Geotechnical Engineering Examination Test Plan

Effective January 2019

General Definition of Geotechnical Engineering:

Geotechnical Engineering is defined as the investigation and engineering evaluation of earth materials including soil, rock, groundwater and man-made materials and their interaction with earth retention systems, structural foundations and other civil engineering works. The practice involves application of the principles of soil mechanics and the earth sciences, and requires knowledge of engineering principles, formulas, construction techniques and performance evaluation of civil engineering works influenced by earth materials. (Title 16, CCR section 404).

This area of practice is structured into six primary content areas:

I. Scope Development and Project Planning (12%)
II. Site Characterization (17%)
III. Engineering Analyses (30%)
IV. Development of Conclusions and Recommendations (20%)
V. Report Content (10%)
VI. Evaluation of Construction, Post-Construction and Site Monitoring (11%)

BPELSG Geotechnical Engineering Test Plan	
	Percentage of Questions on the Exam
I. Scope Development and Project Planning **<u>Professional Activities:</u>** **1. Develop project description based on information obtained from the client and/or design team (e.g., structural loading, location, preliminary project plan)** **2. Evaluate potential geotechnical and regulatory issues that may influence investigation, design and construction of the proposed project** **3. Evaluate relevant data about site and subsurface conditions by reviewing available regional and site-specific information (e.g., geology, topography, reconnaissance, aerial/satellite photographs)** **4. Develop proposal, scope of work, or work plan for field exploration, laboratory testing, analyses, geotechnical recommendations, and construction observation for the proposed project**	**12%**
Test questions on these professional activities may include one or more of the following:	
A. Developing a geotechnical scope of work	
B. Methodologies to gather, review and interpret available information relevant to site and project	
C. The effects of the design team's criteria (e.g., civil, structural) on the geotechnical scope of work	
D. Geotechnical considerations for different project types (e.g., buildings, bridges, tunnels, pipelines, dams)	
E. Regulatory and code requirements	
F. Effects of surface conditions (e.g., topography, existing improvements)	
G. Effects of geology and geomorphology	
H. Effects of local and regional geologic hazards (e.g., earthquakes, landslides, liquefaction)	
I. Field exploration and instrumentation methodologies	
J. Laboratory tests including their application to site characterization and analyses	
K. Analyses relevant to the project	
L. Constraints (e.g., environmental, archaeological, biological) that affect geotechnical scope and/or project planning	
M. Risk and liability considerations	
N. The "standard of care" for geotechnical engineering	
O. Impacts of geotechnical scope of work on project schedule and cost	

II. Site Characterization ***<u>Professional Activities:</u>*** ***1. Identify local and regional geologic hazards (e.g., earthquakes, landslides, liquefaction)*** ***2. Conduct a reconnaissance to assess site conditions*** ***3. Perform subsurface exploration (e.g., drilling, in-situ tests, CPT, test pits) to collect soil, rock and groundwater data and prepare field logs of explorations*** ***4. Measure groundwater depth/pressure and/or ground movement using field instrumentation (e.g., piezometer, inclinometer, extensometer)*** ***5. Review field exploration data for consistency with local geologic information*** ***6. Evaluate the need for changes to proposed exploration program during field investigations*** ***7. Develop soil classifications from field investigations and laboratory testing*** ***8. Determine engineering properties from results of field investigations and laboratory testing*** ***9. Evaluate the need for changes to laboratory testing program***	***17%***
Test questions on these professional activities may include one or more of the following:	
A. Safety regulations pertaining to site exploration	
B. Regulatory and code requirements for site exploration	
C. Exploration methods to evaluate subsurface conditions	
D. Measures to address constraints that affect geotechnical exploration (e.g., underground utilities, environmental, archaeological, biological)	
E. Geophysical methods	
F. Where to locate proposed explorations in the field	
G. Sampling techniques and their purposes	
H. Procedures to log subsurface conditions	
I. Visual-manual soil classification	
J. In-situ testing methods (e.g., CPT, SPT, Torvane shear, percolation, infiltration) and factors that influence the validity of the result	
K. Different types of field instrumentation and their applications	
L. Factors that may alter the work plan during field investigation (e.g., unexpected soil strata, refusal, groundwater)	
M. Site conditions to document during field investigation	
N. Procedures to follow when suspected hazardous materials are encountered in site investigations	
O. Effects of exploration and sampling methods on laboratory test results	
P. Procedures and interpretation of particle-size distribution tests	
Q. Procedures and interpretation of Atterberg Limits test	
R. Procedures and interpretation of density tests	
S. Procedures and interpretation of water content tests	

