16. Bridge Decks and Rails

Sections 3, 4, and 9 of the *LRFD Bridge Design Specifications* present the AASHTO criteria for the structural design of bridge decks. Section 3 specifies loads, Section 4 specifies the modeling and analyses, and Section 9 specifies bridge deck design. Unless noted otherwise in this chapter, the *LRFD Specifications* apply to the design of bridge decks in Alaska.

This chapter documents DOT&PF criteria on the design of deck-on-girder structures; i.e., bridge decks that are constructed compositely in conjunction with concrete or steel girders. Chapter 14 discusses the design of precast, prestressed-concrete, decked bulb-tee girders.

16.1. General

16.1.1. Types/Usage

DOT&PF typically uses a 4-inch asphalt overlay with a waterproofing membra ne on all bridges (both cast-in-place and precast) on the National Highway System (NHS). The types of bridge decks most commonly used by DOT&PF and their typical usage are:

1. **Precast Deck Panels**. Typically, use these on non-NHS facilities in remote locations where concrete batching is impractical. Also, consider their use where accelerated bridge construction is warranted.
2. **Cast-in-Place Decks**. Typically, use these on NHS facilities in urban areas on steel or concrete bridges other than decked girder bridges.

16.1.2. Protection of Reinforcing Steel

Reference: LRFD Articles 2.5.2.1 and 5.14.

DOT&PF typical practice is to use epoxy-coated reinforcing steel in the bridge deck and approach slabs. Epoxy coat both layers of deck reinforcing and all reinforcing extending into the deck from precast and cast-in-place construction. Provide 2½ inches minimum concrete cover from the top surface of the deck to the top layer of reinforcing steel and a 4-inch asphalt overlay with a waterproofing membrane.

16.1.3. Traditional Design Using the "Strip Method"

Reference: LRFD Articles 9.7.3, 4.6.2.1.1, 4.6.2.1.3, and Appendix A4.

Use the traditional deck design using the "strip method" based on LRFD Articles 9.7.3 and 4.6.2.1 for deck design. Do not apply the empirical design procedures of LRFD Article 9.7.2 to the deck design.

The bridge engineer may apply the strip method to concrete decks using the design table for deck slabs in Appendix A4 of the *LRFD Specifications* (LRFD Table A4-1). The introduction to the LRFD table discusses its application and inherent assumptions.

The bridge engineer may apply the LRFD Table A4-1 to design the concrete deck reinforcement. LRFD Table A4-1 tabulates the resultant live-load moments per unit width for reinforcement design as a function of the girder or web spacings, "S." The table distinguishes between positive moments and negative moments and tabulates negative moments for various design sections as a function of the distance from the girder or web centerline to the design section. LRFD Article 4.6.2.1.6 specifies the design sections to be used.

16.2. Design Details

16.2.1. General

The following general criteria apply to bridge decks that are constructed compositely in conjunction with concrete girders and steel girders. Also comply with the requirements in Sections 14.1 and 14.2 that apply to bridge decks.

1. **Thickness**. The thickness of reinforced concrete decks is a 7-inch minimum.
2. **Reinforcing Steel Strength**. The specified yield strength of reinforcing steel must be 60 ksi.
3. **Exposure Condition**. Use a Class 2 exposure factor in LRFD Equation 5.6.7-1 for all bridge decks.
4. **Placement of Top and Bottom Transverse Reinforcing Steel**. The top and bottom transverse reinforcing steel should be offset, preferably at half the spacing. Do not place the top mat directly above the bottom mat.
5. **Reinforcing Steel Spacing**. See Table 14-3.
6. **Reinforcing Bar Size**. The minimum reinforcing steel size used for primary bridge deck reinforcement is a #5 bar. The maximum reinforcing steel size used for bridge deck reinforcement is a #6 bar.
7. **Sacrificial Wearing Surface**. The 2½-inch top reinforcement concrete cover includes ½-inch that is considered sacrificial. For both the deck and superstructure, include its weight as a dead load, but do not include its structural contribution in the structural design. Additional sacrificial concrete cover may be required in regions with heavy truck traffic and without asphalt overlays, such as the Dalton Highway.
8. **Concrete Strength**. The minimum specified 28-day compressive strength of concrete for bridge decks is 5 ksi for Class A-A concrete.
9. **Placement of Transverse Reinforcing Steel on Skewed Bridges**. The following applies:

    a. Skews ≤ 20 degrees: Place the transverse reinforcing steel parallel to the skew.

    b. Skews > 20 degrees: Place the transverse reinforcing steel perpendicular to the longitudinal reinforcement.

    See Section 16.2.5 for a definition of skew angle and for structural considerations related to skewed reinforcing steel placement.
10. **Splices**. See Section 14.2 for splicing requirements.
11. **Shear Connectors for Precast, Prestressed Concrete Bulb-Tee Girder Bridges**. Stirrups should project from the girders into the slab in accordance with LRFD Article 5.7.4 to provide a composite section. Detail bars to hook around longitudinal deck reinforcement.

16.2.2. Precast Deck Panels

Figure 16-1 presents typical connection details for precast concrete deck panels.

Precast concrete deck panels must incorporate grouted keyways between adjacent panels to prevent relative vertical displacement and ensure the transfer of traffic loads between deck panels without joint failure. Refer to NCHRP Report 584, "Full-Depth Precast Concrete Bridge Deck Panel Systems" for examples and justification. Figure 16-1 presents the preferred keyway shape. Grouted vertical deck panel interfaces are considered non-composite for calculation of deck and girder systems.

16.2.3. Deck Haunches

Haunches consist of concrete between the top of a steel flange or concrete girder and the soffit of the bridge deck; they account for construction variations and tolerances.

The haunch may vary across the width of the flange based on the cross slope. It may also vary along the length of the girder due to flange thickness, camber variation, and roadway profile.

In all cases, however, the design haunch thickness should be a ½-inch greater than the theoretical minimum including camber tolerances, bolted field splices, etc.

Include the girder haunch in the load calculations as dead load by applying the maximum haunch dimension throughout the span; however, ignore the haunch in the section's resistance calculations.

Measure the control dimension "Y" (see Figures 16-2 through 16-4) at the centerline of bearing. This dimension varies along the span to compensate for variations in camber and superelevation ordinate. In some cases where vertical curve corrections are small, the bridge engineer can accommodate the vertical curve ordinate in the haunch without including it in the girder.

Detail the haunch flush with the vertical edge of the top flange.

