Geotechnical Notes for Specifications

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1. Introduction

Geotechnical engineering has been commonly recognized as the engineering work that includes geotechnical investigation, analysis, design, and preparing and issuing geotechnical reports. However, issuing the geotechnical reports should not be the end of involvement for the Geoprofessional. To ensure the design is properly contracted and constructed, the Geoprofessional should also assist in the development of the construction contract Plans, Specifications, and Estimate (PS&E) and assist the Resident Engineer with administration of the construction contract.

To assist the development of project specifications, i.e. Special Provisions, the Geoprofessional should be familiar with geotechnical-related sections of the Standard Specifications and Standard Special Provisions (SSPs).

Standard Specifications, including Revised Standard Specifications, provide uniform contract clauses that apply to all Caltrans construction contracts while the SSPs provide the means for the Specification Engineer to draft project specific contract clauses and compile them into a project's Special Provisions.

To ensure consistency and maintain contract quality, a SSP can only be edited according to the instructions embedded in each SSP. Refer to the geotechnical related SSPs in Appendix 2 for embedded instructions for each SSP. The Geotechnical Design Reports and Foundation Reports included in the final PS&E package must provide recommended edits to SSPs that are consistent with the instructions and contents of the Standard Specifications and SSPs.

Edits beyond the instructions embedded in a SSP make that SSP a Nonstandard Special Provision (NSSP). NSSPs require a time-consuming approval process and should be avoided.

For the development of a PS&E package, the Geoprofessional should:

- Provide instructions for recommended edits to SSPs in the Notes for Specifications section of the geotechnical report.

- Draft or assist in the preparation of NSSPs and assist the Specification Engineer with obtaining approval from the Specification Owner of the section of the Standard Specifications, and concurrence from the Division of Construction for geotechnical NSSPs. For the Specification Owner Roster, refer to Caltrans HQ/Design/Office Engineer web site.

- Review the draft PS&E package received from the District or Structure Office Engineer (OE) to verify that:

    - The project plans have incorporated the geotechnical recommendations provided in the Geotechnical Design Report or Foundation Report, and

- The project Special Provisions have incorporated the instructions and recommendations for SSP edits or NSSP development provided in the Geotechnical Design Report or Foundation Report.

In a contract package, the hierarchy of contract parts in descending order is:

1. Special provisions
2. Project plans
3. Revised standard specifications
4. Standard specifications
5. Revised standard plans
6. Standard plans
7. Supplemental project information (with Geotechnical Design Reports and Foundation Reports included)

Therefore, it is critical to provide concise and precise instructions and recommendations for edits of SSPs, which will be compiled into the Special Provisions.

Subsequent sections in this document provide instructions on how to provide instructions and recommendations to the Specification Engineer for SSP editing and assist with NSSP preparation:

Section 2 Notes for Specifications – general instructions

Section 3 Geotechnical Related SSPs and Suggested Instructions – instructions for recommended specification edits and examples of content for *Notes for Specifications* section

Section 4 Nonstandard Special Provisions (NSSPs) – Key issues related to the development of the NSSPs

Appendices

Appendix 1 – List of Typical SSPs for Common Geotechnical Related Construction Items

Appendix 2 – Printout of Geotechnical Related SSPs – with the instructions for specifications edits shown

2. Notes for Specifications

To provide clarity in geotechnical reporting, two new sections, the *Notes for Specifications* and *Notes for Construction*, have been created to replace the previous *Construction Considerations* section in geotechnical reports.

In the *Notes for Specifications* section, provide concise instructions and recommendations to the Specification Engineer to edit SSPs and develop Nonstandard Special Provisions (NSSPs). Do not quote the Standard Specifications in the geotechnical report. Standard Specifications are applicable to all construction contracts. Referring to or quoting from Standard Specifications creates duplication and potential to misstate the Standard Specifications.

To create a clear and concise communication channel between the Geotechnical Designers, Specification Engineers, and Project Engineers, identify SSP section numbers and provide the instructions for the recommended edits. For projects with multiple construction components, list applicable SSPs and provide instructions and recommendations for edits under each construction component. An SSP may be edited for different parts of the project. For example, a large project may include multiple earth retaining systems, highway embankments, and bridges. Conditions, such as groundwater and unsuitable materials, can vary at each construction component location. Each construction component would require different edits for the same SSP.

3. Geotechnical Related SSPs and Suggested Instructions

This section does not provide a comprehensive compilation of geotechnical related SSPs. In addition, SSPs are updated on an as-needed basis and new SSPs are periodically developed and inserted into the SSP list. For up-to-date SSPs, refer to the latest SSP list provided by *Caltrans HQ/Design/Office Engineer*, which can be accessed through the following Caltrans internal web link: *https://design.onramp.dot.ca.gov/2018-construction-contract-standards*.

For questions on geotechnical related SSPs and specifications related issues, contact Geotechnical.Specification@dot.ca.gov.

For each geotechnical related SSP shown below, instructions are provided for the instructions and recommendations that should be included in the *Notes for Specifications* section. The instructions followed by "➢" are action items, while the instructions followed by "❖" are for information and clarification. These instructions were developed based on the edit instructions embedded in each of the SSPs. When reviewing the instructions provided in this section, cross reference the geotechnical related SSPs with the embedded instructions for each SSP compiled in Appendix 2.

This section is organized in the sequential order of contract items listed in the Standard Specifications and the SSPs.

2 Bidding

2-1.06B Supplemental Project Information

- Provide a list of materials, rock cores, and other information may be available for inspection at the Transportation Laboratory or other District offices. For materials and information available at District office, provide address and contact phone number.

  Do not self-reference the title of the geotechnical report. Specification Engineers will compile the list of documents and reports to be included in the Supplemental Project Information that received from the project engineer.

- Use the following table, which is also used by the Specification Engineers, to list the Supplemental Project Information:

Supplemental Project Information

Means	Description
Included in the Information Handout	This field will be filled in by the Specification Engineer
Available as specified in the Standard Specifications	This field will be filled in by the Specification Engineer
Included with the project plans	
Available for inspection at the Transportation Laboratory	*Rock cores, etc.*
Available for inspection at the District Office Telephone no.: _____	
Available for inspection at: _____ _____ Telephone no.: _____	*Rock cores, etc.*
Available for inspection at: http://www.dot.ca.gov/_____	

- During geotechnical review of the Draft PS&E package, verify that the list and contents of geotechnical reports and additional geotechnical information, such as rock cores information, are included in the Supplemental Project Information / Information Handout of the Draft PS&E package.

19 Earthwork

19-3 Structure Excavation and Backfill

19-3.01D(2) Soil Nail Wall and Ground Anchor Wall Zones

- Showing wall zones on the plans is preferred by contractors and Structure Representatives. Work with structure designers and plans detailers to delineate the wall zones on the plans.

- If it was determined not to show wall zones on the plans, provide wall zones for each soil nail wall and ground anchor wall using the following table:

Wall zone	Beginning station	End station	Upper elevation (feet)	Lower elevation (feet)
1				
…				

19-3.03A Removal of Unsuitable Material below the Bridge and Earth Retaining System Footings

- Provide instructions in the *Recommendations* section or during design to have the plans show where the removal of unsuitable material below the bottom of bridge or earth retaining system footings is required.
- Include a note for inclusion of this SSP.
- If material below the bottom of excavated unstable material must be compacted, provide the locations that need to be compacted in the following table:

Structure Name and Number	Begin Station (or Abutment Number)	End Station (or Bent Number)

19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation

- Include a note for inclusion of this SSP if surface water or groundwater is expected during structure excavation but no seal course is recommended and shown (Structure excavation Types D or DH).
- If surface water or groundwater is expected during structure excavation, and you determine that seal course is required, provide a recommendation for seal course (Structure excavation Type A) in the Recommendations section of the Foundation Report.

19-3.03B(2) Soldier Pile Retaining Walls are not Built Completely from the Top Down

- No actions or recommendations are needed from Geotechnical Design but refer to the Standard Specifications and SSPs for details.

19-3.03E(3) Minimum Compacted Backfill behind the Lagging of a Soldier Pile wall is other than 5 feet above the first Row of Ground Anchors

- Provide the required minimum height of compacted backfill above the level of ground anchors before drilling.

19-3.04 Structure Excavation and Backfill Payment Clauses

- ❖ No actions or recommendations are needed from Geotechnical Design but refer to the Standard Specifications and SSP for details.

19-6 Embankment Construction

19-6.02B Geosynthetic Reinforced Embankment

- ➢ Provide the identifications, such as Type 1, Type 2, of geosynthetic reinforcement materials and their Long-Term Strengths (LTS) used in the design. Use different line types and associated legend on the elevation and cross-section views on the plans to show the embedment lengths, elevations, and terminating stations of geosynthetic reinforcement layers.
- ➢ If backfill material must have different requirements than those specified in the Standard Specifications, provide recommended particle size distribution, plasticity index, and pH. Note that the LTS of geosynthetic reinforcement material can be significantly affected by the properties of the selected backfill materials.

19-6.03C Subsidence of the Ground Surface is Anticipated, and Embankment, or Imported Borrow is Measured by Theoretical Basis

- ➢ Indicate if subsidence of ground surface is anticipated due to embankment construction and refer to the *Recommendations* section for the estimated subsidence profile.
- ❖ Provide estimated subsidence profile in the *Recommendation*s section so that the additional quantity and cost of embankment and import borrow, if used, can be estimated.

19-6.03D Settlement Periods and Surcharges

- ➢ If settlement periods are required at bridges, provide instructions and the settlement period in the following table. Provide surcharge height in the following table if applicable. If only settlement periods are required, and no surcharge is required, enter "0.0" in the "Surcharge height" column.

Structure Number	Support Location	Surcharge height (feet)	Settlement period (days)

- ➢ If settlement periods are required for roadway embankments at the earth retaining structures, provide instructions and the settlement period in the following table. Provide surcharge height in the following table if applicable. If only settlement periods are required, and no surcharge is required, enter "0.0" in the "Surcharge height" column.

Earth Retaining Structure Number	Begin Station	End Station	Surcharge height (feet)	Settlement period (days)

19-6.04 Payment Quantity for Anticipated Subsidence – for Embankment Construction

- ❖ No actions or recommendations are needed from Geotechnical Design but refer to the Standard Specifications and SSP for details.
- ❖ If subsidence is anticipated during embankment construction, the magnitude of anticipated subsidence should be provided in the Geotechnical Design Report, so that the payment quantity can be estimated by others. Refer to Geotechnical Design Report Guidelines.

19-6 Borrow Material

19-7.02B Local Borrow

- ❖ If requested, in the *Recommendations* section of the Geotechnical Design Report provide geotechnical assessment of local borrow identified by District.

19-7.02C Imported Borrow

- ❖ If requested, in the *Recommendations* section of the Geotechnical Design Report provide geotechnical assessment of imported borrow identified by District.

46 Ground Anchors and Soil Nails

46-1 General

46-1.01A Ground Anchors and Soil Nails Work Sequence

- ➢ Provide concise instructions on specific work sequencing concerns related to ground anchors and soil nails construction. These may include the timing of ground anchor stressing relative to the construction of other elements due to bearing capacity consideration.

46-1.03E Research Investigation

- ➢ Provide concise instructions for research activities, such as survey markers, slope indicator casings and other equipment.
- ❖ Refer to the SSP for the assistance needed from the contractor.

46-2 Ground Anchors

46-2.01C Alternative Number of Ground Anchors

- ❖ This SSP is listed for information only. Structure designers are responsible for providing information for this SSP when an alternative number of ground

anchors that provide the same horizontal and vertical components and distribution of the design force is allowed.

46-2.01D(2)(b)(i)Locations and Number of Ground Anchor Performance Tests

- ❖ During design, provide locations of ground anchors subject to performance testing. During Geotechnical Review of Draft Structure PS&E, review the plans to verify the locations are shown on the plans.
- ➢ When the locations cannot be determined during design and shown on the plans, provide the minimum number of ground anchors subject to performance testing. Refer to instructions in the SSP for the minimum number of performance tests that should be performed. During construction, assist the Structure Representative with selecting the locations.

46-2.03A Expected Difficult Ground Anchor Installation due to Geotechnical Issues

- ➢ Indicate if:
  - Difficult ground anchor installations are expected due to geotechnical issues, such as loose sands, caving, presence of groundwater, soft clay, cobbles and boulders. Refer to LOTBs or observed surface conditions if available and applicable.
  - Voids may be encountered that may affect drilling and grouting, such as along a landslide plane or voids encountered during the geotechnical investigation or observed on the surface. Lost circulation during geotechnical investigation and voids on the ground surface also suggest the presence of subsurface voids. Refer to the SSP for details.
  - Provide structure numbers, stations and elevations and use the following table if necessary:

Structure Number	Begin station	End station	Elevation	Condition

- ➢ Indicate and provide locations where ground anchors are to be installed under a spread footing or existing structure.

- ❖ For example, if cave in of the drilled hole could negatively affect an existing structure. The top level of ground anchors will be installed with drilled holes advanced with drill casing.

46-3 Soil Nails

46-3.01D(2)(b)(ii)(3) 2% of Total Number of Production Soil Nails

- ❖ Verify the value equal to 2 percent of the total number of production soil nails for each wall or the entire project is provided in the SSP. This is the number of additional proof tests required at locations to be determined by the Engineer. (Note: The Engineer is the Resident Engineer as defined in Standard Specifications 1-1.07B Glossary.)
- ❖ The locations of these proof test nails are to be determined during construction or to be placed at zones that require special attention.

46-3.03A Expected Difficult Soil Nail Installation due to Geotechnical Issues

- ➢ Indicate if:
  - Difficult soil nail installations are expected due to geotechnical issues, such as loose sands, caving, presence of groundwater, soft clay, cobbles and boulders. Refer to LOTBs or observed surface conditions if available and applicable.
  - Provide structure numbers, stations and elevations. Use the following table if necessary:

Structure Number	Begin station	End station	Elevation	Condition

49 Piling

49-1 General

49-1.01D(3) Load Test Piles

- ➢ Provide load test control zones in the following table for driven piles with a diameter greater than 36 inches or if you recommended load tests.

Structure Number	Control zone	Load test pile support location

49-1.01D(4) Dynamic Monitoring of Driven Piles

- ➢ If dynamic monitoring of pile redriving should be performed other than 1 day after the pile is driven, provide the number of days. Refer to the Standard Specifications and SSP for details.

- Use the following table to provide the locations of supports and control zones that require dynamic monitoring to develop bearing acceptance criteria curves:

Structure Number	Control zone	Dynamic monitoring support location

Notes:

1) Dynamic monitoring is required:
   - for driven piles with a diameter of 18 inches and greater, or
   - if the required nominal driving resistance exceeds 600 kips.
2) You may consider additional dynamic monitoring for piles that do not satisfy the conditions identified in Note 1 above:
   - At sites with subsurface condition that the modified Gates formula needs to be verified.
   - At locations closer to or at the support locations, while the load test and dynamic monitoring will be performed at a location within the same control zone but away from the support locations. According to SSP 49-1.01D(3), in control zones where load test is required (for piles with a diameter D >36"), dynamic monitoring will be performed on both load test pile and anchor piles.
   - To verify the integrity of the piles when subject to the dynamic loads under proposed driving system.

49-1.01D(5) Test Borings to Verify Top of Rock Elevation if the Top of Rock Elevations Vary or are Uncertain – for Piling to be Embedded into Rock

- ❖ Use this SSP as the last resort. The preferred option is for Caltrans Geotechnical Design staff to perform this work during construction.
- Indicate if test borings are required during construction to verify top of rock. The intent of this specification is to verify top of rock, not to gather additional geotechnical data.
- Provide locations where test borings should be performed using the following table:

Structure Number	Location

- Provide the minimum depths below the specified pile tip elevation if the required minimum depths are other than 20 feet below the specified tip elevation shown. Refer to corresponding Standard Specifications and SSP for details.

49-1.03 Expected Difficult Pile Installation

- Indicate if difficult pile installation is expected. Provide the locations of the piles, and a list of site conditions based on factual observation using the following table. Refer to the LOTBs, Foundation Report, observed ground conditions, artesian groundwater condition, or exposed excavated surface, for the conditions listed in the table.

Pile Location		Conditions
Structure Number	Support Location	

49-2 Driven Piling

49-2.01A(3)(a) Pile and Driving Data Form Submittal

- ❖ No actions or recommendations are needed from Geotechnical Design but refer to the SSP for expected review of the Pile and Driving Data Form submittals.

