Bridge Design Details 6.1 August 2022

Abutment

The ABUTMENT LAYOUT and ABUTMENT DETAIL sheets provide specific details for the bridge abutment. Additional details such as abutment drainage, bearing pad layout, utility locations, retaining wall connections, and other abutment-related details may be shown on these sheets.

Plan

1. Place at the top, left side of sheet, oriented with the front side facing down and the centerline of abutment horizontal. Alternatively, the PLAN view may be orientated the same direction as the PLAN view shown on the GENERAL PLAN sheet.
2. The minimum scale is ¼" = 1'-0". Use ⅛" = 1'-0" on large structures but show less detail.
3. Show abutment, footing, pile spacing, bearing pad, and wingwall dimensions along the same layout lines used on the FOUNDATION PLAN (Note: Show the centerline of the abutment bearing for seat abutments and the centerline of the abutment for diaphragm abutments).
4. Do not repeat layout stations or bearings shown on the FOUNDATION PLAN.
5. Show wingwall or retaining wall lengths.
6. Show pile spacing (Do not dimension piles from edge of footing).
    - A FOOTING PLAN may be used to show pile spacing if it can't be shown clearly in the PLAN view. Additional DETAILS of footings should be shown in the same orientation as the PLAN view. Show the centerline of bearing.
7. Show North arrow.
8. Show bearing pads and limits of level bearing area. A portion of the expanded polystyrene or expansion joint filler material may be added.
9. Show the centerline of utility and future utility openings. Identify the size of opening and details for buried pipe for bridges with approach slabs, see *Standard Plan*: B6-10 Utility Openings T-Beam and *Standard Plan*: B7-10 Utility Openings Box Girder.
10. Avoid showing portions of approach slabs or reinforcement.

Elevation

1. Place below PLAN view, projected from face of abutment. If PLAN is orientated the same as the GENERAL PLAN, place ELEVATION in front of PLAN, looking normal to face of abutment.
2. Use solid lines for portions below grade. Rear elevations should be avoided. ELEVATION should be a depiction of abutment stem, backwall, and footing. Avoid showing the superstructure on seat type abutments, but if it is shown – use dashed lines.
3. Use the same scale as PLAN view.
4. Show location of weep holes if Structure Approach Drainage is not required. For typical drainage details, see *Standard Plan B0-3*: Bridge Detail 3-1.
5. Show the finished grade or slope paving in front of the abutment (FG should be parallel to the deck when the cross slope is constant and level for crowned slopes).
6. Do not attempt to show the entire skewed wingwalls.
7. Show bearing pads and utility opening information.
8. Do not show all piles (NOTE: All piles not shown).
9. Avoid showing barrier, approach slab, or other detail dimensions.

Wingwall Elevation

1. Projection of PLAN view, if possible; otherwise locate by VIEW letters or simply call out as WINGWALL ELEVATION.
2. Always show looking normal to the wall.
3. Use the same scale as PLAN view unless reinforcement is to be shown. Usually, reinforcement should not be shown at a scale less than ⅜” = 1’-0”.
4. Do not show wingwall layout dimensions given on PLAN view. Call out Standard Plan references instead of re-detailing standard reinforcement.
5. Show SECTION of top of wall details for railings, sidewalks, overhangs, and architectural treatment. Section should show Structure Approach Drainage Details if applicable.
6. Show finished grade or slope paving.
7. Show all piles.
8. Railing need not be shown (NOTE: Barrier railing not shown).

Retaining Wall or Return Wall Elevation

1. Do not show dimensions given on PLAN view or standard plan sheets. Call out Standard Plan references (e.g., footing steps, expansion joints, weakened planes, etc). Show all other layout information along the Retaining Wall Layout Line (RWLOL).
2. Long retaining walls adjacent to bridges may require separate sheets or plans showing PLAN and ELEVATION details.
3. Show SECTION of top of wall details for railings, sidewalks, overhangs, and architectural treatment. Section should show Structure Approach Drainage Details if applicable.
4. Do not show all piles (NOTE: All piles not shown).
5. Distance between footing steps should be in multiples of 8 feet. Maximum height of steps should be held to 4 feet. For typical step details, see *Standard Plan B3-5*: Retaining Wall Details No. 1 - Footing Step. Small steps less than 12 inches should be avoided unless distance between steps is 96 feet or more. If footing thickness changes between steps, the bottom of footing elevation should be adjusted so that the top of footing remains at the same elevation.
6. When sloping footings are used, form and joint lines are permitted to be perpendicular and parallel to the footing for ease of construction. Sloping footing grades shall be constant for the entire length of the wall. If breaks in footing grade (angle points) are deemed necessary, a level-stepped footing shall be used for the entire wall instead of a sloping footing (Maximum permissible slope for a reinforced concrete retaining wall footing is 3% and maximum permissible slope for masonry walls is 2%).
7. Weakened plane joints (*Standard Plan B0-3*: Bridge Detail 3-2) should be shown at nearly equal spaces between expansion joints.
8. Expansion Joints (*Standard Plan B0-3*: Bridge Detail 3-4) shall be shown at maximum intervals of 96 feet (shorter spaces should be in multiples of 8 feet). Expansion joints should not be placed at an angle point in the wall alignment. Waterstop in the expansion joint shall be shown to extend 1 foot below the finished grade. When concrete barriers or curbs are used on top of the retaining walls, the waterstop in the expansion joint shall be shown to extend 6 inches into the barrier or curb.

Sections and Details

1. For general requirements, see *Bridge Design Details*: 1.1 General Detailing - Detail Layout, Sections, and Views.
2. SECTIONS and DETAILS showing reinforcement should not be less than ⅜" = 1'-0" scale; the preferred scale is ½" = 1'-0" minimum.
3. Do not repeat reinforcement shown in the Standard Plans.
4. Abutment SECTION should include the following:
   a) Location of Beginning of Bridge (BB) and End of Bridge (EB), see *Bridge Design Details*: 6.8 BB and EB Locations.
   b) Centerline Bearing for seat type abutment and Centerline Abutment for diaphragm type.
   c) Stem and backwall reinforcement. For post tensioned girder bridges, backwall to be placed after bridge has been stressed.
   d) Footing reinforcement and pile spacing.
   e) Outline of end diaphragm or superstructure (Do not use drop out lines or include reinforcement details of superstructure beyond bars that extend from end diaphragm abutment into deck).
   f) Joint seal type, movement range, and joint seal blockout details.
   g) Waterstop or Structure Approach joint detail, see *Bridge Design Details*: 6.7 Sealed Joints.
   h) Drainage details behind the abutment and "Weep Hole and Geocomposite Drain Detail" alternative when *Standard Plan B0-3:* Detail 3-1 is shown. For more information, see *Bridge Design Details*: 6.3 Abutment Drainage Details.
      - Edit the NOTES in the "Weep Hole and Geocomposite Drain Detail" to remove references to wall types or elements that are not specific to the project plans.
   i) Dimension distance below the soffit and width of maintenance berm. For additional berm information, see *Bridge Design Details*: 2.1 Bridge Layout and *Bridge Design Details*: 6.2 Seat & End Diaphragm Abutments.
5. SHEAR KEY DETAIL should include the following:
   a) Expanded polystyrene and expansion joint filler details.
   b) Shear Key, stem, and wingwall reinforcement.