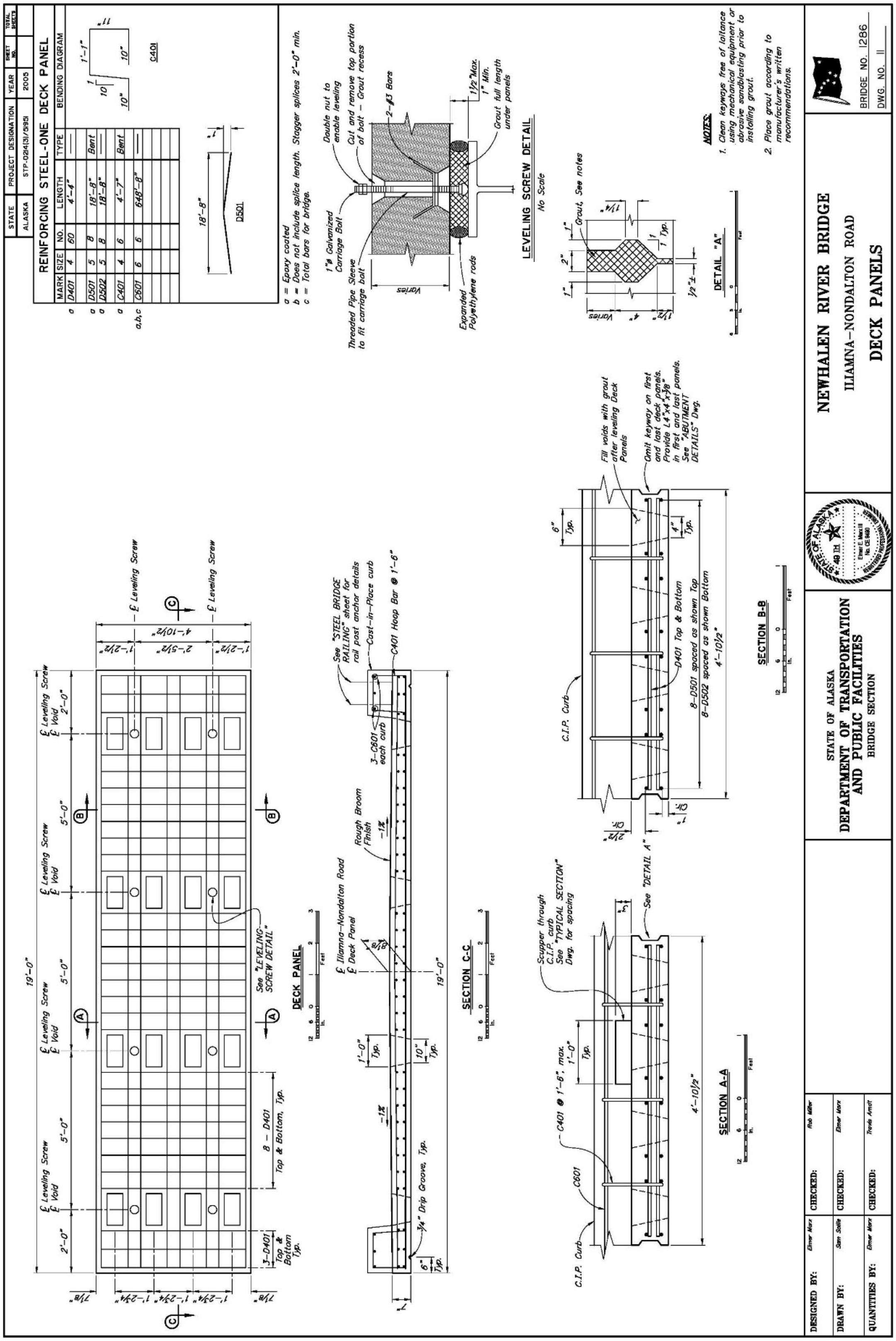


Figure 16-1
Connection Details for Precast Concrete Deck Panels

Haunch Dimensions for Steel Girders/Beams

Figure 16-2 illustrates the controlling factors used to determine the haunch dimension for steel plate girders; Figure 16-3 applies to rolled beams. Refer to the figures to determine the control dimension and haunch thickness requirements for the applicable type of steel member.

Haunch Dimensions for Precast Concrete Girders

Figure 16-4 illustrates the controlling factors used to determine the haunch dimension for precast concrete girders. Control dimension "Y" is the deck thickness "T" plus 3 inches. Use the 3-inch dimension to account for camber growth in the girder at midspan. The amount of camber growth can vary between girders cast at the same time.

Reinforcement for Deep Haunches

Provide additional reinforcement in haunches greater than 4 inches deep (X > 4 inches). The additional reinforcement should consist of a minimum of #4 U-shaped reinforcing bars spaced at a maximum of 12 inches. Properly develop these reinforcing bars into the bridge deck. See Figure 16-5.

16.2.4. Stay-in-Place Forms

Only use stay-in-place (SIP) forms to close the top of steel tub girders that are trapezoidal in shape. Use steel SIP forms.

Design loads for stay-in-place forms should consist of not less than 0.015 ksf for the metal forms and form corrugation fill applied over the areas of the forms. Do not field weld the stay-in-place forms to steel flanges. SIP forms may be shop welded to the girders.

16.2.5. Skewed Decks

Reference: LRFD Article 9.7.1.3.

Skew is defined by the angle between the centerline of support and the normal drawn to the longitudinal centerline of the bridge at that point.

The *LRFD Specifications* suggest that the effects of skew angles not exceeding 25 degrees can be neglected for concrete decks, but the *LRFD Specifications* assume the typical case of bridges with relatively large span-length-to-bridge-width ratios. Further, the commentary indicates that the 25 degrees limit is "somewhat arbitrary." Therefore, DOT&PF uses a 20 degree threshold for the consideration of skew in reinforcement detailing.