49-2.01A(3)(b) Require Driving System Submittal

- Indicate if the requirement for driving system submittals for each of the selected support locations or control zones is included in the *Recommendations* section of the geotechnical report.
- ❖ Each control zone requires a driving system submittal.
- Provide pile type, monitored support locations, and control zones using the following table:

Structure Number	Pile Type	Monitored Support Location	Control Zone

49-2.01C(2) Conditions Require Revising Specifications for Driving Equipment

- Indicate and provide instruction if any of the following conditions exist and revising the specifications is required:
  - Installing sheet piles that have no geotechnical capacity along the length of the pile. Where vibratory hammers for sheet piles may be used; provide the locations using the following table:

Structure Number	Abutment Number	Bent Number

49-2.01C(3) If Drilling for Driven Piles or Casings is Allowed or Restricted

- No action for paragraphs 1, 2, and 4.
- Use the following table to provide the locations of drilling allowed, and the bottom of the drilled hole elevation to attain the specified tip elevation.

Structure Number	Support Location	Bottom of Hole Elevation, feet

Note: According to the Standard Specifications, a "drilled hole" has a diameter less than the least dimension of the pile.

- Indicate if center-relief drilling may be necessary for open-ended CISS and steel pipe piles; provide the exclusion zone above the specified pile tip where center-relief drilling is not allowed.

  Note: For open-ended steel pipe piles and CISS, center-relief drilling is not allowed before driving piles.

49-2.01C(4) Predrilling for Driven Piles in Existing Embankment is Required

- Indicate and provide the following table if:
  - piles are to be installed in existing fills with thickness greater than 5 feet, or
  - predrilling is required due proximity to an obstruction, such as underground utilities, or other structure.

Structure Number	Support Location	Bottom of Hole Elevation, feet	Condition

Note: According to Standard Specifications, a predrilled hole must be at least 6 inches larger than the greatest dimension of the pile cross section and used in embankments constructed under the contract, or near an obstruction.

- Indicate if predrill holes are needed for piles to be driven through existing concrete footings that are to remain structurally functional.

49-2.01C(5) Pile Set Period is Allowed

- Indicate if pile set period is allowed. Use the following table and provide:
  - The locations where pile set period is allowed, and
  - The set period (hours) based on the soil type at the site.

Structure Number	Support Location	Set Period (hours)

- Notify the Specification Engineer that this SSP needs to be revised as follows:
  - Add the following sentence after the first sentence in the first paragraph: "*Leave the top of the pile one foot above cut off for restrike.*"
  - Replace "*12 hours*" in the last sentence of the first paragraph with the set period (hours) provided.
- Refer to the SSP for details.

49-3 Cast-In-Place Concrete Piling

49-3.02A(1) CIDH Piles Designed as End Bearing

- Indicate if there are CIDH concrete piles designed as end bearing. Provide the locations of the piles using the following table.

Structure Number	Support Location

49-3.02B(6)(c) List of Synthetic Slurry for CIDH piles at least 24" in diameter

- No actions or recommendations needed from Geotechnical Design but refer to the SSP for details of the synthetic slurry.
- Standard Specifications, section 49-3.02B(6)(c): "*Do not use synthetic slurries in holes drilled in primarily soft or very soft cohesive soils as determined by the Engineer.*"

49-3.02B(6)(d) Allow the Use of Water Slurry for CIDH Piles with Full-Depth Casing

- By default, water slurry is not allowed in the Standard Specifications.
- Indicate, if in the rare scenario that you allow the use of water as slurry, when a casing is used for the entire length of the drilled hole.

49-3.02C(1) Drilling Sequence for CIDH Piling Center-to-Center Spacing less than 4 Pile Diameters

- Indicate if a drilling sequence is required when the CIDH piling center-to-center spacing is less than 4 pile diameters.

49-3.02C(4) CIDH Piles Designed as End Bearing

- Indicate inclusion of this SSP if there are CIDH concrete piles designed as end bearing.

49-3.02C(6) Not-Allowed Installation Methods for Permanent Steel Casing

- Provide a list of methods not allowed for installing permanent steel casings if any. Refer to the SSP for details.

49-3.02C(7) Permanent Casing for Type II CIDH Piling

- Indicate if the permanent casing must be corrugated metal pipe.
- Indicate if slurry cement backfill is allowed instead of grout. In the rare case that groundwater is below the tip of the casing, and the pile design does not rely on side resistance, then slurry cement backfill instead of grout may be allowed.
- If there are permanent casing installation methods not allowed, provide the list.
- ❖ Refer to the SSP for details.

49-3.03C(2) Clean-Out Depth for Open-Ended CISS Piles

- Indicate if other than 8 feet of the material at the bottom of piles must remain and provide the length.
- ❖ Refer to the SSP for typical practice.

49-4 Steel Soldier Piling

49-4.03B Conventional Drilling Equipment for Soils may not be Suitable and Bedrock or Boulders is shown in LOTBs; Pile Substitutions are Allowed

- Indicate if factual evidence of bedrock or boulders with soil matrix foundation material is shown on LOTBs and conventional drilling equipment for soils may not be suitable for drilling holes.
- ❖ No action for the second paragraph.

49-5 Micropiling

The SSP for micropiles divides into two categories:

Category A: Micropiles resisting primarily axial forces due to axial loading at the top of the micropile. This typically includes bridge foundations and may occasionally include some walls. For Category A, the contractor determines the length, load testing is performed, and typically pressure grouting is used.

Category L: Micropiles subject to primarily shear and bending forces along their length due to lateral loading. This typically includes earth stabilization structures and most walls. For Category L, the State determines the length, load testing is not performed, and gravity grouting is used.

- Provide the category of micropiles for the project here, so that the SSP can be edited accordingly.

49-5.01D(4)(c)(i) Load Tests – Compression, Tension, or both; Proof, Verification, or both; Factored Test Load and Service Load

- Indicate if micropiles need to be load tested in compression.
- Indicate if micropiles need to be load tested in tension.
- Indicate if micropiles need to be load tested in both tension and compression.
- Indicate if micropiles need to be proof load tested.
- Indicate if micropiles need to be verification load tested.
- Indicate if micropiles need to be both proof and verification load tested.
- Indicate if creep test is required during the load tests.
- Review the PS&E package and verify that Factored Test Load (FTL) and Service Load (SL) for respective load tests (compression, tension, or both) are provided by Structure Design.

49-5.01D(4)(c)(ii) Verification Load Tests, Representative Supports or Wall Zones; Creep Test; Adjustment of Load Increment

- For bridges, provide location of each verification test micropile and the control zone that the verification test micropile represents using the following format:

Structure Number	Verification Test Micropile Location	Control Zone

Notes:

If load tests are required, a tension load test is preferred because it is cheaper to perform and typically provides a conservative assessment of pile compressive nominal resistance.

- For walls and slope stabilization structures, provide location of each verification test micropile and limits of the wall zone that the verification test micropile represents using the following table:

Structure Number	Verification Test Micropile Location	Wall Zone Limits	
		Begin Station	End Station

Notes:

1. Load tests are seldom required for slope stabilization and ERS applications.
2. If load tests are required, a tension load test is preferred since it is cheaper to perform and typically provides a conservative assessment of pile capacity.

- Provide an instruction as to whether creep test is required during verification load test.
- Provide recommended adjustment of load increments between 1.00SL and 1.00 FTL, if needed.
- ❖ Refer to the SSP for details.

49-5.01D(4)(c)(iii) Number of Proof Load Tests; Timing of the First Proof Test; Creep Test; Adjustment of Load Increment

- Provide the number of micropiles per bridge support or wall zone to be proof load tested.
- Provide the percentage of micropiles that must be installed per bridge support or wall zone before the first proof test is performed.
- Provide an instruction on whether creep test is required during proof load test.
- Provide recommended adjustment of load increments between 1.00SL and 0.80 FTL, if needed.
- ❖ Refer to the SSP for details.

49-5.01D(5)(b) Verification Load Test Acceptance Criteria

- ❖ Note: Defer to Structure Design for the maximum axial movement allowed.

49-5.01D(5)(c) Proof Load Test Acceptance Criteria

- ❖ Note: Defer to Structure Design for the maximum axial movement allowed.

49-5.03A Minimum Spacing and Elapsed Time when Installing the Next Micropile

- If the required minimum center-to-center spacing is greater than 5 feet, provide the minimum center-to-center spacing from an open hole.
- If the required grout set time is greater than 12 hours, provide the minimum elapsed time before start drilling the adjacent micropile.

  Note: The default minimum center-to-center spacing is 5 feet, and at least 12 hours after initial grout has set.

49-5.03B Verification Test – Provide Geotechnical Equivalence using Isolation

- Provide the locations where the verification test micropile must be lengthened and isolated.
- Provide the amount to be lengthened and the elevation of the bottom of isolation.

  Notes:

  1. Isolation may be required due to the ground surface elevation being significantly higher than the cutoff elevation of the production micropiles, due to sloping strata layers, or due to other situations that cause a lack of

geotechnical equivalence between the verification test micropile and the production micropiles that it represents.

2. The isolation should ensure that the verification test accounts for the same engaged length and ground materials as the production micropiles. Verification test movement criteria may need to be adjusted to be comparable to the proof test movement criteria, due to a longer elastic length.

58 Sound Walls

58-2.03A Friction Angle of the Foundation Material which Determines the Dimensions of the Sound Wall Foundation

- Verify that the Geotechnical Design Report provides the friction angle of the foundation material, which will determine the dimensions of the sound wall foundation, either piles or trench footings.
- Provide the friction angle of the foundation materials using the following table.

Sound Wall Number	Station Limits	Friction Angle (ϕ) of Foundation Materials, degrees

- ❖ Refer to the SSP and Standard Plans for details.

61-2 Culvert and Drainage Pipe Joints

61-2.01D(3) Drainage Pipe Settlement and the Characteristics of Surrounding Soils

- ❖ Pay attention to projects with culverts and drainage pipes, especially under new embankment.
- Indicate if the expected settlement of the pipe is greater than 3 inches, which will trigger field leakage tests of the pipe. Provide estimated lapse time after pipe installation and backfill before the leakage test is performed.
- Indicate if the materials around the pipeline are fine cohesionless (sand or silt) soils.
- ❖ Refer to the SSP for details.

65 Concrete Pipe

65-2 Rock or Unyielding Material under the Concrete Pipe

- ❖ Pay attention to projects with reinforced concrete pipes under new embankment.
- Indicate if rock or other unyielding material may be encountered in the excavation immediately below the bottom of the pipe bedding. The rock or the unyielding material immediately below the bottom of the pipe bedding should be excavated and backfill with structure backfill material.

68 Subsurface Drains

68-2.02F(1) Permeable Material for Underdrains

- If Class 1 permeable material is not to be used for underdrains, provide the recommended permeable material, Class 2 or 3, for underdrains. Refer to Standard Specifications for details.

68-5 Permeable Material Blanket

- Provide the recommended permeable material for permeable material blanket.
- ❖ Refer to the SSP for details.

69 Overside Drains

69-2 Geomembrane and Cushion Fabric

- For each site or application, provide the selection of
  - Geomembrane Class
  - Smooth or Textured Geomembrane, and
  - Cushion Fabric Class

71 Existing Drainage Facilities

71-3.03 Grout Port Locations – Contact Grouting to Rehabilitate Existing Drainage Structures

- If requested, provide recommendations for the grout port locations.

72 Slope Protection

72-2.02C Nonstandard Fabric for Rock Slope Protection

- Provide recommended fabric specifications if the fabric selected is not described in section 96-1.02I Rock Slope Protection Fabric.

96 Geosynthetics

96-1.02B Specify Filter Fabric Class

- Provide the locations/application to receive filter fabric, and the class of filter fabric.
- ❖ The selection of filter fabric should be based on the gradation of the soils at the job site. Refer to the SSP for details.

Examples

Example 1 – Geosynthetic Reinforced Embankment

Notes for Specifications

19-6.02B Geosynthetic Reinforced Embankment

- Backfill gradation requirements

Sieve size	Percentage passing
1-1/2"	100
3/4"	75 – 100
No. 4	40 – 100
No. 40	0 – 80
No. 200	0 – 60

- Backfill quality characteristics requirements

Quality characteristic	Test method	Requirement
Plasticity index (max)	California Test 204	25
pH	California Test 643	5 – 9

- Geosynthetic reinforcement Long Term Strength requirements:

Geosynthetic reinforcement type	Long Term Strength (lb/ft)
GR 1	3,600
GR 2	2,800
GR 3	1,600

19-6.03B Subsidence of the Ground Surface is Anticipated, and Embankment, or Imported Borrow is Measured by Theoretical Basis

- Subsidence of ground surface is anticipated due to embankment construction. Please refer to the *Recommendations* section of the report for the estimated subsidence profile.

Example 2 – MSE Wall

Notes for Specifications

19-3.03A Removal of Unsuitable Material below the Footings

- Include this SSP.
- At the locations shown in the following table, material below the bottom of excavated unstable material must be compacted:

Structure Number	Begin Station	End Station
53-1537	07+00	10+80
	14+70	18+90
	21+30	25+50

19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation

- Groundwater is expected during excavation. Include this SSP.

19-6.03D Settlement Periods and Surcharges

Structure Number	Begin Station	End Station	Surcharge height (feet)	Settlement period (days)
53-1537	05+00	11+70	5	60
	11+70	18+10	10	60
	18+10	26+50	7	30

Example 3 – Ground Anchors

Notes for Specifications

46-2.03A Expected Difficult Ground Anchor Installation due to Geotechnical Issues

Structure Number	Begin Station	End Station	Elevation	Conditions
24-0824	10+00	10+80	All ground anchors	Perched water Cobbles and boulders; as observed on the slope face Loose to medium dense fine sand; refer to LOTBs.
	11+00	11+50	80’ – 96’	Loose fine sand with gravel; refer to LOTBs
24-0825	50+00	51+00	70’ – 90’	Boulders; as observed on the slope face

Example 4 – Driven Piles

Notes for Specifications

49-1.01D(4) Dynamic Monitoring of Driven Piles

Locations of supports and control zones that require dynamic monitoring are:

Structure Number	Control Zone	Dynamic Monitoring Support Location
24-1390	Abut 1	Abut 1
	Bents 2 – 5	Bent 3

49-1.03 Expected difficult pile installation

Pile Location		Conditions
Structure Number	Support Location	
24-1390	All Supports	Groundwater; refer to LOTBs

49-2.01A(3)(b) Require Driving System Submittal

Driving System Submittals are required as described in the *Recommendations* section.

Pile type, support location, and control zone are:

Structure Number	Pile Type	Support Location	Control Zone
24-1390	CISS (24 x 0.5")	Abut 1	Abut 1
		Abut 7	Abut 7

49-2.01C(5) Pile Set Period is Allowed

The support locations that allow pile set period and the minimum set period are shown in the following table:

Structure Number	Support Location	Set Period (hours)
24-1390	Bent 2, 3, 4	36

This SSP needs to be revised as follows:

- Add the following sentence after the first sentence in the first paragraph: "*Leave the top of the pile one foot above cut-off for restrike.*"
- Replace "*12 hours*" in the last sentence of the first paragraph with the minimum set period (hours) provided, or "as shown in the following table".

Example 5 – CIDH Piles

Notes for Specifications

19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation

Type D structure excavation is recommended at the following support locations:

Structure Number	Support Location
24-0390	Pier 2, 3, 4

49-1.03 Expected difficult pile installation

Pile Location		Conditions
Structure Number	Support Location	
24-0391	All Supports	Presence of groundwater; refer to LOTBs and the Foundation Report.
	Pier 3	Boulders or concrete slabs are expected during CIDH pile installation; refer to the Foundation Report.

Appendix 1 – List of Typical SSPs for Common Geotechnical Related Construction Items

The following is a list of typical SSPs for common geotechnical related construction items. These lists are not comprehensive. For any given project, there could be other SSPs that address various geotechnical related construction issues.

