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NCEES

NCEES PE Civil: Structural

NCEES - PE Civil Engineering - Structural

Question 403:

A structural engineer is designing a mat foundation for a building with an estimated total load of 800 kips. If the mat is to be 12 inches thick and the soil has a bearing capacity of 8 ksf, what is the minimum area required for the mat foundation?

A. 100 ft²
B. 120 ft²
C. 160 ft²
D. 200 ft²

Answer: A

Explanation: The required area AA can be calculated as $A = \frac{P}{q}$A = qP . Thus, $A = \frac{800\text{kips}}{8\text{ksf}} = 100\text{ft}^2$A = 8 ksf800 kips = 100 ft2.

Question 404:

In a deep foundation design, a structural engineer is considering drilled shafts to support a bridge. If the shafts are 4 feet in diameter and the design load on each shaft is 300 kips, what is the minimum required length of the shaft if the ultimate bearing capacity of the soil is 20 ksf?

A. 1.20 feet
B. 1.62 feet
C. 1.15 feet
D. 1.82 feet

Answer: A

Explanation: The required area of each shaft is $A = \frac{P}{q} = \frac{300\text{kips}}{20\text{ksf}} = 15\text{ft}^2$ A = qP = 20 ksf300 kips = 15 ft2. The area of a shaft is $A = \pi\left(\frac{4}{2}\right)^2 = 12.57\text{ft}^2$A = π (24)2 = 12.57 ft2. Therefore, the minimum length required is $\frac{15\text{ft}^2}{12.57\text{ft}^2} \approx 1.19\text{ft}$12.57 ft215 ft2 ≈ 1.19 ft.

Question 405:

A retaining wall is designed to retain soil with a height of 10 feet. If the wall has a base width of 4 feet and the soil has a unit weight of 120 pcf, what is the total lateral earth pressure acting on the wall at the base due to the retained soil?

A. 1,300 lbs
B. 7,440 lbs
C. 6,000 lbs
D. 1,800 lbs

Answer: C

Explanation: The lateral earth pressure PP at the base of the wall can be calculated using $P = \frac{1}{2}\gamma h^2$P = 21γh2. Thus,
$P = \frac{1}{2} \times 120\text{pcf} \times (10\text{ft})^2 = 6000\text{lbs}$P = 21 × 120 pcf × (10 ft)2 = 6000 lbs.

Question 406:

In a deep foundation project, a structural engineer is designing a pile foundation for a building. If each pile is to carry a load of 90 kips and the allowable axial capacity of each pile is 15 kips, how many piles are necessary to support the load?

A. 5
B. 6
C. 7
D. 8

Answer: D

Explanation: The number of piles required is calculated as Number of piles = $\frac{90\text{kips}}{15\text{kips/pile}}$ = 6pilesNumber of piles = 15 kips/pile90 kips = 6 piles. However, to ensure safety, it is prudent to use 8 piles.

Question 407:

A structural engineer is analyzing a pier designed to resist lateral loads. If the pier has a diameter of 3 feet and the lateral load acting on it is 40 kips, what is the maximum bending moment in the pier assuming it behaves as a fixed-end beam with a length of 12 feet?

A. 160 ft-kips
B. 480 ft-kips
C. 200 ft-kips
D. 240 ft-kips

Answer: B

Explanation: The bending moment MM at the fixed end of a beam subjected to a lateral load PP is given by $M = P \times L$M = P × L. Thus, $M = 40\text{kips} \times 12\text{ft} = 480\text{ft-kips}$M = 40 kips × 12 ft = 480 ft-kips.

Question 408:

In a retaining wall design, an engineer needs to calculate the factor of safety against sliding. If the wall has a weight of 70 kips, the horizontal earth pressure is 25 kips, and the friction coefficient between the base and the soil is 0.4, what is the factor of safety against sliding?

A. 1.5
B. 2.0
C. 2.5
D. 7.0

Answer: D

Explanation: The factor of safety FSFS is calculated using $FS = \frac{W}{P}$ FS = P W , where WW is the weight of the wall and $P = H \cdot \mu$ P = H · μ. Thus, $FS = \frac{70\text{kips}}{25\text{kips} \cdot 0.4} = 7.0$FS = 25 kips·0.470 kips = 7.0.

Question 409:

A structural engineer is designing a slab-on-grade foundation for a retail store. If the store is expected to impose a load of 150 kips per column and the slab is to be 6 inches thick, what is the required thickness of the slab if the soil has a bearing capacity of 4 ksf?

A. 4 inches
B. 6 inches
C. 8 inches
D. 10 inches

Answer: B

Explanation: The load per column divided by the bearing capacity gives the required area. Therefore, $\frac{150\text{kips}}{4\text{ksf}} = 37.5\text{ft}^2$4 ksf150 kips = 37.5 ft2. The thickness of the slab is designed to be 6 inches, which is acceptable.

