

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DETAIL MANUAL	Chapter: 10 Effective: May 31, 2023 Supersedes: March 19, 2019
FOUNDATION LAYOUT	

10.1 PURPOSE

This drawing shall show a plan view of all footings, piling, or drilled shafts (caissons) for a given structure or structures, and shall present all information necessary for locating their positions in the field.

10.2 RESPONSIBILITY

This drawing shall be prepared and checked in the design unit. The graphic presentation of the information on this drawing shall be the responsibility of the individual preparing this drawing.

10.3 SCALES

Standard Architectural and Civil scales shall be used that are suitable to make the plan view, elevation and typical section legible on a standard sheet. For additional information see Chapter 2.3.

Scales for the distances measured along the “layout” or “work” lines from “bent line” to “bent line”, or along “bent line”, may be represented with broken dimension lines.

For the definitions of “layout line”, “work line”, and “bent line”, see Sections 10.5, 10.6, and 10.8, respectively.

10.4 ORIENTATION OF DETAILS

If the “Foundation Layout” details are to occupy one drawing, they are to be proportioned to the sheet.

If this layout is combined with the “Construction Layout”, it is preferred to have it occupy the bottom half of the drawing; however, if the physical characteristics of the structure or structures deem it necessary, it may be positioned in a different manner. An example of this is shown in Figure 10-2 Example 2.

10.5 LAYOUT LINE

A “layout line”, as used on this drawing, is defined as a line along which and from which all the basic distances, lines, and angles are measured for the purpose of locating the footings, piling, and drilled shafts. This line shall be identified by its proper name. Examples: Centerline Roadway, Survey Line, Centerline of Median, etc.

If the structure is on a horizontal curve, the “layout line” may be a tangent line to the curve. If this tangent line is not related to the PI, it would be identified as follows: “Tangent to POC Station 10 + 10.50”. If the “layout line” is one of the tangents related to the PI of the horizontal curve, it would be identified in one of the following two ways, depending upon which tangent is used as the “layout line” in the particular instance.

10.6 WORK LINE

A “work line”, as used on this drawing, is defined as an auxiliary line to the “layout line”, along which and from which distances and angles are measured for the purpose of locating the footings, piling, and drilled shafts. This line is offset from the “layout line” by means of dimensions along the “bent lines”.

In Figure 10-4, the distance of 14.13' (Pier 2) measured to the edge of the footing from the tangent (layout line), locate lines which are centerlines of the pier footings. These lines can be considered “work lines”, as distances are measured along and from these lines to locate the bounds of the footings.

In Figure 10.5-1 two “work lines” are shown. They are located a distance of 10.25' up from the “layout line” and 10.25' down from the “layout line” along the centerline of pier and footing (bent line), and are identified as “Centerline of Footing”. In this case, these “work lines” are not parallel to the “layout line”, but are normal to the “bent line”. Distances are measured normal to and along these lines to locate the centerline of the piling and the bounds of the footings. In the example, distances of 2.50' measured each side of the “bent line” along the “work line” locate the centerline of piling parallel to the “bent line”. Distances of 2.50' measured along these centerlines each side of the “work line” locate the centerlines of the piling that are parallel to the “work line”. In a similar manner, the bounds of the footings are also located.

10.7 REFERENCE POINTS

The “reference point” is defined as a given point on the “layout line”, from which all points are located. Each “reference point” shall be identified with a station.

The “layout line” may also be the tangent line. The “reference point” on this line can occur at the POC. From this point, the distances can be measured ahead and back along the “layout line”.

10.8 BENT LINES

A “bent line” is defined as a line that intersects the “layout line”. Along these “bent lines” are measured the distances for locating the footings, piling, or drilled shafts.

These “bent lines” shall be identified as “Centerline of Piling”, “Centerline of Pier 2”, “Centerline of Footings”, etc.

In Figure 10.5-1, a graphic example for the locations of a footing or piling at a pier when the “bent line” is skewed is shown.

A note such as: “Pier Pile Spacing is Typical”, makes it unnecessary to repeat the dimensions in the other footings.

10.9 HORIZONTAL CONTROL LINES

If the structure is located on a horizontal curve and utilizes a "layout line" as discussed in 10.5, the "horizontal control line" need only be shown to locate the layout line as shown in Figure 10-4.

