

Chapter 4

Bridge Program Drawings

Section 4.04 -Substructure Layout

Introduction

Substructure Layout details accurately describe the location of bridge footings, pilings, and drilled shaft foundations. All new bridges, bridge widenings, and some maintenance projects require a Substructure Layout. This section relates primarily to Substructure Layout details associated with new bridge construction, although widenings and maintenance projects are similar.

Substructure Types

STEEL PILING is typically a rolled HP shape having parallel flanges with equal web and flange thicknesses and is usually the most economical substructure to use. Steel piling is used when footings cannot be founded on rock or competent soils within a reasonable depth. At locations where soil conditions would normally permit the use of spread footings but the potential for scour exists, piles may be used as a protection against scour. Piles may also be used where an unacceptable amount of settlement of spread footings may occur.

A **SPREAD FOOTING** is a reinforced concrete mass designed to transfer loads directly to the soil and support spill-through type abutments, sill type abutments, full retaining abutments, bent columns, or pier shafts. Spread footings shall be considered a substructure foundation only when the abutment, bent, or pier is not supported by drilled shaft foundations or steel piling below the footing.

DRILLED SHAFT FOUNDATIONS consist of reinforced concrete that is cast in holes drilled in the ground to predetermined elevations. Drilled shafts are used when spread footings cannot be founded on suitable soil or rock strata within a reasonable depth and when piles are not viable due to high loads or obstructions to driving. Drilled shafts may be used instead of spread footings as a protection against scour. Drilled shafts may also be considered to resist high lateral or uplift loads when deformation tolerances are small. Drilled shafts are especially advantageous for use in locations where compressive soils are present and near railroads,

existing pipe lines, and other utilities when the impact from pile driving may cause damage.

General Design and Detail Information

The **SUBSTRUCTURE LAYOUT** describes the layout of the substructure in relation to the centerline survey, the waterway, railroad and/or highway it crosses, and any existing substructure. It is important to show all existing utilities within the right-of-way, adjacent to the construction site. Plans for widenings are laid out to match the as-constructed plans, regardless of the stationing direction of the new survey.

The substructure is designed based on recommendations from the Geology Program. The **GEOLOGY REPORT** will indicate whether piles, spread footings, or drilled shaft foundations may be used. The option is up to the designer. The Geology Report will give minimum footing elevations and allowable loads, minimum pile tip elevations, and minimum drilled shaft elevations and allowable loads.

When piles are driven through material that may damage or deflect the end of the piles, **PILE POINTS** may be required. These will be recommended by the Geology Program. The detailer must choose the correct **PILE POINT DETAIL** based on the size of the piling.

PREDRILLED HOLES are required when piling must pass through layers of material that may deflect the pile before reaching recommended foundation depths. Predrilled holes, when required, will be recommended by the Geology Program.

Piling is usually delivered to the job site in 40'-0" or 60'-0" lengths. To obtain the proper length for each pile, these pieces are cut and spliced together as required. **PILE SPLICE DETAILS** are included to detail the correct welding procedure.

In the Substructure Layout, footings are detailed only if they are not supported by steel piling or drilled shaft foundations. If they are supported by steel piling or drilled shaft foundations, only the steel piling or drilled shafts are detailed.

All longitudinal dimensions are horizontal and include no correction for grade. All dimensions are shown in feet and decimals of a foot (to the nearest 0.01').

The **SKEW AND COMPLEMENT** to the major feature(s) intersected shall be shown. Show the skew and complement to the substructure if different.

The intersected station of centerline survey and the major element to be crossed must be called out in the Substructure Layout. The substructure stations are called out in the Substructure Layout unless a working line is required, in which case the sketches in Section 4.03 - General Plan and Elevation shall apply. Stationing shown shall increase from left to right on the sheet, except in the case of widenings in which stationing shall follow the existing Substructure Layout.

When a new bridge is replacing an existing bridge, the existing substructure is normally removed to 1.00' below ground line or 3.00' below streambed; therefore, when detailing the new substructure, the detailer must also show the existing substructure using phantom lines. The existing substructure need not be dimensioned, but shall be drawn to scale, in its correct location, with respect to the new centerline survey. It may be necessary to request field data for proper location.

SUBSTRUCTURE DATA is a table describing the location of the substructure, bottom of spread footing elevations, pile size and cutoff elevations, and the diameter and top and bottom elevations of drilled shaft foundations.

Cells

Name	Description
HPPLANS	Pile Plan Solid
PILP10X42	Pile Point Detail HP 10X42
PILP12X53	Pile Point Detail HP 12X53
PILP12X74	Pile Point Detail HP 12X74
PILP14X73	Pile Point Detail HP 14X73
PILP14X89	Pile Point Detail HP 14X89
PILSPL	Pile Splice Details

Substructure Layout Checklist

Substructure Layout

- Detail to Scale
- Decimal Dimensions
- Centerline Survey w/Stationing and Bearing
- Centerline Survey at Cross Road w/Stationing and Bearing
- Centerline Bridge Roadway (may be concurrent w/Centerline Survey)
- Centerline Pile/Drilled Shaft/Footing
- Centerline Feature Intersected/Structure/Abuts/Bents/Piers
- Working Line/Construction Line Call-out
- Skew and Complement at Centerline Feature Intersected (also show at substructure if different)
- Longitudinal Dimensions
- Substructure Dimensions
- Offsets (throw on curve)
- Station Call-outs at Substructures/Structure/Feature Intersected
- Pile/Drilled Shaft/Footing Location No.
- Flow Arrow w/Name of Channel
- North Arrow
- Utilities w/Name of Owner (if available)
- Test Holes Call-out
- Existing Structure/Substructure Call-out
- Line Styles

Substructure Data

- Location
- Pile Elevations (top and bottom)
- Drilled Shaft Elevations (top and bottom)
- Bottom of Footing Elevations
- Pile/Drilled Shaft/Footing No.

Miscellaneous

- Pile Splice Details
- Pile Point Detail

Notes

- Gouge Root to Sound Metal
- Pile Size/Locations (if not included in Substructure Data)
- Drilled Shaft Size/Locations (if not included in Substructure Data)