Figure 6A.A.1 Abutment Layout Detailing Example 1

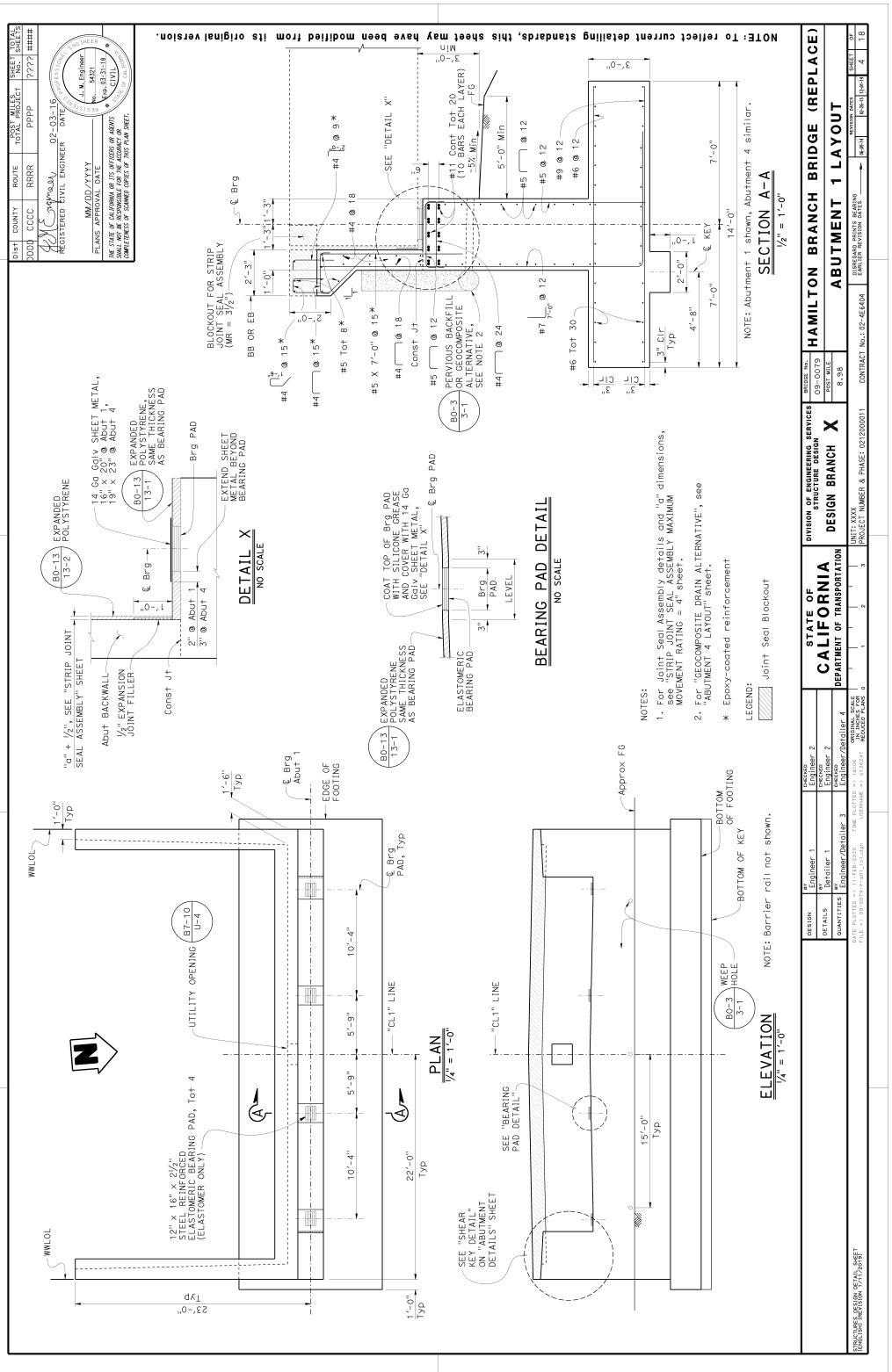


Figure 6A.A.2 Abutment Details Detailing Example 2

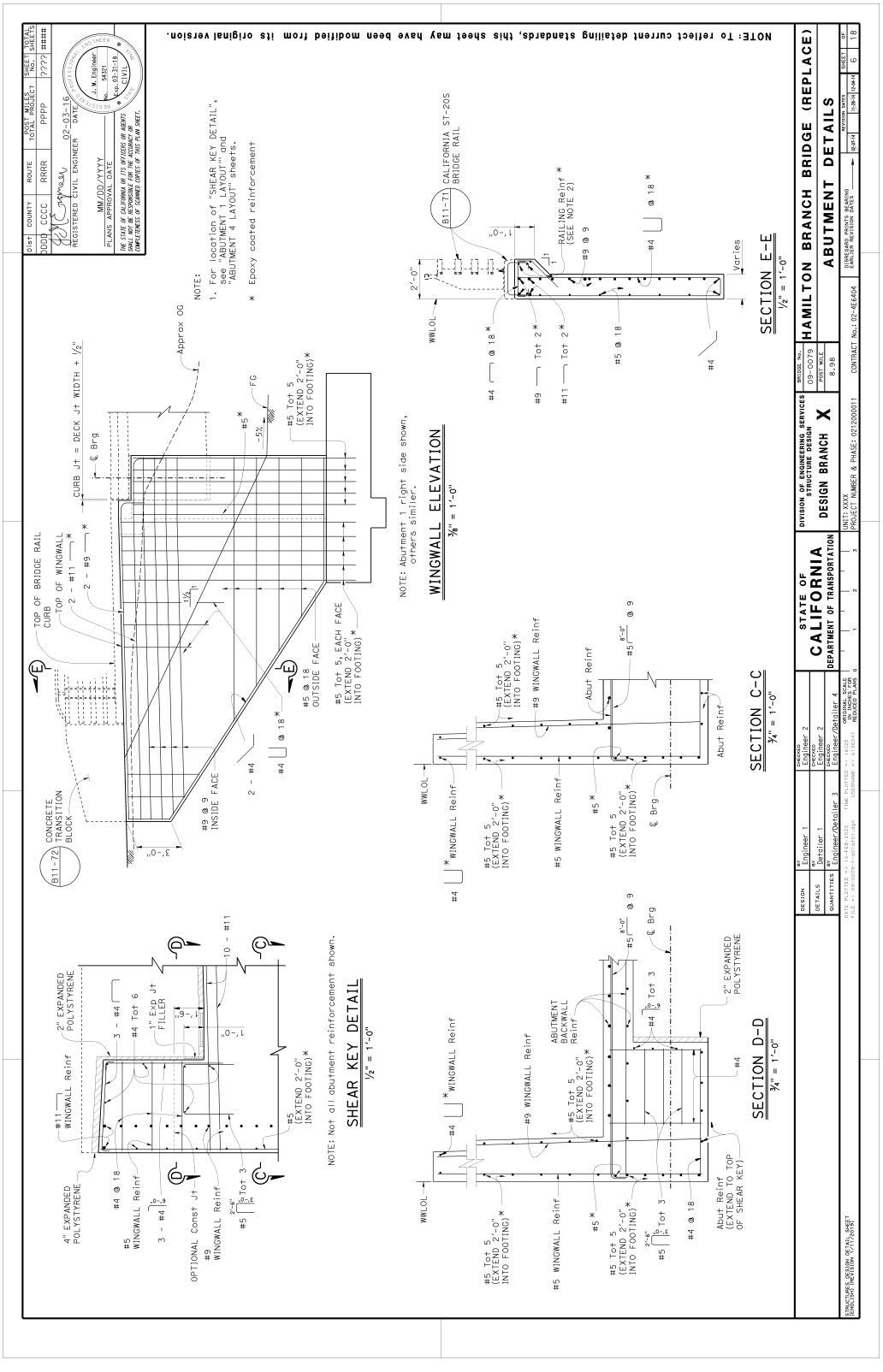


Figure 6A.A.3 Abutment Layout Detailing Example 3

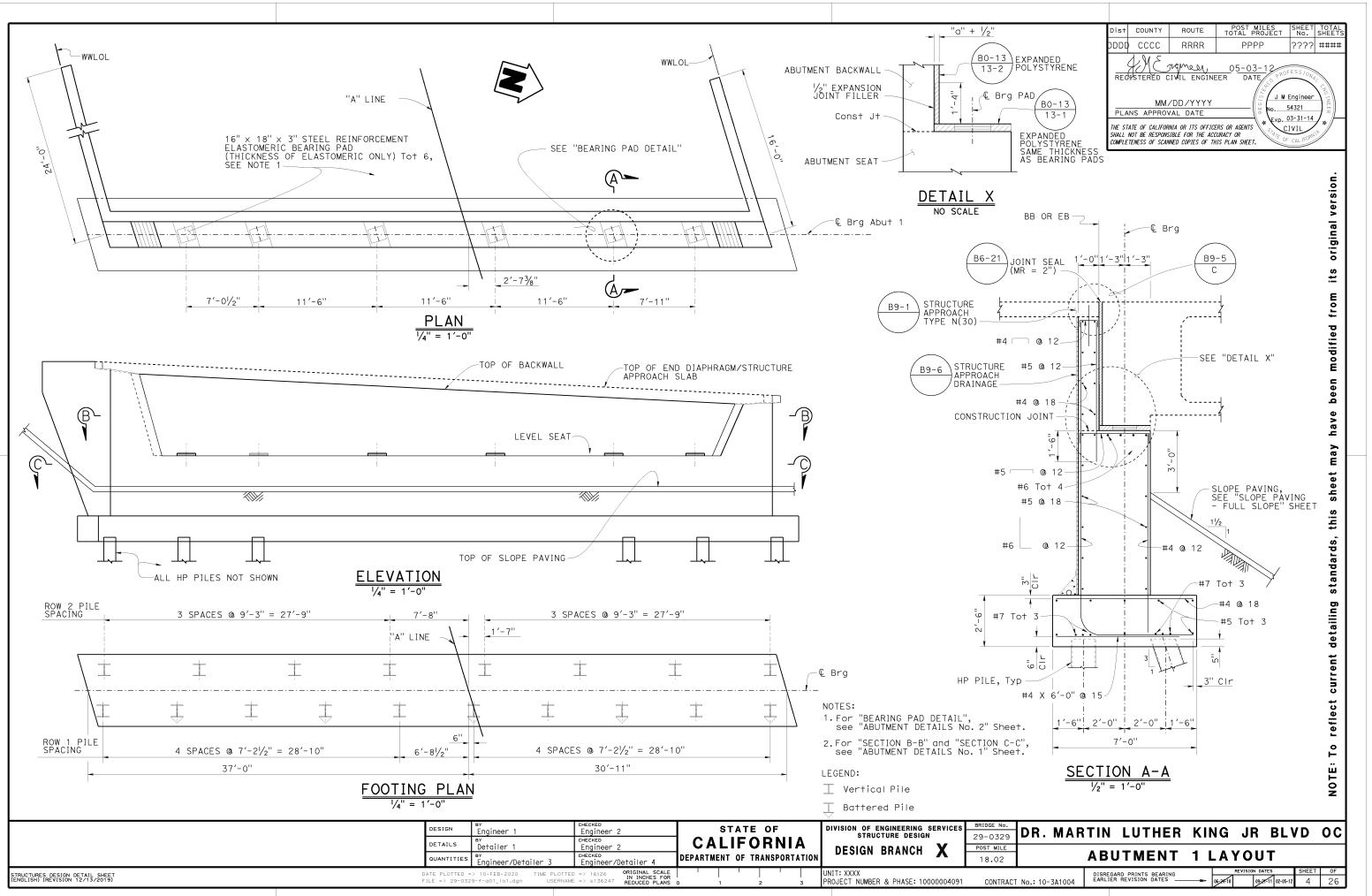


Figure 6A.A.4 Abutment Details Detailing Example 4

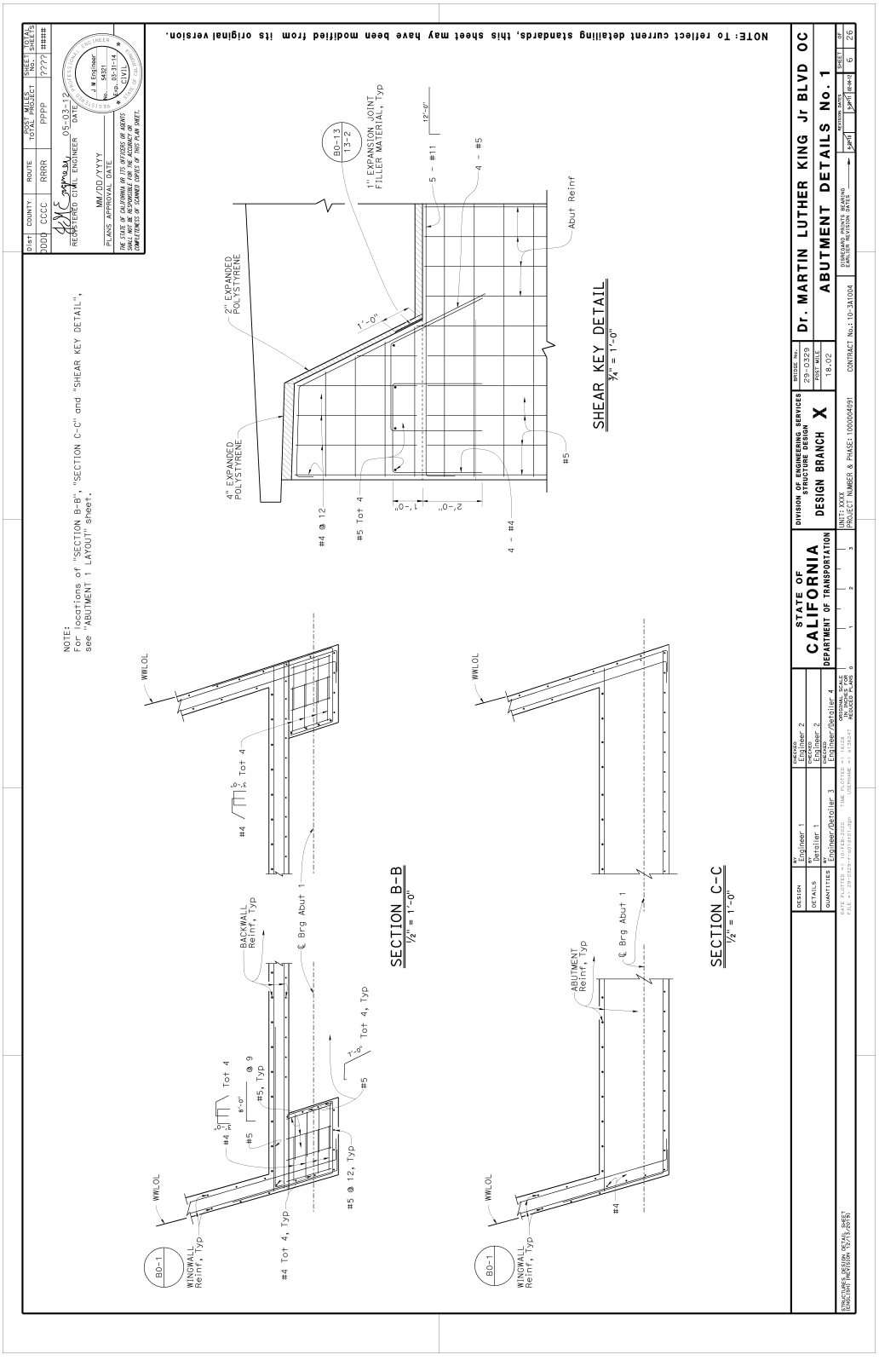


Figure 6A.A.5 Abutment Details Detailing Example 5

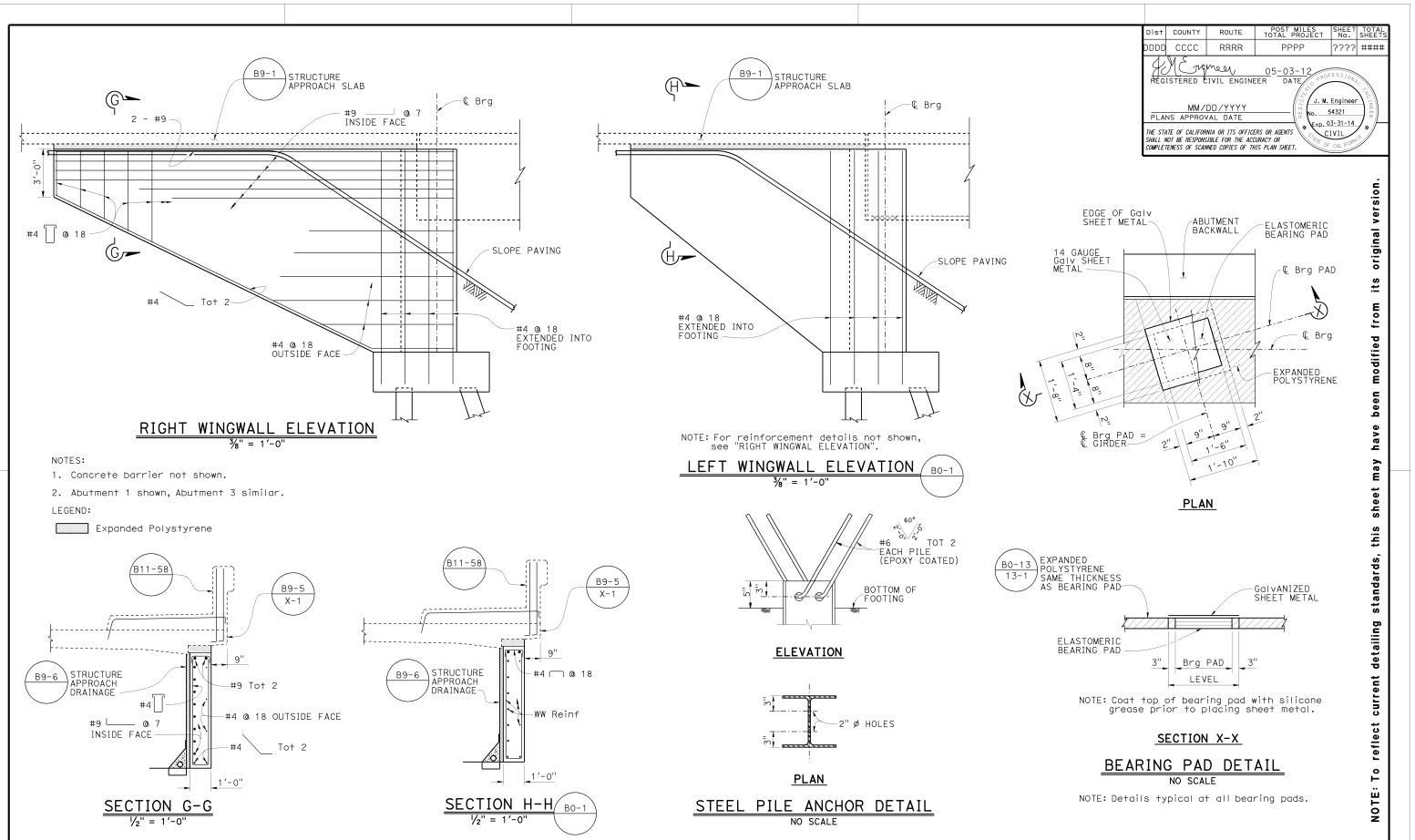


Figure 6A.A.6 Abutment Layout Detailing Example 6

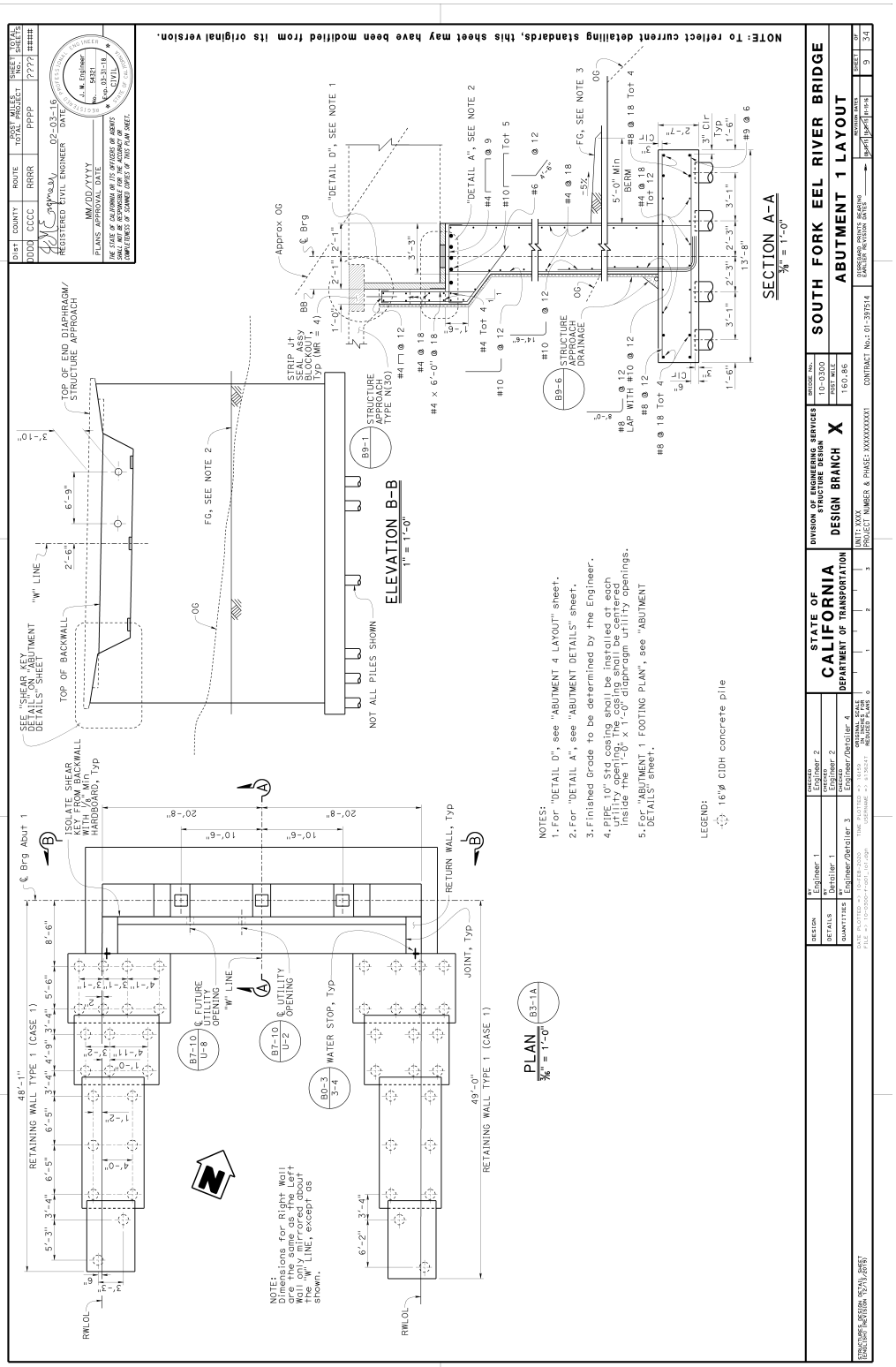
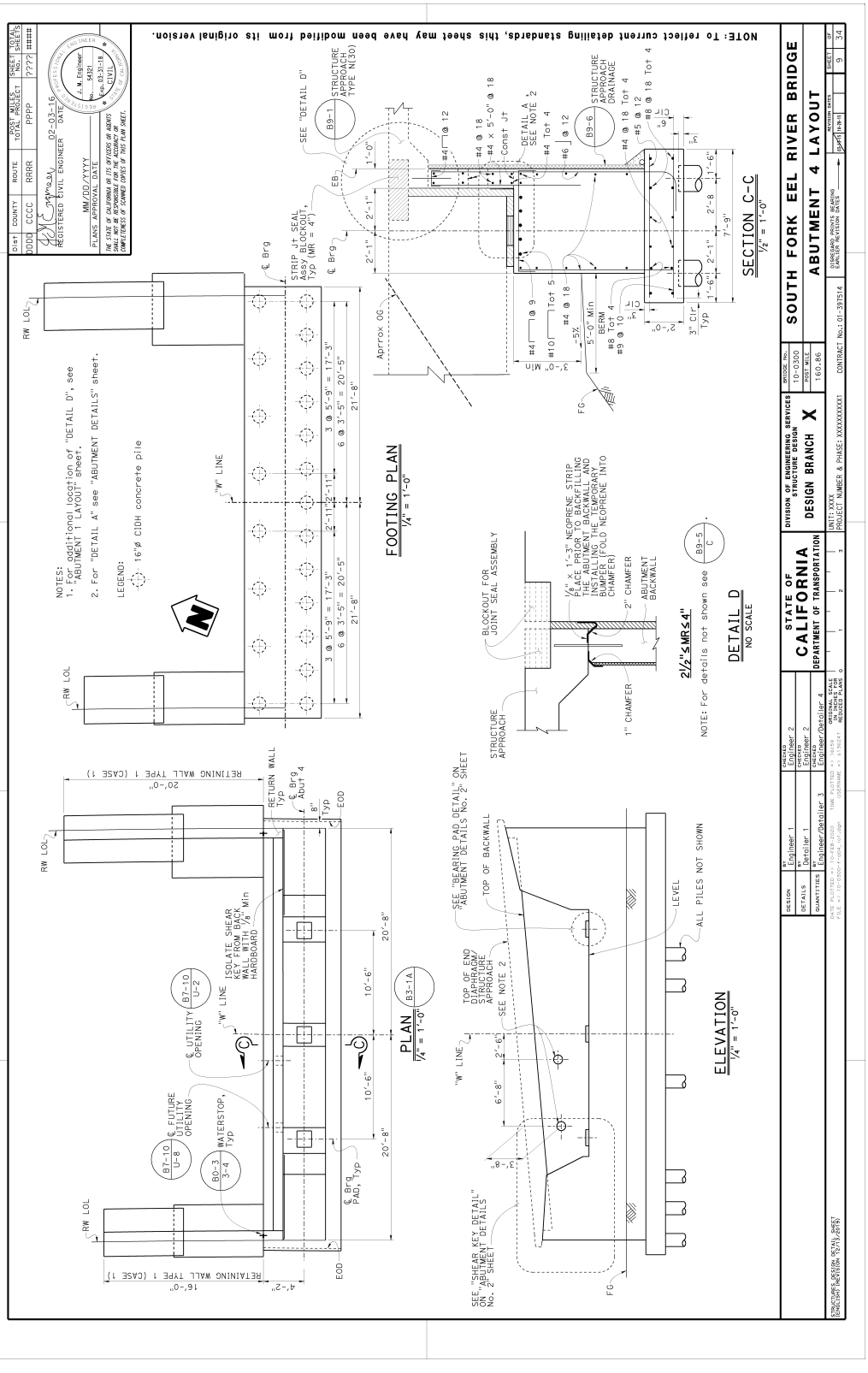