The "horizontal control line" shall be shown and identified by its proper name: "Survey Line", "Centerline of Roadway", or "Centerline of Median", etc.

10.10 STATIONING

A station shall be given at the "reference point" on the "layout lines", as previously discussed in Section 10.7. In the case of a double row of piling, the abutment centerline of bearing shall be defined and the piling offset shall be dimensioned normal to the centerline of bearing.

All stations on the "Footing, Drilled Shaft, and Piling Layout" shall be given to two decimal places. Example: Sta. 259+96.61.

10.11 DIMENSIONS

Dimensions shall be shown from the "reference point" on the "layout line" to the "bent lines".

An example of this is shown in Figure 10.5-1, where distances are measured each way from the "reference point" to the "bent lines".

A "tie in" dimension shall be shown from the nearest piling to the "layout" or "work" line.

Dimensions shall be shown that are measured along or normal to the "bent lines" from the "layout" or "work" lines for the purpose of locating footings, piling, or drilled shafts.

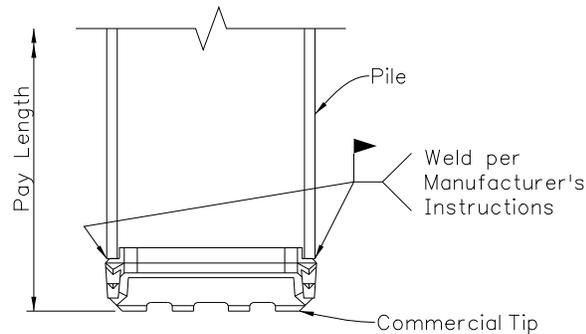
Refer to Figures 10.5-1 and 10-1 through 10-4 for other pertinent dimensions.

All dimensions on the drawing, except footing dimensions, shall be in feet and decimals of a foot, to two decimal places. Footing dimensions shall be given in feet and inches.

10.12 PILING AND DRILLED SHAFT

The following information shall be shown in the plans:

- (a) Sizes - The size of the piling / drilled shaft shall be shown on the drawing
- (b) Maximum Load - The maximum (both factored and service) pile load and footing or drilled shaft pressure shall be shown on the drawing
- (c) Batter - The drawings shall show the amount and direction of battered piling
- (d) Type - End Bearing or Friction Piling
- (e) Pile Reinforcing Tips - For detail, see Figure 10.12-1 below
- (f) Estimated tip elevations, including minimum embedment
- (g) Cutoff elevation
- (h) Estimated bedrock elevation
- (i) Predrilling
- (j) CJP minimum splice elevation
- (k) A location to record the as-built tip elevation of each pile / drilled shaft
- (l) The assumed strength limit resistance factor for geotechnical axial resistance
- (m) The steel grade
- (n) The minimum number of drilled shafts at each pier / abutment to be tested using non-destructive integrity testing (e.g. crosshole sonic logging (CSL))



REINFORCING TIP DETAIL

Use commercial tip APF Hard Bite 77600, 77750, DFP H-776, Versa-Steel VS-300, Construction Supply HT-3300 or approved alternate.

Fig. 10.12-1 Reinforcing Tip Detail

10.13 ANGLES

The angles that the “bent lines” make with the “layout” or “work lines” shall be shown on this drawing, as shown in Figures 10.5-1 and the examples found at the end of this chapter.

10.14 CHECK ITEMS

Listed below is a summary of items that shall appear on the drawing, when applicable. Additional information shall appear, as required.

- (a) Project number in proper location.
- (b) Standard North Arrow.
- (c) Proper identification of “layout line” or “work line” as discussed in Sections 10.5 and 10.6, respectively.
- (d) Bearing of “layout line”.
- (e) Proper identification of “horizontal control line” or lines as discussed in Section 9.5 of the preceding chapter.
- (f) “Work lines” referenced to “layout line” by means of dimensions.
- (g) Stationing as discussed in Section 10.10.
- (h) “Bent lines”, properly identified, as discussed in Section 10.8.
- (i) Dimensions along “layout line” for locating intersection points of “bent lines”, as discussed in Section 10.11.
- (j) Indicate angles that are generated between the “layout” or “work” lines and the “bent lines”.
- (k) Dimensions necessary for locating all footings, piling, and drilled shafts as discussed in Section 10.11.
- (l) Indicate all spread footings, piling, or drilled shafts.
- (m) Give piling size, type, maximum pile load, and estimated tip elevations (see Section 10.12 for additional items)
- (n) Indicate the size of the spread footings.
- (o) Identify centerlines of piling, drilled shafts, and footings.

