

# **GEOTECHNICAL CIVIL PE EXAM PREP**

## **100-QUESTION PRACTICE EXAM 10**

Standalone PDF - U.S. customary units unless noted  
Answer key and worked solutions included

**UNOFFICIAL PRACTICE MATERIAL**

This independently written practice exam is not produced, endorsed, or reviewed by NCEES. Verify current references, standards, and examination policies with NCEES.

## Candidate Instructions

- Complete all 100 questions before consulting the answer key or solutions.
- Suggested pacing: 10 hours total, or two timed 50-question sessions.
- Select the single best answer. The official CBT examination may also use alternative item types.
- Use the official NCEES PE Civil Reference Handbook and design standards applicable to your exam date.
- Round to the nearest listed answer and record errors by concept, formula, units, reference navigation, or pacing.

## Blueprint

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## Site Characterization

**1. A geotechnical principal verifies the design basis. a 5-ft rock core run yields 42 ft of core. determine the core recovery?**

- A. 850%
- B. 840%
- C. 860%
- D. 828%

Answer: A B C D

**2. During a multidisciplinary project risk review, a 6-ft rock core run yields 48 ft of core. determine the core recovery?**

- A. 800%
- B. 788%
- C. 810%
- D. 820%

Answer: A B C D

**3. While comparing field performance with design assumptions, a 5-ft rock core run yields 36 ft of core. determine the core recovery?**

- A. 740%
- B. 730%
- C. 708%
- D. 720%

Answer: A B C D

**4. An independent design checker evaluates this condition. a 5-ft rock core run yields 44 ft of core. determine the core recovery?**

- A. 880%
- B. 890%
- C. 868%
- D. 900%

Answer: A B C D

**5. Before approving the final geotechnical recommendations, a 24-in core run contains 18 in of sound core pieces at least twice the core diameter. determine the RQD?**

- A. 85%
- B. 65%
- C. 75%
- D. 55%

Answer: A B C D

**6. A geotechnical principal verifies the design basis. a 30-in core run contains 20 in of sound core pieces at least twice the core diameter. determine the RQD?**

- A. 77%
- B. 47%
- C. 67%
- D. 57%

Answer: A B C D

**7. During a multidisciplinary project risk review, a 25-in core run contains 15 in of sound core pieces at least twice the core diameter. determine the RQD?**

- A. 40%
- B. 60%
- C. 50%
- D. 70%

Answer: A B C D

**8. While comparing field performance with design assumptions, a 28-in core run contains 22 in of sound core pieces at least twice the core diameter. determine the RQD?**

- A. 69%
- B. 79%
- C. 89%
- D. 59%

Answer: A B C D

**9. An independent design checker evaluates this condition. which field method most directly provides a near-continuous profile of tip resistance and sleeve friction?**

- A. Standard penetration test
- B. Cone penetration test
- C. Field vane test
- D. Plate load test

Answer: A B C D

**10. Before approving the final geotechnical recommendations, which sampler is generally preferred for obtaining a relatively undisturbed sample of soft cohesive soil?**

- A. Thin-walled Shelby tube
- B. Rock core barrel
- C. Grab sampler
- D. Split-spoon sampler

Answer: A B C D

**11. A geotechnical principal verifies the design basis. a soil has 58% passing No. 200, LL = 42, and PI = 18. Under USCS, its broad classification is most likely:**

- A. Clean sand
- B. Organic peat
- C. Silty or clayey fine-grained soil
- D. Well-graded gravel

Answer: A B C D

**12. During a multidisciplinary project risk review, for locating the groundwater surface in a borehole after pore pressures equilibrate, the most appropriate device is a:**

- A. Inclinator
- B. Standpipe piezometer
- C. Pressuremeter
- D. Settlement plate

Answer: A B C D

## Soil Mechanics, Laboratory Testing, and Analysis

**13. While comparing field performance with design assumptions, a soil has water content 18%,  $G_s = 2.70$ , and void ratio  $e = 0.65$ . determine its degree of saturation?**

- A. 85%
- B. 60%
- C. 75%
- D. 95%

Answer: A B C D

**14. An independent design checker evaluates this condition. a soil has water content 22%,  $G_s = 2.65$ , and void ratio  $e = 0.75$ . determine its degree of saturation?**

- A. 63%
- B. 88%
- C. 98%
- D. 78%

Answer: A B C D

**15. Before approving the final geotechnical recommendations, a soil has water content 15%,  $G_s = 2.68$ , and void ratio  $e = 0.55$ . determine its degree of saturation?**

- A. 58%
- B. 73%
- C. 93%
- D. 83%

Answer: A B C D

**16. A geotechnical principal verifies the design basis. a soil has water content 25%,  $G_s = 2.72$ , and void ratio  $e = 0.82$ . determine its degree of saturation?**

- A. 93%
- B. 68%
- C. 83%
- D. 100%

Answer: A B C D

**17. During a multidisciplinary project risk review, at 15 ft depth, total vertical stress is based on an average unit weight of 120 pcf and pore pressure is 500 psf. determine vertical effective stress?**

- A. 1,800 psf
- B. 2,300 psf
- C. 1,300 psf
- D. 800 psf

Answer: A B C D

**18. While comparing field performance with design assumptions, at 20 ft depth, total vertical stress is based on an average unit weight of 118 pcf and pore pressure is 800 psf. determine vertical effective stress?**

- A. 2,360 psf
- B. 1,560 psf
- C. 760 psf
- D. 3,160 psf

Answer: A B C D

**19. An independent design checker evaluates this condition. at 12 ft depth, total vertical stress is based on an average unit weight of 125 pcf and pore pressure is 420 psf. determine vertical effective stress?**