Figure 6A.A.7 Abutment Layout Detailing Example 7



Abutment Detailing Examples – Attachment A

Figure 6A.A.8 Abutment Layout Detailing Example 8

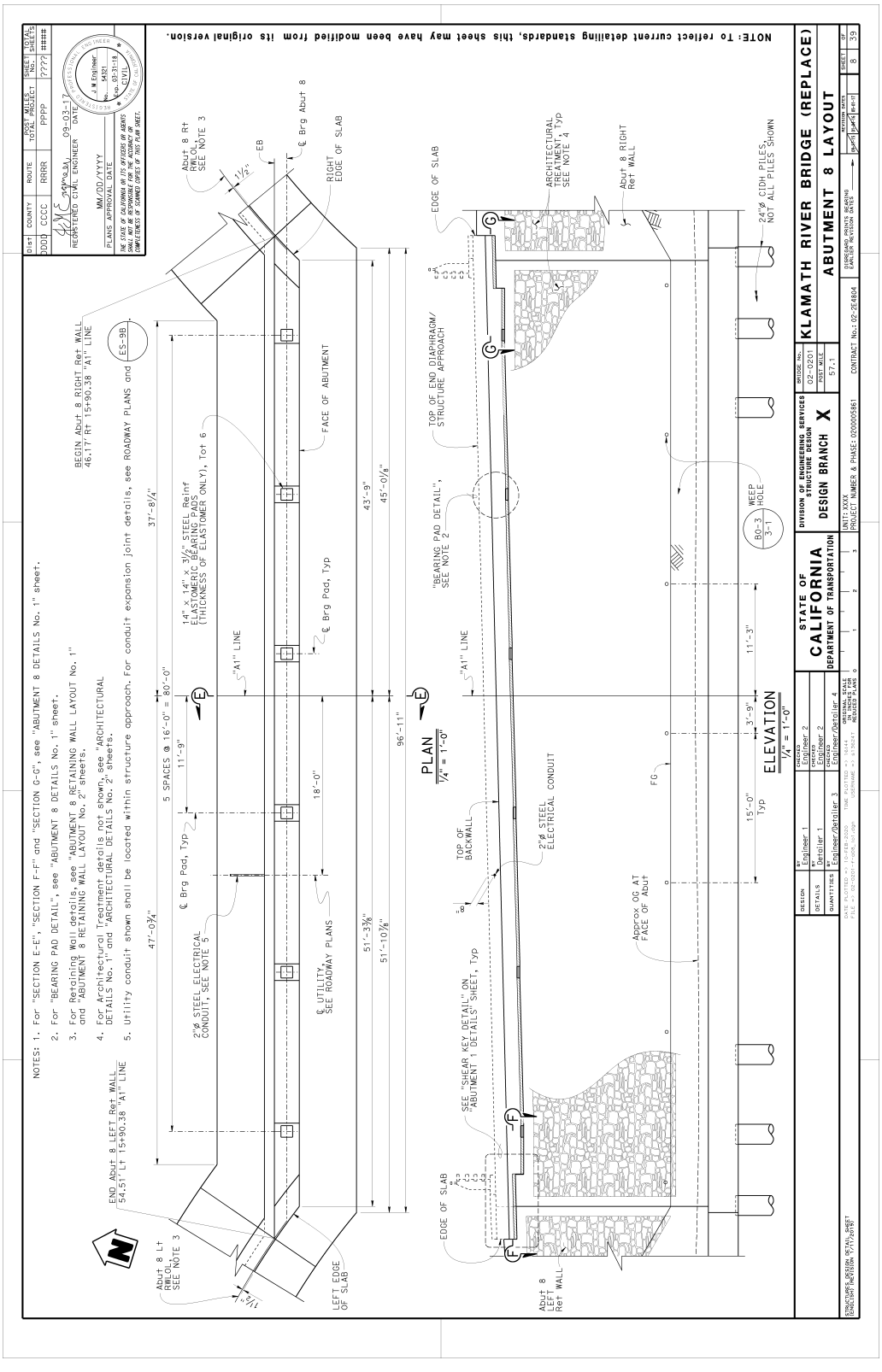


Figure 6A.A.9 Abutment Details Detailing Example 9

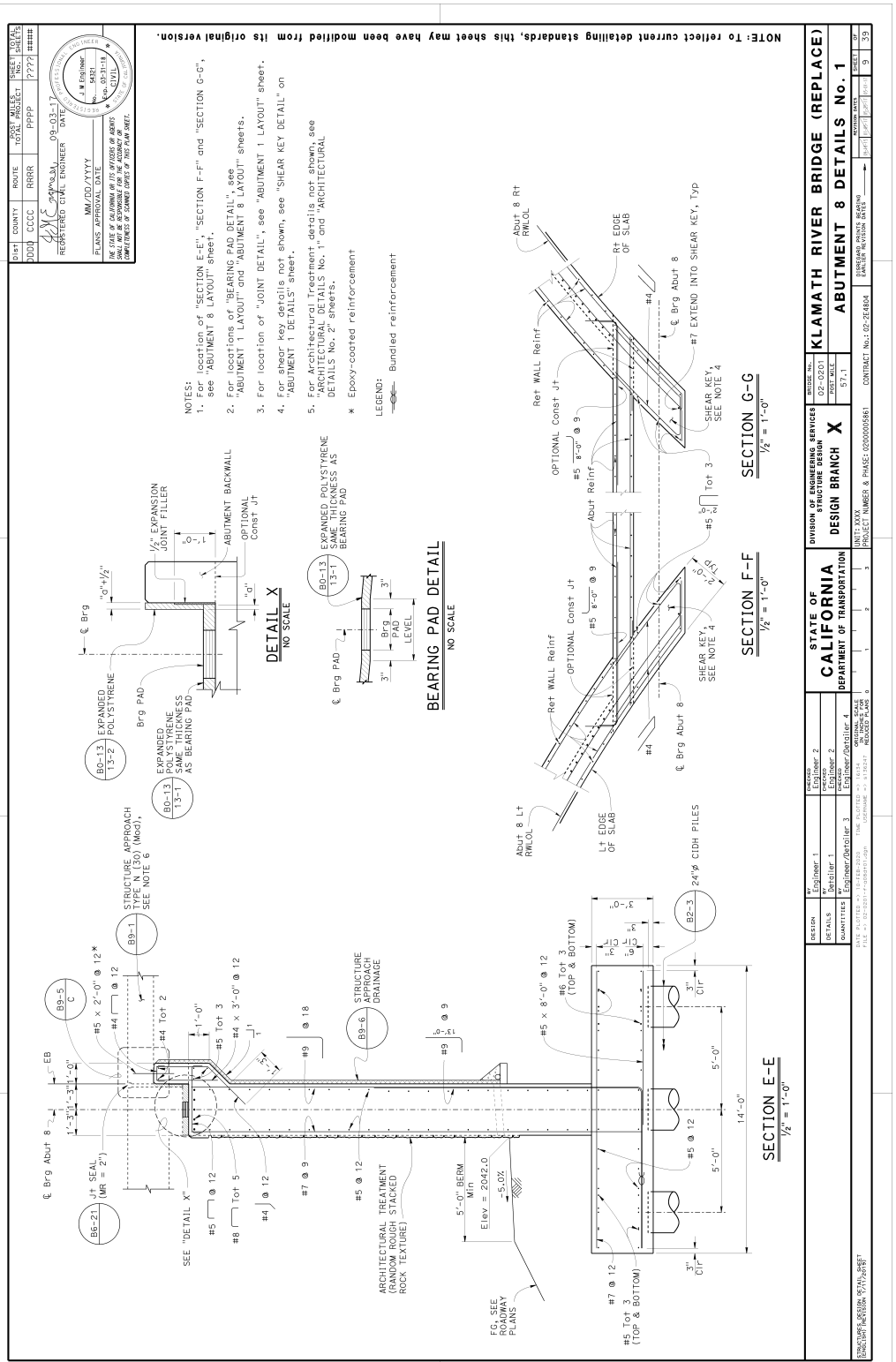


Figure 6A.A.10 Abutment Details Detailing Example 10

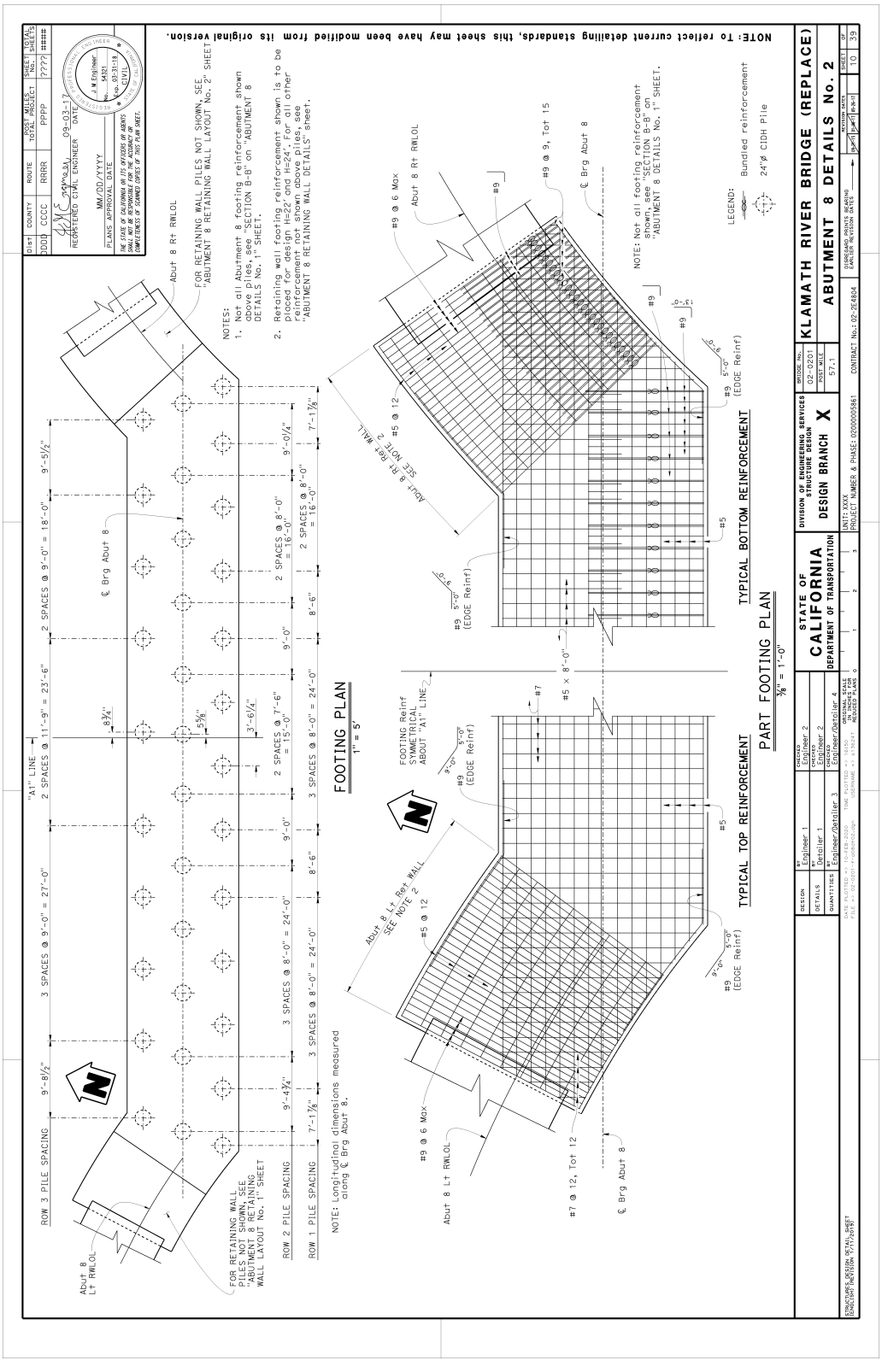


Figure 6A.A.11 Abutment Retaining Wall Layout Detailing Example 11

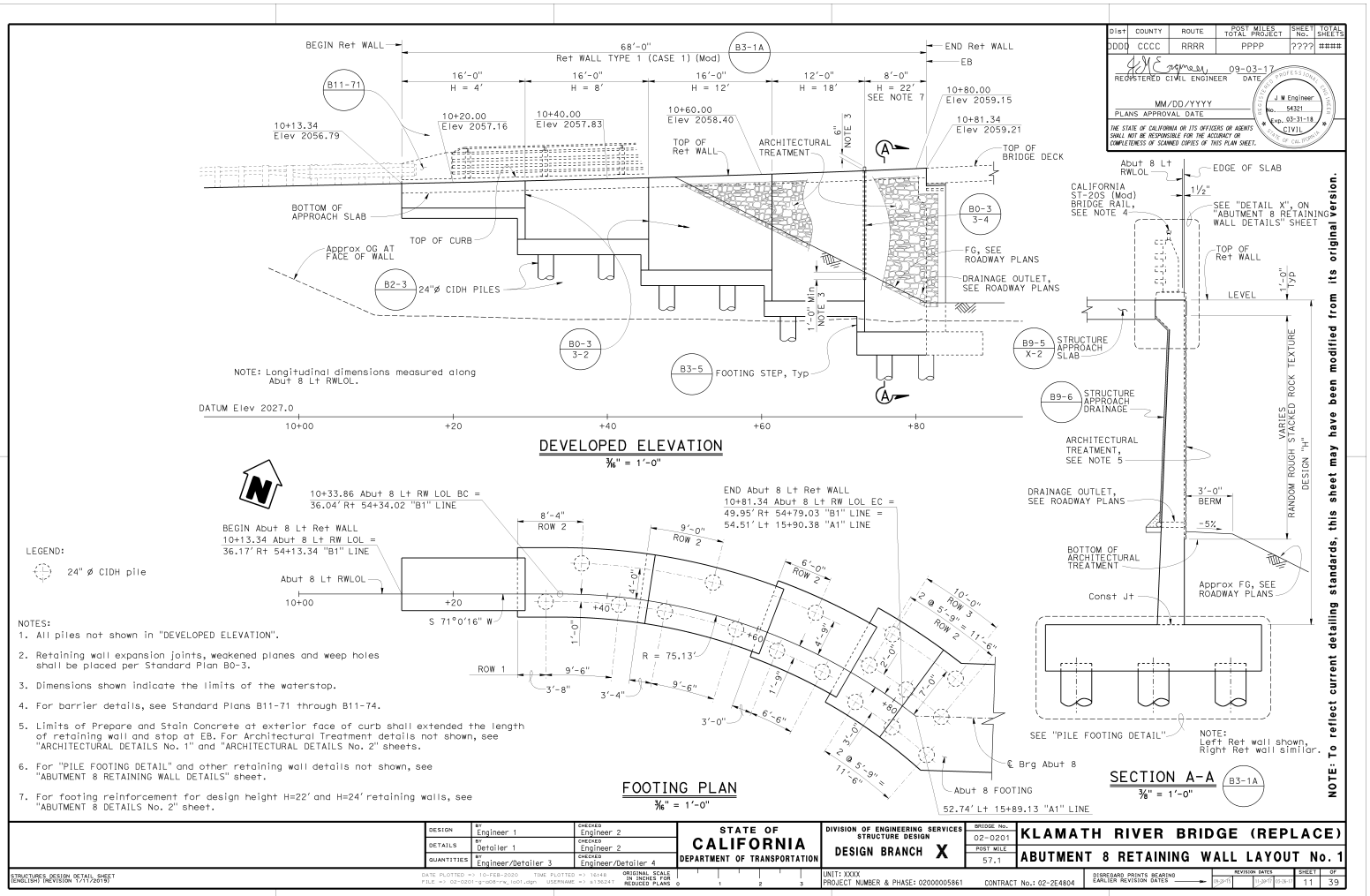


Figure 6A.A.12 Abutment Retaining Wall Details Detailing Example 12

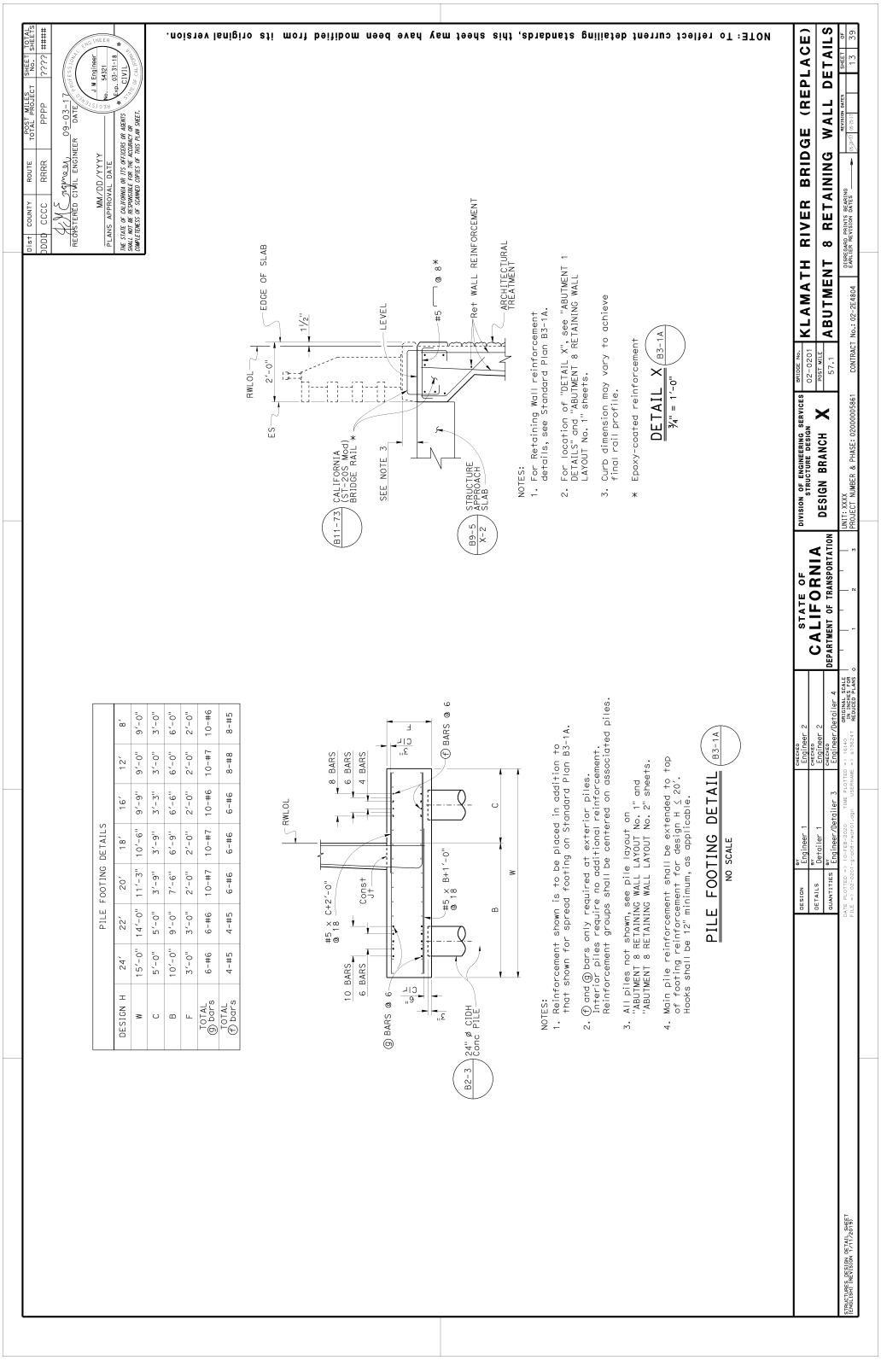


Figure 6A.A.13 Abutment Layout Detailing Example 13

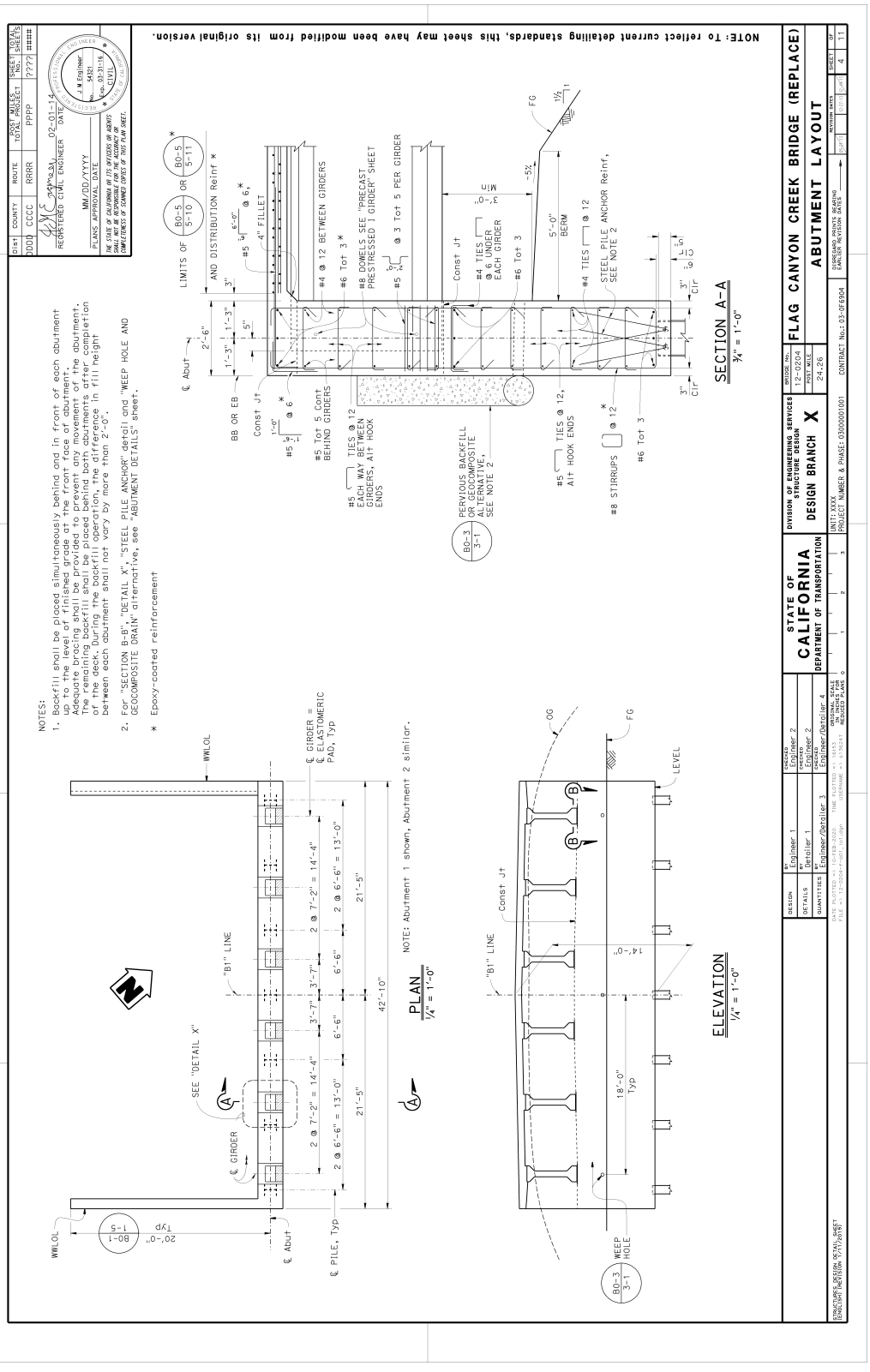


Figure 6A.A.14 Abutment Details Detailing Example 14

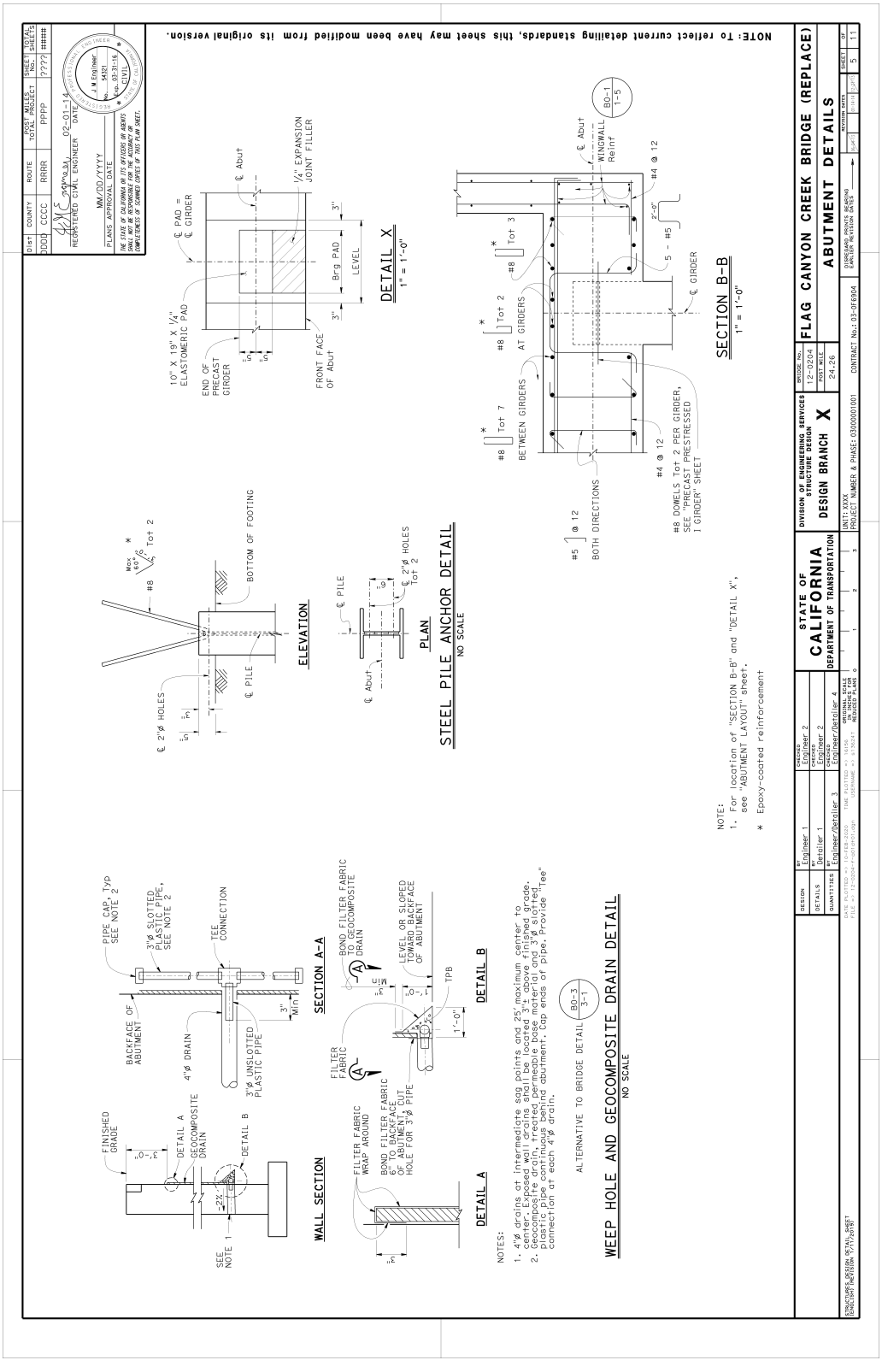


Figure 6A.A.15 Abutment Layout Detailing Example 15

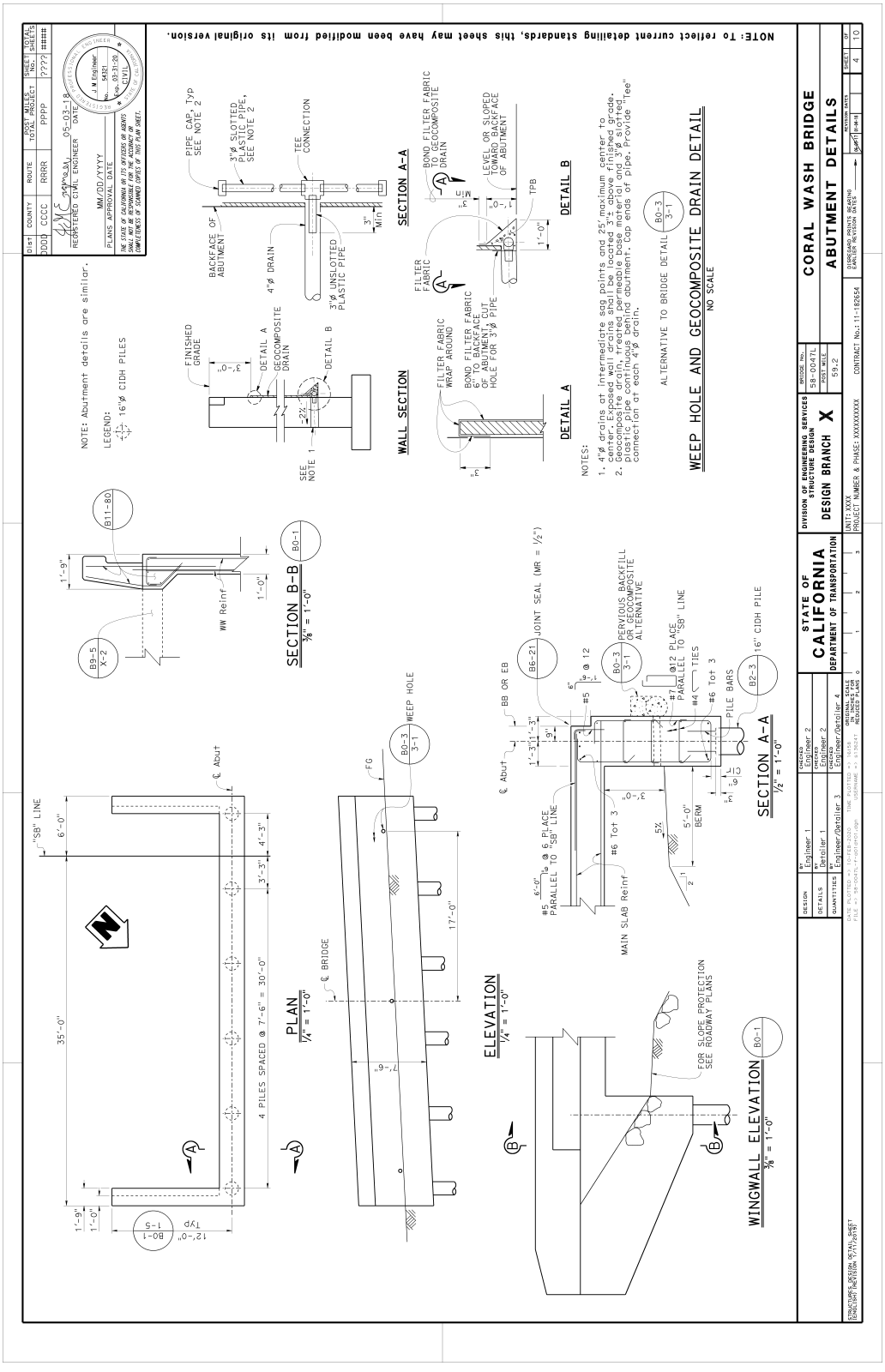


Figure 6A.A.16 Abutment Layout Detailing Example 16

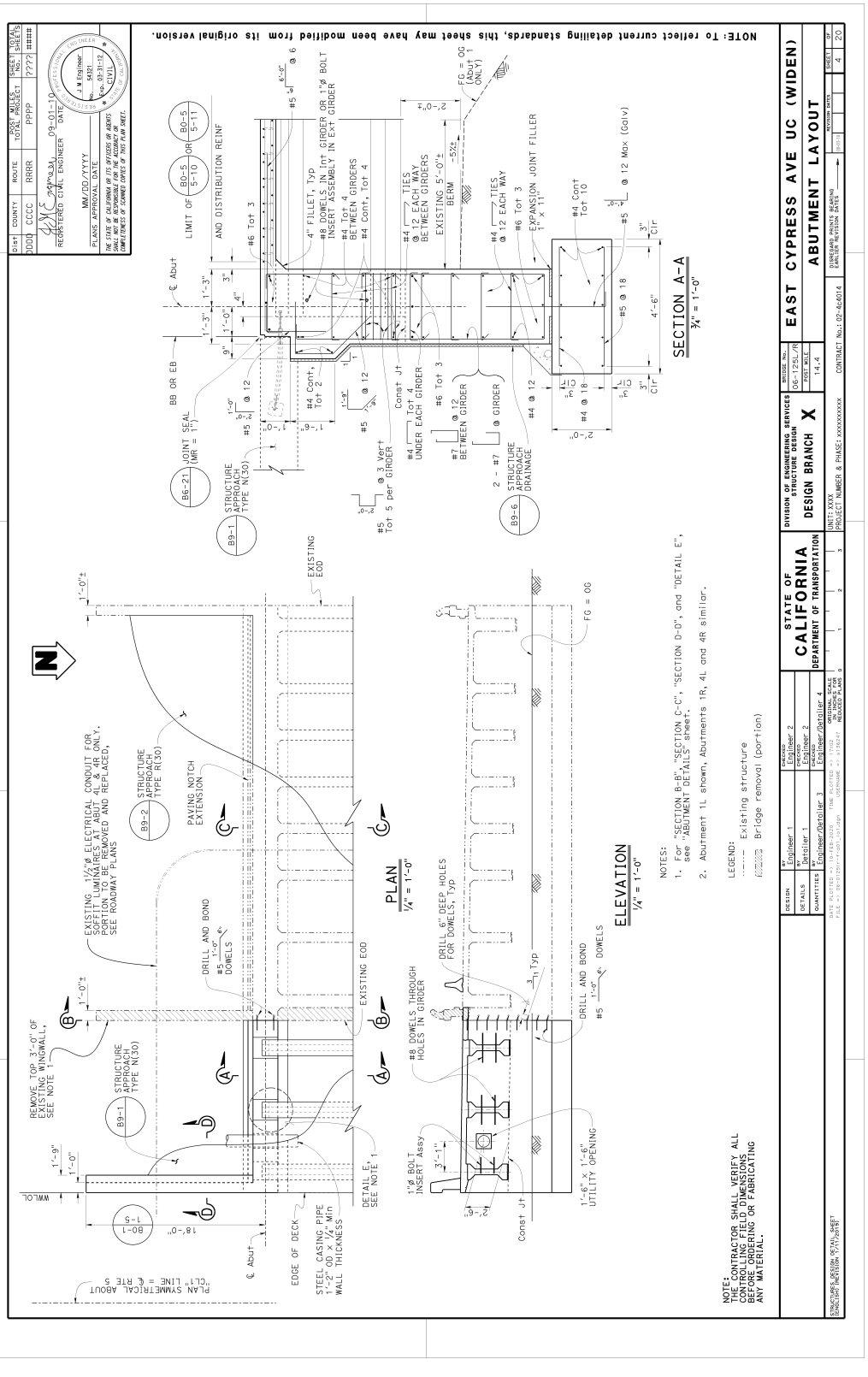


Figure 6A.A.17 Abutment Details Detailing Example 17

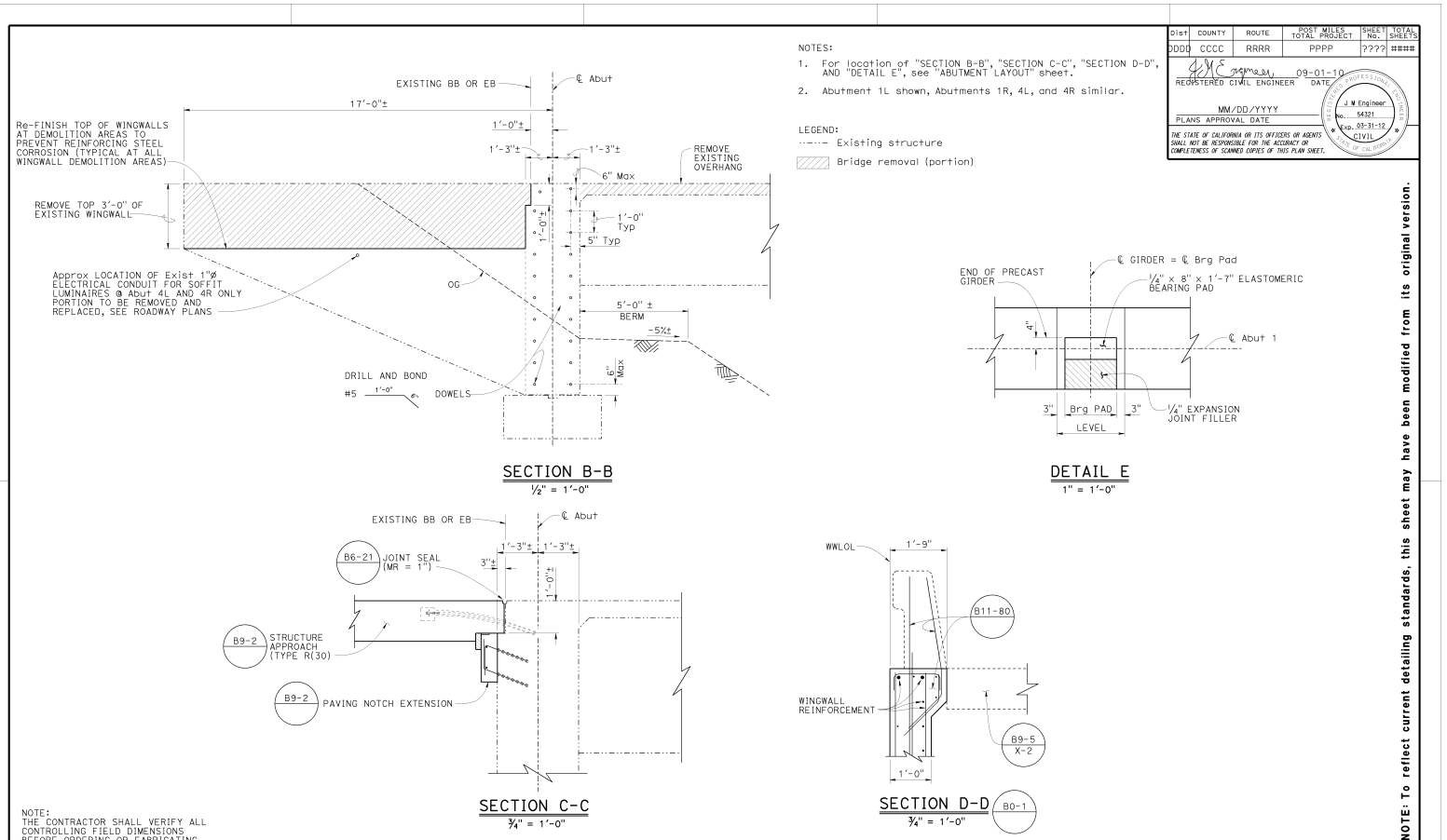


Figure 6A.A.18 Abutment Layout Detailing Example 18

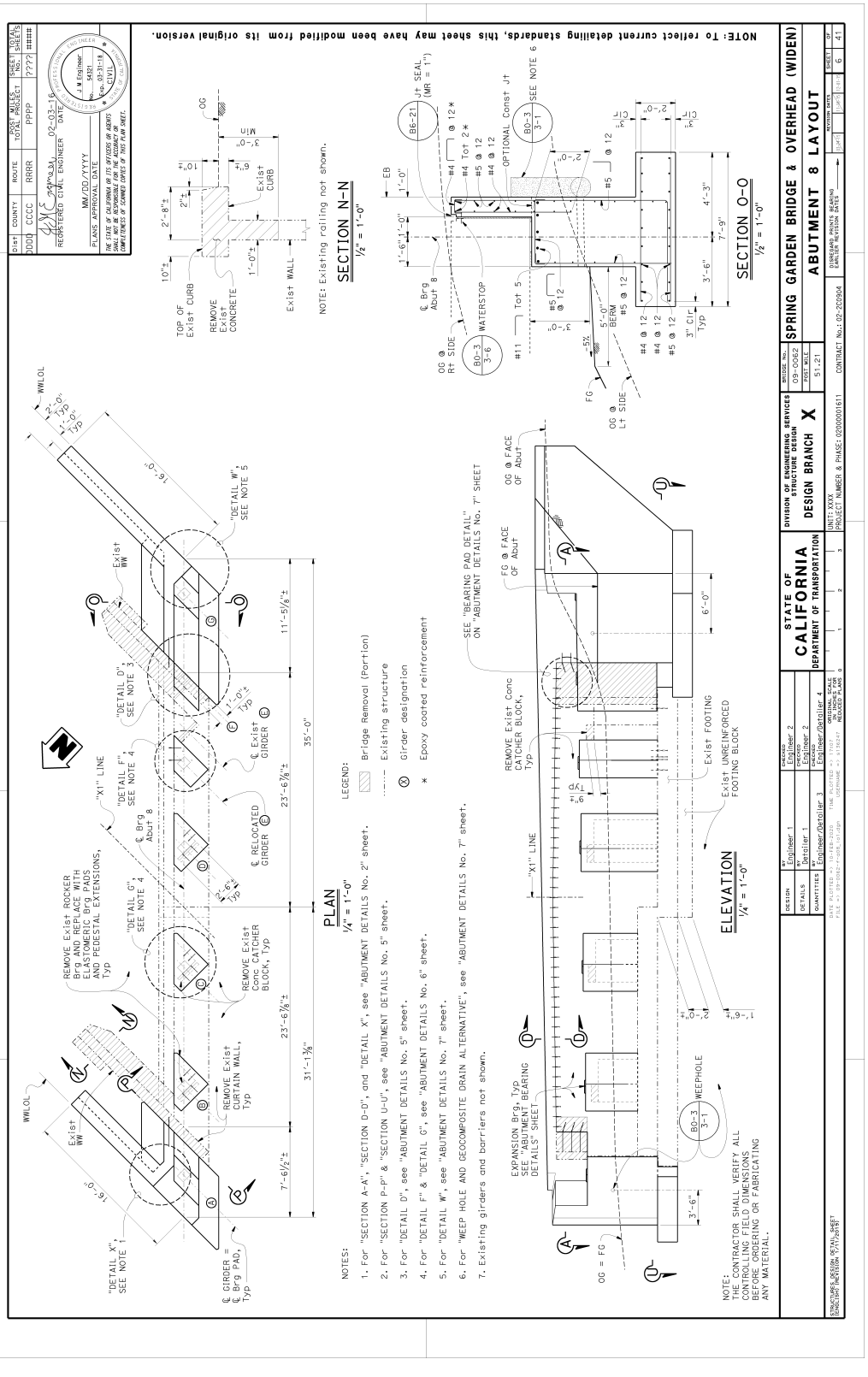
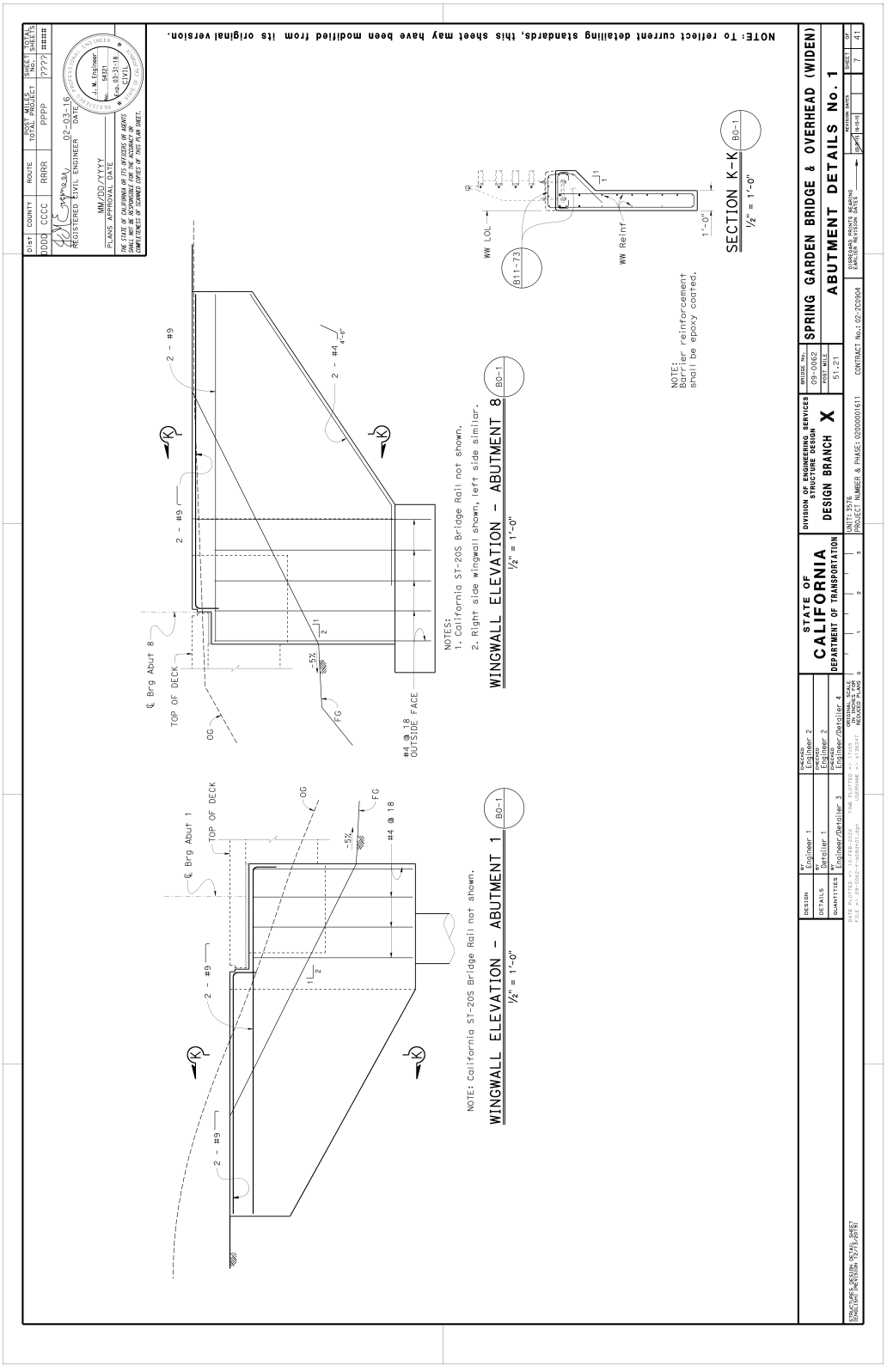


Figure 6A.A.18 Abutment Details Detailing Example 19



Bridge Design Details 6.2 February 2020

Seat & End Diaphragm Abutments

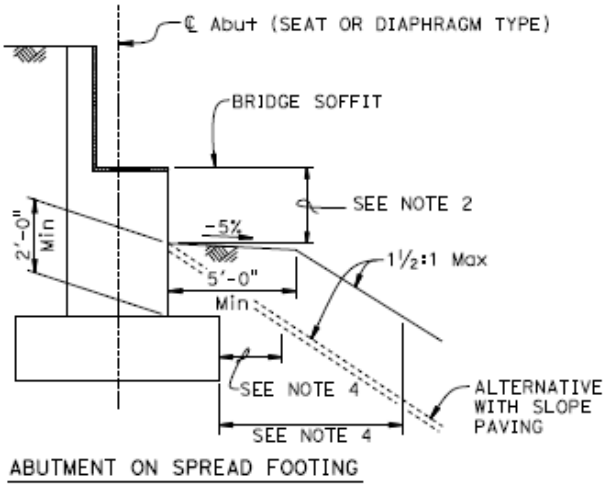


Figure 6.2.1 Abutment Foundation Embedment and Berm

Notes:

1. For Abutment reinforcement, see *Bridge Design Aids*: Section 1 Abutments.
2. The clearance between the top of finish grade slope and the soffit of the bridge should be 3’-0” minimum for abutments with a berm. This clearance allows room for compaction of the berm and for future maintenance inspections. If, for some reason, the berm is wider than 6’-0”, the minimum vertical clearance provided should be increased to provide the necessary room for construction. The clearance may be as little as 2’-0” for abutments without a berm (with slope paving); whereas the clearance can be as much as 4’-0” for typical bridges, depending upon individual project circumstances. Bridges with structure depths greater than 7’-0” would typically have more clearance, than the typical dimensions shown above, to provide a similar appearance as the shallower structures. The clearance is parallel to the deck when the cross slope is constant and level for crown slopes. The dimension shall be shown on the plans.
3. The bottom portion of abutments on piles without footings, shall be embedded a minimum of 3’-6” at the face of abutment when there is no berm (with slope paving). If the slope is flatter than 1½:1 (horizontal:vertical), the embedment can be decreased to as little as 2’-0”.
4. For abutments on spread footings, the horizontal clearance from the top of footing to the face of slope should be 5’-0” minimum, with a 2’-0” minimum cover at the edges of footing.
5. Front face slopes at abutments should be 1½ to 1 or flatter, except under very unusual circumstances.