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- (p) Title the plan in accordance with the particular condition.
- (q) Check for typical notes, as indicated in Section 10.16.
- (r) Check title block for information indicated in Section 10.15.
- (s) Show existing utilities and/or obstructions
- (t) Show river flow limits when applicable
- (u) Show the 811 stamp

10.15 TITLE BLOCK

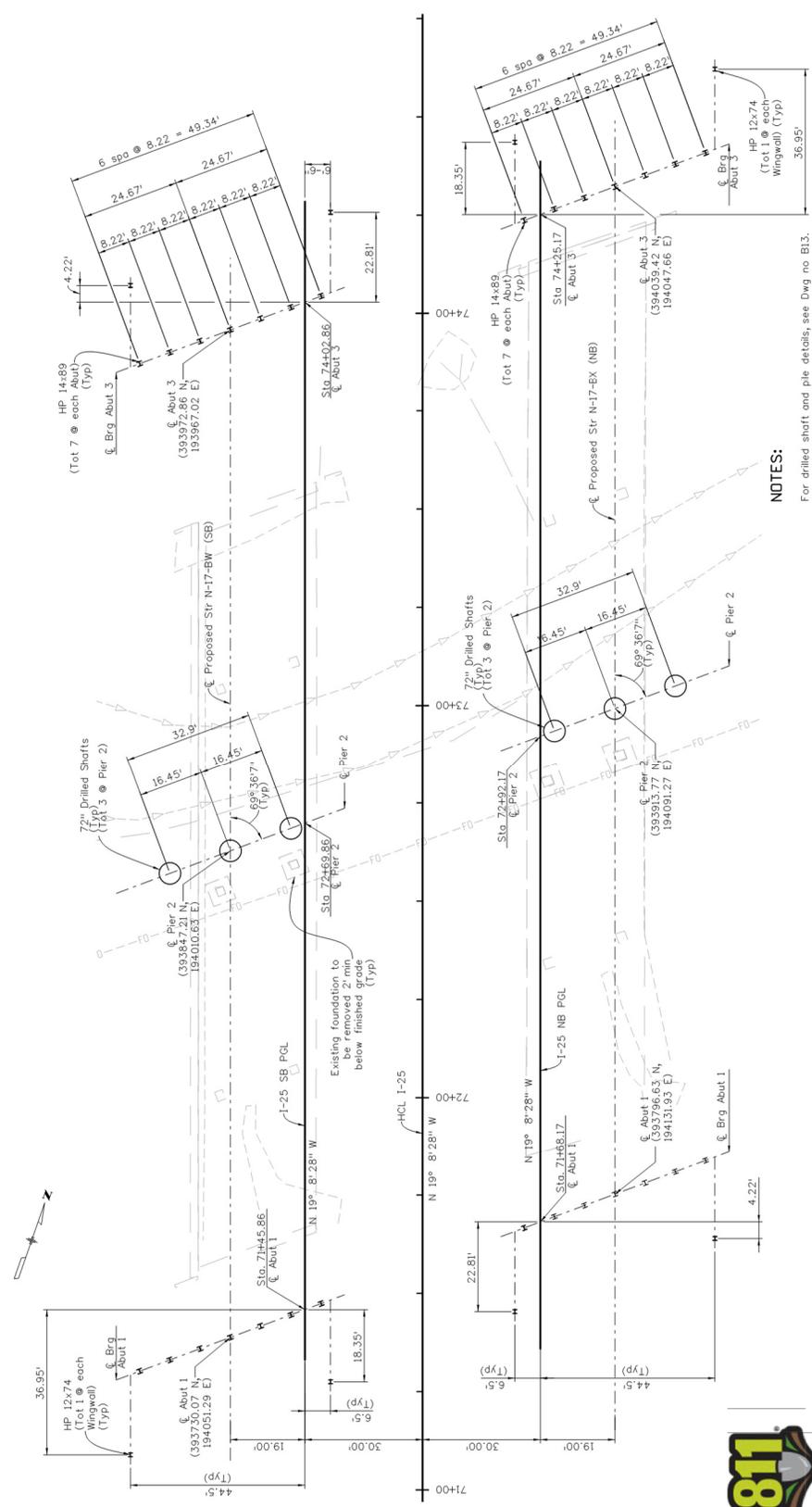
This drawing is titled "FOOTING AND PILING LAYOUT", "FOOTING LAYOUT", "DRILLED SHAFT LAYOUT", "PILING LAYOUT", etc., and shall be so indicated in the title block. If other details are combined on this drawing, they shall be so indicated in the title also. Example: If the "Construction Layout" is placed on the drawing with the "Footing and Piling Layout", the title of the drawing would be "CONSTRUCTION LAYOUT - FOOTING AND PILING LAYOUT".

