South Carolina
Department of Transportation

Office of Engineering Support
803-737-1377 | 803-766-1022 Fax

REVISIONS TO THE SCDOT SEISMIC DESIGN SPECIFICATIONS FOR HIGHWAY BRIDGES

April 2026

The revisions included herein shall apply to the SCDOT Seismic Design Specification for Highway Bridges and they supersede Bridge Design Memorandum DM0115.

REVISIONS TO SECTION 2

2.2 NOTATION:

On Page 2-5, replace

h Height from MSA point of fixity to top of column

with

h Height from MSA point of fixity to top of column/pile or clear height of column from top of footing to top of column (ft)

On Page 2-1, add the following definitions:

Global Displacement Capacity - The ultimate displacement monitored at top of piles or columns before collapse from pushover models of individual bents with full depth foundations and surrounding soils considered; analyzed with pushover loadings parallel or perpendicular to center line of bents and with equivalent superstructure dead load.

Global Yield Displacement - The yield displacement monitored at top of piles or columns when columns/ piles reach their yield moment; obtained from pushover models of individual bents with full depth foundations and surrounding soils considered; analyzed with pushover loadings parallel or perpendicular to center line of bents and with equivalent super structure dead load.

On Page 2-2, add the following definitions:

Local Displacement Capacity - The ultimate displacement monitored at top of piles or columns before collapse from pushover models of individual bents with foundations to the Point of Fixity (obtained from Multimode Spectral Analysis models) and without the surrounding soils; can be obtained from pushover analysis with pushover loadings parallel or perpendicular to centerline of bents with equivalent superstructure dead load; or by simplified formulas if certain conditions are satisfied.

Post Office Box 191
955 Park Street, Room 409
Columbia, SC 29202-0191

www.scdot.org
An Equal Opportunity
Affirmative Action Employer
855-GO-SCDOT (855-467-2368)

Local Yield Displacement - The yield displacement monitored at top of piles or columns when they reach their yield moment; can be obtained from pushover models of individual bents with foundations modeled to the Point of Fixity (obtained from Multimode Spectral Analysis models) and without the surrounding soils; analyzed with pushover loadings parallel or perpendicular to centerline of bents with equivalent superstructure dead load; or by simplified formulas if certain conditions are satisfied.

REVISIONS TO SECTION 3

Table 3.1 Bridge Operational Classification (OC)

Replace the top line for the description of OC I with the following:

All bridges (including ramp and collector-distributor bridges that carry system-to-system movements) that are located on the interstate system or along the following roads:

Table 3.2 Bridge Seismic Analysis Requirements

For Analysis Description of OC I, II, first bullet, revise to:

Functional Evaluation Earthquake (FEE)

- if potential soil shear strength loss or slope instability exists under any FEE design earthquake loads and no geotechnical mitigation is performed at the end bent embankment.

Add the following footnote to the table.

* No seismic design is required for pedestrian-only boardwalks Table 3.4 Bridge Components (Local) Damage Level Objectives:

Replace Reference Note 3 with:

3. Include Bent Caps, Footings (including the piles/shafts supporting the footings), and Oversized Drilled Shafts

3.5 SEISMIC DESIGN CATEGORY (SDC)

Delete last sentence of first paragraph and replace it with:

Use the flow chart in Figure 3.1 to determine the SDC for a structure.

Add a footnote underneath Table 3.5:

The SD1 used to determine SDC is at the top of ground.

3.6 SEISMIC DEMAND

Delete the second paragraph and replace it with:

Displacement demand can be obtained from a Multimode Spectral Analysis (MSA). Section 5 covers displacement demand modeling and computations.

Table 3.6 Bridge System Seismic Displacement Performance Limits

Delete this table.

3.9 DESIGN REQUIREMENTS FOR SINGLE SPAN BRIDGES OR SDC A BRIDGES

Delete and replace the last sentence with the following:

See Section 6, 8 and 9 for design and detailing requirements for single span bridges and SDC A bridges.

Add the following paragraph at the bottom of the section:

Note that while single span bridges are to be designed and detailed as noted above, their SDC shall be determined based on Table 3.5.

3.11 DESIGN REQUIREMENTS FOR TEMPORARY BRIDGES AND STAGED CONSTRUCTION

Delete the last paragraph and replace it as follows:

The following applies to widening of existing bridges. If the bridge has been seismically designed using the 2001 Seismic Design Specifications for Highway Bridges or the 2008 Seismic Design Specifications for Highway Bridges, the widened structure shall be designed to meet the same seismic performance requirements as the existing bridge. For widening of existing bridges that were not seismically designed using the above specifications, seismic design is not required.

3.12 DESIGN REQUIREMENTS FOR PEDESTRIAN BRIDGES

Delete the subsection and replace it with the following:

3.12 DESIGN REQUIREMENTS FOR NON-HIGHWAY BRIDGES

Pedestrian and Utility bridges over roads carrying vehicular traffic shall satisfy OC III performance objectives as indicated in Table 3.3. Pedestrian bridges owned or maintained by the Department or located within Department right-of-way will also satisfy the OC III performance objectives.Railroad bridges over roads carrying vehicular traffic shall satisfy the requirements of AREMA Chapter 9 for life safety and any other AREMA or railroad specific requirements.

3.13.1 Seismic Design Category A and Single Span Bridges

Delete next to last sentence of first paragraph and replace it with:

See Figure 3.2 for the SDC A analysis and design flowchart.

3.13.2 Seismic Design Category B

Delete next to last sentence of first paragraph and replace it with:

See Figure 3.3 for the SDC B analysis and design flowchart.

3.13.3 Seismic Design Category C

Delete next to last sentence of first paragraph and replace it with:

See Figure 3.4 for the SDC C analysis and design flowchart.

3.13.4 Seismic Design Category D

Delete next to last sentence of first paragraph and replace it with:

See Figure 3.5 for the SDC D analysis and design flowchart.

