Standard Plan Overhead and Changeable Message Signs

This module presents the Department’s standard of practice for the investigation, design, and reporting of foundation recommendations for standard plan overhead and changeable message signs (hereafter referred to as sign(s)).

Overhead (OH) and Changeable Message Sign (CMS) foundation design consists of choosing standard designs from the current Standard Plans (2010 Standard Plan S1 to S142), Revised Standard Plans (RSP), and Reference Sheets, Structural Design Aids, Overhead and Roadside Signs, October 2006. Sign types, related foundation types, and pertinent Standard Plan Sheets are in Table 1.

Table 1: Standard Plan OH and CMS and Associated Foundation Types

<table>
<thead>
<tr>
<th>Sign Type</th>
<th>Foundation Type</th>
<th>2010 Standard Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>OH Signs-Truss, Single Post</td>
<td>CIDH, Spread Footing</td>
<td>RSP S1, S2, S8</td>
</tr>
<tr>
<td>OH Signs-Truss, Two Post</td>
<td>CIDH, Spread Footing</td>
<td>RSP S9, S15</td>
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<tr>
<td>OH Signs-Tubular</td>
<td>CIDH</td>
<td>S30, S36, S37</td>
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<tr>
<td>OH Signs-Lightweight</td>
<td>CIDH, Spread Footing</td>
<td>S49</td>
</tr>
<tr>
<td>CMS Model 500</td>
<td>CIDH</td>
<td>S101, S109, S116</td>
</tr>
</tbody>
</table>

Overhead and CMS foundation types and sizes shown on the Standard Plans were designed using assumed soil strength parameters. The objective of a standard plan sign foundation investigation is to determine if the soil strength at the proposed sign location meets or exceeds the assumed soil strength used to design the sign, and the foundation is constructible.

As of April 2014 Standard Plans S7, S14, S41-47 and S 120-135 are cancelled. Lightweight overhead signs (except for Extinguishable Message Sign and Flashing Beacon) and Model 510 CMS are no longer used. Standard Plan spread footings are no longer an option for OH Signs–Tubular and CMS Model 500 although loading is still shown on the standard plans.

Sites that do not meet the minimum design requirements will require a special foundation design. Promptly notify the design engineer when the minimum requirements are not met to determine whether the sign can be relocated or if a special design sign is required. Special designs for sign foundations must follow the Deep Foundations module.

Investigations

Exploration for standard plan overhead sign foundation design seeks to identify and describe the subsurface material, determine its strength or verify that the strength exceeds
the design strength and unit weight, locate the water table (if within the depth of the anticipated sign foundation), and to identify conditions that might affect the foundation construction, such as caving, the presence of cobbles and boulders, or shallow rock.

Borings for standard overhead signs should extend no deeper than 45 feet below the finished grade at the overhead sign. The deepest foundation required for a standard plan overhead sign is 39 feet and there is little reason to consider drilling deeper.

Auger borings are preferred since they mimic the typical construction method for sign CIDH pile foundations. They provide information on hole stability, water table, and presence of cobbles and boulders or shallow rock, which might render CIDH piles difficult to construct. Borings into rock are performed for constructability evaluation only since the minimum strength requirements are met.

Sampling and testing should be limited to Standard Penetration Testing (SPT) in granular soil or undisturbed sampling with field pocket penetrometer or torvane testing in cohesive soils. Soil corrosion testing should be performed as specified in Section 7.1 of the Corrosion Guidelines.

As sign foundation design is based on constructability and standard soil strength cases, laboratory testing should not be performed for the purposes of determining soil strength or Soil Classification. SPT, pocket penetrometer and torvane measurements are sufficient for correlating to soil strength. Use the Soil Correlation module to determine soil strength and unit weight. Presenting the Soil Identification as determined by the visual/manual method provides sufficient information for designing and constructing sign foundations. Consider performing laboratory strength tests when the field test results are near to but less than the minimum strength requirements.

It is not necessary to conduct a drilling program for signs that will be founded entirely in fill that has yet to be placed, such as elevated roadway embankments or sliver widenings, as fills constructed to a minimum of 90% relative compaction exceed the minimum required soil strength.

**Design Procedures**

CIDH pile foundations require a minimum soil angle of internal friction of 30 degrees and a unit weight of 120 pcf (or submerged unit weight of 58 pcf), or a shear strength of 1.2 ksf for cohesive soils. Engineered fills compacted to 95% relative compaction (e.g., approach fills within 150 ft of a bridge abutment) should be assumed to satisfy the requirements for \( \phi = 35^\circ \). Engineered fills compacted to 90% relative compaction (most fills other than abutment approach fills) should be assumed to satisfy the requirements for \( \phi = 30^\circ \).
It is generally not economical to try to shorten piles (see Reference sheets, p. 13 pile foundation depth selection). Do not perform lateral or axial resistance analyses if the minimum soil strength is available.

The Standard Plans currently show a spread footing option for OH Signs-Truss, Single Post and Two Post, and OH Signs-Lightweight. In the rare case where a spread footing design is considered, the geoprofessional must first contact the standard plan owner to obtain the loads and eccentricities, then calculate the bearing capacity, and check it against the design criteria to verify the geotechnical design.