The structure number or numbers, and the first initial and last name of the Designer and Detailer shall be filled in on each sheet.

10.16 TYPICAL NOTES

The following notes shall appear on the drawing, when applicable.

- (a) Dimensions Notes - The piling and footing dimensions shown are at the bottom of the concrete.
- (b) Piling - A notation shall be made on the drawing indicating the piling size.
- (c) Piling Load Note – Maximum Pile Load = _____Tons (or Kips)
- (d) Type - A notation shall be made on the drawing indicating if the Piling is either End Bearing or Friction.
- (e) Show the maximum Footing Pressure, when applicable.
- (f) Estimated Tip Elevation.

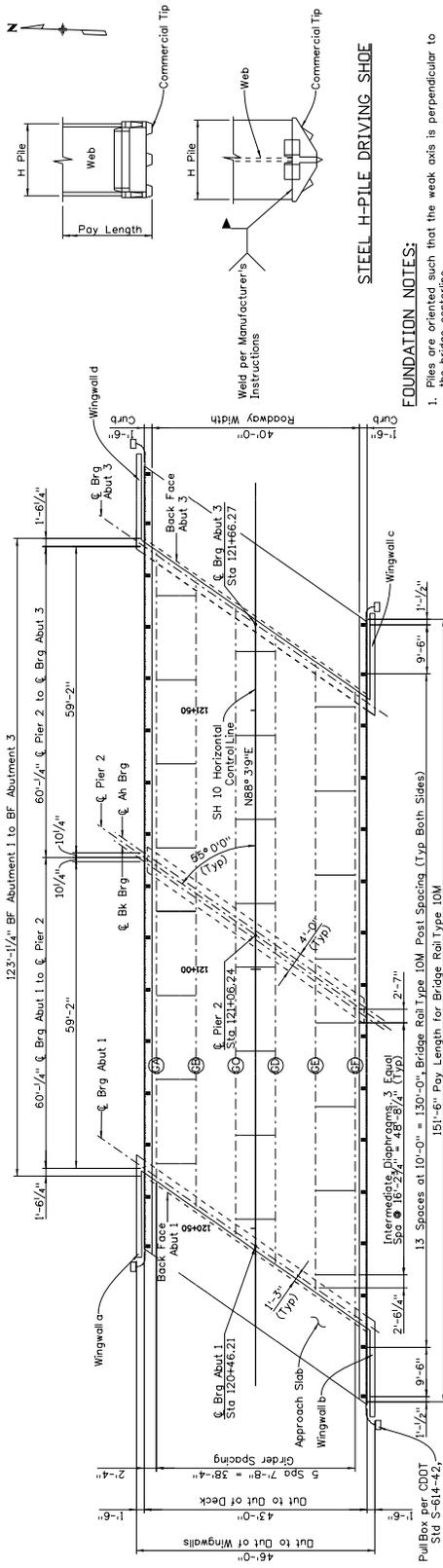


NOTES:
For drilled shaft and pile details, see Dwg no B13.

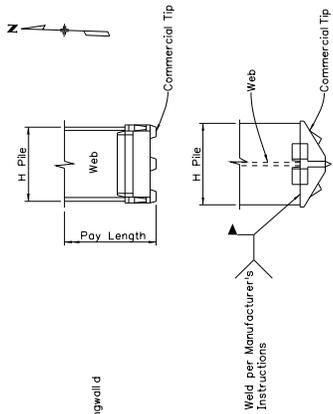
FOUNDATION LAYOUT



Fig. 10-1 Example 1



STEEL H-PILE DRIVING SHOE



FOUNDATION NOTES:

1. Piles are oriented such that the weak axis is perpendicular to the bridge centerline.
2. All welders, welding and weld procedures shall be certified or established per the project specifications.
3. A minimum of one pile dynamic test shall be required per abutment.
4. Only Complete Joint Penetration (CJP) welds shall be used for pile splices

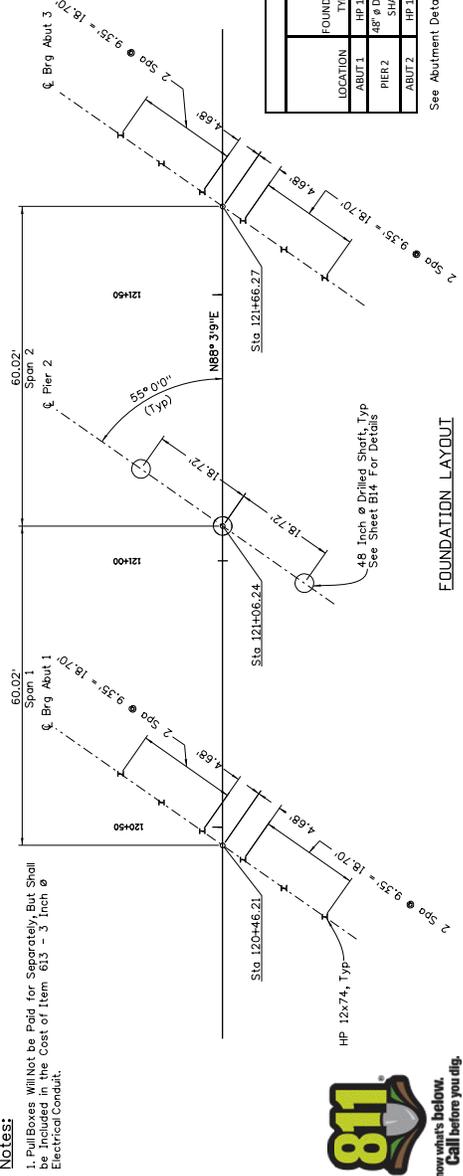
FOUNDATION NOTES:

- Drilled Shafts and Piles are Designed per AASHTO LRFD
- Drilled Shafts:
 Nominal Tip Resistance in Bedrock = 65 ksf
 Nominal Side Resistance in Bedrock = 13.7 ksf
 Resistance Factors for Tip and Side Resistance Are 0.50 and 0.45, Respectively
- Piles:
 Combined Nominal End Bearing and Side Resistance in Bedrock = 35 ksi
 (Grade 50 Steel)
 Resistance Factors for Combined Resistance Is 0.65

DRILLED SHAFT AND PILING DATA						
LOCATION	FOUNDATION TYPE	DRILLED SHAFT ELEVATION	PILE CUT-OFF ELEVATION	ESTIMATED TOP OF BEDROCK ELEVATION	AVERAGE TIP ELEVATION	MAXIMUM UNFACTORED AXIAL LOAD
ABUT 1	HP 12x74	4101	4113	4093	4072	185 kips
PIER 2	48" Ø DRILLED SHAFT	4101	4113	4093	4074	602 kips
ABUT 2	HP 12x74	4101	4113	4093	4072	185 kips
						244 kips
						861 kips
						244 kips

See Abutment Details sheet B11 for cut off information.