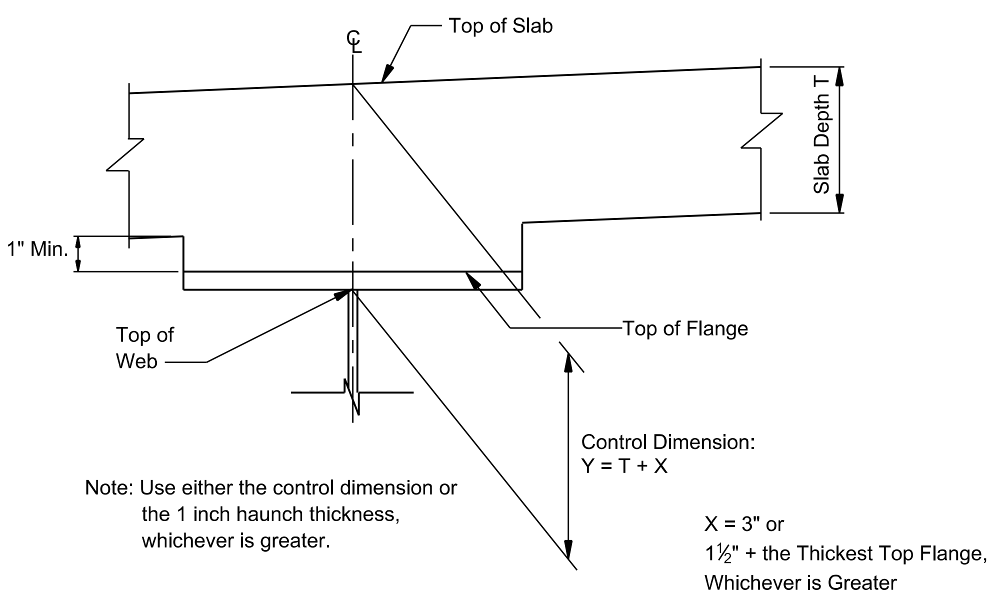


Figure 16-2
Haunch Dimension for Steel Plate Girders

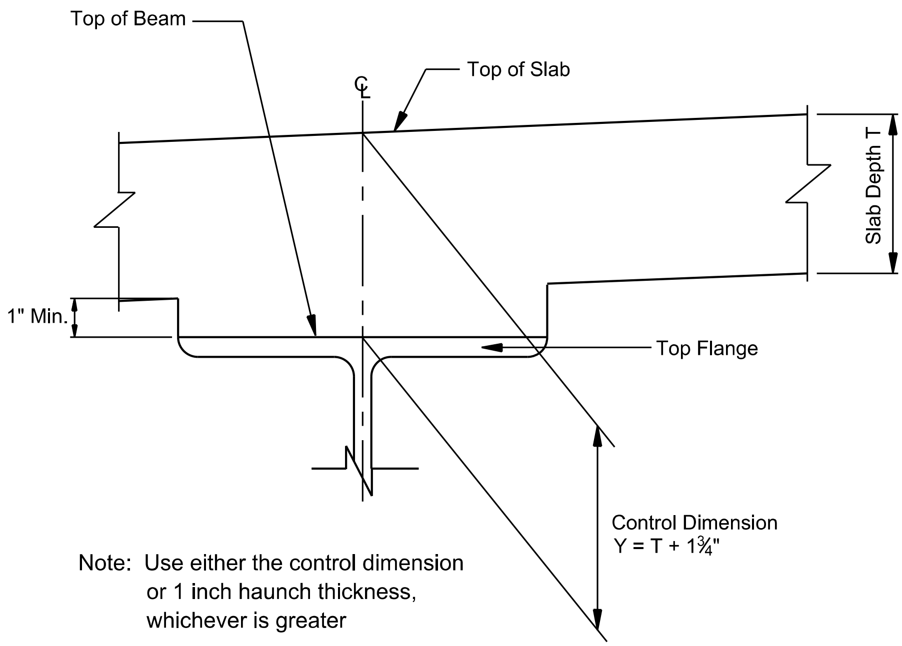


Figure 16-3
Haunch Dimension for Steel Rolled Beam

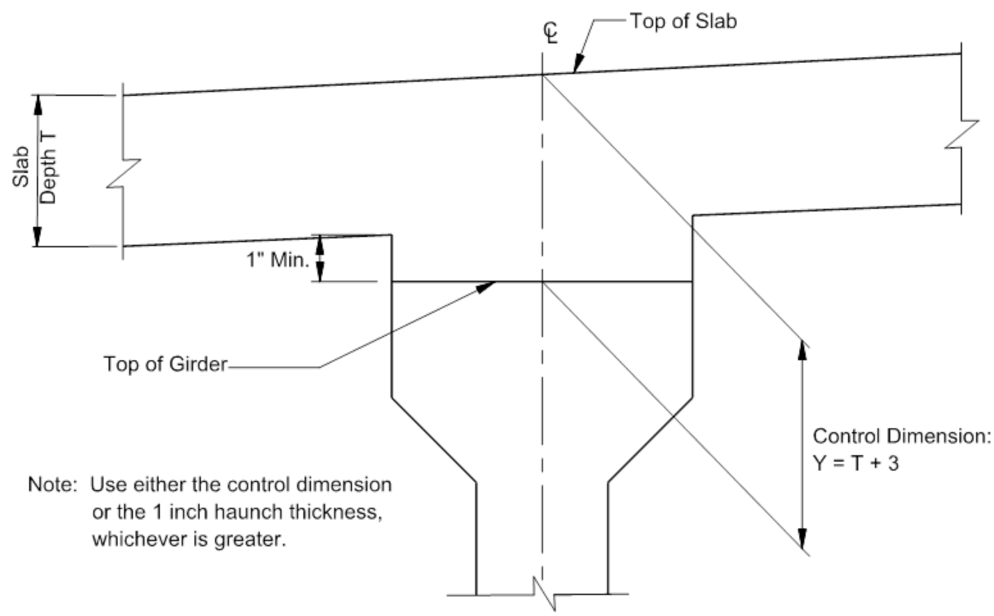


Figure 16-4
Haunch Dimension for Concrete I-Girders

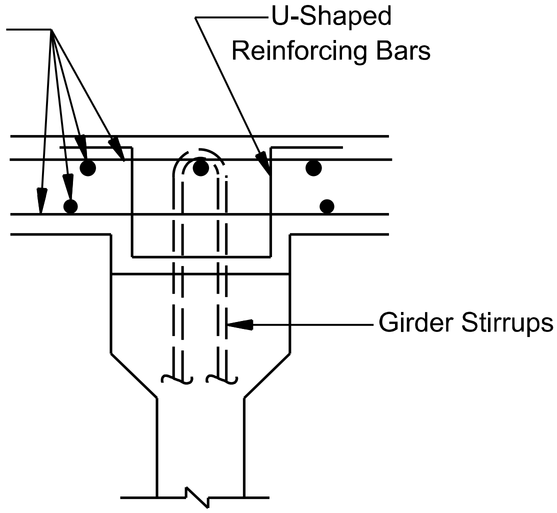


Figure 16-5
Haunch Reinforcment

16.2.6. Concrete Placing Sequence for Composite Bridge Decks

Reference: LRFD Article 2.5.3.

DOT&PF Practices

Bridge plans should include a deck placing sequence for all cast-in-place concrete decks. The deck placement diagram must present the sequence of placing concrete in various sections (separated by transverse construction joints) of deck slabs on continuous spans.

The designated sequence should avoid or minimize the dead-load tensile stresses in the slab during concrete setting to minimize cracking. Arrange the sequence to cause the least disturbance to the portions placed previously.

In addition, for longer span steel girder bridges, the placing sequence can lock-in stresses different from those associated with the instantaneous placement typically assumed in design. Therefore, for these bridges, consider the placing sequence in the design of the girders.

Deck placement should be uniform and continuous over the full width of the superstructure. The first pours should include the positive-moment regions in all spans. For all decks on a longitudinal gradient of 3 percent or greater, the direction of placement is uphill.

Figure 16-6 illustrates a sample placing sequence diagram for a continuous bridge. For precast concrete girders, the cast-in-place abutment diaphragm is cast prior to placing the deck above it. The negative-moment regions for steel girders extend between the points of beam dead load contraflexure. For precast concrete girders, use a minimum of 15 feet on each side of the center of support or 20 percent of the span length, whichever is greater.

For simple spans, it is desirable to place the entire deck in one operation.

Transverse Construction Joints

Where used, place transverse construction joints parallel to the transverse reinforcing steel. Do not place these joints over girder field splices.

Place a transverse construction joint in the end span of bridge decks on steel superstructures where uplift is a possibility during deck placement.

A bridge with a relatively short end span (60 percent or less) when compared to the adjacent interior span is most likely to produce this form of uplift. Uplift during the deck placing operation can also occur at the end supports of horizontally curved decks and in superstructures with severe skews.

If analysis using the appropriate permanent load factors of LRFD Article 3.4.1 demonstrates that uplift occurs during deck placement, require a construction joint in the end span and require placing a portion of the deck first to act as a counterweight.

16.2.7. Longitudinal Construction Joints

Longitudinal construction joints in bridge decks can create planes of weakness that can lead to maintenance problems.

In general, DOT&PF discourages the use of construction joints, although they are unavoidable under certain circumstances (e.g., widenings, phased construction).

Usage

Do not use longitudinal construction joints on decks having a constant cross section where the width is less than or equal to approximately 120 feet. For deck widths greater than 120 feet (i.e., where the finishing machine span width must exceed 120 feet), make provisions to permit placing the deck in practical widths.