- A. 1,080 psf
- B. 1,920 psf
- C. 1,500 psf
- D. 660 psf

Answer: A B C D

**20. Before approving the final geotechnical recommendations, at 18 ft depth, total vertical stress is based on an average unit weight of 115 pcf and pore pressure is 650 psf. determine vertical effective stress?**

- A. 770 psf
- B. 2,070 psf
- C. 1,420 psf
- D. 2,720 psf

Answer: A B C D

**21. A geotechnical principal verifies the design basis. a normally consolidated clay layer is 12 ft thick,  $e_0=0.8$ ,  $C_c=0.28$ . Effective stress doubles by a factor of 2.0. Estimate primary consolidation settlement.**

- A. 13.5 in
- B. 10.1 in
- C. 6.7 in
- D. 3.4 in

Answer: A B C D

**22. During a multidisciplinary project risk review, a normally consolidated clay layer is 10 ft thick,  $e_0=0.7$ ,  $C_c=0.22$ . Effective stress doubles by a factor of 1.8. Estimate primary consolidation settlement.**

- A. 2.0 in
- B. 7.9 in
- C. 4.0 in
- D. 5.9 in

Answer: A B C D

**23. While comparing field performance with design assumptions, a normally consolidated clay layer is 15 ft thick,  $e_0=0.9$ ,  $C_c=0.30$ . Effective stress doubles by a factor of 1.5. Estimate primary consolidation settlement.**

- A. 7.5 in
- B. 5.0 in
- C. 2.5 in
- D. 10.0 in

Answer: A B C D

**24. An independent design checker evaluates this condition. a normally consolidated clay layer is 8 ft thick,  $e_0=0.6$ ,  $C_c=0.18$ . Effective stress doubles by a factor of 2.5. Estimate primary consolidation settlement.**

- A. 2.1 in
- B. 8.6 in
- C. 6.4 in
- D. 4.3 in

Answer: A B C D

## Construction Observation, Monitoring, QA/QC, and Safety

**25. Before approving the final geotechnical recommendations, a nuclear gauge reports wet density 126 pcf at 8% water content. Dry density is closest to:**

- A. 108 pcf
- B. 117 pcf
- C. 126 pcf
- D. 136 pcf

Answer: A B C D

**26. A geotechnical principal verifies the design basis. the laboratory maximum dry density is 121 pcf and field dry density is 116 pcf. Relative compaction is:**

- A. 95.9%
- B. 104.3%
- C. 100.0%
- D. 91.0%

Answer: A B C D

**27. During a multidisciplinary project risk review, which instrument is best suited to monitor lateral movement within an excavation support system?**

- A. Inclinator
- B. Settlement plate
- C. Piezometer
- D. Vibrating-wire load cell only

Answer: A B C D

**28. While comparing field performance with design assumptions, a piezometer reading rises rapidly during embankment placement. The most appropriate immediate interpretation is:**

- A. Excess pore pressure is developing
- B. Settlement is complete
- C. The fill is undercompacted
- D. Soil strength has necessarily increased

Answer: A B C D

**29. An independent design checker evaluates this condition. for cohesive fill, the most representative routine acceptance test pairing is:**

- A. RQD and core recovery
- B. Field density/moisture and a laboratory moisture-density curve
- C. Los Angeles abrasion and slump
- D. CPT and pressuremeter

Answer: A B C D

**30. Before approving the final geotechnical recommendations, a 6-ft-deep trench in Type C soil has no protective system. Under OSHA excavation rules, the condition is generally:**

- A. Not acceptable; cave-in protection is required unless in stable rock
- B. Acceptable if soil is dry
- C. Acceptable if open less than one day
- D. Acceptable with a ladder only

Answer: A B C D

**31. A geotechnical principal verifies the design basis. when proofrolling reveals rutting and pumping, the preferred first response is to:**

- A. Increase asphalt temperature
- B. Ignore it if density tests passed
- C. Identify and remediate the unstable subgrade area
- D. Place thicker pavement immediately

Answer: A B C D

**32. During a multidisciplinary project risk review, a settlement plate installed beneath an embankment primarily measures:**

- A. Vertical movement at its elevation
- B. Pore pressure
- C. Soil suction
- D. Horizontal strain

Answer: A B C D

## Earthquake Engineering and Dynamic Loads

**33. While comparing field performance with design assumptions, liquefaction susceptibility is generally greatest in:**

- A. Intact granite
- B. Stiff overconsolidated clay
- C. Dense dry gravel
- D. Loose saturated clean sand

Answer: A B C D

**34. An independent design checker evaluates this condition. for a pseudo-static slope analysis, seismic loading is commonly represented by:**

- A. A horizontal inertial force  $khW$
- B. Removal of groundwater
- C. A vertical surcharge only
- D. A permanent increase in cohesion

Answer: A B C D

**35. Before approving the final geotechnical recommendations, if  $kh = 0.15$  and a potential sliding mass weighs 2,000 kips, the horizontal pseudo-static force is:**

- A. 150 kips
- B. 2,000 kips
- C. 300 kips
- D. 30 kips

Answer: A B C D

**36. A geotechnical principal verifies the design basis. which field parameter is routinely corrected for overburden and hammer energy before use in SPT-based liquefaction screening?**

- A. Atterberg limit
- B. N value
- C. RQD
- D. Hydraulic conductivity

Answer: A B C D

**37. During a multidisciplinary project risk review, a saturated sand deposit densifies during shaking but drainage is too slow. The immediate consequence is generally:**

- A. Excess positive pore pressure and reduced effective stress
- B. Cementation
- C. Increased effective stress
- D. Negative pore pressure

Answer: A B C D

**38. While comparing field performance with design assumptions, site amplification of earthquake motions is commonly greater for:**