The maximum required ultimate soil bearing capacity of a standard plan overhead sign spread footing is about 7.5 ksf. This is typically satisfied by an average $N_{160}$ value of 10 or larger within the depth $B$ below the bottom of the proposed footing.

Seismic investigations are not necessary except to evaluate liquefaction potential. If liquefaction is probable, the geoprofessional should contact the client and discuss whether or not to include recommendations for mitigation in the report.

Signs are sometimes added to a project by the District late in the PS&E process (after field investigations are completed and/or geotechnical reports have been completed). If soil data are not available, check with the project engineer to determine if a risk-based design, using the most conservative (longest) pile lengths, is appropriate. Such design should only be done if the groundwater elevation is known.

**Truss Single Post Types II through IX**

Single post truss signs may be supported by either spread footings or CIDH piles. Spread footings use the footing dimensions as specified in the revised Standard Plan RSP S2. CIDH pile foundations use Standard Plan S8 for pile dimensions. Also see page 13, Reference Sheets for more refined pile lengths based on specific soil properties.

**Truss Two Post Types I-S through VII-S**

Two post truss signs may be supported by either spread footings or CIDH piles. Spread footings use the footing dimensions as specified in the revised Standard Plan RSP S9. CIDH piles use Standard Plan S15 for pile lengths. Also see page 13, Reference Sheets, for more refined pile lengths based on specific soil properties.

**Overhead Signs- Tubular**

Single post and two post tubular signs are supported by CIDH piles. See Standard Plan S36 and S37 for pile dimensions.
Overhead Signs- Lightweight Extinguishable Message Sign and Flashing Beacons

Lightweight Extinguishable Message Sign and Flashing Beacons may be supported by either spread footings or CIDH piles. Spread footings use the footing dimensions as specified in Standard Plan S49. CIDH pile foundations use Standard Plan S49 for pile dimensions.

Overhead Signs-Truss, Single Post, Unbalanced/Balanced/Full Cantilever Butterfly CMS Model 500

Model 500 CMS are supported by CIDH piles. See Standard Plan S116 for pile details, and page 31 Reference Sheets for pile dimensions.

Related Standards

- Standard Plans (see Table 1)
- Reference Sheets, Structural Design Aids Overhead and Roadside Signs, October 2006.
- Digest of Revisions 2010 Standard Plans Erratum No. 7.
- 2010 Standard Plans-Erratum No. 7.
- Geotechnical Design using Standard Plan and Bridge Standard Detail Sheets

Reporting

Standard plan overhead sign foundation recommendations are conveyed to the client using either the Geotechnical Design Report (GDR) or a memo format. Typically the GDR is used if there are other geotechnical recommendations (cuts/fills, standard plan retaining walls, etc.) for the project along with the sign. The foundation report format (example memo attached) should be used when reporting only sign recommendations. In either case, geotechnical reporting for a sign should be brief and include only the following information:

- Location of the overhead sign
- Sign type
- Summary of investigation performed
- Soil description, strength, and unit weight
- Corrosion test results
- Discussion of liquefaction potential
- Recommended foundation type(s) and dimensions;
  - Pile length and diameter for CIDH piles including the adjustment for sloping ground if applicable (see Reference Sheets, p. 31)
  - Spread footing dimensions and bottom of footing elevation or depth of burial.
• Depth to groundwater and recommendation for wet CIDH methods including gamma-gamma inspection pipes if the pile excavation extends below the groundwater level.
• Construction Considerations

A Log of Test Borings (LOTB) or Boring Record must be included with the design recommendations if a boring was drilled or if an as-built boring was used. A note should be added to the report directing the designer to include the LOTB in the contract plans, along with a list of LOTB sheet titles.

**Revisions**

Memorandum

To: MR. O. H. SIGN
Design Senior, Branch J
Office of Design I
Project Development Division

Attn: SIGN BUILDER
Project Engineer

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Foundation Report for OH SIGN 27B

Date: October 28, 2014
File: 10-MPA-140
PM 42.0/42.7
10-0P9201
1000000198

A foundation investigation was completed in August 2014 for the proposed Type VII Truss Single Post Type OH Sign located at approximately PM 42.1. One 8” auger boring with SPT was drilled at the sign site as shown on the road plans dated May 1, 2014. Results are shown on the LOTB dated September 27, 2014, which must be included in the contract plans.

Geology

Foundation materials consist of two feet of asphalt and road base underlain by medium dense gravelly sand alluvium and colluvium with widely scattered very hard cobbles and boulders up to 24” in diameter. Weathered phyllite rock was encountered at elevation 2200’, 33.5 feet below the ground surface.

Groundwater was measured at elevation 2201’ on April 1, 2014. There is no potential for liquefaction at the proposed OH Sign site. Corrosion tests indicate the site is not corrosive.

Foundation Recommendations

The proposed Type VII OH Sign may be supported by a standard plan CIDH pile foundation as shown on Standard Plan S8 for SPT blow counts of 15. Pile diameter is 5’ 0”, length is 23’.

Construction Considerations

Difficult drilling conditions are expected due to the presence of very hard cobbles and boulders.

If you have any questions regarding this report, please contact Geo Techguy at (916) 555-7269.

cc: District Project Manager
   Structure Construction R.E. Pending File
   District Materials Engineer

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