Detail either a longitudinal joint or a longitudinal closure pour, preferably not less than 3 feet in width. Locate lap splices in the transverse reinforcing steel within the longitudinal closure pour. Such a joint should remain open as long as the construction schedule permits to allow transverse shrinkage of the deck concrete.

Consider the deflections of the bridge on either side of the closure pour to ensure proper transverse fit up.

Location

If a longitudinal construction joint is necessary, do not locate it underneath a wheel line. Preferably, locate a construction joint outside the girder flange and in a shoulder or median area.

If practical, longitudinal construction joints should line up with lane lines to avoid driver confusion at night.

Closure Pours

For staged construction projects, use a closure pour to connect the slab between stages. A closure pour serves two useful purposes. It defers final connection of the stages until after the deflection from deck slab weight has occurred. A closure pour also provides the width needed to make a smooth transition between differences in final grades that result from construction tolerances.

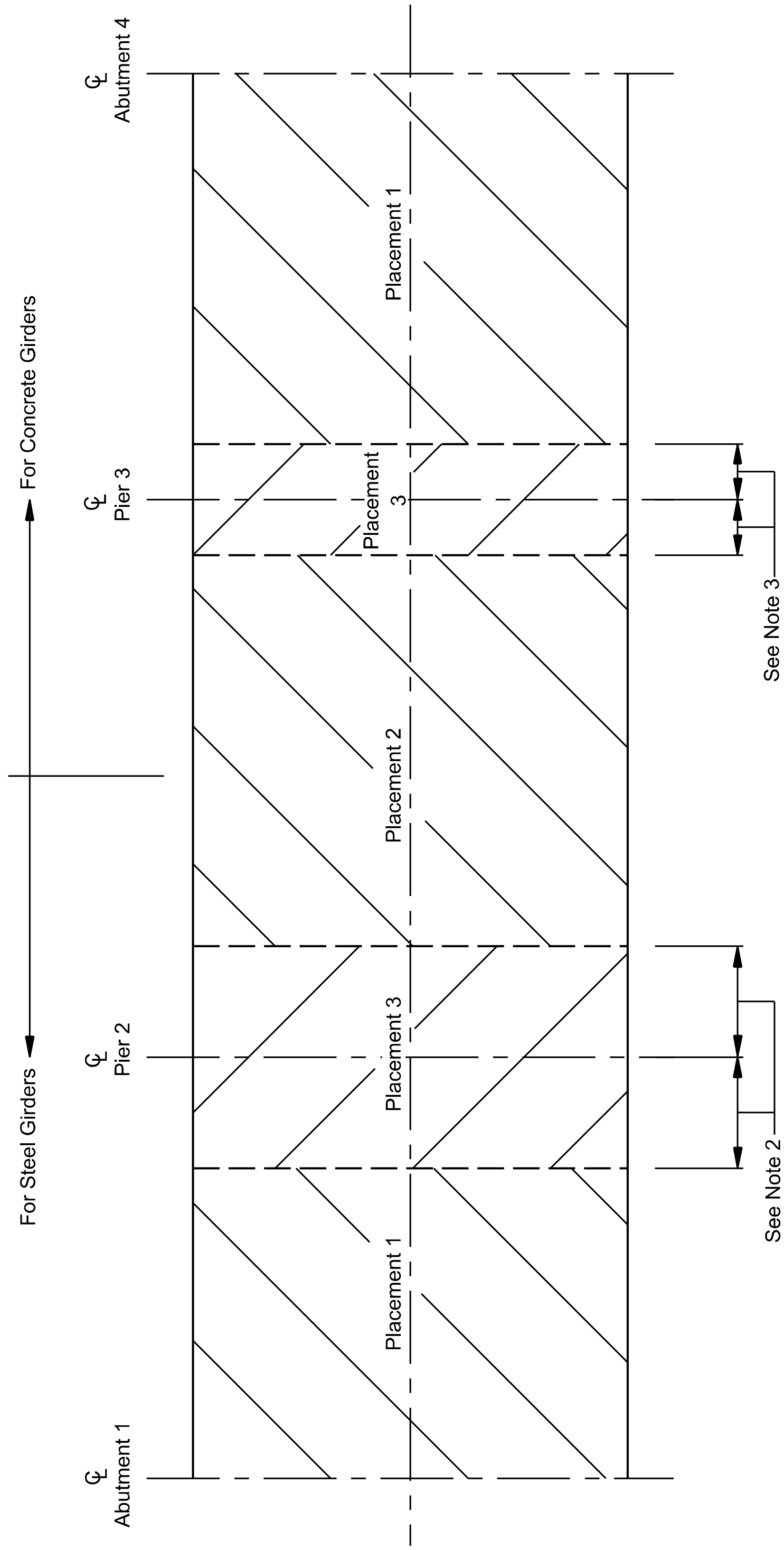
The closure width should relate to the amount of relative dead-load deflection that is expected to occur across the pour after the closure is placed. A minimum closure width of 3 feet is recommended.

Greater closure widths may be required when larger relative dead-load deflections are anticipated. Estimate the required width by considering the closure pour to be a fixed-fixed beam and by limiting the stresses in the concrete to the cracking stress. When a closure pour is used, the following apply:

1. Do not rigidly connect diaphragms/cross frames in the staging bay of structural steel girders until after the adjacent stages of the deck have been placed. Construct concrete diaphragms in the staging bay of prestressed concrete girders after adjacent portions of the bridge are complete. Pour the diaphragms as part of the closure.

2. Reinforcing steel between different stages must not be tied or coupled until after the adjacent stages of the deck have been placed.

3. Support the finishing machine on an overhang jack that is connected to the girder loaded by the deck pour. Do not place the finishing machine on a previously poured deck. Indicate in the contract documents that this method of constructing the closure pour is not allowed. See Figure 16-7.



Notes:
1. The direction of placement should be shown for each placement.
2. Placement 3 limits for steel girders are near the points of beam dead load contraflexure.
3. Placement 3 limits for precast girders are 20% of span length or 15' minimum.

Figure 16-6
Typical Placement Diagram
(Continuous Steel and Precast Girders)

16.2.8. Transverse Edge Beam for Steel Girder Bridges

Reference: LRFD Article 9.7.1.4.

DOT&PF practice is to provide a transverse edge beam to support wheel loads near the transverse edge of the deck in conjunction with an end diaphragm for steel girder bridges. See Figure 16-8.

16.2.9. Deck Overhang/Bridge Rail

Reference: LRFD Article 9.7.1.5.

Overhang Width and Thickness

Bridge deck overhang is defined as the distance between the centerline of the exterior girder to the outside edge of the deck.

DOT&PF practice is that the overhang width will not be more than 40 percent of the girder spacing for I-girders and 50 percent for box girders.

The thickness of the overhang at the outside edge of deck may be less than the interior deck thickness but not less than 7 inches.

The thickness of the overhang at the outside edge of girder should be the deck thickness plus the haunch depth.

Construction

Typical DOT&PF practice is to construct the exterior overhang of the cast-in-place bridge deck slab using an overhang jack for steel and precast concrete girders.

Overhang jacks are connected to the girder at their top and braced against the web or bottom flange on the bottom.