- A. Soft soil deposits
- B. Hard rock
- C. Shallow bedrock only
- D. Massive concrete

Answer: A B C D

**39. An independent design checker evaluates this condition. the cyclic resistance ratio represents:**

- A. Demand imposed by the earthquake
- B. Soil resistance to liquefaction triggering
- C. Post-liquefaction settlement only
- D. Static bearing capacity

Answer: A B C D

## Earth Structures, Ground Improvement, and Pavement

**40. Before approving the final geotechnical recommendations, for a trial planar slide, normal force is 180 kips, driving shear is 90 kips,  $\phi' = 30^\circ$ ,  $c' = 0$  ksf, and plane length is 120 ft. determine the factor of safety?**

- A. 1.15
- B. 1.44
- C. 1.73
- D. 0.81

Answer: A B C D

**41. A geotechnical principal verifies the design basis. for a trial planar slide, normal force is 190 kips, driving shear is 90 kips,  $\phi' = 32^\circ$ ,  $c' = 0$  ksf, and plane length is 140 ft. determine the factor of safety?**

- A. 1.65
- B. 1.32
- C. 1.98
- D. 0.92

Answer: A B C D

**42. During a multidisciplinary project risk review, for a trial planar slide, normal force is 170 kips, driving shear is 90 kips,  $\phi' = 28^\circ$ ,  $c' = 5$  ksf, and plane length is 100 ft. determine the factor of safety?**

- A. 4.59
- B. 8.20
- C. 6.56
- D. 9.84

Answer: A B C D

**43. While comparing field performance with design assumptions, for a trial planar slide, normal force is 210 kips, driving shear is 90 kips,  $\phi' = 35^\circ$ ,  $c' = 0$  ksf, and plane length is 160 ft. determine the factor of safety?**

- A. 2.45
- B. 1.63
- C. 1.14
- D. 2.04

Answer: A B C D

**44. An independent design checker evaluates this condition. which ground-improvement method is most directly used to accelerate consolidation of a thick soft clay layer beneath a surcharge?**

- A. Prefabricated vertical drains
- B. Dynamic compaction only
- C. Rock bolts
- D. Vibrocompaction alone

Answer: A B C D

**45. Before approving the final geotechnical recommendations, lime treatment is generally most effective for:**

- A. Plastic clay
- B. Intact rock
- C. Clean gravel
- D. Organic peat with very high organic content

Answer: A B C D

**46. A geotechnical principal verifies the design basis. a geotextile placed between aggregate base and weak subgrade primarily to prevent intermixing serves as:**

- A. Cathodic protection
- B. Separation
- C. A vapor barrier
- D. Reinforcement only

Answer: A B C D

**47. During a multidisciplinary project risk review, for a geotextile filter, the opening size should primarily balance:**

- A. Creep and thermal expansion only
- B. Tensile strength and color
- C. UV resistance and density
- D. Soil retention and adequate permeability

Answer: A B C D

**48. While comparing field performance with design assumptions, a reinforced-soil slope obtains improved stability mainly from:**

- A. Reduced soil unit weight to zero
- B. Elimination of pore pressure
- C. Increased rainfall infiltration
- D. Tensile resistance mobilized in reinforcement

Answer: A B C D

**49. An independent design checker evaluates this condition. preloading a compressible foundation before final construction is intended to:**

- A. Increase future primary settlement
- B. Raise groundwater permanently
- C. Induce settlement before service
- D. Reduce effective stress

Answer: A B C D

**50. Before approving the final geotechnical recommendations, for flexible pavement, a weaker subgrade generally requires:**

- A. Less structural thickness
- B. Lower compaction
- C. Greater structural thickness
- D. No base course

Answer: A B C D

**51. A geotechnical principal verifies the design basis. the most effective first-line control for seepage-related instability in an earth embankment is often:**

- A. Increase infiltration
- B. Remove downstream toe support
- C. Use open joints
- D. Provide properly designed filters and drains

Answer: A B C D

**52. During a multidisciplinary project risk review, at a landfill liner interface, stability should be checked using:**

- A. Only the soil's internal friction angle
- B. Concrete compressive strength
- C. SPT refusal
- D. The weakest relevant interface shear strength

Answer: A B C D

**53. While comparing field performance with design assumptions, aggregate piers improve soft ground primarily by:**

- A. Providing stiffer inclusions and drainage
- B. Dissolving clay minerals
- C. Creating voids
- D. Eliminating all settlement

Answer: A B C D

## Groundwater and Seepage

**54. An independent design checker evaluates this condition. using Darcy's law,  $k=0.002$  ft/s, hydraulic gradient  $i=0.5$ , and flow area  $A=100$  ft<sup>2</sup>. determine discharge?**

- A. 1.000 ft<sup>3</sup>/s
- B. 0.200 ft<sup>3</sup>/s
- C. 0.050 ft<sup>3</sup>/s
- D. 0.100 ft<sup>3</sup>/s

Answer: A B C D

**55. Before approving the final geotechnical recommendations, using Darcy's law,  $k=0.001$  ft/s, hydraulic gradient  $i=0.8$ , and flow area  $A=150$  ft<sup>2</sup>. determine discharge?**

- A. 0.060 ft<sup>3</sup>/s
- B. 1.200 ft<sup>3</sup>/s
- C. 0.240 ft<sup>3</sup>/s
- D. 0.120 ft<sup>3</sup>/s

Answer: A B C D

**56. A geotechnical principal verifies the design basis. using Darcy's law,  $k=0.003$  ft/s, hydraulic gradient  $i=0.4$ , and flow area  $A=80$  ft<sup>2</sup>. determine discharge?**

