

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

STUDY GUIDE



SAMPLE STUDY GUIDE WITH LIMITED QUESTIONS

**VISIT US ONLINE FOR
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 tests are typically used to obtain drained shear strength parameters c' and ϕ' ?**
 - A. UU triaxial tests.
 - B. CU triaxial tests with pore pressure control.
 - C. CD triaxial or CA triaxial tests.
 - D. Proctor compaction tests.
- 2. The ratio between the volume of voids and the volume of the soil mass is known as what?**
 - A. Porosity
 - B. Degree of saturation
 - C. Moisture content
 - D. Bulk density
- 3. Explain seepage force and its effect on earth pressure behind a retaining structure.**
 - A. Seepage forces act in the flow direction, reducing effective stress and earth pressures behind the wall; seepage can also cause uplift and piping if not controlled.
 - B. Seepage forces increase pore pressure only in the upstream, with no effect on earth pressure.
 - C. Seepage forces have no effect on foundation stresses.
 - D. Seepage forces change gravity.
- 4. Which of the following is not affected by minor loss?**
 - A. Long pipe
 - B. Elbow fitting
 - C. Valve
 - D. Bend
- 5. Which Atterberg limit defines the water content at which soil changes from semisolid to plastic?**
 - A. The liquid limit is the water content at which soil changes from liquid to plastic.
 - B. The plasticity index equals LL minus PL.
 - C. Plastic limit is the water content at which soil changes from semisolid to plastic.
 - D. Shrinkage limit is the water content at which soil changes from plastic to solid.

- 6. A relative density D_r approaching 100% indicates which condition?**
- A. Very dense soil
 - B. Very loose soil
 - C. Moderately dense soil
 - D. Spherical soil structure
- 7. For a floating body to be stable, where is the metacenter located relative to the center of gravity?**
- A. Below CG
 - B. At CG
 - C. Above CG
 - D. At the center of buoyancy
- 8. If the deviator stress is increased in a soil sample, the shear stress will increase on which plane?**
- A. Horizontal plane
 - B. Vertical plane
 - C. Diagonal plane
 - D. Circular plane
- 9. In pipe networks, what is the Hardy Cross method used for?**
- A. A direct method to solve for node pressures using linear equations.
 - B. An optimization method to minimize energy losses in a network.
 - C. A method to compute minor losses coefficients.
 - D. An iterative method to balance head losses around loops so that Kirchhoff's laws are satisfied.
- 10. Which of the following shear tests of soil is not performed in a laboratory?**
- A. Triaxial shear test
 - B. Direct shear test
 - C. Unconfined compression test
 - D. Shear vane test

Answers

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

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Explanations

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1. Which tests are typically used to obtain drained shear strength parameters c' and ϕ' ?

- A. UU triaxial tests.
- B. CU triaxial tests with pore pressure control.
- C. CD triaxial or CA triaxial tests.**
- D. Proctor compaction tests.

Drainage during shear is essential to measure c' and ϕ' because these parameters are defined under effective stress. In a drained triaxial test, the sample is consolidated under a chosen confining pressure, then sheared with a drainage path open so pore water can escape and pore pressures stay essentially zero or controlled. The measured shear strength at failure, for different confining pressures, reflects $\tau_f = c' + \sigma'_n \tan \phi'$. By plotting this strength against the corresponding effective confining stress across the tests, you obtain a straight line whose intercept is the effective cohesion c' and whose slope is $\tan \phi'$. Consolidated drained tests (CD) and related drained configurations (CA) are the standard ways to obtain these parameters. In contrast, tests that prevent drainage or keep pore pressures high (like UU or CU) do not provide accurate drained c' and ϕ' because the effective stress changes with pore pressure during loading. Proctor tests, meanwhile, are for compaction, not shear strength.

2. The ratio between the volume of voids and the volume of the soil mass is known as what?

- A. Porosity**
- B. Degree of saturation
- C. Moisture content
- D. Bulk density

Porosity is the fraction of a soil's bulk volume that is void space. It is defined as V_v / V_t , where V_v is the volume of voids and V_t is the total volume of the soil (solid plus voids). This ratio tells you how much space is available within the soil to hold water or air, which directly impacts drainage, storage, and permeability. The other terms describe different properties: degree of saturation refers to how much of the pore space is filled with water; moisture content is the mass of water per unit dry soil mass; bulk density is the total mass of soil per total volume.

3. Explain seepage force and its effect on earth pressure behind a retaining structure.

- A. Seepage forces act in the flow direction, reducing effective stress and earth pressures behind the wall; seepage can also cause uplift and piping if not controlled.**
- B. Seepage forces increase pore pressure only in the upstream, with no effect on earth pressure.
- C. Seepage forces have no effect on foundation stresses.
- D. Seepage forces change gravity.

Seepage forces come from water moving through the soil behind a retaining wall. As water flows, it raises pore pressure in the soil. Since soil stress is governed by the relation between total stress and pore pressure (effective stress = total stress minus pore pressure), higher pore pressures mean lower effective stress. The lateral earth pressure that a soil mass can mobilize against a wall depends on that effective stress and the soil's strength. When seepage raises pore pressure, the soil becomes weaker and its ability to push back on the wall for a given wall displacement decreases, so the mobilized earth pressure behind the wall is reduced. In addition, the seepage flow itself produces a hydraulic thrust in the direction of flow, which acts on the soil and on the wall. This flow force can contribute to uplift tendencies at the base of the wall if the vertical component of seepage pressure becomes significant, and it is a classic cause of instability if not controlled. If seepage is unchecked, the same flow that reduces effective stress can also lead to piping, an internal erosion mechanism that undermines stability. So the main idea is that seepage raises pore pressure and reduces effective stress, diminishing the earth pressures that the soil behind a retaining wall can mobilize, while the seepage forces themselves produce hydraulic thrust and, without proper measures, uplift and piping risks.