Embankment

19-6.03B	Subsidence of the Ground Surface is Anticipated, and Embankment, or Imported Borrow is Measured by Theoretical Basis
19-6.03D	Settlement Periods and Surcharges
19-7.02B	Local Borrow
19-7.02C	Imported Borrow

Geosynthetic Reinforced Embankment

19-6.02B	Geosynthetic Reinforced Embankment
19-6.03B	Subsidence of the Ground Surface is Anticipated, and Embankment, or Imported Borrow is Measured by Theoretical Basis
19-6.03D	Settlement Periods and Surcharges

Spread Footing

19-3.03A	Removal of Unsuitable Material below the Footings
19-3.03B(1)	Surface Water or Groundwater is Expected during Structure Excavation
90-1.02G(6)	Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H	Concrete in Direct Contact with a Corrosive Environment

Standard Plan Earth Retaining Systems

19-3.03A	Removal of Unsuitable Material below the Footings
19-3.03B(1)	Surface Water or Groundwater is Expected during Structure Excavation
47-2.01A, 47-3.01, 47-6.01A, and 47-6.01C(2)	Alternative Earth Retaining System for Caltrans Standard Walls, MSE, or Crib Wall Designs
51-1.01A	Alternative Earth Retaining Systems for Type 1 – 5 Retaining Walls
90-1.02G(6)	Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H	Concrete in Direct Contact with a Corrosive Environment

Non-gravity cantilever Earth Retaining Systems (Solider Pile wall with laggings)

19-3.03B(1)	Surface Water or Groundwater is Expected during Structure Excavation
49-4.03B	Drilled Holes through Rock Material and Pile Substitutions
90-1.02G(6)	Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H	Concrete in Direct Contact with a Corrosive Environment
49-4.01C	Drilling through Cobbles, Boulders, or Hard Rock is Anticipated
49-4.03A	Drilling through Cobbles, Boulders, or Hard Rock is Anticipated

49-4.03B Drilled Holes through Rock Material and Pile Substitutions

Soil Nail Walls

19-3.01D(2) Soil Nail Wall Zones
19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation
46-1.01A Soil Nails Work Sequence
46-1.03E Research Investigation
46-3.01D(2)(b)(ii)(3) 2% of Total Number of Production Soil Nails
46-3.02A Corrosivity of the Site
46-3.03A Expected Difficult Soil Nail Installation due to Geotechnical Issues

Ground Anchor Walls

19-3.01D (2) Ground Anchor Wall Zones
19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation
19-3.03E(3) When Minimum Compacted Backfill behind the Lagging of a Soldier Pile Wall is other than 5 Feet above the Ground Anchors
46-1.01A Ground Anchors Work Sequence
46-1.03E Research Investigation
46-2.01C Alternative Number of Ground Anchors
46-2.01D(2)(b)(i)Locations and Number of Ground Anchor Performance Tests
46-2.01D(2)(b) and 46-2.01D(2)(c) Ground Anchors as Wall Footing Anchors
46-2.02B Ground Anchor Bearing Plates on Materials Other than Concrete
46-2.03A Expected Difficult Ground Anchor Installation due to Geotechnical Issues
46-3.02A Corrosivity of the Site

Mechanically Stabilized Embankment Wall

19-3.03A Removal of Unsuitable Material below the Footings
19-3.03B(1) Surface Water or Groundwater is Expected during Structure Excavation
47-2.01A, 47-3.01, 47-6.01A, and 47-6.01C(2) Alternative Earth Retaining System for Caltrans Standard Walls, MSE, or Crib Wall Designs
47-3.02B(3) Corrosivity and Marine Environment of the Site

Sound Walls

58-2.03A Friction Angle of the Foundation Material that Determines the Dimensions of the Sound Wall Foundation

Driven Piles

49-1.01D(3) Load Test Piles
49-1.01D(4) Dynamic Monitoring of Driven Piles
49-1.01D(5) Test Borings to Verify Top of Rock Elevation if the Top of Rock Elevations Vary or are Uncertain – for Steel Piling to be Embedded into Rock
49-1.03 Expected Difficult Pile Installation

49-2.01A(3)(b) Require Driving System Submittal
49-2.01C(2) Conditions require Revised Specifications for Driving Equipment
49-2.01C(3) Drilling for Driven Piles or Casings is not Allowed or Restricted
49-2.01C(4) Predrilling for Driven Piles is Required
49-2.04B(1) Alternative "X" Piles for Lateral Load
90-1.02G(6) Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H Concrete in Direct Contact with a Corrosive Environment

CIDH Piles

49-1.01D(3) Load Test Piles
49-1.01D(5) Test Borings to Verify Top of Rock Elevation if the Top of Rock Elevations Vary or are Uncertain – for Steel Piling to be Embedded into Rock
49-1.03 Expected Difficult Pile Installation
49-3.02A(1) and 49-3.02C(4) CIDH Piles Designed as End Bearing
49-3.02B(6)(d) Allow the Use of Water Slurry for CIDH Piles with Full-Depth Casing
49-3.02B(7) Allow Slurry Cement Backfill in the Annular Space
49-3.02C(1) Drilling Sequence for CIDH Piling Center-to-Center Spacing less than 3 Pile Diameters
49-3.02C(6) Not-Allowed Installation Methods for Permanent Steel Casing
49-3.02C(7) Permanent Casing for Type II CIDH Piling with Optional Construction Joint Shown
90-1.02G(6) Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H Concrete in Direct Contact with a Corrosive Environment

CISS Piles

49-1.01D(3) Load Test Piles
49-1.01D(4) Dynamic Monitoring of Driven Piles
49-1.01D(5) Test Borings to Verify Top of Rock Elevation if the Top of Rock Elevations Vary or are Uncertain – for Steel Piling to be Embedded into Rock
49-1.03 Expected Difficult Pile Installation
49-2.01A(3)(b) Require Driving System Submittal
49-2.01C(2) Conditions require Revised Specifications for Driving Equipment
49-2.01C(3) Drilling for Driven Piles or Casings is not Allowed or Restricted
49-2.01C(4) Predrilling for Driven Piles is Required
49-3.03C(2) Clean-Out Depth for Open-Ended CISS Piles
90-1.02G(6) Concrete Placed in Soil or Water with a Corrosive Environment
90-1.02H Concrete in Direct Contact with a Corrosive Environment

Appendix 2 – Compilation of Geotechnical Related SSPs

Section 2-1.06B. Use if supplemental project information is available.

List the available supplemental project information.

If railroad relations and insurance requirements are available, insert *Railroad Relations and Insurance Requirements* in the 1st row.

If water use is restricted and the project requires 100,000 gal or more of water for nonlandscaping work, insert *Water source information* in the 1st row.

If water allowance calculations for landscaping are available, insert *Maximum Applied Water Allowance Calculations for New and Rehabilitated Landscapes* in the 1st row.

If electronic design files (e.g., cross sections, roadway design alignments, smoothness data) are available as described in Project Delivery Directive PD-06, insert the names of the files in the 2nd row.

If bridge as-built drawings are available, insert *Bridge as-built drawings* in the 2nd row.

If logs of test borings are available, insert *Logs of test borings* in the 3rd row.

Insert the telephone number in the 5th row.

For a District 10 project, insert (209) 948-7934.

For districts other than 5, 6, and 10, insert the telephone number to call to schedule a viewing date.

Insert the location and telephone number in the 6th row.

For a District 5 project, insert	**1150 LAUREL LN STE 175** **SAN LUIS OBISPO CA** **(805) 549-3116**
For a District 6 project, insert	**2015 E SHIELDS AVE STE 100** **FRESNO CA** **(559) 230-3115**

If a project has more than 5,000 cu yd of earthwork construction, insert the location and the documents specified in section 5-1.25 in the 7th row. Do not include any electronic design files already listed in the 2nd row.

Add rows as necessary. Delete nonapplicable rows.

Add between the 1st and 2nd paragraphs of section 2-1.06B:

The Department makes the following supplemental project information available:

Supplemental Project Information

Means	Description
Included in the *Information Handout*	
Available as specified in the *Standard Specifications*	
Included with the project plans	
Available for inspection at the Transportation Laboratory	
Available for inspection at the District Office Telephone no.: _____	
Available for inspection at: _____ _____ Telephone no.: _____	
Available for inspection at: http://www.dot.ca.gov/_____	

Section 19-3.01D(2). Use for soil nail walls and ground anchor walls.

1–2. Insert the stations and elevations provided by Geotechnical Services. The entire wall surface must be described by the chart. Add or delete cells as needed. Insert the location of the wall. Add introductions and tables as needed.

Add to section 19-3.01D(2):

1. Use for all soil nail walls if not shown on the plans.

The wall zones for the soil nail wall at _____ are as shown in the following table:

Wall zone	Beginning station	End station	Upper elevation (ft)	Lower elevation (ft)
1				
2				
3				
4				
5				
6				

2. Use for ground anchor walls only if more than 1 wall zone is listed in the foundation report. For ground anchors under spread footings, check with Design if the wall zone is more than 50 feet in length.

The wall zones for the ground anchor wall at _____ are as shown in the following table:

Wall zone	Beginning station	End station	Upper elevation (ft)	Lower elevation (ft)
1				
2				
3				
4				
5				
6				

Section 19-3.03A. Use for bridge and retaining wall earthwork where removal of unstable material below the bottom of the footing is required.

Replace *Reserved* in section 19-3.03A with:

1. If Class 2 AB is not used in the roadwork, edit to specify a stable, cohesive material similar to AB. If possible, specify a material already on the Bid Item List.

Where shown, remove material below the bottom of bridge footings. Replace the material with Class 2 AB and compact it as specified for structure backfill in section 19-3.03E.

2. Edit to be consistent with District plans. If Class 2 AB is not used in the roadwork, edit to specify a stable, cohesive material similar to AB. If possible, specify a material already on the Bid Item List.

Where shown, remove material below the bottom of retaining wall footings. Replace the material with Class 2 AB and compact it as specified for structure backfill in section 19-3.03E. The relative compaction must be at least 95 percent.

3. Use if the remaining base material must be compacted. Complete the table.

A relative compaction of at least 95 percent must be attained to at least 0.5 foot below the bottom of excavated unstable material at the locations shown in the following table:

Bridge name and number	Abutment number	Bent number

Section 19-3.03B(1). Use if structure excavation (Type D) or (Type DH) is shown and no seal course is shown. Insert the type.

Add to the beginning of section 19-3.03B(1):

For footings at locations with structure excavation (Type __), ground or surface water is expected to be encountered but seal course concrete is not needed.

Section 19-3.03B(2). Use for soldier pile retaining walls if the walls are not built completely from the top down. Ensure limits of earthwork are shown. District provides cross-sections; OSD to confirm with District.

Delete the 1st paragraph of section 19-3.03B(2).

Section 19-3.03E(3). Use for soldier pile retaining walls with ground anchors if the height for the compacted backfill is other than 5 feet. Verify with the designer. Insert the backfill height. The height must be adequate to allow anchor testing.

Replace *5* in the 1st sentence of the 3rd paragraph of section 19-3.03E(3) with:

_____

Section 19-3.04. Use for structure excavation and backfill payment clauses.

Add to section 19-3.04:

1. Use for bridge and retaining walls where unstable material below the bottom of the footing is removed and replaced. Edit if the backfill is not Class 2 aggregate.

Class 2 aggregate base placed below footings is paid for as structure backfill.

2. Use when structure excavation (Type D) or (Type DH) is described for sometimes wet, or wet excavation, and no seal course is shown on the project. Insert type (e.g., D, DH). Do not use with par. 3.

Structure excavation for footings at locations not shown as structure excavation (Type __) and where ground or surface water is encountered is paid for as structure excavation (bridge).

3. Use when structure excavation (Type D) or (Type DH) is described for sometimes wet, or wet excavation, and no seal course is shown for that location but a seal course is shown at other locations. Insert type (e.g., D, DH). Do not use with par. 2.

Except at locations where seal course concrete is shown, structure excavation for footings at locations not shown as structure excavation (Type __) and where ground or surface water is encountered is paid for as structure excavation (bridge).

4. Use with SSP 19-3.03B(3) for pier column excavation.

Structure excavation (pier column) is measured from the bottom of the completed foundation excavation to the upper and horizontal limits shown.

5. Use if quantity of pervious backfill material is small. Small is considered to be about 50 cubic yards or less.

Pervious backfill material placed within the limits of payment for bridges is paid for as structure backfill (bridge). Pervious backfill material placed within the limits of payment for retaining walls is paid for as structure backfill (retaining wall).

6. Use if culvert drainage profiles are based on aerial surveys.

Replace item 3 in the list in the 6th paragraph of section 19-3.04 with:

3. Structure excavation more than 1 foot from the depth shown is paid for as a work-character change if you request an adjustment or the Engineer orders an adjustment.

Section 19-6.02B. Use for geosynthetic reinforced embankments.

1. Use if the backfill material must have different requirements from those specified in the Standard Specifications. Insert the percentage passing and plasticity index in the tables.

Replace the 3rd and 4th paragraphs in section 19-6.02B with:

The backfill must comply with the gradation requirements shown in the following table:

Sieve size	Percentage passing
1-1/2"	
3/4"	
No. 4	
No. 40	
No. 200	

The backfill must comply with the quality characteristics shown in the following table:

Quality characteristics	Test method	Requirement
Plasticity index (max)	California Test 204	
pH	California Test 643	

2. Insert the types and LTDS as recommended by the geotechnical designer.

Add to section 19-6.02B:

The LTDS of geosynthetic reinforcement must comply with the requirements shown in the following table:

Geosynthetic reinforcement type	LTDS (lb/ft)

Section 19-6.03B. Use if subsidence of the ground surface is anticipated, and there is a bid item for either embankment, or imported borrow measured by theoretical basis.

Add to the end of section 19-6.03B:

1. Use if the project includes a bid item for embankment. Enter quantity.

A quantity of _____ cubic yards of embankment will be added to the computed embankment quantity for the anticipated effect of subsidence.

2. Use if imported borrow is measured by theoretical basis. Enter quantity.

A quantity of _____ cubic yards of embankment will be added to the computed imported borrow quantity for the anticipated effect of subsidence.

Section 19-6.03D. Use for settlement periods and surcharges.

Add to section 19-6.03D:

1. Use for settlement periods at bridges. For embankments requiring settlement periods but no surcharge; insert 0.0[a] in the surcharge height column. If no such embankments exist, delete the footnote *a* at the bottom of the table.

Settlement periods and surcharges are required for bridge approach embankments as shown in the following table:

Bridge name or number	Abutment number	Bent number	Surcharge height (feet)	Settlement period (days)

[a]At this location, construct embankment by extending the grading plane (GP) in the elevation view of the bridge embankment surcharge detail of standard plan A62B horizontally to the centerline of the abutment.

2. Use for settlement periods at earth retaining structures.

Settlement periods and surcharges are required for roadway embankments at the earth retaining structures as shown in the following table:

Earth retaining structure number	Surcharge height (feet)	Settlement period (days)

Section 19-6.04. Use for embankment construction.

Add to the end of section 19-6.04:

1. Use if the project includes a bid item for embankment and there is anticipated subsidence. Edit to include the quantity.

The payment quantity for imported borrow includes the volume of anticipated subsidence as specified in section 19-6.03B. The payment quantity for embankment includes ____ cu yd for the anticipated effect of subsidence.

Section 19-7.02B. Use for specifying the locations of local borrow sites.

Replace *Reserved* in section 19-7.02B with:

1. Insert locations.

In addition to the locations described for excavation, obtain local borrow from:

1. _____
2. _____

2. Use only if restoration of the local borrow site is required.

After you obtain local borrow, grade the borrow site such that it drains and blends in with the surrounding area.

Section 19-7.02C. Use for specifying imported borrow.

Add to section 19-7.02C:

1. Insert an R-value. Do not specify an R-value greater than that of the native material.

Imported borrow placed within 4 feet of the finished grade must have an R-value of at least _____.

2. Use if gradation requirements are specified.

Process the imported borrow to comply with the grading requirements.

3

Strip materials that adversely affect the imported borrow properties.

4–6. Use if the project has a mandatory source for imported borrow.

4. Insert the location of the mandatory local material source.

Obtain imported borrow from the mandatory local material source at_____.

5. Insert the cost and unit.

The Department has arranged for you to obtain material from the mandatory source for $_____ per _____ for material removed from the site and used in the work. The cost of the material removed is deducted.

6. Use if restoration of the borrow site and haul roads is required. Edit to suit the work.

After obtaining imported borrow, grade the borrow sites and associated haul roads such that sites drain and blend in with the surrounding area. Remove any equipment on the areas before grading.

Section 46-1.01A. Use for ground anchors and soil nails if the designer has a specific work sequencing concern related to ground anchor construction; for example, the timing of ground anchor stressing relative to the construction of other elements. Insert project-specific work sequencing specifications.

Add to section 46-1.01A:

_____.

Section 46-1.03E. Use for ground anchors and soil nails if research investigation is required by the designer. Notify the estimator of the need for supplemental funds. Consult the geotechnical report and edit as necessary to describe the scope of all research activities so the Contractor can estimate the impact on operations.

Replace *Reserved* in section 46-1.03E with:

1. If used for ground anchors, replace "soil nail" with "ground anchor." Edit as necessary if the structure is not a wall.

The Department will conduct research activities within the limits of the soil nail wall.

2. Verify that the locations of the slope indicator casings are shown. Edit as necessary to describe the actual work.

Research activities include installing and monitoring survey markers, slope indicator casings, and other equipment at the locations shown. Survey markers are installed on the face and crest of the wall.

3

Research equipment installation is scheduled in advance. Coordinate construction activities to prevent interference with the equipment installation and monitoring.

4. Edit if the Contractor installs the equipment instead of the Department.

The Department furnishes and installs the research equipment. If the Engineer orders you to assist in installing the equipment, this work is change order work.