- A. 0.960 ft<sup>3</sup>/s
- B. 0.096 ft<sup>3</sup>/s
- C. 0.192 ft<sup>3</sup>/s
- D. 0.048 ft<sup>3</sup>/s

Answer: A B C D

**57. During a multidisciplinary project risk review, boiling or piping at the base of an excavation occurs when:**

- A. Soil is dry
- B. Upward seepage force approaches the submerged soil weight
- C. Downward gradient is zero
- D. Total stress increases

Answer: A B C D

**58. While comparing field performance with design assumptions, for lowering groundwater in a permeable sand excavation, a common system is:**

- A. Compaction grouting only
- B. Settlement plates
- C. Wellpoints
- D. Soil nails only

Answer: A B C D

**59. An independent design checker evaluates this condition. a cutoff wall beneath an earth dam primarily reduces seepage by:**

- A. Increasing hydraulic head
- B. Removing the downstream filter
- C. Lengthening the flow path and intercepting permeable strata
- D. Shortening the flow path

Answer: A B C D

## Problematic Soil and Rock Conditions

**60. Before approving the final geotechnical recommendations, an expansive clay poses the greatest heave risk when:**

- A. It is isolated from water
- B. It is replaced by clean aggregate
- C. Its moisture content increases after construction
- D. Its moisture content remains constant

Answer: A B C D

**61. A geotechnical principal verifies the design basis. collapsible soil typically experiences sudden settlement when it is:**

- A. Frozen
- B. Wetted while stressed
- C. Densified before loading
- D. Dried under no load

Answer: A B C D

**62. During a multidisciplinary project risk review, frost heave requires frost-susceptible soil, freezing temperatures, and:**

- A. Intact rock
- B. Dry conditions
- C. High salinity only
- D. A water supply

Answer: A B C D

**63. While comparing field performance with design assumptions, in karst terrain, the investigation should emphasize:**

- A. Uniform bedrock elevation
- B. Pavement markings
- C. Only surface soil color
- D. Potential solution cavities and variable rockhead

Answer: A B C D

**64. An independent design checker evaluates this condition. for a potentially corrosive soil around buried metal, which test is most directly relevant?**

- A. Slump
- B. Soil resistivity
- C. RQD
- D. Liquid limit only

Answer: A B C D

**65. Before approving the final geotechnical recommendations, a practical rockfall mitigation measure for a steep jointed rock cut is:**

- A. Add surcharge at crest
- B. Remove all drainage
- C. Undercut the toe indiscriminately
- D. Scaling and anchored mesh/catchment

Answer: A B C D

## Retaining Structures

**66. A geotechnical principal verifies the design basis. a level-backfill wall is 12 ft high. Soil has  $\phi'=30^\circ$ ,  $\gamma=120$  pcf,  $c'=0$ , and no surcharge. Using Rankine active pressure, what is the resultant lateral force per foot of wall?**

- A. 2.3 kip/ft
- B. 1.4 kip/ft
- C. 4.6 kip/ft
- D. 3.5 kip/ft

Answer: A B C D

**67. During a multidisciplinary project risk review, a level-backfill wall is 15 ft high. Soil has  $\phi'=32^\circ$ ,  $\gamma=118$  pcf,  $c'=0$ , and no surcharge. Using Rankine active pressure, what is the resultant lateral force per foot of wall?**

- A. 4.6 kip/ft
- B. 1.8 kip/ft
- C. 6.1 kip/ft
- D. 3.1 kip/ft

Answer: A B C D

**68. While comparing field performance with design assumptions, a level-backfill wall is 10 ft high. Soil has  $\phi'=28^\circ$ ,  $\gamma=125$  pcf,  $c'=0$ , and no surcharge. Using Rankine active pressure, what is the resultant lateral force per foot of wall?**

- A. 3.8 kip/ft
- B. 2.9 kip/ft
- C. 1.9 kip/ft
- D. 1.1 kip/ft

Answer: A B C D

**69. An independent design checker evaluates this condition. a level-backfill wall is 14 ft high. Soil has  $\phi'=35^\circ$ ,  $\gamma=115$  pcf,  $c'=0$ , and no surcharge. Using Rankine active pressure, what is the resultant lateral force per foot of wall?**

- A. 1.2 kip/ft
- B. 2.0 kip/ft
- C. 3.0 kip/ft
- D. 4.0 kip/ft

Answer: A B C D

**70. Before approving the final geotechnical recommendations, a level-backfill wall is 18 ft high. Soil has  $\phi'=30^\circ$ ,  $\gamma=122$  pcf,  $c'=0$ , and no surcharge. Using Rankine active pressure, what is the resultant lateral force per foot of wall?**

- A. 7.9 kip/ft
- B. 10.6 kip/ft
- C. 3.2 kip/ft
- D. 5.3 kip/ft

Answer: A B C D

**71. A geotechnical principal verifies the design basis. the resultant of a triangular active earth-pressure distribution acts at:**

- A. At the top
- B.  $2H/3$  above base
- C.  $H/3$  above base
- D.  $H/2$  above base

Answer: A B C D

**72. During a multidisciplinary project risk review, for a uniform surcharge  $q$  behind a wall, the added active pressure is:**

- A. Triangular, maximum at base
- B. Uniform with magnitude  $K_a q$
- C. Equal to  $\gamma H$
- D. Zero

Answer: A B C D

**73. While comparing field performance with design assumptions, passive earth resistance in front of a wall should often be used cautiously because:**

- A. It is always zero
- B. It acts upward only
- C. It is independent of soil strength
- D. Large movement may be required to mobilize it and soil may be removed

Answer: A B C D

**74. An independent design checker evaluates this condition. a drainage layer behind a retaining wall is intended primarily to:**

