

APPENDIX A

Geotechnical Engineering Examination Test Plan

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).

The area of practice is structured into six primary content areas. The percentage given in parentheses represents the proportion of total test points that will address that test plan area.

- I. Scope Development and Project Planning (13%)
- II. Site Investigation (9%)
- III. Laboratory Testing (9%)
- IV. Analyses and Development of Conclusions and Recommendations (56%)
- V. Report Planning (5%)
- VI. Document Review, Construction Monitoring, and Post Construction Observations (9%)

Glossary of Terms Used in Task Statements

The following abilities are arranged hierarchically from the most complex to the least complex. That is, **describe** constitutes the least complex ability in the hierarchy and **develop** constitutes the most complex. Each ability presupposes all abilities preceding it in the hierarchy. For example, the ability to **evaluate** presupposes the abilities to **determine** and **describe**.

As used in the test plan, the following abilities are defined as:

Develop	To formulate and define geotechnical scope, conclusions, recommendations and requirements.
Analyze	A detailed study of findings using geotechnical engineering principles.
Evaluate	Using engineering judgment; apply appropriate criteria to interpret data.
Determine	To measure, monitor, define, discover, identify or establish geotechnical engineering parameters relative to a project.
Describe	To communicate a detailed account of findings, conclusions or recommendations.

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

I. Scope Development and Project Planning – 13%

Evaluate available site and project information. Develop scope of geotechnical work, work plan, and project proposal.

Job Tasks		Associated Knowledges	
<i>T1</i>	Identify project description based on information obtained from the client and/or design team (e.g., structural loading; location; preliminary project plan)	<i>K1</i>	K of methodologies to develop a scope of work for geotechnical investigation.
<i>T2</i>	Evaluate relevant data about site and subsurface conditions by reviewing available regional and site-specific information (e.g., geology; topography; reconnaissance; aerial/satellite photographs)	<i>K2</i>	K of methodologies to gather available information relevant to site and project.
<i>T3</i>	Evaluate potential geotechnical and code issues that may influence investigation, design and construction of the proposed project	<i>K3</i>	K of techniques to review and interpret existing data for the site.
<i>T4</i>	Develop proposal or work plan for field exploration, laboratory testing, analyses, and/or recommendations for the proposed project.	<i>K4</i>	K of how site conditions affect project work plan.
		<i>K5</i>	K of how the design team’s related engineering principles (e.g., civil; structural) affect geotechnical planning
		<i>K6</i>	K of effects of geology and geomorphology on geotechnical planning
		<i>K7</i>	K of effects of local and regional geologic hazards on project planning
		<i>K8</i>	K of environmental issues that affect geotechnical and/or project planning
		<i>K9</i>	K of exploration methodologies that affect project work plan
		<i>K10</i>	K of laboratory tests including their application to site characterization and analyses
		<i>K11</i>	K of analytical methodologies that affect project work plan.
		<i>K12</i>	K of regulatory requirements and codes that affect project work plan
		<i>K13</i>	K of risk and liability issues associated with developing project work plan
		<i>K14</i>	K of field instrumentation methodologies that affect project work plan.
		<i>K15</i>	K of the current “standard of care” for geotechnical investigations.
		<i>K16</i>	K of geotechnical requirements for different types of construction.

K=Knowledge

**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

II. Site Investigation – 9%

Determine and document surface and subsurface conditions, samplings, field tests, and instrumentation. Evaluate adequacy of field exploration and modify programs as required.

Job Tasks		Associated Knowledges	
<i>T5</i>	Conduct a reconnaissance to assess surface conditions	<i>K17</i>	K of how to locate proposed exploration points in the field
<i>T6</i>	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	<i>K18</i> <i>K19</i> <i>K20</i> <i>K21</i> <i>K22</i>	K of safety regulations pertaining to site exploration. K of exploration methods to evaluate subsurface conditions K of different types of instrumentation and their purposes K of sampling techniques and their purposes K of in-situ testing methods (e.g., CPT; SPT; Torvane shear; percolation) and factors that influence the validity of the results
<i>T8</i>	Measure changes in groundwater depth/pressure and/or ground movement using field instrumentation (e.g., piezometer; inclinometer; extensometer)	<i>K23</i> <i>K24</i>	K of conditions that affect geotechnical field sampling techniques K of procedures to follow when suspected hazardous materials are encountered in site investigations
<i>T9</i>	Evaluate the need for changes to proposed exploration program during field investigations	<i>K25</i> <i>K26</i> <i>K27</i> <i>K28</i> <i>K29</i> <i>K30</i>	K of biological and environmental factors that affect geotechnical exploration K of site conditions to document during site investigation K of procedures to log subsurface conditions K of factors that may alter the work plan during field investigation K of regulatory requirements and codes that affect field investigations K of geophysical test methods

