



California Geological Survey - Note 48

Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings
November 2019

Note 48 is used by the California Geological Survey (CGS) to review the geology, seismology, and geologic hazards evaluated in reports that are prepared under California Code of Regulations (CCR), Title 24, California Building Code (2019 CBC). CCR Title 24 applies to California Public Schools, Hospitals, Skilled Nursing Facilities, and Essential Services Buildings. The Building Official for public schools is the Division of the State Architect (DSA). Hospitals and Skilled Nursing Facilities in California are under the jurisdiction of the Office of Statewide Health Planning & Development (OSHPD). The California Geological Survey serves as an advisor under contract with these two state agencies.

Project Name: _____ Location: _____

OSHPD or DSA File #: _____ Reviewed By: _____

Date Reviewed: _____ California Certified Engineering Geologist #: _____

Checklist Item or Topic Within Consulting Report	Adequately Described; Satisfactory	Additional Information Needed
NA = not applicable NR = not addressed by consultant and therefore not reviewed at this time		

Project Location

1. Site Location Map, Street Address, County Name: Correctly plot site on a 7½-minute USGS topographic quadrangle base-map.		
2. Plot Plan with Exploration Data and Building Footprint: Show locations of borings, CPTs, trenches or other explorations.		
3. Site Coordinates: Latitude & Longitude.		

Engineering Geology/Site Characterization

4. Regional Geology and Regional Fault Maps: Concise page-sized illustrations with site plotted.		
5. Geologic Map of Site: Detailed (large-scale) geologic map with proper symbols and geologic legend.		
6. Geologic Hazard Zones: <i>(If applicable)</i> Discuss proposed structures in relation to CGS official map showing Zones of Required Investigation for any seismic hazards (liquefaction, landslide, tsunami, fault rupture) and/or any pertinent geologic hazard map from the Safety Element of the local agency (city/county).		
7. Subsurface Geology: Adequate subsurface exploration: One boring or exploration shaft per 5000 ft ² , with minimum of two for any one building (CBC §1803A.3.1). Borings of adequate depth to characterize hazards and geotechnical properties. CPTs with correlated borings (upload data files). Engineering geologic description summarized from boreholes or trench logs. Summarize ground water conditions.		
8. Geologic Cross Sections: Two or more interpretive geologic sections, based on site exploration data, with pertinent foundations and site grading. Depict extent of liquefiable soils.		
9. Geotechnical Testing of Representative Samples: Broad suite of appropriate geotechnical tests.		
10. Consideration of Geology in Geotechnical Engineering Recommendations: Discuss engineering geologic aspects of excavation/grading/fill activities, foundations and support of structures. Include geologic and geotechnical inspections and problems anticipated during grading. Provide all information as required by CBC §1803A.7, including special design and construction provisions for settlement and bearing capacity failure of foundations bearing on weak/soft, collapsible, liquefiable, or expansive soils. Consideration of seismic compression of fills; and cut/fill differential settlement.		
11. Conditional Geotechnical Topics: <i>(If applicable)</i> Including but not limited to – A. Basement and retaining wall design – demonstrate conformance with CBC §1807A.2 and §1803A.5.12. B. Deep foundations – demonstrate conformance with CBC §1803A.5.5, §1803A.5.12, §1810A, and ASCE 7 §12.13. C. Effects of construction on adjacent structures , including temporary shoring/underpinning.		

Seismology & Calculation of Earthquake Ground Motion

12. Evaluation of Historical Seismicity: Describe briefly how historical earthquakes have affected site.		
13. Classify the Geologic Subgrade (Site Class): ASCE 7, Chapter 20. Provide justification.		
14. General Procedure Ground Motion Analysis: Follows CBC §1613A.2. Report parameters S_s , S_1 , S_{D_s} , S_{D_1} , and T_s . Tools available at: https://earthquake.usgs.gov/hazards/designmaps/ .		
15. Site-Specific Ground Motion Hazard Analysis: <i>(Assumed to be required for Site Class D, E & F unless specific Exception enumerated in ASCE 7 §11.4.8 is invoked.)</i> Required in ASCE 7, §11.4.8. See requirements in ASCE 7, §21.2 to §21.5 and Supplement No. 1, and in CBC §1803A.6. CGS suggests a table showing: (a) 2%-in-50-years probabilistic spectrum, (b) risk coefficients (if using ASCE 7 §21.2.1.1, Method 1), (c) probabilistic MCE_R , (d) 84th percentile deterministic spectrum, <i>if allowed</i> , (e) scaled deterministic spectrum, (§21.2.2), (f) site-specific MCE_R (§21.2.3), (g) 80% of modified General Response Spectrum (§21.3), (h) design response spectrum (§21.3). Also provide S_{D_s} and S_{D_1} values per ASCE 7 §21.4.		
16. Deaggregated Seismic Source Parameters: <i>(If applicable)</i> If needed for liquefaction or slope stability analysis, or for earthquake record selection, provide controlling magnitude (M) and fault distance (R). Might be either deterministic or deaggregate for modal M and R.		

