

GERTC CIVIL ENGINEERING (CE) HYDRAULICS AND PRINCIPLES OF GEOTECHNICAL ENGINEERING (HPGE) PAST BOARD PRACTICE EXAM (SAMPLE)

STUDY GUIDE



SAMPLE STUDY GUIDE WITH LIMITED QUESTIONS

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THE FULL VERSION STUDY GUIDE**

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Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- Practice answering questions under realistic conditions,
- Improve accuracy and speed,
- Review explanations to strengthen weak areas, and
- Approach the exam with greater confidence.

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here's how to get the most out of your Examzify study guide:

1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Your goal is to identify knowledge gaps early.

2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations.

3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

6. Repeat and Review

Don't just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning. Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There's no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly, adapt the tips above to fit your pace and learning style. You've got this!

Questions

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- 1. Which foundation condition does not affect the bearing capacity of the supporting soil?**
 - A. Load imposed onto the soil
 - B. Soil moisture content
 - C. Soil type
 - D. Foundation depth

- 2. The friction angle in soil mechanics is used to describe which soil property?**
 - A. Cohesion
 - B. Porosity
 - C. Friction angle
 - D. Pore pressure

- 3. Which term quantifies the empty spaces within a soil relative to the total soil volume?**
 - A. Porosity
 - B. Degree of saturation
 - C. Moisture content
 - D. Bulk density

- 4. The shear strength is ____.**
 - A. Directly proportional to cohesion
 - B. Inversely proportional to friction angle
 - C. Independent of cohesion
 - D. Proportional to density

- 5. Which of the following is not affected by minor loss?**
 - A. Long pipe
 - B. Elbow fitting
 - C. Valve
 - D. Bend

- 6. What are common methods to improve soil stability and bearing capacity in geotechnical practice?**
- A. Compaction, stabilization, drainage, reinforcement, grouting, soil nailing, controlled drainage.
 - B. Only compaction.
 - C. Only drainage.
 - D. Only reinforcement.
- 7. A venturi meter measures discharge by relating a differential pressure across the throat to flow. Which statement best describes its principle?**
- A. It uses a converging-diverging throat and a direct reading of discharge from the upstream reservoir without pressure measurement.
 - B. It relies on a simple relationship between upstream velocity and discharge with no pressure difference.
 - C. It estimates discharge from the pressure difference across an orifice using a fixed discharge coefficient, independent of geometry.
 - D. It uses a converging-diverging throat and Bernoulli/continuity to infer Q from ΔP between upstream and throat.
- 8. A phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading is called what?**
- A. Consolidation
 - B. Liquefaction
 - C. Compaction
 - D. Dilation
- 9. What is the difference between flow nets and standard penetration tests in terms of information they provide for geotechnical design?**
- A. Flow nets estimate seepage velocity; SPT measures density.
 - B. Flow nets estimate seepage and pore pressures; SPT provides in-situ density/strength indicators used to assess bearing capacity and settlement.
 - C. Flow nets measure seepage velocity; SPT measures magnetic resonance.
 - D. Flow nets measure soil color; SPT measures grain size distribution.

10. The ratio of the volume of voids to the total volume is called?

- A. Degree of saturation
- B. Porosity
- C. Permeability
- D. Void ratio

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Answers

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

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Explanations

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1. Which foundation condition does not affect the bearing capacity of the supporting soil?

A. Load imposed onto the soil

B. Soil moisture content

C. Soil type

D. Foundation depth

Bearing capacity is determined by the soil's own strength and the stress state created by the soil above the footing. The soil type sets the inherent shear strength (through cohesion and friction angle), moisture content changes how that strength is carried (effective stress), and foundation depth changes the overburden pressure and the confining stress that influence the ultimate capacity. The load you put on the soil, however, is the demand the foundation must meet; it does not change the soil's intrinsic strength. So the factor that does not affect the bearing capacity is the load imposed onto the soil.

