

CHAPTER 3 SUBSTRUCTURES

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3.2 Abutments

3.2.1 Introduction

Abutments include the following configurations:

- 1) Conventional
- 2) Mass
- 3) Cantilever
- 4) Integral
- 5) Semi-integral

↪ Refer to *Bridge Design Guide* for more information.

3.2.1.1 Foundation Types

A. Integral Abutment

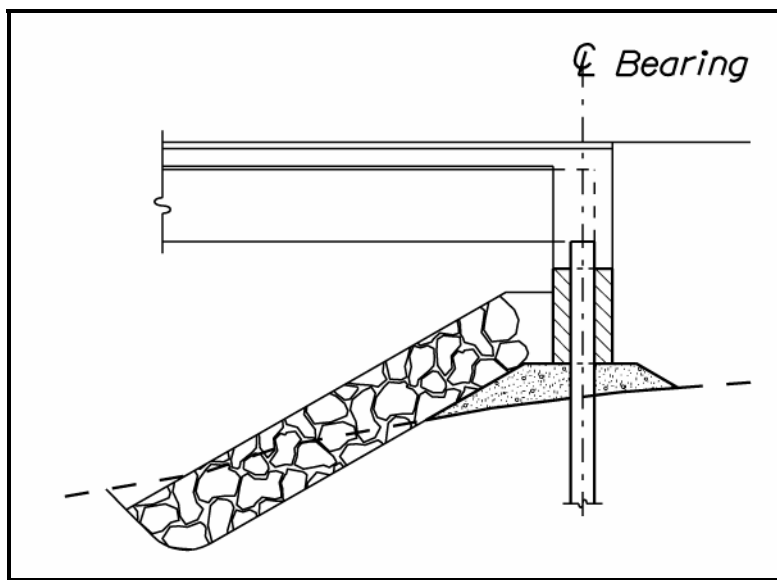


Figure 3-1 Integral Abutment

B. Footing On Ledge

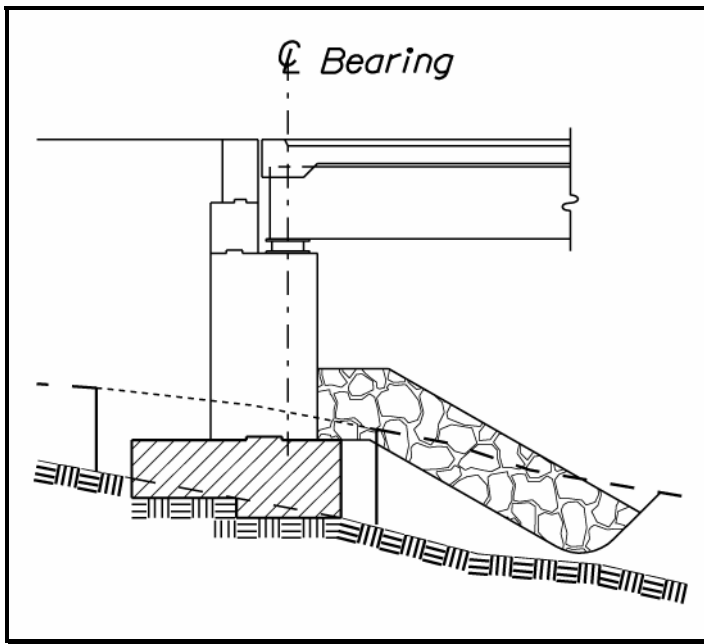


Figure 3-2 Footing On Ledge

C. Footing on Concrete Fill

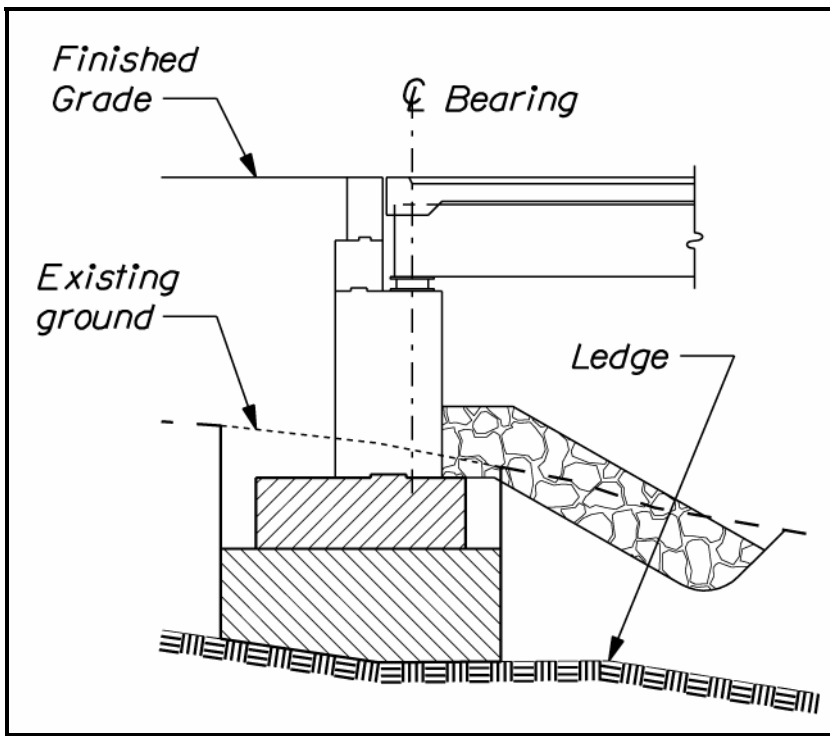


Figure 3-3 Footing On Concrete Fill

D. Footing On Piles

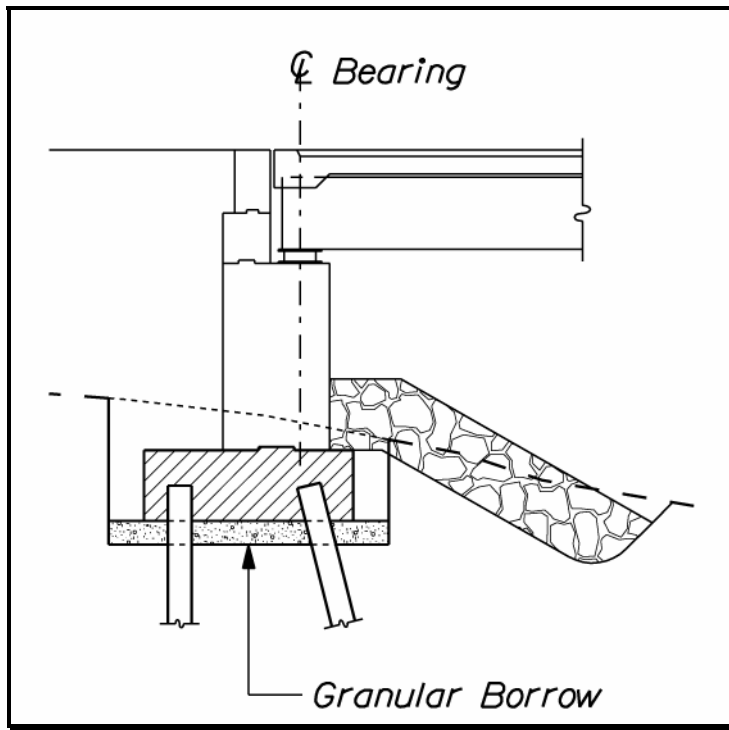


Figure 3-4 Footing On Piles

E. Spread Footing

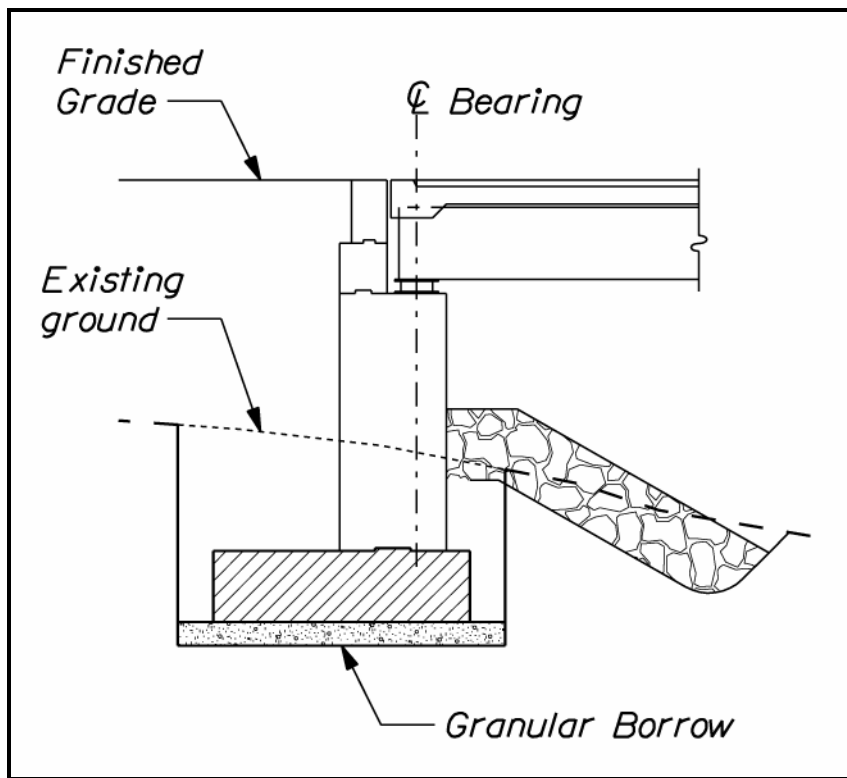


Figure 3-5 Spread Footing

3.2.2 Prerequisites

3.2.2.1 To Get Started (30% Abutment Plans)

The 30% Abutment plans show limits of concrete and pile locations. The purpose of this step is to communicate the geometric design intent to the checker. These plans show only limits of concrete and enough annotation to communicate these limits (i.e. dimensions, elevations.)

❶ It is important to not begin detailing reinforcing steel until the 30% abutment and superstructure plans have been checked by the designer/checker.

To draw the abutments up to this level of completion, the detailer requires the following information:

- 1) CL Bearing Abutment Station
- 2) Skew Angle
- 3) Breastwall/Backwall Thickness
- 4) Footing Widths

- 5) Wing Lengths, Wing Angles, Wing Thickness (Lengths and angles may be calculated by the detailer. Refer to Wingwalls, section 3.2.4 for more information)
- 6) Top and Bottom of Footing Elevations (Sometimes Ledge or Seal Elevations)
- 7) Bridge Seat Elevations/Bearing heights (including preformed leveling pad thickness that is typically placed under the sole plate of the bearing)
- 8) Top of Backwall Elevations
- 9) Top of Wing Elevations
- 10) Top of Parapet Elevations
- 11) Pile Locations
- 12) Pile Batter
- 13) Joint Locations (Construction & Contraction)
- 14) Riprap shelf elevation
- 15) Backfill requirements

3.2.2.2 To Finish Up (100% Abutment Plans)

The following items are required to finish detailing an abutment:

- 1) Checked 30% abutment & superstructure plans
- 2) Completed and checked reinforcing scheme (designer will communicate reinforcing scheme to detailer via sketches)
- 3) Abutment and pile notes
- 4) Pay Limit information (structural earth excavation, integral abutment superstructure, granular borrow, membrane waterproofing, etc.)

3.2.3 Detailing

Abutment details are primarily CIP Concrete details. The Contractor is the main client to keep in mind when detailing abutments.

3.2.4 Wingwalls

3.2.4.1 General Definition

The term “wingwall” (commonly expressed simply as “wing”) refers to a retaining wall that serves to contain the approach roadway fill around an abutment. The wingwall may be an integral part of the abutment or it may stand independently. Wingwalls are constructed in various geometric configurations to achieve the best balance between structure cost and the volume of embankment fill required.

3.2.4.2 Extension Wings

Extension wings project straight out from the abutment parallel to the centerline of bearing. They are the simplest type of wing to build but tend to result in the greatest volume of fill required around the abutment. They should typically be used only with relatively shallow superstructures in order to avoid excessively long wing lengths. The *Bridge Design Guide* requires that extension wings always be used with integral abutments.

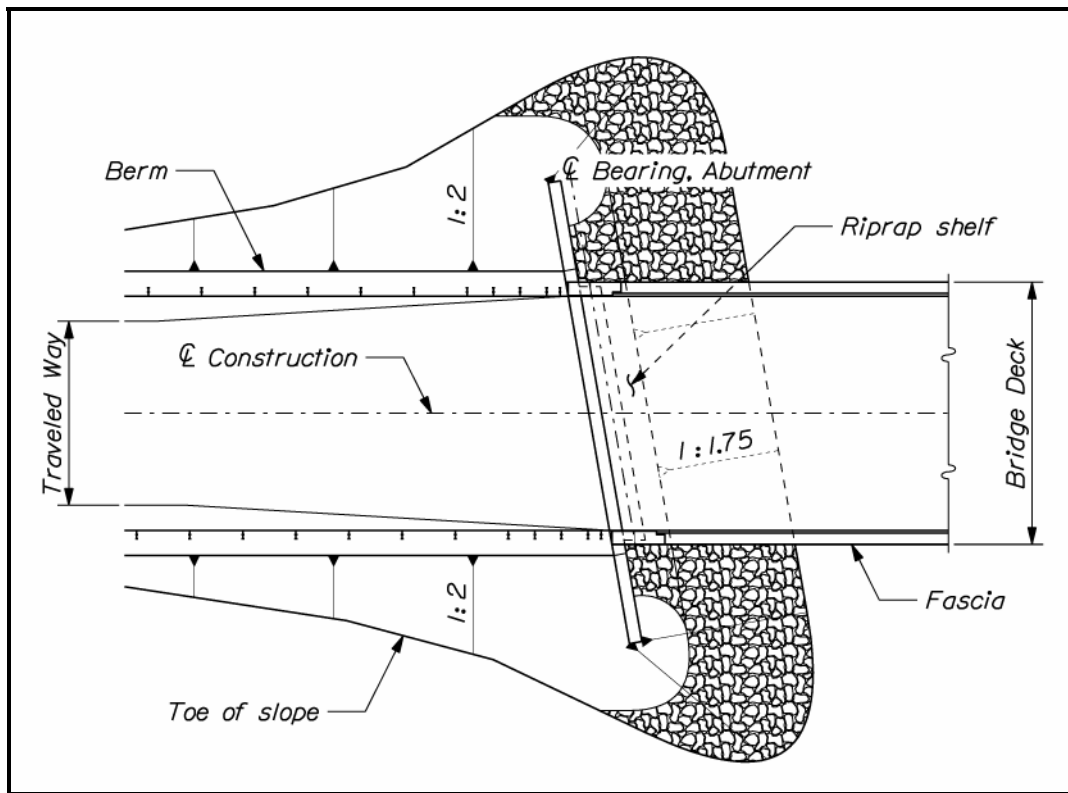


Figure 3-6 Extension Wing Plan

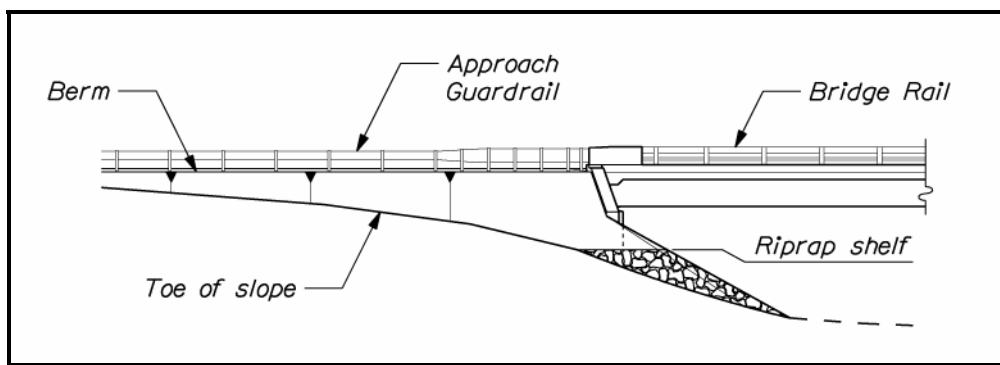
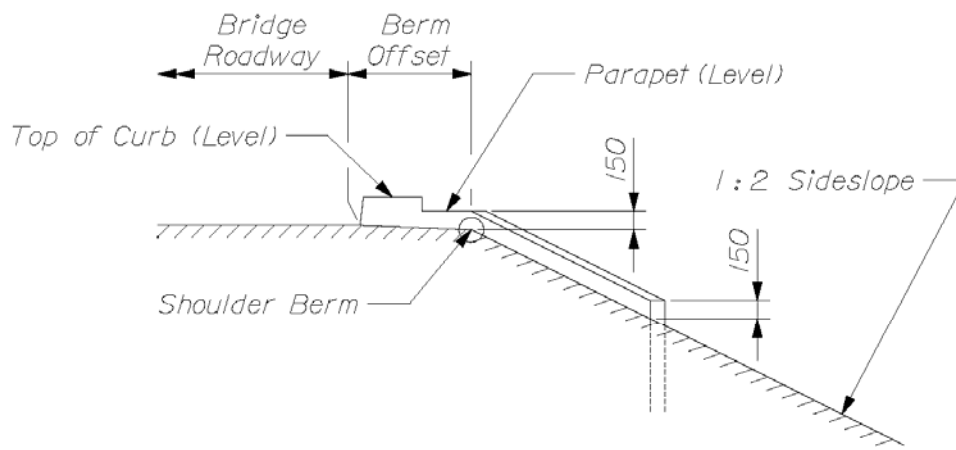
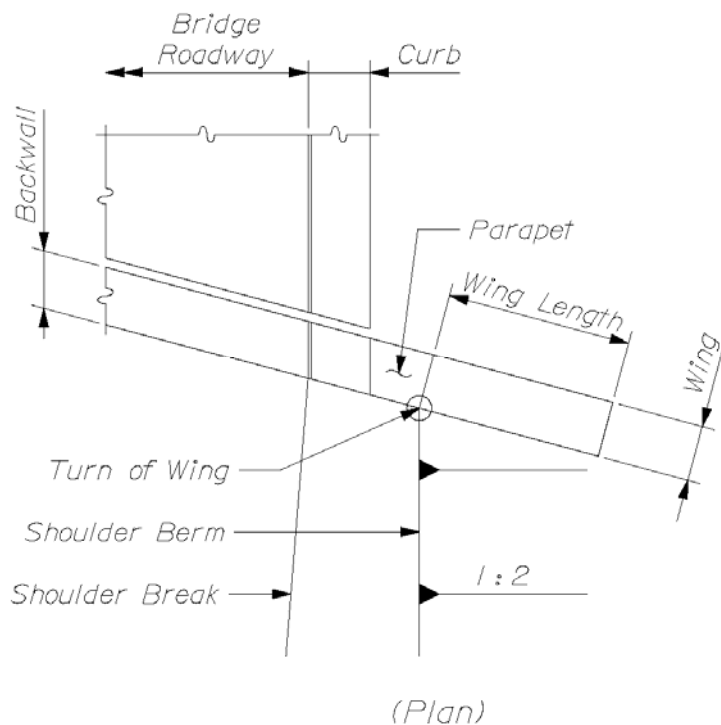