- A. Increase hydrostatic pressure
- B. Prevent buildup of hydrostatic pressure
- C. Increase surcharge
- D. Reduce wall weight

Answer: A B C D

**75. Before approving the final geotechnical recommendations, the external stability checks for a gravity retaining wall include:**

- A. Only nail pullout
- B. Sliding, overturning, and bearing
- C. Only tensile rupture
- D. Only corrosion

Answer: A B C D

**76. A geotechnical principal verifies the design basis. an anchored excavation support wall gains lateral restraint from:**

- A. Tiebacks transferring load beyond the active zone
- B. Settlement plates
- C. Surface paint
- D. Reducing wall stiffness to zero

Answer: A B C D

**77. During a multidisciplinary project risk review, for a braced cut, struts primarily carry:**

- A. Torsion only
- B. Hydrostatic uplift only
- C. Compression
- D. Tension only

Answer: A B C D

**78. While comparing field performance with design assumptions, underpinning is used primarily to:**

- A. Remove all adjacent structures
- B. Measure pore pressure
- C. Support or transfer loads from an existing foundation
- D. Increase excavation inflow

Answer: A B C D

**79. An independent design checker evaluates this condition. a soil nail wall is generally constructed:**

- A. Bottom-up with driven piles only
- B. By preloading the entire wall
- C. Top-down in staged excavations
- D. Underwater without facing

Answer: A B C D

## Shallow Foundations

**80. Before approving the final geotechnical recommendations, for a strip footing, use  $q_{ult}=cN_c+qN_q+0.5\gamma B N_\gamma$ . Given  $c=0$  ksf,  $N_c=30$ ,  $q=1000$  psf,  $N_q=18$ ,  $\gamma=120$  pcf,  $B=6$  ft,  $N_\gamma=15$ , and  $FS=3$ , estimate allowable gross bearing pressure.**

- A. 11.7 ksf
- B. 3.9 ksf
- C. 23.4 ksf
- D. 7.8 ksf

Answer: A B C D

**81. A geotechnical principal verifies the design basis. for a strip footing, use  $q_{ult}=cN_c+qN_q+0.5\gamma B N_\gamma$ . Given  $c=1$  ksf,  $N_c=25$ ,  $q=800$  psf,  $N_q=16$ ,  $\gamma=118$  pcf,  $B=5$  ft,  $N_\gamma=12$ , and  $FS=3$ , estimate allowable gross bearing pressure.**

- A. 16.4 ksf
- B. 2.7 ksf
- C. 5.5 ksf
- D. 8.2 ksf

Answer: A B C D

**82. During a multidisciplinary project risk review, for a strip footing, use  $q_{ult}=cN_c+qN_q+0.5\gamma B N_\gamma$ . Given  $c=0$  ksf,  $N_c=28$ ,  $q=900$  psf,  $N_q=17$ ,  $\gamma=125$  pcf,  $B=8$  ft,  $N_\gamma=14$ , and  $FS=3$ , estimate allowable gross bearing pressure.**

- A. 11.2 ksf
- B. 22.3 ksf
- C. 3.7 ksf
- D. 7.4 ksf

Answer: A B C D

**83. While comparing field performance with design assumptions, for a strip footing, use  $q_{ult}=cN_c+qN_q+0.5\gamma B N_\gamma$ . Given  $c=0$  ksf,  $N_c=32$ ,  $q=1100$  psf,  $N_q=20$ ,  $\gamma=115$  pcf,  $B=7$  ft,  $N_\gamma=18$ , and  $FS=3$ , estimate allowable gross bearing pressure.**

- A. 4.9 ksf
- B. 29.2 ksf
- C. 9.7 ksf
- D. 14.6 ksf

Answer: A B C D

**84. An independent design checker evaluates this condition. a footing loaded eccentrically should be checked for bearing using:**

- A. Pile skin friction
- B. The full area regardless of eccentricity
- C. An effective area and resulting contact-pressure distribution
- D. Only concrete density

Answer: A B C D

**85. Before approving the final geotechnical recommendations, immediate settlement is generally most important in:**

- A. Granular soils
- B. Only frozen soils
- C. Intact rock with no joints
- D. Only organic soils

Answer: A B C D

**86. A geotechnical principal verifies the design basis. primary consolidation settlement is generally most important in:**

- A. Saturated low-permeability clay
- B. Massive granite
- C. Open-graded base
- D. Dry clean gravel

Answer: A B C D

**87. During a multidisciplinary project risk review, if a footing influence zone overlaps a compressible clay layer, increasing footing width generally:**

- A. Extends the stress influence deeper
- B. Makes groundwater irrelevant
- C. Prevents all settlement
- D. Eliminates stress increase

Answer: A B C D

**88. While comparing field performance with design assumptions, for a square footing under a centered vertical load, increasing footing area while holding load constant generally:**

- A. Reverses load direction
- B. Increases average contact pressure
- C. Decreases average contact pressure
- D. Does not affect pressure

Answer: A B C D

## Deep Foundations

**89. An independent design checker evaluates this condition. a pile has unit tip resistance 80 ksf over 4 ft<sup>2</sup> and average unit side resistance 1.2 ksf over 180 ft<sup>2</sup>. Neglect downdrag. determine nominal axial compression resistance?**

- A. 1072 kips
- B. 804 kips
- C. 268 kips
- D. 536 kips

Answer: A B C D

**90. Before approving the final geotechnical recommendations, a pile has unit tip resistance 100 ksf over 3 ft<sup>2</sup> and average unit side resistance 1.0 ksf over 200 ft<sup>2</sup>. Neglect downdrag. determine nominal axial compression resistance?**