REVISIONS TO SECTION 5

Add Section 5.2.5 Accounting for Structure Resonances

Add:

The Structure Engineer of Record shall identify potential resonances of the bridges due to coincidences of the structure fundamental period, the soil column period and the earthquake period according to LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations, FHWA-NHI-11-032, GEC No.3.

It is deemed as resonance if the fundamental structural period (s) and the design earthquake period (T'o) are less than 10% different from each other and both are also in the range of the natural periods of the soil column.

Acceptable solutions to address large displacement demand due to resonances include changing structural configuration to avoid resonant responses and/or designing and detailing bridge structure elements to sustain the high demand.

5.6.2 Backwall/Wingwall Modeling

Delete the subsection and replace it with:

Backwall and wingwall stiffness shall be modeled to account for the mobilized passive resistance due to soil-structure interaction per the GDM.

REVISIONS TO SECTION 6

6.1 ANALYSIS OBJECTIVES

Delete the second sentence of the paragraph and replace it with following:

They can be estimated for SDC B bridges using the equations presented in Sections 6.5.3 and 6.5.4 if the applicable conditions are satisfied.

6.2 DEFINITION OF PLASTIC HINGES

Replace equation (6-3) with:

$$L_p = D^* + 0.08H' \leq 1.5D^*$$

6.4 PLASTIC HINGE ACCESSIBILITY

Delete the last paragraph and replace it with the following:

The key to forcing the plastic hinge above ground with the oversized drilled shaft is to design the reinforcement cage of the shaft with larger diameter than the column framing into the shaft. The diameter of Oversized drilled shafts shall be at least 24 inches larger than that of the column framing into the shaft for clearance and tolerance of construction. Column longitudinal reinforcement shall extend into oversized drilled shafts in a staggered manner as shown in Figure 6.2.

Figure 6.2 Typical and Oversized Drilled Shafts

Delete the elevation view of the Oversized Drilled Shaft in the figure and replace it with the following:

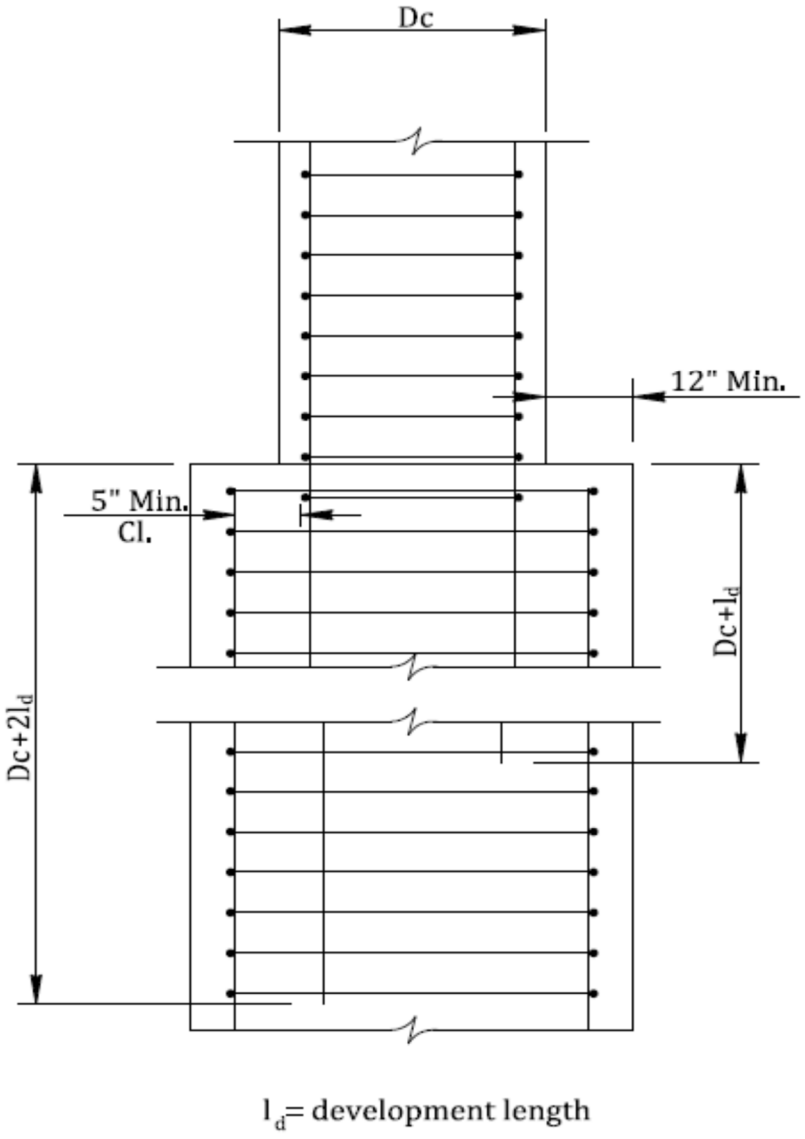


Figure 6.2 Oversized Drilled Shaft

6.5.2 Member Displacement Capacity is revised as follows:

Revise the section title as: “Local Displacement Capacity”.

Delete the first paragraph and replace it with the following:

> The displacement capacity of a member is based on its rotation capacity, which in turn is based on its curvature capacity. The curvature capacity shall be determined by

moment curvature analysis, see Section 6.7. The local displacement capacity (disregarding movement due to movement of surrounding soils and assuming fixed at point of fixity.), Δ_c, of any prismatic column or pile may be idealized as displacement of one or two cantilever segments presented in Equations 6-5 to 6-8 and 6-9 to 6-18, respectively. See Figures 6.3 to 6.6 for details. Figures 6.5 and 6.6 are for typical drilled shaft foundation if point of fixity can be forced above the drilled shaft.