Large overhang widths can cause excessive lateral distortion of the bottom flange and web of the girder. The Contractor must check the twist of the exterior girder and bearing of the overhang bracket on the web.

See Figure 16-9 for typical overhang construction forming on concrete and steel girders.

Structural/Performance Design of Bridge Railing

Reference: LRFD Articles 13.6.1, 13.6.2, and 13.7.2.

All combination bridge rail/deck overhang designs must meet the structural design requirements to sustain rail collision forces in LRFD Article A13.2.

With the Alaska Multi-State Rail or the Oregon Three-Tube Rail, the railing requirements in Article 13.6 are considered satisfied if the appropriate bars shown in Table 14-4 are used, or if the deck moment resistance provided is greater than or equal to the moment resistance of the applicable overhang shown in Table 14-4.

Use a Class 2 exposure factor in LRFD Equation 5.6.7-1 for all bridge rails and deck overhang designs.

Rail Joints

Provide joints on concrete bridge rails and curbs at all locations of expansion in the bridge; i.e., the joints on the bridge deck and barrier will match. Consider additional open joints on longer spans. Design open joints as discontinuities.

The expansion joint seal or hardware should extend up into the barrier or curb at least 12 inches.

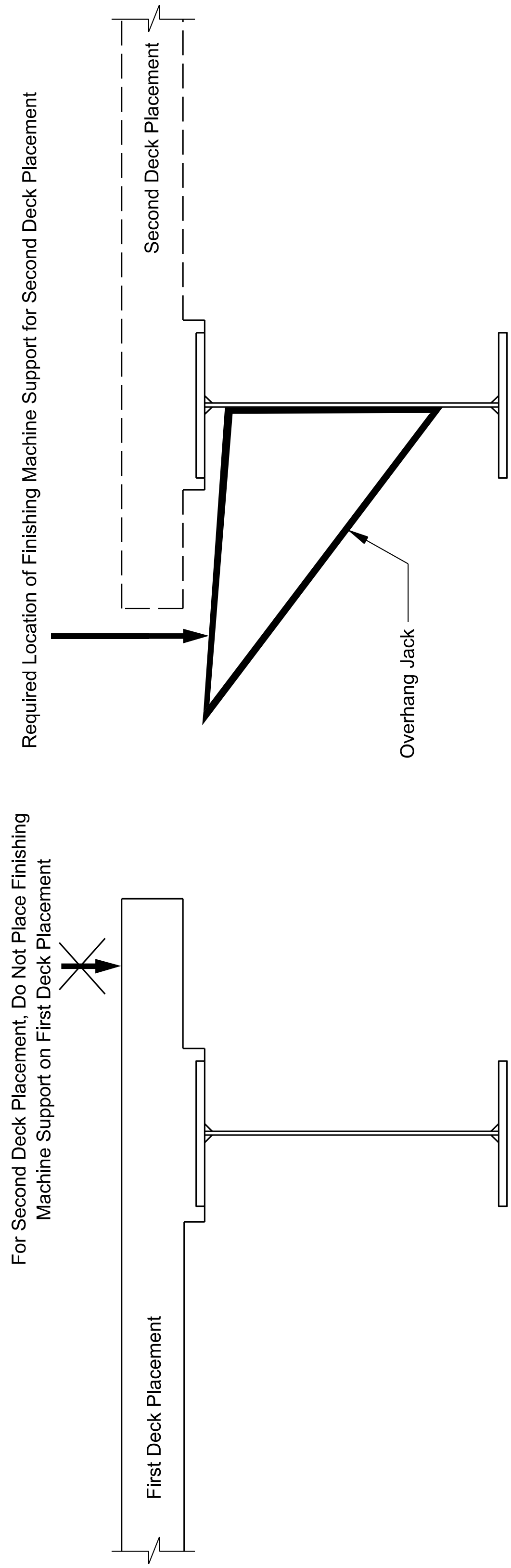


Figure 16-7
Support for Finishing Machine

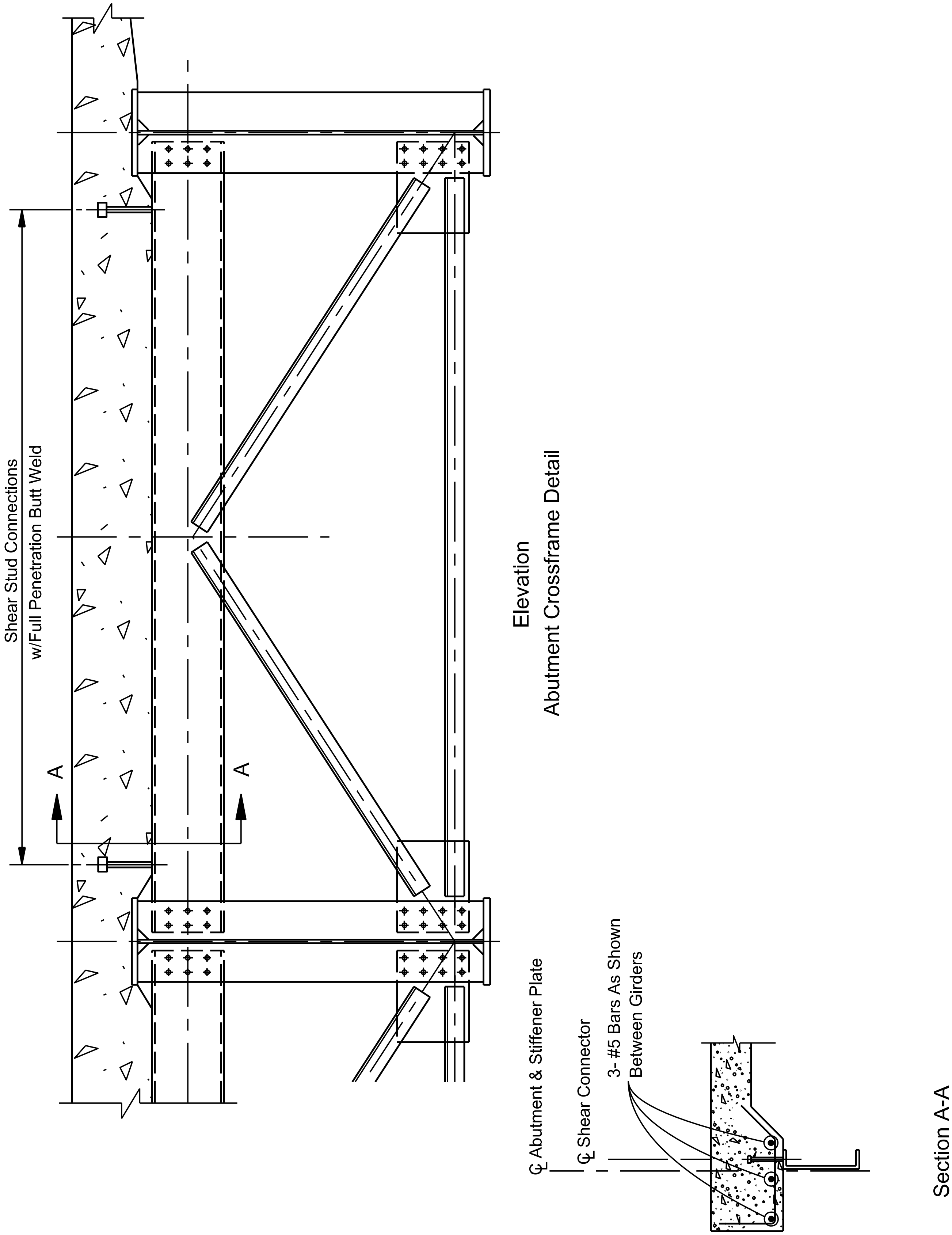


Figure 16-8
Transverse Edge Beam

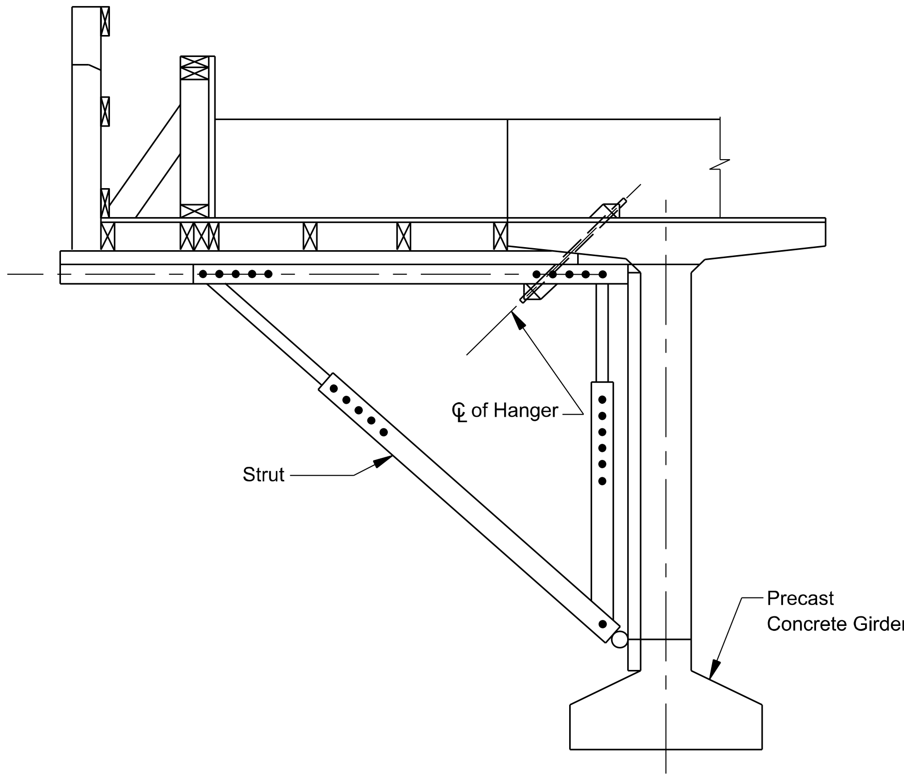


Figure 16-9
Typical Overhang Forming System
(Concrete and Steel Girders)

16.3. Approach Slabs

16.3.1. Usage

Approach slabs are required on all bridges where a concrete batch plant is within a one-hour drive to the bridge site and on bridges with cast-in-place decks.

16.3.2. Design Criteria

The following design criteria apply to approach slabs:

1. **Materials**. Use concrete with a minimum f'_c of 4 ksi. The class of concrete used in the approach slabs should be consistent with the class used in the deck to which they are attached, but may be Class A concrete for decked bulb-tee girder bridges. All reinforcing steel in the approach slab must be epoxy-coated.
2. **Analysis**. If a special design is used, model the approach slab as a simple span.
3. **Slab Length**. The minimum approach slab length should be the length of the wingwall or 15 feet, whichever is greater. Design approach slabs longer than 20 feet as a longitudinally reinforced slab span. The design should assume that the approach slab is a simple span supported by the bridge on one end and by approximately 3 feet of competent soil at the approach roadway end. Use the Extreme Event II load combination.
4. **Skew**. Design the roadway ends of approach slabs parallel to the bridge ends except where the skew is more than 20 degrees. For bridge skews greater than 20 degrees, design the angle of the roadway end of the approach slab to avoid interference with snow plow equipment.

16.4. Deck Drainage

Reference: LRFD Article 2.6.6.

16.4.1. Importance of Bridge Deck Drainage

The bridge deck drainage system includes the bridge deck, sidewalks, railings, gutters, and inlets. The primary objective of the drainage system is to remove runoff from the bridge deck before it collects in the gutter to a point that exceeds the allowable design spread (typically, runoff water must be restricted to the shoulder portion of the deck). Proper bridge deck drainage provides many other benefits, including:

- efficiently removing water from the bridge deck to enhance public safety by decreasing the risk of hydroplaning;
- enhancing long-term maintenance of the bridge;
- preserving the structural integrity of the bridge;
- enhancing aesthetics (e.g., the avoidance of staining substructure and superstructure members); and
- reducing erosion on bridge end slopes.

See Section 10.6.10 of the *Alaska Highway Drainage Manual* for DOT&PF policies on deck drainage.

16.4.2. Responsibilities

The Hydraulics Unit (Statewide Hydraulics Engineer):

- calculates the flow of water on the deck based on the design frequency,
- selects the type of deck drain, and
- determines the hydraulic inlet spacing on the bridge deck to intercept the calculated flow to meet the allowable water spread criteria.

The bridge engineer incorporates the drainage design information into the structural design of the bridge. The roadway designer is responsible for the drainage design for any runoff approaching or leaving the bridge deck. The bridge engineer should assist the roadway designer to ensure that the bridge end drainage is adequately addressed in the contract documents.

16.4.3. Deck Drainage Design Elements

Type of Drainage System

DOT&PF generally uses an open deck drain system.

Deck Slope

To provide proper bridge deck drainage, the minimum profile grade of the bridge should be 0.5 percent. A crest vertical curve may also be used provided the average profile grade from the high point to the ends of the bridge is greater than 0.5 percent.

Accommodate the transverse slope of the bridge deck by providing a suitable roadway cross slope, typically 2 percent for paved roads and 3 percent for gravel roads.

Sag Vertical Curves

If practical, do not locate any portion of a bridge in a sag vertical curve. If the bridge is located in a sag, do not locate the low point of the sag on the bridge or the approach slab. Locate the low point a minimum of 20 feet from the end of the approach slab or, if approach slabs are not used, a minimum of 20 feet from the end of the bridge.

Inlets/Downspouts

The bridge engineer should consider the following when locating inlets and downspouts:

1. **Location With Respect To Structural Elements**. Extend downspouts below structural elements as specified in the *LRFD Specifications*. Do not locate downspouts within 5 feet of the end of any substructure unit or where water could easily blow over and run down a substructure element.
2. **Location With Respect To Ground**. A free fall exceeding 25 feet will sufficiently disperse the falling water so that minimal erosion damage will occur beneath the bridge.

   Where less than 25 feet of free fall is available, consider providing erosion protection on natural ground beneath the outlet. Free falls of less than 25 feet are acceptable where the water free falls onto riprap or flowing water.
3. **Railroads**. Do not allow downspouts over Railroad right-of-way without the Railroad's consent.
4. **Other Exclusions**. Avoid locating downspouts over the traveled way portion of an underpassing highway, sidewalk, or unpaved embankment.