Section 46-2.01C. Use for ground anchors if on a short time limit contract or if an alternative number of anchors is allowed.

1. Use for a short time limit contract if strand tendons are shown on the plans.

Add to the 1st paragraph of section 46-2.01C:

You may submit a certificate of compliance for the corrosion-inhibiting grease instead of submitting a test sample and test data.

2. Use if an alternative number of ground anchors is allowed. Confirm with the designer.

Add to section 46-2.01C:

You may submit calculations and details for furnishing an alternative number of ground anchors that provide the same horizontal and vertical components and distribution of the design force as provided by the anchors shown. Include alternative structure details. Alternative design calculations and details must be sealed and signed by an engineer who is registered as a civil engineer in the State.

Section 46-2.01D(2)(b)(i). Use for ground anchors if performance test locations are not shown or if the compressive strength at loading is not 2,880 psi.

1. Use if performance test locations are not shown. Insert the number provided by the designer. For wall anchors, generally a minimum of 3 anchors but not less than 5 percent of anchors should be performance tested. For footing anchors, generally a minimum of 2 anchors but not less than 10 percent of anchors per footing should be performance tested. For footing anchors, add "at each footing" to the end of the 1st sentence.

Add to section 46-2.01D(2)(b)(i):

Performance test a minimum of ___ ground anchors. The Engineer determines which anchors are to be performance tested.

2. Use if the compressive strength at loading is not 2,880 psi or if requested by the designer to delete "or has cured for at least 7 days." Insert the value provided by the designer. Typically, 80 percent of the 28-day compressive strength is specified as the compressive strength at loading.

Replace the 3rd paragraph of section 46-2.01D(2)(b)(i) with:

Do not stress against the concrete until it has attained a compressive strength of at least _____ psi or has cured for at least 7 days.

Section 46-2.03A. Use for ground anchors with project-specific geotechnical conditions or with a grout cover over the corrugated sheathing of other than 1 inch.

1–3. Use for project-specific geotechnical considerations.

Add to section 46-2.03A:

1. Use for expected difficult ground anchor installation.

Insert the location of the difficult installation. Insert the conditions that affect ground anchor installation as described in the foundation report. Insert other conditions that may apply, such as: low overhead clearance, underground utilities, overhead utilities, noise control, vibration monitoring, staged construction, and traffic control.

Verify and obtain concurrence from Geotechnical Services.

Use multiple pars. if foundation reports show differing conditions:

1. Along the ground anchor wall. Insert stations and elevations as provided in the foundation report.

2. For different structures.

Expect difficult ground anchor installation at _____ due to the presence of the following conditions:

1. _____
2. _____
3. _____

2. Use for horizontal ground anchors installed under a spread footing for a structure or if caving of the drilled hole could be detrimental to an existing structure. Insert the location of the ground anchors. Add stations if necessary. Create a table format for multiple locations.

Install the top level of ground anchors at _____ in drilled holes advanced with drill casing. Withdraw the drill casing as the grout is being placed in the drilled hole, keeping the end of the casing immersed in the grout.

3. Use if the ground anchors will pass through slide planes or foundation material with significant voids. Insert the location of the voids. Add stations and elevations if necessary. Create a table format for multiple locations. Confirm with the designer and Geotechnical Services.

At _____ you may encounter voids in the foundation material along the length of the drilled hole that affect drilling and grouting. Use measures such as a grout sock to avoid the excessive loss of grout into the voids encountered.

4. Use if the designer requires a grout cover over the corrugated sheathing of other than 1 inch. Insert the thickness of the cover.

Replace the 9th paragraph of section 46-2.03A with:

The diameter of the drilled hole must be large enough to provide a minimum grout cover of ___ inches over the corrugated sheathing for the full length of the tendon.

Section 46-3.01D(2)(b)(ii)(3). Use for soil nails. Insert 2 percent of the total number of production soil nails.

Add to the 2nd paragraph of section 46-3.01D(2)(b)(ii)(3):

In addition to the proof test soil nails shown, install and test ____ proof test soil nails at locations determined by the Engineer.

Section 46-3.03A. Use for expected difficult soil nail installation.

Insert the location of the difficult installation. Insert the conditions that affect soil nail installation as described in the foundation report. Insert other conditions that may apply, such as: low overhead clearance, underground utilities, overhead utilities, noise control, vibration monitoring, staged construction, and traffic control.

Verify and obtain concurrence from Geotechnical Services.

Use multiple pars. if foundation reports show differing conditions:

1. Along the soil nail wall. Insert stations and elevations as provided in the foundation report.

2. For different structures.

Add to section 46-3.03A:

Expect difficult soil nail installation at _____ due to the presence of the following conditions:

1. _____
2. _____
3. _____

Section 49-1.01D(3). Use for load test piles.

A load test pile is required for driven piles with a diameter greater than 36 inches or if recommended in the foundation report.

Add to the end of section 49-1.01D(3):

1. Modify or delete table as recommended by Geotechnical Services. Table for control zones and load test pile support locations must not be shown on the plans.

The Department performs load tests on the load test pile at each control zone as shown in the following table:

Bridge no.	Control zone	Load test pile support location

2. Use for driven load test piles.

Driven load test piles and anchor piles are monitored for dynamic response during the final 25 feet of driving under section 49-1.01D(4).

Section 49-1.01D(4). Use for dynamic monitoring of driven piles.

Dynamic monitoring is required (1) for driven piles with a diameter 18 inches and greater, (2) if the required nominal driving resistance exceeds 600 kips or (3) if recommended in the foundation report.

Unless otherwise recommended in the foundation report:

1. For piles with a diameter (D) of 18" ≤ D ≤ 36", dynamic monitoring is performed on the actual driven production pile.

2. For piles with a diameter D >36", dynamic monitoring is performed on the driven load test pile and anchor piles.

1. Use if recommended in the foundation report to specify other than 1 day for when the pile will be redriven. Insert number of days.

Replace item 6 in the 8th paragraph of section 49-1.01D(4) with:

6. After ___ days, install the instrument package on the pile and attach the cables and resume driving the pile to the specified tip elevation.

Add to the end of section 49-1.01D(4):

2. Modify or delete table as recommended by Geotechnical Services. Do not use for load test and anchor piles.

The Department performs dynamic monitoring of the first production pile driven for each control zone at the support location shown in the following table:

Bridge no.	Control zone	Dynamic monitoring support location

Section 49-1.01D(5). Use if steel piling is to be embedded into rock and the top of rock elevations vary.

Test borings are used to verify top of rock elevation. It is not the intent of this specification to gather any other geotechnical data. Use only if requested by the Office of Geotechnical Services.

1. Use to specify test boring locations. Delete the table and edit accordingly for only 1 location.

Add to section 49-1.01D(5):

Perform test borings at the locations shown in the following table:

Bridge no.	Location

2. Use to revise the depth of drilling below the specified tip elevation. Insert depth required.

Replace the 5th paragraph of section 49-1.01D(5) with:

Drill test borings by rotary drill methods to a depth of at least __ feet below the specified tip elevation shown. Test borings must be at least 3 inches in diameter.

Section 49-1.03. Use for expected difficult pile installation. Use this SSP for all types of pile installation.

Insert the conditions that affect pile installation as described in the foundation report. Insert other conditions that may apply, such as: low overhead clearance, underground utilities, overhead utilities, noise control, vibration monitoring, staged construction, and traffic control.

Verify and obtain concurrence from Geotechnical Services.

Insert bridge no. and support locations for difficult pile installation. List specific conditions for each location.

Add to section 49-1.03:

Expect difficult pile installation due to the conditions shown in the following table:

Pile location		Conditions
Bridge no.	Support location	

Section 49-2.01A(3). Use for driven piles. Retain Pile and Driving Data Form.

1. Use for all driven piles except if a driving system submittal or dynamic monitoring is requested by Geotechnical Services. Insert bridge number, pile type, and support location (e.g. Abutment 1, Bent 2) or control zone.

Add to section 49-2.01A(3)(a):

Before installing driven piles, submit a Pile and Driving Data Form for each pile type for each of the support locations or control zones shown in the following table:

Bridge no.	Pile type	Support location or control zone

2. Use if a driving system submittal or dynamic monitoring is requested by Geotechnical Services. Insert bridge number, pile type, and support location (e.g. Abutment 1, Bent 2) or control zone.

Add to section 49-2.01A(3)(b):

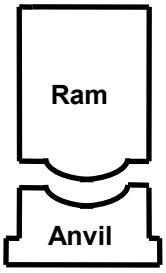
Before installing driven piles, submit a driving system submittal for each pile type for each of the support locations or control zones shown in the following table:

Bridge no.	Pile type	Support location or control zone

CALIFORNIA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION LABORATORY

PILE AND DRIVING DATA FORM

Structure Name :_____ Contract No.:_____
_____ Project:_____
Structure No.:_____ Pile Driving Contractor or
Dist./Co./Rte./Post Mi:_____ Subcontractor_____(Pile Driven By)



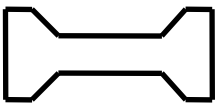
Hammer

Manufacturer:_____ Model:_____
Type:_____Serial No.:_____
Min Rated Energy: _____ at ___ Length of Stroke ____ Fuel Setting
Max Rated Energy: _____ at ___ Length of Stroke ____ Fuel Setting
Ram Weight:_____kips

Modifications: _____
_____
_____

Capblock (Hammer Cushion)

Material:_____
Thickness:_____in Area:_____in^2
Modulus of Elasticity - E:_____ksi
Coefficient of Restitution - e:_____

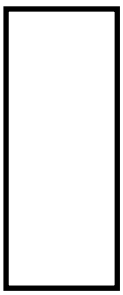


Pile Cap

[Helmet / Bonnet / Anvil Block / Drivehead] Weight:_____ kips

Pile Cushion

Material:_____
Thickness:_____in Area: _____in^2
Modulus of Elasticity - E:_____ksi
Coefficient of Restitution - e:_____



Pile

Pile Type:_____
Length (In Leads):_____ft
Lb/ft.:_____Taper:_____
Wall Thickness:_____in
Cross Sectional Area:_____ in^2
Design Pile Capacity:_____kips
Description of Splice:_____
_____
Tip Treatment Description:_____
_____

DISTRIBUTE:

- ☐ Translab, Foundation Testing
- ☐ Translab, Geotechnical Design
- ☐ Resident Engineer

Note: If mandrel or follower is used to drive the pile, attach separate manufacturer's detail sheet(s) including weight and dimensions.

Submitted By:_____
Date:_____Phone No.:_____

Section 49-2.01C(2). Use if revising the specifications for driving equipment.

Add to section 49-2.01C(2):

1. Use only for locations with low overhead clearance, generally less than 20 feet.

You may use internal drop hammers that strike the tip of closed ended piles or impact hammers that do not comply with the minimum energy requirements to advance piles to within 3 feet of the specified tip elevation at the locations shown in the following table:

Bridge name or no.	Abutment no.	Bent no.

2. Use only for sheet piles or for CISS piles that have no geotechnical capacity along the length of the pile or casing. If only 1 location, delete the table and delete *at the locations shown in the following table:*. Delete *rotators, or oscillators* if this paragraph is used only for sheet piles.

You may use vibratory hammers, rotators, or oscillators to install sheet piles or steel shells for CISS concrete piles at the locations shown in the following table:

Bridge name or no.	Abutment no.	Bent no.

3. Use for boulders, clay lenses, and other natural obstructions to pile driving, including abandoned culverts, slabs, footings, etc. Depth of excavation at uplift piles should be limited. Use only with steel piles. Edit as necessary.

If you encounter obstructions to driving, provide special driving tips or heavier pile sections, subexcavate below the bottom of footing, or take other measures to prevent damage to the pile during driving.

Section 49-2.01C(3). Use if drilling to assist pile driving is not allowed or is restricted by the foundation report.

Replace the paragraph in section 49-2.01C(3) with:

1. Use if drilling is not allowed for any structures on the project.

Do not use drilling to attain the specified tip elevation shown for driven piles.

2. Use if drilling is not allowed at specific locations and drilling is restricted at other locations. Insert locations.

For _____, do not use drilling to attain the specified tip elevation shown for driven piles.

3. Use if drilling is restricted. Insert locations.

Before driving piles, you may drill holes with a diameter not greater than the least dimension of the pile to attain the specified tip elevation shown for driven piles at the locations and to the bottom of hole elevations shown in the following table:

Bridge no.	Abutment no.	Bent no.	Bottom of hole elevation

Add to section 49-2.01C(3):

4. Use if drilling is not allowed at specific locations and may be allowed at other locations. Insert locations.

For _____, do not use drilling to attain the specified tip elevation shown for driven piles.

5. Use if center-relief drilling may be necessary for open-ended CISS and steel pipe piles. Insert depth not to be drilled. Check the plans and foundation report. If SSP 49-3.03C(2), par. 1 is used, match the depth with the clean out depth of the CISS piles.

Drilling through the center of open-ended steel shells or steel pipe piles to attain the specified tip elevation may be necessary. The diameter of the drilled hole must be less than the inside diameter of the pile. Equipment or methods used for drilling holes must not cause quick soil conditions or cause scouring or caving of the hole. Drilling must not be used within __ feet of the specified tip elevation. Do not drill before driving piles.

Section 49-2.01C(4). Use for driven piles if predrilling is required.

Add to section 49-2.01C(4):

1. Use for all piles in existing embankments and fills in excess of 5 feet or if predrilling is required due to a close proximity to an obstruction.

At existing embankments and fills, drive piles in predrilled holes at the locations and to the bottom of hole elevations shown in the following table:

Bridge name or no.	Abutment no.	Bent no.	Bottom of hole elevation

2. Use if piles must be driven through concrete footings that are to remain structurally functional.

Predrill holes through existing concrete footings for driving of steel piles at the locations shown. Do not damage the existing concrete to remain in place. Drilling methods and equipment must be authorized before starting the drilling.

Section 49-2.01C(5). Use if a pile set period is allowed as an option by Geotechnical Services instead of longer piling.

Add to section 49-2.01C(5):

1. Insert location.

If piles at _____ do not attain the nominal driving resistance at the specified tip elevation shown, you may allow them to stand for a set period without driving. The set period must be at least 12 hours.

2

After the set period has elapsed, redrive 2 piles or 10 percent of the piles in the footing, whichever is greater. The Engineer designates which piles are to be redriven. Redriving consists of operating the driving hammer at full rated energy on the pile and calculating the nominal driving resistance of the pile.

3

If the nominal driving resistance is attained for each pile designated to be redriven, the remaining piles in that footing are considered satisfactory and further driving is not required. If redriving the designated piles demonstrates that the nominal driving resistance has not been attained, redrive all piles in the footing until the nominal driving resistance is attained.

Section 49-3.02A(1). Use if CIDH concrete piles are designed as end bearing.

Add to section 49-3.02A(1) :

The CIDH concrete piles shown in the following table are specified as end bearing:

Bridge name or no.	Abutment no.	Bent no.

Section 49-3.02B(6)(c). Use for CIDH piling at least 24 inches in diameter and 5 feet in length.

Add to section 49-3.02B(6)(c):

The synthetic slurry must be one of the materials shown in the following table:

Material	Manufacturer
SlurryPro CDP	KB INTERNATIONAL LLC 735 BOARD ST STE 209 CHATTANOOGA TN 37402 (423) 266-6964
Super Mud	PDS CO INC 105 W SHARP ST EL DORADO AR 71731 (870) 863-5707
Shore Pac GCV	CETCO CONSTRUCTION DRILLING PRODUCTS 2870 FORBS AVE HOFFMAN ESTATES IL 60192 (800) 527-9948
Terragel or Novagel Polymer	GEO-TECH SERVICES LLC 220 N. ZAPATA HWY STE 11A-449A LAREDO TX 78043 (210) 259-6386
BIG FOOT	MATRIX CONSTRUCTION PRODUCTS 50 S MAIN ST STE 200 NAPERVILLE IL 60540 (877) 591-3137
POLY-BORE	BAROID INDUSTRIAL DRILLING PRODUCTS 3000 N SAM HOUSTON PKWY EAST HOUSTON TX 77032 (877) 379-7412

Use synthetic slurries in compliance with the manufacturer's instructions. Synthetic slurries shown in the above table may not be appropriate for a given job site.

Synthetic slurries must comply with the Department's requirements for synthetic slurries to be included in the above table. The requirements are available from the Offices of Structure Design, P.O. Box 168041, MS# 9-4/11G, Sacramento, CA 95816-8041.