- A. 250 kips
- B. 1000 kips
- C. 750 kips
- D. 500 kips

Answer: A B C D

**91. A geotechnical principal verifies the design basis. a pile has unit tip resistance 60 ksf over 5 ft<sup>2</sup> and average unit side resistance 1.5 ksf over 160 ft<sup>2</sup>. Neglect downdrag. determine nominal axial compression resistance?**

- A. 810 kips
- B. 540 kips
- C. 1080 kips
- D. 270 kips

Answer: A B C D

**92. During a multidisciplinary project risk review, a pile has unit tip resistance 90 ksf over 4 ft<sup>2</sup> and average unit side resistance 1.1 ksf over 220 ft<sup>2</sup>. Neglect downdrag. determine nominal axial compression resistance?**

- A. 1204 kips
- B. 602 kips
- C. 903 kips
- D. 301 kips

Answer: A B C D

**93. While comparing field performance with design assumptions, negative skin friction on a pile occurs when:**

- A. The pile is unloaded
- B. Surrounding soil settles more than the pile
- C. Groundwater is absent
- D. The pile settles more than surrounding soil

Answer: A B C D

**94. An independent design checker evaluates this condition. a static pile load test most directly provides:**

- A. Groundwater chemistry
- B. Only concrete slump
- C. Soil color
- D. Load-movement behavior

Answer: A B C D

**95. Before approving the final geotechnical recommendations, dynamic pile testing during driving is commonly used to estimate:**

- A. Consolidation index only
- B. Atterberg limits
- C. Capacity and driving stresses
- D. Rock mineralogy

Answer: A B C D

**96. A geotechnical principal verifies the design basis. crosshole sonic logging is used primarily to assess:**

- A. Wall earth pressure
- B. Concrete integrity between access tubes in drilled shafts
- C. Pile axial load directly
- D. Soil classification

Answer: A B C D

**97. During a multidisciplinary project risk review, a pile group in clay may need capacity checked as:**

- A. A shallow footing only
- B. Both sum of individual capacities and a block
- C. Individual piles only
- D. A retaining wall only

Answer: A B C D

**98. While comparing field performance with design assumptions, for laterally loaded piles, near-surface soil response is important because:**

- A. Bending and deflection are strongly influenced by upper soil resistance
- B. The pile has no stiffness
- C. Axial friction is zero
- D. Tip resistance alone controls

Answer: A B C D

**99. An independent design checker evaluates this condition. driven displacement piles installed in loose sand commonly cause:**

- A. Loss of all shaft resistance
- B. Densification and possible heave of nearby piles
- C. Liquefaction in every case
- D. No ground movement

Answer: A B C D

**100. Before approving the final geotechnical recommendations, a drilled shaft socketed into rock develops resistance from:**

- A. Only buoyancy
- B. Hydrostatic pressure only
- C. Only pile cap weight
- D. Side shear and/or base resistance, depending on design assumptions

Answer: A B C D

# Answer Key

|         |         |         |         |         |         |         |         |         |          |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| 1<br>B  | 2<br>A  | 3<br>D  | 4<br>A  | 5<br>C  | 6<br>C  | 7<br>B  | 8<br>B  | 9<br>B  | 10<br>A  |
| 11<br>C | 12<br>B | 13<br>C | 14<br>D | 15<br>B | 16<br>C | 17<br>C | 18<br>B | 19<br>A | 20<br>C  |
| 21<br>C | 22<br>C | 23<br>B | 24<br>D | 25<br>B | 26<br>A | 27<br>A | 28<br>A | 29<br>B | 30<br>A  |
| 31<br>C | 32<br>A | 33<br>D | 34<br>A | 35<br>C | 36<br>B | 37<br>A | 38<br>A | 39<br>B | 40<br>A  |
| 41<br>B | 42<br>C | 43<br>B | 44<br>A | 45<br>A | 46<br>B | 47<br>D | 48<br>D | 49<br>C | 50<br>C  |
| 51<br>D | 52<br>D | 53<br>A | 54<br>D | 55<br>D | 56<br>B | 57<br>B | 58<br>C | 59<br>C | 60<br>C  |
| 61<br>B | 62<br>D | 63<br>D | 64<br>B | 65<br>D | 66<br>A | 67<br>D | 68<br>C | 69<br>B | 70<br>D  |
| 71<br>C | 72<br>B | 73<br>D | 74<br>B | 75<br>B | 76<br>A | 77<br>C | 78<br>C | 79<br>C | 80<br>B  |
| 81<br>B | 82<br>C | 83<br>A | 84<br>C | 85<br>A | 86<br>A | 87<br>A | 88<br>C | 89<br>D | 90<br>D  |
| 91<br>B | 92<br>B | 93<br>B | 94<br>D | 95<br>C | 96<br>B | 97<br>B | 98<br>A | 99<br>B | 100<br>D |

Use this score as a study diagnostic, not as a predicted licensing result. Review correct guesses as well as missed questions.

## Worked Solutions

### Site Characterization

1. B - Recovery = recovered length/run length  $\times 100 = 42/5 \times 100 = 840\%$ .
2. A - Recovery = recovered length/run length  $\times 100 = 48/6 \times 100 = 800\%$ .
3. D - Recovery = recovered length/run length  $\times 100 = 36/5 \times 100 = 720\%$ .
4. A - Recovery = recovered length/run length  $\times 100 = 44/5 \times 100 = 880\%$ .
5. C - RQD = qualifying sound-core length/run length  $\times 100 = 18/24 \times 100 = 75\%$ .
6. C - RQD = qualifying sound-core length/run length  $\times 100 = 20/30 \times 100 = 67\%$ .
7. B - RQD = qualifying sound-core length/run length  $\times 100 = 15/25 \times 100 = 60\%$ .
8. B - RQD = qualifying sound-core length/run length  $\times 100 = 22/28 \times 100 = 79\%$ .
9. B - CPT provides a nearly continuous sounding of cone tip resistance and sleeve friction.
10. A - A thin-walled tube minimizes disturbance in soft cohesive soils.
11. C - More than 50% passing No. 200 makes the soil fine-grained; LL and PI then distinguish silt/clay.
12. B - A standpipe piezometer measures hydraulic head/groundwater elevation.