Bridge Design Details 6.3 February 2020

Abutment Drainage Details

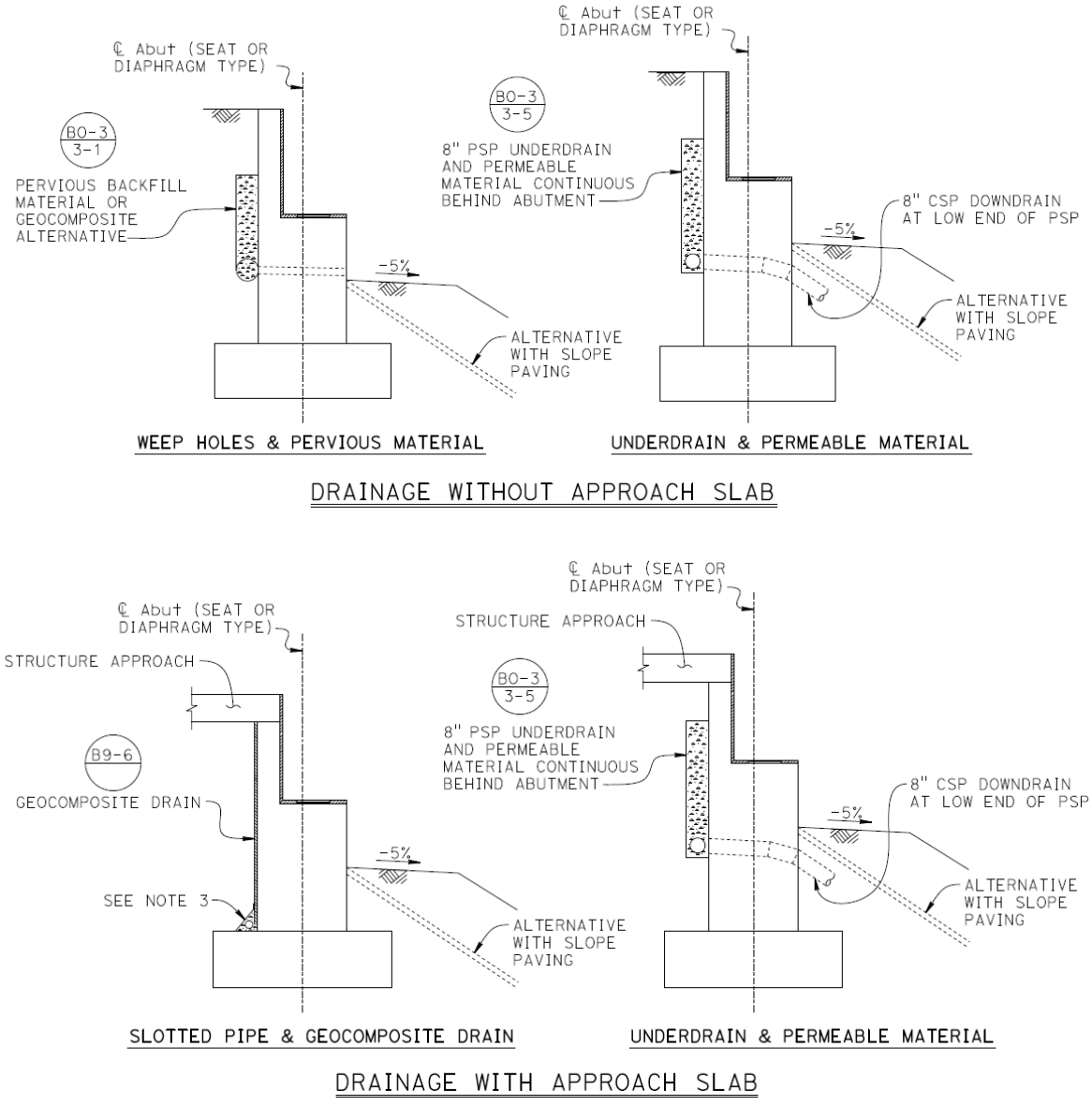


Figure 6.3.1 Abutment Drainage

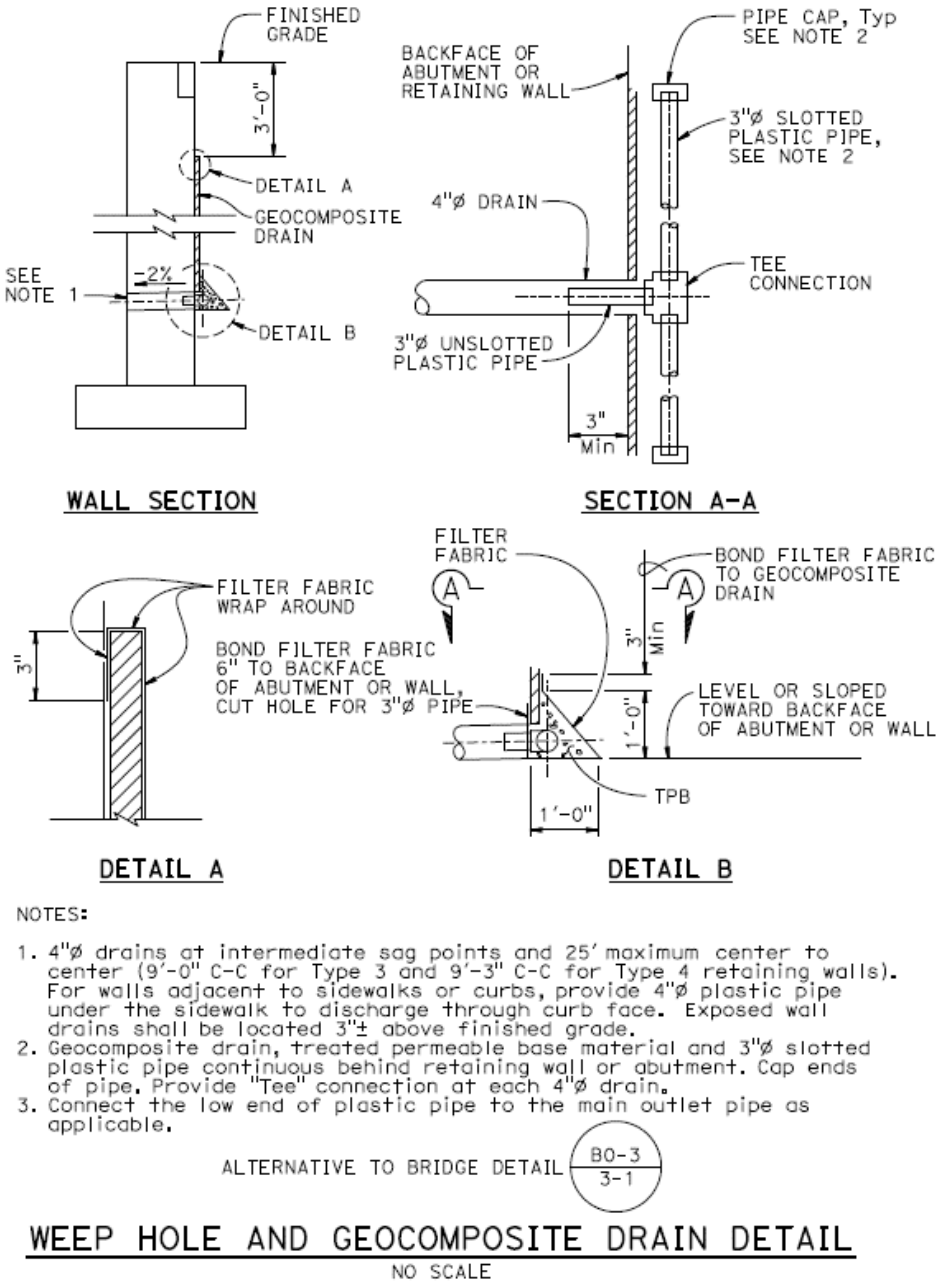


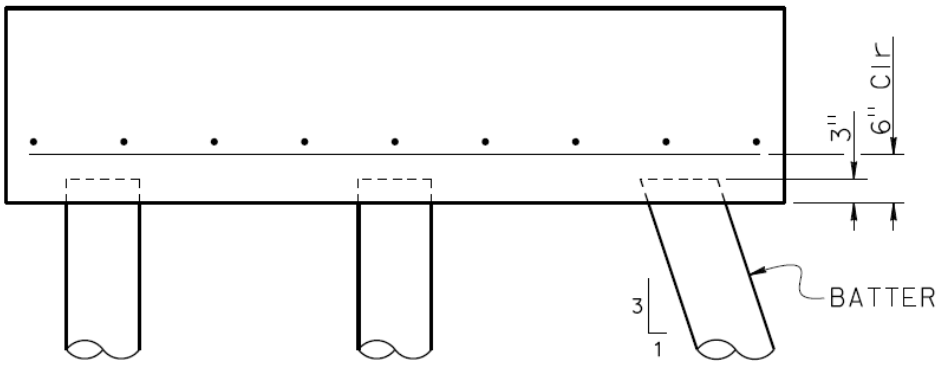
Figure 6.3.2 Weep Hole and Geocomposite Drain Alternative

Notes:

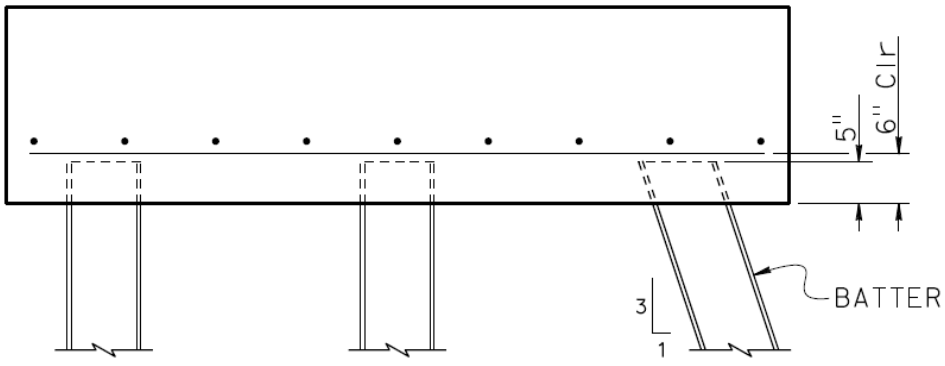
1. Continuous pervious backfill material (*Standard Plan B0-3*: Bridge Detail 3-1), structure approach drainage (*Standard Plan B9-6*: Structure Approach Drainage Details), or perforated pipe with permeable material (*Standard Plan B0-3*: Bridge Detail 3-5) should be placed in accordance with the instructions in *Memo to Designers:* 5-2 Diaphragm Abutments. Permeable material (*Standard Plan B0-3*: Bridge Detail 3-5), is only specified when known water bearing material is present behind the abutment as identified in the Foundation Report.
2. For all abutments (without structure approaches) and for retaining walls, the "Weep Hole and Geocomposite Drain Detail", shown in Figure 6.3.2, shall be added to the plans. This detail provides an alternative detail to the pervious backfill specified in *Standard Plan B0-3*: Bridge Detail 3-1. The plans should show the pervious material and not the alternative geocomposite drain in the abutment or retaining wall sections. Edit the NOTES in the "Weep Hole and Geocomposite Drain Detail" to remove references to wall types or elements that are not specific to the project plans.
3. Reference ROADWAY PLANS or show drainage outlet details behind the abutment whenever possible.

Bridge Design Details 6.4 February 2020

Pile Footings



CONCRETE PILES



STEEL PILES

Figure 6.4.1 Pile Footings

Bridge Design Details 6.5 February 2020

Piles at Abutment Corners

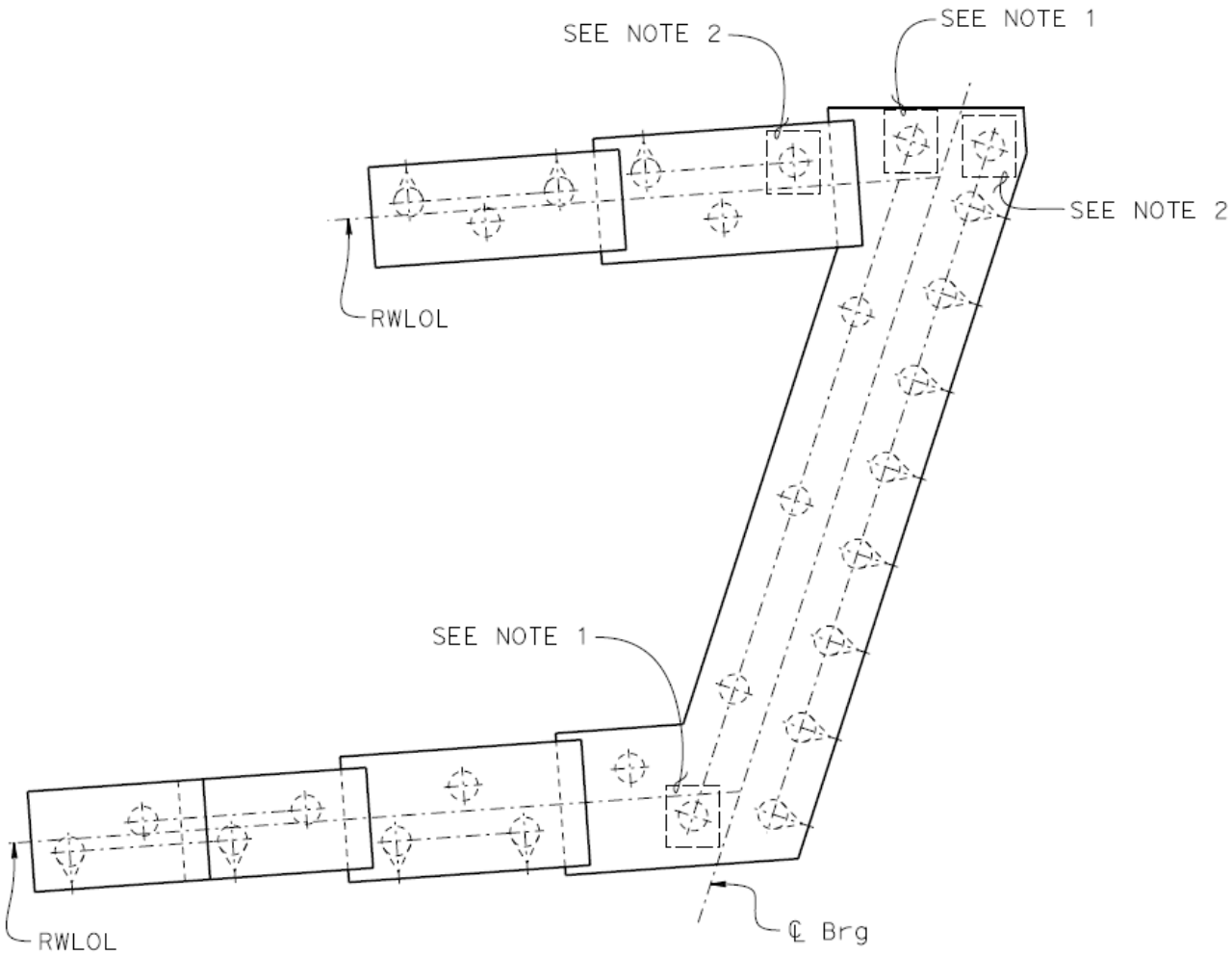


Figure 6.5.1 Piles at Abutment Corners

Notes:

1. Battered pile at this location is unnecessary. Pile should be vertical.
2. Use vertical pile rather than battered piles at sharp acute corners where it may be difficult to drive battered piles.

Bridge Design Details 6.6 February 2020

Bearing Pad Location at Anchorage Blockout

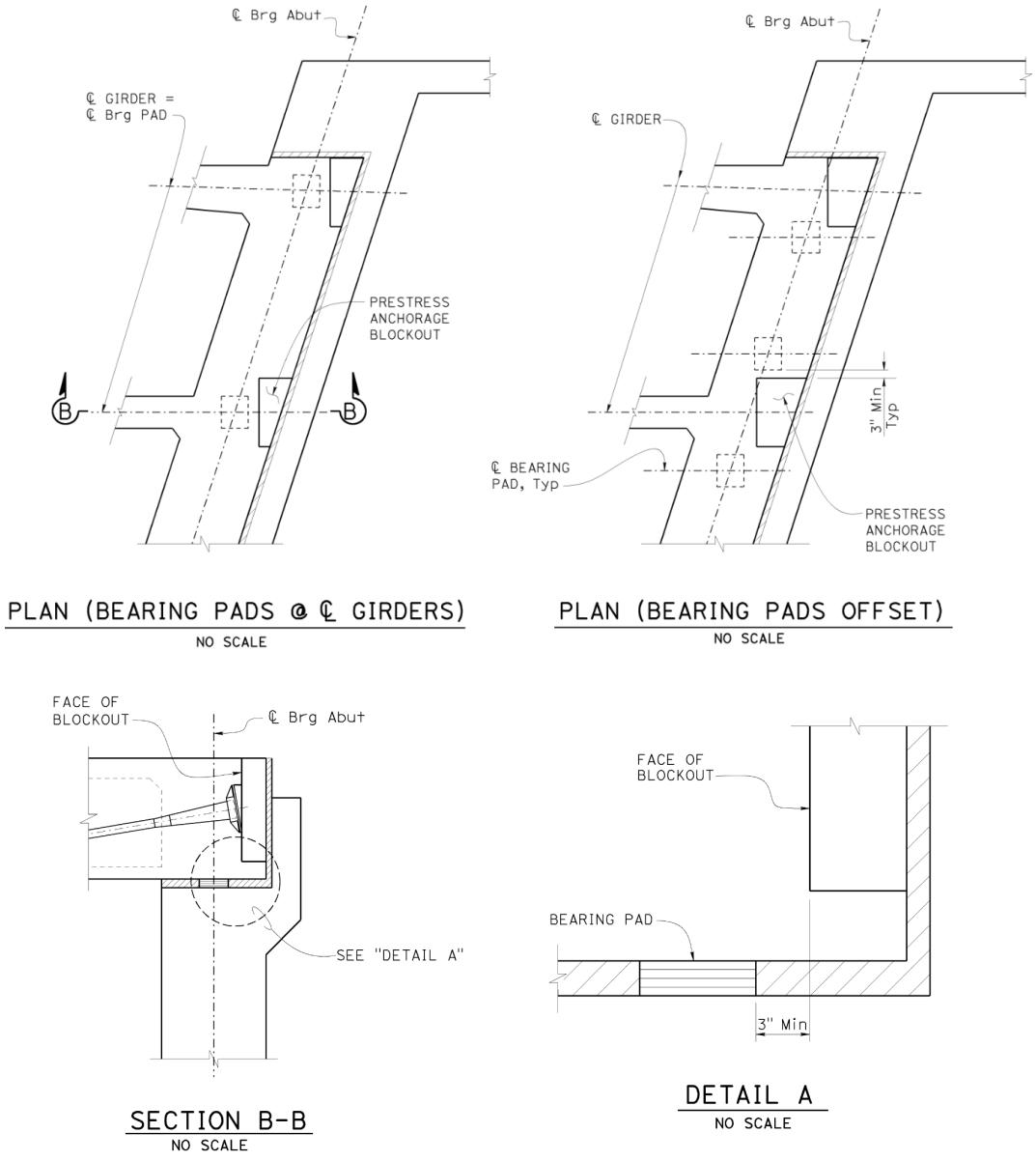


Figure 6.6.1 Bearing Pad Location at Anchorage Blockout

Bridge Design Details 6.7 February 2020

Sealed Joints

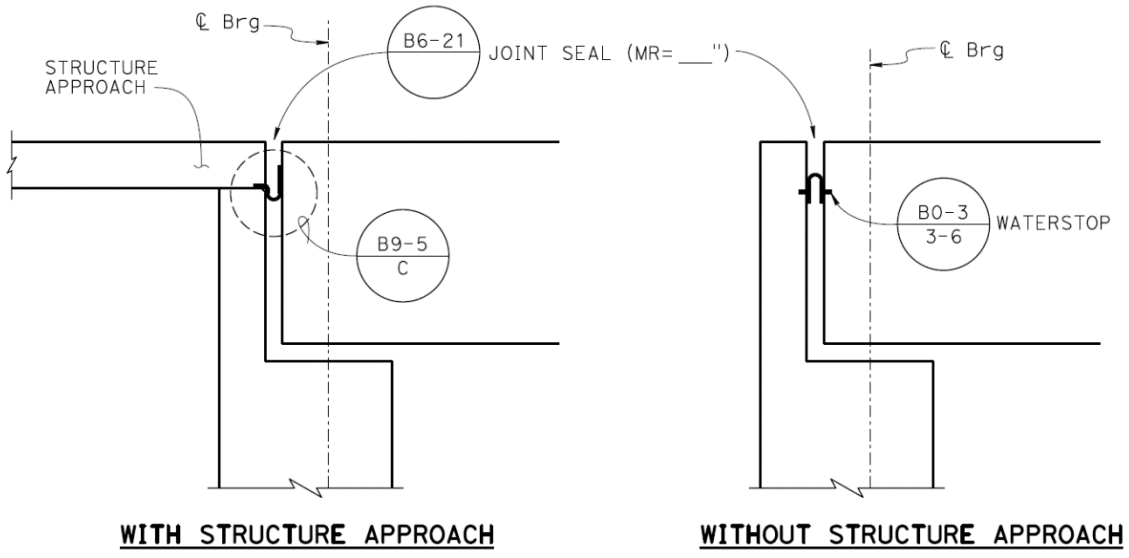


Figure 6.7.1 Sealed Joints (MR ≤ 2")

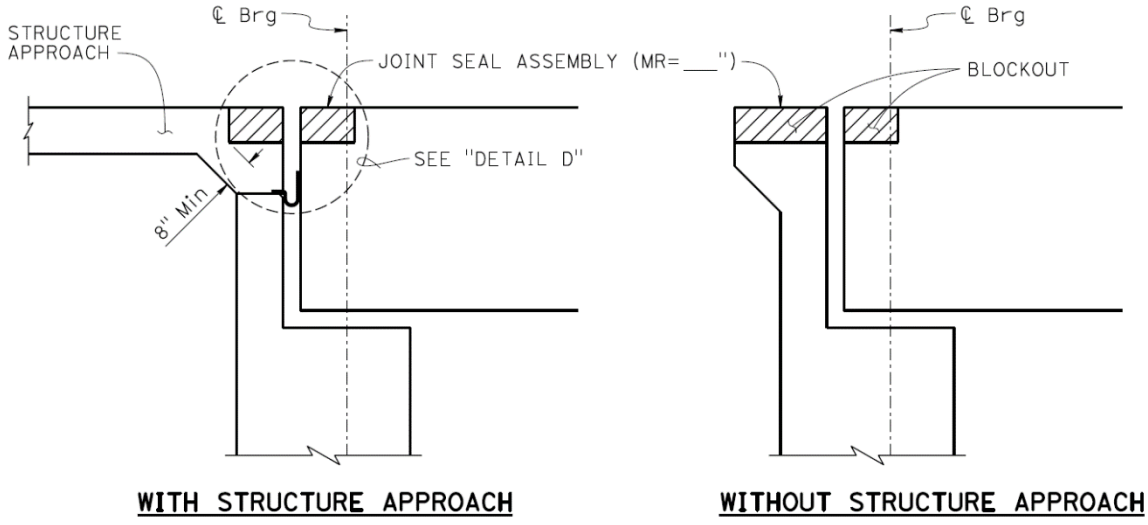


Figure 6.7.2 Joint Seal Assemblies (MR > 2½")

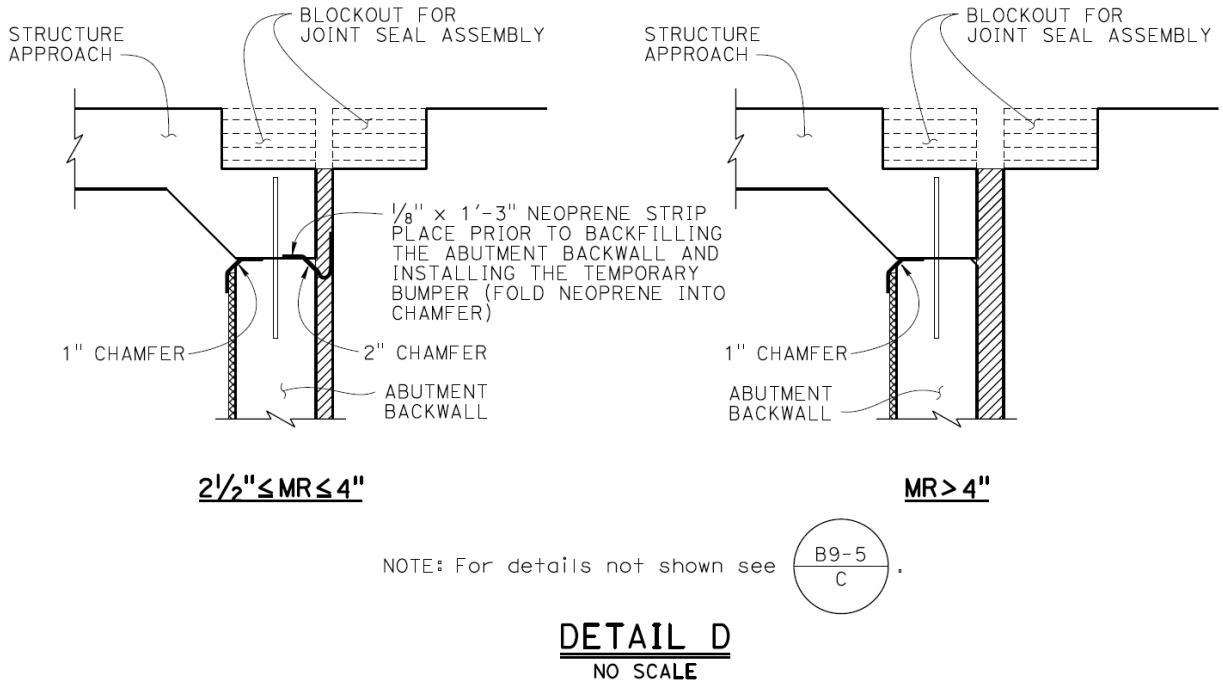


Figure 6.7.3 Joint Seal Protection Detail (MR > 2½")

Note: "DETAIL D" must be shown in the plans for bridges with Standard Plan structure approach slabs with joint MR > 2". Show only the applicable portion of the detail that covers the actual joint MR range of the bridge.