If for any reason the column/shaft can't be considered as a single prismatic element in terms of section properties all the way down to the point of fixity, such as oversized drilled shaft supporting columns or when steel construction casing is used for non-oversized drilled shaft, or when the point of fixity falls below the point where section property changes, the designer shall consider the effect of different moment curvature along depth. Refined analysis with pushover models (assuming fixed at POF and disregarding the surrounding soils) shall be performed for this type of conditions or other complex conditions not covered here.

Delete Equation (6-6) and replace it with the following:

$$\Delta_y = \frac{1}{3}\phi_y (L + L_{sp})^2 \qquad \text{Where } L_{sp} = 0.15 f_{ye} d_{bl}$$

L_{sp} = Strain Penetration

Delete Equation (6-17) and replace it with the following:

$$\Delta_{y_1} = \frac{1}{3}\phi_{y_1} (L_1 + L_{sp})^2$$

Delete Equation (6-18) and replace it with the following:

$$\Delta_{y_2} = \frac{1}{3}\phi_{y_2} (L_2 + L_{sp})^2$$

6.5.3 Simplified Global Displacement Capacity for SDC B Bridges

Delete the first paragraph and replace it with the following:

For SDC B bridges with column/drilled shaft bents or prestressed concrete piles, if these foundation members can be considered prismatic from the top to the depth of point of fixity, the global displacement capacity of each bent may be estimated conservatively with the local displacement capacity (by ignoring the effects of surrounding soil), by either using Equation 6-19 or the Equations given in Section 6.5.2:

Replace

h Clear height of column (ft)

With

h Clear height of column from top of footing to top of column or height from MSA point of fixity to top of column / pile (ft)

Add the following paragraph to the end of the Section:

Perform refined analysis to determine local and global displacement capacities with push over models if the foundation members can't be considered as prismatic.

6.5.4 Simplified Yield Displacement for SDC B Bridges

Delete the section title and replace it with the following:

6.5.4 Simplified Global Yield Displacement for SDC B Bridges

Revise the first paragraph as:

For SDC B bridges, the global yield displacement for each bent may be estimated using either Equation 6-21 or the equations presented in Section 6.5.2, if foundation members can be considered as prismatic.

Revise Equation 6-21 to the following:

$$\Delta_y = \frac{M_p L_y^2}{\Psi E_{ce} I}$$

Delete the definition of variable for Modulus of elasticity (E) and replace it with the following:

E_{ce} Modulus of elasticity for column, Pile or drilled shaft using expected material properties (ksi)

Add the following paragraph to the end of the Section:

Perform refined analysis to determine local and global yield displacement with push over models if the prismatic assumption can't be justified for the foundation members.

6.6.5 Confined Concrete Model

Delete Equation (6-46) and replace it with the following:

$$\varepsilon_{ccu} = 0.004 + \frac{1.4 f_{yh} \rho_s \varepsilon_{su}^R}{f'_{cc}}$$

6.9 REQUIREMENTS FOR CAPACITY PROTECTED COMPONENTS

Replace the second paragraph with the following:

Capacity- protected concrete components such as footings, oversized drilled shafts and bent caps must be designed to remain essentially elastic when the columns or piles reach their ultimate flexural capacities, which are either the elastic flexural capacities based on their elastic properties or the overstrength flexural capacity based on their expected material properties, whichever governs the seismic performance.

For SDC A and single span bridges, design these components based off of the elastic flexural capacities of the piles or columns.

The nominal moment capacity (M_{ne}) for capacity-protected concrete components is the minimum requirement for essentially elastic behavior. M_{ne} shall be determined by either moment curvature analysis or strength design and both shall be based on expected material properties.

REVISIONS TO SECTION 7

7.1.3 Ductility Capacity

Delete the subsection and replace it with the following:

7.1.3 Local Member Ductility Capacity

Local member ductility is different from global ductility. The global ductility capacity is calculated by the global displacements, which include the effects of soil movement. The local ductility capacity of a member is defined using Equations 7-3a or 7-3b with the idealized local displacements. The local displacement ductility capacity shall be obtained with methodology given in Section 6.5.2 or 6.5.3

$$\mu_c = \frac{\Delta_c}{\Delta_y} \text{ for Free Head condition} \qquad (7\text{-}3a)$$

$$\mu_{c1} = \frac{\Delta_{c1}}{\Delta_{y1}} \ \& \ \mu_{c2} = \frac{\Delta_{c2}}{\Delta_{y2}} \text{ for Fixed Head condition} \qquad (7\text{-}3b)$$

Where:

μ_c is the local member ductility capacity, see Figure 6.3 & 6.5 (dimensionless)

μ_{c1} is the local member ductility capacity of first cantilever segment, see Figure 6.4 & 6.6 (dimensionless)

μ_{c2} is the local member ductility capacity of second cantilever segment, see Figure 6.4 & 6.6 (dimensionless)

$\Delta_c, \Delta_{c1}, \Delta_{c2}, \Delta_y, \Delta_{y1}, \Delta_{y2}$ are the idealized local member displacements calculated by the equations given in Section 6.5.2 or equivalent values obtained from refined analysis,

disregarding the displacement of foundations in soil from point of fixity downward and all surrounding soils (in)

Each interior bent or end bent shall have a minimum local member ductility capacity of 3 to ensure dependable rotational capacity in the plastic hinge regions regardless of the displacement demand imparted to that member.

The minimum local member ductility capacity of 3 may be difficult to achieve for columns and drilled shafts (used at end bents) with large diameters (small L/D ratios, D > 10 ft.) and short clear heights, or components with large L/D ratios. Local member ductility capacities less than 3 requires the approval of the RPG Structural Design Engineer in consultation with the Structural Design Support Engineer or the Alternative Delivery Structural engineer and documented in the seismic design summary report.