4. 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.

5. Which Atterberg limit defines the water content at which soil changes from semisolid to plastic?

- A. The liquid limit is the water content at which soil changes from liquid to plastic.
- B. The plasticity index equals LL minus PL.
- C. Plastic limit is the water content at which soil changes from semisolid to plastic.**
- D. Shrinkage limit is the water content at which soil changes from plastic to solid.

The main idea is how a fine-grained soil changes its consistency as moisture increases. As water content rises, soil transitions from solid to semisolid, then to plastic, and finally to liquid. The boundary between semisolid and plastic is defined as the plastic limit. In practice, this limit is determined by rolling a soil sample into threads until it just crumbles at a 3 mm diameter; the moisture content at that moment is the plastic limit. This is why this option correctly identifies the water content where the soil changes from semisolid to plastic. The other limits describe the other transitions: the liquid limit is between plastic and liquid, the shrinkage limit is between plastic and solid, and the plasticity index is LL minus PL.

6. A relative density D_r approaching 100% indicates which condition?

- A. Very dense soil**
- B. Very loose soil
- C. Moderately dense soil
- D. Spherical soil structure

Relative density measures how tightly packed the particles in a granular soil are, compared to its loosest and densest packing states. It's defined so that as the void ratio e approaches the minimum possible value (e_{min}), the relative density approaches 100%. So when D_r is near 100%, the soil is effectively as dense as its grain arrangement allows, with very little void space and high contact between particles. That is why approaching 100% indicates a very dense soil. The other options don't fit this behavior. A very loose soil corresponds to a D_r near zero, because it's near its loosest packing with large void spaces. A moderately dense soil sits somewhere in the middle of the scale. The idea of a spherical soil structure isn't a material state described by relative density.

7. For a floating body to be stable, where is the metacenter located relative to the center of gravity?

A. Below CG

B. At CG

C. Above CG

D. At the center of buoyancy

Stability of a floating body depends on where the metacenter lies relative to the center of gravity. When the vessel heels, the center of buoyancy shifts to align with the new submerged shape, and the buoyant force line moves. The intersection of this shifted buoyant-force line with the original vertical line through the center of gravity defines the metacenter. If the metacenter sits above the center of gravity, the weight and buoyant forces form a restoring couple that tends to bring the body back upright. For small tilts, the restoring moment is proportional to the weight times the metacentric height (GM) times the sine of the heel angle, so a positive GM means stability. If the metacenter were at or below the center of gravity, the righting moment would be zero (neutral) or negative (unstable), leading to tipping rather than righting. Therefore, a stable floating body has the metacenter located above the center of gravity.

8. If the deviator stress is increased in a soil sample, the shear stress will increase on which plane?

A. Horizontal plane

B. Vertical plane

C. Diagonal plane

D. Circular plane

When you apply deviator stress, the distribution of shear inside the soil is described by Mohr's circle. The deviator stress q equals the difference between the principal stresses ($\sigma_1 - \sigma_3$), and increasing q makes the circle larger. The shear on a plane that makes an angle θ with the major principal plane is $\tau = (\sigma_1 - \sigma_3)/2 \cdot \sin(2\theta)$. As q grows, the shear reaches its maximum on planes inclined 45° to the major principal plane (the diagonal planes), where $\tau_{\max} = q/2$. The horizontal plane, which is perpendicular to the major principal stress, is a principal plane and has zero shear regardless of q . The vertical plane aligned with the minor principal direction is another principal plane with zero shear. Thus, the shear stress that increases with deviator stress is found on the diagonal plane, not on the horizontal plane.

9. In pipe networks, what is the Hardy Cross method used for?

- A. A direct method to solve for node pressures using linear equations.
- B. An optimization method to minimize energy losses in a network.
- C. A method to compute minor losses coefficients.
- D. An iterative method to balance head losses around loops so that Kirchhoff's laws are satisfied.**

Hardy Cross is an iterative loop-balancing technique for pipe networks. The idea is to adjust assumed loop flows so that the sum of head losses around every closed loop equals zero, enforcing energy conservation along with mass conservation at the nodes. You start with initial guesses for loop flows, compute the head loss in each pipe (using the chosen loss formula), then check the imbalance around each loop. A loop correction is calculated and distributed to the pipes in that loop according to their resistance, and flows are updated. This process is repeated until the loop sums of head losses are essentially zero. In this way, the method satisfies Kirchhoff's laws for the network without solving a single large direct set of equations, and it handles non-linear head-loss relationships (like Darcy–Weisbach) through iterative updates. Minor losses can be included in the head-loss terms if needed, but the core purpose is balancing major head losses around loops to achieve a consistent flow solution.

10. Which of the following shear tests of soil is not performed in a laboratory?

- A. Triaxial shear test
- B. Direct shear test
- C. Unconfined compression test
- D. Shear vane test**

The main idea is distinguishing between field and laboratory tests for soil shear strength. The in-situ, field-based vane shear test measures undrained shear strength directly in the ground by inserting a four-blade vane and applying torque. This approach preserves the soil's in-situ condition and provides a quick strength estimate for cohesive soils, which makes it a field test. In contrast, the triaxial shear test, direct shear test, and unconfined compression test are standard laboratory tests. They require preparing a soil specimen, controlling confining pressure, moisture content, and density, and measuring strength under well-defined test conditions. That controlled, sample-based approach is why those tests are performed in the lab, while the vane test is typically used in the field for rapid, in-situ assessment.

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:

<https://gertccehpgepastboard.examzify.com>

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

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