Figure 3-7 Extension Wing Elevation

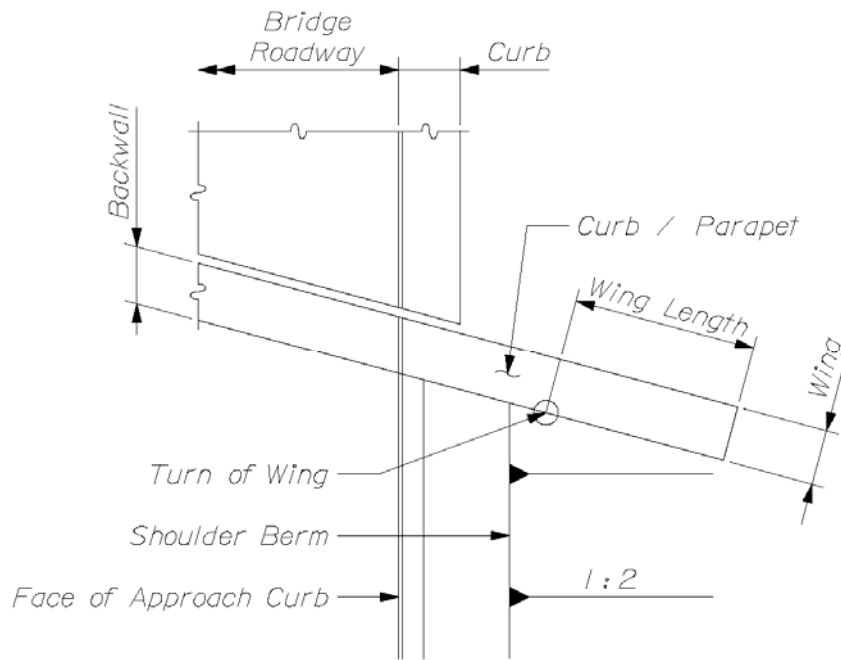
A. Extension Wing on Non-Curbed Approach



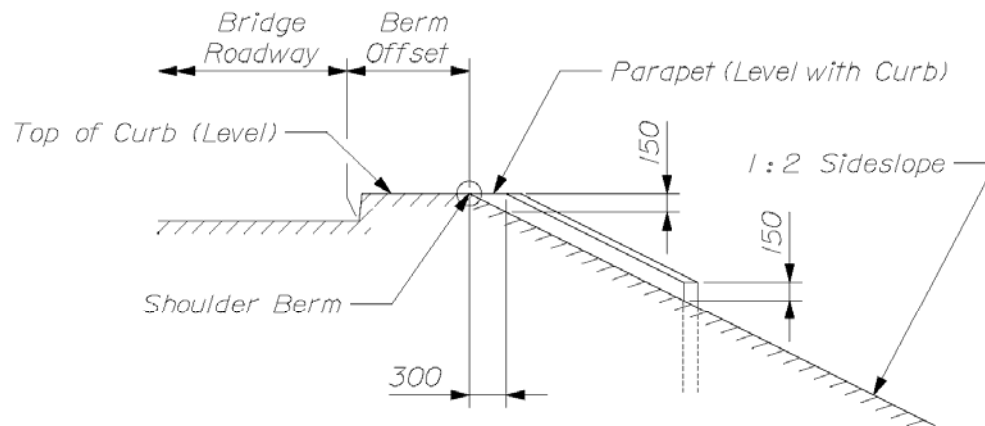
-- NON - CURBED APPROACH SECTION --

EXTENSION WING LAYOUT

B. Extension Wing on Curbed Approach



(Plan)

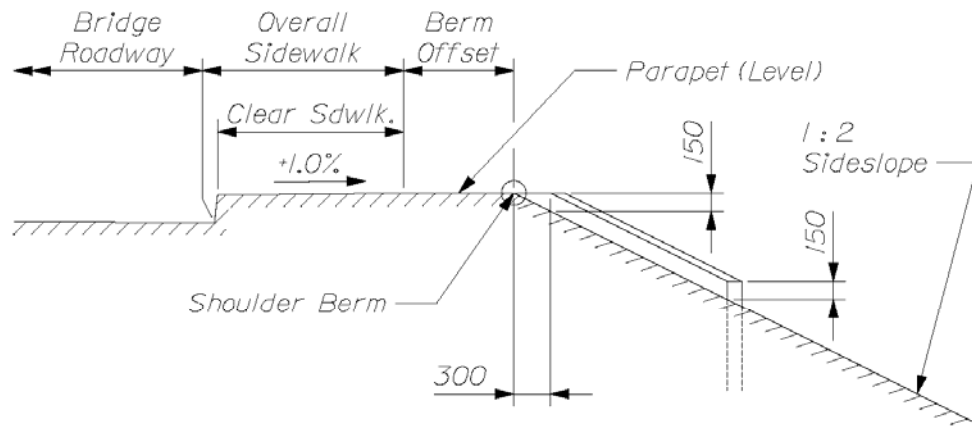
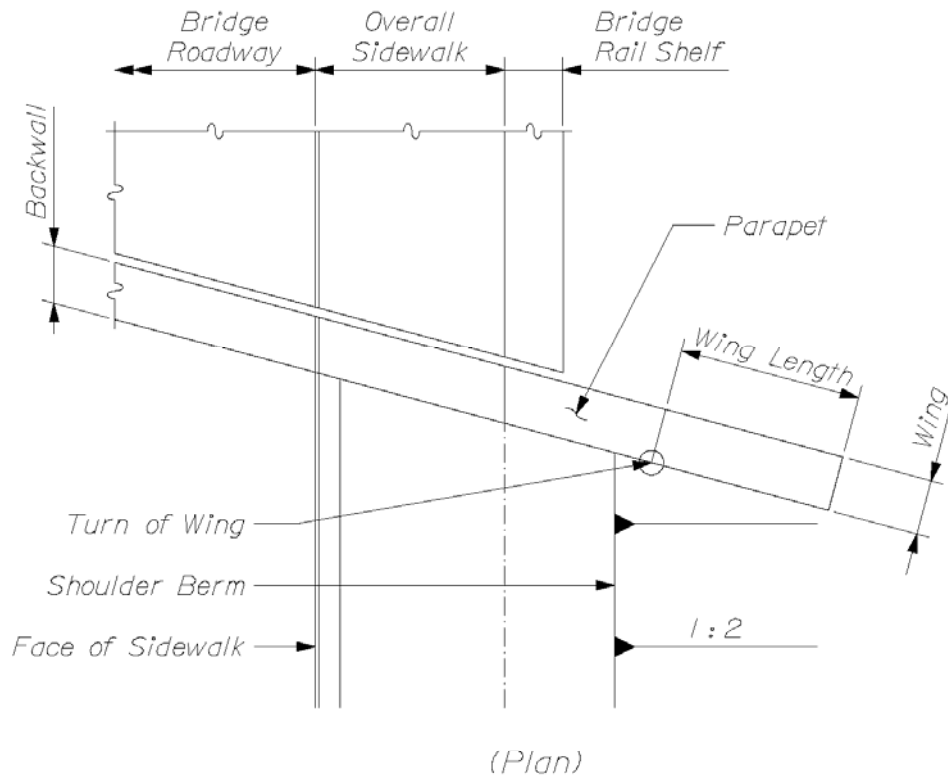


(Elevation at Back of Abutment)

-- CURBED APPROACH SECTION --

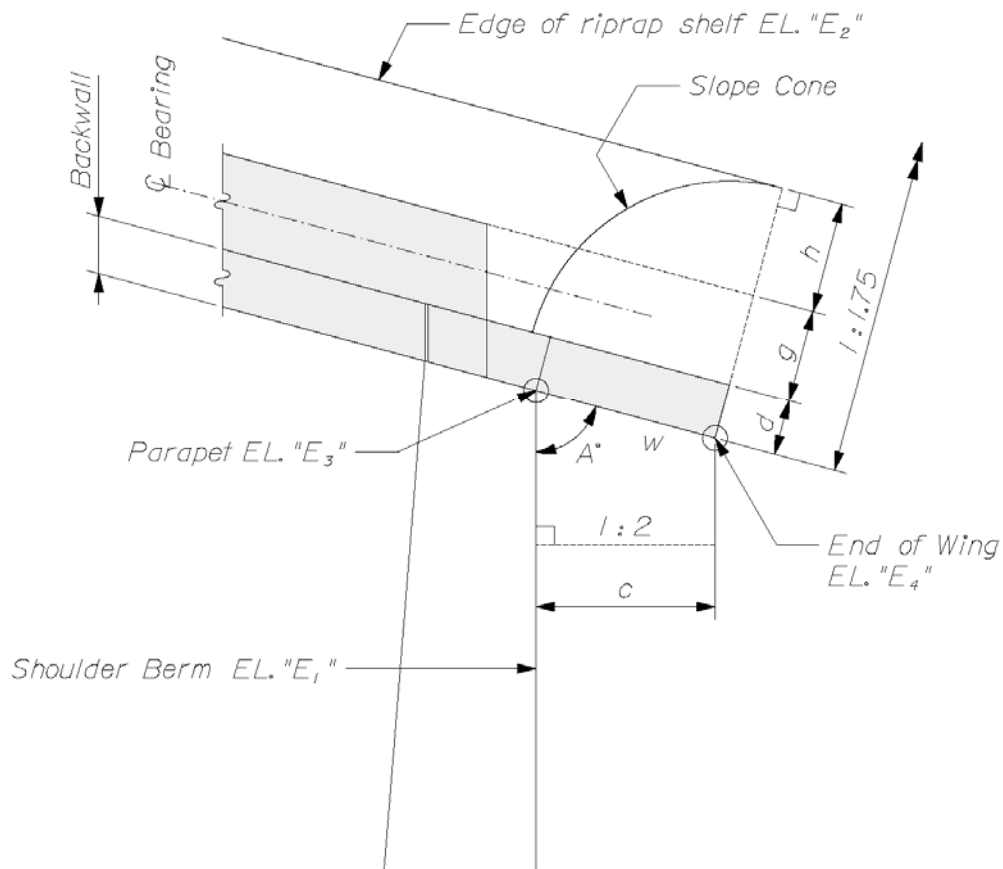
EXTENSION WING LAYOUT

C. *Extension Wing on Sidewalk Approach*



(Elevation at Back of Abutment)
 -- SIDEWALK APPROACH SECTION --
 EXTENSION WING LAYOUT

D. Layout of Extension Wings for Stub or Integral Abutment with Riprap Shelf



-- PLAN --

(Stub or integral abutment with riprap shelf)

NOTES:

1. Angle "A" = 90° +/- Skew Angle
2. Dim. "d" = Wing thickness
3. Dim. "g" = Bridge seat width
4. Dim. "h" = Riprap shelf width
5. Dim "w" = Wing length calculated from given criteria.

EXTENSION WING LAYOUT

E. Example Calculations of Stub or Integral Abutment with Riprap Shelf*EXAMPLE CALCULATIONS**(Stub or integral abutment with riprap shelf)*

Given: Skew Angle = 15°
 Berm EL. " E_1 " = 34.920
 Riprap Shelf EL. " E_2 " = 33.000
 Dim. " d " = 0.450 m

Then: Wing angle $A^* = 90^\circ - 15^\circ = 75^\circ$
 Change in elevation $\Delta E = E_1 - E_2 = 34.920 - 33.000 = 1.920$
 $c = (\sin A) w$

WING LENGTH (Round to nearest 0.150 m)

$$\Delta E = \frac{(\sin A) w}{2} + \frac{(d + g + h)}{1.75}$$

$$1.920 = \frac{(\sin 75.0) w}{2} + \frac{(0.450 + 0.750 + 0.900)}{1.75}$$

$$1.920 = 0.483 w + 1.200$$

$$0.720 = 0.483 w$$

$$1.491 = w$$

► Use Wing Length = 1.500 m

PARAPET ELEVATION (Round up to 0.005 m)

$$E_3 = E_1 + 0.150$$

$$= 34.920 + 0.150 = 35.070$$

► Use Parapet EL. 35.070

EXTENSION WING LAYOUT

*EXAMPLE CALCULATIONS
(Stub or Integral abutment with riprap shelf)*

END OF WING ELEVATION (Round up to 0.005 m)

$$\begin{aligned} E_4 &= E_1 - \frac{(\sin A)w}{2} + 0.150 \\ &= 34.920 - \frac{(\sin 75.0)1.500}{2} + 0.150 \\ &= 34.920 - 0.724 + 0.150 \\ &= 34.346 \end{aligned}$$

→ Use End of Wing EL. 34.350

EXTENSION WING LAYOUT

3.2.4.3 Return Wings

Return wings follow the line of the superstructure fascia straight back from the abutment. The bridge rail system continues along the top of the return wing, with the approach guardrail connection located at its end. Return wings generally result in the greatest concrete quantities but have the least impact to the site due to the reduced volume of fill required. Return wings are particularly suited for use with deep superstructures and high fill sections.

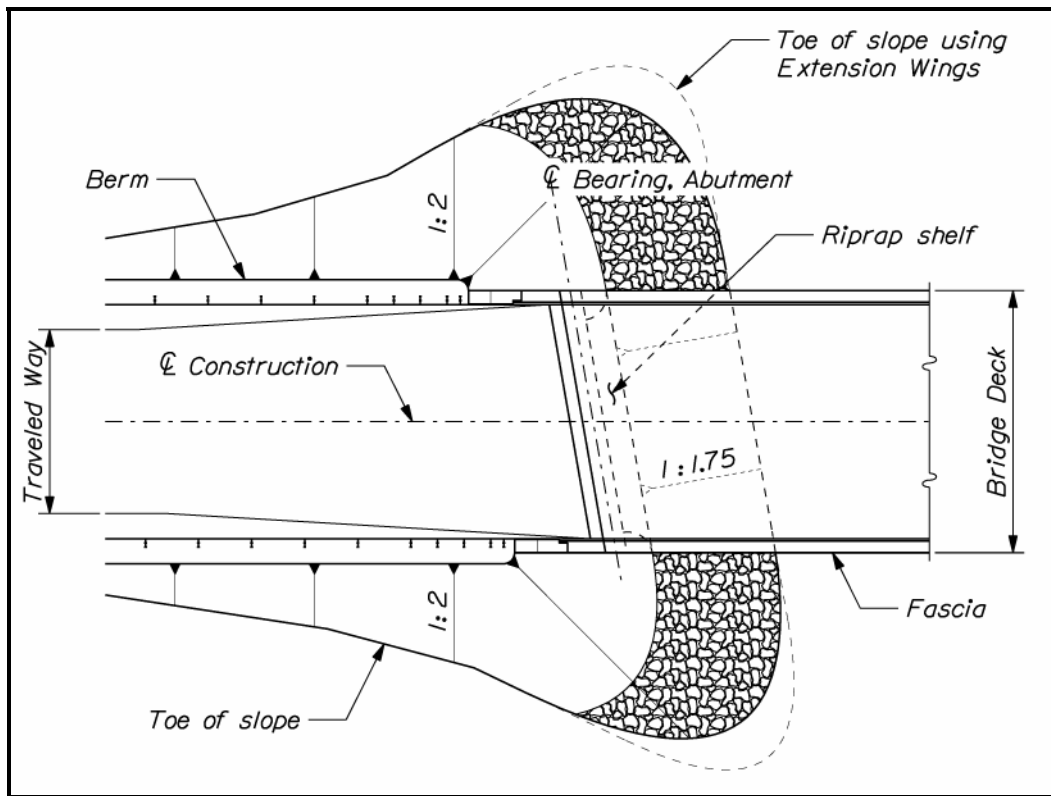


Figure 3-8 Return Wing Plan

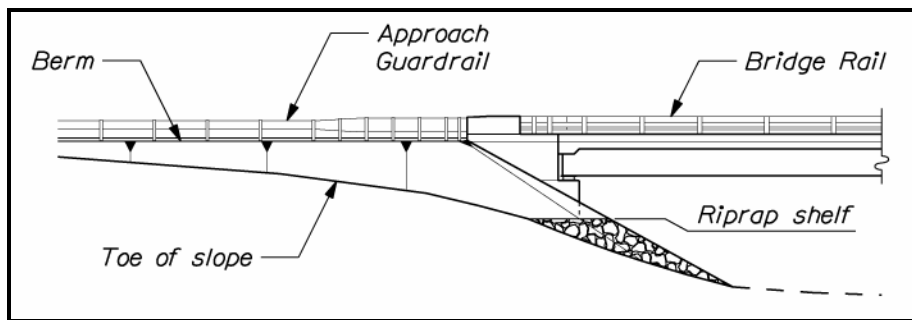


Figure 3-9 Return Wing Elevation

3.2.4.4 Flared Wings

The “ideal” flared wing bisects the angle between the centerline of bearing and the roadway berm. (The occasionally used expression “45 degree wing” is proper only if the bridge has no skew.) Flared wings result in the best balance between structure cost and embankment fill requirements and so are by far the most widely used wing configuration.