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

III. Laboratory Testing – 9%

Determine appropriate laboratory tests and evaluate results to establish engineering and physical properties of earth materials.	
Job Tasks	Associated Knowledges
<i>T10</i> Evaluate shear strength parameters from results of laboratory testing	<i>K31</i> K of effects of exploration and sampling methods on laboratory test results
<i>T11</i> Evaluate moisture-density relationship of soil from results of laboratory testing	<i>K32</i> K of procedures and interpretation of:--2.01 direct shear tests
<i>T12</i> Evaluate compression/swell deformation parameters from results of laboratory testing	<i>K33</i> K of procedures and interpretation of:--2.02 triaxial shear tests
<i>T13</i> Evaluate index properties of soil classification from results of laboratory testing	<i>K34</i> K of procedures and interpretation of:--2.03 unconfined compression tests
<i>T14</i> Evaluate pavement subgrade soil characteristics from results of laboratory testing	<i>K35</i> K of procedures and interpretation of:--2.04 moisture content tests
<i>T16</i> Evaluate soil corrosion characteristics from results of laboratory testing	<i>K36</i> K of procedures and interpretation of:--2.05 dry density tests
<i>T17</i> Evaluate the need for changes to laboratory testing program	<i>K37</i> K of procedures and interpretation of:--2.06 permeability tests
	<i>K38</i> K of procedures and interpretation of:--2.07 compaction tests
	<i>K39</i> K of procedures and interpretation of:--2.08 collapse tests
	<i>K40</i> K of procedures and interpretation of:--2.09 swell/expansion tests
	<i>K41</i> K of procedures and interpretation of:--2.10 consolidation tests
	<i>K42</i> K of procedures and interpretation of:--2.11 Atterberg Limits test
	<i>K43</i> K of procedures and interpretation of:--2.12 grain size distribution tests
	<i>K44</i> K of procedures and interpretation of:--2.13 R-value tests
	<i>K45</i> K of procedures and interpretation of:--2.14 corrosivity/chemical tests

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations - 56%

Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project.	
Job Tasks	Associated Knowledges
<i>T18</i> Develop a model to characterize the engineering properties of the subsurface strata by integration of field and laboratory data for use in analyses.	<i>K51</i> K of evaluating feasibility of alternate solutions <i>K52</i> K of immediate/elastic settlement analyses and the impact on proposed site uses
<i>T19</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.01 a settlement (non-seismic)	<i>K53</i> K of consolidation settlement analyses and the impact on proposed site uses <i>K54</i> K of seismically induced settlement analyses and the impact on proposed site uses
<i>T20</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.02 soil expansion, and/or swell potential	<i>K55</i> K of evaluating impacts of construction procedures to develop conclusions and recommendations <i>K56</i> K of procedures to determine earthquake ground motion (site acceleration)
<i>T21</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.03 collapse potential	<i>K58</i> K of procedures to develop temporary excavation recommendations <i>K57</i> K of procedures and interpretation of:--2.01 direct shear tests
<i>T22</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.04 code-related seismic design criteria	
<i>T23</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.05 earthquake ground motions (site acceleration)	
<i>T24</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.06 site specific response spectra	

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**GEOTECHNICAL ENGINEERS
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IV. Analyses and Development of Conclusions and Recommendations Cont. - 56%

Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project.	
Job Tasks	Associated Knowledges
<i>T25</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.07 geologic hazards	<i>K59</i> K of techniques and applications for ground improvement or modification and their advantages and limitations
<i>T26</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.08 code liquefaction potential	<i>K60</i> K of soil expansion analyses and the impact on proposed site uses
<i>T27</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.09 seismically-induced settlement	<i>K61</i> K of seismic slope stability including deformation analyses and the impact on proposed site uses
<i>T28</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.10 lateral spreading	<i>K62</i> K of static slope stability analyses and the impact on proposed site uses
<i>T29</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.11 vertical and lateral load capacity for shallow foundation	<i>K63</i> K of analyses of lateral capacity of deep foundations and the impact on proposed site uses
<i>T30</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.12 vertical and lateral load capacity for deep foundation	<i>K64</i> K of analyses of axial capacity of deep foundations and the impact on proposed site uses
<i>T31</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.13 mat/post-tensioned foundations	<i>K65</i> K of analyses of bearing capacity of shallow foundations and the impact on proposed site uses
	<i>K66</i> K of techniques and applications of geosynthetics and their advantages and limitations

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations Cont. - 56%

Perform analyses using project requirements, and field and laboratory data. Develop conclusions and recommendations regarding design and construction of project.	
Job Tasks	Associated Knowledges
<i>T32</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.14 soil structure interaction (e.g. piles, deflection, moment, foundation stiffness)	<i>K67</i> K of effects of regulatory requirements, including health and safety regulations, on formulation of recommendations and specifications <i>K69</i> K of analyses of soil collapse potential and the impact on proposed site uses
<i>T33</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.15 foundation constructability	<i>K70</i> K of liquefaction analyses and the impact on proposed site uses <i>K71</i> K of seepage analyses and the impact on proposed site uses <i>K72</i> K of procedures to develop subdrain design based on field and laboratory data
<i>T34</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.16 lateral earth pressure (non-seismic)	<i>K74</i> K of lateral spreading analyses and the impact on proposed site uses <i>K75</i> K of lateral earth pressures (non-seismic) analyses and the impact on proposed site uses
<i>T35</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.17 seismic lateral earth pressures	
<i>T36</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.18 retaining walls	
<i>T37</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.19 anchors and tie-backs	