CONSTRUCTION LAYOUT

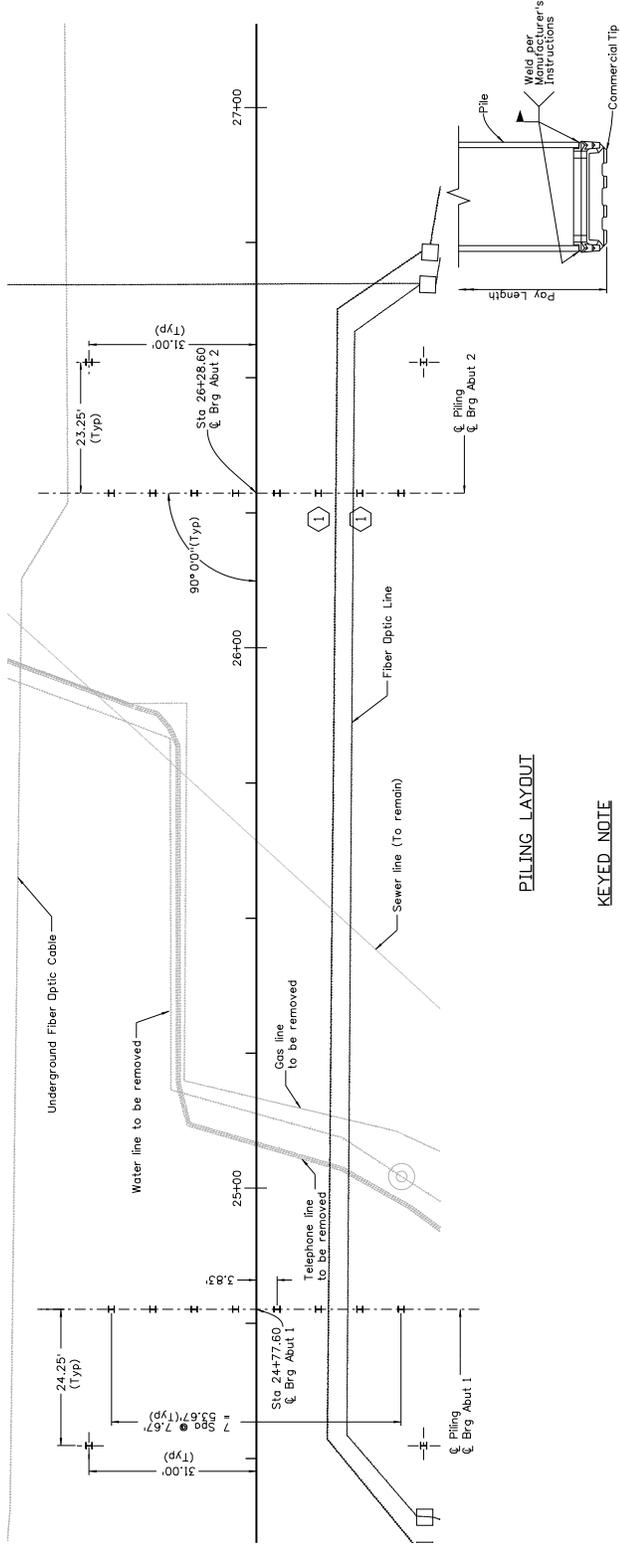


Notes:

1. Pull Boxes Will Not be Paid for Separately, But Shall be Included in the Cost of Item 613 - 3 inch Ø Electrical Conduit.



Fig. 10-2 Example 2



PILING LAYOUT

KEYED NOTE

① Pile Cutoff Elevation 7195.416 ft

NOTES:

- Piling shall be placed in 16" drilled holes up to bedrock. Drilled holes are not required for wing wallpiles.
- All steel piles shall be (AASHTO M270, Grade 50) HP 14 X 89 with a protective cast-steel pile cap and a minimum embedment length of 50 ft. The protective pile point installation shall be included under pay item 504, "Steel Piling (Install only)".
- On site observation of pile driving to confirm the bearing strata and determine the exact elevation at which the competent bedrock or dense gravel/sands, and to check for pile crimping, buckling and alignment by a representative of the geotechnical engineer will be provided.
- A minimum of one pile dynamic load test shall be required per abutment using CDOT's Pile Driving Analyzer (PDA). Final tip elevations and quantities shall be determined by using the minimum embed length criteria of the PDA measurements (33-388-6604) a minimum of ten calendar days prior to beginning of any pile driving work.
- The contractor's Field Engineer shall record actual pile tip elevations in the pile data table for as-constructed plans.
- Pile tips are not required for wing wallpiles.

REINFORCING TIP DETAIL

Use commercial tip, ABF, Hard Bite
77800, 77750, DPF, H-776,
Verso-Steel VS-300, Construction
Supply HT-3300 or approved alternate.
(Scale: None)



PILE DATA

Location	Max Service Load (kip)	Max load (Factored) (kip)	Tip Elevation	Cutoff Elevation	Top of Predrilling Elevation	Bottom of Predrilling Elevation	Pile size	Min bedrock Embedment (ft)	# Piles	Actual Tip Elevation
Abutment 1	277.4	411.7	7153.0	7196.0	7195.0	7170.0	HP 14X89	16.00	8	
Abutment 2	287.0	424.7	7159.4	7195.5	7194.5	7177.0	HP 14X89	16.55	8	
Wingwalls Abut 1	35.2	44.0	7178.0	7193.5	-	-	HP 14X89	0.00	2	
Wingwalls Abut 2	35.2	44.0	7177.5	7193.0	-	-	HP 14X89	0.00	2	

See Abutment Details sheet B12 for cutoff information.