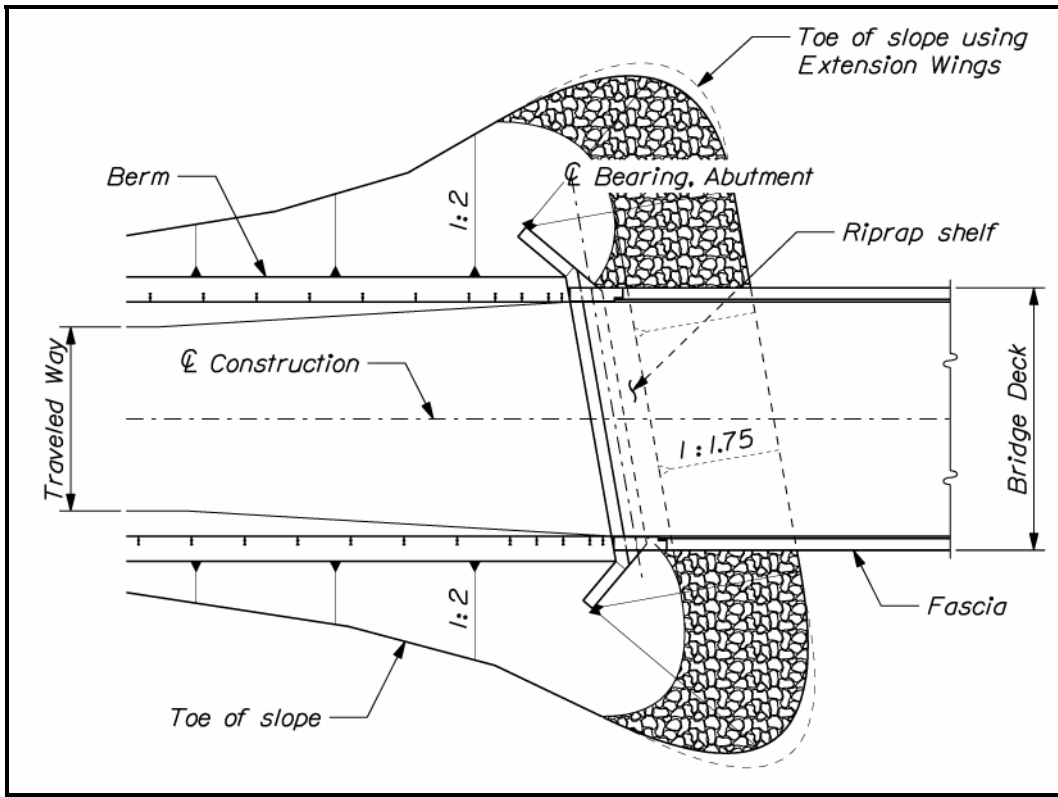


Figure 3-10 Flared Wing Plan

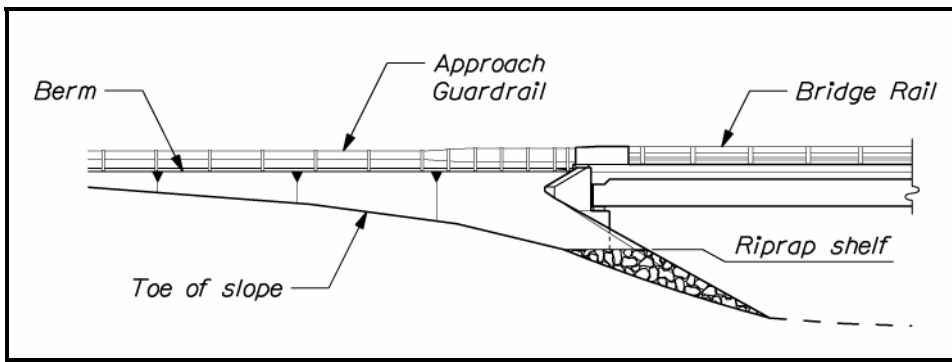
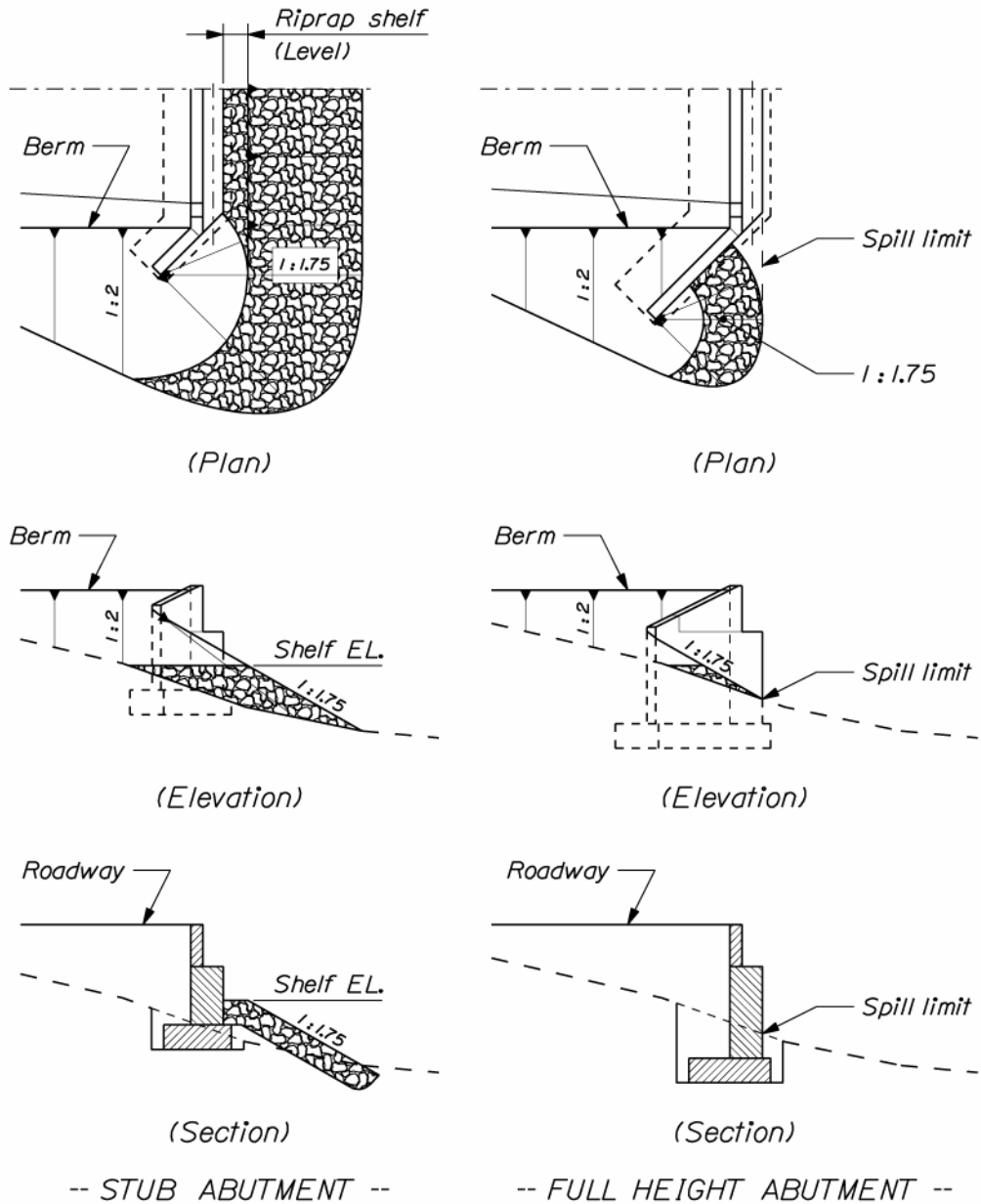


Figure 3-11 Flared Wing Elevation

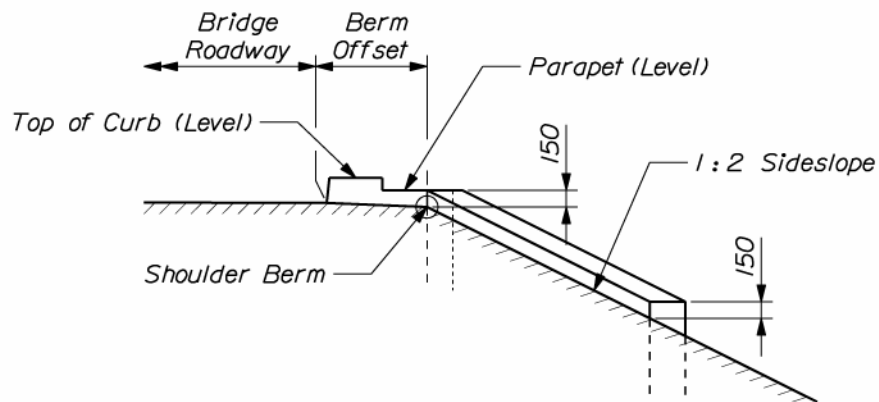
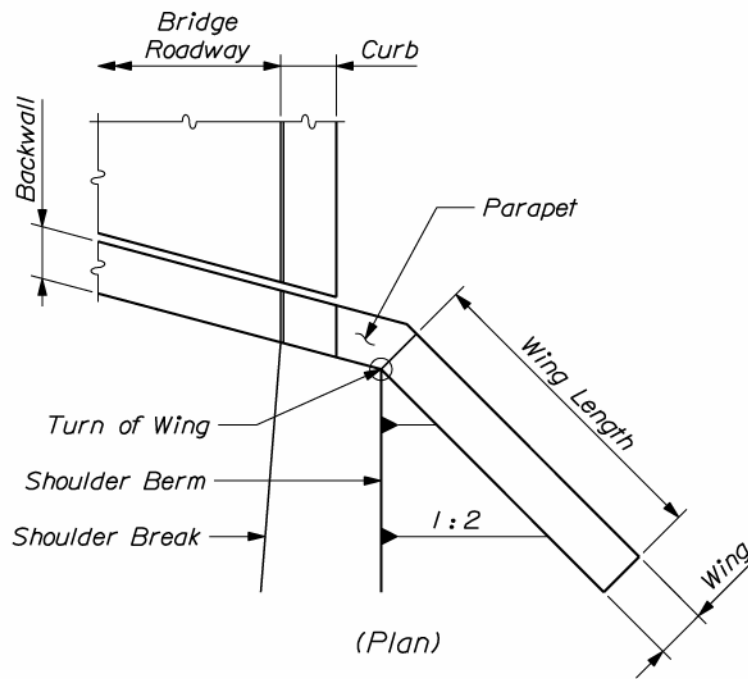
A. General Flared Wing Layout



Note: All other conditions being equal, a stub abutment will have shorter wings than a full height abutment

FLARED WING LAYOUT

B. Flared Wing on Non-Curbed Approach

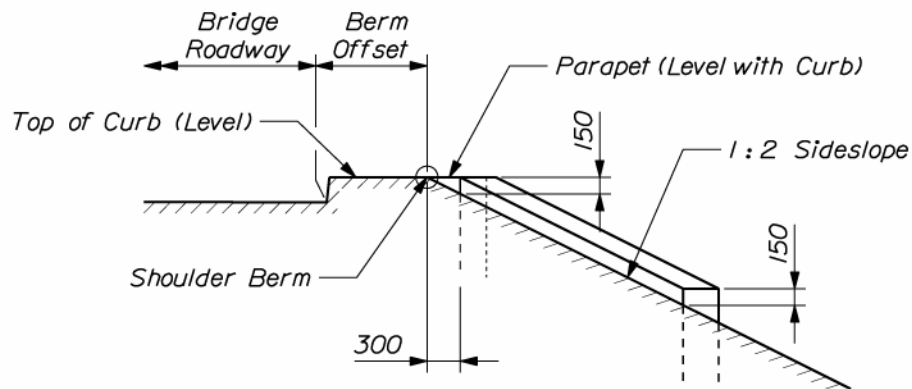
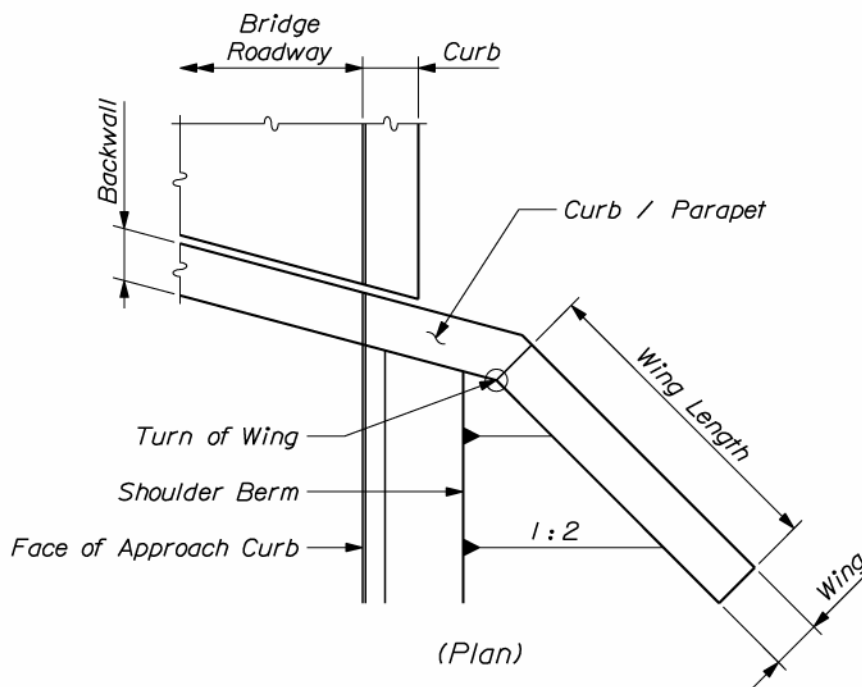


(Elevation at Back of Abutment)

-- NON - CURBED APPROACH SECTION --

FLARED WING LAYOUT

C. Flared Wing on Curbed Approach

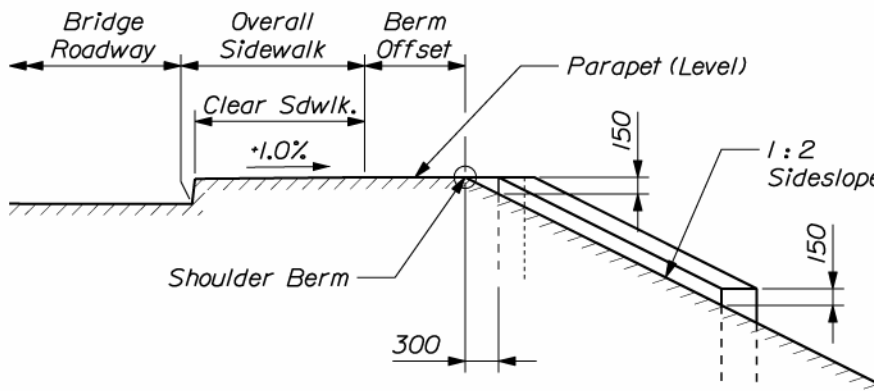
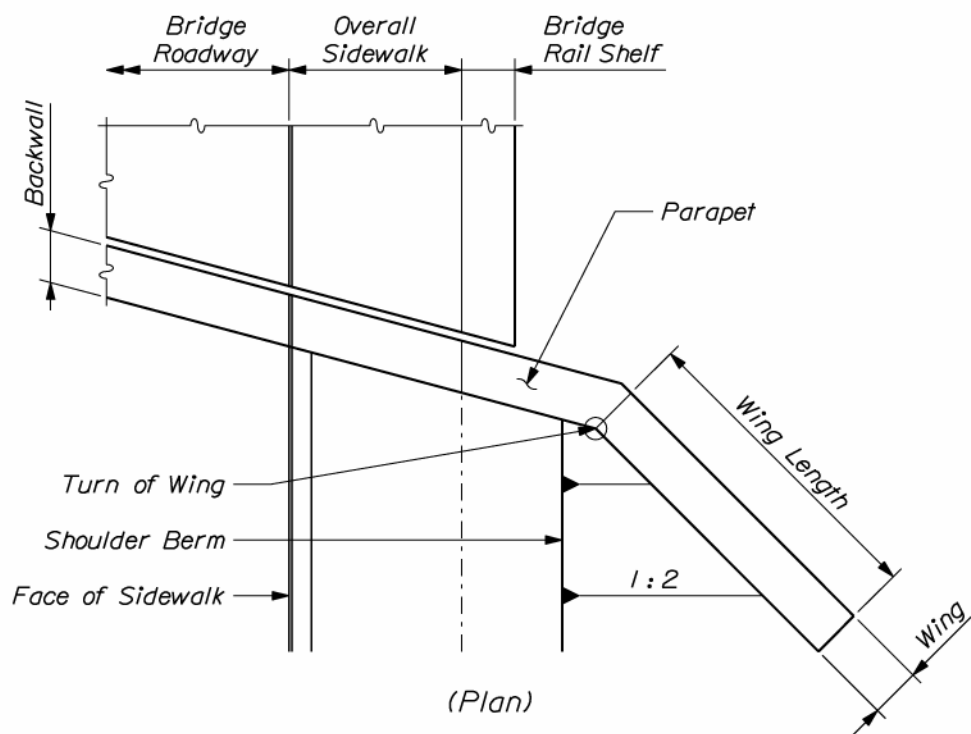