Structural Considerations

The primary structural considerations in drainage system design are:

1. **Deck Reinforcement**. Inlet sizing and placement must be compatible with the structural reinforcement and other components of a bridge deck.

   Where required, provide a thickened deck and additional reinforcement to maintain clearances and deck resistance.

2. **Corrosion and Erosion**. Design the drainage system to deter runoff (and the associated corrosives) from contacting vulnerable structural members and to minimize the potential for eroding embankments. To avoid corrosion and erosion, the design must include the proper placement of outfalls.

   To prevent erosion, direct running water away from the end of wingwalls to the end of a bridge.

Maintenance Considerations

The drainage system will not function properly if clogged with debris or ice. Therefore, it is important to consider maintenance requirements in the design. Provide easy access, adequate space, and safe working conditions for maintenance personnel to maintain the drainage features around the bridge.

Bridge End Drainage

The roadway designer is responsible for designing the bridge end drainage. The typical DOT&PF practice is to use a riprap-lined ditch (drainage swale).

In addition, design bridge end drainage with grate inlets, curb opening inlets, or combination inlets. Design bridge deck inlets at the downslope end of the bridge to collect all of the flow not intercepted by any other bridge deck inlets.

At bridge ends where the approach roadway has curb and gutter, provide catch basins as close as practical to the approach slabs.

16.5. Bridge Deck Appurtenances

16.5.1. Bridge Rails

Reference: LRFD Article 13.7.

Test Levels

LRFD Article 13.7.2 identifies six test levels for bridge rails, adopted from NCHRP 350 *Recommended Procedures for the Safety Performance Evaluation of Highway Features* and the AASHTO *Manual for Assessing Safety Hardware* (MASH). Test Levels One and Two (TL-1 and TL-2) are typically used in work zones in Alaska. Most bridge rails used by the DOT&PF meet the performance criteria for Test Levels Three or Four (TL-3 or TL-4). Only use bridge rails that meet Test Levels Five and Six (TL-5 and TL-6) criteria with the approval of the Chief Bridge Engineer.

Bridge Rail Types/Usage

For new bridge construction, select a bridge rail according to Figure 16-10. The following are preapproved TL-4 Bridge Rails for use on NHS and other State-owned arterial or collector highways:

1. **Alaska 2019 MASH 2-Tube Bridge Rail**. This bridge rail is the most commonly used type on new and replaced bridge rail installations. The Alaska 2019 MASH 2-Tube Bridge Rail meets the TL-4 performance criteria and is preferred due to its decreased frontal area for snow drift and increased viewshed. The traveling public prefers open rails for visual accessibility. The 2-Tube Bridge Rail also has a lower dead weight than concrete bridge barriers. In most cases, this rail is easily adaptable to the bridge types used by the DOT&PF.

2. **38-inch Texas Single Slope Bridge Barrier**. DOT&PF typically uses this barrier on bridges where the Alaska 2019 MASH 2-Tube Rail is not appropriate. The 38-inch Texas Single Slope bridge rail meets the performance criteria for a TL-4. The concrete barrier has relatively low maintenance cost.

These two types represent the vast majority of bridge rails installed by DOT&PF. If the regional office desires another railing option, other available TL-4 bridge rail types include:

- 42-inch concrete Type F-shape bridge barrier,
- 42-inch 3-tube combination rail (Oregon 3-Tube Curb Mount Bridge Rail),
- 32-inch or 42-inch vertical concrete wall, or
- other metal beam bridge rails.

Guardrail-To-Bridge-Rail Transitions

The bridge engineer is responsible for the guardrail-to-bridge-rail transition. The Bridge Section has developed standard details used for most applications (see Alaska Standard Plans G32 (AASHTO MASH TL-3) MASH Bridge Rail Thrie Beam Transition for 2-Tube Bridge Rail, and G-33 (NCHRP Report 350 TL-4 equivalent to AASHTO MASH TL-3) MASH 3-Tube Bridge Rail Thrie Beam Transition for 3-Tube Bridge Rail. The bridge engineer develops special designs, if required, for unusual circumstances. For example, for the 38-inch Texas Single Slope Bridge Barrier, the recommended transition is the Alaska Standard Plan G-32 without the Guardrail Connection Plate or Connection Angle A.

Bridge Rail/Sidewalk

Reference: LRFD Articles 13.4 and 13.7.1.1.

The roadway designer or regional traffic engineer determines the warrants for a sidewalk on a bridge. Sidewalks on bridges create several issues that the bridge engineer must address, including:

- They complicate the bridge rail and guardrail-to-bridge-rail transition designs.
- They require special attention to bridge deck drainage.

Do not provide a sidewalk on a bridge if none exists on the approaching roadway.

16.5.2. Bicycle/Pedestrian Rails

Reference: LRFD Article 13.9.

The roadway designer or regional traffic engineer determines if bicycle accommodation is required across a bridge. Where required, provide a bicycle/pedestrian rail that meets the geometric and loading requirements of LRFD Article 13.9. The minimum required height of the bicycle rail is 42 inches.

16.5.3. Protective Fencing

Use protective fencing across bridges when protection to facilities adjacent to or beneath the structure is warranted. Fencing may be required for overpasses in urban areas and for railroad overheads. Use protective fencing at other locations if requested by the regional office. Detail gates for bridge inspection and maintenance access.

16.5.4. Utility Attachments

The Bridge Section will coordinate with the Utilities Section for any utility attachments proposed on the bridge. Refer to the Alaska Administrative Code (AAC), 17 AAC 15.231, which lists general guidelines for utility installations on bridges. The following discussion presents DOT&PF supplemental information.

Utility companies frequently request approval from DOT&PF to attach utility lines or pipes to bridges.

