure as:

Depth = 15' width of footing is = 10ft. so stress shall be found in 3d and it is equal to =
 $0.15 q = 0.15 * 150 = 22.5 \text{ psf}$

So the total stress = $22.5 + 1127.88 + 627.9 = 1778.28$

Practice Problems PE Style Exam (AM)

3
5

15) A soil sample has 30% passing the No. 4 sieve and 10% passing the No. 200 sieve. The coefficient of uniformity is greater than 4. Classify the soil according to the Unified Soil Classification System.

- A) SP-SM
- B) SW-SM
- C) SP D)
- GW

The Answer is D

According to the Unified Soil classification table the soil can be classified as GW. See the below table.

10% passing Sieve #200 30% passing through #4 means less than 50% on #4

Uniformity is >
4

10% passing means more than 50% larger than #200 sieve and 30% passing from #4 means less than half is smaller than #4 so the soil can be (GW, GP, GM, or GC).

The uniformity bigger than 4 shows the soil is classified as GW.

Practice Problems PE Style Exam (AM)

16) For the shown footing, find the maximum compressive stress. (P= 1000 lb. M= 500 lb-ft. B=D=width of footing = 9 ft.)

- A) 20.3 psf
- B) 8.2 psf
- C) 16.5 psf
- D) 12.3 psf

The Answer is C

To find the stresses under the foundation three different conditions might be happened which are shown in the below picture.

So, the eccentricity is equal to:

$$e = M/P = 500/1000 = 0.5 < D/6 = 9/6 = 1.5$$

So, the method in “b” shall be used because the footing has not tension.

$$\text{Max. Stress} = P/(B*L) * (1 + 6e/L) = 1000/(9*9) * (1 + 6*0.5/9) = 16.46 \text{ psf}$$

Practice Problems PE Style Exam (AM)

17) Referring to the figure, find the maximum tension force at the bottom chord if the force is equal to 1000 lb. the length of span is 20 ft.(4@5'), and height of the truss is given equal to 5 ft.

- A) 1200 N
- B) 1000 N
- C) 5000 N
- D) 2000 N

The Answer is B

To find the force in the bottom chord easily find the bending moment at mid-span.
M/height of truss will give the forces in top and bottom chord. So:

$$M = PL/4 = 1000 \times 20/4 = 5000 \text{ lb.}$$

$$F = M/d = 5000/5 = 1000 \text{ lb.}$$

18) Which model has just compressive force in the diagonal members?

- A) Warren and roof trusses
- B) Howe truss
- C) K and Warren trusses
- D) Pratt truss

**The Answer is
B**

Pratt truss has all tension members while Howe has all compression members. All other types have a mix of compression and tension diagonals. Since the question asked for just compression the answer is Howe truss.

Practice Problems PE Style Exam (AM)

19) If a design engineer wants to use one of the following sections as a simple beam on the sloped roof, which section(s) may give a better results?

- A) I section B) Z and angle sections
- C) I and channel sections
- D) Channel, Z, and Angle sections

The Answers is D

Angles and Z sections have 2 principle axis other than the X and Y axis, because are asymmetric sections. So, if they use on top of the sloped roof the actual load will work on their real axis and consequently it creates the minimum bending moments. With a proper selection of roof angle and principle axis angles the biaxial bending moment on sloped roof will be converted to the uniaxial bending moment. Channel has a center of rotation which will help to decrease the effect of horizontal vector on the sloped roofs. So. All three sections are suitable for the sloped roofs. I sections are the most deficient sections on the sloped roofs, because always they face the biaxial bending moment and consequently the designed sections have more weight than the Z, angle, or channels.

20) For the beam in the referred picture find the maximum bending moment at the mid-span.

- A) 6 KN-m B)
16.6 KN-m C)
14.3 KN-m D)
8.3 KN-m

The Answers is C

Using the super position law, the mid span bending moment is the sum of the bending moment from the simple span beam and the cantilever over hang.

So
:

Simple span beam (mid span) = $wl^2/8 = 3 \cdot 4^2/8 = 6 \text{ KN-m}$

Overhang creates negative bending moment and the concentrated moment is positive so:

The negative bending moment at support = $M - wL^2/2 = 20 - 3 \cdot 1.5^2/2 = +16.625$

At the mid span half of this bending moment will be added to the mid span bending moment (simple beam effect) so, the total moment = $16.625/2 + 6 = 14.3 \text{ KN-m}$

21) What is the ratio between plastic section modulus and elastic section modulus and (shape factor) for the rectangular section as follows:

- A) 1.5
- B) 1.33
- C) 2 D)
- 1.7

The Answers is A

$$\text{Elastic section modulus} = I/C = (bh^3/12)/(h/2) = bh^2/6$$

$$\text{Plastic section modulus} = \Sigma Ay = b*(h/2) * (h/4) * 2 = bh^2/4$$

$$\text{Shape factor} = (bh^2/4) / (bh^2/6) = 3/2 = 1.5$$

22) A contractor need to make a concrete with target strength of 4 KSI and 0.5KSI as standard deviation. What should be the average of compressive strength tests for the concrete mix design?