Bridge Design Details 6.8 February 2020

BB and EB Locations

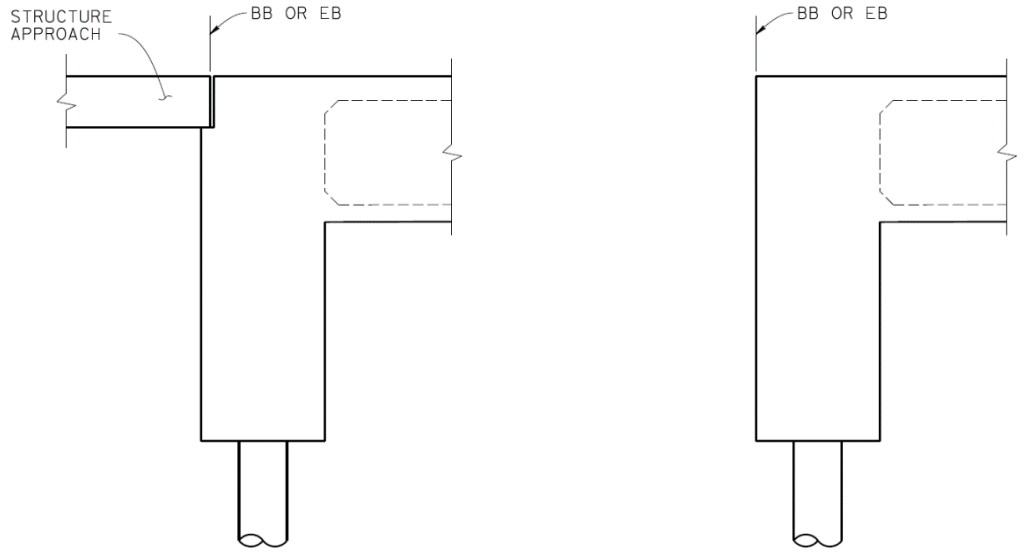


Figure 6.8.1 Diaphragm Abutment BB and EB Locations

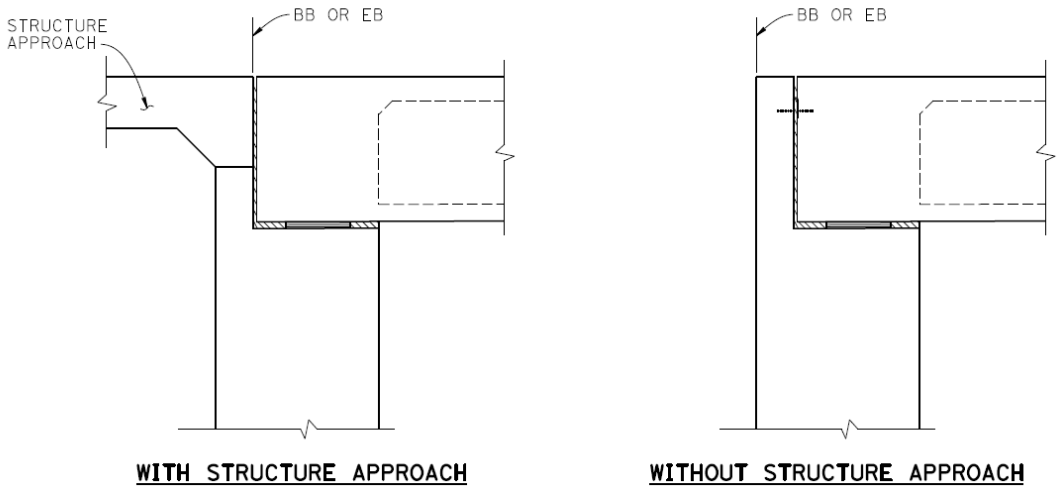


Figure 6.8.2 Seat Abutment BB and EB Locations

Bridge Design Details 6.9 February 2020

Cantilever Wingwalls

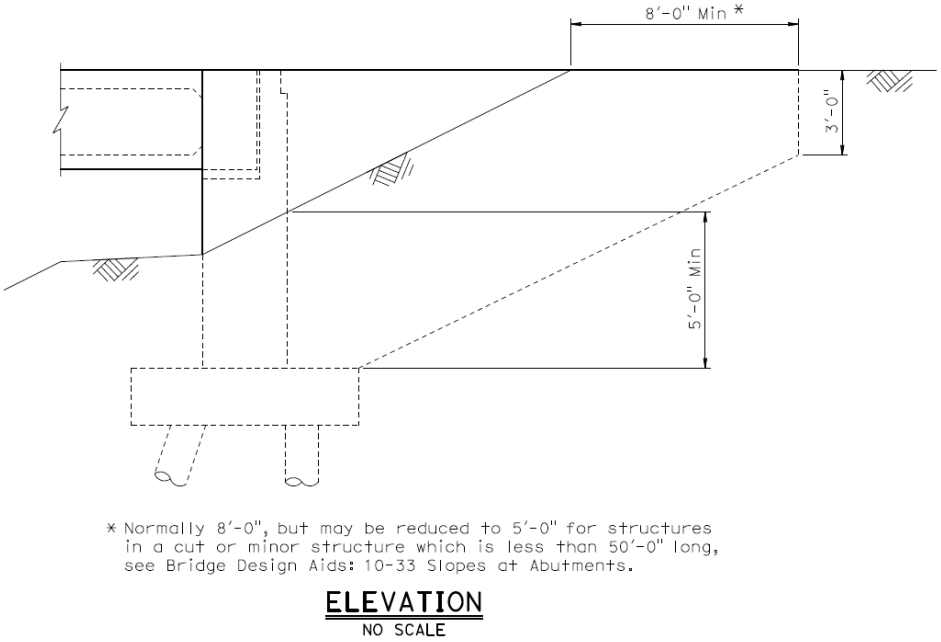


Figure 6.9.1 Minimum Soil Cover

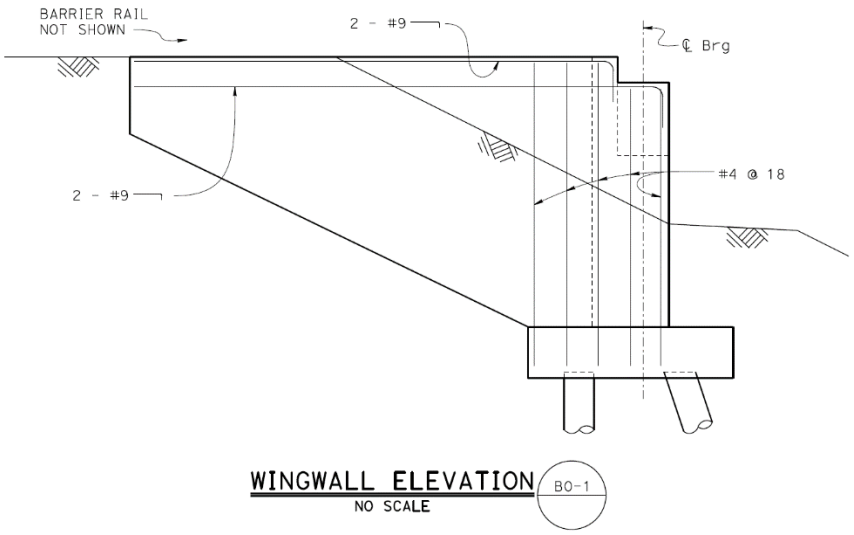


Figure 6.9.2 Seat Abutment with Standard Plan Wingwall

Bridge Design Details 6.10 February 2020

Retaining Wall Wingwalls

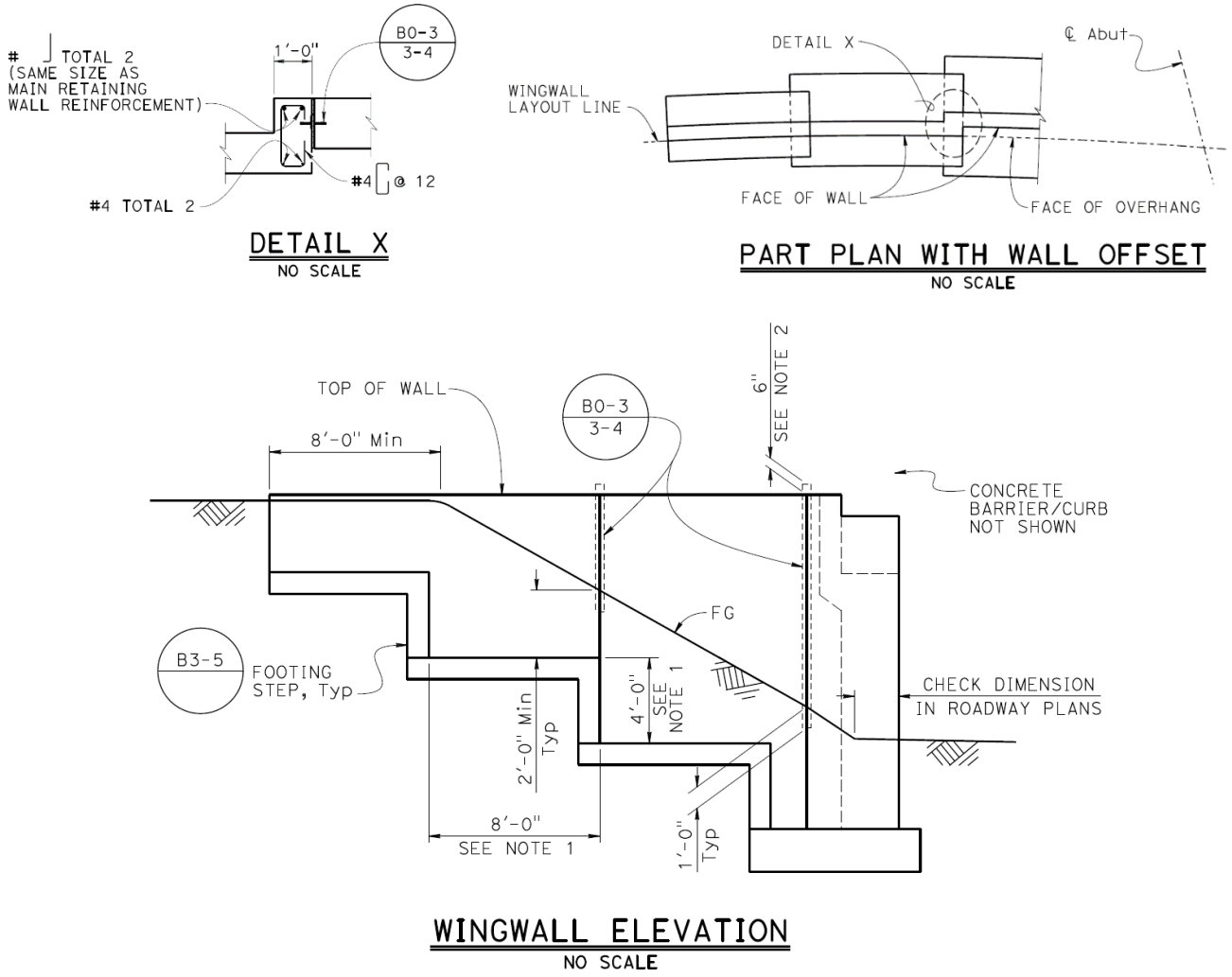


Figure 6.10.1 Retaining Wall Wingwalls

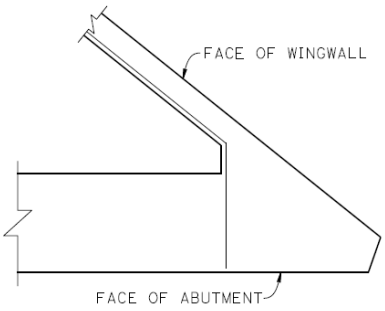
Notes:

1. Preferred step dimensions shown, may vary to fit slope conditions or pile spacings. For additional information refer to *Standard Plan*: B3-5 Retaining Wall Details No. 1.
2. Extend waterstop 6 inches into concrete barrier or curb.

Bridge Design Details 6.11 February 2020

Abutment Wingwall Corners

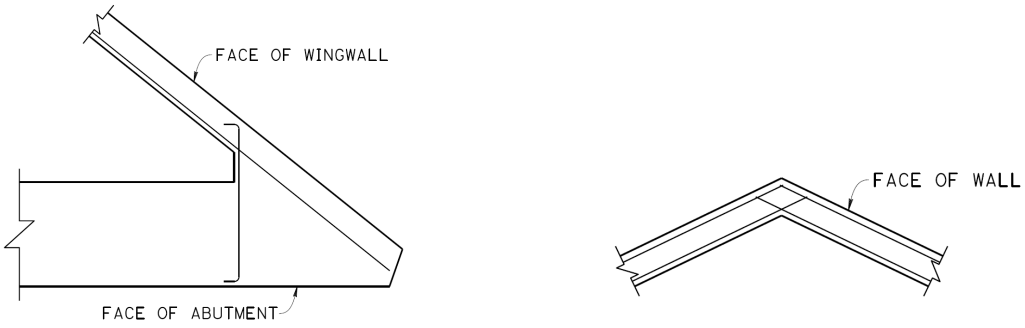
Tension reinforcement shall not be bent around a re-entrant corner of an acute abutment. The small amount of concrete cover is not sufficient to keep the reinforcing from straightening.



INCORRECT

Figure 6.11.1 Abutment Wingwall Corners

Reinforcement in each face should be straight and extend the required development length after it crosses the bar from the other direction. Standard practice for detailing reinforcement in all corners and angle changes in members is shown below.



CORRECT

Figure 6.11.2 Abutment Wingwall Corners

Bridge Design Details 6.12 February 2020

Barriers on Walls

When a barrier or bridge railing is to be placed on a wingwall or retaining wall, the wall must be detailed to alert the contractor of the additional work to be performed. This information is shown on the barrier Standard Plan or on the specific XS-SHEET details and must be referenced in the plans. The details below illustrate the minimum additional detail required for a standard plan concrete barrier. Details for Standard Plan barriers with a curb are similar.

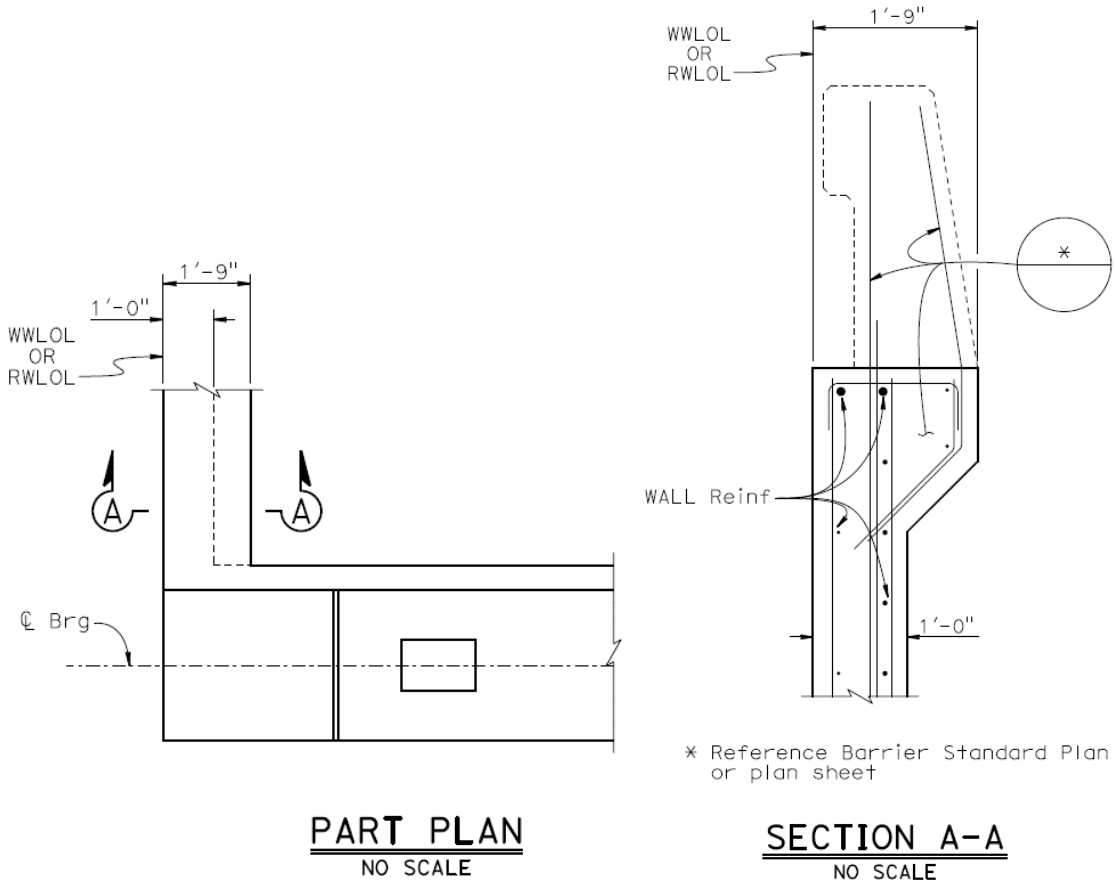


Figure 6.12.1 Concrete Barrier on Walls

Bridge Design Details 6.13 February 2020

Edge Distance Calculation for Bearing Pad

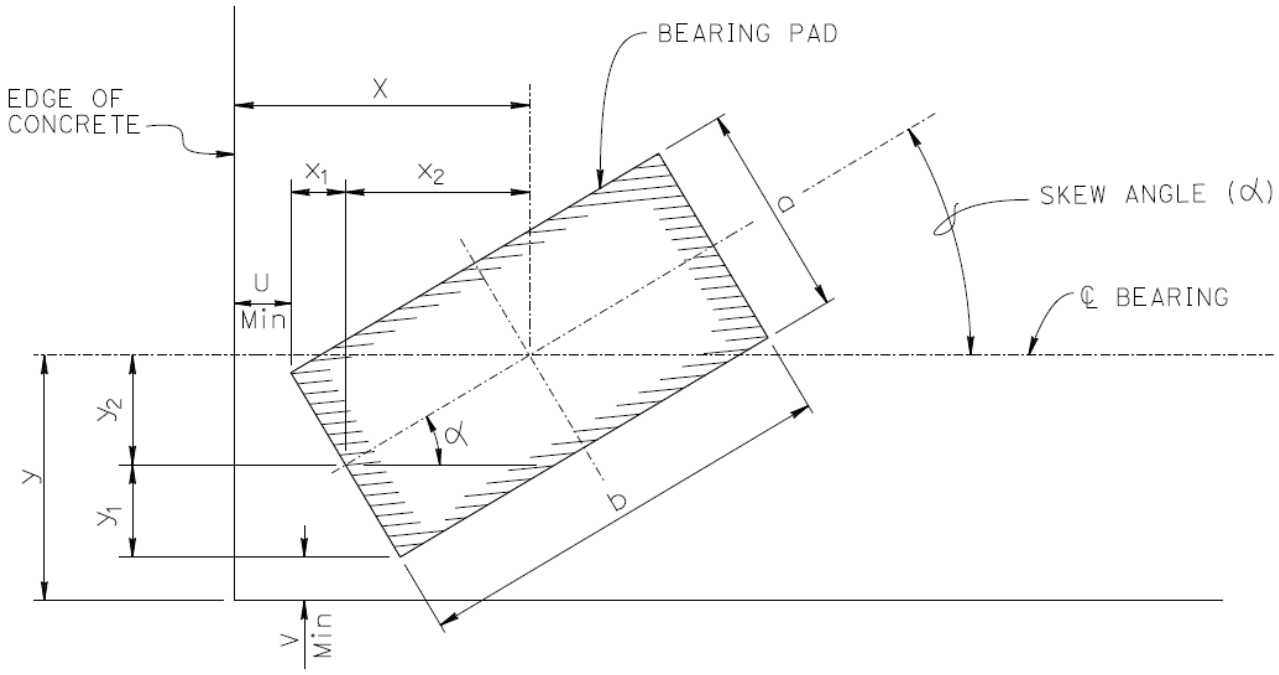


Figure 6.13.1 Bearing Layout

Formulas:

$$Y = V + \frac{a}{2}\cos\alpha + \frac{b}{2}\sin\alpha$$

$$y = V + y_1 + y_2$$

$$y_1 = \frac{a}{2}\cos\alpha$$

$$y_2 = \frac{b}{2}\sin\alpha$$

$$X = U + \frac{a}{2}\sin\alpha + \frac{b}{2}\cos\alpha$$

$$x = U + y_1 + y_2$$

$$x_1 = \frac{a}{2}\sin\alpha$$

$$x_2 = \frac{b}{2}\cos\alpha$$

Example: 10” x 22” Bearing Pad (a = 10”, b = 22”)
Minimum Skew Angle (α) = 27° 10’ 30”
Clearance (U = 3”, V = 3”)

