

SECTION 6

FOUNDATIONS AND ANCHORAGES

When installing a sign structure, the first item to be placed is the foundation. The Standard Plans have details for spread footing and cast-in-drilled-hole (CIDH) foundations including dimensions and depth. However, the CIDH pile depths as found in the Standard Plans are based upon specific soil characteristics. The Designer shall specify the pile depth in the project plans or indicate that the Standard Plans depths are to be used. It is possible that a special design, such as a driven pile foundation, will be included in the project plans for overhead sign structures that are supported on weak soil conditions. For both CIDH and spread footing foundations, the Standard Plans includes a formed pedestal as part of the foundation. Regardless of the type of foundation to be installed, no foundation work should be performed until control stakes have been set by the State to ensure the proper location and elevation of the footing pedestal. These stakes will also be verified by construction field staff to ensure overall conformance with contract documents.

A bridge mounted sign structure has two mounting options: a cast-in-place option, when possible, and a resin capsule bolted anchorage system. The specific details shall be included in the project plans in conjunction with the signs structural details.

This section is intended to give descriptions and contractual requirements for foundations and anchorages as they relate to overhead sign structures. The theory and design behind these items will not be discussed in this section. Structure Construction's Foundation Manual should be referenced for additional information regarding the foundation types that may be used to support an overhead sign structure.

6-1 Cast-in-Drilled-Hole Piles

Cast-in-drilled-hole (CIDH) piles are the most common foundation and the designer's foundation of choice. Often, an overhead sign structure is installed adjacent to an already constructed roadway. In this scenario, a CIDH pile can typically be installed neighboring the roadway without a lane closure. Furthermore, a CIDH pile is typically chosen over a spread footing because a spread footing may necessitate the removal of a portion of the already constructed roadway. For these reasons, the CIDH pile is often the most economic pile for use as a sign structure foundation.

There are many instances in which a CIDH pile should not be used. These instances can be summarized into geological conditions and non-geological conditions. The primary geological conditions that need consideration are the soil profile, location of the water table, and any potential fluctuation in the location of the water table. CIDH piles are not ideal where there is a potential for water in the drilled hole or caving soil conditions.¹ There are many non-geological conditions that would prohibit the use of a CIDH pile but the most common one would be underground utilities. CIDH piles may not be practical at locations where utility lines exist in the subsurface strata.

When drilling is complete for CIDH piles, the drilled hole should be checked to ensure that it is plumb and was drilled to the correct depth and diameter. Any water in the hole shall be removed before placing the reinforcement steel or concrete. Furthermore, just before placing reinforcement or concrete, all loose materials should be removed from the bottom of pile. A cleanout bucket must be used for this purpose as well as to produce a firm flat bearing surface.² Additionally, the Contractor is required to form the pedestal at least 150 mm (6 inches) below ground surface.

All reinforcement steel shall be inspected prior to placement in the drilled hole for contract compliance. Reinforcement shall be clean at time of placement such that the bond between the reinforcement and concrete is not compromised.³ The spiral cages shall be inspected for accurate pitch and secure

¹ Standard Specifications Section 49-4.01 "Cast-in-place concrete piles shall be constructed so that the excavation methods and the concrete placement procedures shall provide for placing the concrete against undisturbed material in a dry or dewatered hole."

² Standard Specifications Section 49-4.03 "The bottom of the drilled hole shall be cleaned just before placing reinforcement or concrete to remove any loose sand, gravel, dirt, and drill cuttings."

³ Standard Specifications Section 52-1.05 "Before concrete is placed, the reinforcement to be embedded shall be free of... coatings of any character that would destroy or reduce the bond."

attachment. The Contractor shall ensure that precast mortar blocks or other approved devices are used to obtain adequate clearance to the face of the pile. Additionally, the reinforcement cage shall be supported by means such that adequate clear coverage is achieved at the pile tip.⁴

The concrete to be used in the construction of CIDH piles must meet several requirements that are defined in the Standard Specifications and the special provisions. The Contractor is required to submit a concrete mix design to the Engineer for review and approval.⁵ In no case shall concrete be placed without an approved concrete mix design.

The Engineer must review the contract to determine if the concrete is designated by compressive strength or cement content. Typically, only concrete with a 28-day compressive strength of 25 MPa (3625 psi) or greater is designated by compressive strength.⁶ Section 56-1, "Overhead Sign Structures," and Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications should be reviewed to determine this as well as any modifications to these sections of the Standard Specifications that may be included in the special provisions.