Fig. 10-3 Example 3

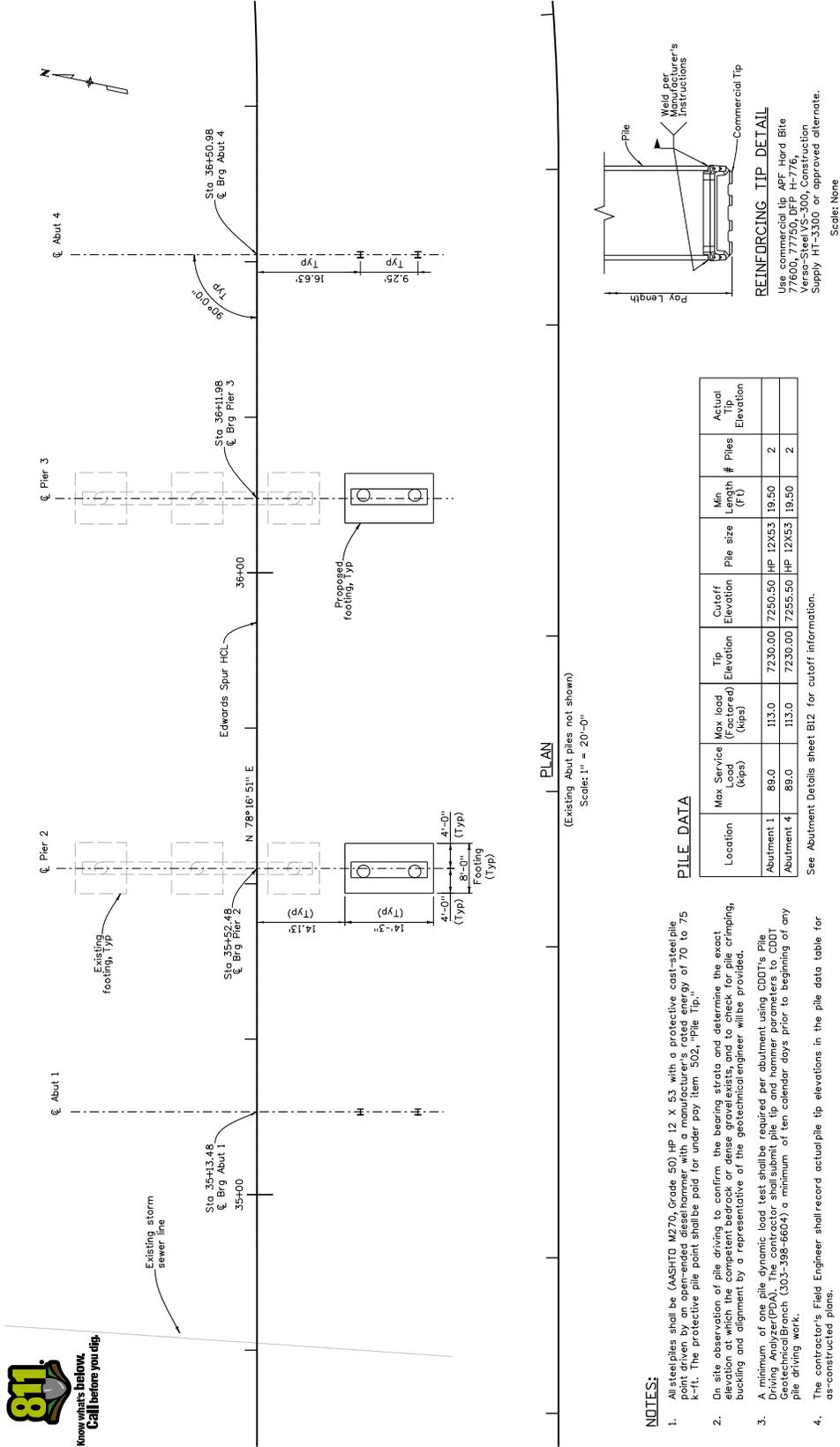


Fig. 10-4 Example 4