### Soil Mechanics, Laboratory Testing, and Analysis

13. C -  $S = wGs/e = 0.18(2.70)/0.65 = 0.748$ , or 75%.
14. D -  $S = wGs/e = 0.22(2.65)/0.75 = 0.777$ , or 78%.
15. B -  $S = wGs/e = 0.15(2.68)/0.55 = 0.731$ , or 73%.
16. C -  $S = wGs/e = 0.25(2.72)/0.82 = 0.829$ , or 83%.
17. C -  $\sigma'v = \sigma v - u = 120(15) - 500 = 1,300$  psf.
18. B -  $\sigma'v = \sigma v - u = 118(20) - 800 = 1,560$  psf.
19. A -  $\sigma'v = \sigma v - u = 125(12) - 420 = 1,080$  psf.
20. C -  $\sigma'v = \sigma v - u = 115(18) - 650 = 1,420$  psf.
21. C -  $S = H Cc/(1+e0) \log_{10}(\sigma'f/\sigma'0) = 12(0.28)/(1+0.8)\log_{10}(2.0) = 6.7$  in.
22. C -  $S = H Cc/(1+e0) \log_{10}(\sigma'f/\sigma'0) = 10(0.22)/(1+0.7)\log_{10}(1.8) = 4.0$  in.
23. B -  $S = H Cc/(1+e0) \log_{10}(\sigma'f/\sigma'0) = 15(0.3)/(1+0.9)\log_{10}(1.5) = 5.0$  in.
24. D -  $S = H Cc/(1+e0) \log_{10}(\sigma'f/\sigma'0) = 8(0.18)/(1+0.6)\log_{10}(2.5) = 4.3$  in.

### Construction Observation, Monitoring, QA/QC, and Safety

25. B -  $\gamma_d = \gamma/(1+w) = 126/1.08 = 116.7$  pcf.
26. A -  $RC = 116/121 \times 100 = 95.9\%$ .
27. A - An inclinometer measures lateral deformation versus depth.
28. A - Rapid loading of low-permeability soil generates excess pore pressure and reduces effective stress.
29. B - Compaction acceptance compares field dry density and moisture with a laboratory Proctor curve.
30. A - Protective systems are generally required at 5 ft or deeper unless the excavation is entirely in stable rock.
31. C - Proofrolling is intended to identify unstable zones requiring undercutting, drying, stabilization, or other remediation.
32. A - The plate provides a reference for vertical settlement of the underlying foundation/fill.

### Earthquake Engineering and Dynamic Loads

33. D - Loose, saturated, cohesionless soils are most susceptible to cyclic pore-pressure buildup.
34. A - The pseudo-static method applies an equivalent inertial force, commonly  $khW$ .
35. C -  $F_h = khW = 0.15(2,000) = 300$  kips.
36. B - Measured SPT  $N$  is normalized, including energy and overburden corrections.
37. A - Contractive tendency under undrained cyclic loading raises pore pressure and reduces effective stress.
38. A - Soft deposits commonly amplify motions and lengthen site period relative to rock.
39. B - CRR is the soil's cyclic resistance; it is compared with cyclic stress ratio demand.

### Earth Structures, Ground Improvement, and Pavement

40. A -  $FS = (c' L + N \tan \phi')/T = [0(120) + 180 \tan 30^\circ]/90 = 1.15$ .

41. B -  $FS = (c' + N \tan \phi')/T = [0(140) + 190 \tan 32^\circ]/90 = 1.32$ .
42. C -  $FS = (c' + N \tan \phi')/T = [5(100) + 170 \tan 28^\circ]/90 = 6.56$ .
43. B -  $FS = (c' + N \tan \phi')/T = [0(160) + 210 \tan 35^\circ]/90 = 1.63$ .
44. A - Vertical drains shorten the drainage path and accelerate consolidation under surcharge.
45. A - Lime reduces plasticity and improves workability/strength in many clayey soils.
46. B - Separation maintains aggregate-base integrity by limiting mixing with subgrade.
47. D - A filter must retain the base soil while allowing drainage without excessive clogging.
48. D - Reinforcement supplies tensile resistance across potential failure surfaces.
49. C - Surcharge/preloading causes consolidation in advance, reducing postconstruction settlement.
50. C - Lower subgrade support requires additional pavement/base structural capacity.
51. D - Filters and drains control pore pressures while preventing migration of soil particles.
52. D - Sliding may localize along the weakest geosynthetic/soil or geosynthetic/geosynthetic interface.
53. A - Aggregate piers reinforce the soil mass, share load, and may provide drainage.

## Groundwater and Seepage

54. D -  $Q = k_i A = 0.002(0.5)(100) = 0.100 \text{ ft}^3/\text{s}$ .
55. D -  $Q = k_i A = 0.001(0.8)(150) = 0.120 \text{ ft}^3/\text{s}$ .
56. B -  $Q = k_i A = 0.003(0.4)(80) = 0.096 \text{ ft}^3/\text{s}$ .
57. B - At the critical upward gradient, seepage force offsets submerged unit weight and effective stress approaches zero.
58. C - Closely spaced wellpoints are commonly used to lower groundwater in sands.
59. C - A low-permeability cutoff lengthens/intercepts the seepage path and reduces flow.