SlurryPro CDP synthetic slurry must comply with the requirements shown in the following table:

SlurryPro CDP

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 67.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 50–120 ≤ 70
pH	Glass electrode pH meter or pH paper	6.0–11.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Super Mud synthetic slurry must comply with the requirements shown in the following table:

Super Mud

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 32–60 ≤ 60
pH	Glass electrode pH meter or pH paper	8.0–10.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Shore Pac GCV synthetic slurry must comply with the requirements shown in the following table:

Shore Pac GCV

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 33–74 ≤ 57
pH	Glass electrode pH meter or pH paper	8.0–11.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	 ≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Terragel or Novagel Polymer synthetic slurry must comply with the requirements shown in the following table:

Terragel or Novagel Polymer

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 67.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 45–104 ≤ 104
pH	Glass electrode pH meter or pH paper	6.0–11.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	 ≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

BIG-FOOT synthetic slurry must comply with the requirements shown in the following table:

BIG-FOOT

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 ≤ 64.0[a] ≤ 64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 30–125 55-114
pH	Glass electrode pH meter or pH paper	8.5–10.5
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	 ≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

POLY-BORE synthetic slurry must comply with the requirements shown in the following table:

POLY-BORE

Quality characteristic	Test method	Requirement
Density During drilling (pcf) Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1, section 4	 62.8-65.8[a] 62.8-64.0[a]
Viscosity During drilling (sec/qt) Before final cleaning and immediately before placing concrete (sec/qt)	Marsh funnel and cup. API RP 13B-1, section 6.2	 50–80 50-80
pH	Glass electrode pH meter or pH paper	7.0–10.0
Sand content, percent by volume Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	 ≤ 1.0

NOTE: Slurry temperature must be at least 40 °F when tested.
[a]If authorized, you may use slurry in a salt water environment. The allowable density of slurry in a salt water environment may be increased by 2 pcf.

Section 49-3.02B(6)(d). Use for CIDH piling at least 24 inches in diameter and full-depth casing if Geotechnical Services allows the use of water slurry.

Replace *Reserved* in section 49-3.02B(6)(d) with:

You may use water as slurry if a casing is used for the entire length of the drilled hole.

Water slurry must comply with the requirements shown in the following table:

Water Slurry Requirements

Quality characteristic	Test method	Requirement
Density Before final cleaning and immediately before placing concrete (pcf)	Mud weight (density), API RP 13B-1 section 4	63.5[a]
Sand content Before final cleaning and immediately before placing concrete (%)	Sand, API RP 13B-1, section 9	≤ 0.5

[a]If authorized, you may use salt water slurry. The allowable density of the slurry may be increased by 2 pcf.

Section 49-3.02C(1). Use for CIDH piling if (1) piling center-to-center spacing is less than 4 pile diameters, or (2) drilling locations include cobbles, boulders, or hard rock.

1. Use if CIDH piling center-to-center spacing is less than 4 pile diameters. Consult Geotechnical Services to see if a drilling sequence is necessary. If necessary, add the sequence.

Add to section 49-3.02C(1):

If the piling center-to-center spacing is less than 4 pile diameters, do not drill holes or drive casing for an adjacent pile until 24 hours have elapsed after concrete placement in the preceding pile and your prequalification test results for the concrete mix design show that the concrete will attain at least 1800 psi compressive strength at the time of drilling or driving.

2. Use if drilling is anticipated through cobbles, boulders, or hard rock. Consult with Geotechnical Services and Structure Construction.

Drilling equipment must be equipped with instrumentation to measure accurately the actual downward force in pounds. Instrumentation must be visible for reading.

Section 49-3.02C(4). Use if CIDH piles are end bearing. Edit *3 inches* if different from the clearance shown.

Add to section 49-3.02C(4):

If the hole is drilled below the specified tip elevation shown, the reinforcement must extend to within 3 inches of the bottom of the drilled hole for the piles that are specified as end bearing.

Section 49-3.02C(6). Use for permanent steel casings. Delete methods of installation not allowed per the Foundation Report.

Add to section 49-3.02C(6):

Install permanent steel casings by impact or vibratory hammers, oscillators, rotators, or by placing in a drilled hole.

Section 49-3.02C(7). Use for Type II CIDH piling if (1) an optional construction joint is shown and the CIDH piling is less than 5 feet in diameter, (2) Geotechnical Services requires corrugated metal pipe for the casing, (3) Geotechnical Services allows the use of slurry cement backfill to backfill the casing, or (4) Geotechnical Services restricts the method of casing installation.

1. Use if an optional construction joint is shown and the CIDH piling is less than 5 feet in diameter.

Replace the 1st paragraph of section 49-3.02C(7) with:

Section 49-3.02C(7) applies to CIDH concrete piles if an optional construction joint is shown and you choose to construct the optional construction joint.

2–4. Use only one of these paragraphs.

Replace item 5 in the list in the 2nd paragraph of section 49-3.02C(7) with:

2. Use if corrugated metal pipe is required.

5. Be corrugated metal pipe and placed in a drilled hole. Casings placed in a drilled hole must comply with section 49-3.02C(6).

3. Use if slurry cement backfill is allowed. Delete methods not allowed for the installation of the casing.

5. Be installed by impact or vibratory hammers, oscillators, rotators, or by placing in a drilled hole. Casings placed in a drilled hole must comply with section 49-3.02C(6) except slurry cement backfill may be used instead of grout.

4. Use if not all methods listed are allowed for the installation of the casing. Delete methods not allowed.

5. Be installed by impact or vibratory hammers, oscillators, rotators, or by placing in a drilled hole. Casings placed in a drilled hole must comply with section 49-3.02C(6).

Section 49-3.03C(2). Use to revise the clean out depth of open-ended CISS piles.

Insert the number of feet that should not be cleaned out at the bottom of the pile. Eight feet is specified in the Standard Specifications. Generally, use at least 2 times the pipe diameter. Check the plans and foundation report.

Replace item 4 in the list in the 3rd paragraph of section 49-3.03C(2) with:

4. Bottom ___ feet of the pile must not be cleaned out.

Section 49-4.03B. Use for steel soldier piling.

Add to section 49-4.03B:

1. Use if rock foundation material or boulders with soil matrix foundation material is shown on the LOTB or foundation report.

Rock subsurface foundation material is anticipated at the soldier pile retaining wall location. Conventional drilling equipment for drilling in soils may not be suitable for drilling holes for the steel soldier piling.

2. Use if pile substitutions are allowed.

If you substitute piles with a larger diagonal dimension for the piles shown, ream or enlarge the drilled hole to provide a hole diameter at least 4 inches larger than the diagonal dimension of the pile.

Section 49-5. Use for micropiles. Micropiles are also known as pin piles, minipiles, root piles, or needle piles.

For purposes of editing this SSP, micropiles are divided into the following 2 categories:

Category A: Micropiles experiencing primarily axial forces due to axial loading at the top of the micropile. This would typically include bridge foundations and may occasionally include some walls. For Category A, the Contractor determines the length, load testing is performed, and pressure grouting is used.

Category L: Micropiles experiencing primarily shear and bending forces along their length due to lateral loading. This would typically include earth stabilization

structures and most walls. For Category L, the State determines the length, load testing is not performed, and gravity grouting is used.

Confirm the category with the designer. These categories are a guide to editing this SSP based on how Caltrans projects are typically done. However, nonstandard editing may be required for some projects.

For all micropiles, the plans must show:

1. Micropile layout, spacing, and inclination

2. Steel reinforcing element dimensions, yield strength, and any no-splice zones or no-joint zones

3. Grout compressive strength and grout cover

4. Anchorage details and amount of embedment into the concrete structure

5. Corrosion protection details, if required

For Category A micropiles only, the plans must show:

1. Value of FTL and whether it is for compression or tension load testing

2. Verification test micropile locations

3. Length of the pipe, HSS, or casing

4. Limits of the micropile length dimensioned as *Length to be determined by the Contractor*

5. If required, minimum micropile length per par. 98

For Category L micropiles only, the plans must show:

1. Micropile length or tip elevation

For all micropiles, the foundation report must discuss:

1. Any requirements for isolating micropiles from settling embankment

2. Any corrosion protection requirements

For Category A micropiles only, the foundation report must discuss:

1. Location of each verification test micropile and a description of which production micropiles are represented by each verification test micropile

2. Number of proof load tests required per footing or wall zone

3. For walls and earth stabilization structures, the limits of the wall zones

4. Whether verification and proof load testing are in tension, compression, or both

5. Whether creep testing is required for the verification or proof load testing

6. Whether measures need to be taken to provide geotechnical equivalence between the verification test micropile and the production piles it represents per par. 105

7. If required, minimum micropile length per par. 98

For Category L micropiles only, the foundation report must discuss:

1. Micropile length or tip elevation

Replace *Reserved* in section 49-5 with:

49-5.01 GENERAL

49-5.01A Summary

1

Section 49-5 includes specifications for constructing micropiles.

2. Use if the plans show an HS threaded bar with fy=120 ksi as a center bar. Delete *and couplers* if splices are not allowed.

HS threaded bars and couplers must comply with the specifications for HS steel prestressing bars in section 50.

3. Use if the plans show bar reinforcing steel as a center bar.

Bar reinforcing steel must comply with section 52, except you may use deformed bar reinforcing steel that complies with ASTM A615/A615M, Grade 60.

49-5.01B Definitions

4

micropile: Small-diameter, bored, CIP composite pile, in which the applied load is resisted by steel reinforcing elements, grout, and frictional ground-grout bond.

5

steel reinforcing element: Steel element used to strengthen or stiffen a micropile, such as bar reinforcing steel, HS threaded bar, pipe, hollow structural section (HSS), or casing.

49-5.01C Submittals

49-5.01C(1) General

6

Do not order materials nor install micropiles until the experience qualifications, shop drawings and calculations, and installation plan are authorized.

49-5.01C(2) Experience Qualifications

7. For Category L micropiles, replace *Construction details, structural details, and load test results* in item 2 with *Construction details and structural details*.

Submit the following experience qualification information:

1. Summary of the micropile subcontractor's experience that demonstrates compliance with section 49-5.01D(2).
2. Construction details, structural details, and load test results from at least 3 completed micropile installations performed by the micropile subcontractor in the last 5 years. The installations must be from 3 separate projects of similar scope to this Contract. Include a project description and the owner's name and current phone number.
3. List of on-site foremen and drill rig operators who will perform the micropile work and a summary of each individual's experience that demonstrates compliance with section 49-5.01D(2).

8. Edit if a different number of days is required for the review, except delete the paragraph if the number of days is 15.

Allow 10 days for review.

49-5.01C(3) Shop Drawings and Calculations

9

Submit 5 copies of micropile shop drawings and calculations to OSD, Documents Unit. Notify the Engineer of the submittal. Include in the notification the date and contents of the submittal.

10. Edit if a different number of days is required for the review, except delete the 1st sentence if the number of days is 20.

Allow 30 days for review. After the review, submit 6 copies for final authorization and use during construction. Within 20 days after final authorization, submit 1 copy of final shop drawings and calculations.

11

The shop drawings and calculations must be sealed and signed by an engineer who is registered as a civil engineer in the State.

12. Edit to suit the project. Delete item 7 for Category L micropiles. Delete item 3.8 if corrosion protection is not required. Delete item 6 if par. 80 is not used. Insert either *pipe*, *HSS*, or *casing* in the blank in item 6, according to the type of element specified in section 49-5.02B(2). If no splices or joints are allowed in any steel reinforcing elements, modify item 3.5 to read *Steel reinforcing element details, including sizes and lengths*.

The shop drawings and calculations must include:

1. Name, address, and phone number of the micropile subcontractor
2. Plan view, including:
   2.1. Station and offset at the beginning and end of the micropile structure and at any change in the structure's horizontal alignment
   2.2. Identification and location of each exploratory borehole
   2.3. Location of any existing utilities, adjacent existing structures, and other potential interferences
   2.4. Micropile layout and spacing
   2.5. Unique identification number for each micropile
3. Typical sections, including:
   3.1. Micropile inclination
   3.2. Drilled hole diameter
   3.3. Micropile tip elevation
   3.4. Micropile cutoff elevation
   3.5. Steel reinforcing element details, including sizes, lengths, splice or joint types, and splice or joint locations
   3.6. Centralizers and any spacers
   3.7. Micropile anchorage details
   3.8. Corrosion protection details
4. Material properties
5. General notes for constructing the micropiles, including overall construction sequencing
6. Data demonstrating the adequacy of any threaded joints in the _____ for the tension load specified in section 49-5.02B(2)
7. Calculations for the micropile length

13. Use if API N80 casing is shown on the plans. If par. 80 is not used, delete item 3.

If you propose an alternative to the API N80 casing shown, include with the shop drawings and calculations:

1. Calculations demonstrating that the structural capacity of the alternative pipe, HSS, or casing is greater than the structural capacity of the API N80 casing shown
2. Details and calculations for any anchorage changes needed to accommodate the alternative pipe, HSS, or casing
3. Data demonstrating the adequacy of any threaded joints for the value of tension specified in section 49-5.02B(2) if this value is greater than 25 percent of the yield capacity of the alternative pipe, HSS, or casing

49-5.01C(4) Installation Plan

14. Edit to suit the project. Delete items 3 and 4 if they do not apply. Delete item 6 if this requirement is not in the foundation report. Delete item 7 if no splices or joints are allowed in any steel reinforcing elements. For Category L micropiles: (1) delete items 9.6, 11, and 12, (2) delete *including details for post-grouting, if used* in item 9.3, (3) modify item 9.4 to read *Methods and equipment for monitoring and recording grout depth and volume as the grout is placed*, and (4) delete *initial pump pressures or* in item 9.5. Delete item 11.5 if par. 105 is not used.

Submit a micropile installation plan, including:

1. Detailed construction procedures, including personnel, materials, testing, and equipment.
2. Layout drawing showing the micropile installation sequence.
3. Information on headroom and space requirements for installation equipment that verifies that the equipment can perform at the job site.
4. Provisions for constructing micropiles near underground facilities.
5. Drilling or coring methods and equipment, including methods to:
   - 5.1. Provide drilled hole support
   - 5.2. Drill a straight hole
   - 5.3. Advance through boulders and other obstructions
   - 5.4. Prevent detrimental ground movements
6. Provisions for isolating micropiles from settling embankments.
7. Length of steel reinforcing element sections to be used, splice or joint locations, and any splice or joint location restrictions.
8. Methods for placing, positioning, and supporting steel reinforcing elements.
9. Grouting plan, including:
   - 9.1. Grout mix design. Include test results from an authorized laboratory for the compressive strength of the mix at 3, 7, 14, and 28 days and the density of the mix.
   - 9.2. Procedures for monitoring grout quality.
   - 9.3. Placement procedures and equipment, including details for post-grouting, if used.
   - 9.4. Methods and equipment for monitoring and recording grout depth, volume, and pressure as the grout is placed.
   - 9.5. Grouting rate calculations, upon request. Base the calculations on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid to be displaced, if applicable.
   - 9.6. Minimum cure time and strength requirements for performing load testing.
10. Plan for the control and disposal of surface and groundwater, drill flush, and waste grout.
11. Load testing plan, including drawings and calculations that describe:
    - 11.1. Testing procedures.
    - 11.2. Reaction load system capacity and equipment setup.
    - 11.3. Types and accuracy of the primary and secondary instrumentation equipment to be used for applying and measuring the test loads and top of micropile movements.
    - 11.4. Installation details for the instrumentation to be used for applying and measuring the test loads and measuring the top of micropile movements.
    - 11.5. Provisions for isolating verification test micropiles as specified under section 49-5.03B.
12. Calibration reports and data for each test jack, pressure gauge, load cell, and electronic displacement transducer to be used. The load cell calibration chart must show applied load versus millivolts per volt.

15

The installation plan must be sealed and signed by an engineer who is registered as a civil engineer in the State.

16. Edit if a different number of days is required for the review, except delete the paragraph if the number of days is 15.

Allow 20 days for review.

49-5.01C(5) Mill Test Reports

17. If project special provisions include an exception to the Buy America specifications, consult with Structure Specifications Research and Development.

Submit certified mill test reports for each heat number of each type of steel reinforcing element at least 7 days before using the materials in the work. The certified mill test reports must include ultimate strength, yield strength, elongation, and chemical composition.

49-5.01C(6) Installation Logs

18. For Category L micropiles, delete *and pressures* in item 11. Delete item 13 if no splices or joints are allowed in any reinforcing elements.

Submit each installation log as an informational submittal within 1 business day of the micropile installation. The installation log must include:

1. Micropile identification number and location
2. Names of superintendent, drill rig operator, grout plant operator, and any other personnel involved in the micropile installation
3. Date, time, and duration of drilling, steel reinforcing element installation, and grout placement
4. Drilling or coring method and speed
5. Details of any hole stabilization method used
6. Description of soil or rock encountered
7. Quantity of groundwater encountered
8. Description of any unusual installation behaviors or conditions
9. Drilled hole diameter
10. Micropile tip elevation
11. Log of grout quantities and pressures, including the time and micropile depth
12. Lengths of steel reinforcing elements
13. Details of splicing operations, including locations of the splices or joints

49-5.01C(7) Grout Test Results

19

Submit grout test results for density, efflux time, and compressive strength within 1 business day of testing.