(Elevation at Back of Abutment)

-- CURBED APPROACH SECTION --

FLARED WING LAYOUT

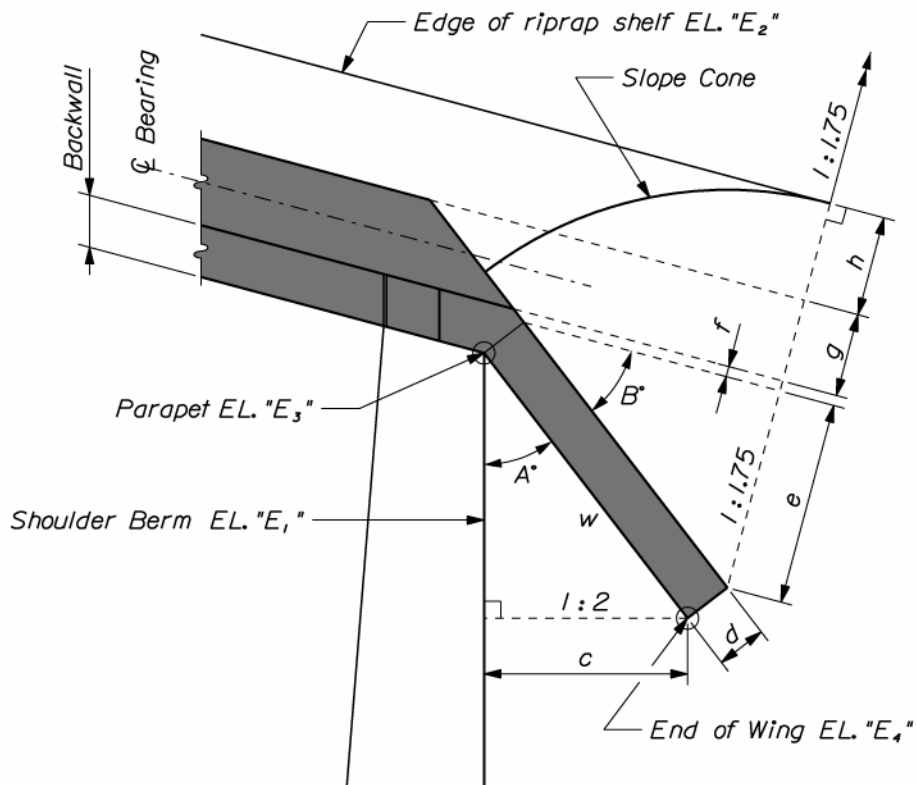
D. Flared Wing on Sidewalk Approach



-- SIDEWALK APPROACH SECTION --

FLARED WING LAYOUT

E. Layout of Flared Wings for Stub Abutment with Riprap Shelf



-- PLAN --
(Stub abutment with riprap shelf)

NOTES:

1. Typically $A^* = B^*$ unless site conditions warrant otherwise.
2. Dim. "d" = Wing thickness
3. Dim. "f" varies depending on wing angle and wall thicknesses.
4. Dim. "g" = Bridge seat width
5. Dim. "h" = Riprap shelf width
6. Dim "w" = Wing length calculated from given criteria.

FLARED WING LAYOUT

*EXAMPLE CALCULATIONS
(Stub abutment with riprap shelf)*

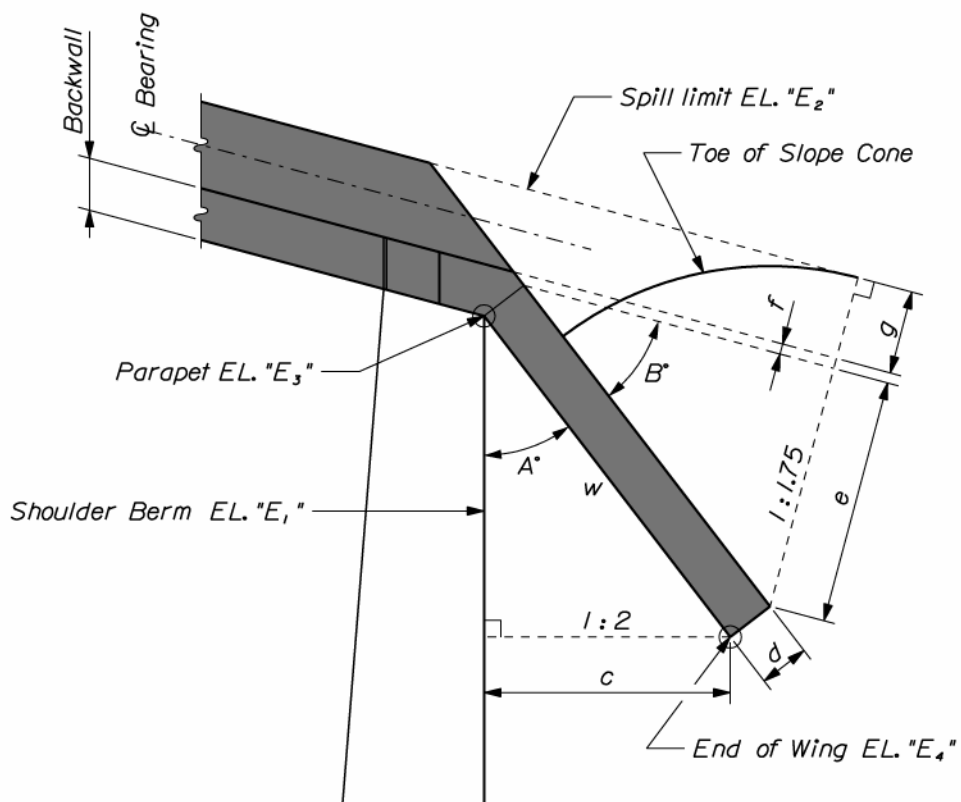
END OF WING ELEVATION (Round up to 0.005 m)

$$\begin{aligned} E_4 &= E_1 - \frac{(\sin A) w}{2} + 0.150 \\ &= 28.180 - \frac{(\sin 37.5) 3.000}{2} + 0.150 \\ &= 28.180 - 0.913 + 0.150 \\ &= 27.417 \end{aligned}$$

→ Use End of Wing EL. 27.420

FLARED WING LAYOUT

F. Layout of Flared Wings for Full Height Abutment with no Shelf



-- PLAN --
(Full height abutment with no shelf)

NOTES:

1. Typically $A^* = B^*$ unless site conditions warrant otherwise.
2. Dim. "d" = Wing thickness
3. Dim. "f" varies depending on wing angle and wall thicknesses.
4. Dim. "g" = Bridge seat width
5. Dim "w" = Wing length calculated from given criteria.

FLARED WING LAYOUT

EXAMPLE CALCULATIONS
(Full height abutment with no shelf)

Given: Skew Angle = 15°
 Berm EL. "E₁" = 28.180
 Spill limit EL. "E₂" = 23.500

Assume A° = B°
 Dim. "d" = 0.450 m
 Dim. "f" = 0.093 m (Measured or calculated)

Then: Wing angle A° = B° = (90° - 15°)/2 = 37.5°
 Change in elevation Δ E = E₁ - E₂ = 28.180 - 23.500 = 4.680
 $c = (\sin A) w$
 $d = (\sin B) w$

WING LENGTH (Round to nearest 0.150 m)

$$\Delta E = \frac{(\sin A) w}{2} + \frac{d}{1.875} + \frac{(\sin B) w}{1.75} + \frac{(f + g)}{1.75}$$

$$4.680 = \frac{(\sin 37.5) w}{2} + \frac{0.450}{1.875} + \frac{(\sin 37.5) w}{1.75} + \frac{(0.093 + 0.750)}{1.75}$$

$$4.680 = 0.3044 w + 0.240 + 0.3479 w + 0.482$$

$$3.958 = 0.652 w$$

$$6.070 = w$$

→ Use Wing Length = 6.000 m

PARAPET ELEVATION (Round up to 0.005 m)

$$E_3 = E_1 + 0.150$$

$$= 28.180 + 0.150 = 28.330$$

→ Use Parapet EL. 28.330

FLARED WING LAYOUT

*EXAMPLE CALCULATIONS
(Full height abutment with no shelf)*

END OF WING ELEVATION (Round up to 0.005 m)

$$\begin{aligned} E_4 &= E_1 - \frac{(\sin A) w}{2} + 0.150 \\ &= 28.180 - \frac{(\sin 37.5) 6.000}{2} + 0.150 \\ &= 28.180 - 1.826 + 0.150 \\ &= 26.504 \end{aligned}$$

→ Use End of Wing EL. 26.505

FLARED WING LAYOUT

3.2.5.3 Abutment No. X Wings

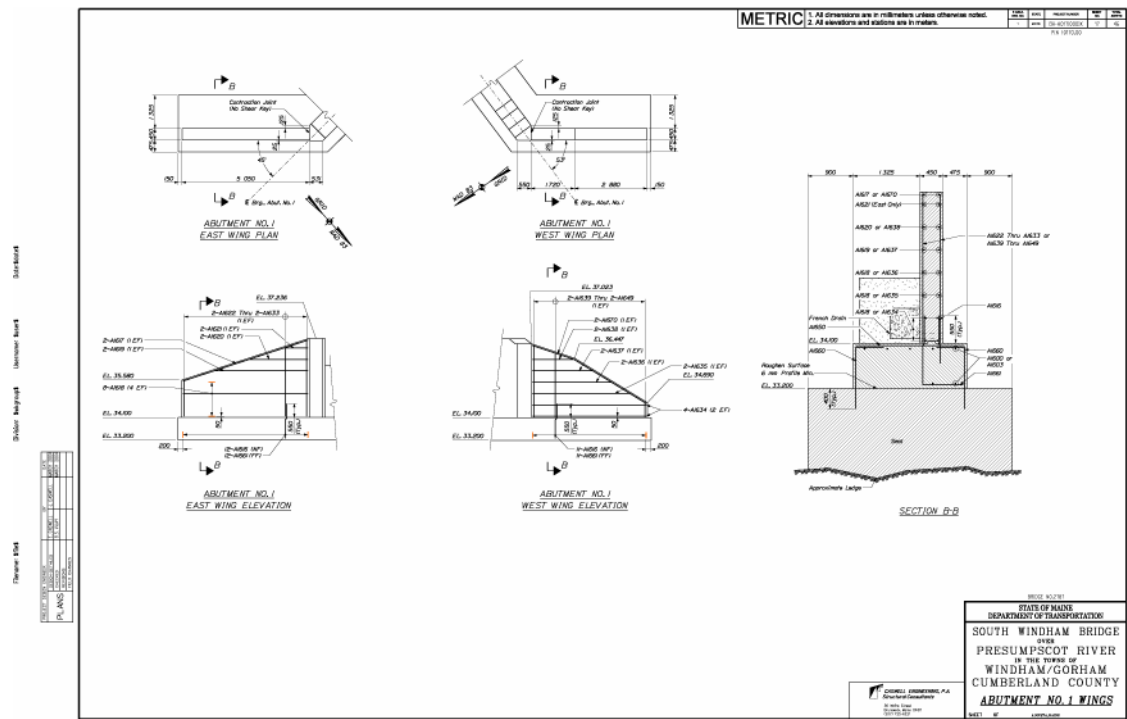


Figure 3-14 Abutment Wings Sheet

Use when abutment wings don't fit on abutment plan.

Will Contain:

- 1) Wing Elevation
- 2) Wing Section

May Contain:

- 1) Wing Plan
- 2) Add'l Special Details, i.e. wing turn blowup

① Abutments for precast box - type superstructures shall be detailed with a horizontal construction joint at the elevation of the bridge seats to aid in the erection of the superstructure and assure correct fit at the parapets.

3.2.6 Standard Notes

3.2.6.1 Abutment Notes

- 1) Reinforcing steel shall have a minimum concrete cover of 2 inches cover in the walls and 3 inches in the footings unless otherwise noted.
- 2) Cover joints where waterstops are not required in accordance with Standard Detail 502 (01).

- 3) Place 4 in. diameter drains in breastwall and wings at XX feet maximum spacing. Exact location to be determined by the Resident in the field.
- 4) Construct French Drains behind the abutments and wingwalls in accordance with Standard Specifications Section 512, French Drains.
- 5) Structural Earth Excavation, Abutments and Retaining Walls, required more than 12 inches below the bottom of the structure will be paid for in accordance with Standard Specifications Section 206 Structural Excavation.
- 6) Abutments, wings, and their footings shall be backfilled with Granular Borrow. Pay limits will be the structural excavation limits in cut areas and a vertical plane located 10 feet behind the walls in fill areas.
- 7) Maximum calculated footing pressure is XX tons per square foot.
(The following note is used with pile-supported integral abutments.)
- 8) Excavate a 24-in. diameter by 12-in. deep hole around the centroid of each pile. The depth is measured from the bottom of the abutment. Fill the hole with abutment concrete. Payment for all labor and materials will be considered incidental to related Contract items.
(The following note is used with precast box or slab type superstructures)
- 9) To ensure an accurate match with the superstructure, the parapet portions of the wingwalls shall be placed after erection of the precast units.
(The following note is used when Transition Barriers are constructed on return wingwalls)
- 10) The Contractor shall install Transition Barrier vertical closed stirrups, as shown in the Standard Details Section 526, prior to the placement of the curb concrete.

3.2.6.2 Pile Notes

- 1) Piles marked with an arrow shall be battered XX% in the direction of the arrow.
- 2) Maximum calculated pile loads: XX kips (including XX kips allowed for negative skin friction).
- 3) Estimate of piles required:

Abutment Number 1:	XX~HP XX x XX @ XX feet
Abutment Number 2:	XX~HP XX x XX @ XX feet
Pier Number 1:	XX~HP XX x XX @ XX feet
Pier Number 2:	XX~HP XX x XX @ XX feet
- 4) HP 13 x XX bearing piles may be substituted for HP 14 x XX (HP 12 x XX) bearing piles at the option of the Contractor.
(The following note is used for integral abutments with steel stringers.)
- 5) Piles shall not be out of position shown by more than 2 inches in any direction.
(The following two notes are used for pile-supported foundations. The Geotechnical Designer will make a recommendation for their use or exclusion. The Structural Designer should

Draw:

- 1) Limits of concrete
- 2) Piles
- 3) Vertical Joints (do not show shear key)
- 4) Centerline of Bearing
- 5) Centerline of Construction / Working Line
- 6) Centerline of Piles (if different than CL Bearing)
- 7) Reinforcing steel
- 8) Limits of Seal

Dimension:

- 1) Limits of concrete. Each point should be located from the working point in two directions: parallel and perpendicular to the centerline of bearing.
- 2) Footing Width(s)
- 3) Wing footing length
- 4) Joint locations
- 5) Pile locations
- 6) Angle of wing footing turn
- 7) Skew angle of CL Bearing to Working Line/CL Construction
- 8) Location of Seal relative to limits of footing

Label:

- 1) North
- 2) Flow
- 3) All Centerlines (Bearing, Construction, Working Lines)
- 4) Detail Name "Footing Plan"
- 5) Station of Working Point (intersection of CL Bearing and CL Construction)
- 6) Reinforcing steel
- 7) Joints
- 8) Detail/Section Cuts
- 9) Pile Batter Direction

5) Earthwork limits (only if it can't be shown on abutment section)

Label:

- 1) CL Bearing
- 2) Detail Name
- 3) Non-standard Chamfer sizes
- 4) Ledge should be labeled "Approximate Ledge"
- 5) Rise/Run of all slopes (battered faces of concrete, piles, limits of backfill, etc.)
- 6) Reinforcing Steel
- 7) Weepers
- 8) Piles (generic label, i.e. "H Pile", w/o specific designation)
- 9) Any horizontal construction joint w/o a shear key needs to be roughened. Point to the surface and label "Roughen surface 1/4" profile min."
- 10) Backfill material, if shown (French Drain, borrow, etc.)
- 11) Pay Limits, if shown (Structural earth excavation, Granular borrow, Gravel borrow, etc.)