Table 7.1 Substructure Unit Quantitative Damage Criteria (Maximum Ductility Demand μ_d)

Revise the table as follows:

Table 7.1 Substructure Unit Quantitative Damage Criteria (Maximum Global Ductility Demand μ_d)

Bridge System		Design Earthquake	Operational Classification (OC)		
			I	II	III
Superstructure		FEE	1.0	1.0	See Note
		SEE	1.0	1.0	1.0
Substructure	Prestressed Concrete Pile Interior Bents	FEE	1.0	2.0	See Note
		SEE	2.0	4.0	4.0
	Prestressed Concrete Pile End Bents	FEE	1.0	2.0	See Note
		SEE	2.0	4.0	4.0
	Single Column Bents	FEE	1.0	2.0	See Note
		SEE	2.0	3.0	4.0
	Multi Column Bents	FEE	2.0	3.0	See Note
		SEE	4.0	6.0	6.0
	Pier Walls Weak Axis	FEE	2.0	3.0	See Note
		SEE	3.0	5.0	5.0
	Pier Walls Strong Axis	FEE	1.0	1.0	See Note
		SEE	1.0	1.0	1.0

Note: Analysis for FEE is not required for OC III bridges. No ductility demand limit is specified for steel piles.

REVISIONS TO SECTION 8

8.1 SDC A AND SINGLE SPAN BRIDGES MINIMUM REQUIREMENTS

Delete the last sentence of the second paragraph and replace it with the following:

See Figures 8.2, 8.3, and 8.4 for details.

Add the following to the end of the section:

The minimum anchorage length requirement of longitudinal reinforcement in Section 8.4.6 and 8.4.7 also apply to SDC A bridges.

8.4 DUCTILE MEMBER DESIGN REQUIREMENTS FOR SDC B, C AND D

Delete the paragraph and replace it with the following:

The provisions of this section are applicable only to SDC B, C and D bridges.

Minimum detailing of columns, drilled shafts, connections between columns and bent caps, and connections between columns and footings is also required. See Figure .2, 8.3 and 8.4 for details.

In addition, minimum support length shall be provided as required in Section 9.1.2 and 9.1.3, as applicable.

8.4.5 Splicing of Longitudinal Reinforcement in Columns

Replace subtitle and first sentence of section 8.4.5 with the following:

8.4.5 Splicing of Longitudinal Reinforcement in Columns and Drilled Shafts

Splicing of longitudinal column, piles, and drilled shaft reinforcement subject to ductility demand greater than 1.0 shall be outside the plastic hinging region as provided in Section 6.4.

8.4.6 Minimum Development Length of Longitudinal Column Reinforcement

Delete the section title and replace it with the following:

8.4.6 Minimum Anchorage Length of Longitudinal Column and Drilled Shaft Reinforcement

Delete Equation (8-5) and notations and replace them with the following:

$$l_{acmin} = 24\ d_{bl} \qquad (8\text{-}5)$$

Where:

l_{acmin} Required minimum anchorage length for longitudinal column reinforcement (in), see Figure 8.2, 8.3 and 8.4

d_{bl} Longitudinal reinforcement nominal bar diameter (in)

8.4.9 Minimum Development Length of Longitudinal Column Reinforcement Extended into Oversized Shafts

Delete the section title and replace it with the following:

8.4.9 Minimum Embedment Length of Longitudinal Column Reinforcement Extended in Oversized Shafts

Delete the paragraph and replace it with the following:

Longitudinal column reinforcement shall be extended into oversized shafts in a staggered manner with the minimum embedment lengths of $(D_c + l_d)$ and $(D_c + 2l_d)$, where D_c is the maximum cross sectional dimension of the column and l_d is the tension development length of the longitudinal column reinforcement. See Figures 6.2 and 8.4.

8.4.10 Transverse Reinforcement Inside the Plastic Hinge Region

Delete the last sentence of the first paragraph and add the following paragraphs below the first paragraph:

The quantity of transverse reinforcement in the plastic hinge regions must be determined considering the following requirements:

If detailed seismic analysis is required (see section 8.7.3): The quantity may be determined based on seismic analysis, but it must not be less than the quantity carried into the cap or footing from the column, drilled shaft or pipe pile reinforced concrete infill as specified in Section 8.7.7.

If no detailed seismic analysis is required: The quantity must be the same as the quantity carried in the cap or footing from the column, drilled shaft or pipe pile reinforced concrete infill as specified in Section 8.7.7.

8.4.11 Transverse Reinforcement Outside the Plastic Hinge Region

Delete the paragraph and replace it with the following:

The spacing of transverse confinement reinforcement outside of plastic hinge regions shall not be greater than the smaller of the spacings determined from the following two requirements:

The maximum spacing of transverse confinement reinforcement detailed outside of plastic hinge region shall satisfy the minimum volumetric ratio limit set by AASHTO LRFD Equation 5.6.4.6-1

The spacing of transverse reinforcement detailed outside of plastic hinge region shall not be more than twice that placed in the plastic hinge region of the same member (note that column and drilled shaft are different members).

8.4.12 Maximum Spacing for Transverse Reinforcement

Add the following paragraph to the end of this section:

Bundled hoops are limited to 2 hoops per bundle.

8.4.14 Transverse Confinement for Oversized Drilled Shafts

Delete the first sentence and replace it with the following:

The volumetric ratio of transverse confinement reinforcement of an oversized drilled shaft shall be at least 50% of volumetric ratio of the confinement reinforcement at the base of the column. The shaft is designed for a loading case with the expected flexural nominal capacity to resist 1.25 times the moment demand generated by the overstrength moment of the column acting at the base of the column.