49-5.01C(8) Load Test Data

20–22. For Category L micropiles, delete pars. 20–22 and add *Not Used*.

20

Submit load test data within 1 business day of the completion of a verification or proof load test. Load test data must include:

1. Micropile identification number and location
2. Installation date
3. Load test date
4. Testing personnel
5. Load testing equipment
6. Raw data from the electronic data acquisition system
7. Readings from the secondary load and displacement measurement systems recorded at each load increment
8. Specified curves plotted using data from the electronic data acquisition system
9. Comparison of the load test results and the acceptance criteria

21

Load test data must be sealed and signed by an engineer who is registered as a civil engineer in the State.

22. Edit if a different number of days is required for the review, except delete the paragraph if the number of days is 15.

Allow 10 days for review.

49-5.01D Quality Assurance

49-5.01D(1) General

23

Not Used

49-5.01D(2) Experience Qualifications

24. For Category L micropiles, delete *and load testing* from item 1.

The micropile subcontractor must:

1. Be experienced in micropile construction and load testing
2. Have successfully constructed at least 5 projects in the last 5 years involving a combined total of at least 100 micropiles
3. Have previous micropile drilling and grouting experience in soil or rock similar to the soil or rock for this Contract

25

Each on-site foreman and drill rig operator must have experience installing micropiles on at least 3 projects completed in the last 5 years.

49-5.01D(3) Preconstruction Meeting

26

Schedule and hold a micropile preconstruction meeting at least 5 business days after submitting the micropile shop drawings, calculations, and installation plan and at least 10 days before starting micropile construction. You must provide a meeting facility.

27

The meeting must include the Engineer, your representatives, representatives from the micropile subcontractor, and representatives from any other subcontractor to be involved in the micropile construction.

28. For Category L micropiles, delete item 7.

The Engineer conducts the meeting. Be prepared to discuss:

1. Contractual relationships and delineation of responsibilities among you and the subcontractors
2. Contacts and communication protocol between you and your representatives, the subcontractors, and the Engineer
3. Coordination of the construction schedule and activities
4. Anticipated subsurface conditions
5. Structural, geotechnical, and construction requirements
6. Materials testing
7. Load testing

49-5.01D(4) Quality Control

49-5.01D(4)(a) General

29

Not Used

49-5.01D(4)(b) Grout Testing

30

Before placing grout into each micropile:

1. Test the grout density under API RP 13B-1 using the Baroid mud balance. Take the grout test samples directly from the grout plant.
2. Test the grout efflux time under California Test 541. Take the grout test samples at the point of placement.

31

Test the grout compressive strength under ASTM C109/C109M at an authorized laboratory. Test at least 1 set of three 2-inch grout cubes from each grout plant each day of operation or for every 10 micropiles installed, whichever occurs more frequently. Take the grout test samples directly from the grout plant.

32–59. For Category L micropiles, delete pars. 32–59, including the headings.

49-5.01D(4)(c) Load Testing

49-5.01D(4)(c)(i) General

32

Section 49-1.01D does not apply to micropile load testing.

33. Edit if a lower grout strength is allowed for load testing.

The grout for each load test micropile must attain the compressive strength shown before you perform the load test.

34

Notify the Engineer at least 10 days before you perform each load test.

35

Perform each load test in the Engineer's presence.

36. Use if tension load testing is recommended in the foundation report. If only verification load testing or only proof load testing is performed in tension, edit accordingly.

Perform verification and proof load testing in tension under ASTM D3689, except do not use the loading apparatus described as "Tensile Load Applied by Hydraulic Jack(s) Acting Upward at One End of Test Beam(s)."

37. Use if compression load testing is recommended in the foundation report. If only verification load testing or only proof load testing is performed in compression, edit accordingly.

Perform verification and proof load testing in compression under ASTM D1143/D1143M.

38. Use if both compression and tension verification load testing or both compression and tension proof load testing are recommended in the foundation report. Edit to suit the project. For proof load testing, edit as appropriate or add an additional requirement.

Perform tension and compression verification load tests on the same verification test micropile. Perform the tension load test first.

39. Use if tension load testing is recommended in the foundation report. In item 1, insert the value of FTL in tension from the plans. In item 2, insert the value of the service load in tension provided by the designer. Service load is not the same as design load. Service load is the unfactored demand in LRFD design. If the values of FTL and SL vary for different supports or wall zones, create a table.

For tension load testing:

1. FTL in the load test schedule must be equal to _____ kips
2. SL in the load test schedule must be equal to _____ kips

40. Use if tension load testing is performed on micropiles containing both a center bar and a pipe, HSS, or casing element. If the designer requires that the test load be applied to both the center bar and the pipe, HSS, or casing, change *the center bar only* to *both the center bar and the pipe/HSS/casing*. Choose either *pipe*, *HSS*, or *casing* according to the type of element specified in section 49-5.02B(2).

Apply the test loads for tension load testing to the center bar only.

41. Use if compression load testing is recommended in the foundation report. In item 1, insert the value of FTL in compression from the plans. In item 2, insert the value of the service load in compression provided by the designer. Service load is not the same as design load. Service load is the unfactored demand in LRFD design. If the values of FTL and SL vary for different supports or wall zones, create a table.

For compression load testing:

1. FTL in the load test schedule must be equal to _____ kips
2. SL in the load test schedule must be equal to _____ kips

42. Use if micropiles are near an existing structure.

Do not use an existing structure as part of the reaction system unless authorized.

43

Use a load cell as the primary load measurement system. The load cell must:

1. Be of the bonded electrical resistance strain gauge type.
2. Have a full scale range no greater than 150 percent of the maximum test load.
3. Be moisture resistant.
4. Be temperature compensated. The maximum temperature sensitivity at zero load must be ±0.05 percent of full scale per degree F.
5. Have a resolution within ±0.025 percent of full scale.
6. Have an accuracy within ±0.25 percent of full scale.

44

Use electronic displacement transducers as the primary movement measurement system. Displacement transducers must be capable of measuring to 0.001 inch and have enough travel to allow the load test to be performed without resetting.

45

Apply the test loads using a hydraulic jack. Use the gauge in the jack and pressure gauge assembly as the secondary load measurement system. Jack ram travel must be sufficient to allow the load test to be performed without resetting the equipment. The pressure gauge must be graduated in 100 psi increments or less.

46

The load cell, the electronic displacement transducers, and the jack and gauge assembly must be calibrated by an authorized laboratory accredited for calibration services using equipment traceable to NIST. The jack and gauge assembly must be calibrated as a unit.

47

Use an electronic data acquisition system to simultaneously monitor and record readings from the primary load and displacement measurement systems. The electronic data acquisition system must continuously take readings at regular intervals from the load cell and electronic displacement transducers.

48

The Department may verify the test loads using Department-furnished load cells. Upon request, furnish the resources necessary to install and support the Department's testing equipment at the load testing location and to remove the equipment after the testing is complete.

49-5.01D(4)(c)(ii) Verification Load Testing

49

Perform verification load testing on each verification test micropile installed.

50. Use for bridges. In column 1, insert the bridge number. In column 2, insert the location of each verification test micropile. In column 3, insert the abutment or bent names for the production micropiles represented by the verification test micropile. Add or delete rows as necessary.

The verification test micropile at each listed location represents the production micropiles at the support locations shown in the following table:

Bridge no.	Verification test micropile location	Support locations

51. Use for walls and slope stabilization structures. In column 1, insert the bridge number. In column 2, insert the location of each verification test micropile. In column 3, insert the beginning and end stations of the wall zone for the production micropiles represented by the verification test micropile. Add or delete rows as necessary.

The verification test micropile at each listed location represents the production micropiles in the wall zone shown in the following table:

Bridge no.	Verification test micropile location	Wall zone limits	
		Beginning station	End station

52. Use if creep testing is not recommended during verification load testing. If recommended by the geotechnical designer, the increments between 1.00SL and 1.00FTL can be made smaller by adding load increment rows.

Perform verification load testing as follows:

1. Incrementally load and unload the micropile as shown in the following table:

Verification Load Test Schedule

Load increment	Hold time (minutes)
AL	Until stable
0.25SL	1–2
AL	Until stable
0.25SL	1–2
0.50SL	1–2
AL	Until stable
0.25SL	1–2
0.50SL	1–2

0.75SL	1–2
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
1.00SL	5
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
1.00SL	1–2
0.80SL + 0.20FTL	1–2
0.60SL + 0.40FTL	1–2
0.40SL + 0.60FTL	1–2
0.20SL + 0.80FTL	1–2
1.00FTL[a]	5
0.75FTL	1–2
0.50FTL	1–2
0.25FTL	1–2
AL	Until stable

NOTES:
AL = alignment load, 0.10SL
SL = service load
FTL = factored test load
[a]Maximum test load

2. At each load increment:
   2.1. Apply the load in less than 1 minute.
   2.2. Maintain a constant load for the hold time shown in the load test schedule. Start the hold time as soon as the load increment is fully applied.
   2.3. Measure and record the top of micropile movement at the end of the hold time.
3. Plot the applied test load versus the top of micropile movement at each load increment.

53. Use if creep testing is recommended during verification load testing. If recommended by the geotechnical designer, the increments between 1.00SL and 1.00FTL can be made smaller by adding load increment rows.

Perform verification load testing as follows:

1. Incrementally load and unload the micropile as shown in the following table:

Verification Load Test Schedule

Load increment	Hold time (minutes)
AL	Until stable
0.25SL	1–2
AL	Until stable
0.25SL	1–2
0.50SL	1–2
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
AL	Until stable
0.25SL	1–2

0.50SL	1–2
0.75SL	1–2
1.00SL	10 or 60
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
1.00SL	1–2
0.80SL + 0.20FTL	1–2
0.60SL + 0.40FTL	1–2
0.40SL + 0.60FTL	1–2
0.20SL + 0.80FTL	1–2
1.00FTL[a]	5
0.75FTL	1–2
0.50FTL	1–2
0.25FTL	1–2
AL	Until stable

NOTES:
AL = alignment load, 0.10SL
SL = service load
FTL =factored test load
[a]Maximum test load

2. At each load increment:
   2.1. Apply the load in less than 1 minute.
   2.2. Maintain a constant load for the hold time shown in the load test schedule. Start the hold time as soon as the load increment is fully applied.
   2.3. Measure and record the top of micropile movement at the end of the hold time.
3. At the 1st application of 1.00SL, perform the creep test as follows:
   3.1. Hold the load for 10 minutes.
   3.2. Measure and record the top of micropile movement at 1, 2, 3, 4, 5, 6, and 10 minutes.
   3.3. If the movement measured from 1 to 10 minutes is greater than 0.04 inch, continue the creep test as follows:
      3.3.1. Hold the load for an additional 50 minutes.
      3.3.2. Measure and record the top of micropile movement at 15, 20, 25, 30, 45, and 60 minutes.
      3.3.3. Plot the top of micropile movement as a function of the logarithm of time from 6 to 60 minutes.
4. Plot the applied test load versus the top of micropile movement at each load increment.

49-5.01D(4)(c)(iii) Proof Load Testing

54–55. Use for micropiles at bridge supports. If there is more than 1 micropile footing and the number of proof test micropiles varies among footings, edit to be location specific.

54. Insert the minimum number of proof load tests recommended in the foundation report. Typically, 10 percent of the micropiles or a minimum of 2 micropiles are tested per footing.

Perform proof load tests on _____ micropiles per footing. The Engineer selects each micropile to be proof load tested. The Engineer does not notify you of which micropile is to be proof load tested until after the micropile has been installed.

55. Insert a value for percent of micropiles. A minimum of 25 percent is recommended.

The 1st micropile proof load test at a footing must be performed after at least ____ percent of the micropiles at the footing have been installed.

56–57. Use for micropiles at walls and slope stabilization structures. If there is more than 1 micropile wall or slope stabilization structure and the number of proof test micropiles per wall zone varies among walls and slope stabilization structures, edit to be location specific.

56. Insert the minimum number of proof load tests recommended in the foundation report. Typically, 15 percent of the micropiles or a minimum of 2 micropiles are tested per wall zone.

Perform proof load tests on _____ micropiles per wall zone. The Engineer selects each micropile to be proof load tested. The Engineer does not notify you of which micropile is to be proof load tested until after the micropile has been installed.

57. Insert a value for percent of micropiles. A minimum of 25 percent is recommended.

The 1st micropile proof load test in a wall zone must be performed after at least ____ percent of the micropiles in the wall zone have been installed.

58. Use if creep testing is not recommended during proof load testing. If recommended by the geotechnical designer, the increments between 1.00SL and 0.80FTL can be made smaller by adding load increment rows.

Perform proof load testing as follows:

1. Incrementally load and unload the micropile as shown in the following table:

Proof Load Test Schedule

Load increment	Hold time (minutes)
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
1.00SL	5
0.80SL + 0.20(0.80FTL)	1–2
0.60SL + 0.40(0.80FTL)	1–2
0.40SL + 0.60(0.80FTL)	1–2
0.20SL + 0.80(0.80FTL)	1–2
0.80FTL[a]	5
AL	Until stable

NOTES:
AL = alignment load, 0.10SL
SL = service load
FTL = factored test load
[a]Maximum test load

2. At each load increment:
   2.1. Apply the load in less than 1 minute.
   2.2. Maintain a constant load for the hold time shown in the load test schedule. Start the hold time as soon as the load increment is fully applied.
   2.3. Measure and record the top of micropile movement at the end of the hold time.
3. Plot the applied test load versus the top of micropile movement at each load increment.

59. Use if creep testing is recommended during proof load testing. If recommended by the geotechnical designer, the increments between 1.00SL and 0.80FTL can be made smaller by adding load increment rows.

Perform proof load testing as follows:

1. Incrementally load and unload the micropile as shown in the following table:

Proof Load Test Schedule

Load increment	Hold time (minutes)
AL	Until stable
0.25SL	1–2
0.50SL	1–2
0.75SL	1–2
1.00SL	10 or 60
0.80SL + 0.20(0.80FTL)	1–2
0.60SL + 0.40(0.80FTL)	1–2
0.40SL + 0.60(0.80FTL)	1–2
0.20SL + 0.80(0.80FTL)	1–2
0.80FTL[a]	5
AL	Until stable

NOTES:
AL = alignment load, 0.10SL
SL = service load
FTL = factored test load
[a]Maximum test load

2. At each load increment:
   2.1. Apply the load in less than 1 minute.
   2.2. Maintain a constant load for the hold time shown in the load test schedule. Start the hold time as soon as the load increment is fully applied.
   2.3. Measure and record the top of micropile movement at the end of the hold time.
3. At the 1st application of 1.00SL, perform the creep test as follows:
   3.1. Hold the load for 10 minutes.
   3.2. Measure and record the top of micropile movement at 1, 2, 3, 4, 5, 6, and 10 minutes.
   3.3. If the movement measured from 1 to 10 minutes is greater than 0.04 inch, continue the creep test as follows:
      3.3.1. Hold the load for an additional 50 minutes.
      3.3.2. Measure and record the top of micropile movement at 15, 20, 25, 30, 45, and 60 minutes.
      3.3.3. Plot the top of micropile movement as a function of the logarithm of time from 6 to 60 minutes.
4. Plot the applied test load versus the top of micropile movement at each load increment.

60–66. For Category L micropiles, delete pars. 60–66. Keep the heading *49-5.01D(5) Department Acceptance*, delete the other headings, and add *Not Used*.

49-5.01D(5) Department Acceptance

49-5.01D(5)(a) General

60

Not Used

49-5.01D(5)(b) Verification Load Test

61. Insert in items 1 and 2 the maximum axial movement allowed. If tension verification load testing is not being done, delete item 1, delete *For compression*

testing, the **in item 2, and capitalize *Axial* in item 2. If compression verification load testing is not being done, delete item 2, delete *For tension testing, the* in item 1, and capitalize *Axial* in item 1. Delete item 4 if verification creep testing is not being done.**

Each verification load test must comply with the following acceptance criteria:

1. For tension testing, the axial movement at the top of the micropile measured from the initial alignment load to the 1st application of 1.00SL must not exceed _____ inch at the end of the 1.00SL hold time.
2. For compression testing, the axial movement at the top of the micropile measured from the initial alignment load to the 1st application of 1.00SL must not exceed _____ inch at the end of the 1.00SL hold time.
3. Slope of the applied test load versus the top of micropile movement must not exceed 0.025 inch per kip at the maximum test load.
4. Creep test movement must comply with one of the following:
   4.1. For a 10-minute load hold, the movement measured from 1 to 10 minutes must be less than 0.04 inch.
   4.2. For a 60-minute load hold, the movement measured from 6 to 60 minutes must be less than 0.08 inch and the rate of movement must be linear or decreasing in time logarithmic scale from the 6- to the 60-minute reading.