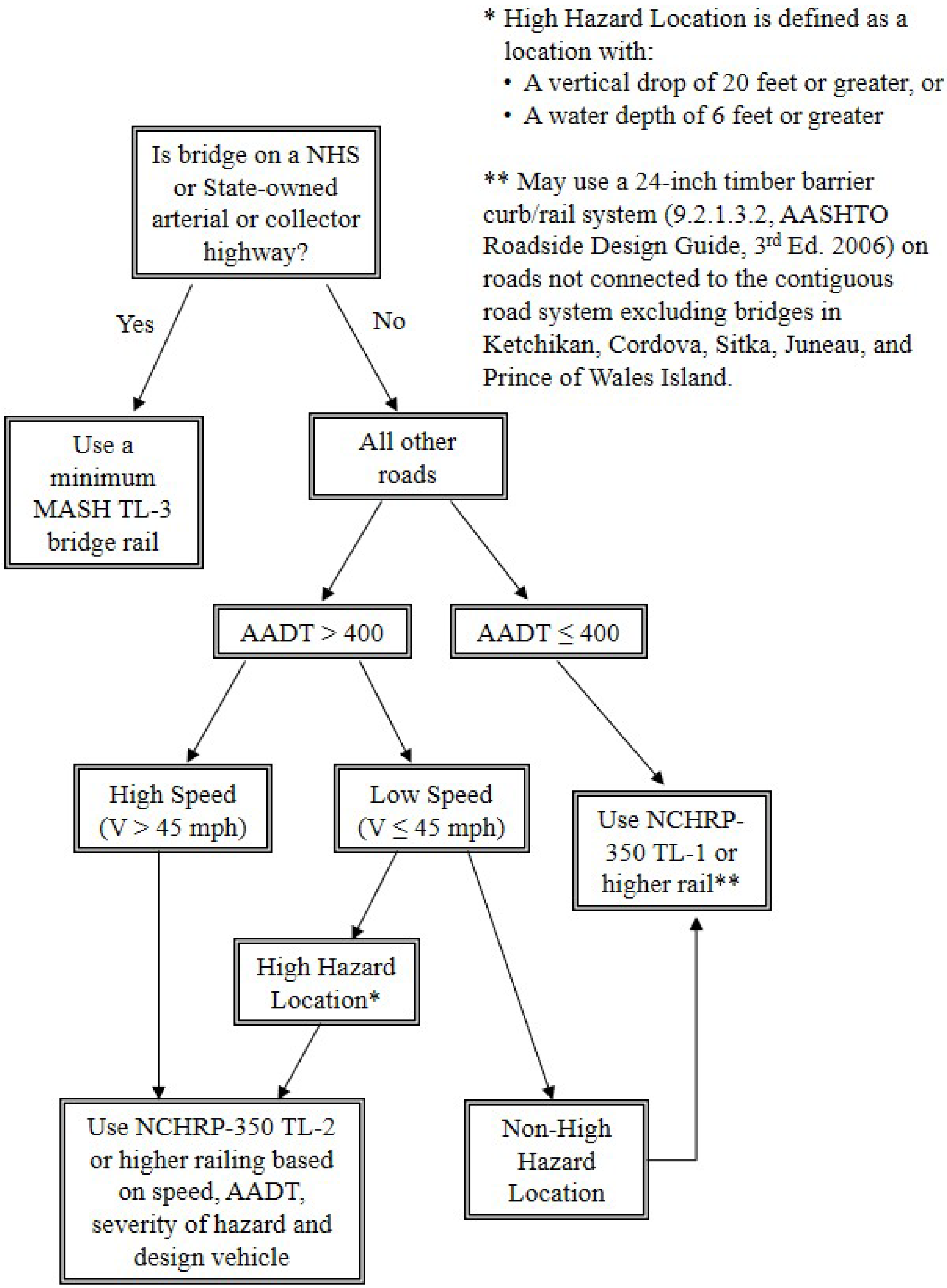


Figure 16-10
Decision Tree for Bridge Rails for
New Bridge Construction

The Bridge Section is responsible for ensuring that the structural performance and function of the bridge is not compromised; that the safety of the individuals using the bridge is not compromised; and that DOT&PF bridge maintenance is not unduly complicated.

On new bridges in urban areas with no planned utilities, detail two 8-inch diameter conduits in each exterior bay of the abutment backwall and intermediate diaphragm for future use by DOT&PF or utility companies. For bridges with approach slabs, extend a utiliduct past the end of the approach slab.

DOT&PF Requirements

These requirements apply to attaching utilities to DOT&PF-owned structures.

Before proposing a utility installation to the bridge, analyze directional drilling/boring and alternative routing.

DOT&PF attempts to provide at least a 75-year service life for each structure; therefore, any utility installation should be capable of performing for a comparable service period without substantive maintenance.

The installation must be of substantial design, proportioned to span between supports without undue deflection under its own weight and the other imposed loads. The installation must be capable of accommodating the thermal expansion and contraction of the bridge.

The installation must be located between girders. Utilities 12 inch or larger in diameter must be located in non-adjacent girder bays for load distribution.

All tie rods at both bridge approach embankments must remain undisturbed.

All exposed components of the installation must be constructed of corrosion-resistant materials or have corrosion-resistant coatings.

All hanger bolts must have double nuts, burred bolt threads, or an approved thread-locking system.

The elevation of all components of the installation must be at least 1 inch above the bottom flange of the girders.

Prevent the abutment fill and/or water from spilling through the holes by filling or blocking the annular gap (created by coring or sawing holes through the abutment backwalls) between the backwalls and the utility.

Locate, map, and minimize cutting of the reinforcing steel in concrete backwalls and diaphragms. Treat all exposed reinforcing steel ends with zinc-rich paint before filling the annular gap.

Repaint any damaged areas of the bridge spray metalizing system caused by the installation of the utility, including drilled/cored holes and incidental damage. Comply with Sections 513 and 708 of the Alaska *Standard Specifications for Highway Construction* that apply to field painting of existing structures. In addition, clean the damaged area to bare metal to meet SSPC-SP 11, Power Tool Cleaning to Bare Metal.

Mark the utility owner’s name and local phone number at both abutments to allow immediate contact in an emergency.

Provide photographs of the completed installation that include typical hanger systems, general view of the utility attachment, view across piers, and photos of the utility at each abutment.

DOT&PF Prohibitions

DOT&PF does not generally permit the following:

- attachments to the underside of cast-in-place concrete decks
- attachments to bottom flanges and webs of concrete decked bulb-tees
- attachments to bridge rails or bridge rail posts
- timber utility components
- welding to or drilling holes in steel bridges

Hazardous Materials

Conduits carrying flammable, hazardous, or corrosive material are permitted on the bridge only after all reasonable crossing alternatives have been exhausted. Shutoff valves must be located beyond both abutments, outside the limits of the bridge. Keep valves operational and accessible, clear of snow, ice, dirt, and debris.

Use valve vaults where environmental elements and/or vandalism pose concern.

Provide a casing extended the full length of the bridge. Size the casing to carry the entire contents of the conduit and vent the line at points well away from the structure. Expect additional requirements on large or high-pressure lines.

Utility Company Responsibilities

A professional engineer, licensed by the state of Alaska, must design the installation. The design engineer must have design experience applicable to the proposed installation.

Provide the Bridge Section with design calculations and plans (drawn to scale) of the proposed layout, including typical sections at the abutments, attachment to the girders, and sections through the diaphragms and over the piers.

Specify the utility's pipe size, pipe thickness, insulation thickness, casing size, and casing thickness on the plan sheets.

Provide a copy of the applicable code references for the hanger/support spacing.

Provide the system's total weight per linear foot, including the weight of the contents inside the proposed conduit.

Submit the plans at least 90 calendar days before the proposed installation date.

The utility owner is responsible for removing all utility components and hangers once the service is no longer needed.

Repair damage to structural steel coatings, block and seal holes through abutment backwalls, replace riprap and structural fill disturbed by the removal, and perform any other repair deemed necessary by the Department.

Bridge plans may be available to assist in the design. Large diameter utilities may require the utility designer to provide calculations for a load rating of the bridge with the new utility loading.

Apply for a utility permit to the DOT&PF regional utility section.

16.5.5. Sign Attachments

If the Traffic Engineering Section proposes to attach a sign to a bridge, they must coordinate with the Bridge Section, which will assess the structural impact on the bridge. If approved, the Bridge Section will design the sign attachment details. Signs cannot decrease the vertical clearance.

16.5.6. Luminaire/Traffic Signal Attachments

The Traffic Engineering Section determines the warrants for highway lighting and traffic signals, and they perform the design work to determine, for example, the spacing of the luminaires and the provision of electricity.

Lighting may be included on bridges that are located in urban areas; traffic signal warrants are determined on a case-by-case basis.

Where attached to a bridge, the Bridge Section will design the structural support details for the luminaire and traffic signal attachments to the bridge.

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