- A) 4.7 KSI
- B) 3.3 KSI
- C) 4.1 KSI
- D) 4.0 KSI

The Answers is A

P67, ACI 318-08, 5.3.2.1

The required compressive strength for the $f'_c < 5$ KSI is given by the following formula:

$$f' = f' + 1.34S$$

S_s = to the standard deviation of the samples and 1.34 according to the normal distribution function represents the 90% success in the samples and 10% failure.

So:

$$f' = 4.0 + 1.34 * 0.5 = 4.67 \text{ KSI}$$

23) Concrete curing shall be maintained above 50 °F and in a moist condition for at least:

- A) 3 days after placement.
- B) 10 days after placement.
- C) 15 days after placement.
- D) 7 days after placement.

The Answer is D

P77, ACI 318-08, 5.11.

This is the definition of code.

Concrete curing shall be maintained above 50 °F and in a moist condition for at least 7 days after placement.

24) Find the maximum bending moment on a beam with the length of 20 ft. for the two 2000 lb. moving load (crane wheels) with the distance of 4 ft.

- A) 20000 lb-ft
- B) 16000 lb-ft
- C) 19200 lb-ft
- D) 18000 lb-ft

The Answers is D

The maximum bending moment for the moving load does not occur in the mid span. The maximum bending moment for the 2 equal moving load is equal to:

$$= 2 \left(1 - \frac{a}{L} \right) P L$$

Where “a” is the distance between loads, L is the length of span, and P is the moving load. So, $M = 2000 \times 20 / 2 \times (1 - 4 / (2 \times 20)) = 18000 \text{ lb-ft}$

25) If the PVC station of 100+00 at 59 ft. elevation is connected to the PVT station at 104+00 referring to the following figure, find the station of the crest.

- A) 101+23 ft.
- B) 102+00 ft.
- C) 101+50 ft
- D) 101+15 ft.

The Answers is A

P3-149, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 3.4.6.

400 ft. vertical curve, therefore:

• PVI is at STA 100+00 and PVT is at STA 102+00 Elevation of the PVI is $59' + 0.02(200) = 63$ ft. Elevation of the PVT is $63' - 0.045(200) = 54$ ft. High point elevation requires figuring out the equation for a vertical curve

- At $x = 0$, $y = c \Rightarrow c = 59$ ft.
- At $x = 0$, $dY/dx = b = G_1 = +2.0\%$
- $a = (G_2 - G_1)/2L = (-4.5 - 2)/(2(4)) = -0.8125$
- $y = -0.8125x^2 + 2x + 59$
- High point is where $dy/dx = 0$
- $dy/dx = -1.625x + 2 = 0$
- $x = 1.23$ stations = 01+23 Station of the crest = $(1+23)+100+00=101+23$

26) A car is traveling at 50 mph in a county at night on a steep wet road with 6% uphill slope. Find the stopping sight distance.

- A) 300 ft.
- B) 389 ft.
- C) 112 ft.
- D) 241 ft.

The Answers is

B

P3-2, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 3.2.2.

According to the AASHTO 2004 code, the stopping sight distance for horizontal curves is equal to:

$$= 1.47 \cdot (2.5) \cdot V + 30(0.347 + G) \cdot \frac{V^2}{2}$$

G is the slope of the road, for the uphill road = +0.06 (it will be negative for the downhill)

Friction coefficient = $f = 0.1$ $V = 50$ mph $S = 1.47 \cdot 2.5 \cdot 50 + 30 \cdot (0.347 + 0.06) \cdot \frac{50^2}{2} = 388.5$ ft.

27) In a close traverse, what is the bearing of NC?

- A) S5E
- B) N85W
- C) S85E
- D) N5W

The Answer is C

A bearing of a line is the direction of the line with respect to any given meridian and is described by 90° quadrant in which the line falls and by the acute angle between the line and the meridian within the quadrant.

Since line BC lies in the second quadrant and so the angle should be measured between line and S, So the angle is: $90 - 5 = 85^\circ$ and the direction is S and E, So, S85E is the answer.