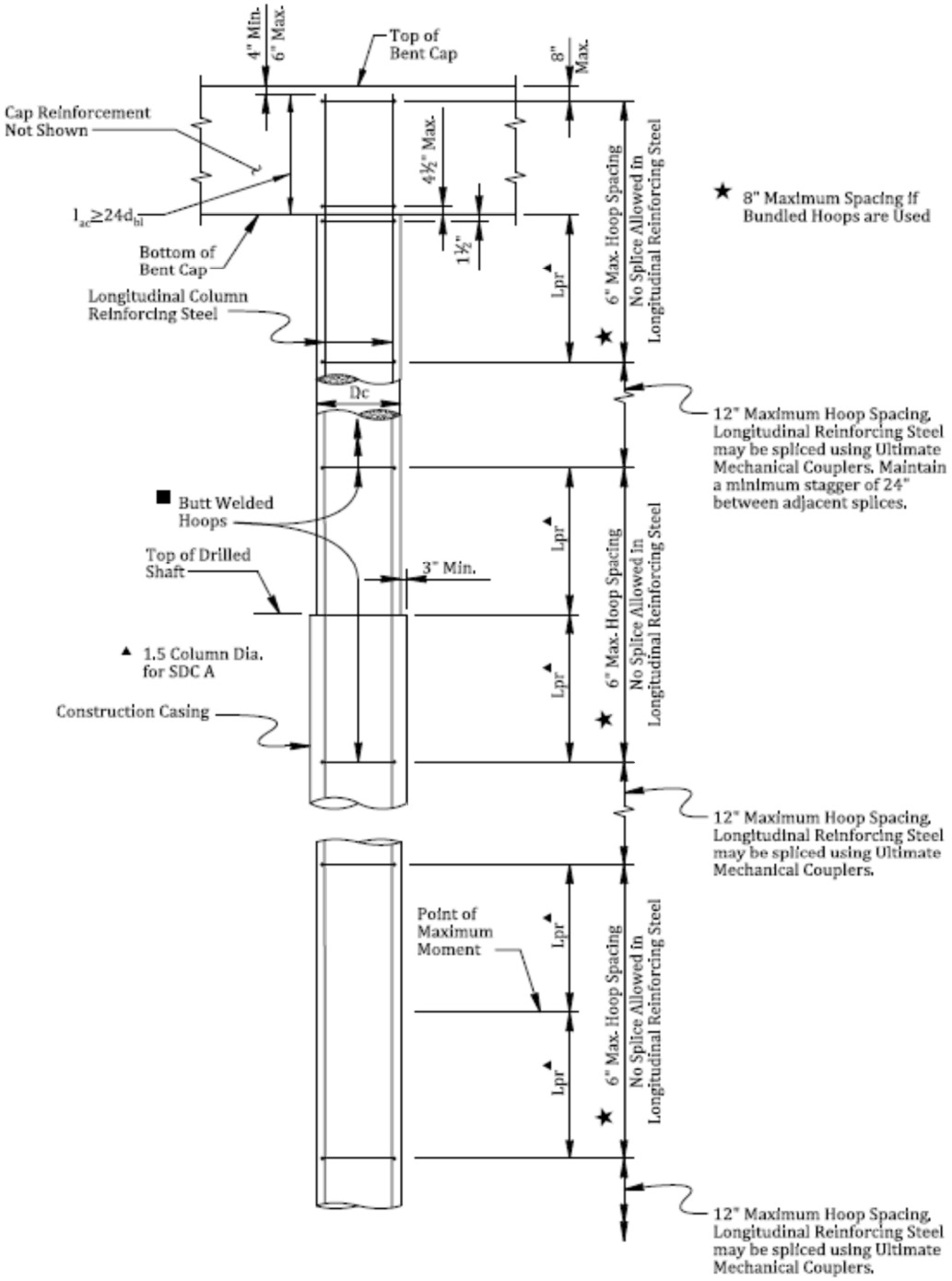
8.4.15 Transverse Confinement for Non-Oversized Drilled Shafts

Delete the first sentence and replace it with the following:

The volumetric ratio of transverse reinforcement in the top portion, 4DC,max, of the drilled shaft shall be at least 75% of the transverse reinforcement required at the base of the column. And the shaft is designed for a flexural expected nominal capacity to resist 1.25 times the moment demand generated by the overstrength moment at the base of the column.

Figure 8.2 Transverse Reinforcement for Column on Non-oversized Drilled Shaft

Delete the figure and replace it with the following:



■ Hoops shall have butt welded splices. The minimum size shall be #6 and the maximum size shall be #8. To prevent the hoop weld splices from being located on the same vertical plane, the locations of the splices shall be staggered around the perimeter of the column by a minimum distance of 1/3 of the hoop circumference.

Figure 8.2 Transverse Reinforcement for Column on a Non-oversized Drilled Shaft

Figure 8.3 Transverse Reinforcement for Column on a Pile Footing

Delete the figure and replace it with the following:

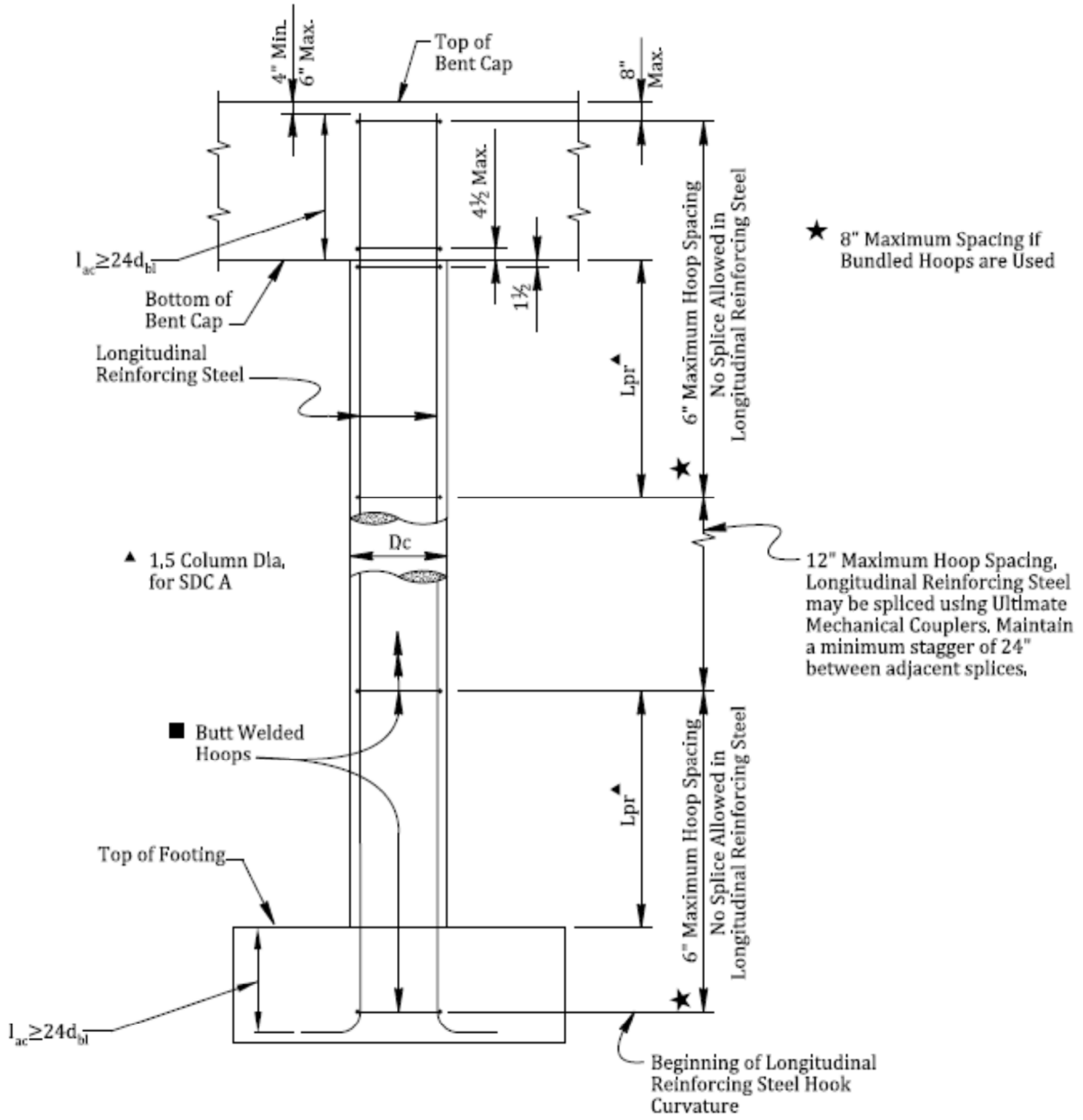
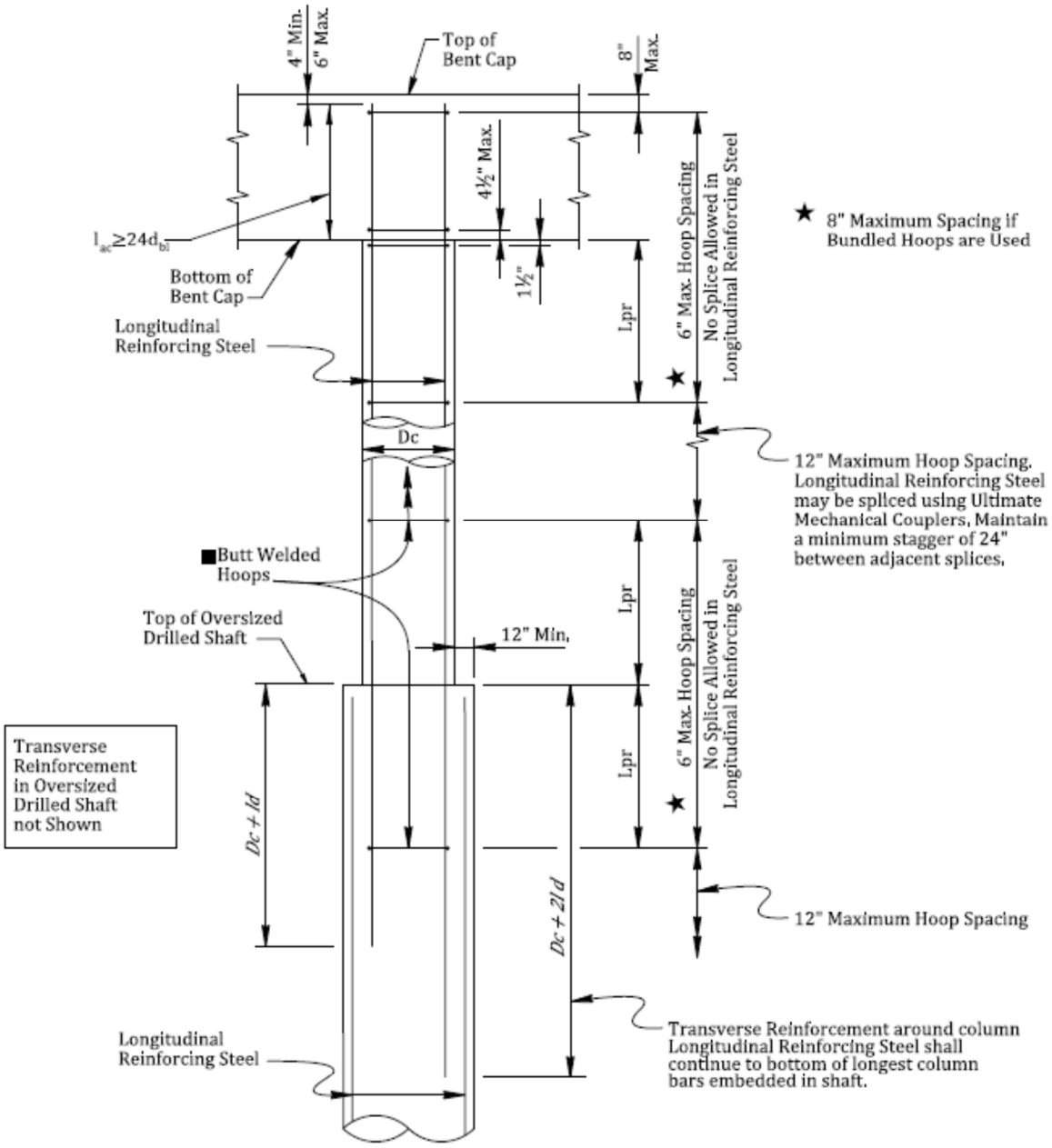


