

Geotechnical Engineering 2010

Information for Applicants

Professional Engineers Specialist Registration Examination On Geotechnical Engineering 2010

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Annex A: FORMAT AND SYLLABUS

Professional Engineers Specialist Registration Examination On Geotechnical Engineering 2010

Information for Applicants

1 INTRODUCTION

The Professional Engineers Act provides for the registration of specialist professional engineer. In particular, a professional engineer registered in the branch of civil engineering may apply to the Professional Engineers Board to be registered as a specialist professional engineer in geotechnical engineering.

To apply for registration, the applicant must have in force a valid practicing certificate. He must possess the requisite number of years of recognised practical experience, a certain number of which must be in geotechnical engineering. He is also required to have a post-graduate engineering degree (such as M.Sc or PhD) majoring in geotechnical engineering or **sat and passed a specialist registration examination on geotechnical engineering conducted by the Board.**

The following sections set out the requirements and details for the specialist registration examination on geotechnical engineering while details on other application requirements are available on the PEB website at www.peb.gov.sg.

2 ELIGIBILITY TO SIT FOR EXAMINATION

A professional engineer registered in the branch of civil engineering may apply to sit for the specialist registration examination on geotechnical engineering conducted by the Board.

3 FEES

The fees for an application to sit for the specialist registration examination on geotechnical engineering is \$1200.

4 DATES OF EXAMINATION

The date for the specialist registration examination on geotechnical engineering is 28 Sep 2010.

5 VENUE

Details of the venue would be given to successful applicants at a later date.

6 APPLICATION FORMS

Application forms can be downloaded from the PEB website at <http://www.peb.gov.sg>. All applications are to be submitted to PEB with applicable fees and documents by 15 Jul 2010 latest. Applicants are advised to send in their applications early to allow time for processing. They would be informed of the status of their applications and other details by post at least two weeks before the examinations.

7 STRUCTURE OF EXAMINATION

A summary of the structure of the examination is shown in the table below. The examination is 'open book' and further details are given in **Annex A: Format and Syllabus**.

| Subjects | Time Allocated | Format |
|--|---------------------------|---|
| <u>Part 1</u> Covers almost all disciplines of geotechnical engineering involving both soil and rock mechanics as well as Singapore geology | 2 hours (9 am - 11 am) | <ul style="list-style-type: none"> Multiple Choice Questions (MCQ) |
| <u>Part 2</u> Covers two compulsory topics on site investigation and soil properties plus four specific topics on excavation, building foundations, tunneling and slope stability | 4 hours (1 pm – 5 pm) | <ul style="list-style-type: none"> Answer 2 compulsory questions on site investigation and soil properties Answer 2 out of 4 questions on specific topics |

8 FINAL RESULTS AND NOTIFICATION

Examination results will be given to candidates on a Pass/Fail basis. No examination scores or marks will be given to candidates. Examination results are mailed to the candidates within twelve weeks after the examination.

9 EXAMINATION APPEALS

A candidate who has failed the examination may submit a written appeal to review his/her performance together with a payment of \$25. The appeal is to be made within 2 weeks after the receipt of results and late appeals would not be considered. The result of the appeal/review will be sent by written mail to the appeal candidate.

10 REVIEW COURSES

The Board does not endorse any review course or material provided as study aides.

11 REFUND OF FEES

Where an applicant who has been accepted is unable to sit for the examination subsequently, the Board may, at its discretion, refund part of the fees that the applicant has paid.

Annex A: FORMAT AND SYLLABUS

I Geotechnical Engineering Examination Part 1

This paper aims to examine the candidates on their understanding of the fundamentals and practice of geotechnical engineering. Candidates are expected to have a broad understanding of the concepts, theories, modes of failure, assumptions and design concerns in various disciplines within geotechnical engineering. This paper is catering for breadth covering topics stipulated in the syllabus.

Format

This is a 2-hour paper with multiple choice questions. The candidates may bring along their own reference materials and calculators as necessary.

II Geotechnical Engineering Examination Part 2

This paper aims to examine the candidates on their proficiency in the practice, application and design aspects of geotechnical engineering at the professional level. Candidates are expected to have a good working knowledge and experience of design, construction and regulatory requirements in geotechnical engineering in Singapore. This paper is catering for depth. It places emphasis on the role of the specialist professional engineer in geotechnical engineering in construction projects in the local context.

Format

This is a 4-hour paper. Section A has two questions covering site investigation and evaluation of soil parameters. Both questions are compulsory. Section B has four questions. The candidates are required to choose two out of the four which can be in the areas of building foundation, earth retaining structure, tunneling, soil improvement and slope stability. The candidates may bring along their own reference materials and calculators as necessary.