T. Procedures and interpretation of swell/expansion tests	
U. Procedures and interpretation of collapse tests	
V. Procedures and interpretation of consolidation tests	
W. Procedures and interpretation of R-value tests	
X. Procedures and interpretation of hydraulic conductivity tests	
Y. Procedures and interpretation of compaction tests	
Z. Procedures and interpretation of unconfined compression tests	
AA. Procedures and interpretation of direct shear tests	
BB. Procedures and interpretation of triaxial shear tests	
CC. Evaluation of soil corrosivity	
DD. Methods to identify local and regional geologic hazards (e.g., earthquakes, landslides, liquefaction)	
III. Engineering Analyses **<u>Professional Activities:</u>** **1. Develop an idealized soil profile(s) to characterize the engineering properties of the subsurface strata by integration of field and laboratory data** **2. Analyze soil movement (e.g., settlement, expansion, collapse) using available data and project requirements** **3. Analyze lateral earth pressures using available data and project requirements** **4. Analyze capacity of foundations and ground anchors using available data and project requirements** **5. Analyze infiltration rates, groundwater conditions and seepage using available data and project requirements** **6. Analyze slope stability using available data and project requirements** **7. Analyze impact of seismicity and geologic hazards (e.g., landslides, liquefaction) using available data and project requirements** **8. Perform pavement design based on available data and project requirements** **9. Analyze earthwork and grading based on available data and project requirements**	**30%**
Test questions on these professional activities may include one or more of the following:	
A. Stress distribution	
B. Immediate/elastic settlement analyses	
C. Consolidation settlement analyses	
D. Collapse potential	
E. Swell/expansion potential	
F. Static lateral earth pressures	
G. Seismic lateral earth pressures	
H. Retaining wall design (e.g., sliding, overturning, global stability, deflection)	
I. Capacity of ground anchors	
J. Mechanically stabilized earth (MSE) wall design	

K. Slope stability and associated deformation (static and seismic)	
L. Vertical and lateral load capacity and deflections for shallow foundations	
M. Axial and lateral load capacity and deflections for deep foundations	
N. Design parameters for mat foundations	
O. Design parameters for post-tensioned slabs	
P. Seepage (e.g., flow nets, infiltration, gradient, uplift forces)	
Q. Construction dewatering	
R. Filter criteria (e.g., dams, subdrains, dewatering, injection wells)	
S. Code-related seismic design criteria	
T. Earthquake ground motions (site acceleration)	
U. Site specific response spectra	
V. Liquefaction evaluation	
W. Seismically-induced settlement	
X. Lateral spreading	
Y. Site earthwork (e.g., bulking, shrinkage)	
Z. Pavement design (e.g., flexible and rigid structural sections)	
IV. Development of Conclusions and Recommendations **<u>Professional Activities:</u>** **1. Develop recommendations to mitigate soil movement (e.g., settlement, expansion, collapse)** **2. Develop recommendations for foundations and slabs** **3. Develop recommendations related to slope stability** **4. Develop recommendations that incorporate lateral earth pressures** **5. Develop recommendations related to groundwater and seepage conditions** **6. Develop recommendations for surface drainage / subsurface infiltration** **7. Develop recommendations to mitigate seismic hazards** **8. Develop recommendations for pavement design (e.g., section thickness, subgrade preparation)** **9. Develop recommendations for earthwork and grading** **10. Develop recommendations for field instrumentation programs** **11. Develop a quality assurance program for project construction to determine conformance with recommendations in geotechnical report**	**20%**
Test questions on these professional activities may include one or more of the following:	
A. Evaluating feasibility of alternatives	
B. Effects of regulatory requirements (e.g., OSHA, CBC, CGS) on formulation of recommendations and specifications	
C. Potential impacts of site recommendations on adjacent properties	
D. Potential discrepancies between field and laboratory data	
E. Effects of settlement on proposed improvements (e.g., immediate, consolidation, collapse, seismic)	