Calculate: $Y = 3” + {}^{10”}/_{2}\ (0.8896) + {}^{22”}/_{2}\ (0.4567)$
$Y = 3” + 4.45” + 5.02” = 12.47”$, use 12½” minimum

$X = 3” + {}^{10”}/_{2}\ (0.4567) + {}^{22”}/_{2}\ (0.8896)$
$X = 3” + 2.28” + 9.78” = 15.06”$, use 15” minimum

Abutment - Checklist

Structure:	Structure Number:
Contract Number:	Project Number & Phase:
Detailer:	Date:
Designer:	Date:
Checker:	Date

Plan

- ☐ 1. Place at the top, left side of sheet, oriented with the front side facing down and the centerline of abutment horizontal. Alternatively, the PLAN view may be orientated the same direction as the PLAN view shown on the GENERAL PLAN sheet.
- ☐ 2. The minimum scale is ¼" = 1'-0". Use ⅛" = 1'-0" on large structures, but show less detail.
- ☐ 3. Show abutment, footing, pile spacing, bearing pad, and wingwall dimensions along the same layout lines used on the FOUNDATION PLAN (Note: Show the centerline of the abutment bearing for seat abutments and the centerline of the abutment for diaphragm abutments).
- ☐ 4. Do not repeat layout stations or bearings shown on the FOUNDATION PLAN.
- ☐ 5. Show wingwall or retaining wall lengths.
- ☐ 6. Show pile spacing (Do not dimension piles from edge of footing).
    - ☐ A FOOTING PLAN may be used to show pile spacing if it can't be shown clearly in the PLAN view. Additional DETAILS of footings should be shown in the same orientation as the PLAN view. Show the centerline of bearing.
- ☐ 7. Show North arrow.
- ☐ 8. Show bearing pads and limits of level bearing area. A portion of the expanded polystyrene or expansion joint filler material may be added.
- ☐ 9. Show the centerline of utility and future utility openings. Identify the size of opening and details for buried pipe for bridges with approach slabs, see *Standard Plan*: B6-10 Utility Openings T-Beam and *Standard Plan*: B7-10 Utility Openings Box Girder.
- ☐ 10. Avoid showing portions of approach slabs or reinforcement.

Elevation

- [ ] 1. Place below PLAN view, projected from face of abutment. If PLAN is orientated the same as the GENERAL PLAN, place ELEVATION in front of PLAN, looking normal to face of abutment
- [ ] 2. Use solid lines for portions below grade. Rear elevations should be avoided. ELEVATION should be a depiction of abutment stem, backwall, and footing. Avoid showing the superstructure on seat type abutments, but if it shown – use dashed lines.
- [ ] 3. Use the same scale as PLAN view.
- [ ] 4. Show location of weep holes if Structure Approach Drainage is not required. For typical drainage details, see *Standard Plan B0-3*: Bridge Detail 3-1.
- [ ] 5. Show the finished grade or slope paving in front of the abutment (FG should be parallel to the deck when the cross slope is constant and level for crowned slopes).
- [ ] 6. Do not attempt to show the entire skewed wingwalls.
- [ ] 7. Show bearing pads and utility opening information.
- [ ] 8. Do not show all piles (NOTE: All piles not shown).
- [ ] 9. Avoid showing barrier, approach slab, or other detail dimensions.

Wingwall Elevation

- [ ] 1. Projection of PLAN view, if possible; otherwise locate by VIEW letters or simply call out as WINGWALL ELEVATION.
- [ ] 2. Always show looking normal to the wall.
- [ ] 3. Use the same scale as PLAN view unless reinforcement is to be shown. Usually reinforcement should not be shown at a scale less than ⅜” = 1’-0”.
- [ ] 4. Do not show wingwall layout dimensions given on PLAN view. Call out Standard Plan references.
- [ ] 5. Show SECTION of top of wall details for railings, sidewalks, overhangs, and architectural treatment. Section should show Structure Approach Drainage Details if applicable.
- [ ] 6. Show finished grade or slope paving.
- [ ] 7. Show all piles.
- [ ] 8. Railing need not be shown (NOTE: Barrier railing not shown).

Retaining Wall or Return Wall Elevation

- [ ] 1. Do not show dimensions given on PLAN view or standard plan sheets. Call out Standard Plan references (i.e. footing steps, expansion joints, weakened planes, etc). Show all other layout information along the Retaining Wall Layout Line (RWLOL).
- [ ] 2. Long retaining walls adjacent to bridges may require separate sheets or plans showing PLAN and ELEVATION details.
- [ ] 3. Show SECTION of top of wall details for railings, sidewalks, overhangs, and architectural treatment. Section should show Structure Approach Drainage Details if applicable.
- [ ] 4. Do not show all piles (NOTE: All piles not shown).
- [ ] 5. Distance between footing steps should be in multiples of 8 feet. Maximum height of steps should be held to 4 feet. For typical step details, see *Standard Plan B3-5*: Retaining Wall Details No. 1 - Footing Step. Small steps less than 12 inches should be avoided unless distance between steps is 96 feet or more. If footing thickness changes between steps, the bottom of footing elevation should be adjusted so that the top of footing remains at the same elevation.
- [ ] 6. When sloping footings are used, form and joint lines are permitted to be perpendicular and parallel to the footing for ease of construction. Sloping footing grades shall be constant for the entire length of the wall. If breaks in footing grade (angle points) are deemed necessary, a level-stepped footing shall be used for the entire wall instead of a sloping footing (Maximum permissible slope for a reinforced concrete retaining wall footing is 3% and maximum permissible slope for masonry walls is 2%).
- [ ] 7. Weakened plane joints (*Standard Plan B0-3*: Bridge Detail 3-2) should be shown at nearly equal spaces between expansion joints.
- [ ] 8. Expansion Joints (*Standard Plan B0-3*: Bridge Detail 3-4) shall be shown at maximum intervals of 96 feet (shorter spaces should be in multiples of 8 feet). Expansion joints should not be placed at an angle point in the wall alignment. Waterstop in the expansion joint shall be shown to extend 1 foot below the finished grade. When concrete barriers or curbs are used on top of the retaining walls, the waterstop in the expansion joint shall be shown to extend 6 inches into the barrier or curb.

Sections and Details

- [ ] 1. For general requirements, see *Bridge Design Details*: 1.1 General Detailing - Detail Layout, Sections, and Views.
- [ ] 2. SECTIONS and DETAILS showing reinforcement should not be less than ⅜" = 1'-0" scale; the preferred scale is ½" = 1'-0" minimum.
- [ ] 3. Do not repeat reinforcement shown in the Standard Plans.
- [ ] 4. Abutment SECTION should include the following:
  - [ ] a) Location of Beginning of Bridge (BB) and End of Bridge (EB), see *Bridge Design Details*: 6.8 BB and EB Locations.
  - [ ] b) Centerline Bearing for seat type abutment and Centerline Abutment for diaphragm type.
  - [ ] c) Stem and backwall reinforcement. For post tensioned girder bridges, backwall to be placed after bridge has been stressed.
  - [ ] d) Footing reinforcement and pile spacing.
  - [ ] e) Outline of end diaphragm or superstructure (Do not use drop out lines or include reinforcement details of superstructure beyond bars that extend from end diaphragm abutment into deck).
  - [ ] f) Joint seal type, movement range, and joint seal blockout details.
  - [ ] g) Waterstop or Structure Approach joint detail, see *Bridge Design Details*: 6.7 Sealed Joints.
  - [ ] h) Drainage details behind the abutment and "Weep Hole and Geocomposite Drain Detail" alternative when *Standard Plan B0-3:* Detail 3-1 is shown. For more information, see *Bridge Design Details*: 6.3 Abutment Drainage Details.
    - [ ] Edit the NOTES in the "Weep Hole and Geocomposite Drain Detail" to remove references to wall types or elements that are not specific to the project plans.
  - [ ] i) Dimension distance below the soffit and width of maintenance berm. For additional berm information, see *Bridge Design Details*: 2.1 Bridge Layout and *Bridge Design Details*: 6.2 Seat & End Diaphragm Abutments.
- [ ] 5. SHEAR KEY DETAIL should include the following:
  - [ ] a) Expanded polystyrene and expansion joint filler details.
  - [ ] b) Shear Key, stem, and wingwall reinforcement.

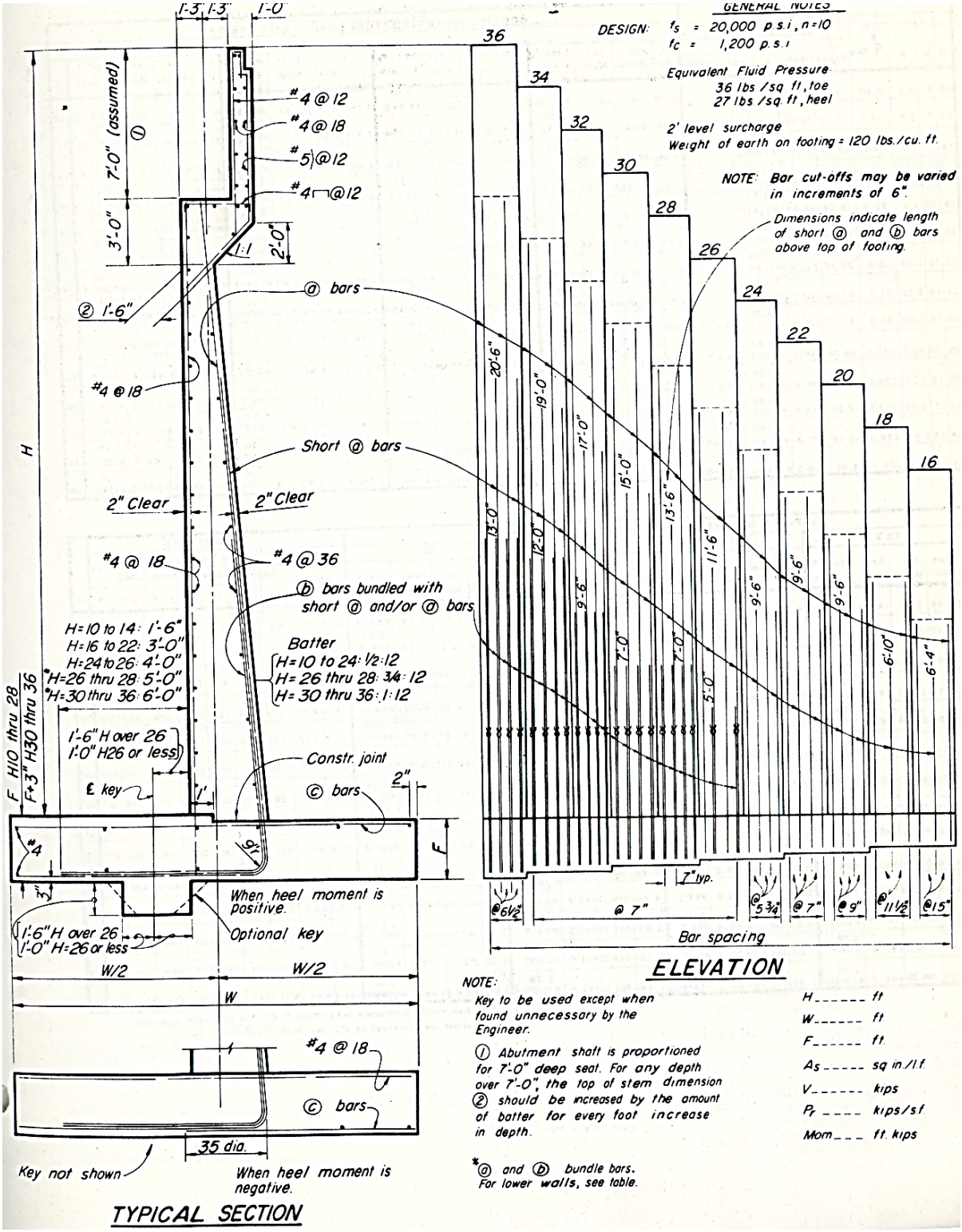


Figure 6A.B.1 High Cantilever Abutment on Spread Footing Details

NOTE: The following information is to only be used for initial abutment design sizing and planning study assumptions. Final design of abutments shall be based on current Bridge Design Specifications.

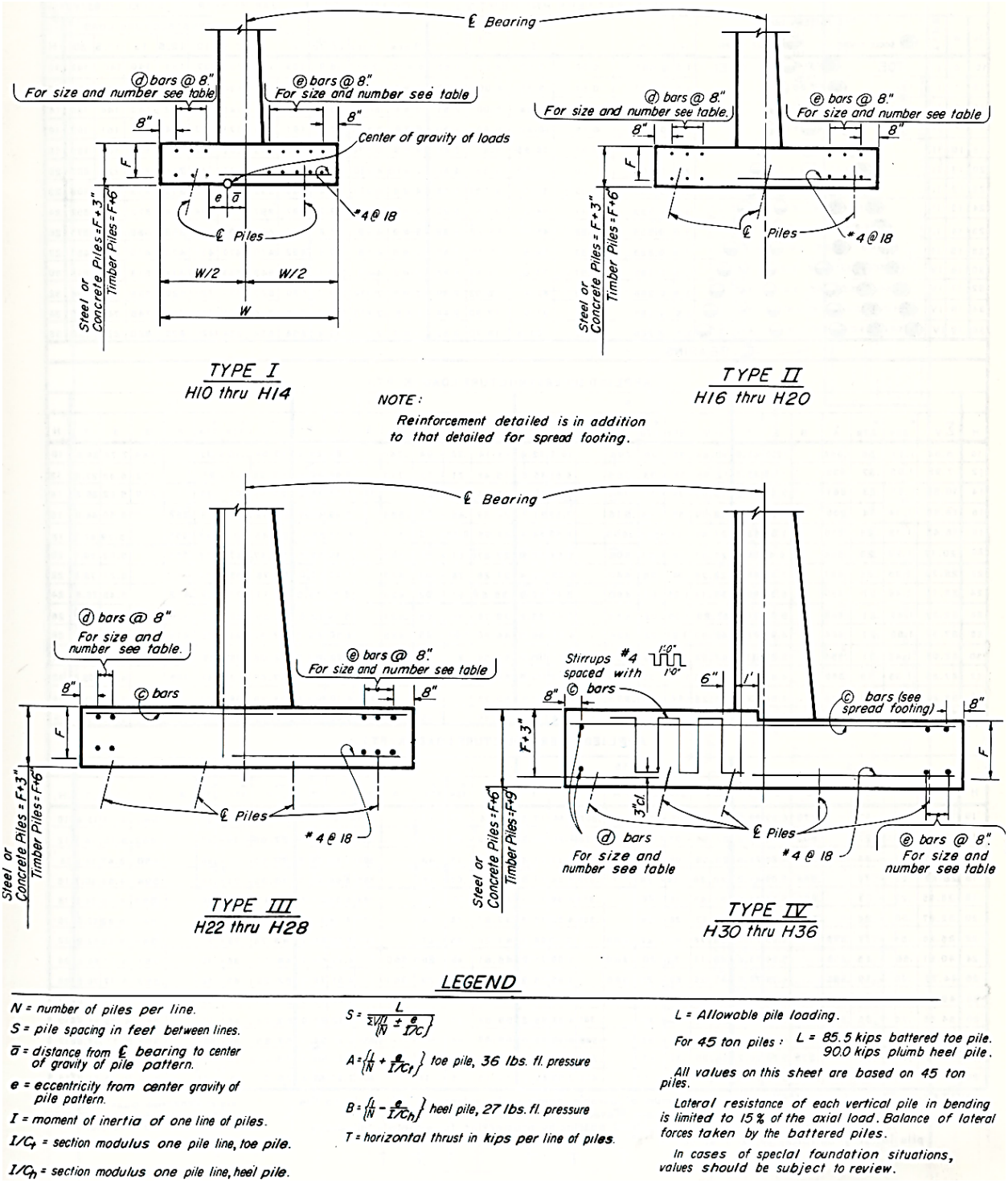
H	W	F	ΣM @ ℄ Brg	ΣV with 0 Supstr	Shaft @ top of ftg. Mom.	As a bars	As b bars	APPLIED SUPERSTRUCTURE LOAD IN KIPS PER FT. 0 toe Pr.	0 toe Mom.	0 heel Mom.	0 heel As c bars	5 toe Pr.	5 toe Mom.	5 heel Mom	5 heel As c bars	7.5 toe Pr.	7.5 toe Mom.	7.5 heel Mom.	7.5 heel As c bars	10 toe Pr.	10 toe Mom.	10 heel Mom.	10 heel As c bars	H
10	6	1.5	-9.40	5.42	9.60	0.42 #8@18		2.47	-2.62	+4.37	0.19 #5@18	3.31	-3.89	+1.21	0.05 #4@18	3.72	-4.52	-1.84	0.08 #4@18	4.14	-5.17	-3.44	0.15 #5@18	10
12	7	1.5	-13.7	7.72	15.55	0.64 #9@18		2.78	-4.88	+7.58	0.33 #7@18	3.50	-6.70	+3.99	0.17 #5@18	3.85	-7.59	+2.22	0.10 #4@18	4.21	-8.50	-2.01	0.09 #4@18	12
14	8	1.5	-19.0	10.25	23.50	0.91 #11@18		3.06	-8.33	+11.35	0.49 #8@18	3.69	-10.70	+7.33	0.32 #7@18	4.00	-11.89	+5.37	0.23 #6@18	4.31	-13.06	+3.33	0.14 #5@18	14
16	9	1.5	-25.4	13.05	33.80	1.24 #11@15		3.33	-12.66	+16.03	0.70 #9@15	3.89	-15.60	+11.57	0.50 #8@15	4.16	-17.04	+9.39	0.41 #7@15	4.44	-18.51	+7.05	0.31 #6@15	16
18	10	1.5	-32.9	16.08	46.65	1.62 #11@11½		3.59	-18.19	+21.73	0.94 #9@11½	4.08	-21.72	+16.84	0.73 #8@11½	4.34	-23.50	+14.41	0.63 #7@11½	4.59	-25.30	+11.94	0.52 #7@11½	18
20	11	1.75	-44.3	19.76	62.40	2.06 #11@9		3.99	-26.60	+29.46	1.08 #9@9	4.44	-30.66	+24.15	0.88 #8@9	4.67	-32.75	+21.50	0.79 #7@9	4.90	-34.83	+18.88	0.69 #7@9	20
22	12	1.75	-55.8	23.33	81.30	2.56 #11@7		4.27	-35.42	+37.70	1.38 #9@7	4.68	-40.14	+31.93	1.17 #11@14	4.90	-42.56	+28.97	1.06 #11@14	5.10	-44.84	+26.21	0.96 #10@14	22
24	13	2.00	-71.7	27.62	103.7	3.13 #11@5¼		4.67	-47.39	+48.85	1.54 #11@11½	5.06	-52.73	+42.62	1.35 #11@11½	5.25	-55.31	+39.60	1.25 #10@11½	5.44	-57.95	+36.52	1.15 #10@11½	24
26	14	2.00	-86.2	31.77	129.8	3.38 #11@7	#9@14	4.90	-60.51	+53.7	1.74 #9@7	5.26	-66.44	+49.0	1.64 #9@7	5.44	-69.37	+45.8	1.53 #9@7	5.61	-72.28	+42.0	1.40 #9@7	26
28	15	2.25	-107.2	36.74	159.3	3.93 #11@7	#8@7	5.32	-77.10	+67.2	1.96 #10@7	5.65	-83.62	+61.0	1.77 #9@7	5.82	-86.88	+59.2	1.73 #9@7	5.98	-90.09	+56.5	1.65 #9@7	28
30	16	2.25	-126.1	41.48	194.4	3.89 #11@7	#8@7	5.55	-94.25	+70.1	2.19 #10@7	5.86	-101.39	+64.3	1.86 #10@7	6.01	-104.91	+61.7	1.80 #10@7	6.17	-108.69	+59.7	1.74 #10@7	30
32	17	2.50	-152.5	47.21	233.5	4.40 #11@7	#9@7	5.94	-116.15	+83.3	2.16 #10@7	6.23	-123.80	+77.4	2.00 #10@7	6.38	-127.73	+74.3	1.93 #10@7	6.52	-131.63	+71.4	1.85 #10@7	32
34	18	2.50	-176.5	52.58	277.4	4.97 #11@7	#11@7	6.19	-139.21	+96.5	2.50 #11@7	6.47	-147.62	+89.6	2.32 #11@7	6.61	-151.82	+87.2	2.25 #11@7	6.75	-156.02	+84.1	2.17 #10@7	34
36	19	2.75	-209.1	58.94	326.6	5.55 #11@6½	#11@6½	6.55	-166.91	+111.6	2.60 #11@6½	6.82	-175.92	+105.1	2.43 #11@6½	6.95	-180.35	+103.5	2.36 #11@6½	7.09	-184.94	+101.2	2.28 #10@6½	36