III Syllabus

- **Geology of Singapore**
 - Basic geological formations of Singapore and their distribution
 - Weathering classification and description of rocks for engineering purposes
 - Classification of recent deposits and their characteristic soil properties

- **Soil Mechanics Fundamentals**
 - Index properties
 - Soil classification

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- Mechanical properties - shear strength, compressibility and permeability
 - Concepts of effective stress versus total stress
 - Soil compaction
 - Bearing capacity of soil
 - Seepage and ground water flow
 - Settlement and consolidation
 - Stress distribution
- **Rock Mechanics Fundamentals**
 - Intact rock properties, Influence of sample size
 - Factors defining the behavior of rock mass versus intact rock; types of discontinuities
 - Rock tests: unconfined compression test, point load test, durability test
 - Rock mass properties; Mohr-Coulomb parameters; Hoek and Brown empirical failure criteria, deformation modulus
 - Shear strength of discontinuities
 - Rock mass classification, RMR and Q
 - Cross-section shapes of underground excavations in rock
 - Typical failure mechanisms in rock excavations and post-failure behavior
 - Design of rock support
 - Interaction of rock support with deformation behavior of rock mass
- **Site investigation**
 - Types of drilling (rotary drilling, wash boring, flight auger, etc)
 - Types of in-situ testing including standard penetration test (SPT), vane shear test (FVT), cone penetration test (CPT), pressuremeter test (PMP), permeability test, Packer test
 - Types of sampling method such as Shelby tube, open drive sampler, piston sampler, Mazier sampler, diamond coring for rocks, etc.
 - Ground water hydrology, such as the source of ground water or pore-pressure which may affect the geotechnical design
 - Significance of soil sample and rock core recovery rate and RQD
 - Planning requirements such as number of borehole and their locations, depth of drilling, types and frequencies of sampling and in-situ testing and types of laboratory tests, etc.
 - Significance of desk top study such as knowing the geological formation and topography, searching for available data from various sources on soil conditions, knowing the presence and types of surrounding structures, etc.
 - Significance of site reconnaissance before drilling and visits during drilling to understand the site conditions, observing the performance of surrounding structures and checking the progress and quality of drilling works, etc.

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- **Field and laboratory testing**
 - Principles of various in-situ tests (SPT, FVT, CPT, PMT, permeability test and Packer test) and the interpretation of test results, sources of errors and the range of applications in geotechnical design
 - Principles of common laboratory tests to obtain index properties, shear strength and modulus (drained and undrained with or without pore-water measurements), consolidation test, permeability test, uni-axial compression test on rock, point load test on rock, etc; interpretation of test results and their range of applications

 - **Soil Properties**
 - Physical properties and their inter-relationships and significance in geotechnical design
 - Mechanical properties such as strength (drained and undrained), compressibility and permeability
 - Chemical properties which may affect the design of foundation

 - **Constitutive Soil Models**
 - Understand limitations and range of applications of Mohr-Coulomb model and other advanced soil models
 - Understand the significance of each soil parameter
 - Know how to evaluate soil parameters for each soil model
 - Understand the significance of total and effective stress analysis as well as undrained, drained and consolidation analysis

 - **Instrumentation**
 - Types of geotechnical instruments and their engineering purposes,
 - Principles of each instrument, method of installation, potential sources of errors in installation and measurement
 - Planning of instrumentation program (location and depth of installation, monitoring frequency, review levels, etc)
 - Interpretation of readings and their implications; potential sources of errors

 - **Foundation Engineering**
 - Shallow foundations – footings and rafts
 - Deep foundations – driven piles, bored piles and caissons
 - Chin's method and Hiley formula
 - Wave equation analysis - PIT, PDA and CAPWAP
 - Pile load tests and interpretation of results
 - Group piles; capacity and settlement
 - Lateral loads on piles
 - Underpinning

 - **Earth Retaining Structures**
 - Earth pressure on walls (Rankine, Coulomb and log-spiral method)
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- RC retaining wall
 - Gravity retaining wall – crib wall, reinforced soil, gabion wall
 - Embedded retaining wall – cantilever, propped and anchored
 - Seepage and pore pressure considerations

 - **Tunnelling**
 - Excavation methods in soil and rock
 - Ground support methods in soil (temporary & permanent)
 - Rock support methods (temporary & permanent)
 - Excavation sequencing
 - Staging of rock support application
 - Maintaining stability of the excavation face
 - Dealing with groundwater during excavation
 - Rock mass improvement

 - **Slope Stability**
 - Taylor's chart, Infinite slope, Swedish method and various approaches utilizing the method of slices, circular and non-circular slip analysis
 - Effect of soil suction on slope stability
 - Total and effective stress analysis as well as drained and undrained analysis, cut slopes and embankment slopes
 - Evaluation of soil strength and ground water regime
 - Preventive works and remedial measures

 - **Soil Improvement**
 - Surface compaction
 - Pre-loading and surcharging
 - Pre-fabricated vertical drains, sand drains
 - Stone columns
 - Dynamic and vibro compaction
 - Deep mixing and jet grouting
 - Chemical grouting
 - De-watering
 - Seepage cut-offs
 - Soil reinforcement – geosynthetics, soil nails

 - **Ground Anchors**
 - Element of ground anchors
 - Load deriving zones
 - Fixed length design
 - Load and creep tests
 - Pre-loading of anchors
 - Corrosion protection

References

Reference materials include but not limited to:

- Codes and Standards under Building Control Act and Regulations, e.g. CP4, CP18, BS5930, BS8002, BS8004, BS8081, CIRIA C580, CIRIA 140, etc.
- Codes and Standards for Roads and Transit Systems to LTA's requirements
- Textbooks and handbooks on soil mechanics, foundation engineering, rock mechanics, tunneling, soil improvement and slope stability