F. Soil expansion impact on proposed improvements	
G. Potentially corrosive soils	
H. Constructability (e.g., retaining walls, foundations, pipelines)	
I. Shallow foundations (e.g., capacity, type, size, embedment)	
J. Deep foundations (e.g., capacity, type, size, depth)	
K. Exterior slab-on-grade support (non-structural)	
L. Retention / retaining wall systems (e.g., types, components, applications)	
M. Pavement recommendations (e.g., structural sections, subgrade preparation/improvement)	
N. Moisture intrusion mitigation	
O. Subdrain design (e.g., retaining wall, canyons, french drains)	
P. Seepage and groundwater impacts and mitigation	
Q. Static and seismic lateral earth pressures	
R. Types and applications of geosynthetics (e.g., subgrade improvement, slope stabilization, MSE, groundwater protection, erosion)	
S. Seismic design criteria and applicable codes	
T. Geologic hazards mitigation (e.g., fault rupture, rockfall, tsunami, landslide)	
U. Site earthwork (e.g., excavatability, compaction requirements, overexcavation, soil suitability)	
V. Temporary excavation and shoring	
W. Impacts of construction procedures	
X. Techniques and applications for ground improvement or modification and their advantages and limitations	
Y. Slope stabilization alternatives	
Z. Field instrumentation and monitoring programs	
AA. Liquefaction mitigation	
BB. Lateral spreading mitigation	
CC. Factors of safety and resistance factors (LRFD) for incorporation into design recommendations	
DD. Quality assurance program	

V. Report Content **Professional Activities:** **1. Describe project scope and purpose of work in a formal written report** **2. Describe findings of document review, reconnaissance, field exploration, laboratory testing, and analyses in a formal written report** **3. Describe methodologies used in field exploration, lab testing and analyses in a formal written report** **4. Describe conclusions, recommendations, and limitations based on geotechnical findings in a formal written report** **5. Prepare and summarize supporting data (e.g., site plan, logs of field exploration, soil profiles/cross-sections, laboratory test data, references, guideline specifications) in a formal written report**	**10%**
Test questions on these professional activities may include one or more of the following:	
A. Components of geotechnical investigation reports	
B. Elements of field and laboratory documentation	
C. Current applicable references	
D. Limitations of the geotechnical investigation and recommendations	
E. Components of geotechnical guideline specifications	
VI. Evaluation of Construction, Post-Construction and Site Monitoring **Professional Activities:** **1. Review plans, specifications, and construction documentation (e.g., submittals and request for information) for conformance with geotechnical recommendations** **2. Observe and test during construction activities to evaluate conformance with geotechnical aspects of plans and specifications** **3. Evaluate the need for revised recommendations based on changed conditions** **4. Evaluate site conditions by installing, monitoring, and evaluating results of field instrumentation** **5. Document results of construction monitoring and post construction observations**	**11%**
Test questions on these professional activities may include one or more of the following:	
A. Factors to consider when reviewing plans and specifications for geotechnical issues	
B. Methods to verify that project construction conforms to geotechnical recommendations, plans and specifications	

C. Required observation and monitoring elements to document during and after construction	
D. Effects of regulatory requirements, including health and safety regulations, during construction	
E. Interpretation of data from observations, testing, and field instrumentation before, during and after construction	
F. Techniques to mitigate differing site conditions encountered during construction	
G. Forensic/failure evaluations and techniques	