62

If a verification load test fails to comply with the acceptance criteria, the verification test micropile is rejected. Revise the micropile length, installation methods, or both, and submit revised shop drawings, calculations, and installation plan.

63

After the revised submittals are authorized, install and test a new verification test micropile that incorporates the changes at an authorized location near the rejected verification test micropile. If post-grouting the micropile is the only change, you may post-grout and retest the rejected verification test micropile instead of installing a new verification test micropile.

64

If the new or retested verification test micropile fails to comply with the acceptance criteria, repeat the process specified above until a verification test micropile complies with the acceptance criteria.

49-5.01D(5)(c) Proof Load Test

65. Insert in items 1 and 2 the maximum axial movement allowed. If tension proof load testing is not being done, delete item 1, delete *For compression testing, the* in item 2, and capitalize *Axial* in item 2. If compression proof load testing is not being done, delete item 2, delete *For tension testing, the* in item 1, and capitalize *Axial* in item 1. Delete item 4 if proof creep testing is not being done.

Each proof load test must comply with the following acceptance criteria:

1. For tension testing, the axial movement at the top of the micropile measured from the initial alignment load to the 1st application of 1.00SL must not exceed _____ inch at the end of the 1.00SL hold time.
2. For compression testing, the axial movement at the top of the micropile measured from the initial alignment load to the 1st application of 1.00SL must not exceed _____ inch at the end of the 1.00SL hold time.
3. Slope of the applied test load versus the top of micropile movement must not exceed 0.025 inch per kip at the maximum test load.
4. Creep test movement must comply with one of the following:
   4.1. For a 10-minute load hold, the movement measured from 1 to 10 minutes must be less than 0.04 inch.
   4.2. For a 60-minute load hold, the movement measured from 6 to 60 minutes must be less than 0.08 inch and the rate of movement must be linear or decreasing in time logarithmic scale from the 6- to the 60-minute reading.

66. For walls and slope stabilization structures, replace *footing* with *wall zone* at 2 locations in item 1 and at 1 location in item 2.

If a proof load test fails to comply with the acceptance criteria, the micropile is rejected. Suspend micropile construction and comply with one of the following procedures:

1. Post-grout and retest the rejected micropile. If the post-grouted micropile complies with the acceptance criteria when retested, post-grout all of the micropiles in the footing using identical methods. Any proof load test performed on a micropile before the post-grouting does not count toward the total proof load tests required for the footing.
2. Proof load test all the micropiles in the footing that have been constructed unless otherwise authorized. Submit a plan for replacing rejected micropiles or for installing additional micropiles, including details for any micropile or footing changes required to provide the total micropiling support capacity shown. Suspend micropile construction until the plan is authorized.

49-5.02 MATERIALS

49-5.02A General

67. Delete for Category L micropiles.

Use identical materials and element sizes for a verification test micropile as to be used for the production micropiles it represents.

68

Welding must comply with AWS D1.1.

49-5.02B Steel Reinforcing Elements

49-5.02B(1) General

69. If project special provisions include an exception to the Buy America specifications, consult with Structure Specifications Research and Development.

Mill secondary steel reinforcing elements must not be used.

70. Use if steel reinforcing elements are not allowed to contain any splices or joints. Edit if some types of reinforcing elements are allowed to contain splices or joints and other types are not, and move the requirement to section 49-5.02B(2) or 49-5.02B(3) if appropriate.

Steel reinforcing elements must not contain splices or joints.

49-5.02B(2) Pipe, Hollow Structural Sections, and Casing

71–74. Edit the above heading to show only the type of element that is specified below. Use 1 paragraph and delete the other 3 paragraphs. If the designer chooses to use a steel designation other than the 4 options below, edit accordingly. Delete pars. 71–80 and add *Not Used* if no pipe, HSS, or casing is shown on the plans.

71. Use if the plans show pipe with fy=35 ksi.

Pipe must comply with ASTM A53/A53M, Type E or S, Grade B.

72. Use if the plans show HSS with fy=42 ksi.

HSS must comply with ASTM A500/A500M, Grade B.

73. Use if the plans show HSS with fy=46 ksi.

HSS must comply with ASTM A500/A500M, Grade C.

74. Use if the plans show casing with fy=80 ksi.

Casing must comply with API N80.

75–76. Use if API N80 casing is shown on the plans.

75. Insert the value of the maximum hole diameter provided by the designer. This value must not exceed 13 inches or 1/3 of the micropile center-to-center spacing. Delete item 4 if no grout is shown between the casing and the soil. Delete item 5 if corrosion protection is not recommended in the foundation report or if the corrosion protection does not include a sacrificial thickness.

You may use alternative pipe, round HSS, or casing instead of the API N80 casing shown if:

1. Structural capacity of the alternative pipe, HSS, or casing is greater than or equal to the structural capacity of the API N80 casing shown
2. Alternative pipe, HSS, or casing complies with the requirements for casing specified in section 49-5
3. Drilled hole diameter does not exceed _____ inches
4. Grout cover on the alternative pipe, HSS, or casing is greater than or equal to the grout cover on the API N80 casing shown
5. Thickness of the alternative pipe, HSS, or casing is greater than or equal to the thickness of the API N80 casing shown

76

Alternative pipe, HSS, or casing must comply with one of the following specifications or another authorized specification:

1. ASTM A1085/A1085M
2. API N80
3. API P110
4. API 5L, minimum PSL1

77. Insert either *Pipe*, *HSS*, or *Casing* in the blank, according to the type of element specified in pars 71–74.

_____ to be welded for structural purposes must have a carbon equivalency as defined in AWS D1.1, Annex H5.1, not exceeding 0.47 percent and a sulfur content not exceeding 0.05 percent.

78. Delete *and splices* if no welded splices are allowed in the pipe, HSS, or casing.

Welded seams and splices must be CJP welds.

79. Delete if no welded splices are allowed in the pipe, HSS, or casing.

Circumferential welds must comply with section 49-2.02B(1)(b).

80. Use if the following 3 conditions apply: (1) pipe, HSS, or casing is shown, (2) the pipe, HSS, or casing is designed to provide tension resistance, and (3) the tension resisted by the pipe, HSS, or casing exceeds 25 percent of the yield capacity of the pipe, HSS, or casing. Insert either *pipe*, *HSS*, or *casing* according to the type of element specified above. Insert the value of tension provided by the designer. Delete if no threaded joints are allowed in the pipe, HSS, or casing.

Threaded joints for the _____ must be capable of developing at least ____ kips in tension.

49-5.02B(3) Bar Reinforcing Steel

81–82. Delete if bar reinforcing steel is not shown on the plans, and delete the section heading.

81. Delete if no splices are allowed in the bar reinforcing steel.

Bar reinforcing steel splices must be service splices.

82

For anchorages that require threading nuts and plates onto bar reinforcing, you may cut threads into the bar reinforcing steel if you provide the next larger bar number designation from that shown.

49-5.02C Anchorage Components

83. Use if the plans show stud connectors or concrete anchors. If the plans show concrete anchors, change *Stud connectors* to *Concrete anchors*.

Stud connectors for the micropile anchorage must comply with the specifications for studs in clause 7 of AWS D1.1.

84. Use if the plans show fy=50 ksi for the anchorage plates.

Steel plates for the micropile anchorage must comply with ASTM A709/A709M, Grade 50, or ASTM A572/A572M, Grade 50.

85. Use if the plans show fy=36 ksi for the anchorage plates.

Steel plates for the micropile anchorage must comply with ASTM A709/A709M, Grade 36, or ASTM A36/A36M.

86. Use if the anchorage detail on the plans shows nuts.

Nuts and washers for the micropile anchorage must be capable of holding the bar at a load producing a tensile stress of at least the specified minimum ultimate tensile strength of the bar.

49-5.02D Grout

87

Grout must be a stable, neat grout consisting of cement and water. Cement must comply with section 90-1.02B(2). Water must comply with section 90-1.02D.

88

If authorized, you may use an admixture in the grout. The admixture must comply with sections 90-1.01C(4) and 90-1.02E, except the admixture must not contain chloride ions in excess of 0.25 percent by weight nor be an accelerating admixture.

89

If authorized, you may add fine aggregate to the grout. Fine aggregate must comply with section 90-1.02C(3). Grout with fine aggregate must:

1. Have a slump of at least 7 inches when measured under ASTM C143/C143M
2. Have an air content of no more than 2 percent when measured under California Test 504
3. Not contain air-entraining admixtures

90

Mix the grout as follows:

1. Add the water to the mixer followed by the cement and any admixtures or fine aggregate.
2. Mix the grout with mechanical mixing equipment that produces a uniform and thoroughly mixed grout.
3. Agitate the grout continuously until the grout is pumped.
4. Do not add water after the initial mixing.

91

Grout must comply with the following requirements:

1. Density must be greater than or equal to the density submitted with the authorized mix design.
2. Efflux time must be at least 11 seconds.
3. Compressive strength must be at least that shown at 28 days.

49-5.02E Centralizers and Spacers

92

Centralizers and spacers must be fabricated from plastic, steel, or other material that is not detrimental to the steel reinforcing elements. Do not use wood centralizers or spacers.

93

Centralizers and spacers must be strong enough to support the steel reinforcing elements during construction activities.

49-5.02F Corrosion Protection

94–97. If corrosion protection is not recommended in the foundation report, delete pars. 94–97 and add *Not Used*. Edit accordingly if the corrosion protection is required only at certain locations.

94. Use if encapsulation is recommended for bar reinforcing steel or HS threaded bars. Insert either *Bar reinforcing steel* or *HS threaded bars* in the first blank and insert either *pipe*, *HSS*, or *casing* in the second blank, according to what is shown on the plans.

_____ must be encapsulated. The encapsulation must:

1. Be shop fabricated using HDPE corrugated tubing that complies with ASTM D3350, Type III, with UV stabilizer
2. Have a minimum nominal wall thickness of 60 mils
3. Provide at least a 0.20-inch inside annulus between the bar and the tubing that is fully grouted before installation
4. Be watertight
5. Be capable of:
   5.1. Transferring stresses from the grout surrounding the bar to the grout bonding to the ground
   5.2. Withstanding abrasion, impact, and bending during handling and installation
   5.3. Resisting internal grouting pressures
   5.4. Resisting chemical attack from aggressive environments and grout
6. Be cleaned of oil, grease, dirt, and other extraneous substances and have any damage repaired or replaced before installation
7. Extend at least 5 feet into the _____

95. Use if epoxy coating is recommended for bar reinforcing steel or HS threaded bars. Insert either *Bar reinforcing steel* or *HS threaded bars* in the first blank and insert either *pipe*, *HSS*, or *casing* in the second blank, according to what is shown on the plans.

_____ must be epoxy coated. The epoxy coating must:

1. Comply with section 52-2.03, except the bend test requirements are waived and the epoxy thickness must be from 10 to 12 mils
2. Extend at least 5 feet into the _____

96. Use if galvanization is recommended for bar reinforcing steel.

Bar reinforcing steel must be galvanized under section 52-3.

97. Delete for Category L micropiles. Insert the type of corrosion protection required above for production micropiles: Encapsulation, Epoxy coating, or Galvanizing.

_____ is not required for steel reinforcing elements used in verification test micropiles.

49-5.03 CONSTRUCTION

49-5.03A General

98–100. Delete for Category L micropiles.

98. Tip elevations for tension and compression must not be shown on the plans. Delete the 2nd sentence unless required by the designer, and use it only for a load case other than tension or compression. Insert the load case (e.g., lateral load, group effect, etc.).

Determine the micropile length and installation methods necessary to comply with the micropile load test acceptance criteria. Your proposed micropile tip elevation must not be higher than that shown in the Pile Data Table for _____.

99

You may perform additional geotechnical investigation for the purpose of determining the micropile length and installation methods.

100

Do not construct any production micropiles until the test results are authorized for the verification test micropile that represents the production micropiles.

101. The values for 5 feet and 12 hours may be edited if other values are recommended in the foundation report. For Category L micropiles, delete *, pressure grout, or post-grout*.

Do not drill, pressure grout, or post-grout a micropile that is within a center-to-center spacing of 5 feet from an open micropile hole or a micropile in which the initial grout has set for less than 12 hours.

49-5.03B Verification Test Micropiles

102–107. For Category L micropiles, delete pars. 102–107 and add *Not Used* under each heading.

102

Install a verification test micropile at each location shown. Notify the Engineer at least 7 days before installing a verification test micropile.

103. Edit accordingly if the test site is not supposed to be level.

Excavate the verification load test site as necessary to provide a level work area. Keep the test site free of water throughout the testing.

104

Construct each verification test micropile in the Engineer's presence. Use identical drilling and grouting methods, inclination, tip elevation, and dimensions as to be used for the production micropiles it represents.

105. Use if (1) the foundation report recommends taking measures to provide geotechnical equivalence between the verification test micropile and the production micropiles it represents and (2) if these measures are not shown on the plans. Insert the location of the verification test micropile, or delete *at* _____ if there is only 1 verification test micropile on the project. Edit if this paragraph applies to more than 1 verification test micropile. Insert the elevation to which isolation is required, or edit the paragraph if measures other than isolation are recommended.

Isolate the verification test micropile at _____ down to an elevation of _____ such that the soil above this elevation is not engaged.

106

After the verification load test results are authorized, remove the verification test micropile and any anchor piles as specified for removing portions of bridges in section 60-2.02.

49-5.03C Proof Test Micropiles

107. Edit accordingly if the test site is not supposed to be level.

Throughout proof load testing, maintain the test site in a condition that is level and free of water.

49-5.03D Drilling

108

Select drilling equipment and methods that are suitable for drilling through the conditions to be encountered without causing damage to any overlying or adjacent structure or service and without causing detrimental ground movements.

109

Use temporary casing or another authorized drilled hole support method in caving or unstable ground.

110. Use if micropiles are constructed near settlement-sensitive structures.

Do not use vibratory pile-driving hammers to advance casing.

111. Use if coring through concrete (e.g., adding micropiles to an existing footing).

Core through concrete structures using methods that do not shatter or damage the concrete adjacent to the hole.

112

Each drilled hole must comply with the following tolerances:

1. Centerline of the drilled hole must not deviate from the micropile location shown by more than 3 inches.
2. Center-to-center spacing of the drilled holes must not deviate from the micropile spacing shown by more than 3 inches.
3. Axis of the drilled hole must not deviate from the alignment shown by more than 1-1/2 inches per 10 feet of length.

113

Remove any material dislodged or drawn into the hole during micropile construction. The drilled hole must be open along its full length to the hole diameter shown before placing grout or any steel reinforcing elements not used to case the drilled hole.

114

Dispose of drill cuttings under section 19-2.03B.

49-5.03E Placing and Splicing Steel Reinforcing Elements

115

Place the steel reinforcing elements before withdrawing any temporary casing.

116. Delete if no splices or joints are allowed in any reinforcing elements, and also delete *and Splicing* in the heading above.

Splice the steel reinforcing elements such that the axes of the 2 spliced lengths are aligned.

117. Use if both a center bar and a pipe, HSS, or casing are shown on the plans. Delete if bar splices are not allowed or if pipe, HSS, or casing threaded joints are

not allowed. Insert either *pipe*, *HSS*, or *casing* according to the type of element specified in section 49-5.02B(2).

If the _____ has threaded joints, locate any bar splices at least 2 _____ diameters from any threaded joint.

118. Use if both a center bar and a pipe, HSS, or casing are shown on the plans.

Use spacers to separate steel reinforcing elements. Place the spacers at 10-foot maximum intervals.

119. Confirm that the plans show centralizers that comply with these requirements. Edit *10-foot* if the designer requests a smaller maximum interval.

For steel reinforcing elements not used to case the drilled hole, use centralizers to support the element in the center of the hole and to provide at least the specified grout cover. Place the centralizers at 10-foot maximum intervals, with the uppermost centralizer a maximum of 5 feet from the top of the micropile and the lowermost centralizer from 2 to 5 feet from the bottom of the micropile.

120. Delete both occurrences of *and spacers* if par. 118 is deleted.

Attach centralizers and spacers to the steel reinforcing elements such that the centralizers and spacers (1) are secure enough to withstand installation stresses and (2) allow the free flow of grout without misalignment of the steel reinforcing elements.

121

Before you insert each steel reinforcing element into a drilled hole, clean the surface of the element of deleterious substances, such as soil, mud, grease, and oil.