2. The friction angle in soil mechanics is used to describe which soil property?

A. Cohesion

B. Porosity

C. Friction angle

D. Pore pressure

Friction angle describes how strongly soil grains resist sliding against each other under shear. In Mohr-Coulomb strength, $\text{shear strength} = \text{cohesion} + (\text{effective normal stress}) \times \tan(\phi)$. The friction angle ϕ captures the frictional part of this strength, i.e., how much shear resistance comes from interparticle friction as normal stress increases. It is not cohesion (the bonding term), not porosity (void space), and not pore pressure (fluid pressure in the pores that affects effective stress). So the friction angle tells you the soil's internal frictional resistance to shear.

3. Which term quantifies the empty spaces within a soil relative to the total soil volume?

A. Porosity

B. Degree of saturation

C. Moisture content

D. Bulk density

Porosity measures the fraction of a soil's total volume that consists of void spaces, whether they are air-filled or water-filled. It is defined as the volume of voids divided by the total soil volume ($V_{\text{void}} / V_{\text{total}}$) and is usually expressed as a fraction or percent. This directly captures the idea of the "empty spaces within a soil relative to the total soil volume." The other terms describe different properties: degree of saturation tells you how much of those voids are actually filled with water, not just that voids exist; moisture content relates to how much water is present by mass relative to dry soil, not the geometric space available; bulk density is the total mass per total volume, reflecting how compacted the soil is, not the proportion of voids.

4. The shear strength is _____.

- A. Directly proportional to cohesion
- B. Inversely proportional to friction angle
- C. Independent of cohesion
- D. Proportional to density

The key idea is that shear strength in soils comes from two components: cohesion and friction along particle contacts. In the common Mohr-Coulomb description, shear strength equals cohesion plus the frictional resistance that grows with normal stress ($\tau_f = c' + \sigma' \tan \phi'$). This means that increasing cohesion adds to the shear-strength resistance, and at a given normal stress, more cohesion yields more shear strength in a direct, linear fashion. The other factors—friction angle and normal stress—also boost shear strength, but the cohesion term directly scales the overall resistance, which is why stating that shear strength is directly proportional to cohesion is the best description. The idea that it would be inversely related to friction angle, or independent of cohesion, or simply proportional to density, doesn't fit the standard relationship where cohesion contributes a linear, additive boost to the shear strength.

5. Which of the following is not affected by minor loss?

- A. Long pipe
- B. Elbow fitting
- C. Valve
- D. Bend

In pipe flow, losses split into major losses from friction along the length and minor losses from localized disturbances caused by fittings and components. A long straight pipe without any fittings experiences head loss only from friction along its length—not from a localized change in flow, so it does not involve a minor loss term. The other items—an elbow or bend that changes the flow direction, and a valve that adds resistance—create abrupt flow disturbances and contribute to minor losses, which are quantified by loss coefficients. Therefore, the long straight pipe is not affected by minor losses, while the elbow, bend, and valve produce them.

6. What are common methods to improve soil stability and bearing capacity in geotechnical practice?

- A. Compaction, stabilization, drainage, reinforcement, grouting, soil nailing, controlled drainage.**
- B. Only compaction.
- C. Only drainage.
- D. Only reinforcement.

Stability and bearing capacity in soils are improved by addressing several key mechanisms at once: increasing soil mass and density, boosting strength and stiffness, controlling pore pressures, and providing external support when needed. Compaction raises density and reduces voids, which increases dry strength and rigidity in granular fills and improves bearing capacity when drainage is considered so pore pressures don't negate the gains. Stabilization adds cementitious or chemical bonds to the soil matrix, enhancing cohesion and stiffness, particularly useful for fine-grained or problematic soils where natural strength is low. Drainage plays a crucial role by lowering pore water pressure, which raises the effective stress and thus the shear strength and bearing capacity. In many projects, simply compacting isn't enough if water pressures remain high; drainage either alone or in combination with other methods ensures stability under load. Reinforcement introduces tensile resistance through geosynthetics, nails, or other anchors, helping distribute loads, control deformations, and improve stability in slopes or weak soils without requiring full excavation. Grouting fills voids and stiffens the ground, reducing settlement and permeability, creating a more capable composite material for support and loading. Soil nailing provides active stabilization by anchoring soil masses, especially in excavation walls or unstable slopes, to resist movement. Controlled drainage manages water flow and pressure over the project life, maintaining stability during construction and service. Using this mix of techniques, rather than relying on a single method, is common because each method targets different aspects of stability and bearing capacity. The other options offer only one approach, which is often insufficient to meet practical performance requirements across varied soils and loading scenarios.