For concrete designated by compressive strength, the minimum 28-day compressive strength shall be verified by test cylinders as specified in Section 90-9, "Compressive Strength," of the Standard Specifications. Additionally, prior to placing any concrete, prequalification is required for all materials, mix proportions, mixing equipment, and procedures proposed for use.⁷ Prequalification can be accomplished by the Contractor by means of either an acceptable certified test data or trial batch reports as

⁴ Standard Specifications Section 52-1.07 "Reinforcement shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections and splices and by using... approved devices of sufficient strength to resist crushing under applied loads.

⁵ Standard Specifications Section 90-1.01 "Before using concrete for which the mix proportions have been determined by the Contractor, ... the Contractor shall submit in writing to the Engineer a copy of the mix design."

⁶ Standard Specifications Section 90-1.01 "Whenever the 28-day compressive strength shown on the plans is 25 MPa (3625 psi) or greater, the concrete shall be considered to be designated by compressive strength."

⁷ Standard Specifications Section 90-9.01 "When concrete is specified by compressive strength, prequalification of materials, mix proportions, mixing equipment and procedures proposed for use, will be required prior to placement of the concrete."

detailed in Section 90-9.01, "Compressive Strength; General," of the Standard Specifications. For concrete designated by cement content, California Test 518 shall be used to determine contract conformance.⁸

Concrete for CIDH piles shall be placed in a manner such that segregation of the concrete aggregate does not occur. For this reason, concrete shall not be permitted to fall from a height greater than 2.5 meters (8 feet) unless the flow of concrete is directed into the center of the hole such that the reinforcement or any other object is not hit as the concrete is being placed in the hole. The concrete shall be consolidated in the upper 5 meters (16 feet) of the pile (or the entire length of the pile for piles less than 5 meters (16 feet) in depth) by means of a vibrator.⁹

Once the CIDH pile is installed, the exposed portion of the pile shall be cured for at least 72 hours in accordance to Section 90-7.07, "Curing Miscellaneous Concrete Work," of the Standard Specifications. Furthermore, the overhead sign structure shall not be installed until seven days have passed from the time the CIDH pile was placed.¹⁰

6-2 Spread Footings

Spread footings are typically used where CIDH piles are not practical. A common example is when utility lines exist alongside a roadway where a sign structure is to be installed. Spread footings, when specified, shall be built to the dimensions shown in the plans. During excavation, should the Contractor excavate a trench greater than or equal to 1.5 meters (5 feet) in depth, the Contractor shall comply to the specifications set forth in Section 5-1.02A, "Trench Excavation Safety Plan," of the Standard Specifications, as well as the Construction Safety Orders of the Division of Occupational Safety and

⁸ Standard Specifications Section 90-1.01 "Compliance with cement content requirements will be verified in conformance with procedures described in California Test 518."

⁹ Standard Specifications Section 49-4.01 "Concrete filling for cast-in-place concrete piles shall be vibrated in the upper 5 m [16 feet] of the pile."

¹⁰ Standard Specifications Section 56-1.07 "Cast-in-drilled-hole concrete pile foundations shall be completed at least 7 days before sign structures are erected thereon. After placing, the exposed surfaces of the foundations shall be cured as provided in Section 90-7, 'Curing Concrete.'"

Health. Prior to placing concrete, the Engineer shall determine the adequacy of the foundation material. Concrete shall be placed against undisturbed soil that, in the opinion of the Engineer, is of sufficient strength to support the designed load. If the Engineer deems the foundation material to be unsatisfactory, they may change the dimensions or elevations of footings to secure a satisfactory foundation.¹¹

6-3 Anchor Bolts

Anchor bolt assemblies must be installed with the foundation reinforcement for an overhead sign structure prior to placing concrete. The size and amount of anchor bolts to be installed is detailed in the contract plans. The Standard Plans contain tables correlating the size and number of anchor bolts to be installed based on the post size for each type of sign structure (except for bridge mounted sign structures). For most sign structures, the project plans indicate the size of the post to be installed. Occasionally, when the overhead sign structure to be constructed is not based upon the Standard Plans (such as a CMS sign structure), the contract plans will include a sheet that specifies the size and number of anchor bolts to be used. In this instance, the anchor bolt information in the project plans should be used as the project plans govern over the Standard Plans.