3.2.7.3 Abutment Plan

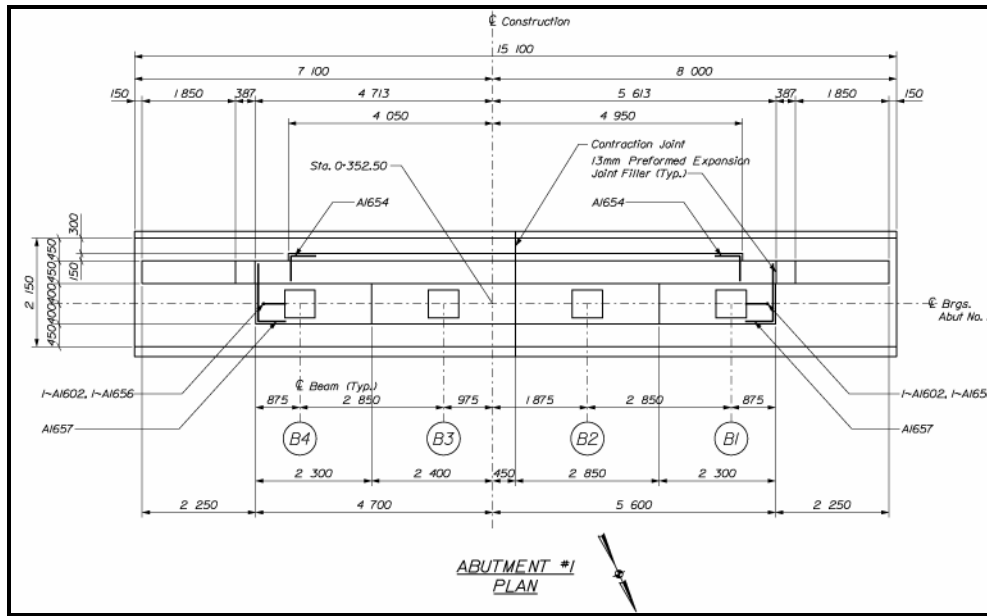


Figure 3-17 Abutment Plan

Intro: Top view of abutment, showing the relationship to the working lines. Plans should include breastwall and wings unless there isn't room.

Sheet-up: Belongs in the upper left of abutment sheet, directly above Abutment Elevation, with centerlines aligned.

Scale: 1/4". Smaller scales are acceptable for large abutments.

Draw:

- 1) Limits of concrete (breastwall, wings, footing, approach slab seat)
- 2) Outline of steel girder bearings
- 3) Parapets
- 4) Vertical Joints (do not show shear key)
- 5) Do not show hidden lines for shear keys in horizontal joints
- 6) Centerline Bearing of Abutment
- 7) Centerline of Construction / Working Line
- 8) Centerline of girders
- 9) Any steps in top of breastwall bearing seats
- 10) May draw reinforcing steel that can't be shown in elevation and section (i.e. horizontal Ls at end of approach slab seat and/or breastwall). Otherwise, no reinforcing steel is shown in this plan.

Dimension:

- 1) Limits of concrete. Each point should be located from the working point in two directions: parallel and perpendicular to the centerline of bearing. Include wings, breastwall, approach slab seat, parapets, etc.
- 2) Wing length
- 3) Any steps in top of breastwall bearing seats.
- 4) Joint locations
- 5) Pile locations
- 6) Bearing locations
- 7) Angle of wing turn
- 8) Skew angle of CL Bearing to Working Line/CL Construction

Note that typically the abutment and wing wall is best shown in section rather than on the plan view.

Label:

- 1) North
- 2) Flow
- 3) All Centerlines (Bearing, Construction, Working Lines, Girders)
- 4) Detail Name "Plan"
- 5) Station of Working Point (create a 1/4 inch circle around the intersection of CL Bearing and CL Construction and pull a leader off labeling the station)
- 6) Label any reinforcing steel shown in plan.
- 7) Joints

- 8) Prefomed expansion joint filler
- 9) Approach Slab Seat
- 10) Detail/Section Cuts

3.2.7.4 Abutment Elevation

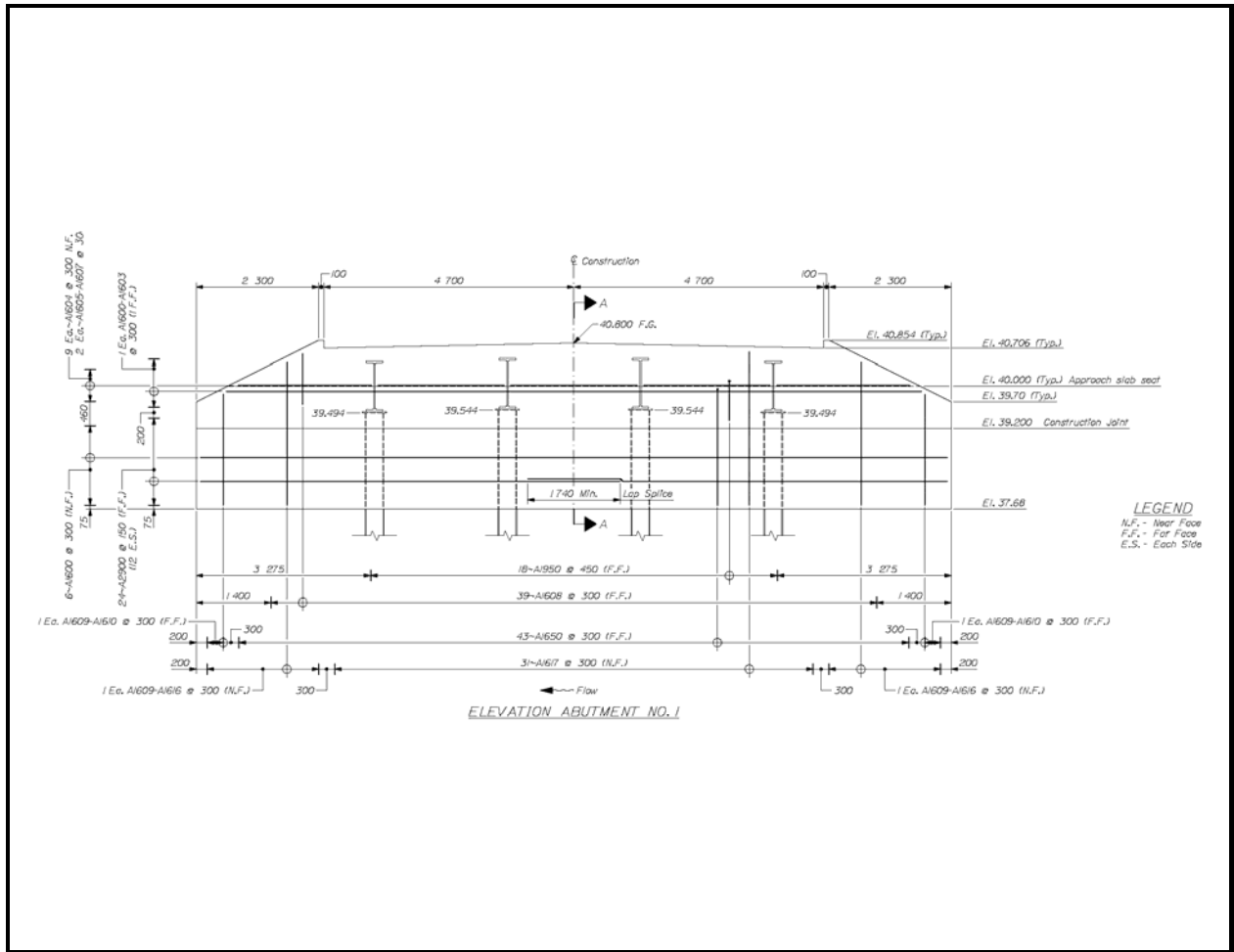


Figure 3-18 Abutment Elevation

Intro: Front view projection of abutment. Abutment No. 1 always shown looking down station, Abutment No. 2 shown looking up station. This detail is primarily for showing reinforcing and elevations.

Sheet-up: Belongs on left bottom of abutment sheet, directly below the plan with centerline/working points aligned.

Scale: should always be the same scale as the abutment plan, typically 1/4"

Draw:

- 1) Limits of concrete (breastwall, wings, footing, seal, backwall, bearings, parapets, approach slab seat)

- 2) Piles (for integral abutments, but not for pile-supported footings)
- 3) Concrete turn points.
- 4) Ledge line
- 5) Vertical and Horizontal Joints
- 6) Hidden lines for far face concrete limits
- 7) Centerline of Construction/Working Line
- 8) Reinforcing steel
- 9) Utility openings

Dimension

- 1) Utility openings are generally dimensioned to the Centerline/Working Line
- 2) Location of vertical reinforcing steel relative to nearest concrete limit.
- 3) Projection/Embedment lengths of reinforcing dowels (only if unable to clearly show in section)
- 4) Lap/Splice lengths of reinforcing tied to dowels (only if unable to clearly show in section)

Label

- 1) Elevations for top of seal, top of footing, end of wing, top of parapet, bridge seats, top of backwall (label NF and FF), utility openings, horizontal construction joints, top of approach slab seat.
- 2) Reinforcing Steel
- 3) Section and Detail Cuts
- 4) Detail Name "Elevation"
- 5) Joints (Horizontal and Vertical, Construction, Contraction, Expansion)
- 6) CL of Construction at CL of Bearings

3.2.7.5 Abutment Sections (Breastwall, Wing)

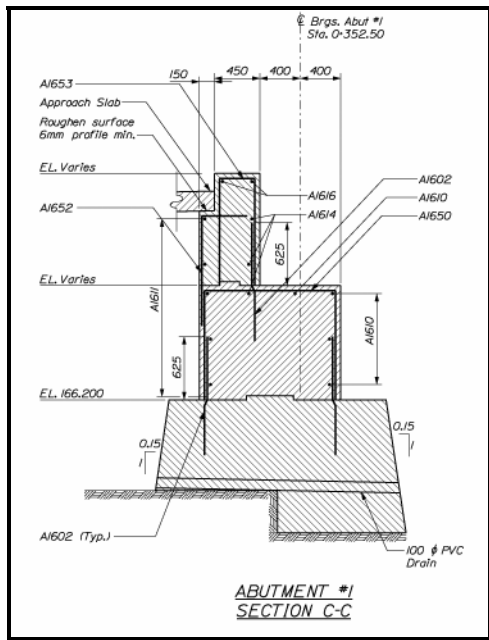


Figure 3-19 Abutment Section

Intro: Sections must be cut on the abutment plan and elevation. They are used to show abutment thickness, reinforcing steel, and to clarify concrete and earthwork limits.

- ♪ Sections should always be cut from the right side of the project looking left, such that the left of the section is downstation, the right is upstation.

Sheet-up: Breastwall section belongs on the same sheet as the abutment plan and elevation. Wing sections go either with the breastwall section or on a separate wing sheet, depending on room.

Scale: 1/2"

Draw:

- 1) Concrete limits (new placements of concrete should be hatched at 45 or 135 degrees, with adjacent separate placements hatched alternately)
- 2) Centerline of Bearing
- 3) In some cases you'll show the superstructure in the vicinity of the abutment (i.e. integral abutments)
- 4) Membrane waterproofing (for integral abutments)
- 5) Horizontal construction joints (show shear keys)
- 6) Piles
- 7) Ledge line
- 8) Reinforcing Steel

- 9) Approach Slab
- 10) French Drains
- 11) Weepers
- 12) Backfill limits (pattern backfill areas)
- 13) Riprap (pattern limits)
- 14) In the case of return wings, you may need to show bridge rail or guard rail mounted on the wings.

Dimension:

- 1) Thickness of the abutment, referenced to the CL Bearing
- 2) Reinforcing dowel embedments/projections and lap splices
- 3) Membrane Waterproofing limits
- 4) Non-typical reinforcing cover (i.e. at bottom of footing)
- 5) Pile Embedment into footing/breastwall
- 6) Earthwork limits
- 7) Riprap thickness
- 8) Width of shelf in front of abutment
- 9) Vertical clearance from superstructure to shelf (integral abutments only)

Label:

- 1) CL Bearing
- 2) Detail Name
- 3) Shelf elevation
- 4) Approach Slab
- 5) Membrane Waterproofing
- 6) Non-standard Chamfer sizes
- 7) Ledge should be labeled "Approximate Ledge"
- 8) Rise/Run of all slopes (battered faces of concrete, piles, finished grade of riprap, limits of backfill, etc.)
- 9) Reinforcing Steel
- 10) Weepers
- 11) Piles (generic label, i.e. "H Pile", w/o specific designation)
- 12) Approach slab seat (and any horizontal construction joint w/o a shear key) needs to be roughened. Point to the surface and label "Roughen surface 1/4" profile min."
- 13) Backfill material (French Drain, borrow, etc.)
- 14) Pay Limits (Structural earth excavation, Granular borrow, Gravel borrow, etc.)

15) Pay Limits of Superstructure concrete (integral abutments only)

3.2.7.6 Wing Plan

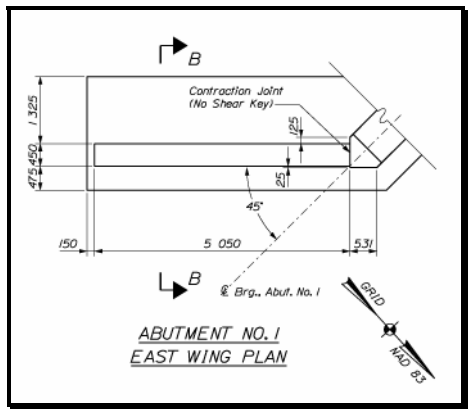


Figure 3-20 Abutment Wing Plan

Intro: If an abutment has wings of a length that makes it difficult to show on the abutment plan, a separate wing plan can be drawn. Refer to the Abutment Plan requirements, above, for what information needs to be drawn, dimensioned and labeled.

Sheet-up: typically, wing plans will not fit on the same sheet as the abutment plan and elevation, and will require the creation of a wing sheet.

Scale: 1/4"

3.2.7.7 Wing Elevation

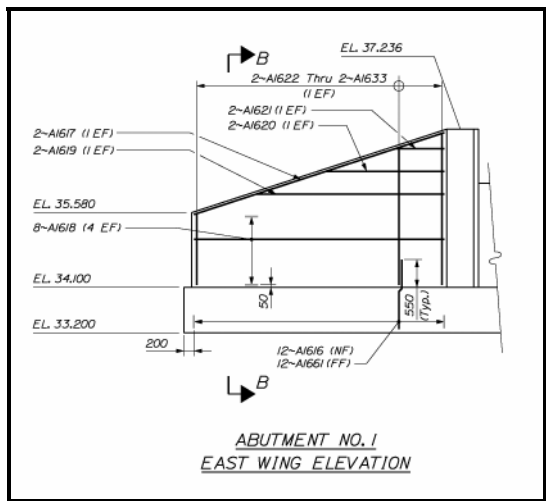


Figure 3-21 Abutment Wing Elevation

Intro: Any flared or return wing will require a wing elevation to be shown. Refer to the Abutment Elevation requirements, above, for what information needs to be drawn, dimensioned and labeled.

Sheet-up: typically, wing elevations will not fit on the same sheet as the abutment plan and elevation, and will require the creation of a wing sheet.

- ♪ It isn't always necessary to show a wing plan when you show a wing elevation. If the full geometry of the wing can be shown in the abutment plan, do not duplicate that information on the wing sheet.

Scale: 1/4"

3.2.7.8 Wing Joint Detail

Intro: Whenever a horizontal construction joint intercepts the top of a sloping wing, the joint must be turned perpendicular to the sloping surface of the wing to prevent a feathered edge. Because a horizontal construction joint requires a shear key, it is also necessary to add this joint to prevent that shear key from intersecting the sloping top surface of the wing.

Sheet-up: This detail should be shown on a sheet where wing sections and elevations are being shown.

Scale: try 1" or 1 1/2"

Draw:

- 1) Construction Joint
- 2) Sloping Surface of Wing
- 3) Any other line work (hidden lines for shear key)

Dimension:

- 1) How far below the surface the construction joint turns (Depends on slope of the wing, start at 3")
- 2) Angle of incidence of joint to wing (90 degrees)

Label:

- 1) Construction Joint
- 2) Detail Name

3.2.7.9 Pile Cap Plate Detail

Intro: On integral abutments, it is necessary to detail the connection between steel stringers and steel piles.

Sheet-up: This detail should be shown on a sheet that contains the breastwall section.