## Problematic Soil and Rock Conditions

60. C - Expansive minerals swell as water content increases.
61. B - Wetting destroys metastable bonding/fabric, producing collapse under load.
62. D - Water migration to the freezing front is essential for ice-lens growth.
63. D - Karst commonly features voids, pinnacles, sinkholes, and highly irregular rockhead.
64. B - Low soil resistivity is a key indicator of potential electrochemical corrosion.
65. D - Scaling removes loose blocks; mesh, anchors, and catchments control remaining hazards.

## Retaining Structures

66. A -  $K_a = (1 - \sin \phi)/(1 + \sin \phi) = 0.268$ ;  $P_a = \frac{1}{2} K_a \gamma H^2 = 2.3 \text{ kip/ft}$ , acting  $H/3$  above the base.
67. D -  $K_a = (1 - \sin \phi)/(1 + \sin \phi) = 0.231$ ;  $P_a = \frac{1}{2} K_a \gamma H^2 = 3.1 \text{ kip/ft}$ , acting  $H/3$  above the base.
68. C -  $K_a = (1 - \sin \phi)/(1 + \sin \phi) = 0.306$ ;  $P_a = \frac{1}{2} K_a \gamma H^2 = 1.9 \text{ kip/ft}$ , acting  $H/3$  above the base.
69. B -  $K_a = (1 - \sin \phi)/(1 + \sin \phi) = 0.176$ ;  $P_a = \frac{1}{2} K_a \gamma H^2 = 2.0 \text{ kip/ft}$ , acting  $H/3$  above the base.
70. D -  $K_a = (1 - \sin \phi)/(1 + \sin \phi) = 0.268$ ;  $P_a = \frac{1}{2} K_a \gamma H^2 = 5.3 \text{ kip/ft}$ , acting  $H/3$  above the base.
71. C - The centroid of a triangle increasing with depth is  $H/3$  above its base.
72. B - A uniform surcharge produces uniform lateral pressure  $K_a q$ .
73. D - Full passive resistance requires relatively large movement and may not remain available.
74. B - Drainage prevents water pressure from adding to lateral earth loads.
75. B - External stability includes sliding, overturning/eccentricity, and foundation bearing/global stability.
76. A - Anchors transfer tensile load into stable ground behind the potential failure zone.
77. C - Struts brace opposing walls and are principally compression members.
78. C - Underpinning provides deeper or supplemental support to protect existing foundations.
79. C - Soil nail walls are commonly built top-down with excavation lifts, nails, and facing.

## Shallow Foundations

80. B -  $q_{ult} = 23,400 \text{ psf}$ ;  $q_{all} = q_{ult}/3 = 7,800 \text{ psf} = 3.9 \text{ ksf}$ .
81. B -  $q_{ult} = 16,365 \text{ psf}$ ;  $q_{all} = q_{ult}/3 = 5,455 \text{ psf} = 2.7 \text{ ksf}$ .
82. C -  $q_{ult} = 22,300 \text{ psf}$ ;  $q_{all} = q_{ult}/3 = 7,433 \text{ psf} = 3.7 \text{ ksf}$ .
83. A -  $q_{ult} = 29,245 \text{ psf}$ ;  $q_{all} = q_{ult}/3 = 9,748 \text{ psf} = 4.9 \text{ ksf}$ .
84. C - Eccentricity reduces effective bearing area and can create nonuniform contact pressure.

- 85. A - Granular soils drain rapidly, so settlement is predominantly immediate.
- 86. A - Slow dissipation of excess pore pressure governs time-dependent settlement in saturated clay.
- 87. A - Wider loaded areas influence stresses to greater depths.
- 88. C - Average contact pressure  $q=P/A$  decreases as area increases.

### Deep Foundations

- 89. D -  $Q_n = q_p A_p + f_s A_s = 80(4) + 1.2(180) = 536$  kips.
- 90. D -  $Q_n = q_p A_p + f_s A_s = 100(3) + 1.0(200) = 500$  kips.
- 91. B -  $Q_n = q_p A_p + f_s A_s = 60(5) + 1.5(160) = 540$  kips.
- 92. B -  $Q_n = q_p A_p + f_s A_s = 90(4) + 1.1(220) = 602$  kips.
- 93. B - Downward relative movement of soil drags the pile, adding downdrag load.
- 94. D - The test measures applied load and corresponding pile-head movement.
- 95. C - Wave measurements can estimate mobilized resistance, stresses, and hammer performance.
- 96. B - CSL identifies anomalous zones in drilled-shaft concrete between tubes.
- 97. B - Group failure may occur by individual pile resistance or as a block; the governing mode controls.
- 98. A - Lateral load transfer and maximum bending commonly involve the upper portion of the pile-soil system.
- 99. B - Displacement driving can densify sand and displace soil, sometimes heaving adjacent piles.
- 100. D - Rock sockets can mobilize side shear and base bearing subject to construction quality and design criteria.

## Performance Tracker

| Knowledge area                                          | Correct | Total | Review notes |
|---------------------------------------------------------|---------|-------|--------------|
| Site Characterization                                   |         | 12    |              |
| Soil Mechanics, Laboratory Testing, and Analysis        |         | 12    |              |
| Construction Observation, Monitoring, QA/QC, and Safety |         | 8     |              |
| Earthquake Engineering and Dynamic Loads                |         | 7     |              |
| Earth Structures, Ground Improvement, and Pavement      |         | 14    |              |
| Groundwater and Seepage                                 |         | 6     |              |
| Problematic Soil and Rock Conditions                    |         | 6     |              |
| Retaining Structures                                    |         | 14    |              |
| Shallow Foundations                                     |         | 9     |              |
| Deep Foundations                                        |         | 12    |              |

Prioritize knowledge areas that remain below your overall average. Redo missed calculations without viewing the worked solution.