
EXHIBIT 11-C FOUNDATION INVESTIGATIONS FOR DESIGN**FOUNDATION INVESTIGATION
FOR DESIGN**

A foundation investigation and report is required for all proposed structure sites. The study and report shall be made by a California licensed Engineering Geologist or Civil Engineer, who specializes in foundations. The report shall, at a minimum, address all “applicable” topics shown in the following Caltrans checklist.

Specific attention is directed to appropriate sections of the *Caltrans Bridge Design Specifications*, Section 4-“FOUNDATIONS.” All driven pile support recommendations shall consider the use of Caltrans Standard Class 45 or Class 70 piles using design loads of 45 and 70 tons, respectively.

A Log of Test Borings sheet shall be drafted and included as part of the foundation report, and as part of the structure plans.

**CHECKLIST FOR STRUCTURE FOUNDATION STUDIES
AND REPORTS****LOG OF TEST BORINGS SHEET**

A log of Test Borings sheet (similar to Caltrans’ sheet) shall be included as part of the Foundation Report. Show the location of each boring or test pit in plan view. Logs of all borings shall be shown in an elevation or profile view on the sheet. Information which should be shown on plots of test borings is as follows:

1. Diameter, type, and date of boring.
2. Location of borings with respect to stationing along survey lines for the proposed project.
3. Elevation of the top of each boring, etc.
4. Description of samplers, sampling methods, and in-situ tests.
5. Test results including Standard Penetration Test. Results of the Standard Penetration Test (ASTM D-1586-84) shall be presented so that quick correlation with the Caltrans data base may be made.
6. Soil or rock descriptions and elevations of strata.
7. Groundwater elevation and date of measurement should be shown adjacent to the boring or test pit where taken.
8. Location, description, and elevation of the benchmark used for determining the top-of-hole elevations shown on the Log of Test Borings.
9. Name and position or title of person conducting the field study.
10. Name and position or title of the registered Engineering Geologist or Civil Engineer approving the “Log of Test Boring Sheet.”

WRITTEN REPORT

A written report shall be prepared, which shall contain an interpretation and analysis of the foundation conditions based upon all available sources of data. Data may come from new or previous exploration programs, laboratory testing, and nearby construction experience, performance of nearby structures, etc. A short description of site topography geology should be included. Emphasis should be placed on slope stability of cuts and excavations, unusual groundwater conditions, springs, etc. All sources of information should be cited. The materials and conditions, which may be encountered during construction, shall be discussed. Problems involving design and construction should be anticipated and recommendations made for their solution. The recommendations shall be brief, concise, and definite. Reasons for recommendations and their supporting data shall always be included. Methods used for calculating pile capacities and soil-bearing capacities should be mentioned for ease of review. Extraneous data, which are of no use to the designer or Resident Engineer, should be omitted.

The written report shall include, but not limited to, information and recommendations regarding applicable items in the following lists:

1. TYPING OF FOUNDATION

A. Pile Support (Driven or Cast-In-Drilled-Hole)

1. Method of support (skin friction and/or end bearing) in rock or soil or both.
2. Suitable pile type(s)-reasons for choice and/or exclusion or types. When appropriate, Caltrans' standard piles should be used.
3. Pile tip elevation
 - a. Specified (use of "indicator piles" is not acceptable.)
 - b. Probable
 - c. Need for pre-drilling or jetting
4. Pile Design Load and Ultimate Capacity in compression and tension. Specify the Safety Factor.
5. Reduction of pile capacity due to negative skin friction.
6. Requirement for load test. Specify which portion of the structures' foundation will be controlled by the test.
7. Effects on adjacent existing structures.
8. Corrosion effects of various soils and waters, and possibility of galvanic reaction from stray currents.
9. Scour depth (elevation) and method of determination.

B. Footing Support

1. Elevation of bottom footing.
2. Allowable and ultimate footing pressure (include Safety Factor). Approximate settlement at uniformly distributed allowable load.
3. Brief Description of materials on which the footing is to be placed.
4. Scour depth (elevation).

C. Drilled Shafts/Pier Columns (Mined Shafts)

1. Geologic description of foundation materials
2. Diameter (or dimensions)
3. Design Load, ultimate loads, and safety factor
4.
 - a. Top of shaft elevation
 - b. Bottom of shaft elevation
 - c. Minimum shaft length into load carrying stratum
 - d. Estimate of shaft wall stability and possible shoring requirements
5. Soil or rock weight and strength parameters for determining end bearing capacity, lateral load capacity, and point of shaft/column fixity.

11. APPROACH FILL REQUIREMENTS

1. Predicted amount of settlement and time delay required prior to beginning foundation construction. Predicted post construction settlement. Possibility of negative friction on pile foundations.
2. Special Requirement:
 - a. Controlled rates of embankment placement.
 - b. Fill height limit on untreated foundation.
 - c. Stripping of unsuitable foundation materials.
 - d. Use of lightweight fills to reduce amount of settlement.
 - e. Use of surcharge, wick drains, or other methods to shorten the required time delay period.
 - f. Specify embankment side slopes.
 - g. Unusual compaction requirements (i.e. 95% relative compaction) where abutments on spread footings are used.

111. CONSTRUCTION CONSIDERATIONS

1. Water table-seasonal or long term fluctuations, data for possible control in excavations (i.e. pumping, well points, trim seals, amounts of groundwater, etc.).
2. Adjacent structures-protection against damage from excavations, pile driving, etc.
3. Pile driving-difficulties, clearance, overhead or underground utilities, other unusual conditions, etc.
4. Excavation-control of earth slopes including shoring, sheet piles, bracing, and safety requirements.

IV SEISMIC DATA

The foundation report should contain the following information, so that an evaluation of seismicity can be made per the Caltrans Bridge Design Specifications.

1. Maximum credible rock acceleration (from CDMG MS-45*)
2. Magnitude of the maximum credible event.

3. Name of the causative fault and distance from the site.
4. Depth to rock or rock-like material ($V_s > 2500$ ft/s). Provide supporting evidence for depth (i.e. boring log or geologic reference)
5. Liquefaction potential.
6. Need for “seismic approach slab.

V. REVIEW OF FINAL STRUCTURE PLANS.

The foundation consultant should review the structure plans to ensure that the foundation recommendations have been followed, and provide revised recommendations, if required by design changes, etc.

***MUALCHIN, LALLIANA (1987) CALIFORNIA DIVISION OF MINES AND GEOLOGY MAP SHEET 45, ROCK ACCELERATION FROM MAXIMUM CREDIBLE EARTHQUAKES IN CALIFORNIA.**