Scale: Start with 3/4" or 1"

Draw:

- 1) Pile
- 2) Stringer
- 3) Cap Plate

Dimension:

- 1) Relationship of plate to CL of Pile

Label:

- 1) Cap Plate to Pile Weld
- 2) Cap Plate to Girder Weld
- 3) Size of plate

3.3 Piers

3.3.1 Introduction

3.3.1.1 Foundation Types

A. Cofferdam and Seal

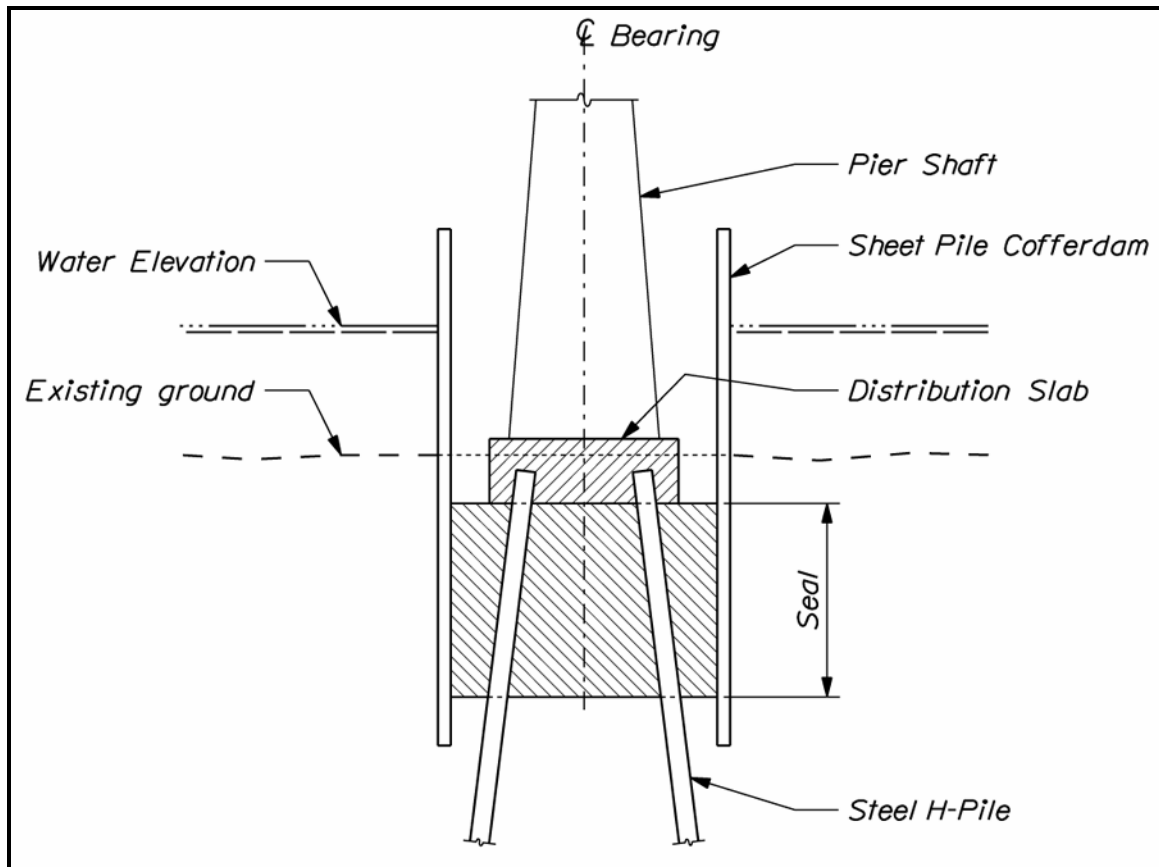


Figure 3-22 Cofferdam and Seal Foundation

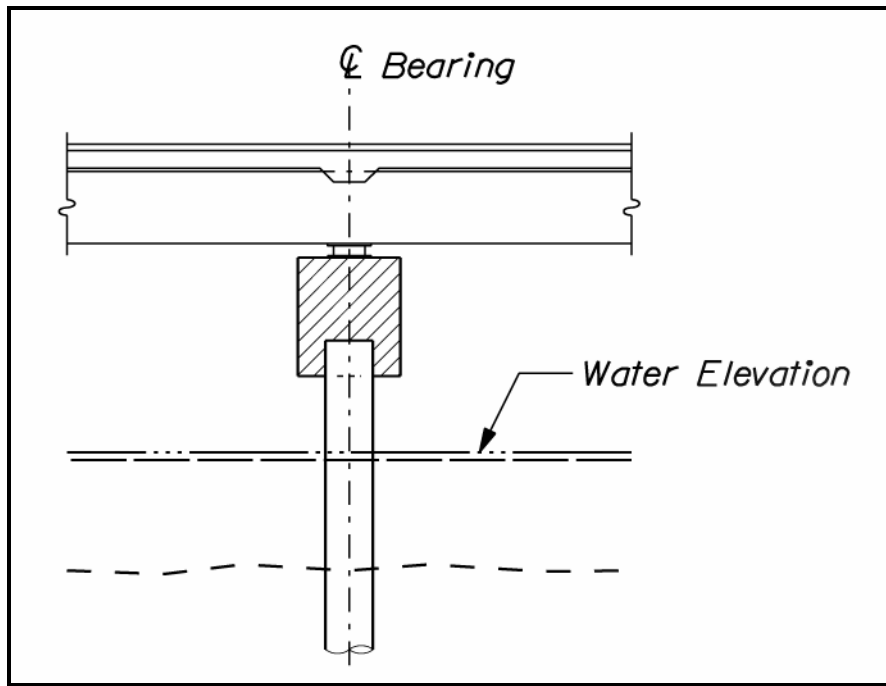
B. Pile Bent

Figure 3-23 Pile Bent Foundation

3.3.2 Prerequisites**3.3.2.1 To Get Started (30% Pier Plans)**

The 30% Pier plans show limits of concrete and pile locations. The purpose of this step is to communicate the geometric design intent to the checker. These plans show only limits of concrete and enough annotation to communicate these limits (i.e. dimensions, elevations.)

❶ It is important to not begin detailing reinforcing steel until the 30% Pier plans and superstructure have been checked by the designer/checker.

To draw the piers up to this level of completion, the detailer requires the following information:

- 1) CL Bearing Pier Station
- 2) Skew Angle
- 3) Bearing Elevations / Heights (including the preformed leveling pad typically placed under the sole plate of the bearing)
- 4) Joint Locations (Construction & Contraction)
- 5) Nose Geometry
- 6) Approximate Ledge Elevations
- 7) For Mass Pier

- a) Top of Seal Elevation
 - b) Ledge Elevations
 - c) Distribution Slab Thickness, Length and Width
 - d) Top of Shaft length & width
 - e) Shaft batters
- 8) For Pile Bent Piers
- a) Pile Cap Length, Width
 - b) Bottom of Cap Elevation
 - c) Pile Locations
 - d) Pile Batter
 - e) Pile Embedment
- 9) For Column-Type Piers
- a) Pier Cap Length & Width
 - b) Bottom of Cap Elevation
 - c) Column Locations and dimensions
 - d) Footing length and width
 - e) Top and Bottom of Footing Elevations
 - f) Footing Pile Layout

3.3.2.2 To Finish Up (100% Pier Plans)

The following items are required to finish detailing a pier:

- 1) Checked 30% pier and superstructure plans.
- 2) Completed and checked reinforcing scheme (designer will communicate reinforcing scheme to detailer via sketches)
- 3) Pier and pile notes

3.3.3 Detailing

Pier details are primarily CIP Concrete details. The Contractor is the main client to keep in mind when detailing piers.

Solid piers (mass piers) on dry land are supported by footings. These footings may or may not be pile-supported.

Solid piers in the water are supported by distribution slabs on seals.

3.3.4 Typical Sheet Names and Contents

3.3.4.1 Pier or Pier No. X

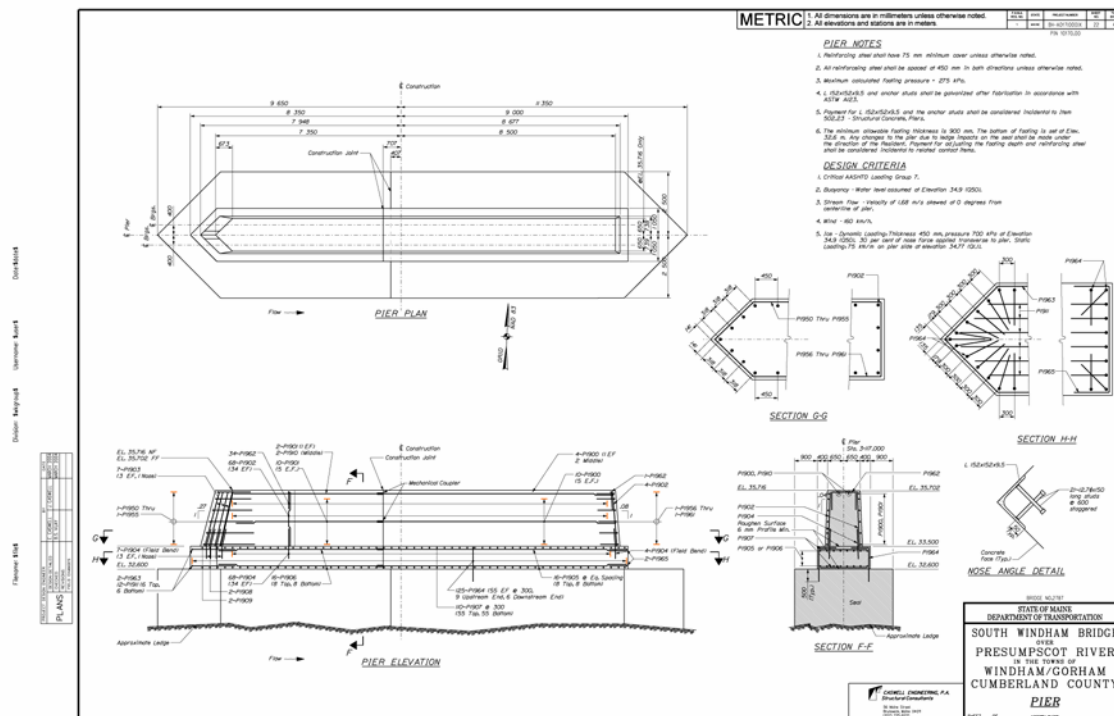


Figure 3-24 Pier Sheet

Will Contain:

- 1) Pier Plan
- 2) Pier Elevation
- 3) Pier Section

May Contain:

- 1) Pier Notes
- 2) Pile Notes
- 3) Other Sections

3.3.4.2 Pier Details

Use only if special details are required, i.e. cathodic protection, rock anchoring, etc.

3.3.5 Standard Notes

3.3.5.1 Pier Notes

- 1) Reinforcing steel shall have a minimum concrete cover of 3 inches unless otherwise noted.

- 2) Maximum calculated footing pressure is XX ton per square foot.

3.3.5.2 Design Criteria

- 1) Critical AASHTO Loading: Group XX.
- 2) Buoyancy: Water level assumed at Elevation XX.
- 3) Stream flow: Velocity of XX ft/sec skewed at XX o to longitudinal centerline of pier.
- 4) Wind: XX mph or XX psf.
- 5) Ice: Thickness XX inches, pressure 100 psi at Elevation XX, 30% of nose force applied transverse to pier.

3.3.5.3 Seal Cofferdam Notes

- 1) The seal concrete placement dimensions shown represent the minimum seal size necessary to meet design requirements and are not based on the use of any particular sheet pile section.
- 2) The horizontal pay limit for seal concrete will be to the dimensions shown on the plans. No additional payment will be made for concrete placed outside of these limits.
- 3) When sheet piling is used for seal cofferdams, appropriate rolled corners shall be used, and the inside face of the sheet piling shall be at or outside of the seal concrete dimensions shown.
- 4) The depth of the seal is set for a water elevation of XX. If the water elevation at the time of construction is higher, the depth of the seal shall be adjusted.

(Note for use with seals without piles)

- 5) The Resident shall approve the method of placing dowels in the seal concrete.

3.3.5.4 Piles

- 1) Piles marked thus H →, shall be battered XX% in the direction of the arrow.
- 2) Maximum calculated pile loads: XX kips (including XX kips allowed for negative skin friction).
- 3) Estimate of piles required:

Abutment Number 1:	XX-HP XX x XX @ XX ft
Abutment Number 2:	XX-HP XX x XX @ XX ft
Pier Number 1:	XX-HP XX x XX @ XX ft
Pier Number 2:	XX-HP XX x XX @ XX ft
- 4) HP 13 x XX bearing piles may be substituted for HP 14 x XX (HP 12 x XX) bearing piles at the option of the Contractor.

(The following note is used for integral abutments with steel stringers.)

Sheet up: Belongs in the upper left of the pier sheet, directly above the Pier Elevation, with the centerlines aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete pier cap
- 2) Centerline of Construction/Working Line
- 3) Centerline of girders
- 4) Centerline of Pier
- 5) Centerline(s) of Bearing (if other than CL Pier)
- 6) Outline of steel girder bearings (May be skewed to CL Bearings)
- 7) Piles (hidden lines)
- 8) Any steps in top of pier (for different bridge seat elevations)
- 9) Construction joints (if required for stage construction)
- 10) May draw reinforcing steel that can't be shown in elevation and section (i.e. horizontal nose reinforcing bars.) Otherwise, no reinforcing steel is shown in this plan.

Dimension:

- 1) Overall length and width of pier
- 2) Limits of concrete. Each point/edge should be located from the working point in two directions: parallel and perpendicular to the CL of Pier
- 3) CL of girder bearings (dimensioned parallel to the CL of Bearings Pier)
- 4) Bearing steps in top of pier
- 5) Skew Angle between CL Pier and line normal to CL Construction/Working Line
- 6) Construction joints

Label:

- 1) Station at intersection of CL Construction/Working Line and CL Pier
- 2) Detail Name
- 3) CL Construction
- 4) CL Pier
- 5) CL Brgs. Pier
- 6) Flow Arrow
- 7) North Arrow
- 8) Reinforcing bars
- 9) Pile batter symbol

10) Construction Joints

3.3.6.2 Pile Bent Pier Elevation

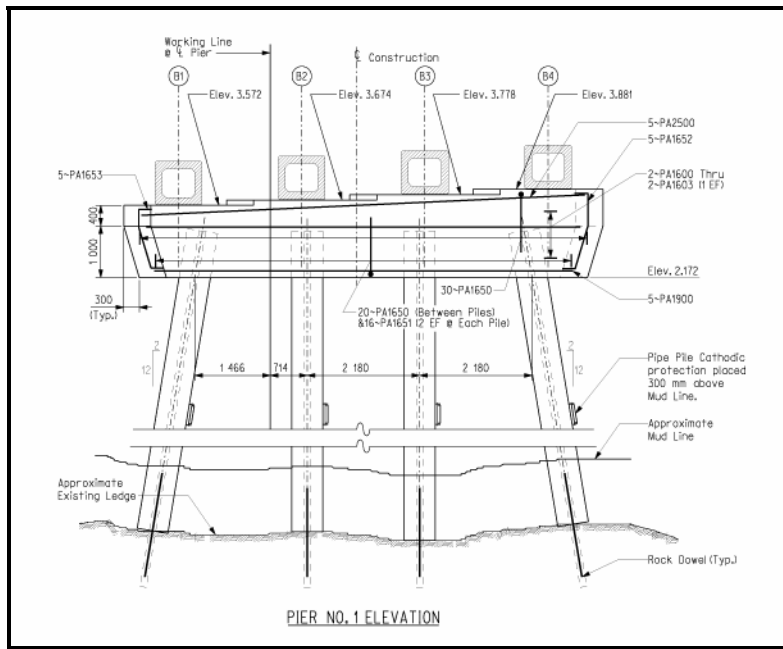


Figure 3-26 Pile Bent Pier Elevation

Intro: Front view of pier, showing the relationship between the bridge seat, pier cap and piles. View is normal to CL Pier.

Sheet up: Belongs directly below the Pier Plan, with the centerlines aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete pier cap
- 2) Centerline of Construction/Working Line
- 3) Girders (and bearings for steel girders)
- 4) Piles
- 5) Pile embedment into pier cap (hidden lines)
- 6) Bridge seat(s)
- 7) Construction joints (if required for stage construction)
- 8) Pier cap reinforcing steel

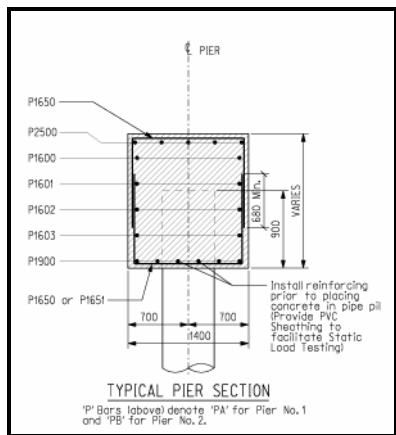
Dimension:

- 1) Sloping top surface of pier nose
- 2) Chamfer on underside of pier nose

- 3) CL of girders
- 4) CL Piles (if you can't show it on the plan)

Label:

- 1) Detail Name
- 2) CL Construction/Working Line
- 3) Bridge seat elevations
- 4) Pile size
- 5) Pile batter
- 6) Reinforcing bars
- 7) Approximate river streambed surface
- 8) Approximate existing ledge location
- 9) Cathodic Protection if required

3.3.6.3 Pile Bent Pier Typical Section**Figure 3-27 Pile Bent Pier Typical Section****Intro:** Cross section through pier.**Sheet up:** Belongs to the right of the pier plan**Scale:** 1/2" or 3/8" (Typically 2x the plan/elevation scale.)**Draw:**

- 1) Limits of concrete
- 2) Chamfer on underside of pier cap.
- 3) Centerline of Pier
- 4) Centerline of Bearings (if other than CL Pier)
- 5) Piles

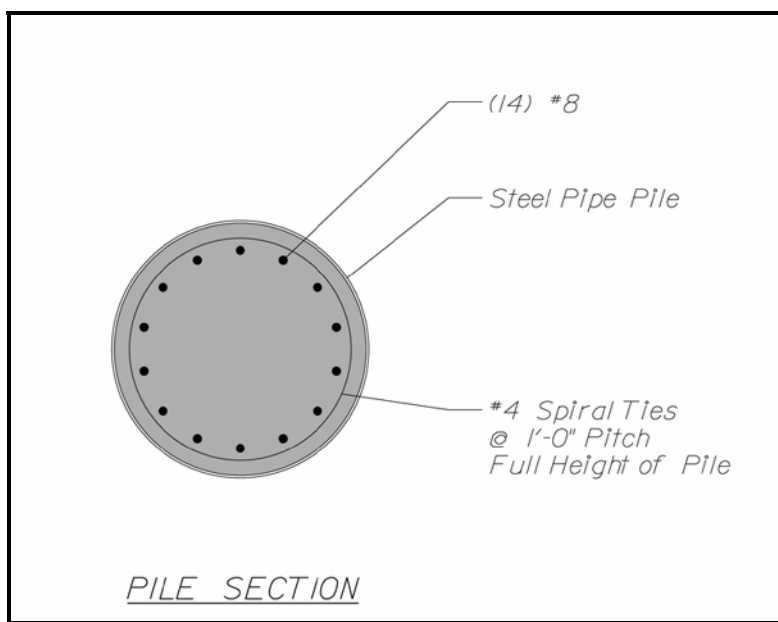
- 6) Pile embedment into pier cap (hidden lines)
- 7) Reinforcing bars

Dimension:

- 1) Pile embedment into pier cap
- 2) Chamfers
- 3) Width of pier cap (only if not shown in plan)

Label:

- 1) Detail Name
- 2) Reinforcing bars
- 3) Centerline of Pier
- 4) Centerline(s) of bearing

3.3.6.4 Pile Bent Pier Typical Pile Section**Figure 3-28 Pile Bent Pier Typical Pile Section****Intro:** Cross section through concrete-filled pipe pile.**Sheet up:** Belongs below pier section or pier elevation**Scale:** 1". Larger scale is acceptable if there is room.**Draw:**

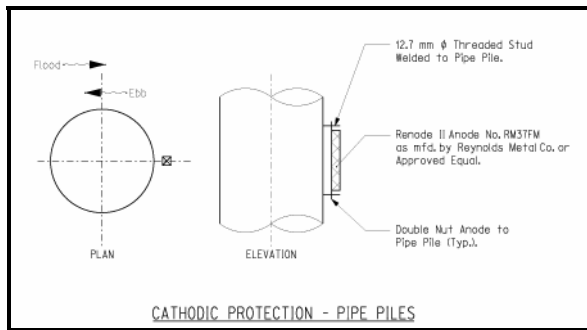
- 1) Steel pipe pile
- 2) Hatch concrete fill inside pipe pile
- 3) Spiral tie reinforcing

- 4) Vertical reinforcing bars

Label:

- 1) Detail Name “PILE SECTION”
- 2) Steel pipe pile
- 3) Size and pitch of spiral tie reinforcing
- 4) Number and size of vertical reinforcing bars

3.3.6.5 Pile Bent Pier Cathodic Protection – Pipe Piles

**Figure 3-29 Pile Bent Pier Cathodic Protection – Pipe Piles**

Intro: Plan and elevation views of anode attached to steel pipe piles for cathodic protection.