Figure 8.3 Transverse Reinforcement for a Column on a Pile Footing

Figure 8.4 Transverse Reinforcement for Column on an Oversized Drilled Shaft

Delete the figure and replace it with the following:



■ Hoops shall have butt welded splices. The minimum size shall be #6 and the maximum size shall be #8. To prevent the hoop weld splices from being located on the same vertical plane, the locations of the splices shall be staggered around the perimeter of the column by a minimum distance of 1/3 of the hoop circumference.

Figure 8.4 Reinforcement for Column on Oversized Drilled Shaft

Note: Shaft transverse reinforcement does not have the same diameter as the column transverse reinforcement

8.6 SHEAR DESIGN

Revise section title to:

8.6 SHEAR DESIGN for SDC B, C, D

Add the following in front of the first paragraph:

Seismic shear capacity shall be based on the nominal material strengths, not the expected material strengths.

Replace

V_c Concrete shear capacity (Section 8.6.1 or 8.6.2) (k)

with

V_c Concrete shear capacity (Section 8.6.1) (k)

Replace

V_s Reinforcement shear capacity (k) (Section 8.6.3)

with

V_s Reinforcement shear capacity (Section 8.6.2) (k)

8.6.1 Concrete Subject to Flexure and Compression

Delete Equation (8-12b). Delete definition for A_{sp}. Add the following:

ρ_s Volumetric ratio of transverse reinforcement (Eq. 6-44)

Replace

μ_d Maximum local displacement ductility of member

with

μ_d Maximum global displacement demand ductility of member

8.7.2 Maximum Allowable Principal Stress

Replace “f’c” with “f’ce” in Equations 8-23 and 8-24.

Revise definition under Equation 8-23 and 8-24 to define “f’ce” as “Expected maximum concrete compressive strength (ksi)”

8.7.3 Minimum Required Horizontal Reinforcement:

Delete the first paragraph and add the following:

When the principal tension stress in the joint obtained from Equation 8-16 is less than the limit established by Equation 8-25, a minimum amount of joint shear reinforcement in the form of column hoops, as determined by Equation 8-26, shall be detailed. Otherwise, the provisions of Sections 8.7.5 through 8.7.6 shall also apply.

8.7.7 Hoop Transverse Confinement Reinforcement

Replace

l_{ac} Required anchorage length for longitudinal column reinforcement (in)

with

l_{ac} Provided anchorage length for longitudinal column reinforcement (in, ≥ l_{acmin}, see Figure 8.2, 8.3 and 8.4)

8.7.8 Knee Joints

Add the following sentence behind the second sentence of the second paragraph:

The couplers shall be staggered at 2 ft minimum along the cap. The skin reinforcement can be lap spliced or mechanically coupled with “service level” couplers and the splice shall be staggered at 2 ft minimum along the cap.

REVISIONS TO SECTION 9

9.2 LONGITUDINAL AND TRANSVERSE CONNECTIONS

Add the following paragraphs at the beginning of the section:

The connection components between superstructures and substructures include anchor bolts, shear keys, dowel bars, retainer blocks, and back walls. For each individual bent, there are two seismic design strategies for these connection components. It is the structural engineer’s decision to choose which strategy to use for a specific bent.

The first design strategy is to design the connection to sustain and transfer all seismic loads to the substructures and foundations. The substructures and foundations are then designed to sustain the seismic loads transferred from the superstructure and satisfy the design criteria.

The other design strategy is to design the connection components to sustain limited seismic loads and allow them to fuse, so that the substructures and foundations are able to sustain the limited seismic loads transferred from the superstructure and still satisfy the design criteria. In this case, the upper limit of the load capacity of the connection components is governed by the load capacity of the substructures and foundations.

Replace the existing first paragraph with the following:

When these components are designed to sustain the full seismic shear loads, the combined resistance of anchor bolts, dowel bars, back wall and/or shear keys (and retainer blocks if applicable), shall be designed to satisfy Equation 9-3 in both the longitudinal and transverse directions for bridges of any SDC.

9.2.1 Anchor Bolt Design

Add the following paragraph to the end of this section:

Anchor bolts shall also be checked for moment resistance to make sure shear, instead of moment capacity governs failure of anchor bolts. Consider build-down blocking if the bearings are too thick to prevent failure governed by moment.

9.2.2 Concrete Superstructure Shear Key Design

Add the following before the first paragraph:

Shear keys shall be provided at bents with expansion joints for SDC B, C, and D bridges.

Delete the last paragraph and add the following:

Shear keys shall be proportioned so that the height of the shear key, or distance from top of load application to top of bent cap, shall not exceed 0.3 times the shear key dimension perpendicular to the center line of the beam. If for any reason the 0.3 ratio limit cannot be satisfied, the shear key shall also be designed with adequate moment resistance no matter if the shear key is designed to fuse or not.

The dimension of the shear key parallel to the center line of the beam shall be detailed as long as possible.

Adequate contact area shall be detailed between the shear key and the diaphragm for load transfer. The diaphragm shall also be designed to sustain the loads due to interaction with the shear key.