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17. Time Histories of Earthquake Ground Motion: <i>(If applicable)</i> Develop target spectra (MCE_R or conditional mean). Justify selected earthquake records. Scale or spectral match to meet ASCE 7 §12.9.2 or §16.2 for linear or non-linear response history analysis, respectively. Show initial and scaled time histories and response spectra.		

Fault Rupture Hazard Evaluation

18. Active Faulting & Coseismic Deformation Across Site: Discuss active faults at the site or projecting toward it. Address location of faults and their activity level. See CGS Special Publication 42. Show location of proposed structures in relation to any potential fault rupture hazard; show location of fault investigation trenches, and recommended setbacks from fault trace (minimum 50-feet).		
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Liquefaction/Seismic Settlement Analysis

19. Geologic Setting for Occurrence of Liquefaction: Perform <i>screening</i> analysis to identify where the following conditions apply: (1) depth of highest historical ground water surface <50 ft, and (2) low-density, non-plastic and low plasticity alluvium, typically with $SPT (N_1)_{60} < 30$		
20. Seismic Settlement Calculations: <i>(If applicable)</i> Evaluate both saturated and unsaturated layers of the entire soil column. Provide calculations (no estimates) and report all input parameters. Evaluate liquefaction triggering using highest historical ground water elevation and PGA_M (CBC §1803A.5.12) and calculate liquefaction settlement for each layer where $FS < 1.3$ (CGS SP117A). Seismic differential settlement (ASCE 7-16, §12.13.9) should be determined from multiple borings defining the full liquefiable interval and located to adequately define lateral variability. If fewer deep borings are available, then assume half of total settlement across a horizontal distance of 30 feet. Report results in terms that include horizontal dimension.		
21. Other Liquefaction Effects: <i>(If applicable)</i> Bearing capacity failure (ASCE 7, §12.13.9.1), surface manifestation (i.e., sand boils), and/or lateral spread (refer to CGS SP117A).		
22. Mitigation Options for Liquefaction/Seismic Settlement: <i>(If applicable)</i> Discuss effectiveness of options to mitigate liquefaction effects. Where liquefiable soils are identified, see ASCE 7, §12.13.9, for foundation design. If ground improvement is proposed, discuss performance objectives, provide measurable acceptance criteria, and recommend field verification program.		

Slope Stability Analysis

23. Geologic Setting for Occurrence of Landslides: Characterize the potential for landsliding both on and off-site affecting proposed project.		
24. Determination of Static and Dynamic Strength Parameters: <i>(If applicable)</i> Conduct appropriate laboratory tests to determine material strength for both static and dynamic conditions.		
25. Determination of Pseudo-Static Coefficient (K_{eq}): <i>(If applicable)</i> Recommended procedure available from CGS Special Publication 117A. Recommend using design-level ground motion based on geometric mean and without risk coefficient (i.e., $(PGA_M)/1.5$), or discuss with CGS.		
26. Identify Critical Slip Surfaces for Static and Dynamic Analyses: <i>(If applicable)</i> Failure surfaces should be modeled to include existing slip surfaces, discontinuities, geologic structure and stratigraphy; include appropriate ground water conditions.		
27. Dynamic Site Conditions: <i>(If applicable)</i> Site response analysis and topographic effects should be considered, if appropriate.		
28. Mitigation Options for Landsliding/Other Slope Failure: <i>(If applicable)</i> Discuss effectiveness of options to mitigate landsliding/slope failure effects. Acceptance criteria for ground-improvement schemes.		

Other Geologic Hazards or Adverse Site Conditions

These exceptional geologic hazards do not occur statewide; however, they may be pertinent to a particular site.

Where these conditions exist, relevant information should be communicated to the design team.

29. Expansive Soils		
30. Corrosive/Reactive Geochemistry of Geologic Subgrade: soluble sulfates and corrosive soils.		
31. Conditional Geologic Assessment: Including but not limited to - A. Hazardous materials methane gas, hydrogen-sulfide gas, tar seeps; B. Volcanic eruption ; C. Flooding Riverine (FEMA FIRMs or local zoning for 100-year flood); see CBC §1612A. Also consider alluvial fan flooding & dam inundation. Is the site elevated or protected from the hazard; D. Tsunami and seiche inundation ; see ASCE 7, Chapter 6; zone maps at web site ASCE7tsunami.online; E. Radon-222 gas ; F. Naturally occurring asbestos in geologic formations associated with serpentine; refer to CGS SP 124; G. Hydrocollapse of alluvial fan soils due to anthropic use of water; H. Regional subsidence ; I. Clays and cyclic softening .		

Report Documentation

32. Geology, Seismology, and Geotechnical References		
33. Certified Engineering Geologist: (CBC §1803A)		
34. Registered Geotechnical Engineer: (CBC §1803A)		