To maintain the proper alignment of anchor bolts, the special provisions require that anchor bolts be installed by means of a permanent steel template. For the template to be permanent, it needs to be cast into the structure's foundation. The Contractor is required to detail this template in their working drawings. The permanent anchor bolt template needs to be checked to verify that the bolt hole spacing is identical to that shown for the base plate. Sometimes, the project plans will specify the specific dimensions of the permanent steel template or specify that more than one template is to be used. When details are given in the project plans for this template, the template should be checked for conformance to the contract documents. When dimensions are not given as part of the contract documents, sound engineering judgment should be used to determine the adequacy of the template and that the template is of sufficient strength such that no unacceptable deformation will occur during the placement of the concrete foundation.

¹¹ Standard Specifications Section 51-1.03 "... The Engineer may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation."

6-4 Bridge Mounted Anchorages

Bridge mounted overhead sign structures are typically attached to a bridge's superstructure at the barrier rail, edge of deck, exterior girder, or bridge soffit. For these structures, the Contractor typically has the option of attaching the sign structure to the bridge using a resin capsule bolt anchorage. When this method of attachment is used, the resin capsule anchorage to be incorporated into the work is subject to the approval of the Engineer. Furthermore, the installation procedure for these anchorages will be per the manufacturer's recommendations. The approved brand of resin capsules for use on Caltrans projects can be viewed in the Bridge Construction Records and Procedures Manual 135-5.0 through 135-5.1. When installing resin capsules into a prestressed structure, the Engineer shall check with the designer to ensure that they reviewed the as-built plans to verify that neither a duct nor tendon will be damaged during installation.

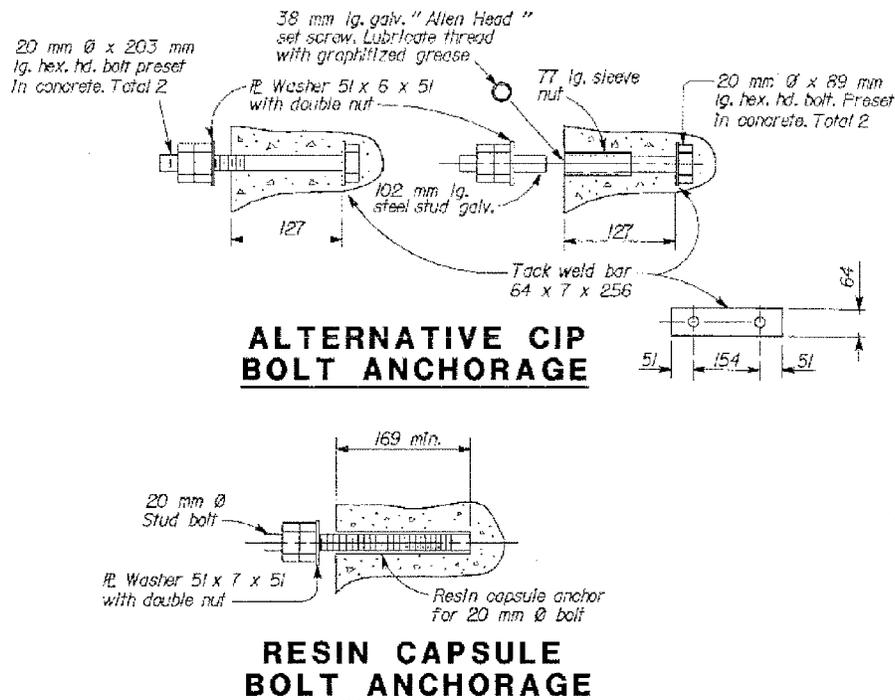


Figure 6-4.1 Example from a Bridge Mounted Sign Structure Drawing showing anchorage details.

When a new concrete barrier rail and/or a new exterior concrete girder is to be constructed at the location where a bridge mounted sign structure is to be installed, the Contractor can opt to use an alternative cast-in-place (CIP) bolt anchorage system. One CIP alternative involves casting two bolts into the concrete structure with a steel plate welded to the end such that the threaded portion protruding through the concrete is long enough for all bolt components to be properly installed. A second CIP alternative is similar to the first except two internally threaded sleeves are cast into the concrete structure and the two bolts are installed at the same time as the sign structure. Typically the contractors prefer this second CIP method because forming tends to be simpler since the sleeves are cast flush with the exterior face of the concrete structure.

All alternative methods for attaching a bridge mounted sign structure will always be specified in the project plans. Although the methods mentioned above are most common, other methods of attachments can be specified. Each of the above methods involves mounting an overhead bridge mounted sign structure to a concrete structure. There is no standard method for attaching an overhead sign structure to a steel member. The Designer will determine whether a bolted or welded attachment is appropriate and will include details in the project plans.