122

If you cannot insert a steel reinforcing element into the drilled hole to the required depth without difficulty, remove the reinforcing element, clean any grout from the surface of the reinforcing element, clean or redrill the hole, and reinsert the reinforcing element. Do not force or drive a reinforcing element into a drilled hole. Micropiles with partially inserted steel reinforcing elements are rejected.

49-5.03F Grouting

123

Grout each micropile the same day the hole is drilled.

124

You may place the grout before or after placing the steel reinforcing elements.

125

Place the grout within 1 hour of mixing.

126

Inject the grout at the lowest point of the drilled hole. Continue the injection until uncontaminated grout flows from the top of the micropile.

127

Grout each micropile in 1 continuous operation. Use grouting procedures that ensure complete continuity of the grout column.

128

If temporary casing is used, extract the casing in stages. After you remove each length of casing, bring the grout level back up to ground level before removing the next length of casing. Maintain the grout at a level above the bottom of the temporary casing adequate to prevent displacement of the grout by material from outside the casing. The tremie pipe or casing must extend at least 10 feet below the grout level in the drilled hole at all times during grout placement.

129. Delete for Category L micropiles.

If grout is placed under pressure:

1. Measure and record the grout quantity and pumping pressure
2. Use a grout pump equipped with a pressure gauge
3. Place a 2nd pressure gauge at the point of injection into the top of the micropile
4. Use pressure gauges capable of measuring pressures of at least 150 psi or twice the actual grout pressure used, whichever is greater
5. Do not use compressed air to directly pressurize the fluid grout

130

Grout tubes may remain in the hole after the completion of grouting but must be filled with grout before pile acceptance.

131

Maintain the grout level at or above the micropile cutoff elevation until the grout has set.

132

Provide a positive means of support for maintaining the position of the steel reinforcing elements until the grout has set.

133. Delete for Category L micropiles.

Load test micropiles must remain undisturbed until the grout is strong enough to provide anchorage during load testing.

134

Dispose of material resulting from grouting.

49-5.03G Ground Heave and Subsidence

135. Delete for Category L micropiles.

Control the grout pressures and grout takes to prevent heave and fracturing of soil or rock formations.

136

If you observe signs of ground heave or subsidence, immediately notify the Engineer and suspend the drilling and grouting operations. If the Engineer determines that the movements require corrective action, take the actions necessary to stop the movement and perform repairs.

49-5.03H Installation Logs

137

Prepare a separate installation log for each micropile.

49-5.04 PAYMENT

138

Section 49-1.04 does not apply.

139. Delete for Category L micropiles.

Verification test micropiles are paid for as micropiles.

Section 58-2.03A. Use for sound walls on piles or trench footings that reference Standard Plan B15-1, B15-5, B15-8, or B15-15.

Insert the sound wall location and the angle of internal friction. Check with Geotechnical Services/Office of Structure Design for the value of ϕ. Add a table of locations if necessary.

Add to section 58-2.03A:

The angle of internal friction (ϕ) to be used with the plans for the soil at sound wall _____ is _____.

Section 61-2.01D(3). Use for field leakage testing of culvert and drainage pipes (1) where settlement is expected to be in excess of 3 inches, (2) for areas having fine cohesionless soils, or (3) whenever infiltration or exfiltration water quality issues exist (e.g., water permits, local agency regulations, etc.).

1. Use if settlement of a pipeline is expected to be in excess of 3 inches. Modify the number of days as necessary to ensure adequate settlement of embankment.

Replace the 10th paragraph of section 61-2.01D(3)(a) with:

Perform final leakage testing of culverts and drainage pipes from 30 to 45 days after backfilling around the pipe unless a different time period is authorized.

2. Use for fine cohesionless soils.

Replace 1000 in the 1st sentence of item 2 of the 1st paragraph of section 61-2.01D(3)(b) with:

600.

3. Use if infiltration or exfiltration water quality issues exist, (e.g., water permits, local agency regulations, etc.)

Replace 1000 in the 1st sentence of item 2 of the 1st paragraph of section 61-2.01D(3)(b) with:

200.

Section 65-2. Miscellaneous RCP requirements for freeze-thaw and corrosive environments, difficult excavation, and timber bulkheads.

1–2. Use when reinforced concrete pipe is allowed on projects constructed at elevations above 3,000 feet. Otherwise delete pars. 1 and 2.

1

Add to section 65-2.01C:

Submit a certificate of compliance for wet-cast pipe and test reports for measured air entrainment.

2

Add to section 65-2.02A:

Wet-cast pipe must be made from concrete placed and consolidated by conventional equipment using concrete with a slump of 2 inches or more. Wet-cast pipe must contain 5.5 ± 1.5 percent air by volume determined under ASTM C231.

3. Use if the designer indicates that results from AltPipe software require adjustment to concrete mix design and/or minimum cover over the reinforcement due to corrosive conditions. Edit the table by adding cementitious material content values as provided by AltPipe. If corrosive conditions are not indicated, delete par. 3.

Replace the 2nd paragraph in section 65-2.02A with:

For cementitious material content, use one of the options shown in the following table. You may use SCM.

Minimum Cementitious Material Content in Pounds per CY

Minimum Concrete Cover	Minimum cementitious material content based on maximum water to cementitious material ratio	
	0.35	Minimum cementitious material content based on maximum water to cementitious material ratio 0.40
1.00 inch	----lb/cu yd	----lb/cu yd
1.25 inches	----lb/cu yd	----lb/cu yd
1.50 inches	----lb/cu yd	----lb/cu yd

4–5. Use if (1) it is anticipated that rock or other unyielding material will be encountered in the excavation below the bottom of the bedding shown on Standard Plan A62DA; otherwise delete pars. 4 and 5.

Include supplemental funds in the Engineer's Estimate for excavation work.

Add to section 65-2.03B:

4

If you encounter solid rock or other unyielding material at the planned elevation of the bottom of the bedding shown, remove the material below the bottom of the bedding to a depth of 1/50 of the height of the embankment over the top of the culvert but not less than 6 inches or more than 12 inches. Backfill the resulting trench below the bottom of the bedding with structure backfill material under section 19-3.03E. Do not compact the outer bedding before pipe placement.

5

The excavation and backfill below the planned elevation of the bottom of the bedding shown is change order work.

6. Use if timber bulkheads are shown; otherwise delete. If used, show timber bulkheads on the project plans.

Add to section 65-2.03B:

Construct and place timber bulkheads across the ends of unconnected reinforced concrete. Wood for timber bulkheads must be construction heart grade redwood at least 1 inch thick.

Section 68-2.02F(1). Use to specify Class 2 or Class 3 permeable material for underdrains.

1. Insert the Class 2 or Class 3 as recommended by the Office of Roadway Geotechnical Engineering. Edit as directed by the Office of Roadway Geotechnical Engineering.

Replace paragraph 3 of section 68-2.02F(1) with:

Use ____ permeable material for underdrains.

Section 68-5. Use if permeable material blanket is described.

Replace *Reserved* in section 68-5 with:

68-5.01 GENERAL

1

Section 68-5 includes specifications for installing permeable material blankets.

68-5.02 MATERIALS

2. Insert the class of permeable material.

Permeable material for permeable material blanket must be Class _____ and must comply with section 68-2 except for payment.

3

Filter fabric must comply with section 96-1.02B.

68-5.03 CONSTRUCTION

4

Place filter fabric as follows:

1. Ensure the subgrade complies with the compaction and elevation tolerance specified for the material involved before placing the filter fabric on the subgrade.
2. Handle and place filter fabric under the manufacturer's instructions.
3. Align and place the fabric without wrinkles.
4. Overlap or stitch adjacent borders of the fabric from 12 to 18 inches. The preceding roll must overlap the following roll in the direction the permeable material is being spread or must be stitched. If the fabric is joined by stitching, the fabric must be stitched with yarn of a contrasting color. The size and composition of the yarn must be as recommended by the fabric's manufacturer. There must be 5 to 7 stitches per inch of seam.
5. Cover the fabric with the planned thickness of permeable material or aggregate subbase material as shown within 24 hours after the filter fabric has been placed.
6. Maintain at least 6 inches of the material between the fabric and your equipment during spreading and compaction of the permeable material and aggregate subbase. Where embankment material is to be placed on the filter fabric, maintain at least 18 inches of embankment material between the fabric and your equipment. Do not operate or drive equipment or vehicles directly on the filter fabric.

68-5.04 PAYMENT

Not Used

Section 69-2. Use for geomembrane and cushion fabric.

When not using cushion fabric, delete *AND CUSHION FABRIC* in the title.

Replace section 69-2 with:

69-2 GEOMEMBRANE AND CUSHION FABRIC

69-2.01 GENERAL

69-2.01A Summary

1

Section 69-2 includes specifications for placing geomembrane for overside drains.

69-2.01B Definitions

2

Not Used

69-2.01C Submittals

3. Edit when not using cushion fabric and when not seaming.

Submit before installation:

1. Shop drawings, which must include:
   1.1. Proposed panel layout identifying the seams and details
   1.2. Construction equipment and method
2. Quality control plan for:
   2.1. Material handling
   2.2. Storage
   2.3. Installation
   2.4. Geomembrane and seam tests
   2.5. Repair
3. Test seam samples

69-2.01D Quality Assurance

4. ASTM D4437 provides options for nondestructive testing, which includes ASTM D5641, ASTM D5820, ASTM D6365, and ASTM D7006. If any specific tests are preferred, edit as appropriate.

Perform nondestructive testing of geomembrane seams over the full length of seamed tracks under ASTM D4437.

5

Perform destructive testing of geomembrane seams under GSI GRI Test Method GM14 and GM19 and ASTM D7747 and ASTM D7749.

6

When tested under the ASTM D7747 and ASTM D7749, the seam strength and related properties of geomembrane must have the values of the geomembrane with the same thickness and formulation as shown in GSI GRI Test Method GM19.

7

Mark, number, measure, and report each location that fails nondestructive testing.

69-2.02 MATERIALS

8. Specify the application and the class of geomembrane based on the required degree of survivability. For multiple applications, copy par. 11 and edit.

Use Class A for condition that requires very high survivability as instructed in the Geotechnical Design Report.

Use Class B for condition that requires high survivability as instructed in the Geotechnical Design Report.

Use Class C for condition that requires medium survivability as instructed in the Geotechnical Design Report.

Geomembrane for ____ must be Class __.

9. Insert *smooth* or *textured* as instructed in the Geotechnical Design Report.

Geomembrane must be _____ on both sides.

10. Edit as necessary.

Geomembrane must be:

1. Water and gasoline resistant
2. Free from holes, bubbles, blisters, and contamination by foreign matter
3. Be able to conform to subgrade irregularities by its own weight without heating, bending, or overburden placed on it

11. Edit as instructed in the Geotechnical Design Report.

Cushion fabric must be Class __.

69-2.03 CONSTRUCTION

12

Remove loose or extraneous material, large rocks, and sharp objects from the subgrade that may come in contact with the geomembrane and cushion fabric. Compact subgrade to receive geomembrane under section 19-5.03B.

13. Edit for cushion fabric.

Place geomembrane and cushion fabric as shown.

14. Delete if not using cushion fabric.

Cushion fabric must be placed below and above geomembrane.

15. Edit for cushion fabric.

Geomembrane and cushion fabric must not be installed:

1. In standing water
2. While raining
3. During strong winds
4. When the temperature is below 32 degrees F

16

The geomembrane must rest in intimate contact with the subgrade.

17. When not using cushion fabric, delete *or cushion fabric*.

Do not operate equipment or vehicles directly on geomembrane or cushion fabric.

18. Delete when not using cushion fabric.

Cushion fabric pieces must be shingled. Overlaps must be at least 12 inches. Patch or replace cushion fabric damaged during construction. The patch material must extend at least 18 inches beyond damaged area.

19

Place geomembrane in a manner that minimizes handling and seaming.

20. Use when welding of geomembrane sheets is not required as instructed in the Geotechnical Design Report.

Geomembrane sheets must be shingled with the upstream piece on top of the downstream piece. Overlaps must be at least 18 inches. Geomembrane sheets must be seamed by welding or solvent-bonding at subgrade with slopes 5 percent or less.

21. Use when on-site welding of geomembrane sheets is required as instructed in the Geotechnical Design Report.

Geomembrane sheets must be welded or solvent-bonded. Overlap must be at least 6 inches. The seaming overlap must be smooth and free of wrinkles. Seam must be at least 1 inch wide. Seams must follow the direction of the slope. Butt seams or roll-end seams are not allowed.

22

Patch or replace geomembrane damaged during construction. The patch material must have rounded corners and extend at least 6 inches on all sides of damaged area. Patched and damaged geomembrane must be field seamed by welding or solvent-bonding.

23. Delete when anchor trenches are not shown. Edit for cushion fabric.

Anchor the transverse and longitudinal edges of the geomembrane and cushion fabric in trenches at least 8 inches deep.

24. Delete when there are no culverts, transitional devices, or headwalls shown.

At the joint between geomembrane and culvert, culvert transitional device, or headwall:

1. No cushion fabric is required
2. Overlaps must be:
    2.1. At least 6 inches
    2.2. Closely fitted
    2.3. Secured
    2.4. Sealed watertight

25. Delete when not using rocks over the geomembrane.

Place rocks such that the rock drop will not damage the geomembrane and cushion fabric. Place rocks from downstream and up slope. Minimize spreading of rocks to avoid damaging geomembrane and slippage of cushion fabric.

69-2.04 PAYMENT

26

The payment quantity for geomembrane does not include the additional quantity used for overlaps.

Section 71-3.03. Use for injecting grout from within the culvert to fill voids between culvert outer wall and the surrounding ground. The culvert must be at least 60 inches in diameter and human entry must be possible.

If the only work on the project is culvert contact grouting, include a bid item for mobilization.

Replace *Reserved* in section 71-3.03 with:

71-3.03A General

1

Section 71-3.03 includes specifications for drilling, probing voids, installing grout ports, pumping grout from within the culvert, and filling voids between the culvert outer wall and the surrounding ground.

2

Submit a grout plan under section 71-3.01A(3)(d) and include the tabulated probe results. Obtain authorization before starting grouting.

71-3.03B Materials

3

Not Used

71-3.03C Construction

4

Before starting contact grouting of the culvert, assemble equipment and materials at the job site.

5

Grouting activities must comply with section 13. Furnish pumps, if necessary, to remove drill cuttings, wastewater, and excess grout.

6. Edit to suit the work. Grout port locations must be shown on the plans, and grout port location information may be included in the geotechnical recommendations. Delete third sentence if not applicable.

Install grout ports at the 2, 4, 8, and 10 o'clock circumferential positions every 6 feet along the culvert as shown. Install valves or removable plugs at grout ports to verify grout coverage and control grout flow. Extend grout ports through the invert paving using steel pipes or suitable packers. Grout ports must be watertight. If authorized, you may screw grout ports in place or attach them by other methods. Do not weld grout ports to galvanized surfaces.

7

Probe at each grout port location. The probe must be at least 4 feet long, fit through the grout ports, and be rigid enough to sense probe refusal.

8. If this work is anticipated, include supplemental funds

If ordered, hammer soundings and additional probing for voids is change order work.

9

Prevent deformation of the culvert and culvert lining during grouting.

10. If grouting around a concrete culvert or a metal culvert with a concrete lining add "or if cracking of concrete occurs" to the 2nd sentence.

Pump grout into voids until it appears that all water and air has been ejected. Plug grout ports or close port valves as soon as you stop pumping the grout.

11

The maximum injection pressure at the nozzle must not exceed 5 psi for fluid, unsanded grout mix.

12

Monitor the culvert for deformation and cracks. If cracking occurs in a concrete culvert or lining, reduce the grout injection pressure. If deformation of the existing structure exceeds 1/2 inch at any location, reduce the grout injection pressure.

13

Repair any permanent deformations or cracks resulting from your grouting work. The Department does not pay for these repairs.

71-3.03D Payment

14

Record the quantity of grout that is installed and submit this quantity. The Department does not pay for grout that leaks through to the inside of the culvert. The Department does not pay for grout material that is wasted, disposed of, or remaining on hand after completion of the work.

Section 72-2.02C. Use for nonstandard fabric for RSP.

1. Edit to suit the work.

Replace the paragraph in section 72-2.02C with:

Fabric must comply with the specifications for _____.

Section 96-1.02B. Use for projects with filter fabric.

Add to section 96-1.02B:

1. Specify the application and the class of filter fabric (based on testing of soil on the job site). For multiple applications, copy paragraph 1 and edit. If the soil is not tested, specify Class A as the default.

Use Class A if less than 15 percent passes a no. 200 sieve.

Use Class B if 15 to 50 percent passes a no. 200 sieve or the plasticity index is more than 7.

Use Class C if more than 50 percent passes a no. 200 sieve.

Filter fabric for ____ must be Class __.