7. A venturi meter measures discharge by relating a differential pressure across the throat to flow. Which statement best describes its principle?

- A. It uses a converging-diverging throat and a direct reading of discharge from the upstream reservoir without pressure measurement.
- B. It relies on a simple relationship between upstream velocity and discharge with no pressure difference.
- C. It estimates discharge from the pressure difference across an orifice using a fixed discharge coefficient, independent of geometry.
- D. It uses a converging-diverging throat and Bernoulli/continuity to infer Q from ΔP between upstream and throat.**

Venturi meters rely on converting a change in pressure into a change in velocity through a smooth, converging-diverging throat. As fluid speeds up in the throat, its static pressure drops. By measuring the pressure difference between the upstream section and the throat and knowing the pipe geometry, you apply Bernoulli's equation and the continuity relation ($Q = A_1 v_1 = A_2 v_2$) to solve for the volumetric discharge. In other words, the flow rate is inferred from how the pressure drop across the throat relates to the velocity change, with geometry and density fixed inputs. This principle is what makes a venturi meter capable of relating ΔP to Q , unlike simple orifice or velocity-only approaches.

8. A phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading is called what?

- A. Consolidation
- B. Liquefaction**
- C. Compaction
- D. Dilation

When soils are saturated and experience rapid loading like earthquake shaking, excess pore water pressure builds up quickly. This raises the water pressure in the pore spaces while the soil skeleton can't drain fast enough, so the effective stress that holds the grains together drops. With lower effective stress, shear strength and stiffness plummet, and the soil can behave like a liquid. This rapid loss of strength and stiffness under shaking is liquefaction. It's most common in loose, saturated sands and silts under undrained, cyclic loading. By contrast, consolidation is slow drainage under static loads, compaction is densification under static loading, and dilation refers to a volume increase tendency in dense soils during shear—none of which describe the rapid, earthquake driven strength drop described here.

9. What is the difference between flow nets and standard penetration tests in terms of information they provide for geotechnical design?

- A. Flow nets estimate seepage velocity; SPT measures density.
- B. Flow nets estimate seepage and pore pressures; SPT provides in-situ density/strength indicators used to assess bearing capacity and settlement.**
- C. Flow nets measure seepage velocity; SPT measures magnetic resonance.
- D. Flow nets measure soil color; SPT measures grain size distribution.

The main idea is that flow nets provide information about hydraulic behavior in soils, while the Standard Penetration Test (SPT) provides in-situ mechanical state indicators. Flow nets are used to visualize seepage through a soil mass, showing seepage paths, the discharge along those paths, and the distribution of pore-water pressures (which relate to seepage velocity). This hydraulic information helps assess issues like piping, hydraulic stability, and the need for drainage or barriers. SPT, performed in the field, measures how resistant the soil is to penetration. Those resistance values correlate with soil density for granular soils and with consistency/strength for cohesive soils. Engineers use these indicators to evaluate bearing capacity and potential settlements, supplying the mechanical side of design rather than the hydraulic behavior. So, the correct interpretation is that flow nets give seepage and pore-pressure/hydraulic information, while SPT gives in-situ density and strength indicators used to assess bearing capacity and settlement.

10. The ratio of the volume of voids to the total volume is called?

- A. Degree of saturation
- B. Porosity**
- C. Permeability
- D. Void ratio

Porosity is the fraction of a material's volume that is pore space. It is defined as the volume of voids divided by the total volume, V_v / V_t , where total volume equals the sum of solids and voids. This directly matches the idea of how much of the material's volume is available for fluids like air or water. Other terms describe different aspects: degree of saturation is how much of the void space is filled with water (V_w / V_v), not the share of the total volume; permeability concerns how easily fluids can move through the pore network, which depends on pore connectivity and size rather than a simple volume ratio; void ratio compares voids to solids (V_v / V_s), not to the total volume.

Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we'd love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

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We wish you the very best on your exam journey. You've got this!

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