Sheet up: Belongs to the right of the pile section

Scale: 3/4”

Draw:

- 1) Plan View
 - a) Pipe pile
 - b) Anode
 - c) Orthogonal centerlines of pipe pile.
- 2) Elevation View
 - a) Pipe pile (with cut lines)
 - b) Anode
 - c) Threaded stud connection of anode to pipe pile.

Label:

- 1) Detail Name (“CATHODIC PROTECTION – PIPE PILES”)
- 2) Flow arrow (Plan View)
- 3) Elevation View
 - a) Anode elevation

- b) Anode type/description/payment
- c) Threaded stud welded to pipe pile
- d) Double nut anode to threaded stud

3.3.6.6 Column Bent Pier Plan

Intro: Top view of pier, showing the relationship to the working lines.

Sheet up: Belongs in the upper left of the pier sheet, directly above the Pier Elevation, with the centerlines aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete pier cap
- 2) Centerline of Construction/Working Line
- 3) Centerline of girders
- 4) Centerline of Pier
- 5) Centerline(s) of Bearings (if other than CL Pier)
- 6) Outline of steel girder bearings (May be skewed to CL Bearings Pier)
- 7) Concrete Columns (hidden lines)
- 8) Any steps in top of pier (for different bridge seat elevations)
- 9) Construction joints (if required for stage construction)
- 10) May draw reinforcing steel that can't be shown in elevation and section (i.e. horizontal nose reinforcing bars.) Otherwise, no reinforcing steel is shown in this plan.

Dimension:

- 1) Limits of concrete. Each point/edge should be located from the working point in two directions: parallel and perpendicular to the CL of Pier
- 2) Overall length and width of pier
- 3) CL of girder bearings (dimensioned parallel to the CL of Bearings Pier)
- 4) Bearing steps in top of pier
- 5) Skew Angle between CL Pier and line normal to CL Construction/Working Line
- 6) Construction joints

Label:

- 1) Detail Name
- 2) CL Construction
- 3) CL Pier

- 4) CL Brgs. Pier
- 5) CL Girders
- 6) Station at intersection of CL Construction/Working Line and CL Pier
- 7) Reinforcing Steel
- 8) North
- 9) Construction joints

3.3.6.7 Column Bent Pier Elevation

Intro: Front view of pier, showing the relationship between the bridge seat(s), pier cap, columns and footings. View is normal to CL Pier.

Sheet up: Belongs directly below the Pier Plan, with the centerlines aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete pier cap
- 2) Centerline of Construction/Working Line
- 3) Bridge seat(s)
- 4) Girders (and bearings for steel girders)
- 5) Columns (consider using cutlines for tall columns)
- 6) Column footings
- 7) Construction joints (if required for stage construction)
- 8) Pier cap, column and footing reinforcing bars

Dimension:

- 1) Sloping top surface of pier nose (if required)
- 2) CL of Columns (only if you can't show it on the plan)

Label:

- 1) Detail Name
- 2) CL Construction
- 3) Bridge seat(s) and top of footing elevations
- 4) Column size
- 5) Reinforcing bars
- 6) Approximate finish grade

3.3.6.8 Column Bent Pier Typical Section

Intro: Cross section through pier cap, column and footing. If the footings are pile supported, show the piles in this section.

Sheet up: Belongs to the right of the pier elevation

Scale: 1/2" or 3/8" (Typically 2x the plan/elevation scale. Use cutlines through columns to show both cap and footing)

Draw:

- 1) Limits of pier cap, column and footing
- 2) Centerline of Pier
- 3) Centerline(s) of Bearings (if other than CL Pier)
- 4) Piles, if required
- 5) Pile embedment into footing (hidden lines)
- 6) Pier cap, column and footing reinforcing bars

Dimension:

- 1) Pile embedment into footing
- 2) Width of Cap, tied to CL Pier (only if not shown in plan)
- 3) Width of Footing, tied to CL Pier (only if not shown in plan)
- 4) Chamfers
- 5) Reinforcing Lap Splice / Embedment Lengths

Label:

- 1) Detail Name
- 2) CL Pier
- 3) CL Brgs. Pier
- 4) Reinforcing bars
- 5) Pile size, if required
- 6) Pile batter, if required

3.3.6.9 Column Bent Pier Column Section

Intro: Cross section through concrete column.

Sheet up: Belongs to the right of the pier plan and above pier section

Scale: 1". Larger scale is acceptable if there is room.

Draw:

- 1) Limits of concrete column
- 2) Hatch concrete

- 3) Spiral tie reinforcing
- 4) Vertical reinforcing bars

Label:

- 1) Detail Name (“COLUMN SECTION”)
- 2) Concrete column
- 3) Size and pitch of spiral tie reinforcing
- 4) Number and size of vertical reinforcing bars

3.3.6.10 Column Bent Pier Footing Plan

Intro: Top view of column footings, showing the relationship to the working lines. If the footings are pile supported, show the pile layout in this plan.

Sheet up: If the footing plan does not fit on pier sheet under the pier elevation, add a Pier Footing Sheet and show the plan in the upper left of the sheet.

Scale: 3/16”. Larger scale is acceptable if there is room.

Draw:

- 1) Limits of concrete footings
- 2) Centerline of Construction/Working Line
- 3) Centerline of Pier
- 4) Centerline of Columns
- 5) Footing reinforcing bars
- 6) Piles, if required
- 7) Centerlines of piles, if required

Dimension:

- 1) Limits of concrete footings. Each point/edge should be located from the working point in two directions: parallel and perpendicular to the CL of Pier
- 2) CL of piles or indicate pile spacing
- 3) Skew Angle between CL Pier and line normal to CL Construction/Working Line
- 4) Reinforcing Steel (location and laps)

Label:

- 1) Detail Name
- 2) CL Construction/Working Line
- 3) CL Pier
- 4) CL Columns
- 5) CL Piles

- 7) Any steps in top of pier (for different bridge seat elevations)
- 8) Construction joints (if required for stage construction)
- 9) Nose Angle (steel protection for shaft nose)

Dimension:

- 1) Limits of concrete. Each point/edge should be located from the working point in two directions: parallel and perpendicular to the CL of Pier
- 2) Overall width of footing and top and bottom of pier shaft
- 3) CL of girder bearings (dimensioned parallel to the CL of Bearings Pier)
- 4) Bearing steps in top of pier
- 5) Skew Angle between CL Pier and line normal to CL Construction/Working Line
- 6) Construction joints

Label:

- 1) Detail Name
- 2) CL Construction / Working Line
- 3) CL Pier
- 4) CL Brgs. Pier
- 5) Station at intersection of CL Construction/Working Line and CL Pier
- 6) Flow Arrow
- 7) North Arrow
- 8) Construction joints

3.3.6.12 Solid Pier Elevation

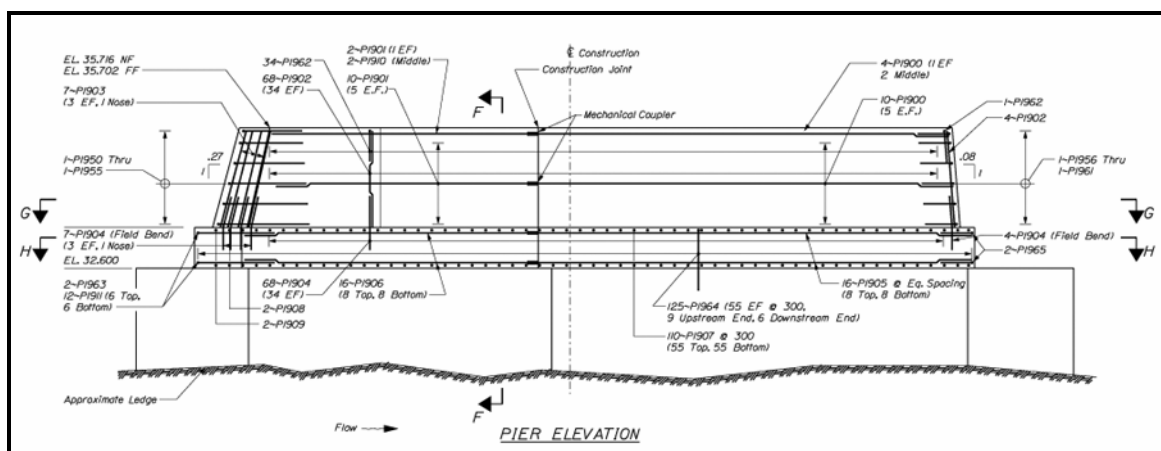


Figure 3-31 Solid Pier Elevation

Intro: Front view of pier, showing the relationship between the bridge seat(s), shaft and footing
View is normal to CL Pier.

Sheet up: Belongs directly below the Pier Plan, with the centerlines aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete pier shaft and footing
- 2) Centerline of Construction/Working Line
- 3) Bridge seat(s)
- 4) Construction joints (if required for stage construction)
- 5) Reinforcing steel (if footing is supported on piles, omit footing bars here and show on Footing and Pile Layout Plan)

Dimension:

- 1) Sloping top surface of pier nose (if required)
- 2) Reinforcing laps/embedments

Label:

- 1) Bridge seat(s) and top of footing elevations
- 2) Pier Batter
- 3) Reinforcing bars
- 4) Approximate existing ledge location

3.3.6.13 Solid Pier Typical Section

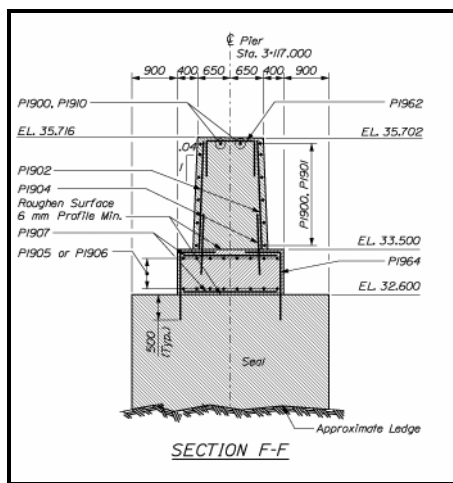


Figure 3-32 Solid Pier Section

Intro: Cross section through pier shaft and footing.

Sheet up: Belongs to the right of the Pier Elevation with bridge seat(s) aligned.

Scale: Same as Pier Elevation, typically 1/4" or 3/8"

Draw:

- 1) Limits of concrete
- 2) Centerline of Pier
- 3) Centerline(s) of Bearings (if other than CL Pier)
- 4) Piles, if required
- 5) Pile embedment into footing (hidden lines)
- 6) Reinforcing bars.

Dimension:

- 1) Width of shaft and footing from CL Pier
- 2) Pile embedment into footing

Label:

- 1) Detail Name
- 2) Reinforcing bars
- 3) Pier shaft batter
- 4) Pile size, if required
- 5) Pile batter, if required

3.3.6.14 Solid Pier Footing and Pile Layout Plan

Intro: Top view of footing and piles, showing the relationship to the working lines. This plan is required only when footing is pile supported.

Sheet up: Belongs in the upper left of the Pier Footing Sheet.

Scale: 1/4" or 3/8". Use same scale as Pier Plan

Draw:

- 1) Limits of concrete footing
- 2) Centerline of Construction/Working Line
- 3) Centerline of Pier
- 4) Piles
- 5) Centerlines of piles
- 6) Construction joints (if required for stage construction)
- 7) Footing reinforcing bars

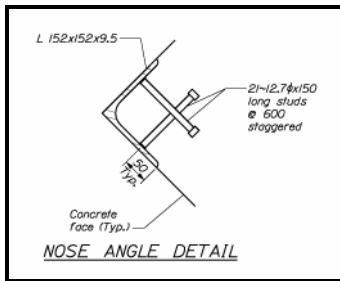
Dimension:

- 1) Limits of concrete. Each point/edge should be located from the working point in two directions: parallel and perpendicular to the CL of Pier
- 2) Overall length and width of footing

- 3) CL of piles or indicate pile spacing
- 4) Skew Angle between CL Pier and line normal to CL Construction/Working Line
- 5) Construction joints

Label:

- 1) Detail Name
- 2) Station at intersection of CL Construction/Working Line and CL Pier
- 3) Pile size
- 4) Reinforcing bars
- 5) North Arrow
- 6) Flow Arrow at water crossings.
- 7) Construction joints
- 8) Pile batter symbol

3.3.6.15 Solid Pier Nose Angle Detail**Figure 3-33 Solid Pier Nose Angle Detail****Intro:** Cross section through structural steel nose angle**Sheet up:** Belongs below to the right of the Pier Section**Scale:** 1½".**Draw:**

- 1) Structural steel angle
- 2) Shear studs
- 3) Face of concrete shaft

Dimension:

- 1) Location of shear studs

Label:

- 1) Detail Name
- 2) Structural steel angle size

- 3) Size, spacing and total number of shear studs
- 4) Face of concrete shaft

3.4 Cast-in-place Concrete Retaining Walls

3.4.1 Introduction

Cast-in-place Concrete Retaining Walls include:

- 1) Cantilever walls
- 2) Gravity walls

3.4.2 Prerequisites

3.4.2.1 To Get Started (30 Retaining Wall Plans%)

The following information should be gathered before you begin detailing:

- 1) Wall length and location
- 2) Wall thickness(es)
- 3) Wall batter (where applicable)
- 4) Footing Toe and Heel width
- 5) Top of wall elevation
- 6) Top and Bottom of Footing Elevations (Sometimes Ledge or Seal Elevations)
- 7) Pile Locations
- 8) Pile Batter
- 9) Joint Locations (Construction & Contraction)
- 10) Backfill requirements
- 11) Potential Utility Impacts
- 12) Potential Railing/Roadway impacts

3.4.2.2 To Finish Up (100% Retaining Wall Plans)

- 1) Checked 30% retaining wall plans
- 2) Completed and checked reinforcing scheme (designer will communicate reinforcing scheme to detailer via sketches)
- 3) Retaining wall and pile notes
- 4) Pay Limit information (structural earth excavation, granular borrow, etc.)

3.4.3 Detailing

CIP Retaining Wall details are primarily CIP Concrete details. The Contractor is the main client to keep in mind when detailing CIP Retaining Walls.

Walls are dimensioned to their control points. Control points are always on the face of the wall at the top of both ends of the wall.

3.4.4 Typical Sheet Names and Contents

3.4.4.1 Retaining Wall

Will Contain:

- 1) Retaining Wall Plan
- 2) Retaining Wall Elevation
- 3) Retaining Wall Section
- 4) Retaining Wall Notes

May Contain:

- 1) Footing and Pile Layout Plan
- 2) Pile Notes
- 3) Plans and Elevations for additional wall or walls

3.4.5 Checklists

3.4.5.1 Retaining Wall Footing and Pile Layout Plan

Intro: Top view of footing and piles. This plan is required only when footing is pile supported.

Sheet up: Belongs in the upper left of the Retaining Wall Sheet.