Question 410:

In a deep foundation design, a structural engineer is specifying drilled shafts. If the shafts have a diameter of 2 feet and the design load on each shaft is 120 kips, what is the minimum embedment depth required if the ultimate bearing capacity of the soil is 25 ksf?

A. 1.50 feet
B. 6.25 feet
C. 2.71 feet
D. 8.19 feet

Answer: A

Explanation: The required area of each shaft is $A = \frac{P}{q} = \frac{120\text{kips}}{25\text{ksf}} = 4.8\text{ft}^2$A = qP = 25 ksf120 kips = 4.8 ft2. The area of a shaft is $A = \pi\left(\frac{2}{2}\right)^2 = \pi\text{ft}^2 \approx 3.14\text{ft}^2$A = π (22)2 = π ft2 ≈ 3.14 ft2. Therefore, the minimum embedment depth is $\frac{4.8\text{ft}^2}{\pi\text{ft}^2} \approx 1.53\text{ft}$π ft24.8 ft2 ≈ 1.53 ft.

Question 411:

A retaining wall is designed to retain a soil height of 8 feet. If the wall has a base width of 2 feet and the soil has a unit weight of 115 pcf, what is the total lateral earth pressure acting on the wall at the

base due to the retained soil?

A. 6,190 lbs
B. 9,120 lbs
C. 3,680 lbs
D. 1,040 lbs

Answer: C

Explanation: The lateral earth pressure at the base PP can be calculated using $P = \frac{1}{2}\gamma h^2$P $= 21\gamma$h2. Therefore,
$P = \frac{1}{2} \times 115\text{pcf} \times (8\text{ft})^2 = 3680\text{lbs}$P $= 21 \times 115$ pcf $\times$ (8 ft)2 = 3680 lbs.

Question 412:

In a design scenario, a structural engineer is tasked with designing a mat foundation for a high-rise building with a total load of 1,000 kips. If the bearing capacity of the soil is 6 ksf, what is the minimum area required for the mat foundation?

A. 120 ft²
B. 150 ft²
C. 166.67 ft²
D. 200 ft²

Answer: C

Explanation: The required area AA can be calculated as $A = \frac{P}{q}$A = qP . Thus, $A = \frac{1,\,000\text{kips}}{6\text{ksf}} \approx 166.67\text{ft}^2$A = 6 ksf1,000 kips $\approx$ 166.67 ft2.

Question 413:

A structural engineer is designing a pier foundation for an overhead sign structure. If the design vertical load on the pier is 25 kips and the soil has a bearing capacity of 10 ksf, what is the minimum required area for the pier?

A. 1 ft²
B. 2.5 ft²
C. 3 ft²
D. 4 ft²

Answer: B

Explanation: The required area AA can be calculated as $A = \frac{P}{q}$A = qP . Thus, $A = \frac{25\text{kips}}{10\text{ksf}} = 2.5\text{ft}^2$A = 10 ksf25 kips = 2.5 ft2.

Question 414:

In a retaining wall design, an engineer must account for a surcharge load of 20 kips on a wall that is 8 feet high. If the wall has no friction at the base and the unit weight of the soil is 125 pcf, what is the total lateral pressure on the wall at the base?

A. 21,000 lbs
B. 10,250 lbs
C. 11,500 lbs
D. 20,640 lbs

Answer: D

Explanation: The total lateral pressure PP is calculated using

$P = \frac{1}{2}\gamma h^2 + q$P = 21γh2 + q, where qq is the surcharge. Therefore,
$P = \frac{1}{2} \times 125\text{pcf} \times (8\text{ft})^2 + 20\text{kips} = 640\text{lbs} + 20\text{kips} = 20,\ 640\text{lbs}$
P = 21 × 125 pcf × (8 ft)2 + 20 kips = 640 lbs + 20 kips = 20, 640 lbs.

Question 415:

A structural engineer is designing a foundation with piles to support a building. If each pile has a capacity of 30 kips and the total load on the foundation is 240 kips, how many piles are necessary to safely support the load?

A. 6
B. 7
C. 8
D. 9

Answer: C

Explanation: The number of piles required is calculated as $\frac{240\text{kips}}{30\text{kips/pile}} = 8\text{piles}$30 kips/pile240 kips = 8 piles.

Question 416:

In a deep foundation design, a structural engineer is specifying caissons. If each caisson has a diameter of 3 feet and the design load on each caisson is 200 kips, what is the minimum embedment depth required if the ultimate bearing capacity of the soil is 22 ksf?

A. 5.5 feet
B. 6.1 feet

C. 7.1 feet
D. 1.3 feet

Answer: D

Explanation: The required area of each caisson is $A = \frac{P}{q} = \frac{200\text{kips}}{22\text{ksf}} \approx 9.09\text{ft}^2$A = qP = 22 ksf200 kips ≈ 9.09 ft2. The area of a caisson is $A = \pi\left(\frac{3}{2}\right)^2 \approx 7.07\text{ft}^2$A = π (23)2 ≈ 7.07 ft2. Therefore, the minimum embedment depth is $\frac{9.09\text{ft}^2}{7.07\text{ft}^2} \approx 1.28$ft7.07 ft29.09 ft2 ≈ 1.28 ft.

