### Foundation Report -Overview of How Caltrans Performs and Determines Geotechnical Site Conditions

THOMAS SONG OFFICE OF GEOTECHNICAL DESIGN NORTH (OGDN) GEOTECHNICAL SERVICES (GS) DIVISION OF ENGINEERING SERVICES (DES)



### Types of Differing Site Conditions

- Man made buried objects
- Unanticipated boulders/ cobbles
- Caving soils
- Unsuitable material
- Unanticipated groundwater
- Complex geology (shear zones, faults, bedding contacts)
- Rock too hard/ rock matrix too weak
- Inadequate bearing capacity
- Geology encountered at the site doesn't match boring logs
- Contaminated Ground water (District Environmental would take Lead)

### Objectives/ Agenda

- GS process for foundation recommendations
- Types of site condition challenges that can be encountered
- ► How GS manages risk
- Ongoing continual improvement



### Foundation Report Process

### FOUNDATION REPORTS for BRIDGES

January 2021



### DIVISION OF ENGINEERING SERVICES GEOTECHNICAL SERVICES

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### Site Investigation Plan

- Review of existing records
  - ► Maps
  - ▶ Literature
  - ► LOTB's
  - ► Reports

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GeoDOG Home Website Updates Form Search

Map Search

Help

Resources Geotechnical Services

### GeoDOG - Digital Archive of Geotechnical Data

GeoDOG (Digital Archive of Geotechnical Data) is the user interface for the Geotechnical Services (GS) Archive. Information archived in GeoDOG typically consists of geotechnical reports, Log of Test Borings, Boring Records, laboratory test results, and other technical data. Find files in GeoDOG using the map-based or form-based search tools. Select the "Upload Files" button to submit new files to GeoDOG (for caltrans users only GS Archive Upload

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### Planning Borings

- Number, locations, and depths
- AASHTO LRFD BDS Section 10.4.2, Subsurface Exploration
- Caltrans/GS Internal Guidance
  - Geotechnical Manual Geotechnical Investigations Module

|                        | •  | •   |
|------------------------|--|---|
| 1 - 1                  | Minimum Number of Exploration Points and   | Minimum Danish of Family and an   |
| Application            | Location of Exploration Points   | Minimum Depth of Exploration  |
| Ketaming Walls         | A minimum of one exploration point for each<br>retaining wall. For retaining walls more than<br>100 ft in length, exploration points spaced every<br>100 to 200 ft with locations alternating from in<br>front of the wall to behind the wall. For anchored<br>walls, additional exploration points in the<br>anchorage zone spaced at 100 to 200 ft. For soil-<br>nailed walls, additional exploration points at a<br>distance of 1.0 to 1.5 times the height of the wall<br>behind the wall more det 100 to 200 ft.  | Investigate to a depth below bottom of wall at least to a<br>depth where stress increase due to estimated foundation<br>load is less than ten percent of the existing effective<br>overburden stress at that depth and between one and two<br>times the wall height. Exploration depth should be great<br>enough to fully penetrate soft highly compressible soils,<br>e.g., peat, organic silt, or soft fine grained soils, into<br>competent material of suitable bearing capacity, e.g., stiff<br>to hard cohesive soil, compact dense cohesionless soil, or<br>bedrack  |
| Challon                | Per substructure of a mission of abutments midths  | Denth of emleration should be:  |
| Shallow<br>Foundations | For substructure, e.g., piers or abutments, widths<br>less than or equal to 100 ft, a minimum of one<br>exploration point per substructure. For<br>substructure widths greater than 100 ft, a<br>minimum of two exploration points per<br>substructure. Additional exploration points<br>should be provided if erratic subsurface<br>conditions are encountered.   | <ul> <li>Depth of exploration should be:</li> <li>great enough to fully penetrate unsuitable foundation soils, e.g., peat, organic silt, or soft fine grained soils, into competent material of suitable bearing resistance, e.g., stiff to hard cohesive soil, or compact to dense cohesionless soil or bedrock;</li> <li>at least to a depth where stress increase due to estimated foundation load is less than ten percent of the existing effective overburden stress at that depth; and</li> <li>if bedrock is encountered before the depth required by the second criterion above is achieved, exploration depth should be great enough to penetrate a minimum of 10 ft into the bedrock, but rock exploration should be sufficient to characterize compressibility of infill material of near-horizontal to horizontal discontinuities. Note that for highly variable bedrock conditions, or in areas where very large boulders are likely, more than 10 ft or rock core may be required to verify that adequate quality bedrock is present.</li> </ul>   |
| Foundations            | abutments, widths less than or equal to 100 ft, a<br>minimum of one exploration point per<br>substructure. For substructure widths greater<br>than 100 ft, a minimum of two exploration points<br>per substructure. Additional exploration points<br>should be provided if erratic subsurface<br>conditions are encountered, especially for the<br>case of shafts socketed into bedrock.<br>To reduce design and construction risk due<br>to subsurface condition variability and the<br>potential for construction claims, at least one<br>exploration per shaft should be considered for<br>large diameter shafts (e.g., greater than 5 ft in<br>diameter), especially when shafts are socketed<br>into bedrock. | anticipated pile or shaft tip elevation a minimum of 20 ft,<br>or a minimum of two times the minimum pile group<br>dimension, whichever is deeper. All borings should<br>extend through unsuitable strata such as unconsolidated<br>fill, peat, highly organic materials, soft fine-grained soils,<br>and loose coarse-grained soils to reach hard or dense<br>materials.<br>For piles bearing on rock, a minimum of 10 ft of rock<br>core shall be obtained at each exploration point location<br>to verify that the boring has not terminated on a boulder.<br>For shafts supported on or extending into rock, a<br>minimum of 10 ft of rock core, or a length of rock core<br>equal to at least three times the shaft diameter for isolated<br>shafts or two times the minimum shaft group dimension,<br>whichever is greater, shall be extended below the<br>anticipated shaft tip elevation to determine the physical<br>characteristics of rock within the zone of foundation<br>influence.<br>Note that for highly variable bedrock conditions, or in<br>areas where very large boulders are likely, more than 10 ft<br>or rock core may be required to verify that adequate |

Table 10.4.2-1—Minimum Number of Exploration Points and Depth of Exploration (modified after Sabatini et al., 2002)

### Site Ready to Drill Process SIP, SAQ, **Preliminary Drill** Site Foundation Environmental Request **Drill Schedule** Investigation Study Request **Report Request** Package **Finalized** Plan **Submitted Submitted** Best Case Scenario- 3-4 Months Average Scenario- 6-9 Months

Worst Case Scenario- 12-36 Months

### Planning for Site Conditions

- Research of site
  - As built data
  - Geology Map
  - DWR wells data
- Physical Challenges to Borings
  - Steep/mountainous terrain
  - Highly variable geology
- Logistical/Administrative Challenges to Borings
  - Environmental Clearance
  - Lane Closures
  - Well Drilling Permit/LEA



### Geotechnical Risk Management

Cost/Time

Alternatives to CCO- VCEP

Project Risk Register

- Env or ROW restrictions that require GS to extrapolate
- Late project changes
- Examples of Situations where we take a Calculated Risk
  - Overhead Sign Structures
  - Soundwalls
  - Culverts

### Process Improvements

GS Quality Management System
 Dewatering Module
 Collapsible Soils Module
 Below Grade Structure Module
 Groundwater Module
 Lessons Learned/ Root Cause Analysis
 Project Risk Management Training



# Questions/Comment?

## THANK YOU