Closed cell extruded polystyrene foam shall be used to fill the gaps between the shear key and the diaphragm. See Figure 9.2 for shear key detailing requirements.

9.2.3 Steel Superstructure Shear Key Design

Add the following before the first paragraph:

Shear keys shall be provided at bents with expansion joints for SDC B, C, and D bridges.

9.2.4 Integral Backwall Design:

Delete the first paragraph and replace it with the following:

For integral end bents, the lateral seismic forces are transmitted to the piles in part by the reinforcement connecting the superstructure to the end bent cap. The integral backwall shall be designed in conjunction with anchor bolts to satisfy the condition of Equation 9-3.

9.4.1 Prestressed Concrete Beam End Diaphragms at Expansion Joints

Delete the third paragraph and replace it with the following:

Closed cell extruded polystyrene foam shall be used to provide gaps between the shear keys and the concrete diaphragms. The foam shall provide ¼” to ½” gaps on the sides of the shear keys and 2” gaps between the bottoms of the concrete diaphragms and the tops of the shear keys. Details are provided in Figure 9.2 .This allows for the anchor

bolts to be engaged in the shear force transfer between the superstructure and the substructure.

9.4.2 Prestressed Concrete Beam Closure Diaphragms

Delete and replace the section with the following:

Prestressed concrete beam closure diaphragms are used at fixed bearing interior bent locations to develop continuity for live loading between spans of a prestressed concrete beam superstructure. The bearings at the closure diaphragms are fixed. Shear keys may be used at the closure diaphragm locations when needed to provide transfer of seismic forces between superstructure and substructure.

The design of the concrete beam closure diaphragms shall be done using a strut and tie model as directed in the AASHTO LRFD Specifications for SDC B to SDC D bridges. Sample reinforcement and details can be seen in Figure 9.5.

Figure 9.2 Concrete Superstructure Shear Key

Delete Figure 9.2 and replace with the following:

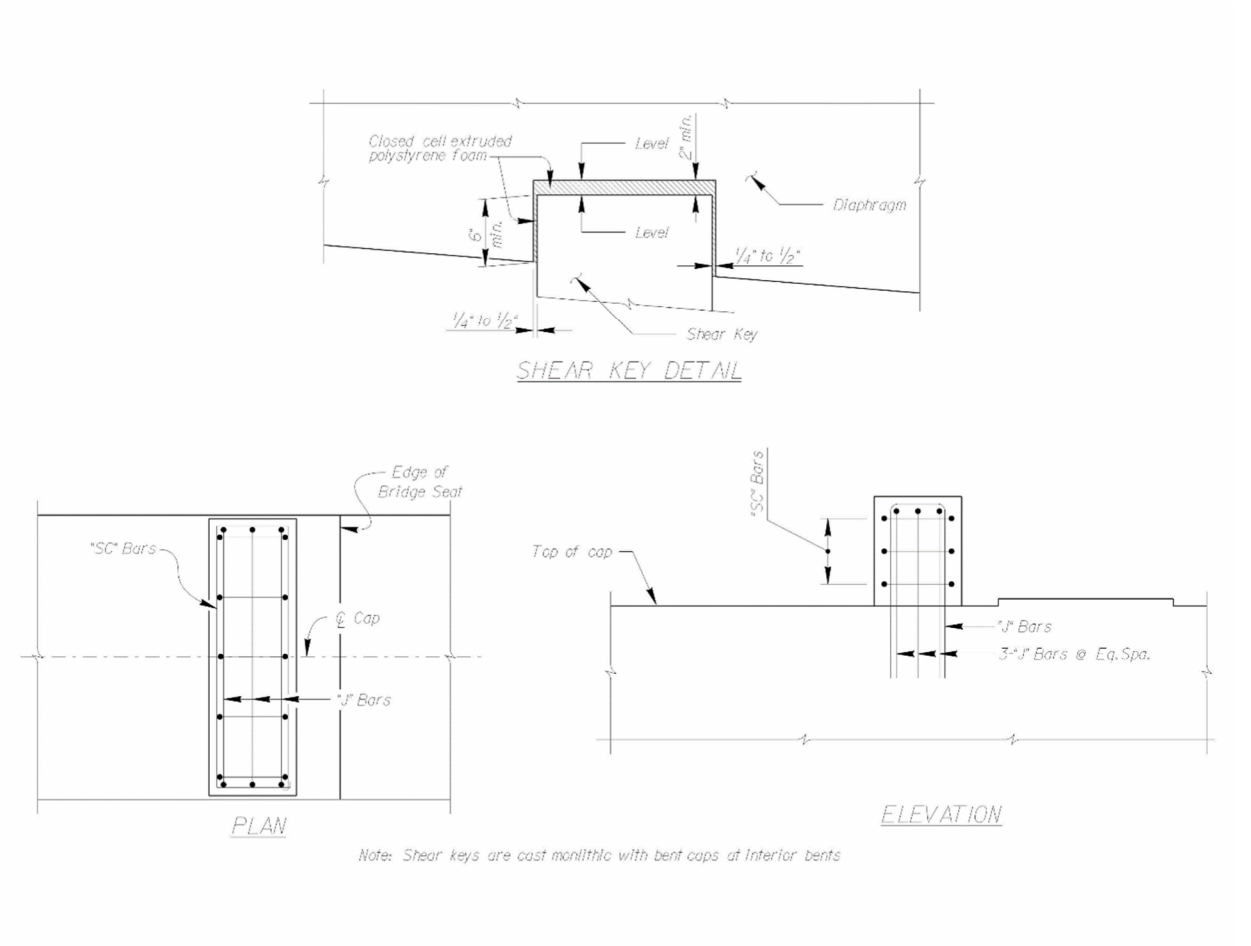


Figure 9.2 Concrete Superstructure Shear Key