28) A horizontal curve is designed with a 1500 ft. radius. The tangent length is 400 ft. and the PT station is 20+00. Find the length of the curve?

- A) 382 ft.
- B) 540 ft.
- C) 420 ft.
- D) 781 ft.

The Answer is D

P3-18, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 3.3.

Since we know R and T we can use $T = R \cdot \tan(\Delta/2)$ to get Δ

$400 = 1500 \tan(\Delta/2)$ then $\Delta = 29.86$
degrees $D = 5729.6/R$. Therefore $D = 3.82$ $L =$
 $100(\Delta)/D = 100(29.86)/3.82 = 781$ ft.

29) In the following intersections layouts, which one is strongly recommended in the both urban and the rural areas for the local road or street.

A B C D

The Answers is C

P10-1, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 10.2.

According to the AASHTO definitions, the full and half cloverleaf intersections and trumpet are recommended for the rural highways (A, B, and D) and not recommended for the local roads. The diamond (C) is recommended for the urban and rural local roads.

30) A district road with a bituminous pavement (friction coefficient=0.16) has a horizontal curve of 700 ft. If the design speed is given equal to 45 mph find the super- elevation.

- A) 3%
- B) 5%
- C) 7%
- D) 9%

The Answers is A

P3-43, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 3.3.5. For 70 mph, $f = 0.16$ $R_v = V^2/15(f+e)$ or $e + f = V^2/15 R$, then: e (super elevation) = $45^2/(15*700)-0.16 = 0.03$

31) Degree of curve is

A) Equal to the interior angle. B) Bearing of the curve. C) Defined in degree. D) Proportion to the reciprocal of the radius.

The Answer is D

P3-18, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed.

This is the definition in AASHTO code.

32) Spiral (transition) curves

A) are never used. B) have a particular radius. C) are used to produce a transition between two tangents. D) are used to produce a gradual transition from tangents to circular curve.

The Answer is D

P3-59, AASHTO Geometric Design-Green Book 2011, 2011, 6th ed., 3.3.8.

This is the definition for the spiral curve.

5
3

33) Which one has more pressure at the depth of h ?

A) B) C)

D) They have equal pressure

The Answer is D

According to the fluid mechanic principles, the pressure is not related to the shape, so at the depth of “ h ” the amount of pressure is the same for all shapes.

Practice Problems PE Style Exam (AM)

34) A 3h storm over a 150 km^2 area produces a total runoff volume of $7 \times 10^6 \text{ m}^3$. With a peak discharge of $360 \text{ m}^3/\text{Sec}$. What is the total excess precipitation?

- A) 1.4 cm
- B) 2.6 cm
- C) 3.6 cm
- D) 4.6 cm

The Answer is D

According to the unit hydrograph definition:

$V = \text{total volume of runoff} = A_d(\text{area of the drainage watershed}) * P_{ave}(\text{average precipitation})$

$$P_{ave} = V/A_d = 7 \times 10^6 / (150) \times 10^6 = 0.046 \text{ m} = 4.6 \text{ cm}$$

.

35) A 3h storm over a 150 km^2 area produces a total runoff volume of $7 \times 10^6 \text{ m}^3$ with a peak discharge of $360 \text{ m}^3/\text{Sec}$. find the unit hydrograph discharge?

- A) $78 \text{ m}^3/\text{s.cm}$
- B) $120 \text{ m}^3/\text{s.cm}$
- C) $210 \text{ m}^3/\text{s.cm}$
- D) $260 \text{ m}^3/\text{s.cm}$

The Answer is A

According to the unit hydrograph definition:

$V = \text{total volume of runoff} = A_d(\text{area of the drainage watershed}) * P_{\text{ave}}(\text{average precipitation})$

$$P_{\text{ave}} = V/A_d = 7 \times 10^6 / (150) \times 10^6 = 0.046 \text{ m} = 4.6 \text{ cm}$$

$$Q_{p,\text{unit}} = \text{Peak discharge} / P_{\text{ave}} = 360 / 4.6 = 78.2$$

36) What is the flow rate for a street V channel finished (clean) concrete channel with a width of 1', channel slope of 0.5%, with a "normal" water depth of 0.5'?

- A) 0.55 cfs
- B) 1.20 cfs
- C) 0.25 cfs
- D) 2.41 cfs

The Answers is A

n is 0.015, hydraulic radius=
(d Cos α)/2

1'

$\alpha = \text{Arch tan } (0.5/0.5) = 45^\circ$ So, HR = $0.5 * (\cos 45) / 2 = 0.176$

d=0.5' S is 0.005 ft/ft, so V = 2.2 ft/sec Q =
V*A= 2.2 ft/sec*(0.5*0.5)/2*2 sq.ft. = 0.55 cfs

Practice Problems PE Style Exam (AM)

37) Rainfall intensity is

- A) The amount of precipitation per second.
- B) The runoff after a rainfall.
- C) The amount of precipitation per hour.
- D) The design storm.