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations Cont. – 56%

Describe scope, purpose, methods, findings, conclusions, recommendations, and limitations of geotechnical investigation.	
Job Tasks	Associated Knowledges
<i>T38</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.20 mechanically stabilized earth (MSE) wall	<i>K76</i> K of seismic lateral earth pressures analyses and the impact on proposed site uses <i>K77</i> K of seismic design criteria and applicable codes <i>K78</i> K of methods to evaluate impact of geologic hazards on proposed site uses
<i>T39</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.21 temporary shoring	<i>K79</i> K of factors of safety for incorporation into design recommendations
<i>T40</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.22 slope stability	<i>K80</i> owner's level of risk associated with the design recommendations <i>K81</i> K of potential impacts of site recommendations on adjacent properties
<i>T41</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.23 slab-on-grade support	<i>K82</i> K of mat/post-tensioned slab design and the impact on proposed site uses
<i>T42</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.24 moisture intrusion mitigation	
<i>T43</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.25 seepage and groundwater conditions	
<i>T44</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.26 construction dewatering	

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

IV. Analyses and Development of Conclusions and Recommendations Cont. - 56%

Describe scope, purpose, methods, findings, conclusions, recommendations, and limitations of geotechnical investigation.	
Job Tasks	Associated Knowledges
<i>T45</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.27 site earthwork	<i>K83</i> K of slab-on-grade design and the impact on proposed site uses <i>K84</i> K of analyses of soils for suitability as fill materials and the impact on proposed site uses
<i>T46</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.28 ground improvement or ground modifications	<i>K85</i> K of moisture intrusion mitigation techniques <i>K86</i> K of potential discrepancies between field and laboratory data <i>K87</i> K of modeling idealized subsurface strata, their limitations and the impact on proposed site uses
<i>T47</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.29 pavement design	<i>K88</i> K of potential post-construction distress and mitigative measures <i>K89</i> K of pavement design and the impact on proposed site uses <i>K91</i> K of field instrumentation monitoring data (e.g. inclinometer; piezometer; extensometer) and their application
<i>T48</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.30 geosynthetics	
<i>T49</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.31 corrosive soils	
<i>T50</i> Develop conclusions and recommendations, appropriate to the project requirements, by analyzing the field and laboratory data for the following: --2.32 field instrumentation program	
<i>T51</i> Develop a quality assurance program for project construction to determine conformance with recommendation in geotechnical report	
<i>T52</i> Develop remedial geotechnical recommendations based on analyses of post construction distress	

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**GEOTECHNICAL ENGINEERS
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V. Report Planning Cont. – 5%

Describe scope, purpose, methods, findings, conclusions, recommendations, and limitations of geotechnical investigation.	
Job Tasks	Associated Knowledges
<i>T53</i> Describe project scope and purpose of work in a formal written report	<i>K92</i> K of components of geotechnical investigation reports
<i>T54</i> Describe findings of document review, reconnaissance, field exploration, laboratory testing, and analyses in a formal written report	<i>K93</i> K of current applicable references
<i>T55</i> Describe methodologies used in field exploration, lab testing and analyses in a formal written report	<i>K94</i> K of components of guideline specifications for geotechnical aspects of proposed project
<i>T56</i> Describe conclusions and recommendations based on geotechnical findings in a formal written report	<i>K95</i> K of limitations of the geotechnical investigation
<i>T57</i> Describe limitations of the findings, conclusions and recommendations of the geotechnical investigation in a formal written report	<i>K96</i> K of elements of field and laboratory documentation
<i>T58</i> Describe site plan, logs of field exploration, soil profiles/cross-sections, laboratory test data, references and guideline specifications in a formal written report	

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**GEOTECHNICAL ENGINEERS
EXAMINATION OUTLINE**

VI. Document Review, Construction Monitoring, and Post-Construction Observation – 9%

Evaluate conformance of contract plans and specifications with geotechnical recommendations. Observe, monitor, test, evaluate, and document geotechnical aspects of construction.	
Job Tasks	Associated Knowledges
<i>T59</i> Evaluate site conditions before, during and/or following construction by installing, monitoring, and evaluating results of geotechnical instrumentation	<i>K97</i> K of methods to verify that project construction conforms to geotechnical recommendations and specifications
<i>T60</i> Review the plans and specifications for conformance with geotechnical recommendations	<i>K98</i> K of required observation and monitoring elements to document during and after construction
<i>T61</i> Observe and test during construction activities to evaluate contractor’s conformance with plans and specifications	<i>K99</i> K of effects of regulatory requirements, including health and safety regulations during construction
<i>T62</i> Evaluate the need for revised recommendations based on changed conditions	<i>K100</i> K of factors to consider when reviewing plans and specifications for geotechnical issues
<i>T63</i> Document results of construction monitoring and post construction observations	<i>K101</i> K of interpretation of data from observations, testing, and instrumentation before, during and or after construction
	<i>K102</i> K of procedures to follow when suspected hazardous materials are encountered during construction
	<i>K103</i> K of techniques to mitigate unanticipated/change in geotechnical or site conditions encountered during construction

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