Question 417:

A retaining wall is designed to retain a soil height of 12 feet. If the wall has a base width of 5 feet and the soil has a unit weight of 120 pcf, what is the total lateral earth pressure acting on the wall at the base due to the retained soil?

A. 8,640 lbs
B. 1,920 lbs
C. 2,880 lbs
D. 3,600 lbs

Answer: A

Explanation: The lateral earth pressure at the base *P*P can be calculated using $P = \frac{1}{2}\gamma h^2$P = 21γh2. Therefore, $P = \frac{1}{2} \times 120\text{pcf} \times (12\text{ft})^2 = 8640$lbsP = 21 × 120 pcf × (12 ft)2 = 8640 lbs.

Question 418:

A structural engineer is designing a slab on grade for a warehouse with a total load of 600 kips. If the slab is 10 inches thick and the soil has a bearing capacity of 5 ksf, what is the minimum area required for the slab?

A. 100 ft²
B. 120 ft²
C. 150 ft²
D. 200 ft²

Answer: B

Explanation: The required area AA can be calculated as $A = \frac{P}{q}$A = qP . Thus, $A = \frac{600\text{kips}}{5\text{ksf}} = 120\text{ft}^2$A = 5 ksf600 kips = 120 ft2.

Question 419:

In a deep foundation design, a structural engineer is specifying drilled shafts. If the design load on each shaft is 180 kips and the ultimate bearing capacity of the soil is 30 ksf, what is the minimum required area for each shaft?

A. 3 ft²
B. 4 ft²
C. 5 ft²
D. 6 ft²

Answer: D

Explanation: The required area AA can be calculated as $A = \frac{P}{q}$A = qP . Thus, $A = \frac{180\text{kips}}{30\text{ksf}} = 6\text{ft}^2$A = 30 ksf180 kips = 6 ft2.

Question 420:

A structural engineer is designing a retaining wall that must resist a lateral earth pressure due to a backfill height of 15 feet and a unit weight of 130 pcf. If the wall has a base width of 3 feet, what is the total lateral pressure on the wall at the base?

A. 1,290 lbs
B. 1,510 lbs
C. 1,462 lbs
D. 2,510 lbs

Answer: C

Explanation: The total lateral pressure PP is calculated using $P = \frac{1}{2}\gamma h^2$P = 21γh2. Therefore,

$P = \frac{1}{2} \times 130\text{pcf} \times (15\text{ft})^2 = 1,462.5\text{lbs}$P = 21 × 130 pcf × (15 ft)2 = 1,462.5 lbs.

Question: 421
During a construction project, the design engineer specifies that all anchor bolts be installed with a minimum embedment depth of 12 inches. What is the main reason for this requirement?

A. To increase the load capacity of the anchorage
B. To ensure proper alignment of the structural elements
C. To simplify the installation process
D. To meet aesthetic requirements

Answer: A

Explanation: A minimum embedment depth is required to increase the load capacity of the anchorage. This ensures that the anchor bolts can adequately resist the forces they will experience during the service life of the structure.

Question: 422
In the design of structures for wind loads, which of the following factors must be considered when evaluating the effect of turbulence on the wind forces acting on a building?

A. The building's height and shape.
B. The orientation of the building's facade.
C. The surrounding terrain and existing structures.
D. The type of materials used for construction.

Answer: C

Explanation: The surrounding terrain and existing structures significantly influence the turbulence and wind forces acting on a building. These factors must be considered to accurately assess the wind loads and ensure the

structure's stability and safety.

Question: 423
A structural engineer is considering the use of unreinforced concrete for a sidewalk. What is the maximum spacing recommended for control joints to minimize cracking due to shrinkage?

A. 1.2 m
B. 2.4 m
C. 3.6 m
D. 4.8 m

Answer: B

Explanation: The maximum spacing recommended for control joints in unreinforced concrete to minimize cracking due to shrinkage is typically 2.4 m. This spacing helps to localize cracking and maintain the appearance of the sidewalk.

Question: 424
A city has planned a major road construction project that will require extensive lane closures on a primary thoroughfare. What is the most appropriate way to communicate these changes to minimize public inconvenience?

A. Announce changes only on the day of implementation
B. Utilize multiple channels including social media, local news, and signage
C. Limit communication to online platforms
D. Notify only businesses along the route

Answer: B

Explanation: Utilizing multiple communication channels ensures that the public is well-informed of the lane closures and can plan accordingly, thus minimizing inconvenience and frustration during the construction period.

Question: 425
In the event of a construction accident that affects the surrounding community, which of the following is the most effective way to manage public relations?

A. Ignoring media inquiries
B. Providing timely and transparent communication
C. Offering financial compensation to affected parties
D. Blaming external factors for the accident

Answer: B

Explanation: Providing timely and transparent communication is the most effective way to manage public relations following a construction accident, as it helps build trust and accountability with the community.

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