The Answer is C

This is the definition.

38) What is the definition According to the US environment protection (EPA) which area needs permit for the land disturbing and it will called as “disturb”?

A)10 or more acres B) 1 or more acres

C) 100 or more acres D) 1000 or more acres

The Answers is

B

US environment protection (EPA) effective March 10, 2003 any activity in the area of 1 or more acres needs NPDES (National Pollutant Discharge Elimination System) permit.

39) 8 MGD (million gallon per day) of water flows into the new schedule-40 steel pipe network as shows below. Find the rate of flow in the upper branch.

8", L=200', C80

D=8", L=150

4", L= 100, C=100

- A) 1.1 MGD
- B) 6.2 MGD
- C) 5.0 MGD
- D) 1.95 MGD

The Answers is

B

Parallel pipes have three principles that govern the distribution of flow between the two branches. 1- head loss are the same for each branch 2- head loss at each junction is the same as each branches, 3- the total flow rate is the sum of the flow rates in the two branches. According to the 3rd principle, $V_t = V_a + V_b$ So: Diameter = 8" flow area = 50.24 in² Diameter = 4" flow area = 12.56 in² Using the Hazen-Williams expression for the velocity of flow in the pipe: $V = (0.55CD^{0.63}hf^{0.54})/L^{0.54}$ $V_1 = 0.55 * 80 * (8/12)^{0.63} * hf^{0.54} / 200^{0.54} = 1.95 hf^{0.54}$ The same for lower branch: $V_2 = 2.28 hf^{0.54}$. $hf_1 = hf_2$ $V_1 * A_1 / V_2 * A_2 = (1.95 * 50.24) / (2.28 * 12.56) = 3.42$, $V_2 = 0.29 V_1$ $V_t = V_1 + V_2 = V_1.A_1 + 0.29 V_1.A_2 = 1.29 V_1.A_1 = 1.29 Q_1$, then $Q_1 = 5MGD / 1.29 = 6.2MGD$

40) In a drainage project for an underground subway station if the required amount of well drawdown is 3 ft. in the 50 ft. depth of the aquifer. The hydraulic conductivity is given equal to 120 gal/(day-ft²), well radius is equal to 0.3 ft. and the water table recover at radius of 1000 ft. find the required pumping flow rate ?

A) 13524 gal/day B) 71020 gal/day C) 18520 gal/day D) 5624 gal/day

The Answer is A

$(-)$

$(\frac{1}{2})$

Where, K= hydraulic conductivity = 120 gal/ (day-ft²)

For the maximum drawdown of well we need to check it at the well center, so:

y₁ = 5 ft. and, y₂ = 50 - 3 = 47 ft.

Since we want to find the Q at the center of well we do not need the information about the radius of well and radial distance and r₁ = r₂

$= \frac{120(50 - 47)}{2.303}$

$\left(\frac{1000}{0.3} \right)$

61

= 13524.17 /

Second PE Style Exam (AM) Questions

6
2

Practice Problems PE Style Exam (AM)

1) Find the net excavation in cubic yard.

A) 31 B) 10 C) 20 D) 50

6
3

**STA
12+10**

Fill = 50 cf, C=0
cf

**STA
12+40**

Fill= 0, C= 60
cf

**STA
12+70**

Fill = 35 cf, C=20
cf

Practice Problems PE Style Exam (AM)

2) The elevation of station C is given equal to 01+20. If the back sight on A is 3.5 ft. and the foresight for C in 5.1, another foresight reading on B shows 2.2 ft. Find the elevation of the point B.

A) 1+20.5 B) 1+22.9

C) 1+17.1 D) 1+18

6

4

Practice Problems PE Style Exam (AM)

3) For the pre-stressed concrete bridge girder which one is the most likely closer to the required volume of concrete for this girder if the length of girder is given equal to 30 ft. Height = 3 ft.

- A) 3.95 cf
- B) 152.3 cf
- C) 118.8 cf
- D) 145.8 cf

4) A precast concrete wall with the thickness of 8", height of 8' and width of 6'. A hauler truck should carry these precast walls. The capacity of the hauler is 20 US tons. How many pieces of wall can be transported by the hauler?

- A) 10 B) 8
- C) 12 D) 3

6
5