Scale: 1/4" or 3/8". Use same scale as Retaining Wall Plan

Draw:

- 1) Limits of concrete footing
- 2) Steps in footing
- 3) Face of retaining wall (control line)
- 4) Piles
- 5) Centerlines of piles
- 6) Construction joints (if required for stage construction)
- 7) Footing reinforcing bars

Dimension:

- 1) Limits of concrete (tied to control line)
- 2) Overall length and width of footing
- 3) Steps in footing
- 4) CL of piles or indicate pile spacing

- 5) Construction joints

Label:

- 1) Detail Name
- 2) Station and Offset of Control Points
- 3) Pile size
- 4) Reinforcing bars
- 5) North Arrow
- 6) Construction joints
- 7) Pile batter symbol

3.4.5.2 Retaining Wall Plan

Intro: Top view of retaining wall. Plan should include both wall and footing.

Sheet up: Belongs in the upper left of the retaining wall sheet, directly above the Retaining Wall Elevation, with the control points aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete
- 2) Any steps in top of wall
- 3) Construction joints

Dimension:

- 1) Limits of concrete.
- 2) Overall width of footing and top and bottom of wall
- 3) Steps in wall and/or footing
- 4) Construction joints

Label:

- 1) Detail Name
- 2) Station and Offset of Control Points
- 3) North Arrow
- 4) Construction joints

3.4.5.3 Retaining Wall Elevation

Intro: Front view of wall, showing the relationship between the wall and footing View is normal to face of wall.

Sheet up: Belongs directly below the Retaining Wall Plan, with the control points aligned.

Scale: 1/4" (Check sheet up before proceeding. If plan and elevation won't fit above and below at 1/4", try 3/16" scale.)

Draw:

- 1) Limits of concrete wall and footing
- 2) Construction joints
- 3) Reinforcing steel (if footing is supported on piles, omit footing bars here and show on Footing and Pile Layout Plan)
- 4) Proposed grade (at face of wall)
- 5) Existing grade (at face of wall)
- 6) Approximate Ledge

Dimension:

- 1) Reinforcing laps/embedments

Label:

- 1) Top of wall elevation(s)
- 2) Top of footing elevation(s)
- 3) Reinforcing bars
- 4) Approximate existing ledge
- 5) Approximate finished grade
- 6) Approximate existing grade

3.4.5.4 Retaining Wall Section

Intro: Sections must be cut on the Retaining Wall plan and elevation. They are used to show wall thickness, reinforcing steel, and to clarify concrete and earthwork limits.

- ♪ Sections should always be cut from the right side of the project looking left, such that the left of the section is downstation, or looking upstation, such that project left is on the left.

Sheet-up: Belongs on the Retaining Wall Sheet, to the right of the plan and elevation.

Scale: 1/2"

Draw:

- 1) Concrete limits
- 2) Horizontal construction joints (show shear keys)
- 3) Piles
- 4) Ledge line
- 5) Reinforcing Steel

- 6) French Drains
- 7) Weepers
- 8) Backfill limits (pattern backfill areas)
- 9) Riprap (pattern limits)
- 10) If the retaining walls are close to the road, you may need to show guard rail mounted on the walls.

Dimension:

- 1) Thickness of the wall
- 2) Reinforcing dowel embedments/projections and lap splices
- 3) Non-typical reinforcing cover (i.e. at bottom of footing)
- 4) Pile Embedment into footing/breastwall
- 5) Earthwork limits
- 6) Riprap thickness

Label:

- 1) Detail Name
- 2) Non-standard Chamfer sizes
- 3) Ledge should be labeled "Approximate Ledge"
- 4) Rise/Run of all slopes (battered faces of concrete, piles, finished grade of riprap, limits of backfill, etc.)
- 5) Reinforcing Steel
- 6) Weepers
- 7) Piles (generic label, i.e. "H Pile", w/o specific designation)
- 8) Backfill material (French Drain, borrow, etc.)
- 9) Pay Limits (Structural earth excavation, Granular borrow, Gravel borrow, etc.)

3.5 Pre-Engineered Retaining Walls

3.5.1 Introduction

Pre-Engineered Retaining walls include the following:

- 1) Prefabricated proprietary Walls
 - a. Proprietary Retaining Walls
 - b. Prefabricated Bin Type Retaining Walls
 - c. Modular Block Walls
 - d. MSE Walls
- 2) Anchored Walls
- 3) Gabions

3.5.2 Prerequisites

3.5.2.1 To Get Started

- 1) Exact length and location of the wall
- 2) Elevations of top and bottom of wall

3.5.2.2 To Finish Up

- 1) Wall Notes
- 2) Proposed and Finished grade relationship to face of wall

3.5.3 Detailing

Pre-Engineered Retaining Wall details are primarily performance-based details. The Designer and Fabricator of the wall are the main clients to keep in mind when detailing Pre-Engineered Retaining Walls.

Even though the exact depth of the wall system isn't normally shown to scale, it should be checked for conflicts with utilities or stage construction activities.

Walls are dimensioned to their control points. Control points are always on the face of the wall at the top of both ends of the wall.

3.5.4 Typical Sheet Names and Contents

3.5.4.1 Retaining Wall

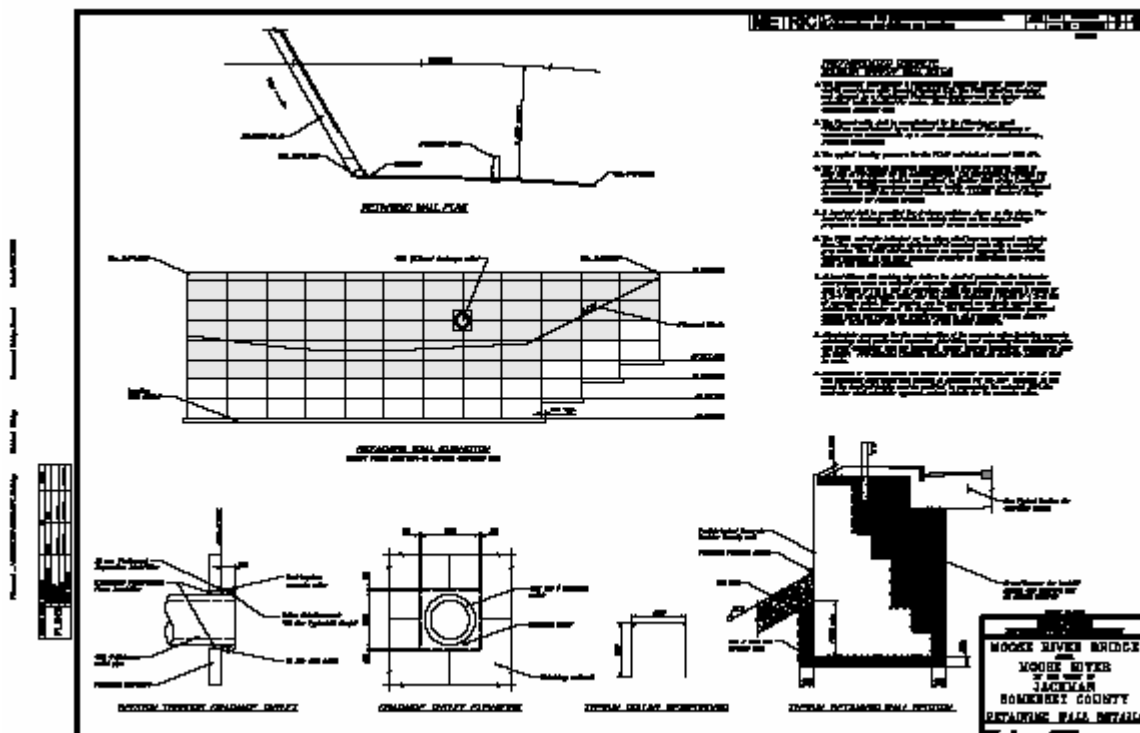


Figure 3-34 Retaining Wall Sheet

Will Contain:

- 1) Wall Plan
- 2) Wall Elevation
- 3) Wall Section
- 4) Wall Notes

May Contain:

- 1) Plans and Elevations for additional wall or walls
- 2) Utility/Other Details

3.5.5 Standard Notes

3.5.5.1 Prefabricated Concrete Modular Gravity Wall Notes

- 1) The Contractor shall provide a Prefabricated Concrete Modular Gravity (PCMGM) wall in accordance with Special Provision 635. The PCMGM shall be designed and stamped by a Registered Professional Engineer and the design shall be submitted to the Resident for review. Plan Details are shown for estimating purposes only.

- 2) The precast units shall be manufactured by the following, or equal: “T-Wall” as manufactured by Superior Concrete Co., Inc. of Auburn, Maine, or DoubleWal as manufactured by a licensed manufacturer of DoubleWal Corp., Plainville, Connecticut.
- 3) The applied bearing pressure for the PCMG wall shall not exceed XX tsf.
(The following note is used when the bridge passes over salt water.)
- 4) The PCMG wall shall consist of LP concrete and epoxy-coated rebar.
(The following note is used when cofferdams are required.)
- 5) Cofferdams for the PCMG wall installation shall be included with Pay Item 511.07 – Cofferdam.

3.5.6 Checklists

3.5.6.1 Wall Plan

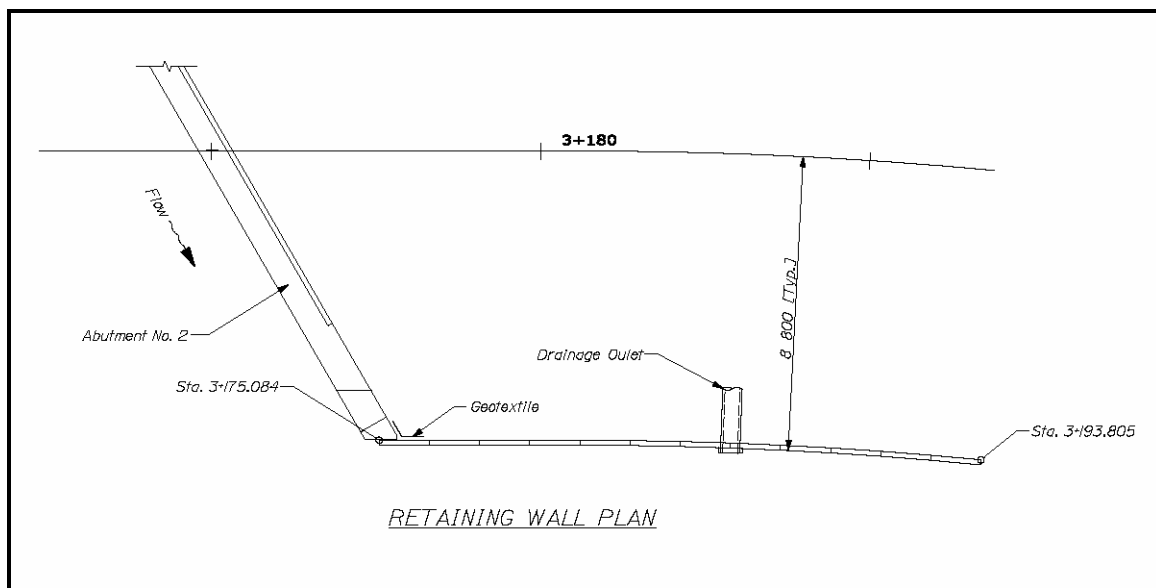


Figure 3-35 Wall Plan

Intro: The wall plan shows the length and location of the retaining wall. All dimensions are given relative to control points, which are located at the top face of the wall.

Sheet up: Belongs on the Retaining Walls sheet, at the top left.

Scale: 1/4"

Draw:

- 1) Wall – the thickness is diagrammatic.

Dimension:

- 1) Wall length

Label:

- 1) Detail Name
- 2) Station and offset of control points.

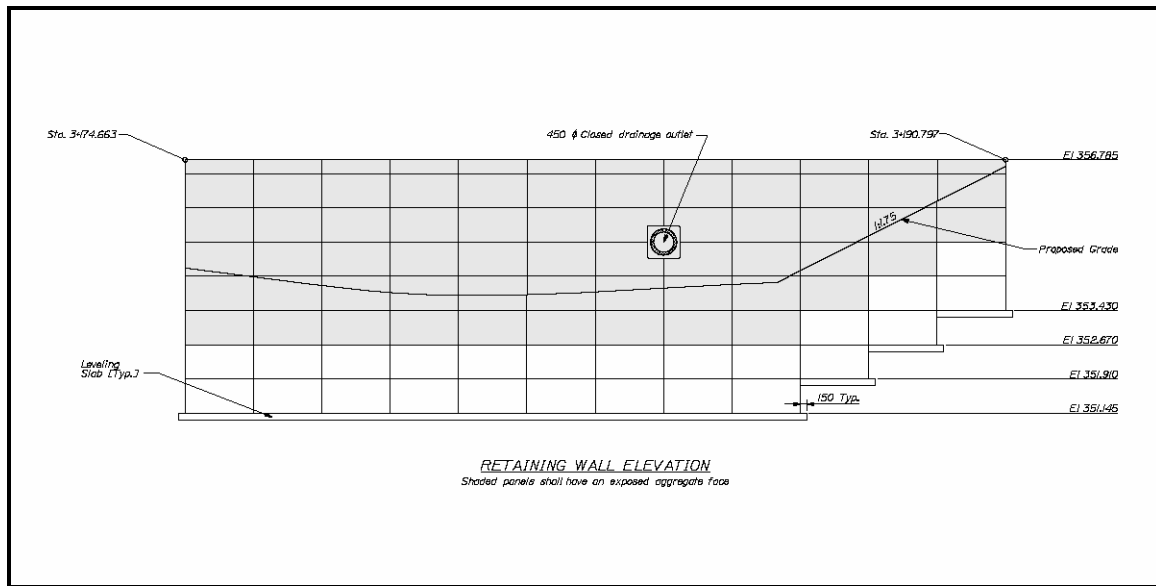


Figure 3-36 Wall Elevation

3.5.6.2 Wall Elevation

Intro: The wall elevation shows the height of the wall, top and bottom elevations, and proposed and existing grade.

Sheet up: Belongs on the Retaining Walls sheet, directly below the plan with control points aligned.

Scale: 1/4" or same as plan.

Draw:

- 1) Top of wall
- 2) Bottom of wall
- 3) Proposed Grade
- 4) Existing Grade

Label:

- 1) Detail name
- 2) Top of wall elevation
- 3) Bottom of wall elevation
- 4) Existing Grade
- 5) Proposed Grade

3.5.6.3 Wall Section

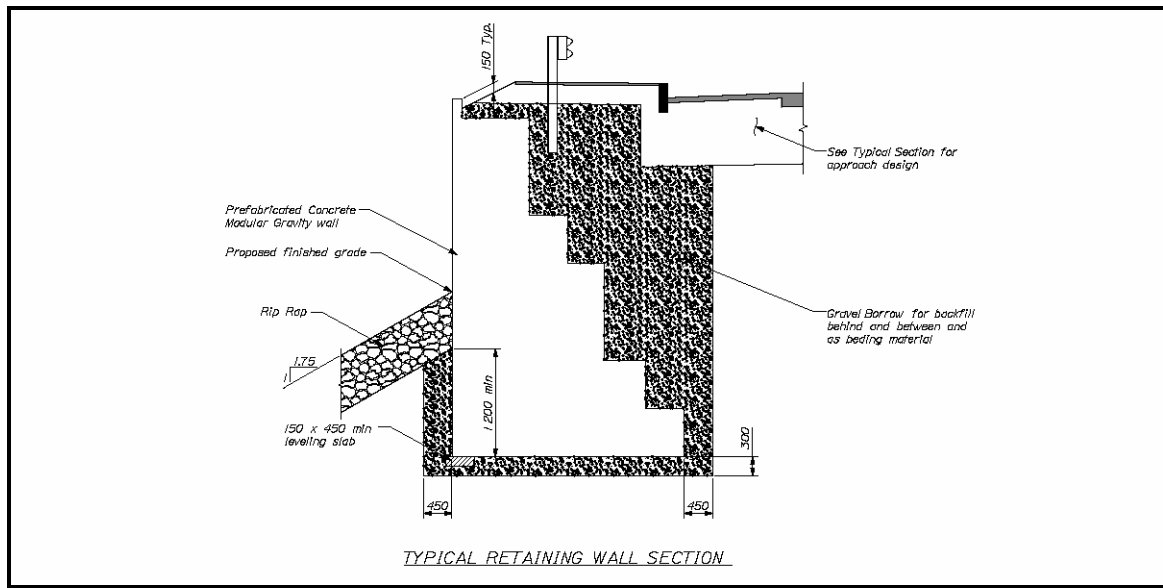


Figure 3-36 Wall Section

Intro: The wall section shows the relationship of the wall to the proposed ground, backfill, and bedding material.

Sheet up: Belongs on the Retaining Walls sheet.

Scale: 1/2"

Draw:

- 1) Wall (thickness diagrammatic)
- 2) Proposed grade and roadway elements above wall
- 3) Proposed grade below wall
- 4) Bedding material
- 5) Approximate backfill limits and material
- 6) Show any utilities in the vicinity of the wall

Dimension:

- 1) Depth of bottom of wall below finished grade in front of wall
- 2) Reveal at top of wall (control point to finished grade at back of wall)
- 3) Width of bedding material in front of wall
- 4) Width of backfill material behind back of wall
- 5) Depth of bedding material below wall

Label:

- 1) Detail Name

- 2) Control Point
- 3) Backfill Material
- 4) Bedding Material
- 5) Finished grade slopes, above and below wall
- 6) Utilities