H	APPLIED SUPERSTRUCTURE LOAD IN KIPS PER FT. 12.5 toe Pr.	12.5 toe Mom	12.5 heel Mom	12.5 heel As c bars	15 toe Pr.	15 toe Mom	15 heel Mom.	15 heel As c bars	17.5 toe Pr.	17.5 toe Mom	17.5 heel Mom	17.5 heel As c bars	20 toe Pr.	20 toe Mom	20 heel Mom.	20 heel As c bars	QUANTITIES Conc cf/ft	Bar Reinforcing Steel (lbs./ft.) Applied Superstructure Load 0	5	7.5	10	12.5	15	17.5	20	H
10	4.56	-5.80	-4.99	0.22 #6@18	4.97	-6.45	-6.61	0.31 #7@18	5.39	-7.09	-8.17	0.38 #7@18	5.81	-7.73	-9.74	0.45 #8@18	24.5	57	55	57	58	59	61	61	63	10
12	4.57	-9.41	-3.74	0.15 #5@18	4.93	-10.31	-5.55	0.26 #6@18	5.28	-11.21	-7.32	0.34 #7@18	5.64	-12.12	-9.13	0.42 #8@18	29.1	74	69	68	70	71	72	74	76	12
14	4.62	-14.23	-1.98	0.09 #4@18	4.94	-15.44	-4.05	0.19 #5@18	5.25	-16.60	-6.01	0.28 #6@18	5.56	-17.78	-8.01	0.37 #7@18	33.8	102	99	96	93	94	95	96	98	14
16	4.72	-20.00	+4.92	0.22 #5@15	5.00	-21.47	+2.68	0.12 #4@15	5.27	-22.90	-3.98	0.17 #5@15	5.55	-24.40	-6.25	0.29 #6@15	38.9	129	124	119	115	112	109	113	115	16
18	4.84	-27.06	+9.52	0.41 #6@11½	5.09	-28.84	+7.10	0.31 #5@11½	5.34	-30.24	+4.63	0.20 #4@11½	5.59	-32.37	-3.80	0.18 #4@11½	43.8	172	164	158	158	152	147	143	145	18
20	5.13	-36.78	+16.25	0.59 #6@9	5.36	-38.89	+13.06	0.48 #6@9	5.59	-40.98	+10.92	0.40 #5@9	5.81	-42.97	+8.29	0.30 #5@9	51.7	231	220	211	211	203	203	196	196	20
22	5.31	-47.11	+22.87	0.83 #9@14	5.52	-49.53	+20.49	0.75 #9@14	5.72	-51.89	+17.62	0.64 #8@14	5.94	-54.27	+14.69	0.54 #8@14	57.4	307	291	291	281	271	271	264	264	22
24	5.64	-60.67	+33.31	1.05 #10@11½	5.83	-63.21	+30.19	0.95 #9@11½	6.02	-65.94	+27.21	0.86 #9@11½	6.21	-68.65	+24.13	0.76 #8@11½	66.5	366	366	353	353	353	341	341	331	24
26	5.80	-75.32	+40.3	1.35 #11@14	5.98	-78.30	+36.9	1.23 #11@14	6.16	-81.29	+33.6	1.17 #11@14	6.34	-84.23	+31.4	1.05 #10@14	77.8	400	400	400	400	382	382	382	371	26
28	6.14	-93.30	+53.1	1.55 #9@7	6.32	-96.66	+50.2	1.47 #9@7	6.48	-99.85	+46.8	1.37 #11@14	6.64	-103.14	+43.9	1.28 #11@14	90.8	492	470	470	470	470	470	451	451	28
30	6.33	-112.04	+56.0	1.63 #9@7	6.49	-115.69	+52.8	1.54 #9@7	6.65	-119.29	+49.9	1.43 #9@7	6.80	-122.80	+46.9	1.36 #9@7	103.6	543	543	543	543	518	518	518	518	30
32	6.67	-135.31	+68.3	1.76 #10@7	6.82	-139.31	+65.4	1.69 #9@7	6.97	-143.23	+62.2	1.60 #9@7	7.11	-147.00	+59.3	1.52 #9@7	117.3	620	620	620	620	620	594	594	594	32
34	6.89	-160.12	+80.4	2.08 #10@7	7.03	-163.83	+77.1	2.00 #10.7	7.16	-168.32	+74.0	1.91 #10@7	7.30	-172.53	+70.8	1.83 #10@7	126.7	776	776	776	745	745	745	745	745	34
36	7.22	-189.28	+99.1	2.30 #10@6½	7.35	-193.78	+96.2	2.24 #10@6½	7.48	-198.21	+88.6	2.18 #10@6½	7.61	-202.63	+85.1	2.00 #10@6½	141.4	854	854	854	820	820	820	820	820	36

NOTE: For walls with seats less than 7'-0", the concrete quantity shall be increased by 2% per foot of variation.

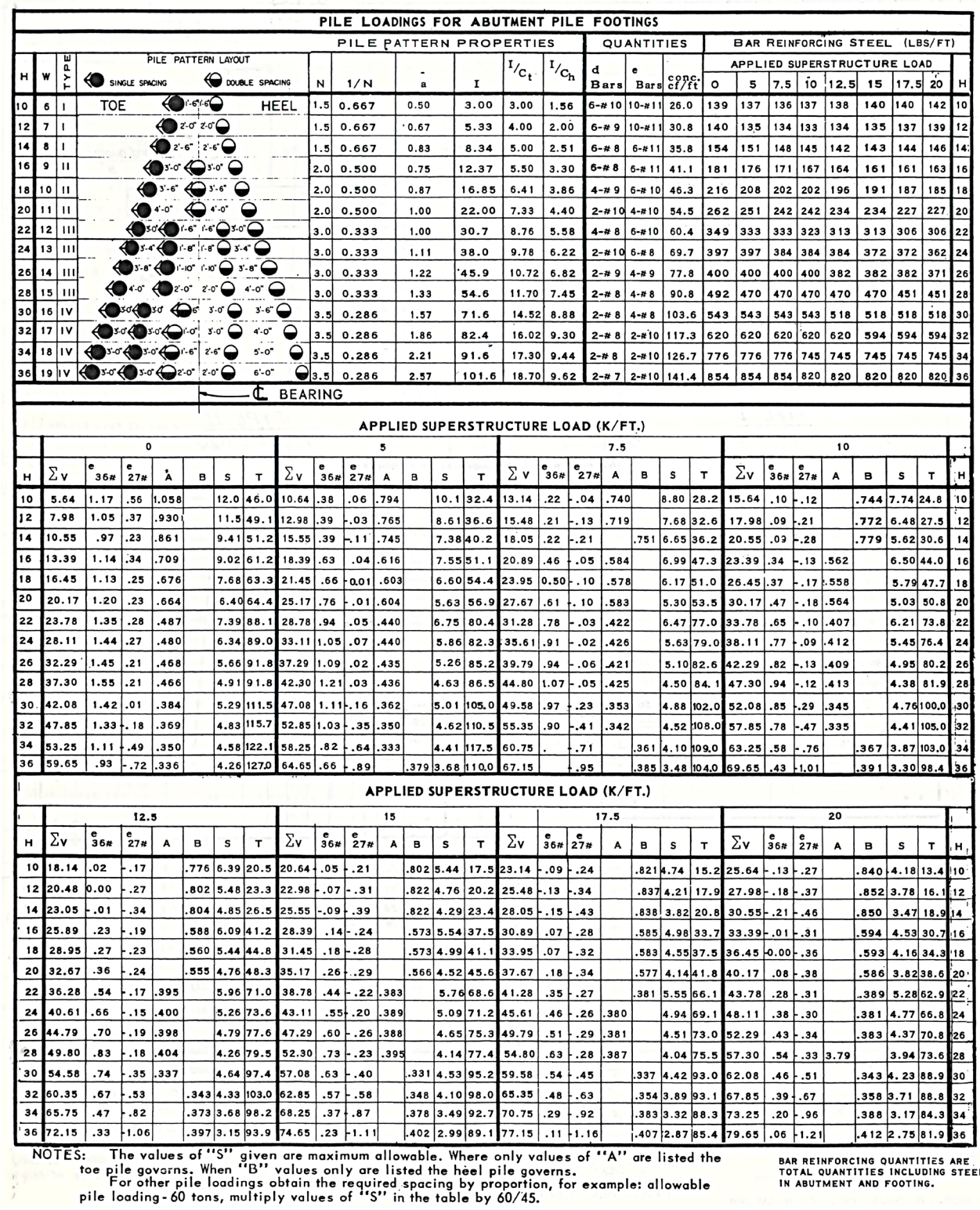
NOTE: The following information is to only be used for initial abutment design sizing and planning study assumptions. Final design of abutments shall be based on current Bridge Design Specifications.

Figure 6A.B.2 High Cantilever Abutment on Spread Footing Information



NOTE: The following information is to only be used for initial abutment design sizing and planning study assumptions. Final design of abutments shall be based on current Bridge Design Specifications.

Figure 6A.B.3 High Cantilever Abutment on Pile Footing Details



PILE LOADINGS FOR ABUTMENT PILE FOOTINGS

PILE PATTERN PROPERTIES

H	W	TYPE	PILE PATTERN LAYOUT (SINGLE SPACING / DOUBLE SPACING)	N	1/N	a	I	I/C_t	I/C_h
10	6	I	TOE 1'-6" 1'-6" HEEL	1.5	0.667	0.50	3.00	3.00	1.56
12	7	I	2'-0" 2'-0"	1.5	0.667	0.67	5.33	4.00	2.00
14	8	I	2'-6" 2'-6"	1.5	0.667	0.83	8.34	5.00	2.51
16	9	II	3'-0" 3'-0"	2.0	0.500	0.75	12.37	5.50	3.30
18	10	II	3'-6" 3'-6"	2.0	0.500	0.87	16.85	6.41	3.86
20	11	II	4'-0" 4'-0"	2.0	0.500	1.00	22.00	7.33	4.40
22	12	III	3'-0" 1'-6" 1'-6" 3'-0"	3.0	0.333	1.00	30.7	8.76	5.58
24	13	III	3'-4" 1'-8" 1'-8" 3'-4"	3.0	0.333	1.11	38.0	9.78	6.22
26	14	III	3'-8" 1'-10" 1'-10" 3'-8"	3.0	0.333	1.22	45.9	10.72	6.82
28	15	III	4'-0" 2'-0" 2'-0" 4'-0"	3.0	0.333	1.33	54.6	11.70	7.45
30	16	IV	3'-0" 3'-0" 3'-6" 3'-0" 3'-6"	3.5	0.286	1.57	71.6	14.52	8.88
32	17	IV	3'-0" 3'-0" 1'-0" 3'-0" 4'-0"	3.5	0.286	1.86	82.4	16.02	9.30
34	18	IV	3'-0" 3'-0" 1'-6" 2'-6" 5'-0"	3.5	0.286	2.21	91.6	17.30	9.44
36	19	IV	3'-0" 3'-0" 2'-0" 2'-0" 6'-0"	3.5	0.286	2.57	101.6	18.70	9.62

℄ BEARING

QUANTITIES

H	d Bars	e Bars	conc. cf/ft
10	6-#10	10-#11	26.0
12	6-#9	10-#11	30.8
14	6-#8	6-#11	35.8
16	6-#8	6-#11	41.1
18	6-#8	6-#11	41.1
20	4-#9	6-#10	46.3
22	2-#10	4-#10	54.5
24	4-#8	6-#10	60.4
26	2-#10	6-#8	69.7
28	2-#9	4-#9	77.8
30	2-#8	4-#8	90.8
32	2-#8	4-#8	103.6
34	2-#8	2-#10	117.3
36	2-#8	2-#10	126.7
36	2-#7	2-#10	141.4

BAR REINFORCING STEEL (LBS/FT)

H	APPLIED SUPERSTRUCTURE LOAD 0	5	7.5	10	12.5	15	17.5	20	H
10	139	137	136	137	138	140	140	142	10
12	140	135	134	133	134	135	137	139	12
14	154	151	148	145	142	143	144	146	14
16	181	176	171	167	164	161	161	163	16
18	216	208	202	202	196	191	187	185	18
20	262	251	242	242	234	234	227	227	20
22	349	333	333	323	313	313	306	306	22
24	397	397	384	384	384	372	372	362	24
26	400	400	400	400	382	382	382	371	26
28	492	470	470	470	470	470	451	451	28
30	543	543	543	543	518	518	518	518	30
32	620	620	620	620	620	594	594	594	32
34	776	776	776	745	745	745	745	745	34
36	854	854	854	820	820	820	820	820	36

APPLIED SUPERSTRUCTURE LOAD (K/FT.)

H	0 ΣV	0 e 36#	0 e 27#	0 A	0 B	0 S	0 T	5 ΣV	5 e 36#	5 e 27#	5 A	5 B	5 S	5 T
10	5.64	1.17	.56	1.058		12.0	46.0	10.64	.38	.06	.794		10.1	32.4
12	7.98	1.05	.37	.930		11.5	49.1	12.98	.39	-.03	.765		8.61	36.6
14	10.55	.97	.23	.861		9.41	51.2	15.55	.39	-.11	.745		7.38	40.2
16	13.39	1.14	.34	.709		9.02	61.2	18.39	.63	.04	.616		7.55	51.1
18	16.45	1.13	.25	.676		7.68	63.3	21.45	.66	-0.01	.603		6.60	54.4
20	20.17	1.20	.23	.664		6.40	64.4	25.17	.76	-.01	.604		5.63	56.9
22	23.78	1.35	.28	.487		7.39	88.1	28.78	.94	.05	.440		6.75	80.4
24	28.11	1.44	.27	.480		6.34	89.0	33.11	1.05	.07	.440		5.86	82.3
26	32.29	1.45	.21	.468		5.66	91.8	37.29	1.09	.02	.435		5.26	85.2
28	37.30	1.55	.21	.466		4.91	91.8	42.30	1.21	.03	.436		4.63	86.5
30	42.08	1.42	.01	.384		5.29	111.5	47.08	1.11	-.16	.362		5.01	105.0
32	47.85	1.33	-.18	.369		4.83	115.7	52.85	1.03	-.35	.350		4.62	110.5
34	53.25	1.11	-.49	.350		4.58	122.1	58.25	.82	-.64	.333		4.41	117.5
36	59.65	.93	-.72	.336		4.26	127.0	64.65	.66	-.89		.379	3.68	110.0

H	7.5 ΣV	7.5 e 36#	7.5 e 27#	7.5 A	7.5 B	7.5 S	7.5 T	10 ΣV	10 e 36#	10 e 27#	10 A	10 B	10 S	10 T
10	13.14	.22	-.04	.740		8.80	28.2	15.64	.10	-.12		.744	7.74	24.8
12	15.48	.21	-.13	.719		7.68	32.6	17.98	.09	-.21		.772	6.48	27.5
14	18.05	.22	-.21		.751	6.65	36.2	20.55	.09	-.28		.779	5.62	30.6
16	20.89	.46	-.05	.584		6.99	47.3	23.39	.34	-.13	.562		6.50	44.0
18	23.95	0.50	-.10	.578		6.17	51.0	26.45	.37	-.17	.558		5.79	47.7
20	27.67	.61	-.10	.583		5.30	53.5	30.17	.47	-.18	.564		5.03	50.8
22	31.28	.78	-.03	.422		6.47	77.0	33.78	.65	-.10	.407		6.21	73.8
24	35.61	.91	-.02	.426		5.63	79.0	38.11	.77	-.09	.412		5.45	76.4
26	39.79	.94	-.06	.421		5.10	82.6	42.29	.82	-.13	.409		4.95	80.2
28	44.80	1.07	-.05	.425		4.50	84.1	47.30	.94	-.12	.413		4.38	81.9
30	49.58	.97	-.23	.353		4.88	102.0	52.08	.85	-.29	.345		4.76	100.0
32	55.35	.90	-.41	.342		4.52	108.0	57.85	.78	-.47	.335		4.41	105.0
34	60.75	.	-.71		.361	4.10	109.0	63.25	.58	-.76		.367	3.87	103.0
36	67.15		-.95		.385	3.48	104.0	69.65	.43	-1.01		.391	3.30	98.4

APPLIED SUPERSTRUCTURE LOAD (K/FT.)

H	12.5 ΣV	12.5 e 36#	12.5 e 27#	12.5 A	12.5 B	12.5 S	12.5 T	15 ΣV	15 e 36#	15 e 27#	15 A	15 B	15 S	15 T
10	18.14	.02	-.17		.776	6.39	20.5	20.64	-.05	-.21		.802	5.44	17.5
12	20.48	0.00	-.27		.802	5.48	23.3	22.98	-.07	-.31		.822	4.76	20.2
14	23.05	-.01	-.34		.804	4.85	26.5	25.55	-.09	-.39		.822	4.29	23.4
16	25.89	.23	-.19		.588	6.09	41.2	28.39	.14	-.24		.573	5.54	37.5
18	28.95	.27	-.23		.560	5.44	44.8	31.45	.18	-.28		.573	4.99	41.1
20	32.67	.36	-.24		.555	4.76	48.3	35.17	.26	-.29		.566	4.52	45.6
22	36.28	.54	-.17	.395		5.96	71.0	38.78	.44	-.22	.383		5.76	68.6
24	40.61	.66	-.15	.400		5.26	73.6	43.11	.55	-.20	.389		5.09	71.2
26	44.79	.70	-.19	.398		4.79	77.6	47.29	.60	-.26	.388		4.65	75.3
28	49.80	.83	-.18	.404		4.26	79.5	52.30	.73	-.23	.395		4.14	77.4
30	54.58	.74	-.35	.337		4.64	97.4	57.08	.63	-.40		.331	4.53	95.2
32	60.35	.67	-.53		.343	4.33	103.0	62.85	.57	-.58		.348	4.10	98.0
34	65.75	.47	-.82		.373	3.68	98.2	68.25	.37	-.87		.378	3.49	92.7
36	72.15	.33	-1.06		.397	3.15	93.9	74.65	.23	-1.11		.402	2.99	89.1

H	17.5 ΣV	17.5 e 36#	17.5 e 27#	17.5 A	17.5 B	17.5 S	17.5 T	20 ΣV	20 e 36#	20 e 27#	20 A	20 B	20 S	20 T
10	23.14	-.09	-.24		.821	4.74	15.2	25.64	-.13	-.27		.840	4.18	13.4
12	25.48	-.13	-.34		.837	4.21	17.9	27.98	-.18	-.37		.852	3.78	16.1
14	28.05	-.15	-.43		.838	3.82	20.8	30.55	-.21	-.46		.850	3.47	18.9
16	30.89	.07	-.28		.585	4.98	33.7	33.39	-.01	-.31		.594	4.53	30.7
18	33.95	.07	-.32		.583	4.55	37.5	36.45	-0.00	-.36		.593	4.16	34.3
20	37.67	.18	-.34		.577	4.14	41.8	40.17	.08	-.38		.586	3.82	38.6
22	41.28	.35	-.27		.381	5.55	66.1	43.78	.28	-.31		.389	5.28	62.9
24	45.61	.46	-.26	.380		4.94	69.1	48.11	.38	-.30		.381	4.77	66.8
26	49.79	.51	-.29	.381		4.51	73.0	52.29	.43	-.34		.383	4.37	70.8
28	54.80	.63	-.28	.387		4.04	75.5	57.30	.54	-.33	3.79		3.94	73.6
30	59.58	.54	-.45		.337	4.42	93.0	62.08	.46	-.51		.343	4.23	88.9
32	65.35	.48	-.63		.354	3.89	93.1	67.85	.39	-.67		.358	3.71	88.8
34	70.75	.29	-.92		.383	3.32	88.3	73.25	.20	-.96		.388	3.17	84.3
36	77.15	.11	-1.16		.407	2.87	85.4	79.65	.06	-1.21		.412	2.75	81.9

NOTES: The values of "S" given are maximum allowable. Where only values of "A" are listed the toe pile governs. When "B" values only are listed the heel pile governs.
For other pile loadings obtain the required spacing by proportion, for example: allowable pile loading - 60 tons, multiply values of "S" in the table by 60/45.

BAR REINFORCING QUANTITIES ARE TOTAL QUANTITIES INCLUDING STEEL IN ABUTMENT AND FOOTING.

NOTE: The following information is to only be used for initial abutment design sizing and planning study assumptions. Final design of abutments shall be based on current Bridge Design Specifications.

Figure 6A.B.4 High Cantilever Abutment on Pile Footing Information